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JAC

WORKSHOP MANUAL

HFC1130KR1-G1560

JAC International

2008.05

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JAC Motors

WORKSHOP MANUAL

HFC1130KR1-G1610

Foreword

This workshop manual was prepared as reference to properly carry out servicing and maintenance on Jianghuai vehicles.

The contents, pictures and technical parameters this manual supplied are the latest data. Because of the continuously development and renewal of technique and products, there may be some difference between the explanation and the vehicles.

This shop manual was prepared for 4 x 2 Truck. Configurations as follows:

HFC1130KR1-G1610，CA4DF3，LC6T138，JAC G1610 rear axle(5.125).

Please inform Customer Service Department of JAC International if there is any mistake, and you will be highly appreciated.

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08	Suspension	SU
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10	Body	BOD

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Specifications

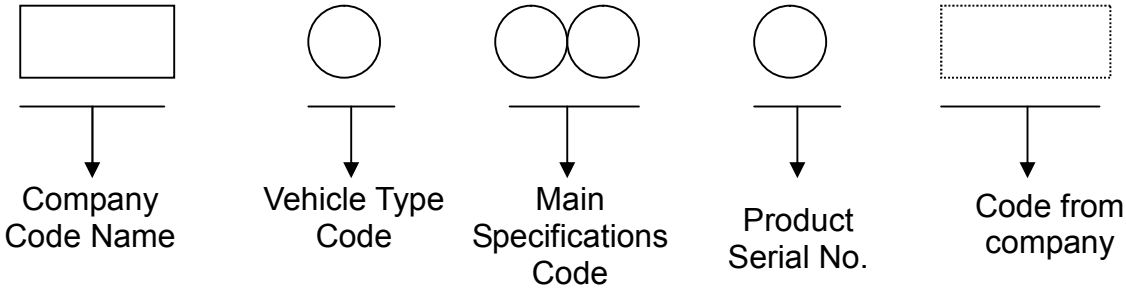
HFC1130KR1(G1610) Specifications

高顶/半高顶 High/Half Height Roof Cab，tilt cab	型号 Model	HFC1130KR1
	驱动形式 Drive mode	4*2
	结构区别号 Serious number	G1610
发动机 Engine	型号 Model	CA6DF3-18E3
	排量(cc)Displacement	6740
	最大输出功率（Hp/rpm）Max output power	180/2300
	680/1400	680/1400
变速箱 Transmission	CA6T138-85	
驱动桥 Real axle	型号 Model	JAC(5.125)
主参数 Main parameter	外形尺寸（mm）Overall dimension	8980*2390*3105
	轴距（mm）Wheelbase	5300
	轮距（mm）Tread	2040/1860
	总质量（Kg）Mess weight	19400
	车架断面尺寸 Frame section sizes(mm)	265*75*8
轮胎 Tire		9.00-20

The above mentioned specifications are subject to change without prior notice.

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1.2 Vehicle Model：HFC3251KR1



Company Code Name：HFC-----represents JAC motor

Vehicle Type Code：1---Cargo truck 2---Off-road vehicle 3---Dumper

4---Tractor 5---Special purpose vehicle 6---Passenger car

7---Sedan 9---Semitrailer

Main Specifications Code：25---represents the maximum gross weight is 25 tons.

Product serial No.： 1---Product development serial No.（1st change，2nd development）

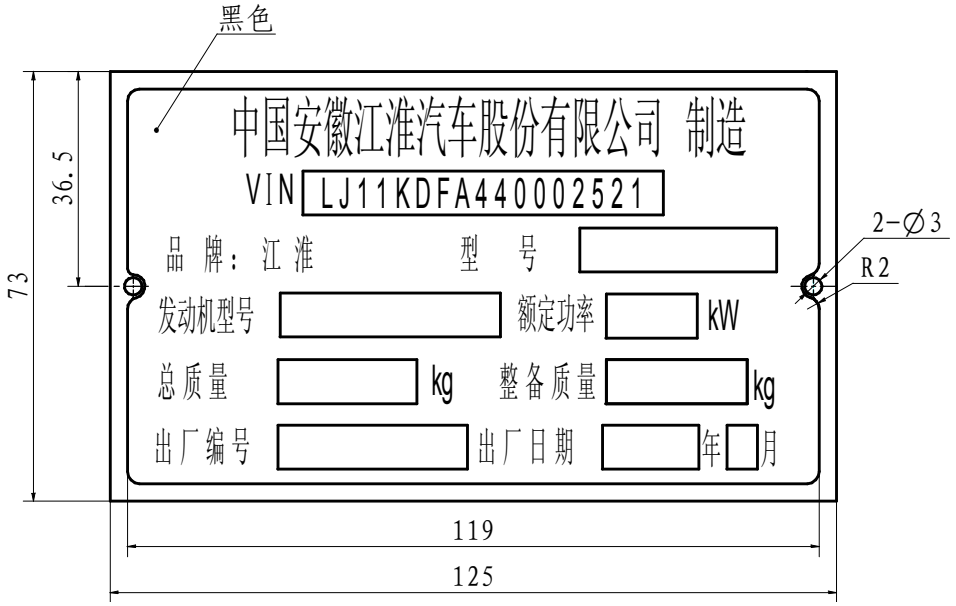
Code from company：K---Diesel R1---King cabin

For example：HFC3251KR1 represents JAC vehicle with king cab, 25 tons maximum gross weight, the first change.

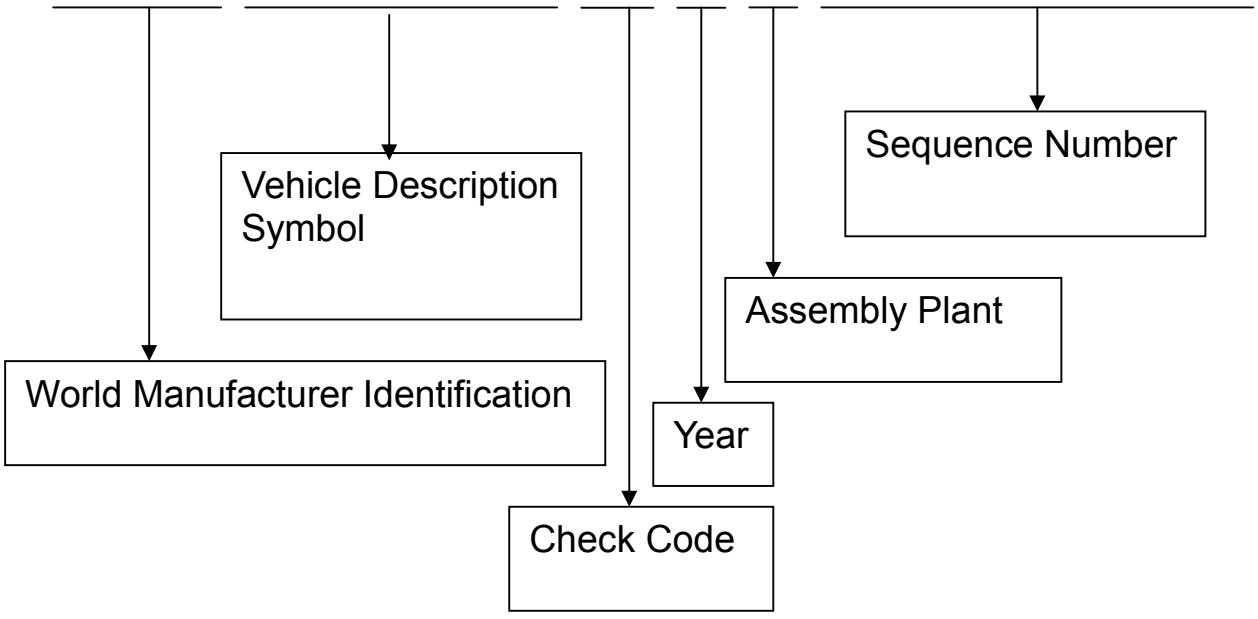
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1.3 VIN----Vehicle Identification Number

VIN comprises of 17 digits. They separately represent:



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
L	J	1	1	K	D	B	C	X	8	X	X	X	X	X	X	X



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1.4 Tightening Torques of Bolts and Nuts for Hyundai

Unless otherwise specified, the parts and equipment of vehicle must be tightened by the following standard bolts nuts. Tightening torques for these bolts and nuts are shown below.

Note:

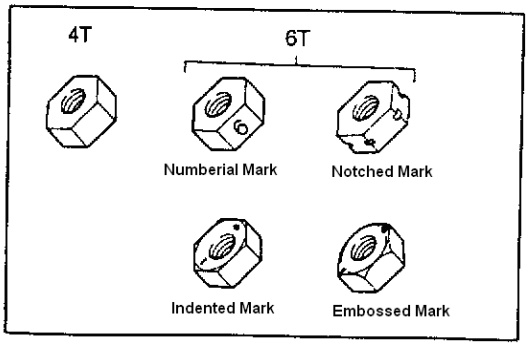
Threads and seat surface must be in dry state.

When there is a difference between the nut and bolt(stud) identification marks, tighten to the torque corresponding to the bolt(stud) identification mark.

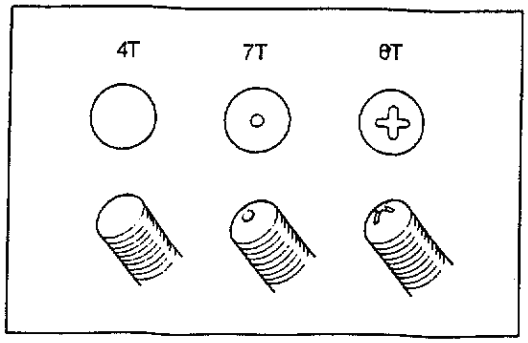
Standard bolts and nuts

Dia /mm	Pitch mm	4T(Head mark4 or ○)	7T(Head mark 7 or ⊖)	8T(Head mark 8 or ⊕)
5	0.8	2.0－2.9(0.2－0.3)	3.9－5.9(0.4－0.6)	4.9－6.9(0.5－0.7)
6	1.0	3.9－5.9(0.4－0.6)	6.9－10.8(0.7－1.1)	7.8－11.8(0.8－1.2)
8	1.25	8.8－13.7(0.9－1.4)	16.7－25.5(1.7－2.6)	19.6－29.4(2.0－3.0)
10	1.25	18.6－27.5(1.9－2.8)	34.3－53.9(3.5－5.5)	44.1－58.8(4.5－6.0)
	1.5	17.7－26.5(1.8－2.7)	32.4－49.0(3.3－5.0)	42.1－58.8(4.3－6.0)
12	1.25	33.3－49.0(3.4－5.0)	68.6－93.2(7.0－9.5)	83.4－108(8.5－11)
	1.75	30.4－46.1(3.1－4.7)	63.7－83.4(6.5－8.5)	73.5－98.1(7.5－10)
14	1.5	58.8－83.4(6.0－8.5)	118－157(12－16)	127－177(13－18)
	2.0	53.9－73.5(5.5－7.5)	108－137(11－14)	118－167(12－17)
16	1.5	93.2－127(9.5－13)	177－235(18－24)	196－265(20－27)
	2.0	88.3－118(9.0－12)	157－216(16－22)	186－255(19－26)

Identification marks of nut



Identification marks of stud



The mechanic performance table of bolts in China

Quality Grade(mark)	6.8	8.8	9.8	10.9	12.9
Tensile strength limit σbmax(MPa)	600	800	900	1040	1220
Yield limit σsmax(MPa)	480	640	720	940	1100
Corresponding to Hyundai standards	4T	6T	7T	8T	10T

The number before the radix point represents one percent of the nominal tensile strength;

The number after the radix point represents ten times of the ratio of the nominal yield limit and nominal tensile strength.

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CA6DF3-18E3 ENGINE

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1.1 Main technical specifications

1.1.1 Main technical specifications for CA4DF2 diesel engine

Model	4DF2-13	4DF2-14	4DF2-16	4DF2-17
Type	In-line, 4stroke, water-cooled, direct injection combustion chamber			
Aspiration	Exhaust-turbocharged、Air-air cooled			
Compression ratio	16.8: 1			
Number of cylinders	4			
Cylinder bore (mm)	110			
Piston stroke (mm)	125			
Total displacement (L)	4.751			
Rated power/Rated speed (kW/r/min)	96/2500	103/2300	117/2300	125/2300
Max. torque/Speed at Max. torque (N·m/r/min)	430/1500	510/1400	580/1400	580/1400
Crankshaft rotation direction (Viewing toward flywheel)	Counter-clockwise			
Firing order	1-3-4-2 (first cylinder near the fan)			
Lubrication method	Forced splash			
Start mode	Electric start			
Min. Stable idling speed (r/min)	750±50			
Steady state speed regulation	10～14%			
Min. fuel consumption at full load (g/kW·h)	≤205			
Exhaust temperature (℃)	≤520			
Smoke (Rb)	≤2.5			
Net mass (kg)	480 (clutch and intercooler are not included)			
Emission	Satisfyling phase Ⅱ of GB17691-2001 (Europe Ⅱ)			

1.1.2 Main specifications for CA6DF1 diesel engine

Model	6DF1-24	6DF1-26	6DF1-28
Type	In-line, 4 stroke, water-cooled, direct injection combustion chamber		
Aspiration	Exhaust-turbocharged¢ Air-air cooled		
Compression ratio	16.8: 1		
Number of cylinders	6		
Cylinder bore (mm)	110		
Cylinder stroke (mm)	125		
Total displacement (L)	7.127		

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Rated power/ Rated speed (kW/r/min)	177/2300	192/2300	206/2300
Max. torque/Speed Max. torque (N·m/r/min)	890/1400	930/1400	960/1400
Crankshaft rotation direction (Viewing toward flywheel)	Counter-clockwise		
Firing order	1-5-3-6-2-4(first cylinder near the fan)		
Lubrication method	Forced splash		
Start mode	Electric start		
Min. stable idling speed (r/min)	750±50		
Steady state speed regulation	10～14%		
Min. fuel consumption at full load (g/kW·h)	≤205		
Exhaust temperature (℃)	≤480	≤500	≤520
Smoke (Rb)	≤2.5		
Net mass (kg)	700 (clutch and intercooler are not included)		
Emission	Satisfying phase Ⅰof GB17691-2001 (Europe Ⅰ)		

1.1.3 Main specifications for CA6DF2 diesel engine

Model	6DF1-24	6DF2-24	6DF21-26
Type	In-line, 4 stroke water-cooled, direct injection combustion chamber		
Aspiration	Exhaust-turbocharged. Air-air cooled		
Compression ratio	16.8: 1		
Number of cylinders	6		
Cylinder bore (mm)	110		
Cylinder stroke (mm)	125		
Total displacement (L)	7.127		
Rated power/Rated speed (kW/r/min)	162/2300	177/2300	192/2300
Max. torque/Speed at Max. torque (N·m/r/min)	780/1400	890/1400	930/1400
Crankshaft rotation direction (Viewing toward flywheel)	Counter clockwise		
Firing order	1-5-3-6-2-4(first cylinder near the fan)		
Lubrication method	Forced splash		
Start mode	Electric start		
Min. stable idling speed (r/min)	750±50		
Steady state speed regulation	10～14%		
Min. fuel consumption at full load (g/kW·h)	≤205		
Exhaust temperature (℃)	≤480	≤500	≤520
Smoke (Rb)	≤2.5		
Net mass (kg)	700 (clutch and intercooler are not included)		
Emission	Satisfying phase Ⅱ of GB17691-2001 (Europe Ⅱ)		

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1.2 Data for adjustment and operation

Item \ Model		4DF2	6DF1	6DF2
Cold valve clearance (mm)	Intake valve	0.30		
	Exhaust valve	0.35		
Fuel supply advance angle (crankshaft rotation angle (℃A)		9±1		
Deflection of fan belt (mm)		10～15(under a force of 39.2 applied)		
Outlet temperature of coolant (℃)		≤95		
Oil pressure (kPa)		Rated speed: 343～490; idle speed: ≥98		
Injector adjusting pressure (kPa)		25～26		
Protrusion of injector top from the cylinder head bottom surface (mm)		3.4～3.9		
Protrusion of valve guide pipe form the Spring seat hole in cylinder head (mm)		18		

Amount of lubricating oil injected to oil pan matching with different type of oil sump

Type of oil sump matching with 4DF	Amount of oil injected to oil pan (L)	Representative model	Type of oil sump matching with 6DF	Amount of oil injected to oil pan (L)	Representative model
Long oil sump	14.5	4DF2	Saddle model	25	6DF1-25-02
Weld model	13.5	4AKZA5-1	Single oil sump	25	6DF1-26-10
Low oil sump	12.5	4BK	Gradient single oil sump	25	6DF1-24-09

1.3 Fit and wear limits of main parts of diesel engine

No.	Description	Fitting mode	Nominal dimensions (mm)	Value of clearance or interference (mm)	Limits (mm)
1	Crankshaft main journal and main bearing	Clearance	ϕ85	0.06～0.134	0.2
2	Crankshaft main journal thrust face and thrust washer	Axial clearance	37	0.105～0.309	0.4
3	Crankpin and connecting rod bearing	Clearance	ϕ70	0.06～0.128	0.2
4	Crankpin and connecting rod big end	Axial clearance	42	0.18～0.43	0.6

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5	Piston pin and connecting rod small end bush			Clearance	ϕ42	0.027～0.057	0.12
6	Piston pin and piston pin seat hole			Clearance	ϕ42	0.002～0.015	0.04
7	Piston skirt and cylinder liner			Clearance	ϕ110	0.15～0.175	0.35
8	Piston ring end clearance						
	1st compression ring			Clearance		0.35～0.55	1.5
	2nd compression ring			Clearance		0.30～0.50	1.5
	Oil ring			Clearance		0.25～0.45	1.5
9	Piston ring and piston ring groove						
	1st compression ring and piston ring groove			Axial clearance		0.12～0.16	0.25
	2nd compressing ring and piston ring groove			Axial clearance	2.5	0.10～0.135	0.2
	Oil ring and piston ring groove			Axial clearance	4	0.05～0.085	0.15
10	Piston TDC and cylinder head bottom plate			Clearance		0.9～1.1	
11	Valve guide pipe and cylinder head			Interference	ϕ15	0.015～0.051	
12	Intake valve stem and valve guide pipe			Clearance	φ9	0.020～0.057	0.15
13	Exhaust valve stem and valve guide pipe			Clearance	ϕ9	0.045～0.082	15
14	Intake valve seat and cylinder head			Interference	ϕ46	0.045～0.086	
15	Exhaust valve seat and cylinder head			Interference	ϕ44	0.045～0.086	
16	Depression of exhaust valve on bottom face of cylinder head			Depression		1.0～1.4	2.2
17	Depression of exhaust valve on bottom face of cylinder head			Depression		1.0～1.4	2.2
18	Valve rocker arm bush and rocker arm hole			Interference	ϕ26	0.034～0.076	
19	Valve rocker arm bush and rocker arm shaft			Clearance	ϕ24	0.047～0.103	0.2
20	Cylinder liner flange higher than cylinder block top face			Protrusion		0.045～0.105	
21	Valve tappet and hole on cylinder block			Clearance	ϕ31	0.045～0.086	0.2
22	Camshaft bush and hole on cylinder block	4 cylinder	6 cylinder	Interference	Outside diameter of bush	0.036～0.085	
		Rank 1-4	Rank 1-6		ϕ64		

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		Fifth rank	Seventh rank		ϕ64.5		
23	Camshaft bush and camshaft journal			Clearance	ϕ60	0.08～0.16	0.25
24	Camshaft and thrust washer			Axial clearance	6	0.08～0.218	0.35
25	Intermediate timing gear (1) and bush			Interference	ϕ52	0.03～0.076	
26	Intermediate timing gear (2) bush and gear shaft			Clearance	ϕ48	0.04～0.10	0.2
27	Intermediate timing gear (2) and gear shaft			Axial clearance	46	0.18～0.292	0.4
28	Intermediate timing gear (1) and intermediate timing gear (2)			Interference	ϕ52	0.002～0.052	
29	Intermediate timing gear (3) and bush			Interference	ϕ36	0.034～0.076	
30	Intermediate timing gear (3) bush and gear shaft			Clearance	ϕ32	0.03～0.086	0.2
31	Intermediate timing gear (3) and gear shaft			Axial clearance	31	0.12～0.293	0.4
32	Oil pump gear end face and cover			Axial clearance	40	0.025～0.089	0.15
33	Cylinder of oil pump gear and pump block			Radial clearance	ϕ49.5	0.025～0.08	0.15
34	Tooth side clearance					≥0.085	0.3
35	Water pump impeller and water pump shell block			Clearance		0.10～0.60	

1.4 Tightening torque of threaded fasteners for diesel engine

1) Tightening torque of the main threaded fasteners should be performed according to next table

Work piece number or specification	Description of parts	Torque (N·m)	Note
1003046-1-CK 1003047-1-CK	Cylinder head bolt (M15×2)	245±15	Spread oil
1004023-1/CK	Connecting rod bolt (M13×1.25)	145±15	Spread screw gum
1002235-1-AKZ	Piston cooling injecting nozzle fixing bolt	50±5	No spreading screw gum
1005123/CK	Flywheel bolt (M16×1.5)	275±10	Spread screw gum
1005144-1-CK	Main bearing bolt (M18)	294±19.6	Spread oil
KA-1-1005123	Damper or crankshaft belt wheel fixing bolt (M14×1.5)	180±10	Spread oil

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GB6170-1986	Air compressor gear fixing nut (M18)	147±15	Spread oil
1006023/CK	Timing gear fixing bolt-camshaft (M20×1.5)	200±15	Spread oil
Q150B1030	Hexagon-headed bolt M10 (fixing cylinder head)	33±6	
	Hexagon-headed bolt M10 (fixing water pump belt wheel)		
	All specifications of hexagon-headed bolt M8 (fixing intake connecting pipe)	19±6	
Q150B1060	Hexagon-headed bolt M10 (fixing exhaust manifold)	32±10	
Q340B10	Hexagon nut, style Ⅰ M10 (fixing exhaust manifold)	32±10	
Q150B1230	Hexagon-headed bolt M12 (fixing front oil seal seat)	57±10	
Q150B0820	Hexagon-headed bolt M8 (fixing rear oil seal seat)	19±6	
Q341B20	Hexagon nut, style Ⅰ M20×1.5 (fixing driven gear-fuel injection pump)	180±15	Spread oil
Q150B1285	Hexagon-headed bolt M12 (fixing bracket-fuel injection pump)	57±10	
Q150B0880	Hexagon-headed bolt M10 (fixing fuel injection pump)	32±10	
Q360B10	Hexagon nut, style Ⅱ M10 (fixing fuel injector)	70±10	
Q150B1075	Hexagon-headed bolt M10 (fixing rocker arm shaft bracket)	41±10	
Q150B1022 Q150B1030	Hexagon-headed bolt M10 (fixing plate of gear casing cover)	32±10	
M12x1.5orM20x1.5	Drain oil plug of oil sump	150±10	Punching oil sump may be bigger than others
M20x1.5orM30x2	Drain oil plug of oil sump	170±10	

2) 4DF、6DF Tightening torque of clutch threaded fasteners should be performed according to next table

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Specifications of bolts	Clutch (≤ ϕ 350) (N • m)	Clutch (≤ ϕ 430) (N • m)	Note
M8	28±2		Tighten bolt on the cross when fix clutch assy.
M10	54±9	70±8	
M12	80±9		

3) Tightening torque of other threaded fasteners should be performed according to next table

Grade / Screw thread diameter	8.9(general plain steel) (N·m)	10.9(hardened and tempered steel) (N·m)
6	5±2	7±2.5
8	12±5	15±5
10	25±7	35±10
12	54±10	68±15
14	80±15	108±10
16	118±20	147±25

Note: Above-mentioned fasteners should be tightened with torque wrench.
Change it according to the formula (1kgf·m=9.8N·m) if the unit standard of your torque wrench is based on kilogram.

1.5 Adjusting parameters for injection pump

Adjusting parameters of fuel injection pump of 4DF、6DF1 and 6DF2 types engine based on normal test system will be seen in table 1.5-1, 1.5-2, 1.5-3 respectively. Please specially note the following items:

●Only the company that has professional service capability can repair and adjust fuel injection pump.

●Amount of oil that is measured by different fuel injection pump test-bed will be some different, so the data of oil in the table is just reference. After adjusting the amount of oil according to the table, if the diesel engine has abnormal circumstances such as black smoke, it should be put on test-bed again and reduce amount of oil and improve uniformity of every cylinder properly. Don’t increase the amount of oil to increase power optionally, which will be harmful to the reliability of diesel engine.

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Table 1.5-1 Adjusting parameter for fuel injection pump matching with CA4DF2 diesel engine

Model	4DF2-14				4DF2-16				4DF2-17			
Operation condition	Speed (r/min)	Injection volume (ml/200times)	Non-uniformity (%)	Air pressure (Mpa)	Speed (r/min)	Injection volume (ml/200times)	Non-uniformity (%)	Air pressure (Mpa)	Speed (r/min)	Injection volume (ml/200times)	Non-uniformity (%)	Air pressure (Mpa)
Rated	1150	32.4±1.5	8	0.12	1150	37±1.5	8	0.12	1150	39.3±1.5	8	0.12
Calibrated	750	32.3±1.5	6	0.12	750	36±1.5	6	0.12	750	36±1.5	6	0.12
Low speed	450	12.5±1		0	450	13±1		0	450	13.3±1		0
Starting	150	36±2			150	38±4			150	39±4		
Actuation of the governor	1180				1180				1180			
Idle speed	350	2.5±1	35		350	2.6±1	35		350	2.6±1	35	
Stopping of fuel	1360				1360				1360			

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Table 1.5-2 Adjusting parameter for fuel injection pump matching with CA6F1 diesel engine

Model	6DF1-24				6DF1-26				6DF1-28			
Operation condition	Speed (r/min)	Injection volume (ml/200times)	Non-uniformity (%)	Air pressure (Mpa)	Speed (r/min)	Injection volume (ml/200times)	Non-uniformity (%)	Air pressure (Mpa)	Speed (r/min)	Injection volume (ml/200times)	Non-uniformity (%)	Air pressure (Mpa)
Rated	1150	37±1.5	8	0.12	1150	40±1.5	8	0.12	1150	43±1.5	8	0.12
Calibrated	750	36±1.5	6	0.12	750	37.6±1.5	6	0.12	750	38.8±1.5	6	0.12
Low speed	450	13±1		0	450	13.6±1		0	450	14.2±1		0
Starting	150	38±4			150	40±4			150	42±4		
Actuation of the governor	1180				1180				1180			
Idle speed	350	2.6±1	35		350	2.8±1	35		350	3±1	35	
Stopping of fuel	1360				1360				1360			

Table 1.5-3 Adjusting parameter for fuel injection pump matching with CA6DF2 diesel engine

Operation condition	6DF2-22				6DF2-24				6DF2-26			
Rated	Speed (r/min)	Injection volume (ml/200times)	Non-uniformity (%)	Air pressure (Mpa)	Speed (r/min)	Injection volume (ml/200times)	Non-uniformity (%)	Air pressure (Mpa)	Speed (r/min)	Injection volume (ml/200times)	Non-uniformity (%)	Air pressure (Mpa)
Calibrated	1150	33.8±1.5	8	0.12	1150	37±1.5	8	0.12	1150	40±1.5	8	0.12
Low speed	750	31.5±1.5	6	0.12	750	36±1.5	6	0.12	750	37.6±1.5	6	0.12
Starting	450	12.5±1		0	450	13±1		0	450	13.6±1		0
Actuation of the governor	150	36±4			150	38±4			150	40±4		
Idle speed	1180				1180				1180			
Stopping of fuel	350	2.4±1	35		350	2.6±1	35		350	2.8±1	35	
Operation condition	1360				1360				1360			

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Table 1.5-4 Adjusting parameter for fuel injection pump matching with CA4DF2-13 diesel engine

Operation condition	4DF2-13			
Rated	Speed (r/min)	Injection volume (ml/200times)	Non-uniformity (%)	Air pressure (Mpa)
Calibrated	1250	27.5±0.9	±5	0.1
Low speed	750	24±0.8	±3	0.1
Starting	500	20±0.9		0
Actuation of the governor	100			
Idle speed	1270			
Stopping of fuel	375	35±0.7	±10	
Operation condition	1460			

Chapter 2 Technical methods for meeting the emission standard and cautions on operation

CA4DF & CA6DF turbocharged and inter-cooled diesel engines have met requirements of the first and second stage of GB17691 specification. Now main technical methods and cautions on operation are introduced as follows.

2.1 main technical methods for meeting the emission standard

① P7100 high pressure oil pump

In order to increase the pressure at the nozzle of oil pump end, the hydraulic pressure system HYDSIM software is used for simulation computation, and P1700 fuel injection pump is chosen because of its stronger working capability. It makes the pressure at the end of pump come to 900-1000bar. The pressure wave at nozzle is basically realized the injection rule with the first slow and then rapid way. So this meets the basic requirements of emission of fuel system. Proper delivery valve is selected to ensure the reliability of fuel injection pump.

The RQV-K actiyator adopted in the diesel engine has more powerful control ability and rotates more stably in each working conditions.

Because the oil injection advance angle of diesel engines that meet the emission standard is small, a new advance device is designed for optimizing capability of diesel engine. Its excellent advance capability of fuel supply not only meets the emission requirement but also ensures the economy. The dimensions of advance device have been much improved. The working capability and torque bearing capability of its flywheel have been largely enhanced, which ensure the reliability of diesel engine.

Different types of fuel injection pumps are used for different kinds of diesel engines because of their different power.

② P fuel injector

Because of the excellent working capability of P7100 fuel injection pump, P fuel injector is chosen to match with the pump to reduce the inertia of needle value, and makes injection start more quickly and flow cutting off more thoroughly. Otherwise, the outer radius of the P fuel injector is very small, so the fuel hole on oil cylinder head is designed near to the center of the gas cylinder. In this case, the mixture of oil and air has been obviously improved and the burning is more thorough. The specification of fuel injection nozzle is 6*0.25mm.

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③ Optimizing turbocharger

In order to achieve the optimal capability matching, through optimizing and matching for different kinds of diesel engine, the high efficiency turbochargers with intake and exhaust valve are adopted. This ensures the emission standard, the light smoke and high/low speed capability. Different kinds of turbochargers are used for different kinds of diesel engines.

④ Improving burning chamber

Burning chamber with high extrusive flow function is selected to improve the mixing capability of oil and air at low speed running, which can enhance the low speed capability. On the other hand, the compression ratio could be properly increased to enhance the heat efficiency and improve the economy and start performance.

⑤ Optimizing valve train

Optimal design is done for intake and exhaust cam line and intake and exhaust manifold by BOOST software computation in the working process of diesel engine. The air-configured phase is improved by the optimization. The intake valve diameter is decreased while the exhaust valve diameter is increased.

⑥ New cylinder head with intake and exhaust way

Intake way with small whirlpool ratio and exhaust way with low resistance is used for the cylinder head.

2.2 Cautions on operation of engines

① High quality diesel oil with low sulfur content and grade CF lubricating oil have a strong influence on emission standard of diesel engines. So the users must choose quality-reliable diesel oil and lubricating oil according to the specification of this manual.

② Fuel supply advance angle of injection pump has a strong influence on the pollution of diesel engine. So the users must ensure that the fuel supply advance angle is within the range specified in this manual.

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③ Because the emission standard could be met by the combination of the technical methods introduced in 2.1. The parts such as fuel injection pump, turbocharger, and fuel injector must be chosen the same model type and producer as the original diesel engines used. Pay attention to types on the nameplates of these three parts (these are steel seal number on the shell of fuel injector). The products must be bought the same model type and producer as the original ones.

④ Parts such as piston, piston ring, cylinder liner, camshaft, cylinder head, valve, valve seat, vale split collets and rocker arm and so on must be bought the same as the original ones to replace.

Please especially notice that the type, model delivery data and serial number should be mentioned when purchasing spare parts so that the correct ones will be supplied to you.

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Chapter 3 Construction of diesel engine

3.1 Suspension system and peripheral accessories setting

The appearance of CA4DF and CA6DF are included in the pictures at the pre-pages of the text.

3.1 CA4DF Diesel Engine

4-point elastic suspension is adopted for CA4DF series diesel engines. The front suspension cushions are installed on both sides of cylinder block front end, and the rear ones on both sides of the flywheel housing.

Intake manifold, air heater or flame pre-heater, fuel injector, fuel injection pump, high pressure lines, fuel cooler, water drain tap, fuel filter, air compressor, oil filter, oil pressure sensor, fuel pipes, etc., are mounted on the side of fuel injection pump.

Alternator, starter motor, exhaust manifold, turbocharger, oil filter, oil dipstick, etc., are mounted on the side of the exhaust manifold.

Water pump, pulley (or crankshaft vibration damper), fan, fan clutch, fan belt, thermostat house (thermostat, water temperature sensor), etc., are mounted on front end of the engine.

3.1.2 CA6DF Diesel Engine

4-point elastic suspension is adopted for CA6DF series diesel engines. The front suspension cushions are installed on both sides of cylinder block front end, and the rear ones on both sides of the flywheel housing.

Intake manifold, air heater or flame pre-heater, fuel injector, fuel injection pump, high pressure lines, fuel filter, oil cooler, water drain tap, conditioner compressor bracket, oil dipstick, fuel pipes, etc., are mounted on the side of fuel injection pump.

Alternator, exhaust manifold, turbocharger, oil filter whose base oil pressure sensor are fixed on, centrifugal oil fine filter, oil filter of the turbocharger, air compressor, steering pump, exhaust water pipes, water temperature sensor, etc., are mounted on the side of the exhaust manifold.

Water pump, silicon oil crankshaft vibration damper, pulley, fan, fan clutch, fan belt are mounted on the front side of diesel engines.

Oil filler hole of 4 cylinders and 6 cylinders diesel engines are all positioned on the cylinder head cover.

The air-air coolers of 4 cylinders and 6 cylinders diesel engines are all positioned in front of the water tank radiator. With the help of fan and wind produced by vehicles, it cools fresh atmosphere that is generated by air compressor, then put it into intake manifold (see Fig.3-4).

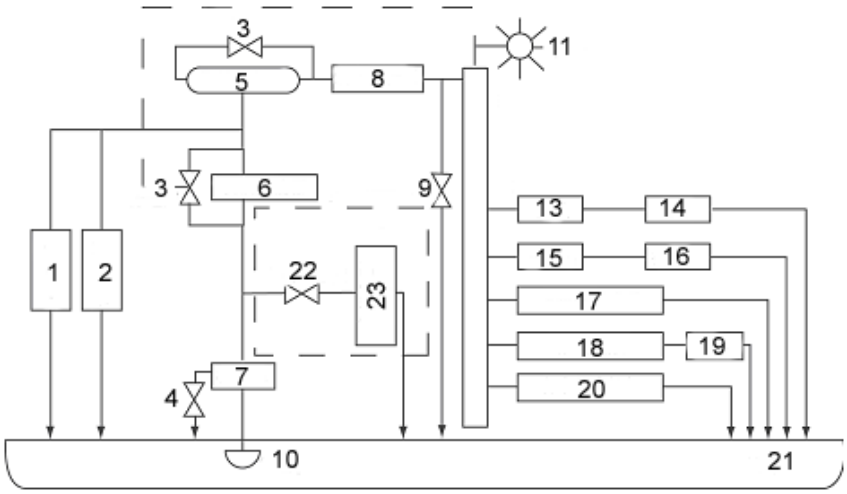
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3.2 Lubricating system

Lubricating system consists of oil sump, oil collector, oil pump, centrifugal oil fine filter (only for CA6DF), oil cooler, piston cooling nozzle, oil gallery regulating valve and oil channels, etc. The combination of forced lubrication and splash lubrication is adopted.

Oil pump is located under the last main bearing of engine block, and it is driven by the gears of crankshaft. Pressure limiting valve on oil pump will open when pressure at the oil pump outlet exceeds 0.9-1.1Mpa, part of the oil directly returns to oil sump, so as to ensure pressure in short time on lubricating system not too high when diesel engine is cold-started.

The oil pump sucks oil from oil sump via the oil collector.



1-fuel Injection pump 2-air compressor pump 3-bypass valve 4-pressure limiting valve of oil pump 5-oil cooler 6-oil filter 7-oil pump 8-oil pressure alarm 9-pressure limiting valve of main oil gallery 10-oil collector 11-indicating lamp 12-main oil gallery 13-crankshaft 14-connecting rod 15-camshaft 16-rocker arm shaft 17-piston cooling jet 18-turbocharged filter 19-turbocharger 20-intermediate gear shaft 21-oil sump 22-oil inlet pressure limiting valve 23-centrifugal oil fine filter

Fig 3-1 lubricating system

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The T-joint located in oil outlet pipe separately supplies oil to paper oil coarse filter and centrifugal fine filter. The oil passing through oil filter enters oil cooler first, then the oil gallery, main bearing and crankpin bearing. Through the oil gallery on the back baffle of cylinder block oil enters oil duct on 5^{th} bearing (7^{th} of CA6DF) of camshaft and the central oil duct in camshaft to lubricate cam shaft bearings and through the vertical oil duct to lubricate rocker arms and valve stem ends. Cams are lubricated by oil path and gears by oil splash.

The oil passing through centrifugal oil filter directly returns to oil sump.

The oil gallery pressure regulating valve under the fuel injection advance device is used to keep the working pressure in oil gallery within 343-490kPa. The wear of diesel engine will make the oil pressure decrease because of the increasing clearance of bearing shell and liners. When the oil pressure is less than 80kPa at idling running or less than 300kPa at high speed running without load, the clearance of bearings should be checked and the bearing shell should be replaced.

After filtering by the turbocharged filter, the lubricating oil from the first main bearing of 4DF will lubricate the turbocharger, the return oil will flow to the oil sump via the return oil pipes. The oil from the final rank of the camshaft will lubricate the air compressor pump and its gear shaft, the return oil will flow to the oil sump via the gear chamber.

One gallery is located under the oil coarse filter seat for the 6DF engine, oil form it is used to lubricate the air compressor pump and the turbocharger via the turbocharged oil filter respectively. The oil lubricated the bearings of crankshaft of air compressor pump will from the driving end of air compressor pump flow to the oil sump via the gear chamber. The oil lubricated the bearings of turbocharger will flow to the oil sump via the return oil pipes.

The oil pipes for lubricating the injection pump are set on the main oil gallery; the oil lubricated the injection pump will flow to the oil sump via return oil pipes.

Centrifugal oil fine filter (Fig. 3-2) is connected in parallel with the oil gallery. An inlet opening limiting pressure valve is mounted on the seat of oil filter, only when the inlet oil pressure exceeds 150-200kPa, can oil enter centrifugal oil filter. When the inlet oil pressure is 300kPa, the rotor speed can reach 5000rpm, and the impurities in oil will accumulate on the wall of rotor by the centrifugal force. Customers should clear these impurities termly.

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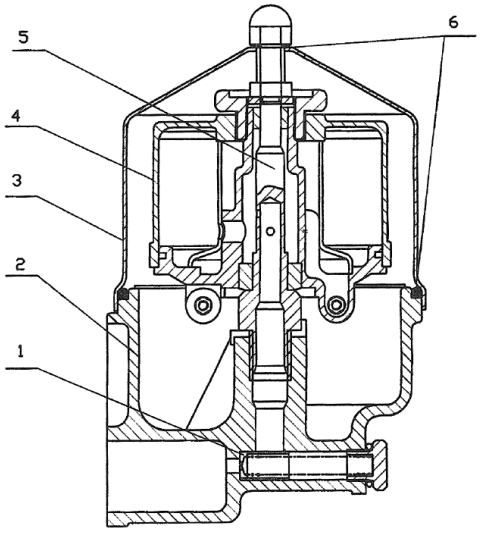


图 3-2 离心式机油滤清器

1-进油限压阀； 2-底座； 3-转子罩； 4-转子； 5-转子轴； 6-橡胶密封权（2 处）

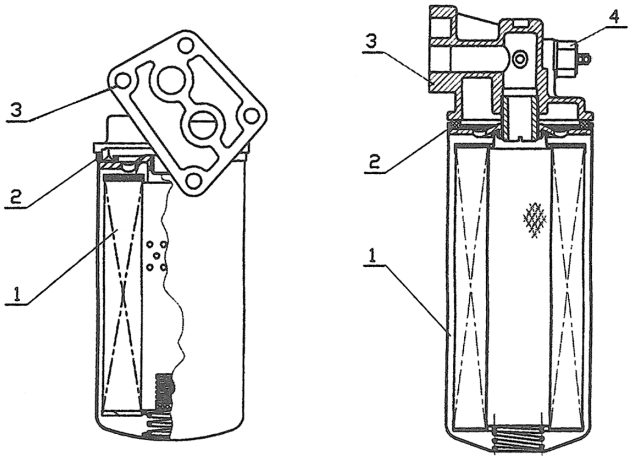
Fig. 3-2 centrifugal oil filter

1.inlet pressure limiting valve 2.seat 3.cover of rotor 4.rotor 5.rotor shaft 6.o-ring (two)

Oil filter is spin-oil filter (Fig.3-3). A filter restriction indicator is mounted on the seat of oil filter. When the restriction increases to 150±30kPa, the bypass valve opens (oil no longer enters filter element and directly returns to oil gallery), and the alarm lights up to remind you to maintain or change the filter element. The bypass valve will also open when engine cold-starts because of the high oil viscosity, the alarm lamp also lights up in short time, but it will go out when engine runs, it is normal.

Water cooling oil cooler is used to decrease the oil temperature, prevent the oil from oxygenation because of the over high temperature of oil. The amount of heat transferred to the oil will increase because of the high heat load of turbocharger and injecting oil cool system for piston.

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4DF 机型用 6DF 机型用

图 3-3 机油滤清器

1-旋装滤芯 2-橡胶密封圈 3-滤座 4-堵塞报警器

Fig 3-3 oil filter

For 4DF For 6DF

1.spin-on stage 2.rubber ring 3.seat 4.restriction alarm

3.3 cooling system

Cooling system consists of water pump, thermostat, fan, water drain trap, water outlet pipe (thermostat house for 4DF), and water tank radiator in the car, etc. (Fig. 3-4). The water from radiator is pumped to the inlet hole on the left side of cylinder block by the centrifugal water pump. Passing through oil cooler the cooling water enters water jacket of each cylinder, then the cylinder head, finally the water outlet pipe (thermostat house for 4DF). Two thermostats for adjusting water temperature are set on the end of water outlet pipe for 6DF; while a thermostat is set in the thermostat house for 4DF. The principle is as follows: If the temperature of the cooling water from the water outlet pipe (thermostat house for 4DF) is lower than opening temperature, the thermostat will close, the cooling water directly returns to water pump through the gluey pipe, and no longer enters radiator, this called small cycle; when the temperature of cooling water exceeds the all-open temperature, the control valves of thermostats open, then the cooling water enters radiator.

The engine adopt waxen thermostat. When the thermostats fully open, their lift should not be less than 8mm if thermostat can not open, outlet water temperature will increase soon, so it must be changed termly. Users can put thermostat in water and burn it to check if thermostat works well.

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You should choose thermostat with different opening temperature by different conditions (see the following table), the first two thermostat is fit for plain areas, while the last one is fit for altiplano with altitude over 3000m.

Picture number of thermostat	K-1306010	136020/CK-1	1306010G_K
Opening temperature（℃）	76±2	82±2	65±2
Fully-opening temperature（℃）	86±2	95±2	75±2
All open lift（mm）	≥8	≥8	≥8
Remark	For high temperature and heavy load conditions	For low temperature and light load conditions	For altiplano areas

Cooling water pump is of centrifugal type (Fig. 3-5), with flow of 240L/min at speed of 300rpm, and lift higher than 13.2m.

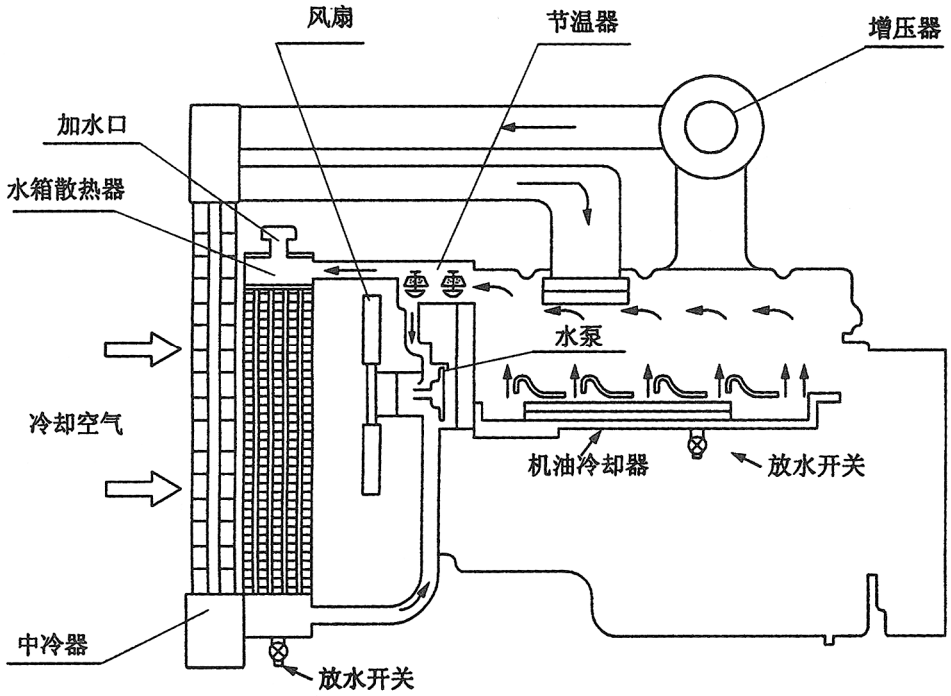


图 3-4 冷却系统及增压中冷系统示意图

Fig. 3-4 cooling system and turbocharger air cooler

Inlet water hole fan thermostat turbocharger

Radiator of water tank water pump

Cooling air oil cooler water drain tap

Air cooler

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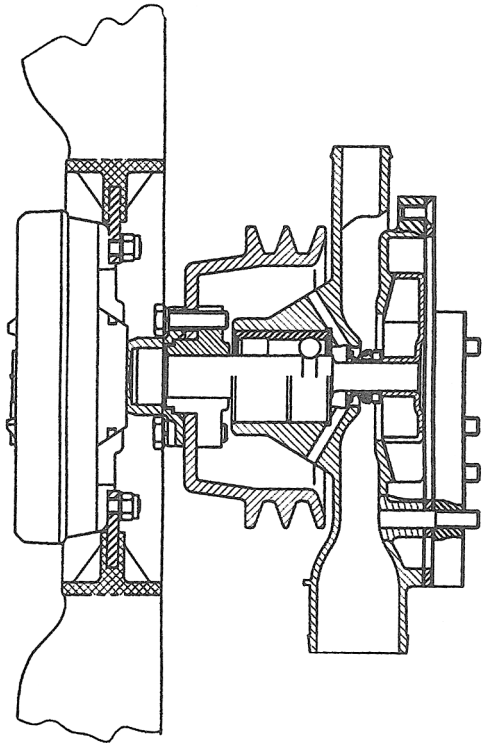


图 3-5　水泵风扇总成

Fig 3-5 water pump fan assy.

The diameter and blade numbers should be confirmed by engineis power and overall design requirement of different car cooling system. Since the cooling fan of automotive engine is of suction type, it should be fitted in the right direction. Fan clutch uses its front end sensor to sense the cooling wind temperature on the rear end of water tank radiator, and regulate the slip difference of silicon oil clutch to control fan rotate speed (high speed leads to high temperature, vice versa). If the sensor is broken, users can lock the clutch by the load on the fan clutch, then fan rotate speed is the same as water pump rotate speed.

Water temperature sensor plug is located on outlet water pipe (4DF on thermostat house) and is connected to water temperature instrument in driving room to display outlet water temperature.

3.4 fuel system

fuel system consists of fuel filter, injection pump, high pressure fuel lines, injector, fuel return pipes, oil tank, fuel filter, etc. Injection pump assy. consists of injection advance device, governor, injection pump, fuel transfer pump, etc. injection advance device and governor are of centrifugal type. Passing through the coarse filter on vehicle and fuel filter on engine, fuel enters fuel injection pump, through high pressure fuel lines to injector. When fuel pressure reaches above starting injection pressure, the needle valve opens to spray fuel to cylinder.

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Small amount of fuel leaking from injector and over fuel in the low pressure chamber of injection pump return through fuel return line to fuel tank (see fig 3-6).

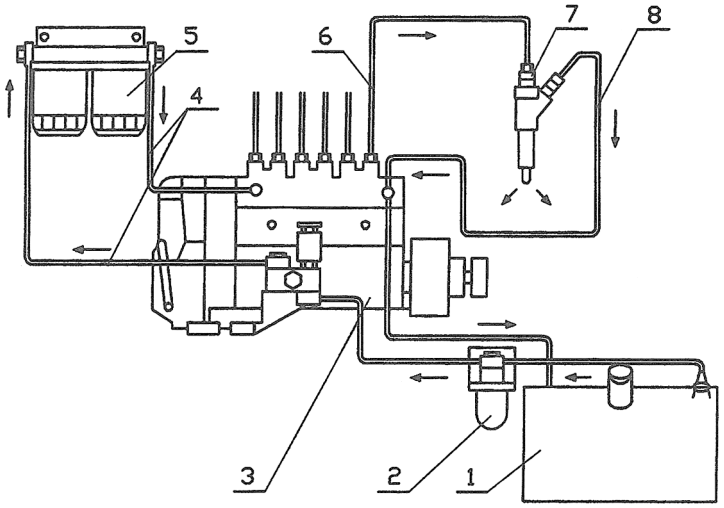


图 3-6 燃油供给系统示意图

1-燃油箱 2-柴油粗滤器 3-喷油泵 4-低压油管

5-柴油滤清器 6-高压油管 7-喷油器 8-回油管

Fig 3-6 fuel supply system

1-fuel tank 2-fuel coarse filter 3-fuel injection pump 4-low pressure fuel lines

5-fuel filter 6-high pressure line 7-injector 8-fuel return line

3.4.1 Fuel injection pump

To ensure the capability and achieve exhaust standard, P7100 pump, which has better working ability, is adopted for 4DF and 6DF.

Pressure lubricating is adopted. Lube oil fuel injection pump and governor should be regularly changed, according to the same change interval as that of the oil in oil sump and oil in injection advance pump should also be regularly changed or filled.

When assemble fuel injection pump, the first thing is to align the pointer on flywheel housing with stated oil providing advance angle, then the mark 1 on injection pump gear should be pointed to the arrow on end of injection pump, then fit the fuel injection pump in the base hole on flywheel housing, the bolts on the connecting plate can be tightened. Check the advance angle (Fig. 5-6) regulates the pump if not installed properly.

RQV-K mechanical centrifugal governor with full-scale governing handle is adopted for P7100 fuel injection pump (see Fig 3-8). Fuel cut-off handle is located on top-right cornet of oil door handle. After stopping, the stopping handle should be reset to the original position.

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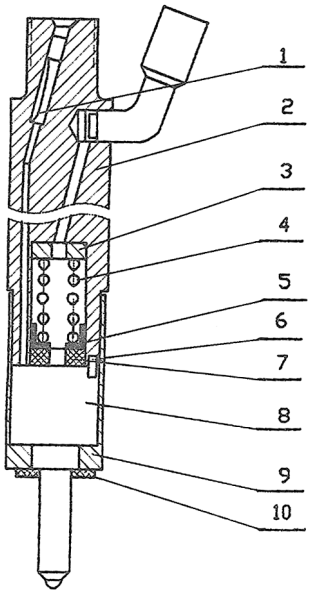


图 3-7 P 型喷油器结构图

1-缝隙滤清器 2-喷油器体 3-调压垫片 4-调压弹簧 5-弹簧座 6-定位销
7-隔板部件 8-油嘴部件 9-油嘴紧帽 10-密封铜垫片

Fig 3-7 P-shaped injection structure

1-gap filter 2-injector body 3-pressure regulating gasket 4-pressure regulating spring 5-spring seat 6-oriernting pin 7-separator component 8-oil nozzle tighten cap 10-copper sealing ring

3.4.2 Injector

To ensure the capability of the diesel engine, and achieve the exhausting standard, P shaped nozzle, which has small inertia and can produce high oil pressure, is adopted by 4DF and 6DF diesel engine. S-shaped nozzle uses gasket with various thickness to adjust the injection oil pressure (part whose id is 3 in picture 3-7), while the ordinary used S-shaped nozzle uses adjusting bolt. Thickness of the gasket ranges from 1.0-2.0m, there is one spec every 0.01mm (the total specs is 100), the fuel injector producers usually adopt gasket with thickness from 1.7-1.9mm. Before assembly, the injector must be cleaned. At 45 inclinations, the needle should be able to slip freely into the needle valve body.

The pressure cap on injector should be tightened with torque of 35±5N.m. The torque cannot be too high, or else it may arouse needle valve distorting. The number of injection holes if 6, the hole diameter is 0.25mm. To avoid dunghill accumulating, the fuel injector should be covered by defending cover, then be putted into copper sleeve and be pressed by clamp plate. The bolt should be tightened with torque of 70±10N.m.

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3.4.3 Fuel transfer pump

Plunger type fuel transfer pump is mounted on side of injection pump (see fig 3-8), sucking fuel from fuel tank to supply fuel for injection pump. You can press the pump oil handle to let out the atmosphere in the fuel system for the new engine.

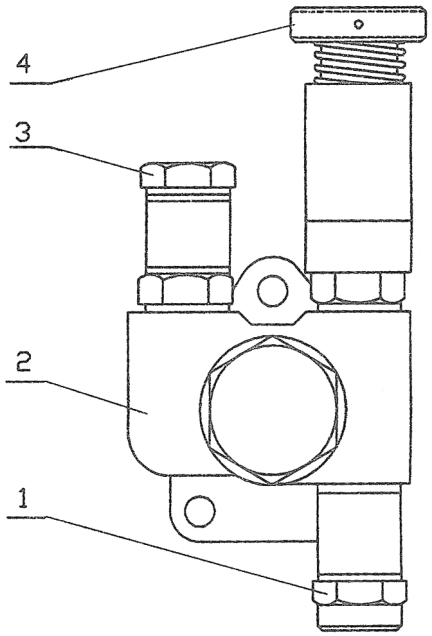


图 3-8 输油泵

1-进油管接螺钉 2-输油泵体 3-出油管接螺钉 4-泵油手柄

Fig 3-8 fuel transfer pump

1-inlet oil pipeis linking bolt 2-fuel transfer pump body 3-outlet oil pipeis linking bolt 4-pump handle

3.4.4 Fuel filter

The fuel filter is spin-on filter, 4DF has one stage, and 6DF has two stages, see picture 3-9. the fuel filter is used to filtrate mechanic impurity and water in fuel, to decrease abrasion.

Fuel filter stage should be regularly replaced and maintained, joint bolt of inlet and outlet oil manifold should be tightened with torque of 25±5N.m

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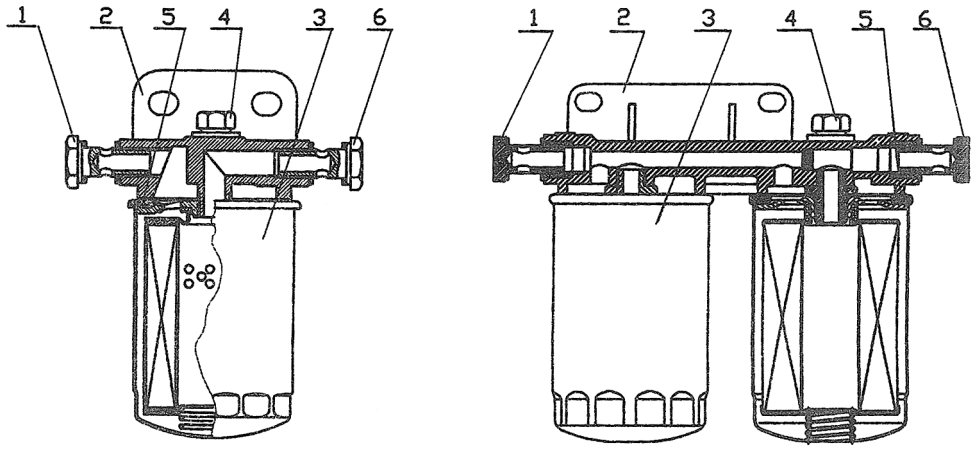


图 3-9 旋装式柴油滤清器

1-进油管接头螺钉 2-底座 3-旋装滤芯 4-放气螺塞 5-橡胶密封圈 6-出油管接螺钉

Fig 3-9 spin-on fuel filter

1-inlet oil pipe jointing bolt 2-seat 3-spin-on stage 4-air-exhaust screw plug 5-rubber ring 6-outlet oil pipe joint bolt

3.5 intake and exhaust system

Intake and exhaust system consists of air filter, intake connection pipe, air heater or flame pre-heater, strainer, intake pipe, exhaust pipe, gasket, etc. Most of the engines adopt 2-stage dry paper filter, and the oil bath type filter are used in damp areas. The types of air filter are chosen by car producers according to the power of diesel engines and the environment. A reminder is set at intake connecting pipe or filter to monitor the stem circs of filter stage and remind the customers to clear and change stages in good time (see the detail at maintaining of filter).

3.6 turbocharged and inter-cooled system

Turbocharged and inter-cooled system consists of turbocharger, air-air intercooler, lube oil filter and the inlet and outlet pipes, etc.

Turbocharger consists of exhaust turbine and compressor. When the exhaust gas flows the turbine housing, then turbine wheel begins to rotate. The compressor wheel is attached to the same shaft as the turbine wheel. When the compressor wheel spins, air is sucked in from the air filter. The air is compressed here and pushed into engineis cylinder, and this create conditions to improve the fuel engine efficiency. The construction of turbocharger is shown in Fig. 3-10.

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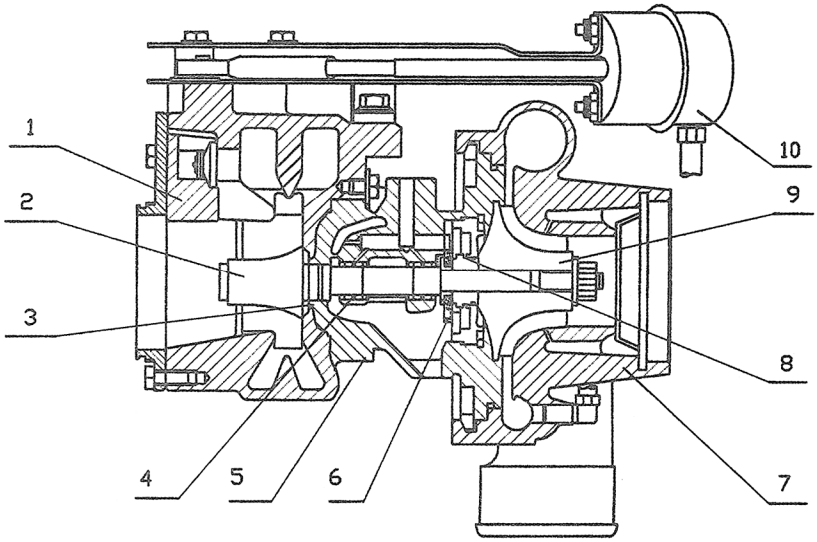


图 3-10 涡轮增压器

1-涡轮壳 2-涡轮部件 3-涡轮密封环 4-浮动轴承 5-中间壳
6-止推轴承 7 压气机壳 8-压气机密封环 9-压气机叶轮 10-排气放气阀

Fig 3-10 turbine turbocharger

1-turbine shell 2-turbine component 3-turbine sealing ring
4-floating bearing 5-intermediate casing 6-thrust bearing
7-compressor casing 8-compressor sealing ring
9-impeller of compressor 10-exhaust valve

The air-air iner-cooler which is located on front end of water tank radiator uses fan and wind produced by head-on vehicles to cool the inlet air and this can increase engine power and improve engine capability.

Due to the extreme high speed of rotor (about 100,000rpm), to ensure the lubrication and the cleanliness of lube oil if of great importance. The element of lube oil filter should be regularly replaced.

3.7 Electrical system

3.7.1 electrical components

Electrical system is of 24V and consists of starter, alternator, air heater or flame pre-heater, eater temperature sensor, oil pressure alarm, oil pressure sensor, oil restriction indicator, etc.

Starter power is 6kw with speed of 2500r/min to ensure engineis starting speed over 200rpm.

The rated voltage of the alternator is 28V, and rated circuit is chosen according to different car types. It is internal ground with internal voltage adjustor. (Fig.3-11).

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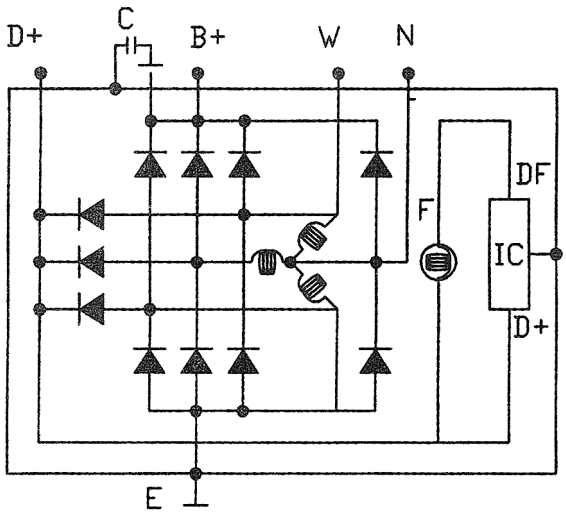


图 3-11 4DF、6DF 发电机电气原理图

Fig3-11 4DF & 6DF engine wiring diagram

Water temperature sensor is worked together with the water temperature gauge, to show the cooling water temperature from outlet pipes.

Oil pressure alarm is located in oil gallery of the engine: it works with alarm, when the pressure in oil gallery drops below 80kpa, the alarm lamp will light. Some car types have oil pressure sensor, and oil pressure can be read from oil pressure gauge in driving room.

Oil restriction indicator is located on the base of oil filter; the detail will be seen in Fig.3.2

3.7.2 intake air preheat

The diesel engines in our factory can start successfully above –5℃ without any preheat measures, but it becomes difficult in winter. To achieve the corresponding requirements for different cars, you van choose one type from the below equipments to preheat the inlet air in winter.

1. Air heater

Air heater uses resistance sheet to heat the air into the cylinder block to ensure engineis starting at -5℃~15℃ in winter. The heater is a sheet-shaped resistance, it consumes power of 1.83kw. Its allowable continuous time is 40 seconds (too long the resistance plate will be destroyed), sees the structure in Fig.3-12.

2. Flame intake air pre-heater

Flame intake air pre-heater inject the flame burned by fuel directly into intake pipe to increase intake air temperature largely, ensure the cold starting equipment starting at -15℃~40℃ in cold winter. (See Fig.3-13)

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Before the engine start, insert the key and turn it to position 1, then the accumulator supply power for the controller. If the cooling water temperature is 0℃, then temperature sensor sends this signal to the controller, and the controller supply electricity for the flame plug with ratio of 100%. The flame plug is heated and the indicator lights up. After 30 seconds, the flame is very hot, and the preheat program is finished, then the controller supply electricity for flame plug with ratio of 68% and provide voltage protection.

The indicator light flickers when preheating is finished, then the engine can be started. Press the start button, the indicator will send electricity-supply instruction to the electromagnetic valve, then the fuel lines will be connected and fuel flows to the flame plug and generates flame.

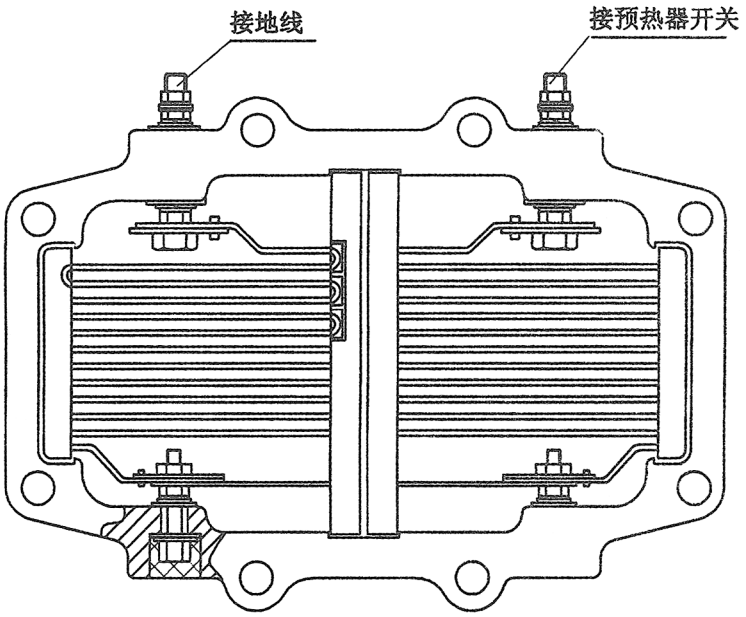


图 3-12 空气加热器

Fig 3-12 air heater

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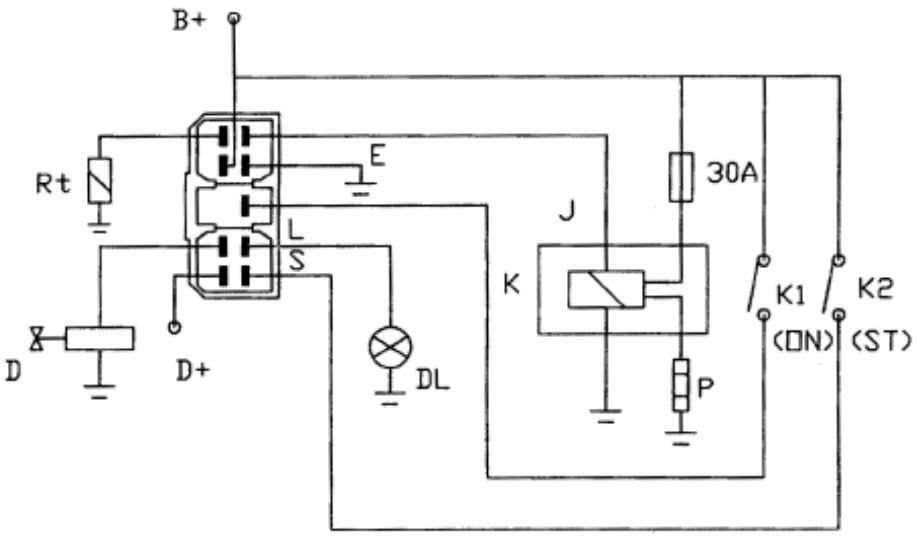


图 3-13 火焰预热器接线图

K1-点火开关NO 档 K2-点火开关ST档 P-预热塞 DL-预热指示灯
D-供油电磁阀 D+ -接发电机 D+端 K-预热继电器 Rt-预热用温度传感器

Fig3-13 flame pre-heater wiring picture

K1-ignition switch NO position K2-ignition switch ST position
P-preheat plug DL-preheat indicator D-electromagnetic valve
D+-motor D+ port K-preheat relay
RT-temperature sensor for preheating

At the same time, the controller will start timing, if the driver don't start or fail to start in 30 seconds, preheat circuit will be automatically cut off and electromagnetic circuit and signal indicator circuit will start overtime-protection.

After the engine starts, alternator starts working, magnetic field D+ reaches the indicator, and unchains the time-lapse protection. The ratio of electricity-protection decreases from 68% to 50%, alternator supplies electricity to the preheating plug directly and start voltage protection.

When engine runs stably, driver should move back the key to the original position, and stops flame plug working.

Cautions on operation of flame pre-heater device

1. Along with temperature decreasing, please firstly check fuel and lubricating oil you used is fit to use as the manual lists. Accumulator should also adopt low temperature ones. (Ordinary battery cannot work well in cold environment).

2. Time that you press starting button should not past 30 seconds. If it doesn't catch fire in 30 seconds, you can prolong time properly, but should not exceed 45seconds, in case the starter is

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damaged. If the rotate speed is too low, you should stop starting operation immediately, check if oil is too dense, and voltage of accumulator is natural, if still not ok, dismantle starter and check its rotate speed and joggle journey.

3. If you press the starting button in 3 seconds after the preheat program, then loosen the button and the engine doesn't rotate. You can press the button again in 5.5 seconds to start the engine.

4. If the preheat indicator flickers for 30 seconds, and you still not press the starting button or fail to start, flame pre-heater will stop working automatically. You can wait for 2 minutes and start again.

5. If the engine start without pre-heating successfully, the rotate speed of the engine should be controlled in the range of 800~1000r/min and runs stably for several minutes until the indicator dies, then runs normally.

6. When water temperature is above 0℃, flame pre-heater works and the indicator doesn't light, it indicates that users can start the diesel engine directly.

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Chapter 4 Cautions on Operation of Diesel Engine

4.1 Choice of diesel oil

Select the oil type for diesel engine according to ambient temperature of the atmosphere. In cold winter, diesel oil with low condensation point should be used, vice versa in summer. Users can choose the oil type recommended in table 4-1. EX: oil type –35 should be chosen at ambient temperature of –27℃.

Table 4-1 Oil Type and Applicable Temperature

Oil type	NO.10	NO.0	NO.-10	NO.-20	NO.-35
Cetane number	50	50	50	45	43
Condensation point (℃)	+10	0	-10	-20	-35
Lowest applicable temperature (working ambient temperature)(℃)	+18	+8	-2	-12	-27

After confirming the oil type, users should choose the high quality diesel oil with low sulfur content (the national standard sulfur content in diesel oil for diesel engine should be lower than 0.5%), this is quite beneficial for improving the emission of diesel engine and decreasing the corrosion & wear of relevant parts of diesel engine.

Diesel oil must be kept highly clean, away from dirt in air and impurities in the oil tank. Before being filled into the oil tank, it should be kept still for over 72 hours and then the upper layer should be taken. This is quite important for the protection from early wear of the injector plunger.

4.2 Choice of lubricating oil

4DF and 6DF diesel engines are turbocharged and inter-cooled diesel engines, their mechanical and heat loads of moving parts are much high. To ensure the normal running, the life of diesel engine and improve the emission of diesel engine, the CF grade lubricating oil for turbocharged diesel engine should be chosen. In addition, the choice of lubricating oil type must also depend on the working ambient temperature (see table 4-2), EX: when the ambient temperature is –10℃, 15W/40 lubricating oil should be chosen. The viscosity of lubricating oil suitable for low temperature is low, so the oil pressure will be lower in high ambient temperature. The viscosity of lubricating oil suitable for high temperature is high; so the starting will be difficult with oil pressure increasing slowly and pressure higher in low ambient temperature. These cases are disadvantageous for the reliability of the diesel engine. Users should choose the lubricating oil type according to the ambient temperature of the atmosphere.

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Table 4-2

Type in grade L-ECF	10W	5w /30	10w /30	15w /30	15w /40	20w /40	20w /20	30	40
Ambient temperature (℃)	-20～-5	-25～ 25	-20～ 20	-10～ 25	-10～ 35	-10～ 30	-10～ 10	5～30	>25

Lubricating oil must be kept clean, away from dirt and impurities. After filling, the level of lubricating oil in the oil sump should be checked in the following way: draw out the oil dipstick, wipe it with gauze and again insert it into the oil. Then draw it out and see whether the oil level is between the upper and lower marks. The level must never be below the lower mark.

Lubricating oil

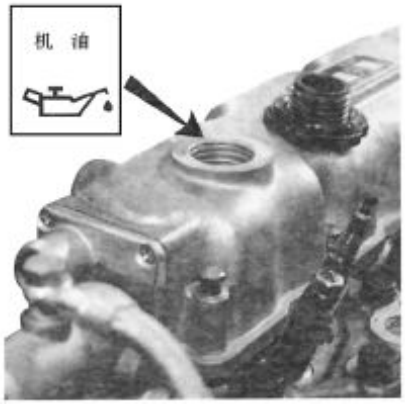


图 4-1 机油的加注方法

Fig 4-1 filling of lubricating oil

4.3 Choice of cooling water

Soft water (river water, rain water, of tap water from river & lake), instead of hard water (well water or spring water), should be filled into the cooling system of the engine. For hard water contains CaCO3 and MgCO3, which, after precipitated on the block, on the water way of cylinder cover, the outer surface of the cylinder liner and inner surface of the radiator of water tank, will increase the restriction of water flow and influence the heat rejection of cooling system.

Hard water must be softened before being used. One way of softening is to add NaPO4 into water (2g for one liter of water). Another way is to boil the water. Cooling water must be clean, otherwise, the impurities in it may cause wear of the impeller and water sealing plug of the water pump and clogging in pipes of the cooling tank.

In order to enhance the resistance to erosion of parts such as cylinder liner and the impeller of water pump, type NL emulsified antirust oil may be used. Usage: Mix 3~4kg antirust oil with 96~97kg water.

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When the ambient temperature is below 0℃, in case that the machine would be frozen, antifreeze fluid should be added to the cooling water. Generally the antifreeze fluid has three types: alcohol-water type, glycerin-water type, and glycol-water type. Different ratios of these chemical materials to water will lead to different freezing points. The ingredients of antifreeze fluid display in table 4-3

Table 4-3 Ingredients of antifreeze fluid

Freezing point (℃)	Alcohol-water type (Alcohol mass percentage%)	Glycerin-water type (Glycerin mass percentage%)	Glycol-water type (Glycol mass percentage%)
-5	10	21	-
-10	20	32	28
-15	25	43	32
-20	30	51	38
-25	35	58	45
-30	40	64	48
-40	55	73	55
-50	70	-	60

Note:

1. The antifreeze fluid is not edible for its toxicity.
2. After temperature increased, heat expansion amount of antifreeze fluid is much big.

So the injection amount of antifreeze fluid should be 8% less than the previous injection amount of water, in case those components such as water tank will be breached.

3. The poor antifreeze fluid, which corrodes the cylinder block, is forbidden.

Antifreeze fluids of different ingredients or brands cannot be mixed.

4.4 Preparations before starting

4.4.1 Preparations before starting

Check the level of lubricating oil in the oil sump.

Check the stored diesel oil in the fuel tank and open the fuel switch.

Check whether the cooling water in the water tank of radiator and subsidiary water tank is full.

A new engine should be dearated the fuel system and cooling system according to the following way.

4.4.2 Deaerate the fuel system

Air in the fuel system may cause abnormal fuel supply of the injection pump, resulting in difficulties in starting the engine, unstable running and even forcing the engine to stop. Therefore the fuel system must be deaerated when the fuel in the fuel tank runs out and needs refilling or when the injection pump, the fuel filter and the fuel pipes have been removed and refitted.

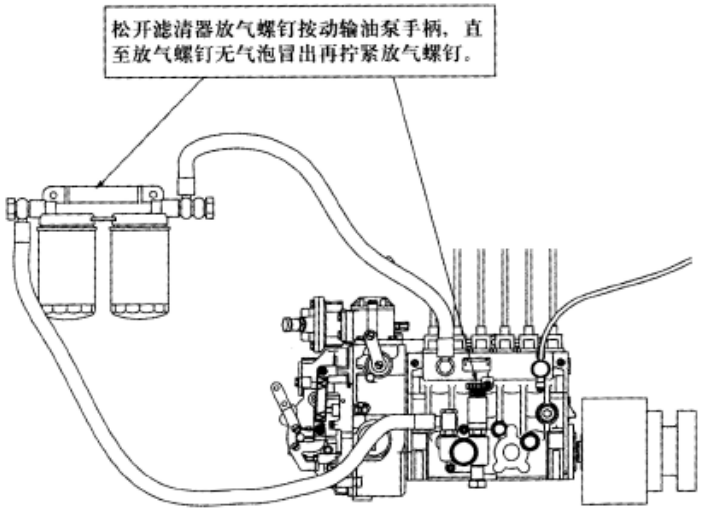
Below are the procedures of deaerating air in the fuel system:

Unscrew the outlet screw on the fuel filter and then press the handle of fuel supply pump

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repeatedly until there is no bubble in the fuel released from the outlet screw. Then screw it again while keeping pressing the handle. Finally, screw the handle (see fig4-2)

Loosen the deaerating screw, press and pull the handle until
no air bubbles escape from the diesel oil flowing off
from the deaerating screw. Then tighten the deaerarting screw.



注：4DF 机型柴油滤清器为单级且在油泵右侧

图 4-2 排除燃油系统中空气

Note: The fuel filter of 4DF diesel engine is single grade and located on the right of the fuel pump.

Fig 4-2 Deaerate fuel system

4.4.3 Deaerate the cooling system

The cooling system must be deaerated before cooling water enters the system, otherwise, it may block the system, making the engine overheat, and therefore cause the serious fault of scuffing. The procedures of deaerating are as follows: unscrew the hexagon-headed plug near the fan of the water outlet pipe of diesel engine (or the hexagon-headed plug on the thermostat cover, only for 4DF2 diesel engine) and inject water into the cooling system, until there is no bubble in the cooling water flowing from the screw of hexagon-headed plug (see fig 4-3). If antifreeze fluid is used, it should be recollected for saving and reducing pollution.

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Loose4n the hexagon-headed plug until no bubble escape from cooling water, then tighten the plug

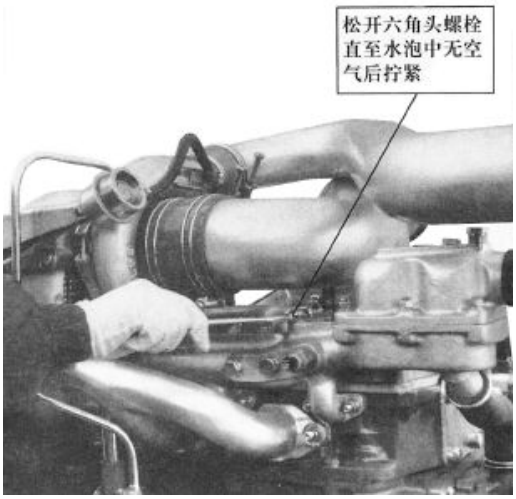


图 4-3 排除冷却系统中空气

Fig 4-3 Deaerate cooling system

4.4.4 Inject lubricating oil to the turbocharger

Before a new engine or the engine that has been shut down for a long period of time is started, firstly the oil inlet pipe of turbocharger should be removed, then inject clean lubricating oil to the oil inlet and the filter of turbocharger so as to ensure that the bearings of turbocharger be lubricated as early as the engine is started. The turbocharger should also be filled with lubricated oil after being checked or replaced the filter of turbocharger (see fig 4-4). The oil filled into the turbocharger must be of the same type as that filled into the engine, and also it must be clean.

4.5 Procedures of starting

As starting, the gearbox should be free and unconnected with the clutch.

Below are the procedures of starting:

Unlock the switch to turn on the electrical power supply.

Press the starting button to start the engine. As soon as the engine starts, the button should be released, and the switch put to its original position. To protect the engine and batteries, the button should never be pressed for over 15 seconds at a time. If it fails to start, the engine should be restarted at intervals of 60 seconds. If it fails three times in succession, it may be restarted only after the fault has been found and remedied.

The lubricating oil pressure should be checked soon after starting.

The lubricating oil pressure at idling running should be higher than 98kPa. The alarm of oil pressure will ring when the oil pressure is less than 80kPa, this must bestopped the engine immediately to check.

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After a newly assembled engine or the one changed lubricating oil is started, the lubricating oil level in the oil sump should be checked. If necessary, oil should be added or drained so as to keep the oil level between the upper and lower marks.

Remove oil inlet pipe of turbocharger, fill lubricating oil into the inlet and filter of turbocharger respectively

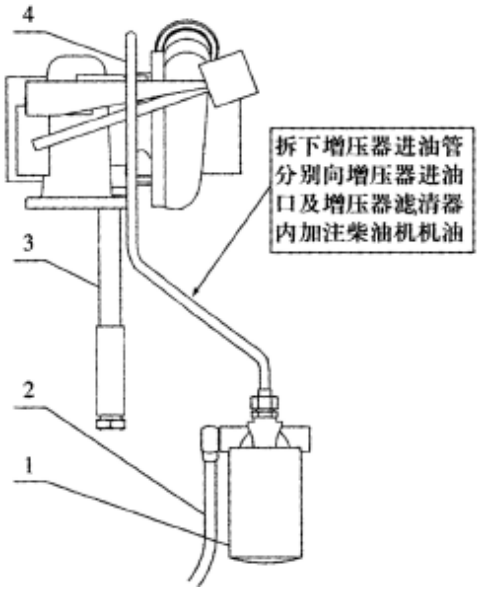


图 4-4 向增压器加注润滑油

1-增压器滤清器 2-滤清器进油管 3-增压器回油管 4-增压器进油管

Fig 4-4 Fill lubricating oil into turbocharger

1-the filter of turbocharger 2-oil inlet pipe of filter

3-oil return pipe of turbocharger 4-oil inlet pipe of turbocharger

4.6 Cautions on running

The engine must not run at full load as soon as it starts. It should run first for a period of time at low or medium speed. Only when the water temperature reaches 60℃ and the engine runs normally can it be operated at full load. What must be specially mentioned here is as follows:

1. It is harmful for the diesel engine to warm up the engine at idling running in winter after starting.

2. It is harmful for the friction parts of the diesel engine to increase the oil supply quickly. Because the oil pressure of friction parts of diesel engine is not built as starting, suddenly entering into the high speed running will easily damage friction parts, especially in winter the bearings of turbocharger will be easily adhered.

Pay attention frequently to the lubricating oil pressure and the cooling water temperature.

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The oil pressure at high or medium speed should be within 245~490kPa while the cooling water outlet temperature should be within 75~95℃.

Check frequently after starting or before stopping whether there are any abnormal noises or faults. Stop immediately if abnormality should occur, and restart after the fault has been remedied.

Pay frequent attention to the tightness of water pipes, oil pipes, gas pipes, etc. remedy as soon as any one of them leaks.

A newly bought or overhauled engine can run at full speed and full load only after running 2000km (or 40 hours) at medium or low speed with light duty.

It will be harmful for the wear and economy of diesel engine of the temperature of outlet water is too low. The open extent of thermostat in the outlet pipe will decrease or stop at low water temperature. Moreover, the double-metal temperature sensor on the clutch of silicon oil fan will start working because of low wind temperature of cooling water tank. Users in the extremely cold areas can open the blind of cooling tank to further reduce the wind volume and increase the water temperature.

In the high temperature areas that the ambient temperature is higher than 35℃ in summer, users should take reducing load of engine into consideration to ensure the outlet water temperature is less than 100℃.

All limiting screws on the fuel injection pump have been lead sealed before sale. The customers themselves should not remove the seal to make adjustment.

4.7 Cautions on stopping

The engine should run at low speed for several minutes before its load is removed, and it should not be stopped until the cooling water temperature drops lower than 60℃ and the turbocharger rotates much slower. Now stopping the engine is quite beneficial to protect the engine and turbocharger.

What must be specially mentioned here is that the heated parts such as the piston, piston ring, cylinder cover are in the high temperature state at full load running, but if the engine enters into idling running immediately, the volume of cooling water and cooling wind will be especially small at the same time, a lots of heat will be transferred to the cooling water and make the water temperature increase quickly in a little time or even make the water boil. So the engine should run at low speed without load for several minutes before stopping (especially in summer).

The operation method at accelerate-stop-free slide way is forbidden for the turbocharged diesel engine.

If the cooling water contains no antifreeze fluid while the ambient temperature is below 0℃, the cooling water should be drained after stopping to protect the parts, such as the cylinder block, from cracking. The draining switches of 4DF & 6DF diesel engine are on the head of lubricating oil cooler.

If the engine is to be shut down for a major period, cleaning should be carefully done. The cooling water must be drained and the engine sealed with grease to prevent from rusting.

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4.8 Cautions on operation in winter

The engine must be taken into special maintenance when the environment is lower than 5℃.

Lubricating oil and diesel oil special for winter must be used (see table 4-1,4-2), and the diesel oil must not be contaminated with water in case the oil pipes may be blocked.

To change the lubricating oil into that for low temperature use, first drain the oil in the oil sump and the fuel injection pump, and clean the lubricating oil filter, oil sump and oil collector, then fill lubricating oil for low temperature into the oil sump and fuel injection pump. The interval of changing oil must be shortened when the ambient temperature is lower than -10℃.

Better add antifreeze fluid to the cooling water (see table 4-3). But be careful not to add over 30% antifreeze unless the ambient temperature keeps lower than -35℃, for too much antifreeze is apt to gum up in the cooling system and therefore block the water pipes. When filling coolant, water should be added as well as antifreeze.

In winter, after the engine without antifreeze fluid stops, the water should be drained after its temperature drops to 40~50℃.

In extremely cold areas, vehicles had better not be parked open; otherwise the oil sump must be heated before starting to prevent the oil from being too thick. If antifreeze is not used, hot water should be filled into the water tank, and the air-heater or flame pre-heater should be actuated to make the engine easy to start.

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Chapter 5 Maintenance requirements of diesel engine

Maintenance, which exerts a decisive influence on the nicer performance and the service life of the engine, is a necessity for a long-term reliability and economy of the engine. Therefore, users should strictly abide by the following regulations for maintenance.

5.1 Run-in of new diesel engine and technical maintenance

Maintenance includes the maintenance in the run-in period and the technical maintenance in the running period (Generally third level maintenance), items of maintenance can be seen in table 5-1 and 5-2.

The aim of run-in of new diesel engine is to make the friction parts of kinetic components of diesel engine achieve good copulate performance through 2000km running at low load and speed. After the run-in period, the diesel engine can be normal running according to the maintenance displayed in table 5-1.

Table 5-1 Item Of Maintenance After The Run-in Period

Interval	No.	Items of maintenance
Run-in period (2000km or 40h)	1	Drain diesel oil of oil sump and fuel injection pump, clean the oil sump carefully and change the lubricating oil
	2	Clean the strainer of the oil collector
	3	Check the tightening torque of nut on the driven-gear of oil pump
	4	Check the tightening torque of bolts on the main bearing
	5	Check the tightening torque of bolts on the connecting rod
	6	Check the tightening torque of bolts on the cylinder head
	7	Check and adjust the valve clearance
	8	Replace filter elements of the fuel and oil filter, clean the oil filter and remove dust on the air filter element
	9	Check the fuel supply advance angle
	10	Check the tension of the fan belt
	11	Check for the defects on the suspension pad or whether the nuts are loose

After the normal running of diesel engine, the daily and third level maintenance should be done according to the time in the following table.

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Table 5-2 Items Of Technical Maintenance

Interval	No.	Items of maintenance
Daily maintenance	1	Check oil level in the oil sump and amount of cooling water in the water tank
	2	Check tightness of the connections of water-, oil- and gas ways
	3	Clean the engine
	4	Remedy faults and abnormalities found
First level maintenance (2500km or 50h)	1~4	The same as daily maintenance
	5	Clean the centrifugal oil filter and remove dust on the inner surface of rotor
	6	Check the tension of the fan belt
	7	Remove the dust on the air filter element
	8	Check the tightness of connections of turbocharged and inter-cooled system
Second level maintenance (10000km or 200h)	1~8	The same as first level maintenance
	9	Change the oil in the oil sump and the injection pump, clean the oil sump and the oil collector
	10	Replace the elements of lubricating and turbocharger oil filter
	11	Replace the fuel filter element
	12	Clean fuel tank, fuel transfer pump strainer and fuel line
	13	Check and adjust the valve clearance
	14	Check and adjust the injection pump advance angle
	15	Check the pressure and atomization appearance of the fuel injector
Third level maintenance (500000km or 1000h)	1~15	The same as first level maintenance
	16	Clean the oil cooler
	17	Check the tightness of cylinder head-, connecting rod- and main bearing bolts
	18	Depending on the running conditions, decide if it is necessary to dismantle the cylinder head and grind valve
	19	Depending on the actual running conditions, decide whether to have the injection pump checked and adjusted, by the professional service agent
	20	Remove the carbon deposits on the turbocharger compressor, turbine housing and rotor blades
Note	What must be specially mentioned here to users is that the air filter, fuel filter and lubricating oil filter are very important to the using life of diesel engine, so the filter elements must be of the same as the original’s.	

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5.2 Working requirements of maintenance

5.2.1 check the oil level in the oil sump

Oil level should be checked with the engine shut down and kept horizontal. Draw out the oil dipstick, wipe it with clean cloth and insert it to the limit position. Draw it out again and he normal oil level should be between the upper and lower marks. If the level is lose to or below the lower lark, oil should be added immediately, and better each the upper mark. If the upper mark is surpassed, redundant oil should be rained from the oil sump screw plug, otherwise the oil over the upper marks will overflow from the front and rear oil seals. (see Fig. 5-1).

Upper limits of oil level
Lower limits of oil level

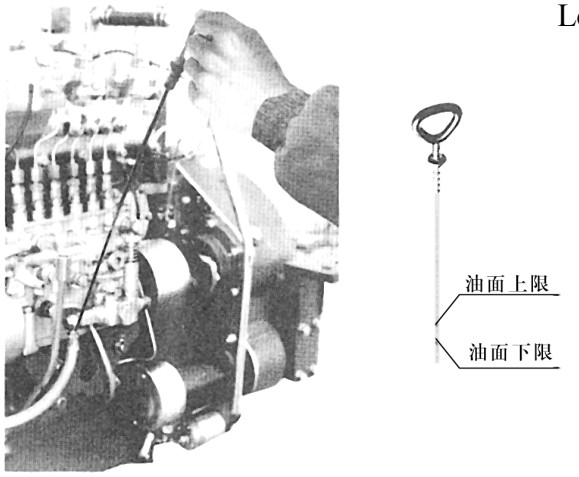


图 5-1 油底壳机油面的检查

Fig 5-1 Check lubricating oil level in the oil sump

5.2.2 maintenance of the air filter

Meticulous, prompt maintenance of the air filter, together with protection of cylinder from dust, is of a vital significance for the service life of cylinder, piston, piston ring and valve of the engine. The maintenance interval of the air filter depends on the quantity of dust in the working surroundings. In a severely dusty area, the interval should be shortened, and otherwise prolonged. For the air filter with the restriction indicator, when the inductance indicator in the driving room lights up, the air filter must be maintained. For an air filter with mechanical restriction indicator, the maintenance indicator should be observed, with the engine running at a high speed, if the indicator is on the red position the element of filter should be maintained.

At present, common secondary paper air filter has two filter elements (primary filter element and safety filter element). To maintain the air filter, first open the filter cover by unscrewing the nut on it, and then take out the filter element to remove the dust. Tap by hand or wooden stick at the two ends of the element while rotating it so that dust can be shaken off. It can also be done to blow the

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element from inner side with clean compressed air not higher than 600kPa. At the same time, check the safety filter element (the small one in the primary filter element), and maintain it similarly if it has dust.

Generally, the primary filter element should be replaced after six maintenances. The safety filter element needn't maintenance with the primary filter element together, but if the safety filter element is found covered with dust, which shows the primary filter element is damaged, substitution must be made (see Fig. 5-2).

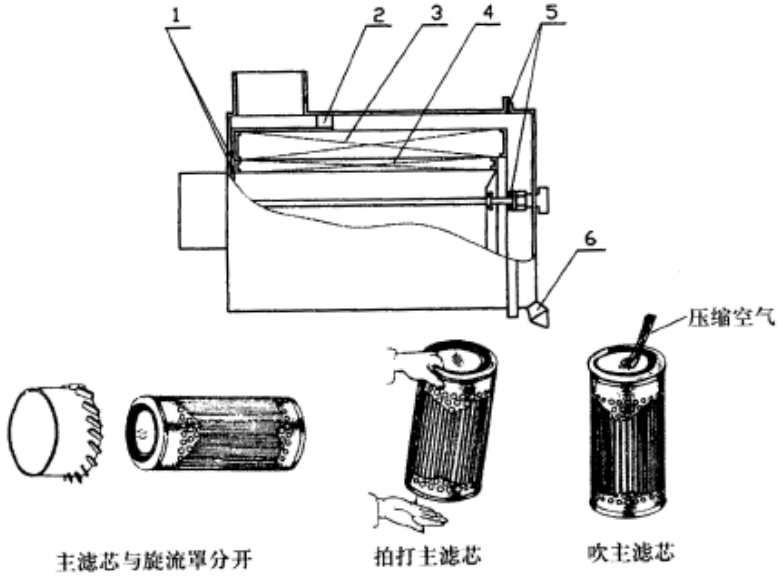


图 5-2 纸质空气滤清器的保养

1-橡胶密封垫（两处） 2-旋流罩 3-主滤芯

4-安全滤芯 5-橡胶密封垫（两处） 6-自动排尘器

Detach filter element and cyclone cover Flap filter element Blow filter element

Fig5-2 Maintenance of paper element of air filter

1-rubber sealing washer(2) 2-cyclone cover 3-filter element

4-safety filter element 5-rubber sealing washer(2) 6-auto dust catcher

Furthermore, paper filter element can't be stained with oil and water when maintenance, it will make the filter element damaged. Every rubber sealing work piece of air filter must be in good condition and fixed when assembly to ensure that sealing is not short circuit.

For oil-bath air filter, maintenance should not proceed until one hour after the engine has stopped, to ensure that all the oil drips from the filter element, clean the element, the shell and the oil bowl of the air filter with clean diesel oil before filling it with clean new oil. While filling, be sure that the oil level is lower than the mark; otherwise, the oil may be sucked into the cylinder when the engine running or the downriver paper filter element may be tainted to make it damaged.

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It must be emphasized here that no matter the air filter of whatever type, the assembly of rubber seal washer and rubber pipes is of great importance for the filter element, otherwise, unfiltered dust may enter into the cylinder directly. Because the component of dust is SiO_2, its hardness is two times of cylinder liner, entry of dust into the cylinder may lead to abnormal wear of cylinder liner and piston ring. So users in the area where is dusty should often maintain the air filter and select high quantity filter element that is same as one of original producer. Notice that the content or the air filter should be large when selecting cars; you had better select the car that has two air filters or cyclone dust catcher.

Clean the upper and lower filter element after all oil drips from them

Lower filter element

Fill the filter with clean new oil after drain quondam oil and clean it, be sure that the oil level is lower than the mark

Oil basin

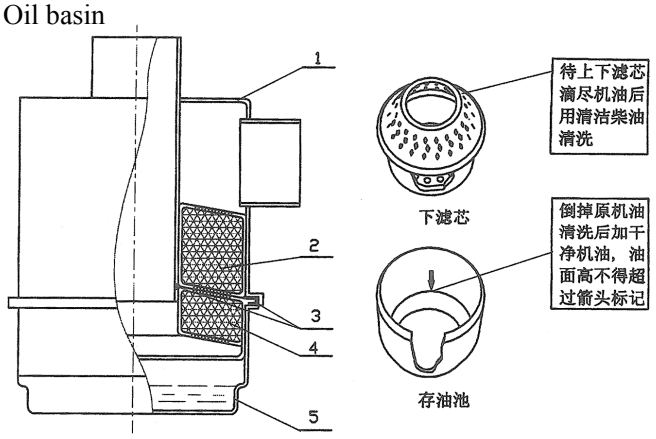


图 5-3 油浴式空虎器的保养

1-空滤器体 2-空滤器上滤芯 3-橡胶密封圈（两处） 4-空滤器下滤芯 5-存油池

Fig 5-3 Oil bath type air filter

1-air filter block 2-upper filter element of air filter 3-rubber sealing ring (2)

4-lower filter element of air filter 5-oul basin

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5.2.3 check the tension of the belt

Tension of the fan belt should be checked frequently. Excessive tension may cause early damage of water pump bearing and generator bearing, while inadequate tension may cause slipping and heating of the belt and therefore shorten the belt life.

Check according to Fig. 5-4 the tension of the belt. Press a single belt with force of 39N, and see whether the belt deflection meets the standard of 10-15mm. If not, it should be adjusted by changing the position of the generator relative to the adjusting arm. To guarantee the consistency in the tension of the two belts, it should be noted that the two belts must be replaced simultaneously, and the belts produced by different factories can't be used for the same engine.

Normal

Inadequate tension

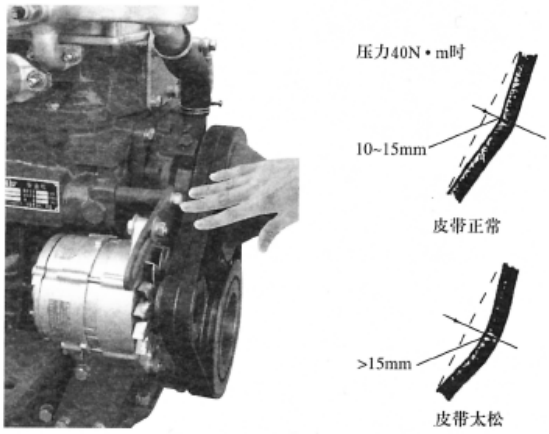


图 5-4 风扇皮带的调整

Fig 5-4 Adjustment of fan belt

5.2.4 maintenance of the diesel oil filter

Diesel oil filter adopts revolving fixed element and let filtered clean diesel oil enter into the fuel injection pump and fuel injector to ensure normal and enduring operation of them. The injector nozzle elements should be replaced after 10000km running.

All kinds of impurities will deposit in oil tank of car, filter net of oil supply pump and oil pipe, so clean them according to the regulation of maintenance after 10000km's running to ensure cleanness of diesel oil.

5.2.5 check and adjust valve clearance

Proper valve clearance is a guarantee of normal power output of the engine as well as reliable and endurable operation of the valve train. Hence it is quite important to check and adjust the vale clearance.

Below are the procedures of checking and adjusting:

Having confirmed that the first cylinder is at the top dead center, adjust primarily valve clearance of the first cylinder, and model 4DF according to the firing order 1-3-4-2 each time a

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crankshaft travel of 180∞ is achieved; model 6DF according to the firing order 1-5-3-6-2-4 each time a crankshaft travel of 120∞ is achieved. The valve clearance should be adjusted according to data in 1.2 (see Fig 5-5). After all the cylinders have been adjusted, check by observation or touch by hand in idling running whether there is any mistakes in adjustment.

5.2.6 change oil for the engine

The high temperature will aging and metamorphose diesel oil, and metal wearing impurities will pollute diesel oil when running, so regular oil change is of great significance for the life of the engine. In freezing area, the mileage of replacing diesel oil should be shortened, for example the driving mileage of replacing diesel oil should be changed into 5000km if the diesel engine works under –10℃.

Oil change should be carried out in a hot engine, because hot oil is apt to take away the impurities in it and be completely discharged. Tighten it (better to replace the washer) again after draining off oil, and then fill new oil.

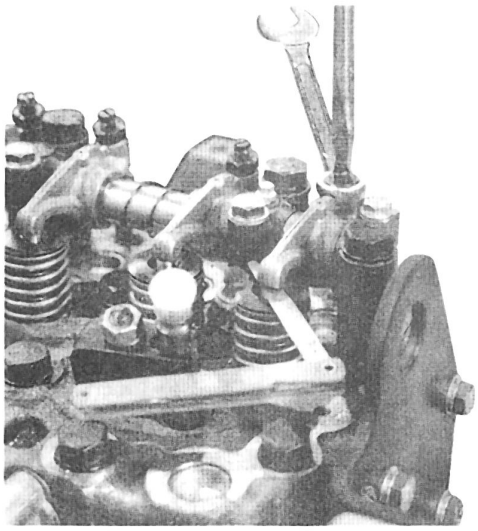


图 5-5 检查调整气门间隙

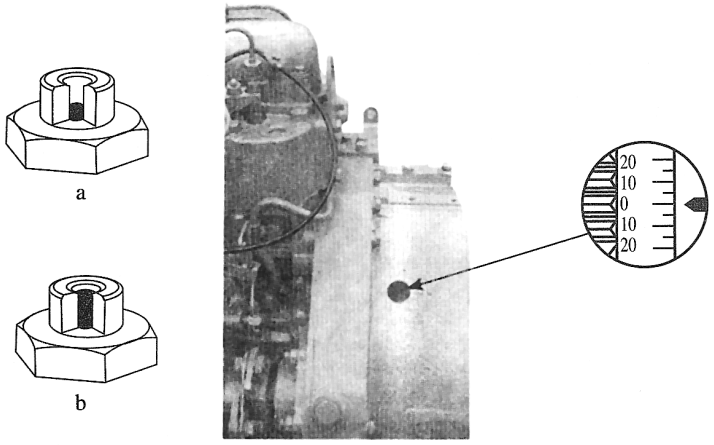
Fig 5-5 Check and adjust valve clearance

5.2.7 check fuel supply advance angle of the injection pump

There is no strict regulation for the interval of checking fuel supply advance angle of the injection pump. Under the condition of deterioration in performance of the engine, advance angle of the injection pump should be first checked. Checking is also necessary after the injection pump is reassembled.

The procedures of checking are as follows: (see Fig. 5-6)

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(a) 供油前出油阀接头中油面 (b) 开始供油时出油阀接头中油面波动

图 5-6 检查喷油泵供油提前角

Fig. 5-6 Check fuel supply advance angle of the injection pump

(a) Fuel level in the delivery vale fitting, before fuel supply

(b) Fluctuation of fuel level in the delivery valve fitting, at the beginning of fuel supply

1. Remove the high-pressure fuel pipe on the injection pump of the first cylinder and blot up the diesel oil in tie-in of oil-flow valve with clean gauze.

2. Crank the crankshaft counter-clockwise. At the same time, observe the fuel level in delivery valve fitting. At the beginning of a rise of the fuel level appears stop cranking the crankshaft.

3. Check whether the pointer on the belt pulley end or on the flywheel observation window is pointing to an angle value as stipulated in 1.2. Check once more if necessary, and adjust it if it is not at the right position.

4. The performance of fuel supply advance angle of the injection pump has an important influence on the output, so we should check it carefully.

5.2.8. check the injection pressure and spray quality of the injector

The injector should be checked on a special test bed. While oil is being pumped with the rate of 30 times per minute, under the pressure o f25-26Mpa, there should be equably spray, clear cut off fuel, and a special clear sound (see Fig. 5-7).

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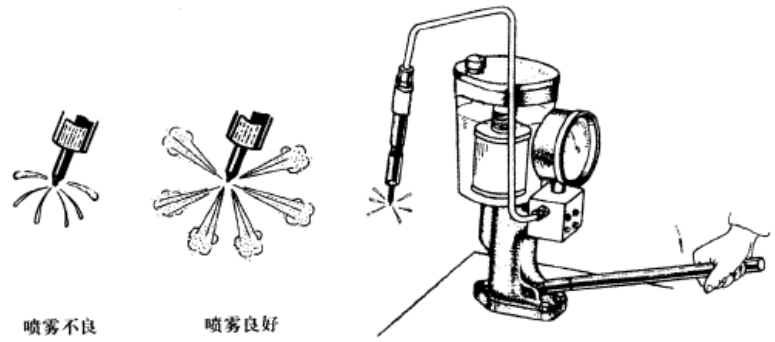


图 5-7 检查喷油器喷雾质量

Poor spray Good spray

Fig 5-7 Check the spray quality of injector

In case of a poor spray quality of the injector, needle valve elements can be dismantled and cleaned and adjusted to the standard pressure value. While checking the injector, pay attention not to confuse injectors from different cylinders, so as to ensure that the intrusion of the injector tip from the cylinder head bottom plane is within a permissible range. If a new injector is to be substituted, it should be adjusted with a copper pad. The valve block and needle valve must be assembled as per the original position, and interchanging is forbidden.

5.2.9 Maintenance of the turbocharger system

The connections of turbocharger with intake and exhaust pipes should be tightly sealed. Any leakage is not allowed. If leakage occurs between the exhaust pipe and turbocharger, the efficiency of the turbocharger will be terribly degraded, and the temperature of exhaust gas will be sharply increased. It is very harmful to the normal sunning of diesel engine. If leakage occurs between the intake and exhaust gas pipe of cooler and intake gas pipe of diesel engine, the intake gas pressure will be reduced, the power of engine will be decreased, exhaust temperature will be also increased.

If leakage occurs in the exhaust pipes, the voice of engine running will be abnormal and there will be carbon at the position of leakage. Users can remove the faults according to these circumstances. Because the pressures of each inner intake pipe of turbocharged and inter-cooled diesel engine are all higher than the ambient pressure, users can check the seals of pipe connections through spreading the soap water made by themselves on the pipe connections. The intercooler will also damage after long time service, the same method can be used to check.

Before a new engine is started, the turbocharger and its filter must be filled with clean oil through the turbocharger oil inlet pipe, to ensure that the turbocharger bearing can be lubricated as soon as the engine is started. The oil filter element on the turbocharger must be replaced after 8000-10000km’s running.

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Before stopping, the engine should keep idle running for 3-5 minutes, so that the turbocharger can slow down and cool off and its sound may be monitored. If any abnormality is found, stop and check the engine immediately. If the turbocharger rotor is not free in rotating, with sound of sticking or friction, repairs should be done in well-equipped service station.

After every 500 working hours (or 30,3000km), the axial clearance of the turbocharger rotor should be checked, and dust and carbon deposits on the compressor casing and on the rotor blades should be removed. To accomplish these, remove the turbocharger off the engine, and replace the metal pad between the turbocharger and the exhaust pipe. Mechanical methods are not permitted in removing the dirt on the rotor parts, which should be done with the aid of patroller other kinds of detergent special for aluminum comp0ressor. Please note the any rotating part dismantled of the turbocharger must not be damaged or deformed, the same for rubber seals. When reassembly the sealing washer between turbocharger and exhaust pipe should be replaced.

The turbocharger has the bypass valve, control the open and close of bypass valve according to the pressure of compressor. When the pressure exceeds the stipulated value, through the moving rod of adjuster open the bypass valve; exhaust parts of cylinder gas to the muffler via the bypass valve. This not only can improve the performance of low speed of diesel engine but also prevent the engine from rude running at high speed and oil consumption increasing.

Before delivery the adjuster of turbocharger with bypass valve has been strictly adjusted, users should not adjust and disassemble by themselves. Don’t use the moving rod of adjuster to lift the turbocharger or make the adjuster of bypass valve deformed.

Checking the axial clearance:

Place the probe of a dial against the end of the turbocharger-driving shaft.

Push the shaft to the probe and record the value, and repeat the procedure in the opposite direction.

The difference between the two values is the axial clearance, which should not exceed 0.20mm.

Check the radial clearance:

Place the probe of the dial against the top of the impeller. Press the impeller down and record the value, and then lift it up and record the value. The difference between the two values is the radial clearance, which should not exceed 0.65mm.

5.2.10 cautions on limiting screws of the injection pump throttle

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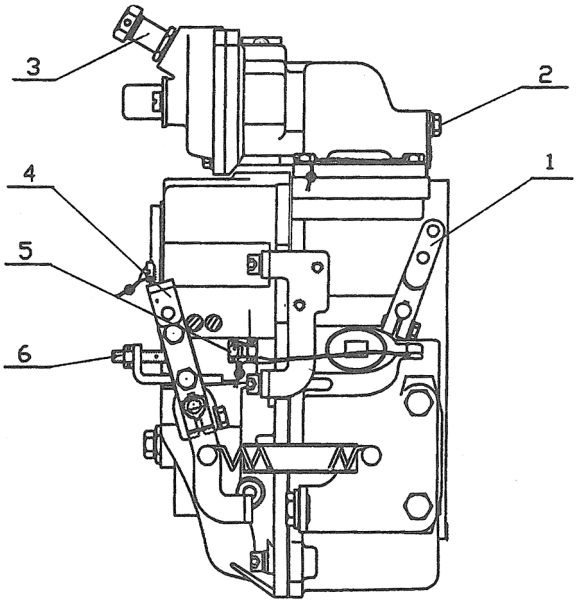


图 5-8 喷油泵手柄及限位螺钉

1-停油手柄　2-增压补偿器管接螺钉

3-油门手柄　4-高速限位螺钉　5-怠速限位螺钉

Fig 5-8 Limiting screw and injection pump throttle handle

1-stop oil handle

2-the screw of pipe connections of turbocharged compensator

3-injection pump throttle handle

4-high speed throttle limiting screw

5-idling throttle limiting screw

The RQV-K actiyator is adopted for P7100 pump of 4DF & 6DF diesel engine (see fig 5-8). In the test before delivery, the limiting screws are adjusted and lead sealed, users are not allowed to adjust them. The fuel pump should be repaired in special service station and readjusted according to the oil quantity, then lead sealed thereafter.

5.3 Cautions on starting a new or overhauled engine:

A new or overhauled engine must first operate a run-in period of 2000km (or 40h), during which it should run at low or medium speed. Within the first 200km, no load can be applied to the automobile; within 1500km, load should not surpass 70 percent the rated value; after 1500km running, load can be increased to 90 percent of the rated value.

After the run-in period, maintenance of the engine should be carried out according to the regulations described in Table 5-1.

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Chapter 6 Cautions on assembly of diesel engine

The machine should be assembled correctly according to the technical regulations of this manual if we want credible operation of the diesel engine. So the user must pay more attention to the content of this chapter when disassembling and assembling the machine.

6.1 Total technical requirement of assembly of whole machine

(1) Each part and accessory especially lubricating ducts and oil pipes must be cleaned then use compressed air to blow to ensure no scrap iron, oil dirt and sundries, when re-assembling them, the surfaces of all parts must be clean.

(2) The entire sealing gasket, rubber seals should be replaced or ensured no defects.

(3) All the moving surfaces should be spread with grease before assembling.

(4) All the fastening parts with requirements of torque and sequence must be tightened to the specified values in the correct sequence, important bolts and nuts used in connecting rod, flying wheel, shock absorber must be fixed by screw thread fixed glue when they were assembled and disassembled many times.

(5) Pay attention to the assembly direction and sigh (such as main bearing cap, connecting rod big end cap, thrust bearing plate etc.) Main bearing cap and connecting rod must be partnered and assembled according the order of cylinder at the same times, otherwise big accident such as bite into of bearing shell may taken place. Some cylinder order of accessories (such as piston, cover of cylinder, piston ring, connecting rod, bearing shell etc.) can not be throw into confusion when the accessories were first assembled, that is to say these accessories must be assembled as its original position to insure its engage stage.

(6) The gumming of sealing locations should be carried on according to the instructions of gum to prevent oil and water leakage.

(7) The diesel engine must be run some circles after each assembly of main moving parts (such as crank, connecting rod piston, axis of cam, gear) and whole machine to inspect if any faults exist.

(8) To insure the let achieve the standard: adjustment of ahead angle of oil injecting, spreading pressure of oil injector and height of extending the cover of cylinder must according to the requirement of manual strictly.

6.2 Assembly of cylinder liner

(1) Locate rubber O-ring into the groove on cylinder block without curl, and spread some soap-water on the exposed surface to protect it from damage by shearing when pressing cylinder liner.

(2) Vertically press the cylinder liner of the same group (grouped according to the inner diameter) into cylinder block. Slightly knock the cylinder liner with wooden hammer to make its shoulder closely contact with the recess on cylinder block.

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(3) After pressing cylinder liner, check whether the top surface of cylinder liner's should is 0.045-0.105mm higher than the top surface of cylinder block. The difference between the height of two neighboring cylinder liners above the top surface of cylinder block should not exceed 0.03mm.

6.3 Assembly of crankshaft

(1) Fit the main bearing shells into the main bearing recess on cylinder block (the guide lugs on shell should be inserted into the recess on main bearing recess). Check for the coincidence of the oil duct of main bearing seat and that of the main bearing shell, and spread oil on the shell. Thrust bearing plate should be mounted on the rear end thrust surface of last bearing seat. The face with two grooves of the thrust bearing plate is the layer of antifriction alloy, and should be fitted outward and contact with the moving surface of crankshaft. Two elastic dowels on thrust bearing plate should protrude 2-2.5mm from the surface of cylinder block or that of main bearing cap. Too small protrusion cannot keep the thrust plate.

(2) After cleaning, fit the crankshaft on the main bearing shells, and spread oil on the main journals. Turn the crankshaft several turns to make it properly fit with the main bearing shells.

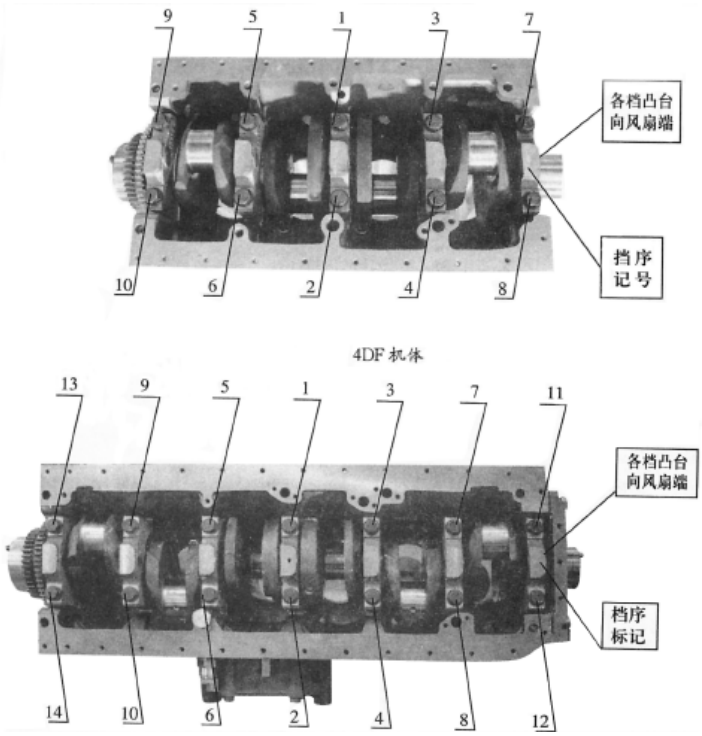
(3) Assembly of main bearing cap

Fit the lower main bearing shell in each main bearing cap, and two thrust bearing plates respectively to the two end surfaces of the seventh main bearing cap (the face with groove outwards). The elastic cylindrical pin should be depressed into thrust bearing plate by 0.5-0.8mm.

According to the embossed order for pairing and the arrow, fit the main bearing cap into the corresponding main bearing seats (see fig 6-1). Slightly knock the main bearing caps to make them closely fit with cylinder block. Both sides of a min bearing cap should not mismatch with the sides of bearing recess on cylinder block, especially the last main bearing cap assembled thrust plate.

(4) After oil is spread on the thread, the bolts of main bearing should be put into the thread holes on cylinder block, and the main bearing caps tightened from the center to both ends (see fig 6-1). After all the bolts have been tightened, crank the crank shaft to check for stick. Finally push forward the crankshaft, check the clearance of the thrust bearing plate (it should be within 0.185-0.386mm).

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Each block protruding flat towards fan end

Marks of block order

Machine body of 4DF engine

Each block protruding flat towards fan end

Marks of block order

Machine body of 6DF engine

Fig 6-1 step figure of tightening main bearing cap bolts

6.4 Assembly of piston-Connecting rod assy.

The piston-connecting rod assy. should be grouped according to weight, the weight difference of pistons on the same engine should not exceed 8g, and that of connecting rods not exceed 15g.

When assembling, take care of the sings for matching on body of connecting rod and the side of big end cap and the arrowhead on top of pistons should face toward the fan end of the engine. (see Fig. 6-2). For convenience, before the assembly of piston pin, the piston can be boiled in water. The elastic snap ring on each end of piston pin should be properly inserted onto the groove.

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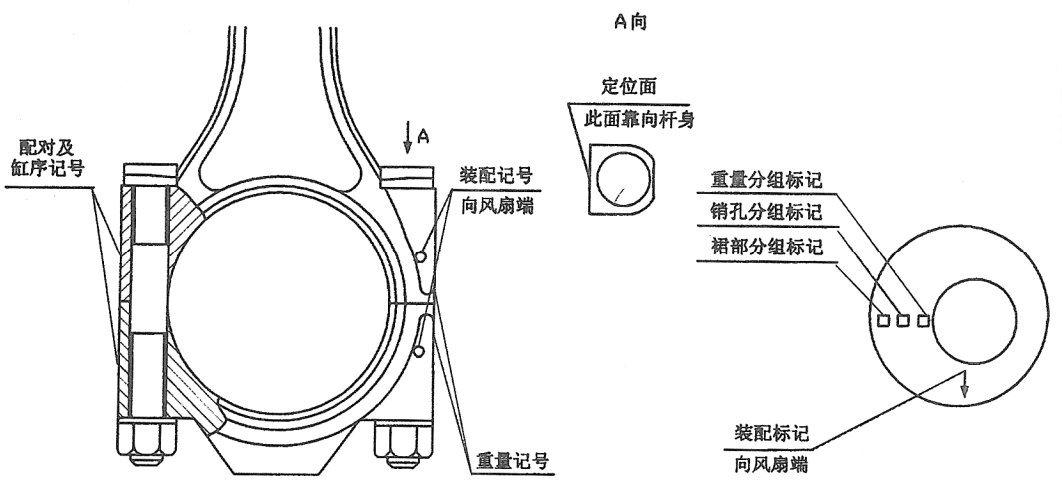


图 6-2 活塞连杆的装配

Partnership and marks of cylinder order
Assembly sign toward fan end
Weight mark
A direction
Positioning face
This face leaning against rod body

Weight classification mark
Piston pinhole classification mark
Skirt classification mark

Assembly sigh toward fan end

Fig. 6-2 Assembly of piston connecting rod

The tapered side of first piston ring should be fitted upward, as well as the side with inner bevel of the second piston. Piston ring should rotate freely in ring grooves, the angle between the gap of the first ring and piston pin centerline should be 30∫; the gaps of second and third rings should be staggered in 120∫ successively (see Fig 6-3).

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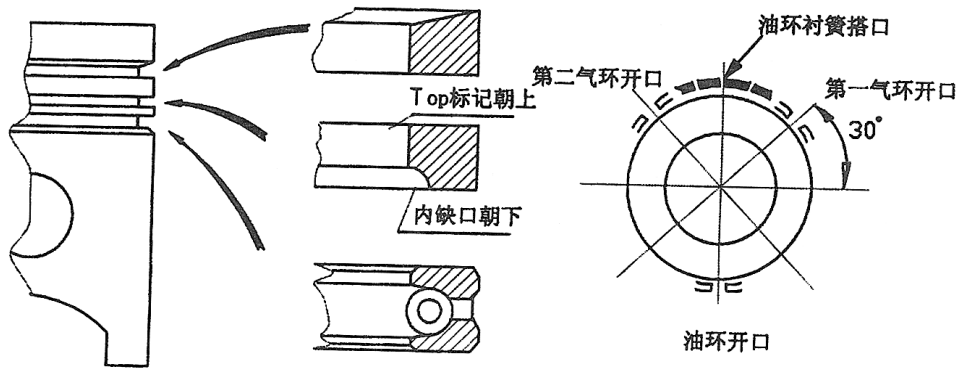


图 6-3 活塞环的装配

Top sign upwards
Inside gap downwards
Second mouth of air ring
Mouth of oil-ring bush spring
First mouth of air ring

Mouth of oil-ring
Fig. 6-3 assembly of piston ring

The shape of the upper head of connecting rod bolt is unsymmetrical. When being fitted, the location of the head relative to body of connecting rod should be in accordance with Fig. 6-2. The tightening of the connecting rod nuts should be symmetrically carried on at twice.

Head of bolt of connecting rod is not symmetrical, so the relative position of body of connecting rod and head of bolt must according to Fig. 6-2 and can't be reversed. The process of tightening nuts of connecting rod should be separated into two times and carried on symmetrically.

6.5 Assembly of camshaft

Fit the thrust plate and semi-circular key on camshaft, then the timing gear (the face of gear with sign outward), lock washer, tighten the bolts (see fig 6-4). Carefully fit the camshaft assembly into the bushings on cylinder block, and then tighten the thrust plate on cylinder block.

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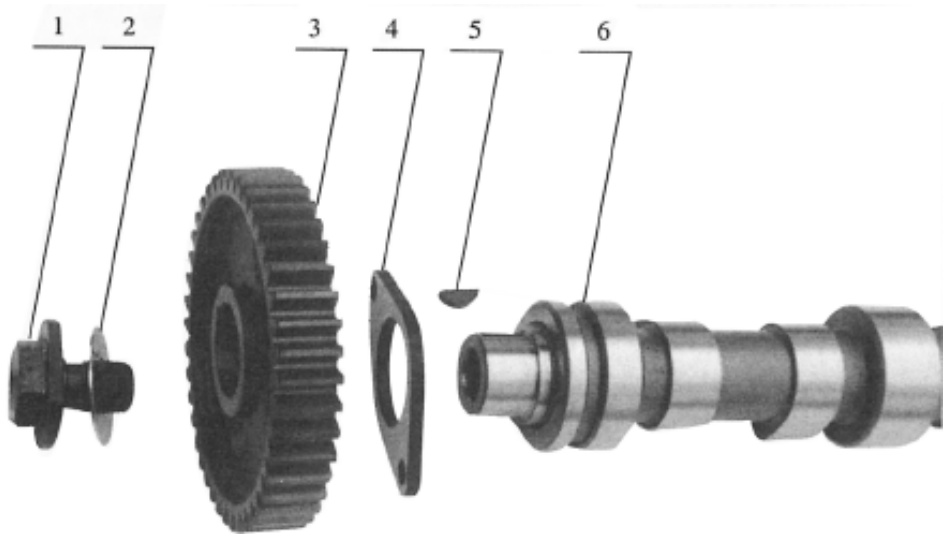


图 6-4 凸轮轴的装配
1-紧固螺栓 2-锁紧垫圈 3-延时齿轮 4-正推片 5-半圆键 6-凸轮轴

Fig. 6-4 assembly of camshaft
1-Force bolt 2-fix washer 3-delaying gear 4-thrust plate
5-half circular key 6-camshaft

6.6 Assembly of gear train

Following the assembly of crankshaft and camshaft, assemble timing gears in order. Pay attention to the meshing signs on the end faces of gears. The meshing signs on every gear should accord with the regulations in Fig 6-6. When assembling 6DF transmitting shaft of oil-spraying pump or 4DF oil-spraying pump, it is necessary to crank the crankshaft to the compression top dead center of the first cylinder, and align the sign of compressor gear with the pointer in eye-hole on flywheel to ensure the correct meshing of gear (2). The timing gear shaft (2) (3) bushes and surface of each gear should be lubricated by adding some oil when assembling.

Signs of each gear should face to end of flywheel when assembling. But sign of timing gear (2) (namely small gear with 26 teeth in fold gear) was marked on the back because of the limitation of size and structure, so the corresponding top of the gear was marked with white paint as assembling sign when the production leave factory. Users can re-paint it with white paint in corresponding position of steel mark for convenient assembly when they disassemble the machine and inspection it.

6.7 Assembly of cylinder head and valve train

(1) Before the cylinder head assy. is fitted, the valve and valve seat must be ground (the sealing band should be continuous). After being ground, the cylinder head and valve should be cleaned. The valves for different cylinders should not be exchanged.

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Sign 1, the upper constringent stop point of a cylinder, should be aimed at the inspecting pointer of flywheel shell

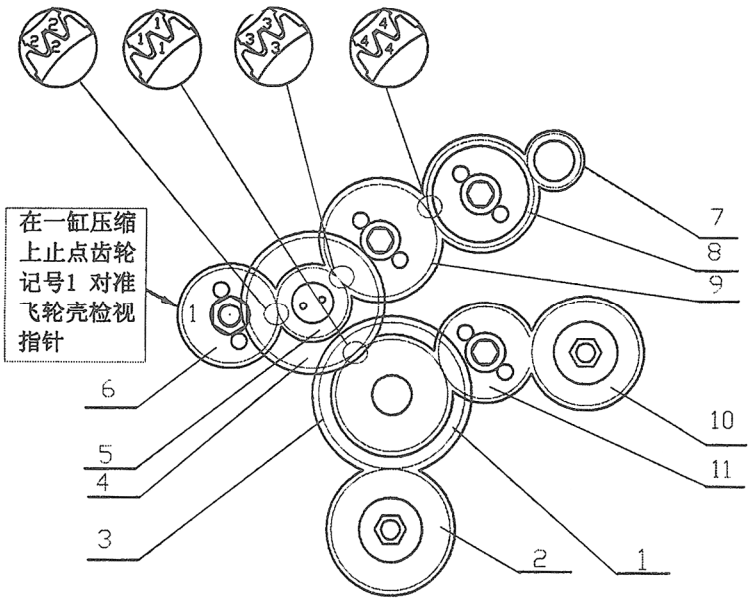


图6-5 齿轮系的装配

1-曲轴主动齿轮 2-机油泵传动齿轮 3-曲轴机油泵齿轮
4-正时中间齿轮(一) 5-正是中间齿轮(二) 6-喷油泵齿轮
7-转向泵齿轮 8-凸轮轴齿轮 9-正时中间齿轮(三)
10-空压泵齿轮 11 空压泵中间齿轮

Fig. 6-5 assembly of gear train

1-Dynamic gear of crankshaft 2-oil pump transmitting gear
3-crankshaft oil pump gear 4-intermediate timing gear (1)
5-intermediate timing gear (2) 6-injection pump gear
7-turning pump gear 8-camshaft gear 9-intermediate timing gear (3)
10-air compressor gear 11-air compressor intermediate gear

(2) After assembling down seat of valve spring, press the sealing ring of valve tube to the end of the valve guide.

(3) Fit intake and exhaust valves, valve spring and valve collet. The collet should be properly contacted with the upper seat of valve spring (The status can be examined by knocking head of the valve by wooden wimble) to ensure the valve knock in correct position and not fall down.

(4) Tightening moment of press board of oil-sprayer should within 70±10N.m, the tip of oil-sprayer should extrude from the bottom surface of cylinder head by 3.4-3.9mm.

(5) After spreading with oil on tappet, fit it into the tappet hole on cylinder block. It should slide freely in the hole.

(6) Fit elastic pin (notice: two elastic pin of 4DF type and 6DF type have the function of water-flow directing, the head with hole in the cylinder should faces to the air-entrance side and cylinder head gasket.

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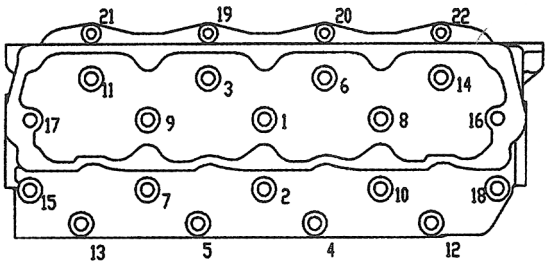
After aligning the pins on both cylinder head and cylinder block, tighten all cylinder head bolts sequentially from the center to both ends. In no way omit any bolts. (see Fig. 6-5). The metal gasket used in type of 6DF can be disassembled and reused again and again as long as no damage on it.
(7) Adjust intake valve and exhaust valve clearances to the specified values after assembling valve pushing bar and pushing arm discreteness. Crank engine to check for any abnormality in the valve clearances of each cylinder, the integrity of push rod, etc.

6.8 Assembly of flywheel

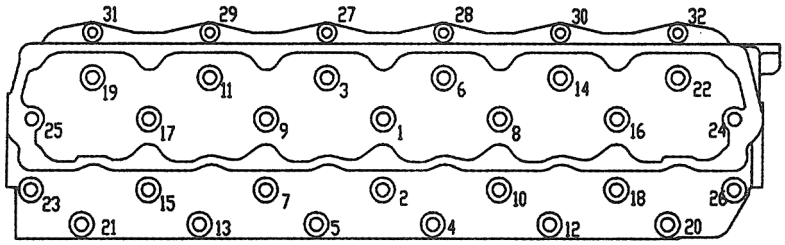
The outputting torque of diesel engine was transferred outside by flywheel, so the tightening torque of flywheel bolts must acquired according to the prescript of this book. Tightening direction should in diagonal order. Diesel engine has seven flywheel bolts and use single thick gasket.

6.9 Assembly of crankshaft damper or front pulley

The function of crankshaft damper is decrease the torsional vibrant swing when crankshaft vibrating. Crankshaft length of 6DF type is longer than 4DF type, torsional vibrant swing produced in operating process also big.



4DF 缸盖



6DF 缸盖

图 6-6 缸盖螺栓拧紧顺序图

4DF cylinder cap

6DF cylinder cap

Fig. 6-6 sequence of tightening cylinder head bolts

So diesel engines with its type 6DF are assembled with silicon oil damper. The torsional vibrant swing of diesel engines with its type 6DF is smaller because its crankshaft is shorter, so in our factory if the machine has silicon oil damper is decided by front transferring power of corresponding machine type.

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The fix bolt of damper (or front pulley) should be tightened by required torque of this manual.

6.10 assembly of peripheral accessory and adjustment of whole machine

Main peripheral accessories of diesel engine include fuel injection pump, fuel injection pump drive axis, exhaust water tube, water pump, intake and exhaust manifold, turbocharger, lubricating oil filter, diesel oil filter, air compressing pump, generator, starter, fan and all kinds of pipes. Cleanness of each accessory should be paid attention to when assembling, no sundries enter into the turbocharger, airway of cylinder head, intake and exhaust manifold should be ensured. Connection of all kinds of pipes should be correct and airproof.

Adjustment of whole machine should carry out earnestly according to the technical data of this manual after general assembly was finished.

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Chapter 7 Trouble and remedies

Trouble of diesel is inevitable in using, it can bring about serious accident if we can't find out and eliminate it in time. In this part, the causes and remedies of the common faults are described as follows for reference.

7.1 Difficult to start or failure of the engine to start

Causes	Remedies
Air in fuel system	Deaerate the fuel system by supply pump and check for leakage
Blocked in fuel system	Dismentle and clean
No fuel supply or intermittent fuel supply	Check for the sealing of plunger and check valve of fuel supply pump and efficiency of spring
Incorrect advance angle of the injection pressure too low	Check and adjust
Poor spray quality or the injection pressure too low	Clean the injector nozzle couple parts, adjust injection pressure, check the wear of injector plunger and delivery valve and integrity of delivery valve spring
Excessive wear of piston rings and liners, high blow-by	Replace piston rings and liners
Poor tightness caused by sticking, loss of elasticity, break of piston rings	Clean or replace piston rings
Valve leakage	Check for the sealing between valves and valve seats. Repair and grind the sealing surface of valve, readjust the valve clearance
Too cold in winter	Use heater to warm up the engine
The voltage of batteries too low to enable the engine to reach the required min. starting speed	Recharge the batteries
Loose connection in electric wiring	Check and reconnect the loose ones
Starter gear cannot mesh with flywheel	Check and repair the starter
Electromagnetic valve disabled and the injection pump in the no supplying fuel situation	Check the work of wiring and the electromagnetic valve

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7.2 Failure of the engine to develop full power

Causes	Remedies
Air filter blocked, insufficient air intake	Clean or replace air filter element
Clogging in fuel pipe or fuel filter, insufficient fuel injection	Clean fuel line or replace fuel filter element
Incorrect advance angle of fuel supply	Readjust
Incorrect valve clearance	Readjust
Poor atomization, blocked in injection holes, needle valve sticks	Check, clear or replace the injector nozzle couple parts and readjust injection pressure
Insufficiency of fuel supply of injection holes, needle valve sticks	Check worn of plunger and delivery valve. Replace the worn parts if necessary
Overheating of engine	Check cooling system and remove the scale deposits in cooling system
Excessive carbon deposits in exhaust manifold or muffler	Remove the carbon deposits
Insufficient compression pressure in cylinder	Check for the sealing between valve and valve seat, check for the worn parts of piston ring, cylinder. Liner, piston ring and piston, if necessary
Poor quality of fuel	Use the fuel in accordance with the specifications
Too high the ambient temp or running at altitudes	Running under these conditions, the engine will decrease the power, so the customers should reduce the load
Bigger clearance of the bearing of the turbocharger, deformation of the impeller or stuck with shaft	Repair or replace the turbocharger

7.3 Sudden Stopping Of The Engine

Causes	Remedies
Air entrapped into fuel system	Deaerate the fuel system
Blocked in fuel lines or fuel or fuel fitter	Clean the blocked parts or replace filter element
Fuel supply pump inefficient	Repair or replace the fuel supply pump
Crankshaft seizure	Caused by too low oil pressure or no pressure. Repair the journal and bearing shells of crankshaft. Replace crankshaft if necessary.
Piston seizure	Check water pump and belt, change piston, piston rings and liners. Check and readjust the injection pump and injector.

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7.4 Overspending Of the engine

Causes	Remedies
Governor invalid	Check governor
Governor spring broken	Change the broken spring
Control rack and ring gear stick	Check and repair injection pump Note: in this case, the engine must be shut down at once, cut off fuel supply, stop the air inlet. If the engine is equipped with exhaust brake valve, shut it down to force the engine at once.

Note: 1. In this case, the engine must be shut down at once, cut off fuel supply, stop the air inlet. If the engine is equipped with exhaust brake valve, shut it down to force the engine at once.
2. When vehicle moving downwards from high place and in drag mode, high mode level must be increased as the speed becomes high to avoid the big accidents due to such as engine being dragged, key block fell off and pushing shaft bent.

7.5 Abnormal noises in operation

Causes	Remedies
Excessive clearance between valves and rocker arms, valve spring broken or push rod bent, metallic knocking sound from valve train.	Check and change
Fuel supply too early, resulting in rhythmic metallic knocking sound in cylinder	Check and readjust timing
Deep and unclear sound in cylinder resulting from too late fuel supply	Check and readjust timing
Excessive clearance between piston and cylinder. Knocking sound in cylinder weakens with the warming up of engine	Change the worn piston, piston rings and liners.
Excessive clearance between piston pin and bearing of the connecting rod small end. Light and sharp sound, specially in idling.	Change piston pin and bearing of the connecting rod small en to ensure the correct clearance.
Excessive clearance of main bearing shell and connecting rod big end bearing. Knocking sound suddenly reduced and the sound would be deep and strong in low speed.	Change main bearing shells, connecting rod bearing shell and crankshaft to ensure correct clearance.
Excessive clearance due to badly worn gear, knocking sound may be heard from gear housing.	Change the all of gears
Excessive axial clearance of crankshaft.	Change the thrust plate of crankshaft or
Knocking sound in idling operation	camshaft to ensure the correct clearance.

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Knocking sound in idling operation	camshaft to ensure the correct clearance
Damage of water pump shaft resulting in continuous noise.	Change shaft or assemblies of water pump or alternator
Friction between turbine scroll and impeller of turbocharger	Check and replace

7.6 Unstable Running

Causes	Remedies
Excessive water mixed in diesel fuel	Check the water content in the fuel and change with correct fuel
Inefficiency of injectors	Check and clean, or replace injectors
El line leaks	Check for the tightness of the lines
Uneven fuel supply to each cylinder	Check and adjust injector pump (carried out on test bench by qualified personal)
Spring of injection pump plunger broken	Replace the spring
Governor hunting	Check and repair governor

7.7 Abnormal color or smoke

Causes		Remedies
Black smoke	Overload	Unload the excessive load
	Injection pressure too low or insufficient injection pressure	Clean or replace injector nozzle couple parts, readjust the injector pressure
	Incorrect advance angle of fuel supply	Readjust advance angle of injector pump
	Poor quality of fuel	Replace with the fuel in accordance with specifications
	Blocked in air filter, insufficient air intake	Clean air filter or replace filter element
	Incorrect valve clearance, valve stem sticks in valve guide or valve conic sealing surface leaks	Check the valve clearance; clean valve and valve guide; check and grind valve conic sealing surface
Blue smoke	Piston ring gaps located at the same side	Relocate in 120° spacing
	Piston ring seizure or badly worn	Check and remove
	Drop or damage of oil seal if valve stem	Replace the oil seal of valve guide
	Inefficiency of oil seal of turbocharger	Repair turbocharger; ensure proper tightness
White smoke	Water is leaked to the chamber	Check for tightness of cylinder head gasket, cracking of cylinder head, cavitation, cracking of cylinder liner
	Excessive water in fuel	Replace with specified fuel

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7.8 Overheating of the engine

Causes		Remedies
Too high oil temperature	Overload, hot weather	Reduce the excessive load
	Inefficient of by-pass valve due to clogging of oil cooler core and oil gallery	Clean or replace oil cooler; check by-pass valve; clean oil channel
Coolant temperature too high	Dirty radiator element	Clean the radiator
	Insufficient coolant	Add coolant
	Insufficient thermostat	Replace the thermostat
	Insufficient water pump or loose pump belt	Dismantle and repair water pump; adjust the tension of water pump belt
	Cooling water channel clogged by dirty	Clean the clogged portion
	Overload in hot weather	Reduce load and speed

7.9 Dilution of Oil

Causes	Remedies
Piston ring gumming or badly worn out of the limits; oil is leaked into cylinder oil or fuel not in accordance with specifications	Clean the gummed up piston rings; replace the worn rings
Oil or fuel not in accordance with specifications	Replace with the right fuel or oil
Fuel coming into oil pan; injection pressure too low, or needle couple stick, poor atomization of fuel	Check, adjust injection pressure or replace needle couples
Serious worn of the piston in injection pump or inside leakage, and the through the back line oil leaked back into oil pan	Replace the piston of injection pump and readjust the oil pump

7.10 Oil pressure too low

Causes	Remedies
Insufficient oil in oil pan	Refill oil
Oil pressure gauge or sensor inaccuracy	Replace oil pressure gauge or sensor
Excessive clearance between crankshaft journal and main bearing shell	Replace worn main bearing shell or crankshaft
Wear of gear, bearing and body of oil pump	Replace the pump
Pressure regulating spring broken	Clean the pressure regulating valve or replace spring

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Incorrect oil and viscosity of oil is too low	Use the correct oil
Clogging in oil filter or oil cooler	Clean or replace oil filter element or oil cooler
Clogging in oil collector	Clean
Piston cooling injector damaged	Check and replace

7.11 Mixing of oil and water

Causes	Remedies
(1) Water is leaked into oil pan; oil level in oil pan rising	
Water seals of cylinder liner broken	Replace
Cracking in cylinder liners or cylinder head	Replace cylinder block or cylinder head
Cylinder head gasket broken	Replace cylinder head gasket
(2) Oil in water tank	
Element of oil cooler broken	Replace oil cooler element
Sealing gasket of oil cooler broken	Replace the gasket

7.12 Turbocharger Faults

Causes	Remedies
Boost pressure is too low	
Leakage in intake, exhaust pipes	Check for cracking of the intake and exhaust pipes and tightness of the gasket
Turbocharger bearing broken	Dismantle and replace bearing
Abnormal noise and vibration	
Exhaust turbine or compressor blades deformed or broken	Check and repair
Seizure of turbocharger bearing due to insufficient lubrications	Repair turbocharger; check the oil passage of turbocharger
Foreign maters	Check and repair

7.13 Starters Faults

Causes	Remedies
Starter does not rotate	
Short circuit in evicting coil	Repair
Short circuit in armature	Repair
Brush broken or burnt	Repair or replace
Damage electromagnetic switch	Repair
Electromagnetic switch of starter broken	Repair

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Rotation of starter inefficient	
Bushing of bearing worn	Replace the new bushes
Poor contact of bush	Clean the contact surface of inverter
Inverter dirty	Clean the contact surface of inverter, and polish it with abrasive cloth
Loose terminal connection	Re-weld
Slipping of frictional clutch	Adjust the frictional torque of clutch
Insufficient charging or capacity of batteries	Charge or replace batteries
Difficult withdrawal of the gear, the switch contacts and fuses	Repair the switch

7.14 Injector faults

Causes	Remedies
Little or no fuel injected	
Needle sticks with barrel	Clean, lap or replace
Needle and barrel badly worn	Replace
Injection pressure too low	
Deformation or break of the spring	Replace the spring
Injection pressure too high	
Needle valve sticks	Clean or replace
Clogging of injection holes	Clean
Heavy leakage	
Injection spring broken	Replace
Needle and valve seat surface damaged	Replace
Deformed cap	Replace

7.15 Failure Of Injection Pump

Causes	Remedies
Insufficient or no fuel supply	
Air in fuel system	Desecrate the fuel system
Check the valve of supply pump for sticking or spring broken	Clean or replace spring
Delivery valve stuck or spring broken	Clean or replace spring
Valve stem of delivery and sealing surface worn	Replace
Plunger worn of spring broken	Replace
Fuel inlet pressure too low	Replace oil filter element
Ring gear screw of plunger loosen	Readjust fuel volume and tighten the screw
Leakage between plunger and barrel; fuel level in oil pan rising	Check injection pump, replace plunger together with barrel

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7.16 Failure Of Governor

Causes	Remedies
Idling unstable or too high	
Control arm not been put to the end	Check and adjust
Ring gear and regulating rack stick	Check and adjust
Hunting	
Permanent deformation of governing spring	Replace spring
Distance of weights flying out different from that of retracting back	Check and adjust
Floating lever worn	Check and adjust
Over speeding	
High speed limiting screw loosen	Readjust
Governor spring broken	Replace spring
Adjusting rack and ring gear stick	Check and repair

7.17 Failure Of Air Compressor

Causes	Remedies
Inefficient compression due to scale on exhaust valve, broken valve spring and piston ring, worn cylinder liner	Remove scale and replace the faulty parts
Piston ring sticks, broken, worn cylinder liner, clogging of oil return line	Check and the faulty parts
Worn crankshaft and bearing; piston hits cylinder head	Check and the faulty parts

7.18 Increase Of Fuel Consumption

Causes	Remedies
Increase of restriction of air intake system	Check air filter element
Serious leakage in fuel system	Check the sealing of the circuit
Incorrect fuel supply advance angle of injection pump	Check and adjust the advance angle of fuel supply
Injector fault	Check injector, repair or replace
Incorrect adjustment of injection pump	Check and adjust injection pump on test bench
Abnormal working of the turbocharger, inefficient sealing or not good gas-tightness of the lines in compression system	Check and repair the turbocharger and the lines of the compression system
Moving parts are heavily worn	Check worn cylinder liner, piston, piston ring; check tightness of valve, valve seat; check worn moving parts and repair

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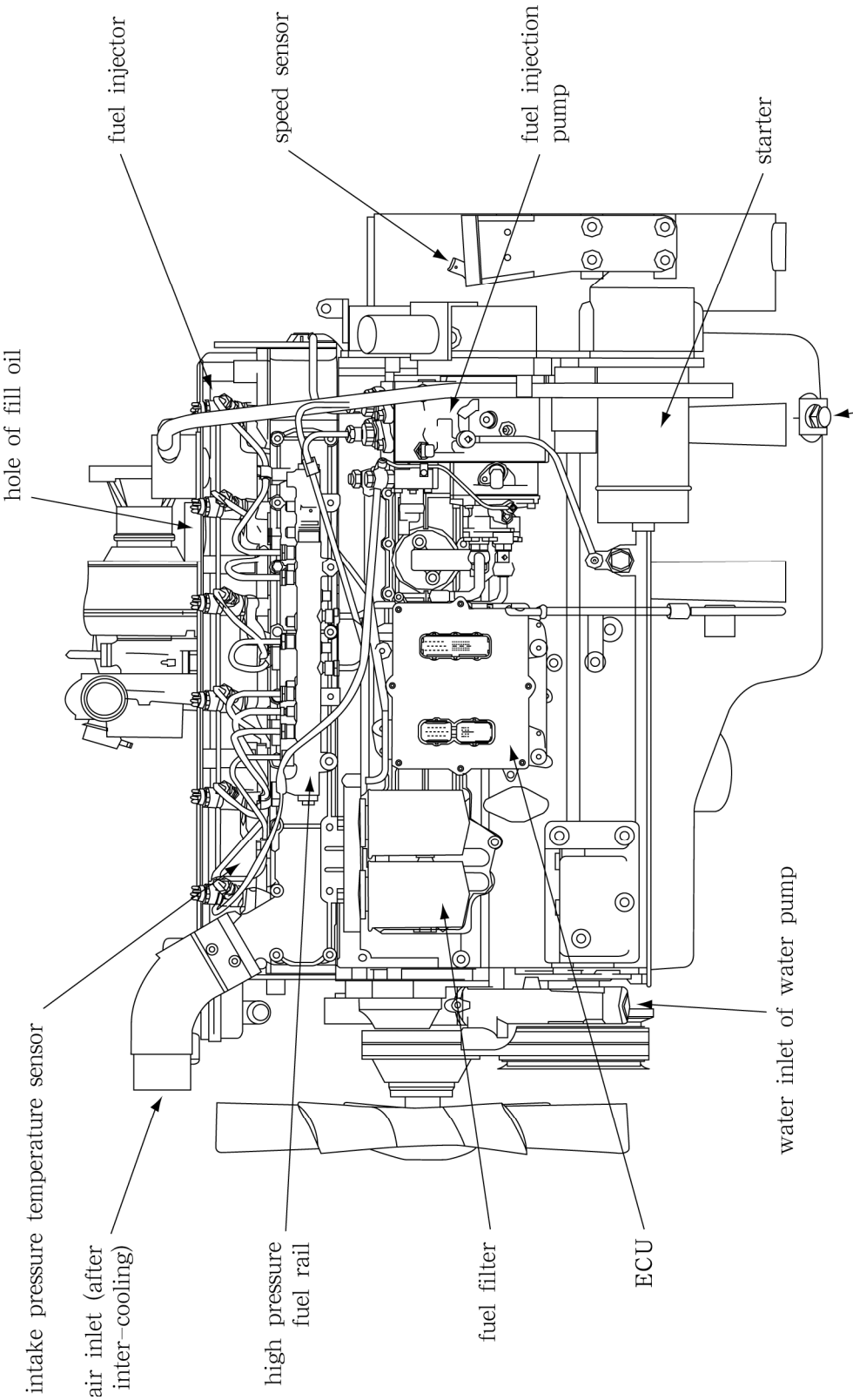
7.19 Increase Of Oil Consumption

Causes	Remedies
Serious external leakage of oil	Check leaks outside of engine, crankshaft oil seal, and replace the broken parts
Clogging in air filter	Clean or replace air filter element
Block in crankcase ventilation inlet	Clean crankcase breather
Worn valve guide, valve stem sealing damaged	Replace valve guide or valve stem seal
Excessive oil leakage of air compressor	Replace air compressor
Inefficient seal ring of turbocharger	Replace seal ring
Worn cylinder liner, piston, piston ring and valve conic sealing surface, etc.	Repair engine; replace worn part

7.20 Failure of the Fire Pre-heating Device

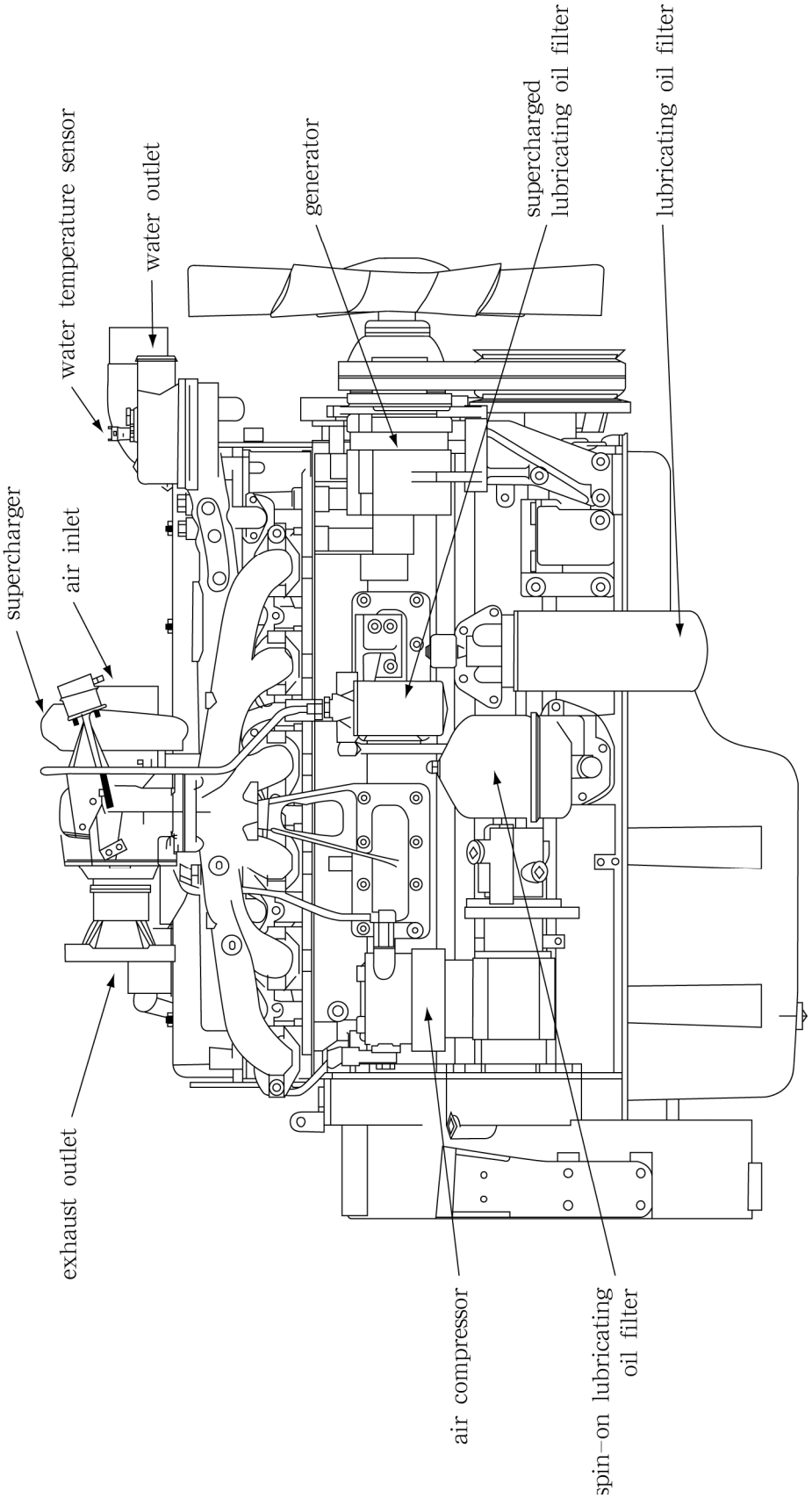
If the starting fails, please check the temperature of the pre-heater	Causes	Remedies
Cold	No power	Check the circuit, controller, plug in connector, the pre-heater connecting wire
	Pre-heater circuit broken	Change the pre-heater
Hot	Electromagnetic valve does not work	Check the electromagnetic valve and the wire
	No fuel coming into pre-heater	Clean the strainer and nozzle hole
	Engine faults	Check the fuel system’s negotiability
Very hot	Short-circuit of the pre-heater	Change the new pre-heater

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Appearance Picture of Diesel Engine (At Intake Side)

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Appearance Picture of Diesel Engine (At exhaust Side)

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1.Main Parameter specifications of diesel engine

1.1 Parameter of diesel engine

Data	CA6DF3-18E3	CA6DF3-20E3	CA6DF3-22E3	CA6DF3-24E3
Cylinder bore (mm)	107			
Piston stroke(mm)	125			
Displacement (L)	6.7			
Compression ratio	17:1			
Rated power/rated speed				
(kW/r/min)	132/2300	147/2300	162/2300	177/2300
(Ps/r/min)	180/2300	200/2300	220/2300	240/2300
Maximum torque/speed				
(N • m/r/min)	680/1300~1500	760/1300~1500	860/1300~1500	930/1300~1500
Fire Order	1-5-3-6-2-4			
Valve clearance				
(COOL)				
Intake (mm)	0.30			
Exhaust (mm)	0.35			
Rotation direction	Counter clockwise			
(from the end of flywheel)				
1m noise dB(A)	≤99.5			
Full load	≤2.0			
(bosh)				
Free accelerate smoke	≤2.0			
(bosh)				
Start method	28V electric start			
Exhaust emission	GB17691-2005 third stage			
Diesel engine weight				
Net weight (kg)	650			
Gross weight	700			
(including the lubricating oil of diesel engine and accessories)(kg)				

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1.2 Temperature and pressure Parameter of diesel engine

Exhaust temperature before turbo ℃	≤650
Diesel oil temperature ℃	40±5
Lubricating oil temperature ℃ (rated speed)	≤95
Outlet temperature of coolant ℃	85±5
Pressure of lubricating oil (Idling speed kPa)	≥150
Rated speed kPa (Allowed lowest pressure)	343~441

1.3 Tighten torque and tighten method of main screw thread connections

Table 1-1

Description	quantity×specification	Screw tighten torque(N.m)	Note
Cylinder head bolt	26×M15×2	245±15	Spread lubricating oil
Connecting rod	12×M12×1.5	155±5	Spread screw thread glue
Flywheel bolt	7×M16×1.5	275±10	Spread lubricating oil
Main bearing bolt	14×M18	90N.m+180°	Rotating angle method
Piston cool nozzle tighten bolt	6×M12	35±5	Don't Spread screw thread glue
Damper tighten bolt	5×M14×1.5	180±10	Spread screw thread glue
Timing gear tighten bolt-camshaft	1×M20×1.5	206 +9.8 -19.6	Spread lubricating oil
Air compression pump gear shaft tighten bolt	1×M12	63 +9.8 0	Spread screw thread glue
Air compression pump gear tighten nut	1×M18	157 +4.9 -24.5	Spread lubricating oil
Front oil seal seat bolt	5×M12	59 +8 -12	
Rear oil seal seat bolt	5×M8	20 +5 -7	
Fuel injection pump driven gear tighten nut	1×M20×1.5	157 +4.9 -24.5	Spread lubricating oil

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Description	quantity×specification	Screw tighten torque(N.m)	Note
Fuel injection pump fixed bolt	4×M10	25±2	
Arm shaft bracket fixed bolt	6×M10	43+7 -10	
Plate of gear chamber cover fixed bolt	7×M10	34+7 -10	
Exhaust manifold fixed bolt	4×M10	32±5	
Oil sump plug	1×M20×1.5	170±10	Symmetry tighten
Fuel injector connecting wire bolt	6× 2×M4	1.25~1.75	
Low pressure fuel pipe bolt	1×M12×1.25	25~35	
High pressure oil pipe screw cap (end of oil pump)	6×M18×1.5	25~35	
High pressure oil pipe screw cap (end of fuel injector)	6×M14×1.5	25~28	
Oil pump lubricating oil inlet pipe bolt	1×M10×1	10~15	
Air intake pressure temperature sensor	1×M16	4~6	
Water temperature sensor	1×M12×1.5	25±2	
High pressure oil rail fixed bolt	6×M8	30±2	
ECU fixed bolt	4×M6	10±2	

Note: Other bolts and common bolt tighten torque reference to specification for《service and maintenance manual for CA4DF CA6DF series diesel engines 》.

1.4 Selection of diesel oil

In order to ensure the exhaust emission of diesel engine meet with the requirement of environment protection and make the user safety, we suggest to use diesel oil met with DB11/239-2004 Beijin standard, allow user to use diesel oil met with GB/T19147-2003 standard, but when using this diesel oil, whole vehicle fuel system must be design and affirmed by our company. If fuel system not be affirmed by our company, or user use diesel oil lower than this standard, can result in the life of whole vehicle spare parts be effected badly.

Diesel oil should be selected as per its ambient temperature condition to define the brand number. In case of low air temperature in winter, diesel oil with low freezing point should be used, and vice versa in summer, user can select diesel oil as per the recommendation in Table 1-3. For example, if the ambient temperature is －29℃, -35# diesel oil should be used.

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Table 1-3 Relationship between the brand number of diesel oil and applicable lowest air temperature

Brand number of diesel oil	10#	0#	-10#	-20#	-35#
Cetane value	49	49	49	46	45
Freezing point (℃)	+10	0	-10	-20	-35
Applicable lowest air temperature (working ambient temperature of diesel engine) (℃)	+18	+4	-5	-14	-29

Don’t use any milky diesel oil and other diesel oil.

The diesel oil must be kept very clean, and must not be contaminated by dust and impurities.

Before the diesel oil is to be fed into fuel tank, it is necessary to keep it at standstill for more than 72 hours, and to take the diesel oil at upper layer.

Note: Diesel oil quality is of influence to electronic control common rail system of National Ⅲ diesel engine, please must use fuel filter recommended in 4.2.2, can filtrate water and impurity efficiently, to ensure the National Ⅲ diesel engine can normal running. Otherwise can badly mangle electronic control common rail system of diesel engine.

1.5 Selection of Lubrication Oil

For ensuring normal running, long service life and improvement of emission, please use lubricating oil which meet the requirement of API (American Petroleum Institute) are recommended.: CH-4 multi-class lubrication oil. Please use special “Wuxi Diesel Brand” CH-4 class or CH-4 class above lubrication oil.

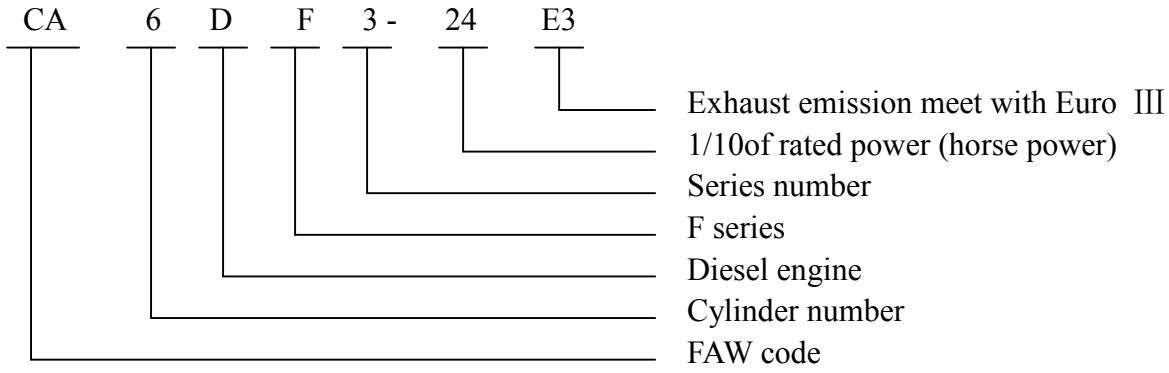
Use area	cold area	common area(full year)	southern area
Brand number of lubricating oil	5W/30	15W/40	40

Note: Selection of lubricating oil is of influence to usage life of National Ⅲ diesel engine, please select normal brand lubricating oil. Otherwise can make the diesel engine be spoiled badly.

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2.service instruction of National Ⅲ diesel engine

2.1 Siginification of diesel engine code name



2.2 Notice for new diesel engine

The new diesel engine for the automobile shall restrain its rotation speed no more than 80% of the rated speed within the initial 2000km (about 40h);

After using new engine, Oil gauge, thermometer, alarming indication light and the other instruments shall be checked to ensure the diesel engine running normal.

Lubricating oil shall be added to the oil sump according to the regulations for new engine;

New engine start may be difficult when first ignition (including discharge or replace fuel injection pump, rail, high pressure pipe, fuel injector assy), need delay the time of diesel engine dragged by starter and start many times (notice: per time of dragging is not exceed than 30 sec., the start interval of continues two times is not less than 2 minutes). But before ignition, it's easy to ignite for whole vehicle with hand oil pump, adopt hand oil pump can clean the air of low pressure oil pipe, start is more easier for diesel engine.

Daily maintenance shall be carried out according to the regulations in Chapter 3;

2.3 Start at low temperature

When start at low temperature, if air intake heater controlled by electronic control unit, please start diesel engine as following:

1) Start key should revolve to "on" position.

2) If coolant temperature is low than -10℃, pre-heat indicator light on instrument panel is light, and extinguished after pre-heat ended.

3) After pre-heat indicator light extinguished, key button should revolve "start" position, start engine.

4) If start is successful, key button should revolve to "on" position

Notice:

1) Because pre-heat can consume amount of electric power and energy, so should avoid operating repeatedly, otherwise can bring storage battery huge burden.

2) Start engine within 5 seconds after pre-heat indicator light extinguished, diesel engine can start easy, when diesel engine start just now, don't run with high speed or idle rotation repeatedly without load or keep high speed.

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3. Notice for maintenance of National Ⅲ diesel engine

The content of maintenance of National Ⅲ diesel engines , see table 3-1. If the diesel engines often work in the condition of the environmental temperature is lower than - 18℃ or higher than 3 8℃, the maintenance interval shall be shortened. If the diesel engines often work in dusty environment or is often stopped, the period of maintenance also must be shortened.

Table 3-1

Interval	No.	Maintenance
Break-in period is finished (2000km or 40 hours)	1	Discharge the oil inside the oil sump, clean the oil sump carefully and change new lubricating oil
	2	Clean the oil collector filter web
	3	Check tightening torque of fixed bolt of the exhaust manifold
	4	Check and adjust the valves clearance
	5	Replace the diesel oil filter and lubricating oil filter core, and clean spin-on lubricating oil filter, clean the dust on air filter core
	6	Check the fuel thick filter
	7	Check the tension of fan belt
	8	Check if there is crack in the suspension washer and if the nuts are loose.
Daily maintenance	1	Check the height of the oil level and the water volume of cooling water
	2	Check the seal tightness of diesel engine, water and electric line
	3	Do cleanly things well
	4	Eliminate abnormal phenomena
First class maintenance (2500kmor 50 hours)	1~4	Same as daily maintenance
	5	Check spin-on lubricating oil filter, clean the dust of rotor inner wall
	6	Check the air filter, clean the dust of filter core
	7	Check the tension of fan belt
	8	Replace seal tightness of each pipe connection of supercharge system

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Table 3-1

Interval	No.	Maintenance
Two class maintenance (10000km or 200 hours)	1~8	Same as the content of first class maintenance
	9	Clean oil sump and oil collector filter web, replace new lubricating oil
	10	Replace diesel oil filter, lubricating filter core and supercharge lubricating oil filter core
	11	Clean diesel oil tank, fuel delivery pump filter web and diesel oil piping
	12	Check and adjust valve clearance
Three class maintenance (50000km or 1000 hours)	1~12	Same as the content of 2 class maintenance
	15	Clean oil coolant
	16	Check the tightening of cylinder head bolt, connecting rod bolt, main bearing bolt etc, important bolts.
	17	According to the running condition, define if disassemble cylinder head grinding valve
	18	According to the running condition, define if check and adjust
	19	Clean the carbon of supercharger air compressor, turbine rotor lamina and shell

Above check method of maintenance content, requirement and notice, please reference to《Service and maintenance manual for CA4DF, CA6DF Series diesel engines》,maintenance diagnosis and notice of electronic control high pressure common rail fuel injection system for diesel engine, please see chapter 4.

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4. Introduction and adjustment for electronic control high pressure common rail fuel injection system

This chapter only Introduced work principle, structure adjustment and maintenance diagnosis of electronic control high pressure common rail fuel injection system for National Ⅲ diesel engines. Test and eliminate method of normal mechanical fault for diesel engine, reference to regulation of 《Service and maintenance manual for CA4DF CA6DF series diesel engines》

4.1 Common rail fuel injection system

In order to meet with the requirement of emission and noise of national, fuel system of diesel engine not only has very high fuel injection pressure, meantime has precision fuel injection volume and proper fuel injection ratio, traditional mechanical fuel system can't be fit with requirement, so CA6DF3 series diesel engines choose advanced BOSCH common rail fuel system in the world.

Adopt common rail fuel system can make fuel injection process of diesel engine realized altitudinal flexible control, fuel injection volume, fuel injection pressure and fuel injection timing can according to requirement to control independently , fully eliminate effect of diesel engine speed and cycle supply oil volume, meanwhile can according to requirement to realize multi-segment injection of 5 times, to make fuel regulation more ideal. System has fault diagnosis and protection function, these methods are efficient to optimize diesel engine performance and upgrade diesel engine life.

●Main content of CA6DF3 series diesel engine fuel system electronic control

1) Control of fuel injection volume, fuel injection pressure, fuel injection timing: Fuel injection volume, fuel injection pressure, fuel injection timing be carried precision control is important content of diesel engine electronic control, size and number of fuel injection volume, fuel injection pressure, fuel injection timing is test with diesel engine speed and accelerograph open degree, system according its received speed signal of diesel engine and signal of accelerator pedal open degree, to calculate fuel injection parameter of corresponding work condition, fuel injection parameter is realized precision control. System can according to the signal of intake temperature, pressure, water temperature to adjust these fuel injection parameters.

2) Control of fuel injection times: In order to reduce Nox emission and diesel engine noise, CA6DF3 series diesel engines adopt pre-injection technology under partial work condition, to reduce noise of diesel engine .

3) Idling speed control: CA6DF3 series diesel engines be feed back controll by idling fuel injection volume, can ensure diesel engine idling speed stabilized on goal speed , to avoid diesel engine idling speed running, due to air-condition etc. outside load make diesel engine speed without stability , acceleration is slow.

4) Fuel volume control of each cylinder: For multi-cylinder diesel engine, difference of fuel injection volume for each cylinder can occur fluctuation of diesel engine speed, CA6DF3 series diesel engines judge difference of each cylinder fuel injection volume by changes of diesel engine speed when each cylinder is working, make adjustments to reduce speed fluctuation for diesel engine.

5) Control of start pre-heat: In winter, system improve start performance at low temperature

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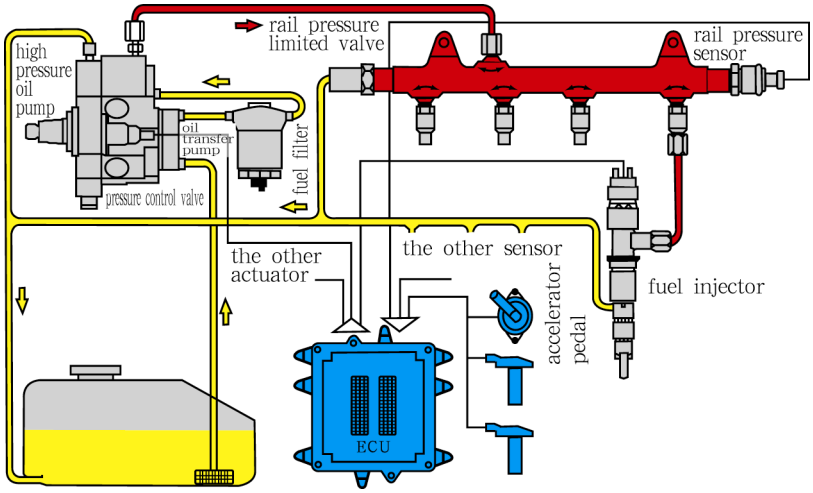
of diesel engine by electrified time of control air intake heater.

6) Function of fault diagnosis: ECU has the function of fault diagnosis, When fault signal be tested by ECU, first fault light is lit, meanwhile fault signal be saved as type of code, repair men will eliminate this fault.

7) Function of safety protection: System has function of safety protection, example when air intake temperature, pressure, cooling water temperature is abnormity, system protected diesel engine by reducing oil type, to ensure the vehicle to get place of maintenance.

4.2 Fuel injection system parts

Used common rail fuel system of CA6DF3 series diesel engines is shown as picture. Blue part is electronic parts, red part is high pressure parts, yellow part is low pressure parts, arrow is show flow direction of fuel.



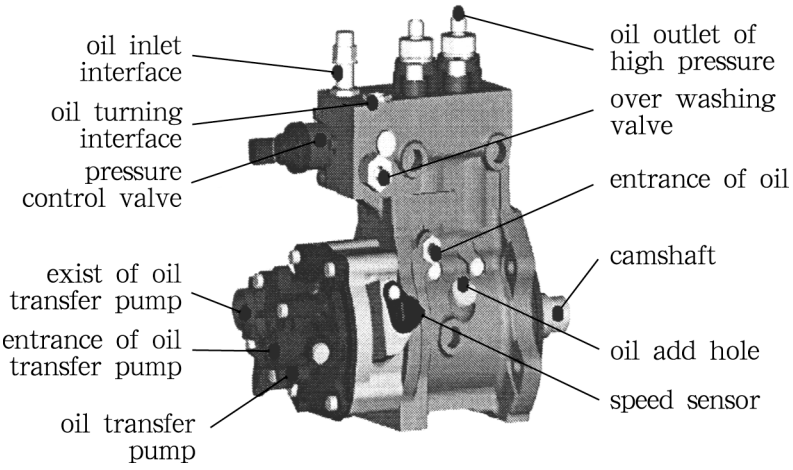
4.2.1 High pressure parts

High pressure parts is consisted of oil pump, rail, fuel injector and high pressure oil pipe.

●Oil pump

High pressure oil pump is one of key parts of electronic control common rail fuel injection system. It is pressure source of high pressure fuel. Using oil pump of CA6DF3 series diesel engines electronic control fuel injection system is CPN2.2 type high pressure oil pump. Show as picture.

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Parts of high pressure oil pump and function:

1) Oil transfer pump: CPN2.2 choose gear oil transfer pump, located on the rear end of high pressure oil pump and together with high pressure oil pump integration. Main task of oil transfer pump is supply fuel to high pressure oil pump. Oil inlet and oil outlet on oil transfer pump, connected with primary class filter exist of oil tank side and oil inlet of diesel oil filter.

2) Pressure control valve: The pressure in high pressure rail fluctuated because of supplying oil , leak off and oil turning , stabilization of pressure can keep by pressure

FAWDE Chapter 4 Introduction and adjustment for electronic control high pressure common rail fuel injection system control valve(Metering Unit).

3) Pump block: CPN2.2 is double cylinder piston pump, two high pressure oil exist connected with two entrance of rail. Oil pump is lubricated by oil, lubricating oil entrance is in the middle of pump.

4) Camshaft position sensor. Camshaft position sensor is used to judge coming time of engine 1st cylinder compressed top death point. As base signal of fuel injection, it can keep gammy function of engine.

Installation gist of oil pump:

1) First finishing partly assembly of fuel injection pump, install connection flange, o-ring and driving gear.

2) Running driving gear of fuel injector, make the gear trough between mark “3 ” and “3” on driving gear corresponding to orientation hole, and then make orientation pin of fuel injection pump be installed special tools screw into flange, make its head hold out and wedge in gear trough between mark “3 ” and “3”, gear shouldn’t rotate at this time.

3) Running flywheel , make 1st cylinder piston on the piston of top death point.

4) To make fuel injection pump flange assembly bolt hole corresponding to gear chamber cover plate assembly hole, thrust the oil pump slightly (if gear can’t joggle successfully, can adjustment slightly.)

5) Tighten flange assembly bolt, screw out special tool orientation pin, after add sleeve tighten renew.

Notice:

1) When add lubricating oil at first running or replaced new high pressure oil pump, must add 200cc lubricating oil to oil inlet of oil pump.

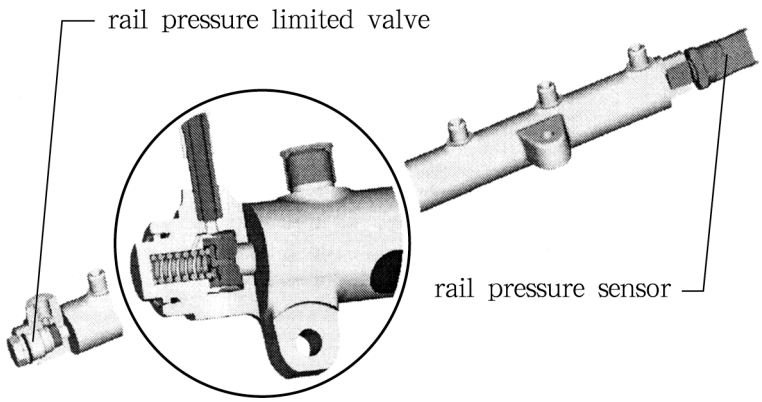
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2) Forbid knock ,hit oil pump and adjust with any ways.
3) High pressure oil pump is high precision parts, has strict requirement to cleanliness, All protection covers of high, low pressure oil pipe connector must be well when transport, convey and storage, only dismantle and seal before assembly.

●Rail

High pressure oil rail is another key parts of electronic control common rail fuel injection system. It will save high pressure oil from high pressure oil pump output in common rail oil antrum, to keep common rail pressure set by ECU, supply high pressure fuel and oil to each fuel injector.

High pressure oil rail integrated one common rail rail pressure sensor, one pressure limited valve, two oil inlets of high pressure oil, six flow volume limited valves. Show as drawing:



Parts of high pressure oil rail and function explanation

1) Rail pressure limited valve: When common rail pressure exceed the highest pressure afford by common rail pipe, rail pressure limited valve can open automatically, common rail pressure will reduce to ensure safety.

2) Flow volume limited valve. There is six flow limited valves on upper of rail, connected with high pressure oil pipe of six cylinders separately, its function is prevent fuel injector injection continuous under special condition. Once oil volume transferred by rail exceed regulated level, flow limited valve can work, cut supply fuel of this cylinder .

3) High pressure oil inlet: There is two oil inlets on lower rail, connected with high pressure oil outlet of high pressure pump.

4) Rail pressure sensor: Rail pressure sensor located on right end of common rail, to measure instantaneous oil pressure in rail and supply to ECU.

Notice:

1) Forbidden rail pressure sensor disassembling freely, has danger o f leak off.

2) Only under higher rail pressure, flow volume limited valve can work, when rail pressure is lower, leak off of high pressure oil pipe or fuel injector fault result in fuel injection volume exceed limited , rail pressure can fall suddenly and lead to engine stop work. If leak off seriously engine can’t start because of rail pressure can’t be set up.

3) High pressure oil rail is a sensitive hydraulic pressure software, forbidden knocking, hitting, don’t allow to disassemble parts sensor on oil rail, limited valve, flow volume limited valve.

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4) High pressure oil rail is high precision parts, has strict requirement to cleanliness, All protection covers of high pressure oil pipe connector must be well when transport, convey and storage, only dismantle and seal before assembly. forbidden high pressure oil rail parts cleaning or blushing with any liquid or gas.

● Fuel injector

This fuel injector is one of key parts of Electronic Control common rail fuel injection system, difference from injection of Euro Ⅱ engine is this fuel injector is electronic control fuel injector, top of fuel injector is electromagnetism control valve, fuel injection volume and injection timing are determined by electrify time of electromagnetism valve. Electrify time of electromagnetism valve is controlled by running condition of ECU which according to the engine.

Installation gist of fuel injector:

1) Rubber sealing ring of fuel injector will be daubed with Vaseline.

2) Fuel injector is put into cylinder head, installing fuel injector board and bolts.

3) Installing fuel injector bunch, fuel injector connecting bolts are tightened with 1.25~1.75N.m torque. Forbidden two connection head of fuel injector linking together. After finishing connection, connection pole is covered with special cap.

4) During assembly, forbidden conveying fuel injector with hand to support electromagnetism valve parts on fuel injector upper end, should protect connection pole of electromagnetism valve and information card of upper end.

Notice:

Forbidden fuel injector body and each oil inlet oil turning cleaning with compress air or dirty fuel or the other liquid.

● High pressure oil pipe

High pressure oil pipe has total 8 pipes, from high pressure oil pump to high pressure oil rail has 2 pieces, from high pressure oil rail to each cylinder fuel injector has 6 pieces.

Notice:

1) When high pressure oil pipe be discharged and installed, flow volume limited valve and high pressure oil pipe fixed nuts must be carried at the same time, and keep flow limited valve not rotating.

2) After high pressure pipe be installed, high pressure oil pipe clamper must be installed and fixed tighten.

3) High pressure oil pipe has strict requirements for cleanliness, forbidden high pressure oil pipe parts cleaning or blushing with any liquid or gas.

4) All protection covers of high pressure oil pipe connector must be well when transport, convey and storage, only dismantle and seal before assembly.

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4.2.2 Low pressure oil piping parts

● Oil tank

Must using oil tank without plumbum.

Oil outlet pipe inner diameter should ensure ≥12mm, Oil turning pipe inner diameter should ensure ≥12mm,

Notice: When oil volume reach position of alertness line, must add oil.

● Fuel primary filter

Fuel primary class filter should has ability of oil water departure and has hand oil pump. So that low pressure system eliminate air.

● Fuel filter

Common rail system has special requirement for characteristics of filtrate efficiency of fuel filter and flow volume, please choose fuel filter same as delivery filters.

Commend type: WDK999

Manufacturer: MANN+HUMMEL

Piece No. 1117001-630-0000

● Low pressure oil pipe

Low pressure pipe include: oil tank-oil transfer pump-inlet, oil transfer pump outlet-fuel filter inlet, fuel filter outlet-pump body and fuel injector, rail, oil turning pipe of pump. All low pressure oil pipes have requirement of cleanliness, forbidden using oil pipe without requirement of cleanliness replaced low pressure oil pipe, forbidden blowing and cleaning use high pressure air or cleaning use not clean fuel or liquid.

Low pressure oil pipe pathway is as following, inner diameter of low pressure piping enter, turning oil pipe have an effect on engine performance, please choice oil inlet pipe and oil turning pipe. Otherwise system occurs many protection, have an effect on power performance of engine and response performance.

	Diameter of oil inlet pipe(mm)	Max. temperature(℃)	Max. flow volume(L/h)
Oil pump oil inlet	≥12	<100	<400
Oil pump oil turning	≥12	<100	<400
Fuel injector oil turning	≥4	<135	(6cyl<50)
DBV oil turning	≥8	<135	<200

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4.3 Electronic control system parts

● Electronic control Unit (ECU)

Electronic control Unit (ECU) is core of Electronic control common rail system. ECU through each kinds of sensors and switches to collect current work information of engine, to analyze and calculate the best work parameter table which rated under this condition, to control fuel injection volume of engine, time of fuel injection and fuel injection pressure, so that to adjust work state of engine, to achieve aim of save oil, high efficiency, low emission. Electronic controller for CA6DF3 diesel engine adopted EDC7U31 of Bosch Company, this ECU is installed on engine cylinder block to supply to user.

Notice:

1) ECU will not be placed outside for long time. When outside should prevent outside matter entering patch connectors interface and cooling piping, so must use sealing cover covered interface and cooling piping, and prevent ECU outside shell rusting..

2) When discharge should be carefully, avoiding ECU be mangled, because when cover and shell body has phenomena of depressed, it will short circuit, make the ECU can't be used.

3) ECU should be placed very carefully, don't allow to fall from altitude to prevent internal parts of ECU mangling.

4) ECU can't be placed in wet environment, can't be washed, can't be weld with electricity, do well the protection of waterproof and dustproof.

5) Don't use hand or finger to touch ECU patch connectors terminal, to prevent static and internal parts mangling.

6) Should prevent outside matter entering patch connectors interface of ECU to mangle the patch connectors terminal.

7) Patch connectors of ECU is corresponding to each other, insert and pull out should be carefully, to prevent terminals mangling.

● Crankshaft position (speed) sensor

Speed sensor is installed on flywheel shell to measure engine speed. This electric signal transport to ECU, according to this signal ECU calculate engine speed, reference camshaft sensor signal to know piston stroke position of each cylinder piston in cylinder,
So that to control time of fuel injection, fuel injection pressure and fuel injection volume.
Notice:

1) The clearance between speed sensor and flywheel top surface(1.0±0.5), After replacing sensor must check and confirm with ruler, if exceed scope , it's need to proper adjustment.

2) Near the speed sensor, don't place magnetoelectricity equipment or big electricity wires.

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● Intake temperature pressure sensor

Intake temperature pressure sensor is installed on intake manifold, to measure intake absolute pressure of intake manifold and intake temperature.

Notice:

1) Intake temperature pressure sensor should be placed very carefully, don't allow to fall from altitude to prevent internal parts of intake temperature pressure sensor mangling.

2) Biggest tightening torque of bolt are installed is (4~6)N.m;

3) Do well waterproof protection when transportation.

4) When replacing sensor, don't allow acid, alkali, fuel, lubricant, water enter ambient connecting parts. If discover sensor or base seat is leak off when replacing sensor or maintenance on time, should seal and fix anew. Avoid O-ring be mangleg when assemble, please don't use silicon oil as lubricant.

5) Please don't use knock tool(example hammer)

● Water temperature sensor

Water temperature sensor is installed on temperature controller body, to measure the temperature of engine coolant.

Notice:

1)Biggest tightening torque of screw thread is (25±2)N.m

2) Parts surface which corresponding to water temperature sensor should without impurity example cutting and lubricant.

3) Water temperature sensor should be sealed with temperature controller body,

● Accelerator pedal sensor

Accelerator pedal sensor should be installed in accelerator pedal under driver instrument board.

Accelerator pedal has special type, don't interchange with other companies or different type accelerator pedals.

Recommend type: TDQ-2

Manufacturer: Nanjin Aolian Automotive Electron Electricity Equipment Co. Ltd.

Piece No. 3602070A621-0000

● Bunch

Bunch is a vinculum of signal transfer of electronic control fuel injection system, has engine bunch and whole vehicle bunch.

A. Engine bunch

Engine bunch connected each sensor, actuator, fuel injector and ECU.

Notice:

1) Tightening torque of fuel injector bunch fixed bolts (1.25~1.75) N.m, tighten and loose must be carefully, prevent bolts of fuel injector breaking.

2) To prevent anode and cathode of fuel injector adapter shorting circuit or shorting circuit with cylinder block.

3) When fuel injector adapter of engine bunch patched with fuel injector, must one-to-one correspondence.

4) Patch connector of engine bunch and each sensor and actuator is one-to-one correspondence.

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5) In the engine bunch, patch connectors of assistant speed signal on oil pump are same as patch connectors of oil volume measurement unit. So when assistant speed signal is end, please distinguish with yellow label.

6) Patch connector of engine bunch should without water or oil.

7) Should be very carefully when installing and pulling out patch connector of engine bunch, prevent the patch connector destroying.

8)When patching with each sensors and actuators, can't pull engine bunch roughly to prevent bunch from breaking.

B. Whole vehicle bunch

Whole bunch connected ECU and each sensors of whole vehicle, relay and switch etc. electricity parts.

4.4 Repair summary of electronic control system

● Fault test of electronic control system

Fault detection mode of electronic control system is fault code detection. Its step is as following:

1) Turn ignition switch from "OFF" to "ON" position. Don't start the engine. The indicate lights (include fault indicate light of diesel engine) on instrument panel should be lighted.

2) Start the engine

3) If the engine is normal running, electronic control system without fault, fault indicator light of engine lit 3 seconds later, it should extinguish.

4) If the fault indicator light of engine is not extinguished, it shows that control system of engine has fault.

5) Turn ignition switch from "ON" to "OFF" position.(turn off the diesel engine)

6) Put the interface of special fault diagnosis instrument connected with diagnosis Socket of engine bunch.(see usage instruction of fault diagnosis instrument)

7) Turn ignition switch from "OFF" to "ON" position, don't start engine.

8) Read the fault code in fault diagnosis instrument, fault diagnosis instrument display "fault code", example:

Fault code	P0123	Display content	Signal of accelerator pedal sensor is too high

9) According to fault classification the which corresponding to fault code and reason, to replace spare parts or repair fault parts to eliminate the fault.

10) After eliminating the fault, after eliminating original fault code, electronic control fuel injection system is diagnosed again with fault diagnosis instrument, after ensuring without fault, delivery and use again.

● Display code of fault diagnostic instrument test and fault classification

Test fault of system voltage

Fault code	U3003	Display content	System supply power voltage is too high

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Fault code	U3003	Display content	System supply power voltage is too low

Fault test of ECU

Fault code	P0643	Display content	ECU sensor voltage 1 is too high

Fault code	P0642	Display content	ECU sensor voltage 1 is too low
Fault code	P0653	Display content	ECU sensor voltage 2 is too high
Fault code	P0652	Display content	ECU sensor voltage 2 is too low
Fault code	P0699	Display content	ECU sensor voltage 3 is too high
Fault code	P0698	Display content	ECU sensor voltage 3 is too low

Fault test for storage battery short circuit

Fault code	P0478	Display content	For storage battery short circuit

Fault test for exhaust brake control valve

Fault code	P0477	Display content	Exhaust brake control valve earth short circuit
Fault code	P0477	Display content	Exhaust brake control valve open circuit, without load

Fault test for cooling liquid temperature sensor

Fault code	P0018	Display content	Signal of cooling liquid temperature sensor is too high
Fault code	P0017	Display content	Signal of cooling liquid temperature sensor is too low
Fault code	P0015	Display content	Signal of cooling liquid temperature sensor is mistake when CAN communication

Fault test for air intake temperature sensor

Fault code	P0098	Display content	Signal of air intake temperature sensor is too high
Fault code	P0097	Display content	Signal of air intake temperature sensor is too low
Fault code	P0095	Display content	Signal of air intake temperature sensor is mistake when CAN communication

Fault test for fuel measurement unit

Fault code	P0251	Display content	Fuel oil measure cell open circuit
Fault code	P0252	Display content	Fuel oil measure cell is over heat

Fault code	P0253	Display content	Fuel oil measure cell earth short circuit
Fault code	P0254	Display content	Fuel oil measure cell short circuit to storage battery

Fault test for air intake pressure sensor

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Fault code	P0238	Display content	Signal of air intake pressure sensor is too high
Fault code	P0237	Display content	Signal of air intake pressure sensor is too low
Fault code	P0235	Display content	Signal value of air intake pressure sensor is error when CAN communication
Fault code	P0236	Display content	Signal of air intake pressure sensor is error

Fault test for brake signal

Fault code	P0571	Display content	Brake signal is error
Fault code	P0504	Display content	Brake signal is invalidation

Fault test for clutch signal

Fault code	P0704	Display content	Clutch signal is not defined when CAN communication
Fault code	P0704	Display content	Clutch signal is invalidation

Fault test of T15

Fault code	P0477	Display content	Exhaust brake control valve earth short circuit
Fault code	P0477	Display content	Exhaust brake control valve open circuit, without load

Fault test for atmosphere pressure sensor

Fault code	P2229	Display content	Signal of atmosphere pressure sensor is too high
Fault code	P2228	Display content	Signal of atmosphere pressure sensor is too low
Fault code	P2227	Display content	Signal of atmosphere pressure sensor is invalidation

Fault test of air heater

Fault code	P0542	Display content	Air heater output to short circuit for storage battery
Fault code	P0541	Display content	Air heater output open circuit/earth short circuit

Fault test for crankshaft speed sensor

Fault code	P0335	Display content	Crankshaft speed sensor without pulse signal
Fault code	P0336	Display content	Pulse signal of Crankshaft speed sensor is error

Fault test for camshaft sensor

Fault code	P0340	Display content	Camshaft sensor without pulse signal
Fault code	P0341	Display content	Pulse signal of camshaft sensor is error

Signal deviation between crankshaft speed sensor and camshaft sensor

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Fault code	P0016	Display content	Signal deviation between crankshaft and camshaft sensor

Fault inspect for accelerator pedal sensor (1)

Fault code	P0122	Display content	Signal of accelerator pedal sensor (1) is too low
Fault code	P0123	Display content	Signal of accelerator pedal sensor (1) is too high
Fault code	P0121	Display content	Signal of accelerator pedal sensor (1) is invalidation

Fault inspect for accelerator pedal sensor (2)

Fault code	P0222	Display content	Signal of accelerator pedal sensor (2) is too low
Fault code	P0223	Display content	Signal of accelerator pedal sensor (2) is too high
Fault code	P0221	Display content	Signal of accelerator pedal sensor (2) is invalidation

Fault inspect for cooling temperature exceed upper limited value

Fault code	P0217	Display content	Cooling liquid temperature of diesel engine is too high

Fault test for fuel injector

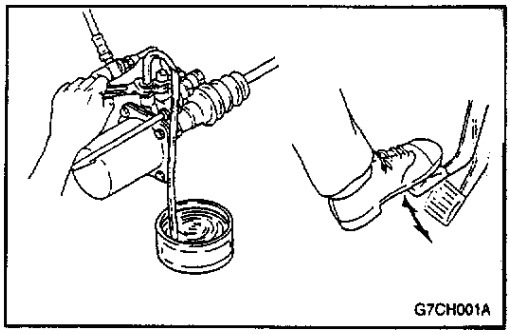
Fault code	P0262	Display content	Short circuit between 1st cylinder fuel injector junction and battery
Fault code	P0261	Display content	1st cylinder fuel injector two junctions short circuit
Fault code	P0265	Display content	Short circuit between 2nd cylinder fuel injector junction and battery
Fault code	P0264	Display content	2nd cylinder fuel injector two junctions short circuit
Fault code	P0268	Display content	Short circuit between third cylinder fuel injector junction and battery
Fault code	P0267	Display content	3rd cylinder fuel injector two junctions short circuit
Fault code	P0271	Display content	Short circuit between 4th cylinder fuel injector junction and battery
Fault code	P0270	Display content	4th cylinder fuel injector two junctions short circuit
Fault code	P0274	Display content	Short circuit between 5th cylinder fuel injector junction and battery
Fault code	P0273	Display content	5th cylinder fuel injector two junctions short circuit
Fault code	P0277	Display content	Short circuit between 6th cylinder fuel injector junction and battery
Fault code	P0276	Display content	6th cylinder fuel injector two junctions short circuit

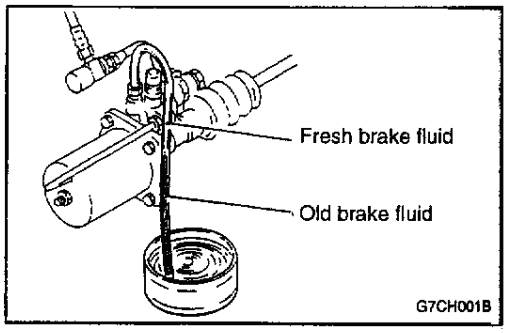
Fault test for high pressure oil rail

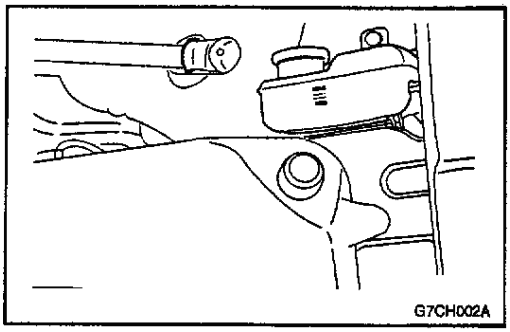
Fault code	P0193	Display content	Voltage is higher than top limited
Fault code	P0192	Display content	Voltage is lower than low limited
Fault code	P0191	Display content	Rail pressure sensor is wrong

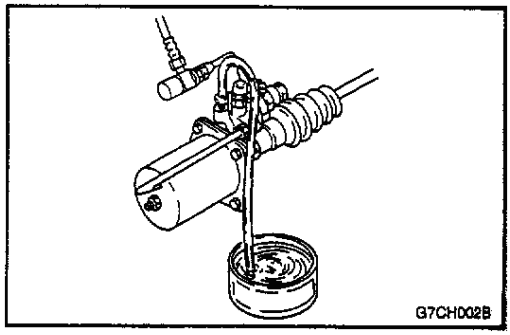
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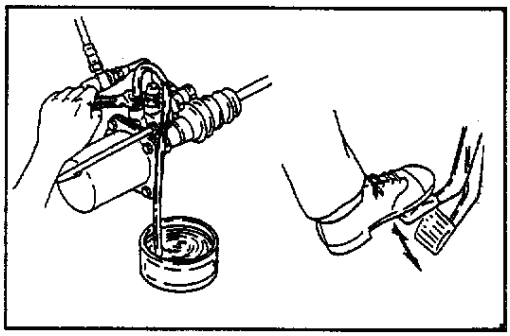
Clutch











Replacement of Brake Fluid

1. Fit vinyl pipe to the air bleeder of the clutch booster and put the other end of the vinyl pipe in an empty container. Loosen the air bleeder of the clutch booster and depress the clutch pedal until no more brake fluid flows out.

2. While pouring in fresh brake fluid into the reservoir tank, continue to depress the clutch pedal until the fluid of the clutch system is replaced with the fresh fluid(the fluid flowing out change in color).

Note

Do not feed brake fluid until its level exceeds "H" on the brake fluid reservoir tank.

Never use brake fluid of different kind.

3. Remove the vinyl pipe, tighten the air bleeder, and install the protector.

Bleeding of Clutch System

1. Supply brake fluid to the clutch fluid reservoir tank on the driver side up to "MAX" level.

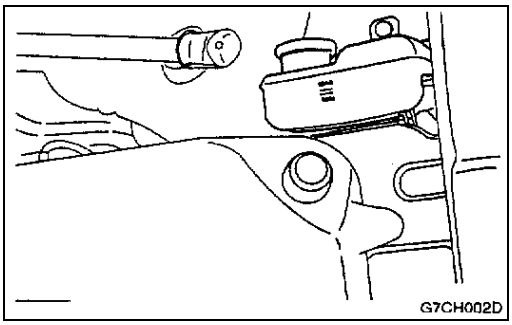
Note

Never leave the brake fluid reservoir oil tank empty during the procedure.

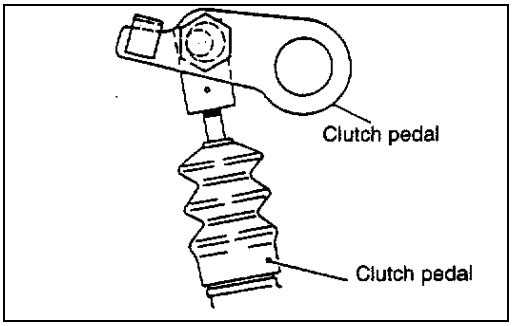
2. Remove the air bleeder protector from the clutch booster and, instead, fit one end of a transparent vinyl pipe.
   Place the other end of the pipe in a container filled with brake fluid.

3. Pump the clutch pedal several times and keep it depressed and, at the same time, loosen the air bleeder to discharge brake fluid. Then, immediately, tighten the air bleeder and release the pedal.
4. Repeat step(3) until the brake fluid runs clear from the air bleeder containing no air bubbles. Then, tighten the air bleeder securely.

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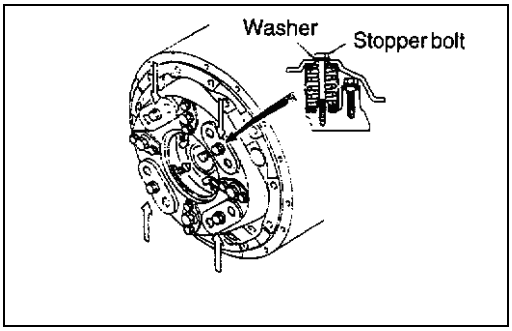


5. Check for the level of fluid in the clutch reservoir tank and add fluid as necessary up to the “MAX” level.

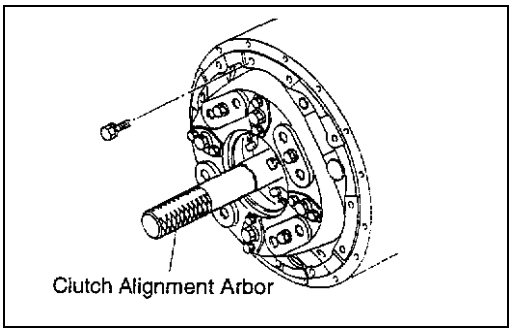


Adjustment of Clutch Pedal

Adjust the end play by the stopper bolt or the length of push rod.



1. Disconnect the control rods and associated parts around the transmission.
2. Remove the propeller shaft.
3. Remove the transmission.
4. Remove the pressure plate and lever assembly.

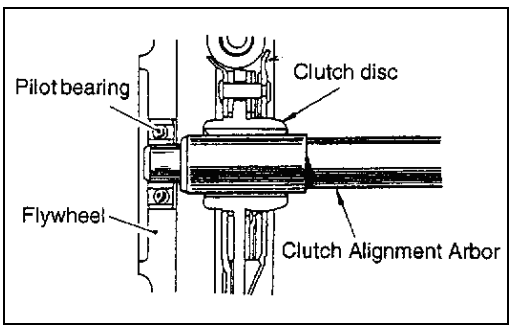


5. When removing the pressure plate and lever assembly, fix the pressure plate with Stopper Bolt and Washer(special tool).

6. Install Clutch Alignment Arbor(special tool) to prevent dropping of the clutch disc and then remove the pressure plate and lever assembly.

Note

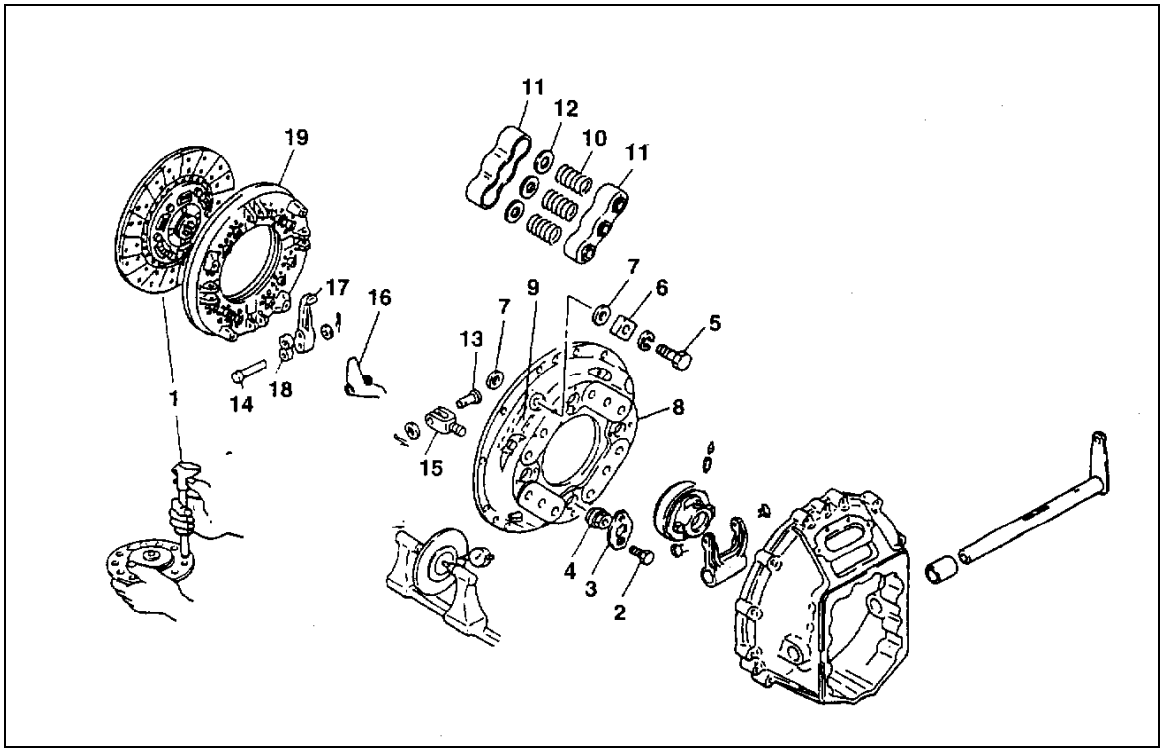
Before removing the clutch proper, be sure to install the stopper bolt and plain washer to prevent breakage of the strap plate.



Installation

Install the clutch disc using the special tool, Clutch Alignment Arbor.

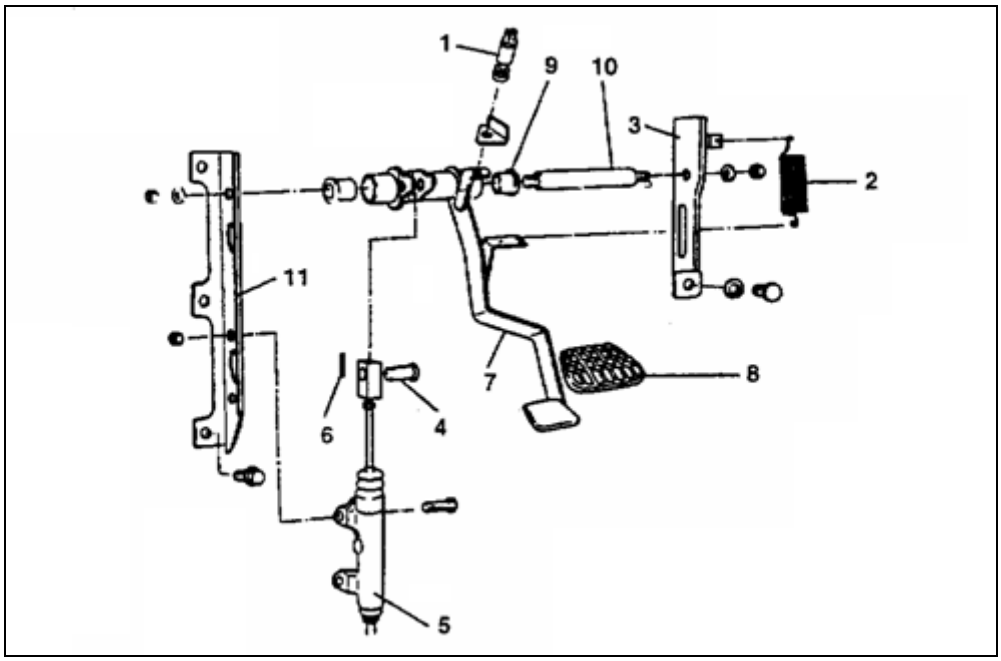
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Disassembly sequence

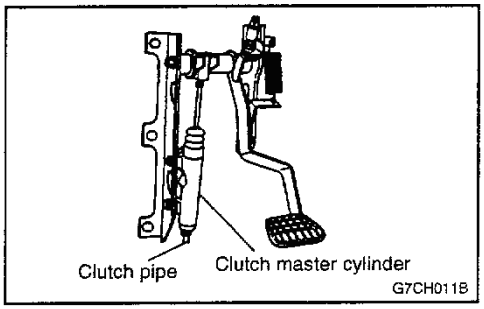
1. Clutch disc 2. Lock bolt 3. Lock washer 4. Support nut 5. Strap bolt 6. Strap support washer 7. Strap washer 8. Clutch cover 9. Strap plate 10. Pressure spring 11. Spring seat 12. Adjusting washer 13. Release lever pin 14. Release lever pin 15. Lever support 16. Return spring 17. Release lever 18. Bushing 19. Pressure

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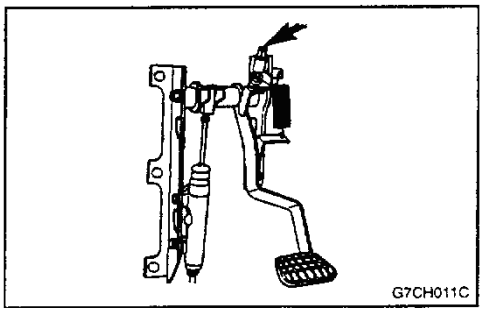


Disassembly procedure

1. Clutch switch 2. Return spring 3. Bracket(RH) 4. Clevis pin 5. Master cylinder
6. Bushing 7. Clutch pedal 8. Pedal pad 9. Bushing 10. Shift 11. Bracket（LH）

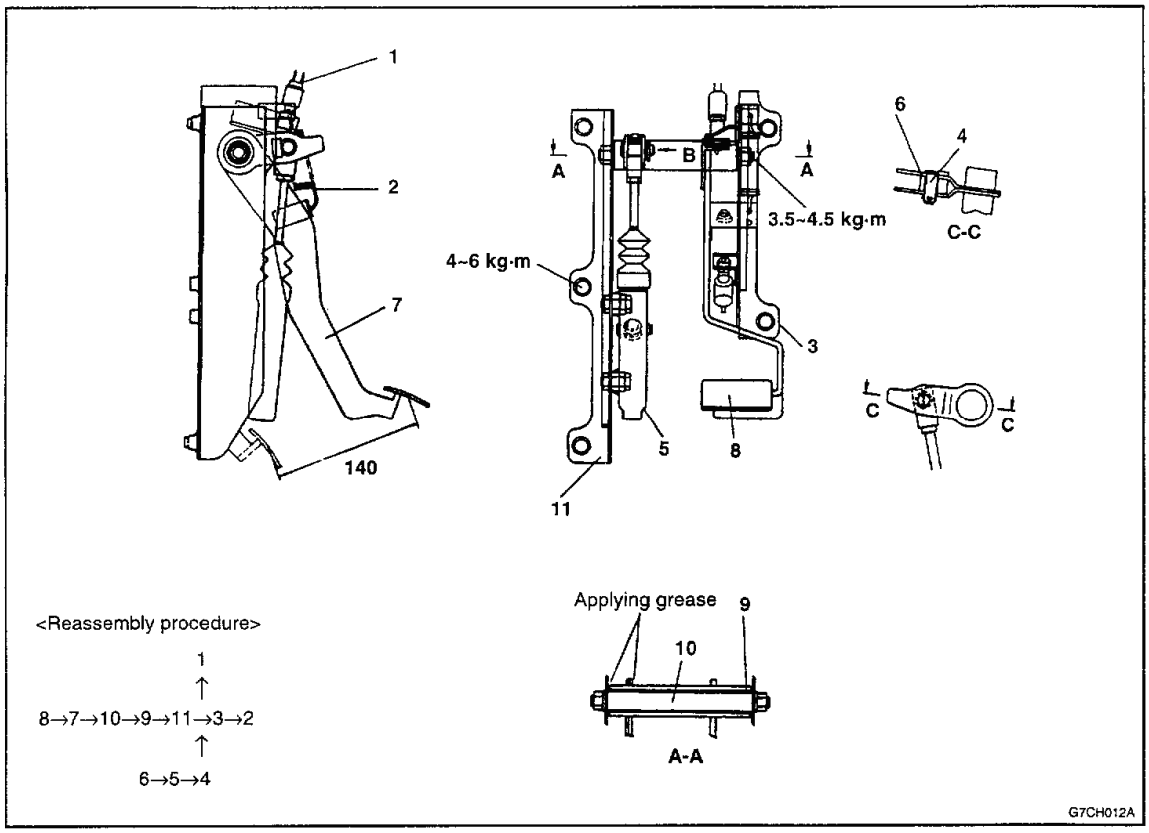


1. Before removing, drain the clutch fluid.
2. Remove the return spring of the clutch pedal.
3. Separate the clutch hose and clutch pipe from the clutch master cylinder.
4. Remove the clutch switch connector.



5. Remove the clutch pedal assembly.

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Disassembly

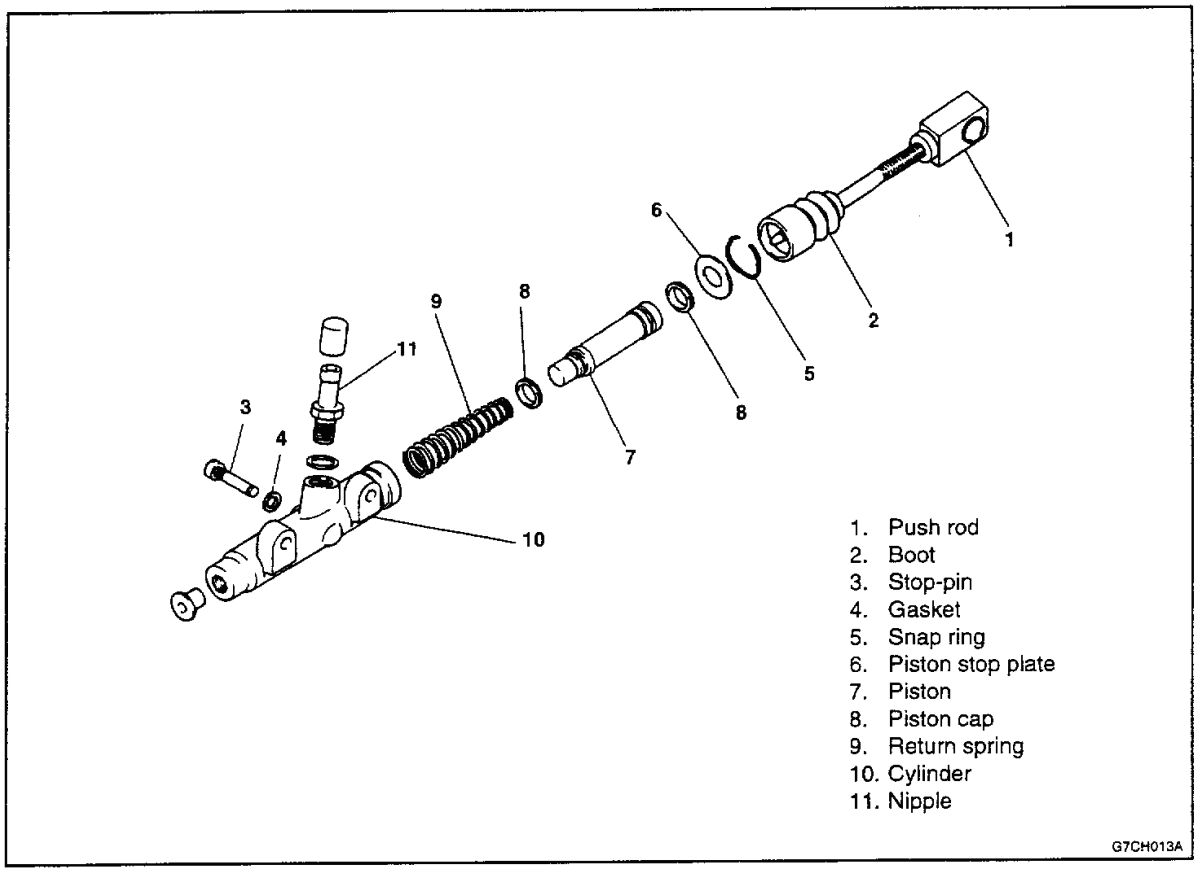
1. Disassemble the push rod and the boot
2. Remove the snap ring
3. Remove the stop-pin
4. Remove the piston

Reassembly

Reassembly is the reverse of the disassembly.

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Master Cylinder



Disassembly

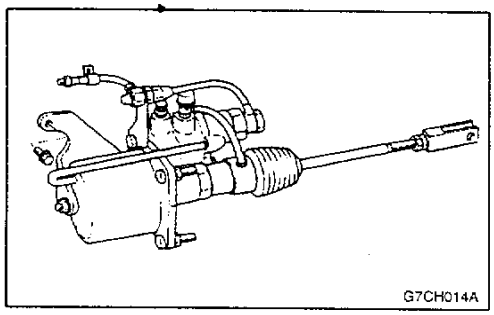
1. Disassemble the push rod and the boot
2. Remove the snap ring
3. Remove the stop-pin
4. Remove the piston

Reassembly

Reassembly is the reverse of the disassembly.

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Booster

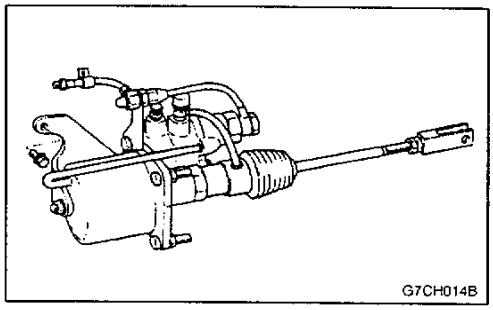


Removal

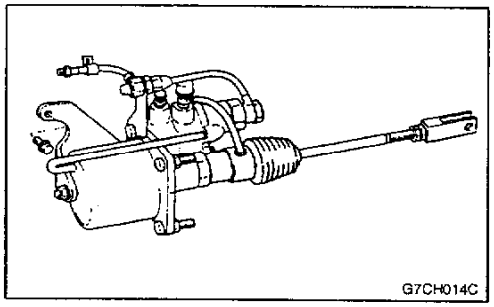
1. Remove brake fluid from the clutch system, then remove air pipes and oil pipes from the clutch booster.

Note

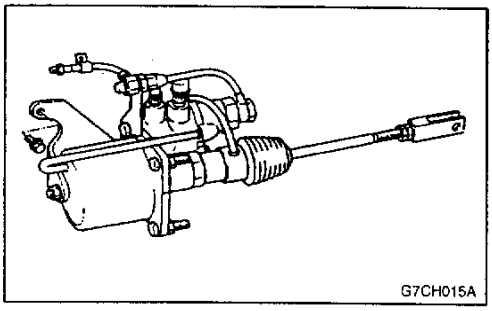
Plug the open clutch booster ports and pipes removed to prevent entry of dust and dirt.



2. Remove the clevis pin from the end of the push rod of the clutch booster to disconnect the connection of the release fork shaft lever.

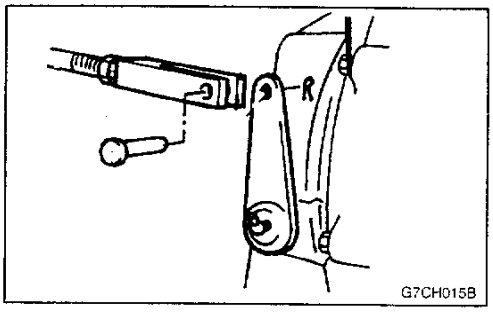


3. Remove the mounting bolts and remove the clutch booster from the transmission.



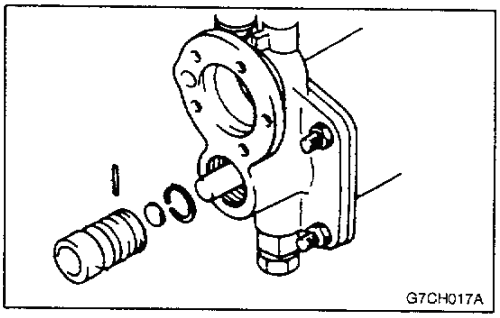
Installation

1. Install the clutch booster to the transmission and tighten the mounting bolts to specification.

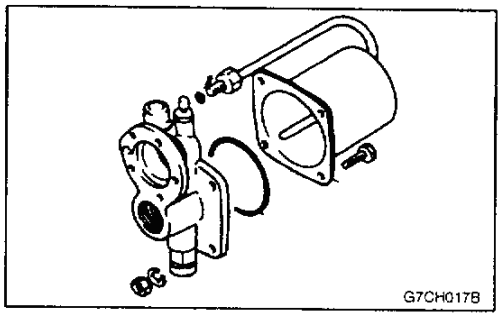


2. Connect the clutch booster push rod to the release fork shaft lever. Then , install air pipes and oil pipes to the clutch booster and tighten them to specification.

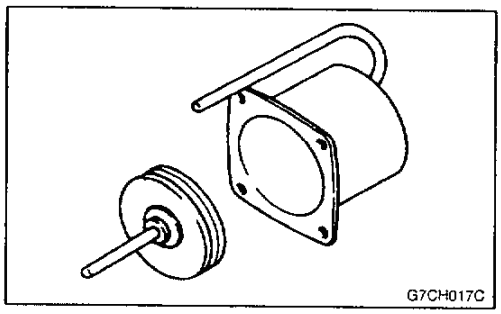
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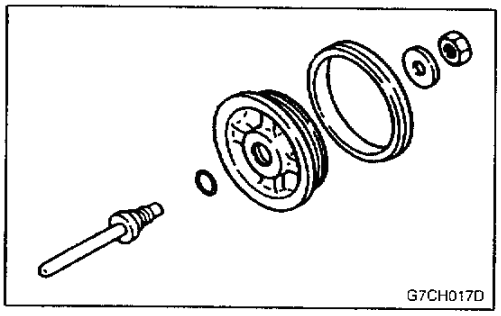
6. Disassemble the retaining ring, pin and piston assembly.



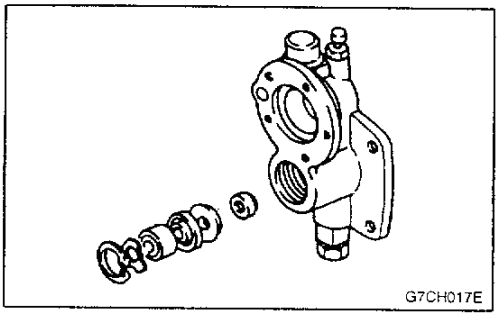
7. Disassemble the body assembly and O-ring.



8. Remove the power piston assembly.

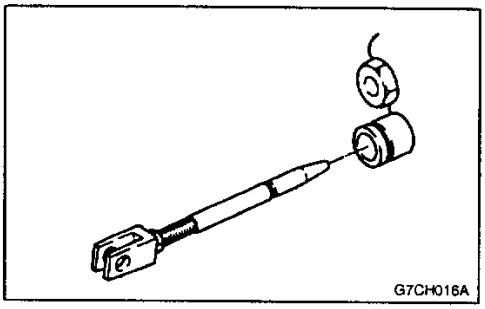


9. Disassemble the power piston assembly.



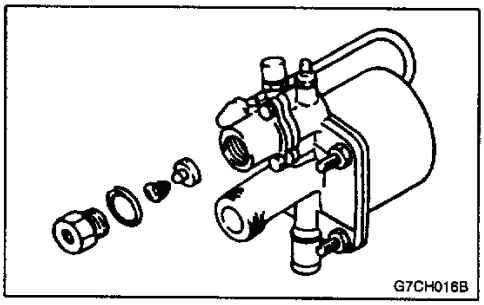
10. Remove the ring and disassemble the washer, retainer, cup packing, washer and oil seal.
11. Remove the cup packing.

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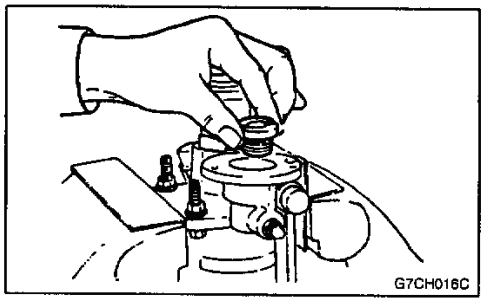


Disassembly

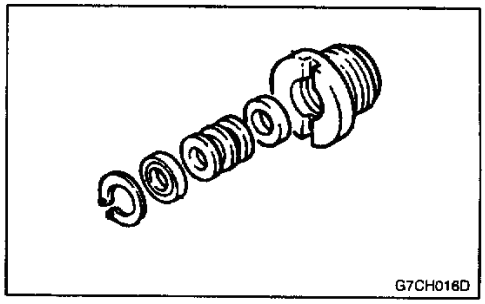
1. Remove the push rod



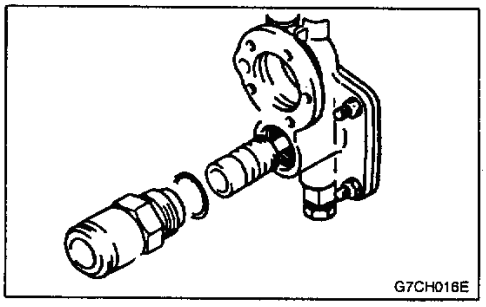
2. Remove the connector, gasket, poppet spring and proper valve.



3. Disassemble the valve fitting and gasket.

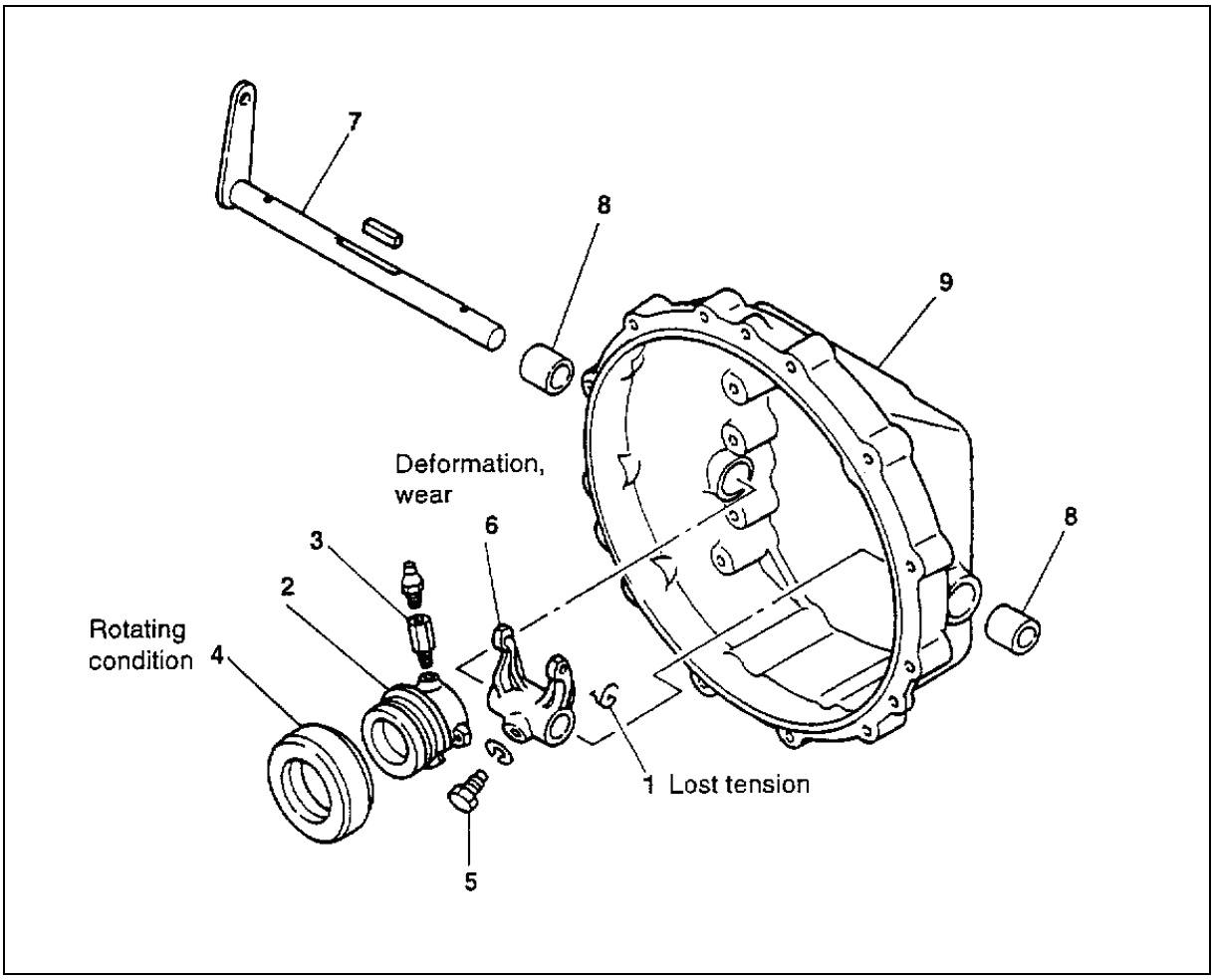


4. Disassemble the ring and cup packing.



5. Disassemble the hydraulic cylinder.

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Removal sequence

1. Return spring
2. Clutch shifter
3. Elbow
4. Clutch release bearing
5. Set screw
6. Clutch release fork
7. Release fork shaft
8. Needle roller bearing
9. Clutch housing

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CA6T138
Transmission

FAW Eaton Transmission Co., Ltd

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Ⅰ. Product Introduction

CA6T138 transmission has 6 forward speeds and 1 reverse speed among which the 2nd to 6th speed have synchronizer with neat, quick and non-shock shifting. During machining, the advanced manufacturing technology is applied and many digital equipments are utilized to assure product quality, especially for gear manufacturing, the new technologies like grinding, shot peening, phosphating etc. are applied to assure gear high precision, high strength, low noise, good wear-proof, wide usage, good carrying capacity and stable operation.

Ⅱ. Special Reminder

1.Please handle transmissions carefully without press and shock.

2.No lifting transmission from control tower, otherwise will break the thread hole for fixing the control tower on shift bar housing.

3. For any transmission failures, please check carefully and send to nearby FAW Service Station. Don't disassemble by yourself.

4.Special attention! Don't drive the vehicle while counter shaft stops rotating, such as 2nd level chassis hauling or running in neutral position, which can cause transmission lubrication termination and bearings burning,

5. Please try to avoid sudden speed up and brake when driving in order to avoid transmission breakage due to sharp shock.

6. Before start up, keep vehicle running for 2-3 minutes with clutch engaged and transmission in neutral position to assure bearing lubrication.

7. In shifting operation, clutch pedal must be fully stepped and move the shifting lever to target position and engage stably and correctly. When engage into 5th, 6th and reverse position, should feel elasticity of shifting safety thrust stick and make engagement operation after pressing thrust stick back.

Ⅲ. Transmission Maintenance

1. Initial maintenance should be performed after vehicle running in for 2000Km(within 15days) according to "Warranty Service Manual". Clean transmission inside and replace

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new gear oil(free service in nearby FAW Service Station). Clear up the metal powder on oil plug magnet and meanwhile check if all the fasteners are loose or not, and fasten if necessary. Check oil leaking of all contact faces and oil seals.

2. After initial maintenance, once maintenance every 10000Km and replace all gear oil and clear up the metal powder on oil plug magnet.

3. Frequently check vent plug to assure transmission balanced air pressure and to avoid oil leaking and sealing part breakage due to uneven transmission pressure because of vent plug stopped.

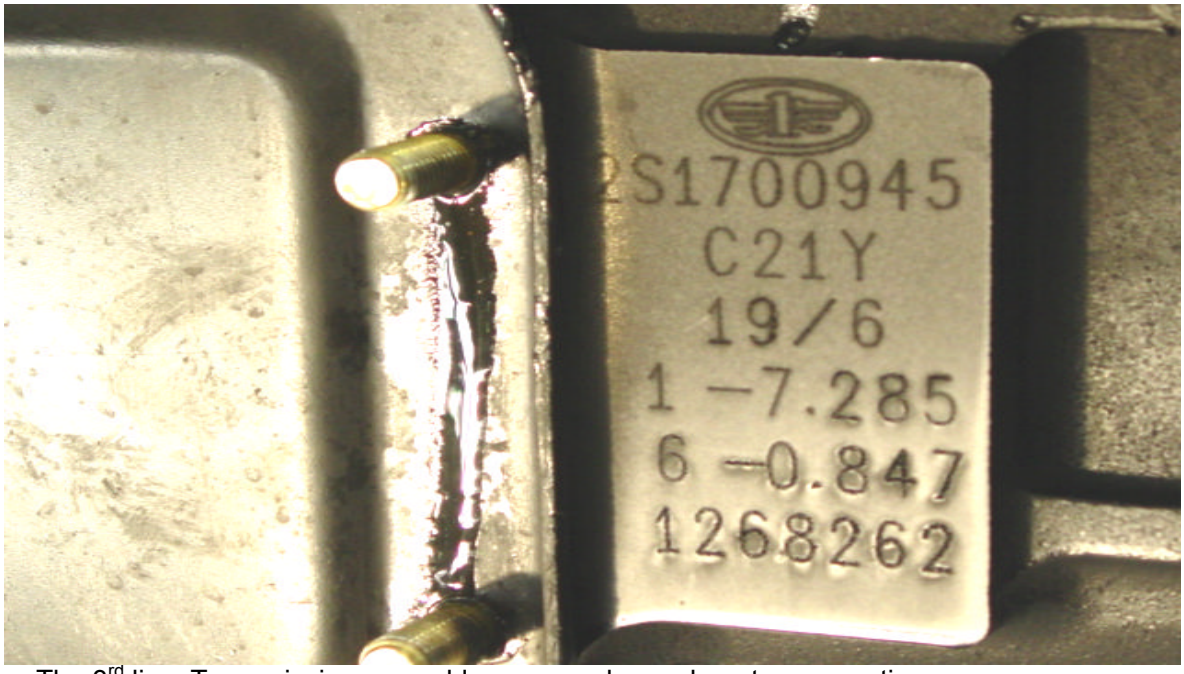
Ⅳ. Product Identification

The electric printed identification on transmission flank face (near to PTO) is as following:

Identification Explanation

The numbers under “FAW” logo represent respectively:

The 1st and 2nd lines: Transmission assembly model identification.



The 3rd line: Transmission assembly worm and speedometer gear ratio.

The 4th line: Transmission assembly 1st speed ratio.

The 5th line: Transmission assembly 6th speed ratio.

The 6th line: Transmission assembly production serial number.

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Ⅴ. Maintenance Data

Ⅴ-1 Main Specifications：

Transmission Model			CA6T138				
Serial No.			1700945BJH-3				
Structure			6 forward and 1 reverse with synchronizers on 2nd to 6th speed				
Control Type			Manual remote control				
Center Distance			138				
Rated Input Torque(Kg.f.m)			85				
Max. Input Rev. (r/min)			3000				
Weight			204				
Dimension (L*W*H)			835*411.5*537				
Gear Type		1st and rev.	Spur gear				
		2nd to 6th	Helico gear				
Gear Ratio							
Speed	1st	2nd	3rd	4th	5th	6th	Rev
Ratio	7.285	4.193	2.485	1.563	1.000	0.783	6.777
Lubricant #		80W/90（GL-4） 80W/90（GL-4）Gear Oil					
Lubricant Qty (L)		9.5					

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Ⅴ-2. Maintenance Criteria

Item	Standard Dimension(mm)	Wear Limit (mm)
Flank Clearance forAll Gears		
Rev.	0.08 ~ 0.16	0.50
1st	0.08 ~ 0.18	
2nd	0.08 ~ 0.16	
3rd	0.08 ~ 0.16	
4th-6th	0.04 ~ 0.12	0.40
Axial Clearance for Main Shaft Gears		
Rev. Gear	0.20 ~ 0.35	1.00
Idle Gear	0.15 ~ 0.60	1.20
1st Gear	0.15 ~ 0.30	0.80
2nd Gear	0.15 ~ 0.30	0.80
3rd Gear	0.15 ~ 0.30	0.80
4th Gear	0.15 ~ 0.30	0.80
6th Gear	0.175 ~ 0.475	1.80
Flank Clearance for Blocks on Shift Bar Housing		
Rev and 1st /2nd	1.2 ~ 5.0	5.1
1st/2nd and 3rd /4th	0.9 ~ 3.3	3.4
3rd/4th and 5th/6th	1.7 ~ 4.5	4.6
Other Clearance		
Spare Travel for Synchronizer (2nd to 6th)	1.8 ~ 2.35	Min0.2

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Ⅴ-3. Fastening Torque

No.	Position	Tightening Torque
1	Main shaft lock nut	588~784
2	Clutch housing bolt	245~323.4
3	Drainage plug	100~120
4	Counter shaft rear cover bolt	70~80
5	Input shaft cover bolt	70~80
6	Rear cover bolt	70~80
7	Shift bar housing bolt	37~49
8	Control tower bolt	37~49
9	Releasing fork screw	24~37
10	Air plug fastener	26.5~31.4
11	Rev light switch fastener	26.5~31.4
12	PTO plate lock bolt	19.6~31.4
13	Idle gear plate lock bolt	16~30
14	Idle gear lock pin bolt	18.6~25.5
15	Sleeve screw	8~10.5

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Ⅵ. Failure Diagnosis & Reason Analysis

Ⅵ-1. Failure Diagnosis

Ⅵ-1-1. Initial Check

1.Visual check: look for the damage evidence, especially key components, eg. installation points.

2.Ask the drivers or owners to get related information, eg. working condition and failures history

3.Build the records, including maintenance and lubricating cycles; the presented failures; mileage and time

Ⅵ-1-2. Transmission Tear Down Check

1.Keep the oil sample for checking the impurity content when necessary.

2.During dissembling the transmission, check if the components were 3.assembled correctly or not, if there is any leakage or any low quality components

4.Wash each component carefully.

5.Check each component carefully.

Ⅵ-1-3. Define Failure Type

Ⅵ-1-4. Define Failure Cause and Troubleshooting

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Ⅵ-2. Transmission Common Failures and Troubleshooting

Failures	Cause	Troubleshooting
High noise	Lack of lubricant oil	Refill the oil
	Viscosity of the lubricant is low	Replace the lubricant
	Wear of bearings or gears	Replace the worn parts
Abnormal sound	Bearing burnt or damage	Replace
	. Gear damage or break	Replace
	Release bearing and PTO damage	Replace
	Parts in manual brake or clutch damage	Replace
Hard shifting	Incomplete disengagement of the clutch	Adjust
	Improper adjustment of the driving mechanism	Adjust
	Synchro block drop	Set in
	Synchro ring and cone wear	Replace
Jump out	Sliding sleeve and connecting plate wear	Replace
	Big radial clearance caused by needle bearing wear	Replace
	Big axial clearance caused by gear wear	Replace
	Improper adjustment of the driving mechanism	Adjust
	Self-lock system failure	Replace
	Fork wear	Replace or welding
	Strengthened parts of fork interference	Grind
Disordered	Interlock system failure	Replace
	Rod end wear	Replace or welding
	Shifting block wear	Replace or welding
	Flexible pin drop, damage	Replace
	Shift bar break or shift bar housing damage	Replace

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Oil Leakage	Air plug jammed or damage	Replace
	Fastener loose	Re-fasten
	Shim damage or sealing glue not evenly applied	Replace or re-apply the glue
	Oil seal wear or damage	Replace
	Too much lubricant oil	Reduce oil quantity

Ⅵ-3. Attention Points for Disassembling

1. In this manual, the directions is defined in this way: the output end of the transmission as “back” and the input end as “front”; “left” and “right” is seen from output end (back) to the front of the transmission.
2. Before the transmission dissembled from the vehicle, make sure that the vehicle parked at the flat and safe place, and shifted to the neutral position, flame out and switch off and the wheels blocked.
3. Before tearing down the transmission, make sure that the case of the transmission completely cleaned.
4. The disassembly should be done under a clean environment to avoid the dust or other impurities to contaminate the internal of the transmission, which might cause the further wear and bearing damage.
5. The dedicated tools should be used during disassembling, the removed bearings should be washed carefully.
6. When disassembling the sub-assembly, the components should be placed on a clean work table in sequence to avoid any loss of the components and be convenient for the re-assembling.
7. The circlip clamp should be used when disassembling the circlips.
8. Take care of the force applying to the shaft or cases during the disassembling. Please do not over-forced to avoid the damage of components. It should be noted that some components are not allowed to be disassembled and any force is not allowed to apply to the driven parts which are running.

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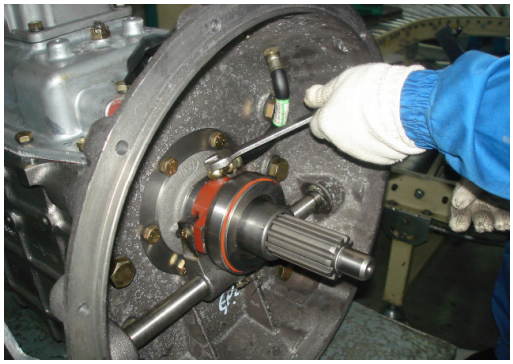
Ⅵ-4. Disassembling Transmission

1. Screw off the drainage plug located at the bottom of the transmission, and drain the lubricant in the transmission completely (Draining should be done when the oil is warm.)
2. Remove PTO connecting shaft, and then remove the drive shaft assembly and middle support.
3. Take the odometer cable apart from the transmission.
4. Take the transmission control system apart.
5. Disassemble the clutch booster (fix it on the frame temporarily).
6. Remove the wires and hoses connecting on the transmission.
7. Hang the transmission by steel wire rope, or put a jack below the transmission to support it.
8. Disassemble the bolt for connecting clutch housing and fly wheel house.
9. Take the transmission away from the vehicle using jack or steel wire rope.

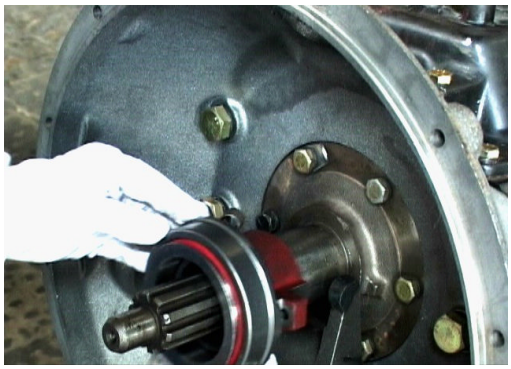
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Ⅶ. CA6T138 Transmission Disassembling and Assembling

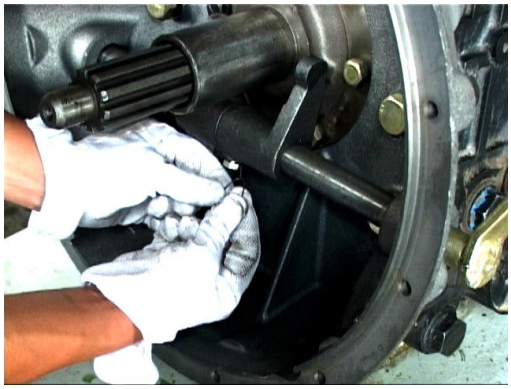
（Ⅰ）Transmission Disassembling



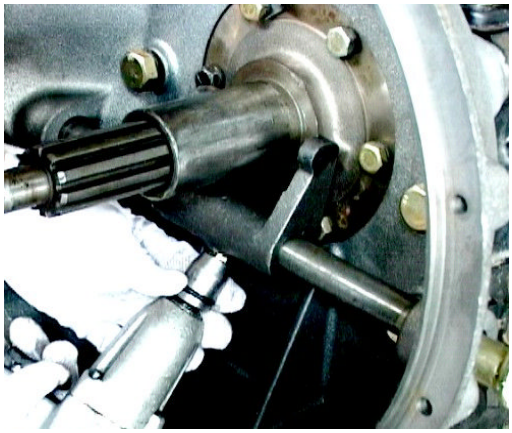
1. Remove release bearing oil fill pipe



2. Remove release bearing

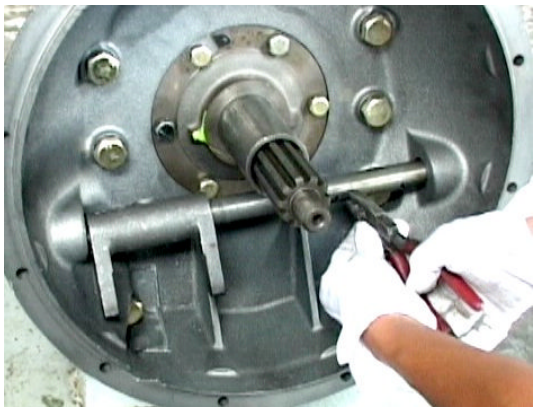


3. Untie release fork wire

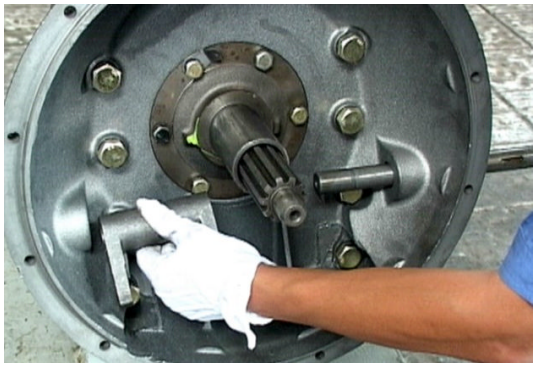


4. Screw down release fork screw

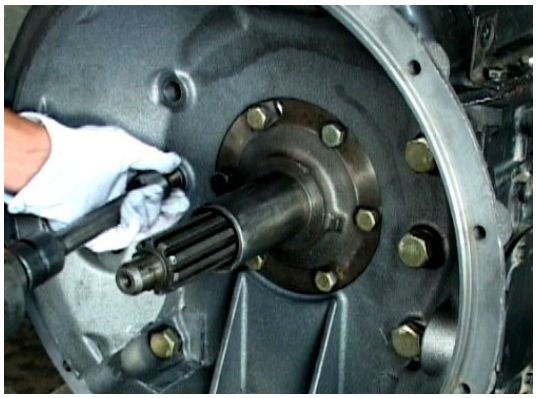
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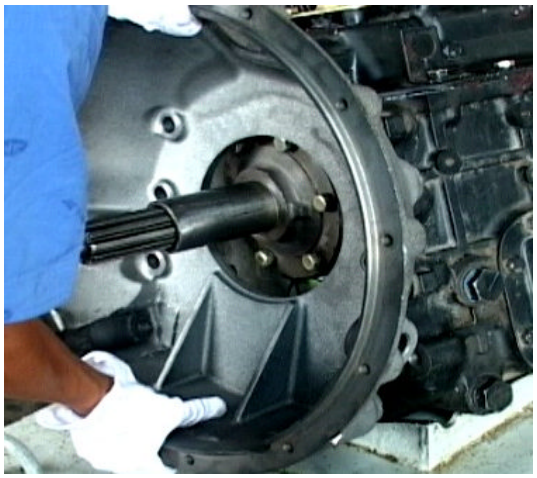
5. Remove release fork positioning spline



6. Remove release fork and release fork thrust arm assy



7. Take the clutch housing screw apart



8. Remove clutch housing

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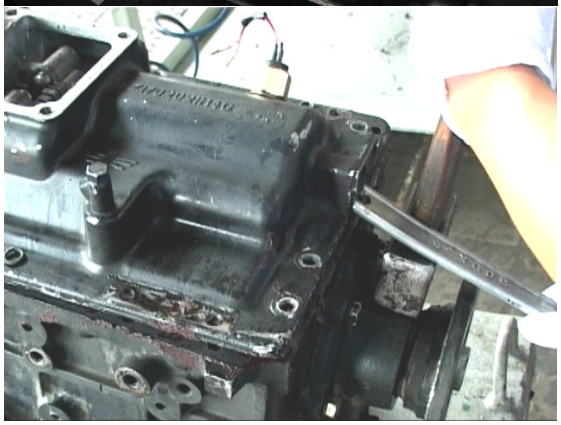
9. Remove control tower screw



10. Remove control tower assy

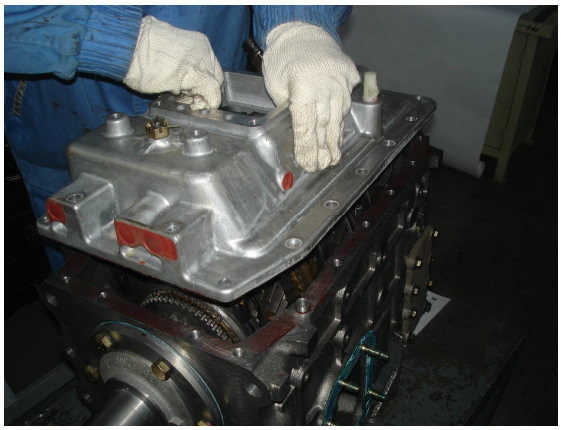


11. Remove shift bar housing screw

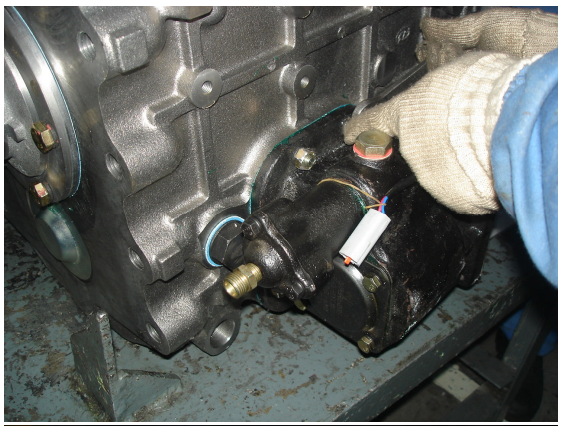


12. Prize up shift bar housing ass'y

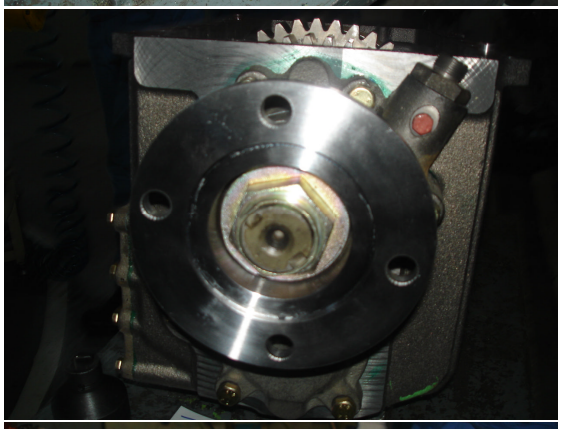
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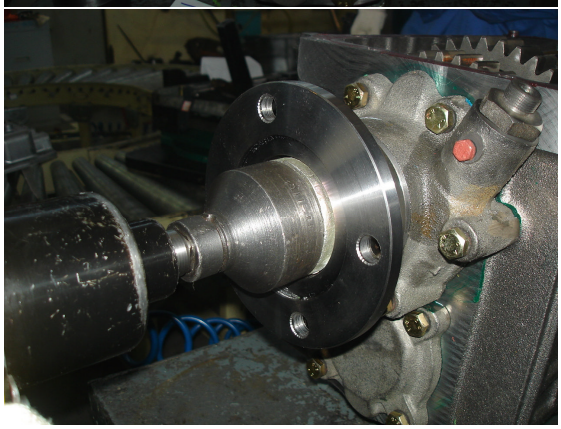
3. Remove shift bar housing ass'y



14. Remove PTO



15. Unlock the riveting point of main shaft lock nut to make it flat

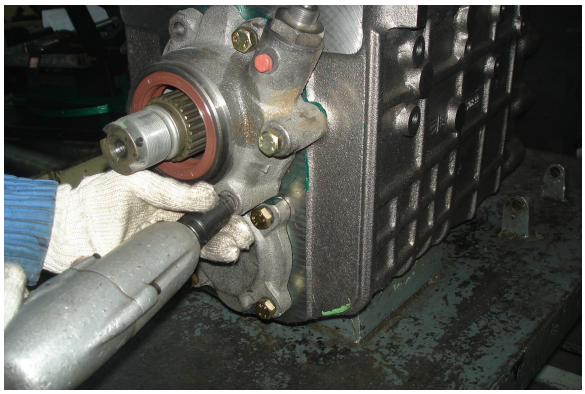


16 Remove main shaft lock nut

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17. Remove flange ass'y



18. Loosen rear cover screw

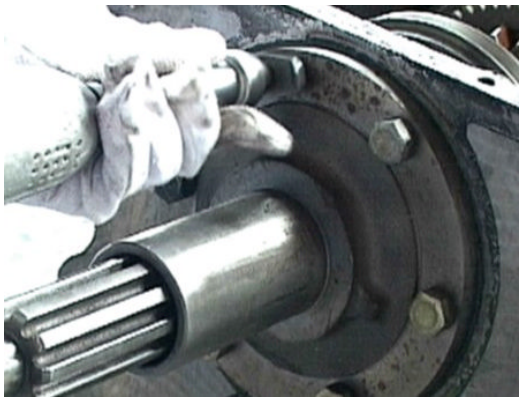


19. Knock it down by bronze stick and remove rear cover ass'y

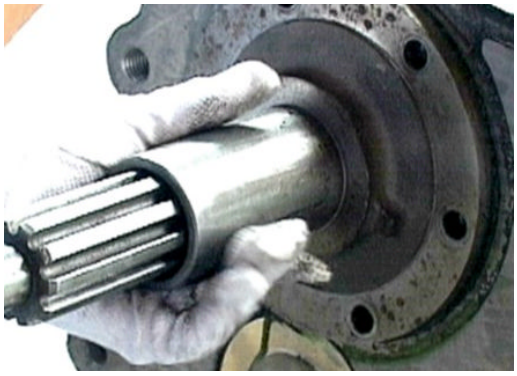


20. Remove speedometer worm

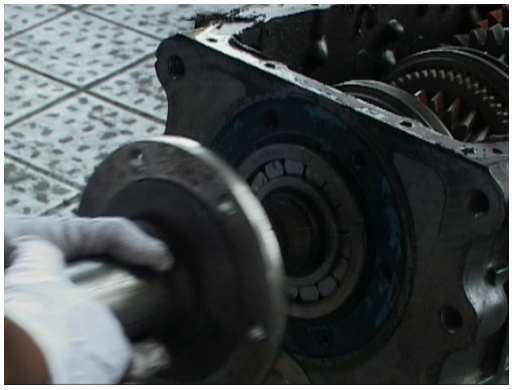
https://truckmanualshub.com/



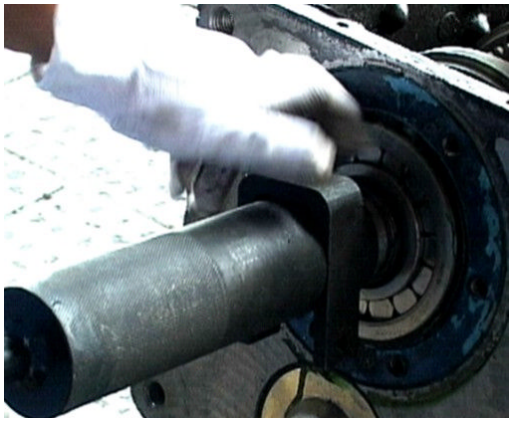
21. Loosen input shaft cover screw



22. Knock down input shaft cover ass'y



23. Remove input shaft ass'y

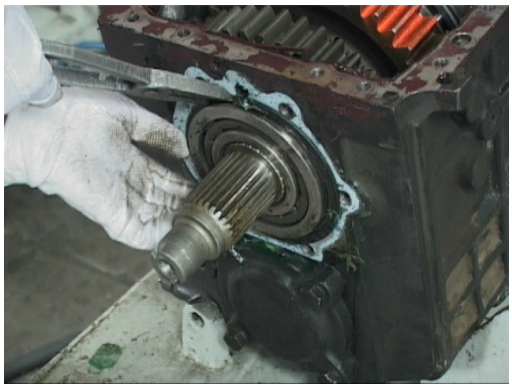


24. Install input shaft puller on input shaft ass'y

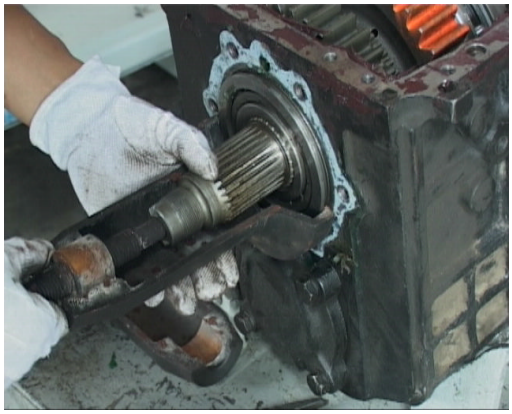
https://truckmanualshub.com/



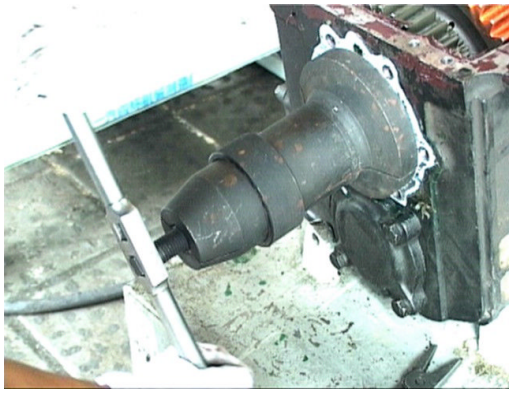
25. Pull input shaft ass'y out



26. Remove main shaft rear bearing circlip



27. Install main shaft rear bearing puller on bearing circlip

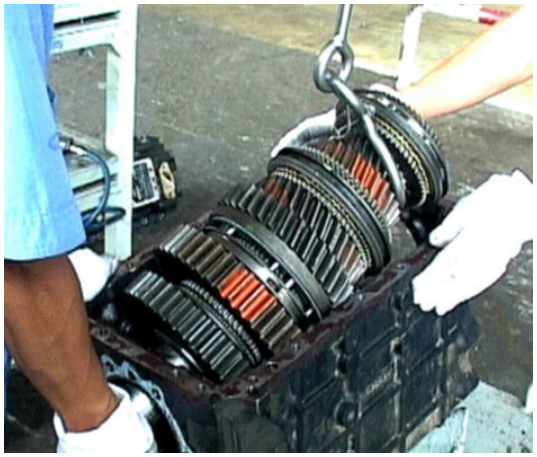


28. Pull out main shaft rear bearing by rotating puller screw

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29. Screw main shaft screw cap onto main shaft



30. Lift main shaft out



31. Remove counter shaft rear cover screw

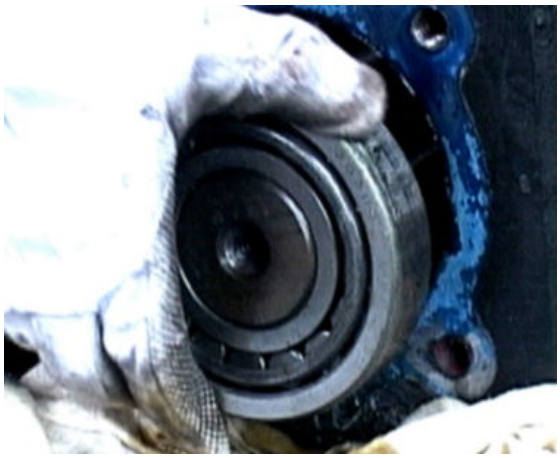


32. Knock down counter shaft rear cover

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33. Remove counter shaft rear cover



34. Remove counter shaft rear bearing outer ring



35. Remove idle gear shaft lock pin screw and lock pin

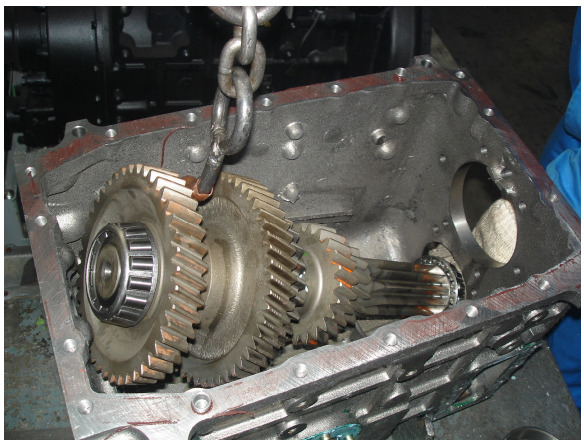


36. Remove idle gear shaft

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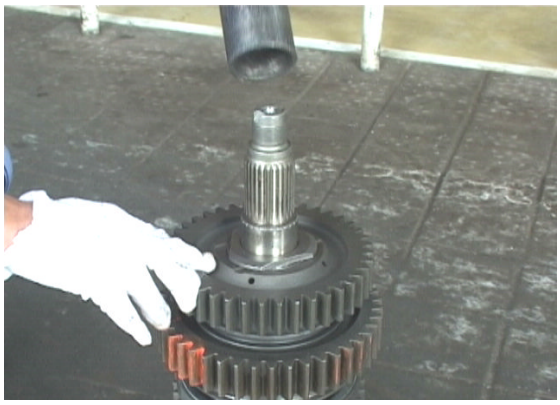
37. Remove idle gear



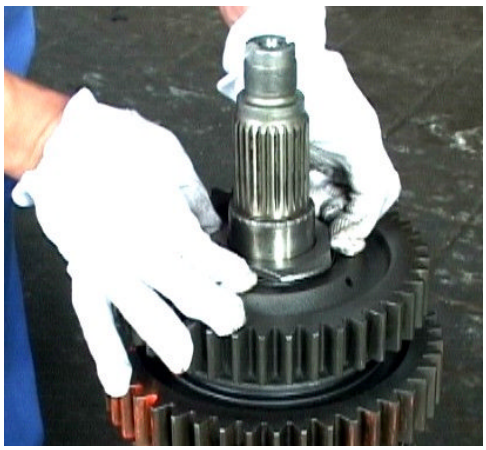
38. Lift out counter shaft ass'y

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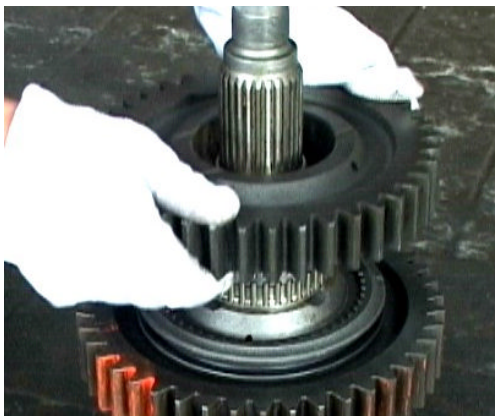
（Ⅱ） Disassembling Main shaft



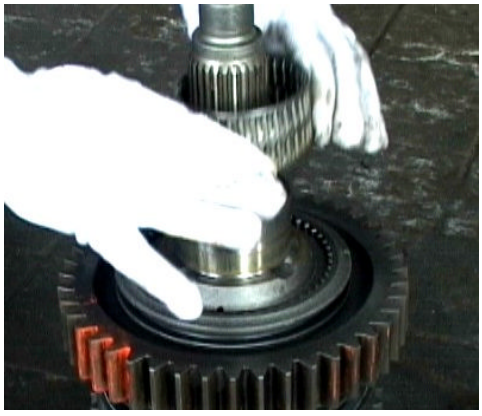
1. Remove M/S screw cap



2. Remove reverse speed thrust pad



3. Remove reverse gear

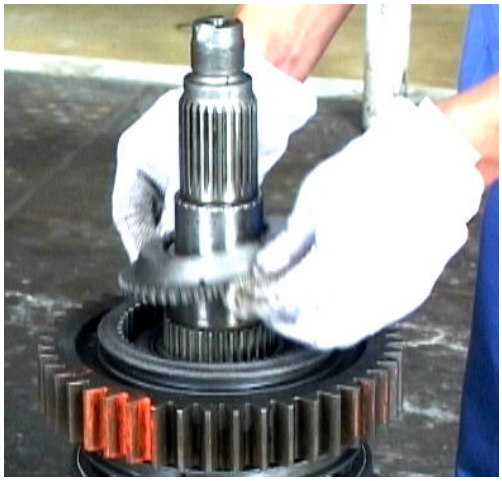


4. Remove reverse needle bearing

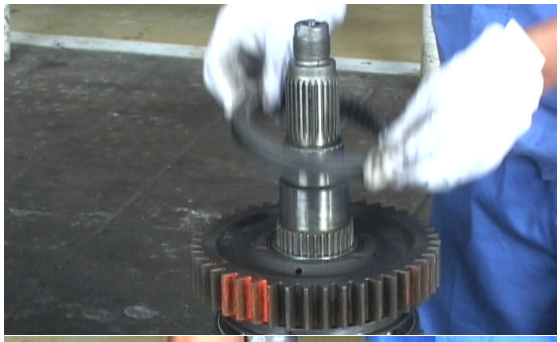
https://truckmanualshub.com/



5. Pull out reverse gear bush by using puller



6. Remove reverse hub



7. Remove reverse sliding sleeve



8. Remover 1st gear

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9. Remove 1st gear needle bearing



10. Pull out 1st gear bush by using puller



11. Remove 1st gear bush

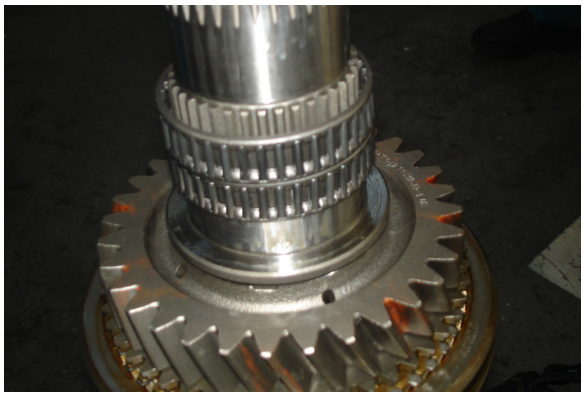


12. Remove 2nd synchro hub

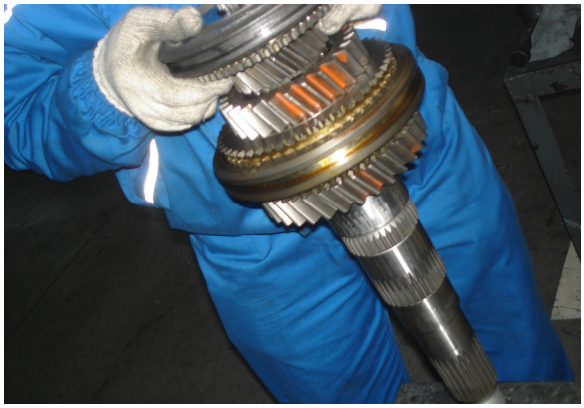
https://truckmanualshub.com/



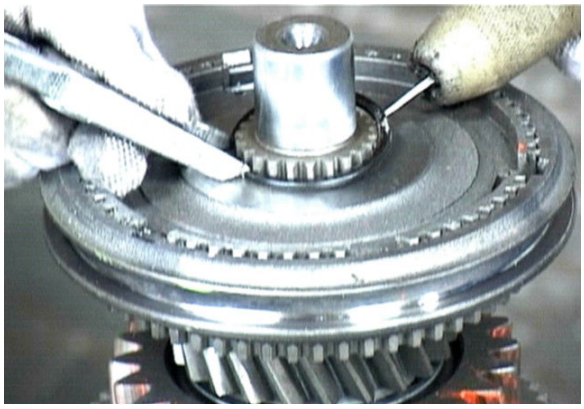
13. Remove 2nd gear



14. Remove 2nd gear needle bearing

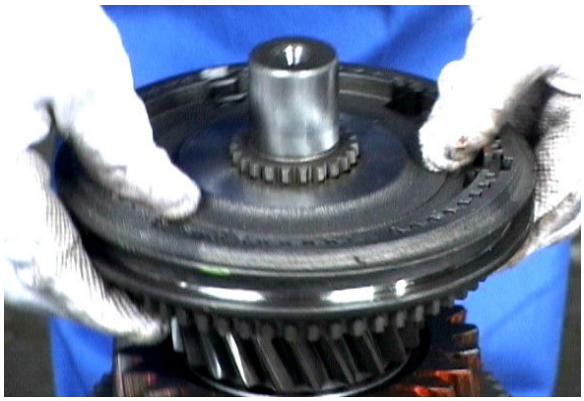


15. Turn the rest parts with the angle of 180°

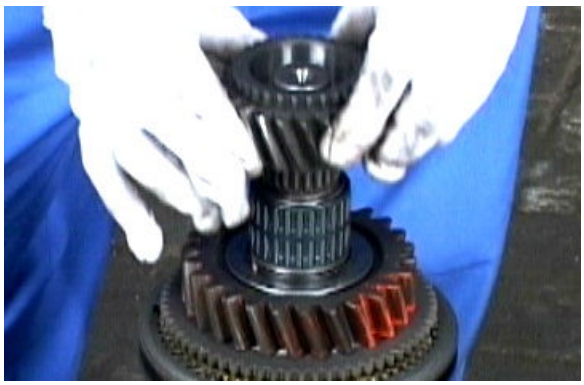


16. Remove 5/6 synchro hub circlip

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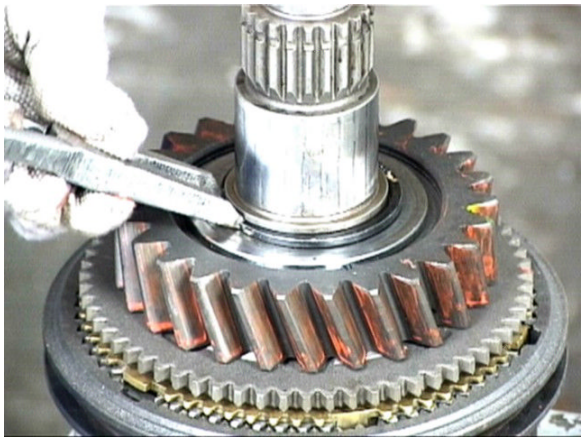
17. Remove 5/6 synchro hub



18. Remove 6th gear



19. Remove 6th gear needle bearing

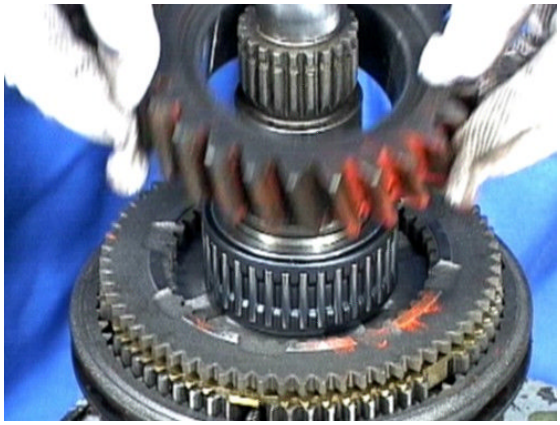


20. Remove 4th gear bush circlip

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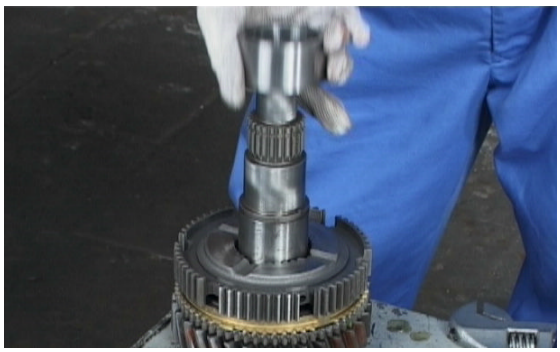
21. Remove 4th gear bush retainer



22. Remove 4th gear



23. Remove 4th gear needle bearing



24. Remove 4th gear bush

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25. Remove 3/4 synchro hub



26. Remove 3rd synchro ring



27. Remove 3rd synchro cone



28. Remove 3rd gear

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29. Remove 3rd needle bearing



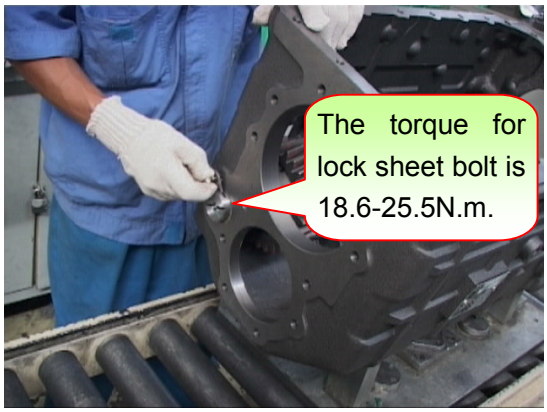
30. Complete M/S disassembling

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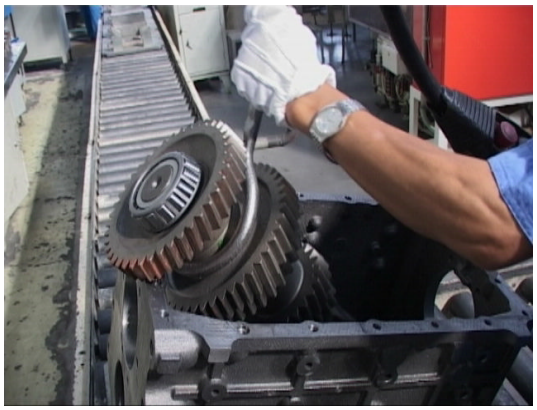
（Ⅲ）Transmission Assembling



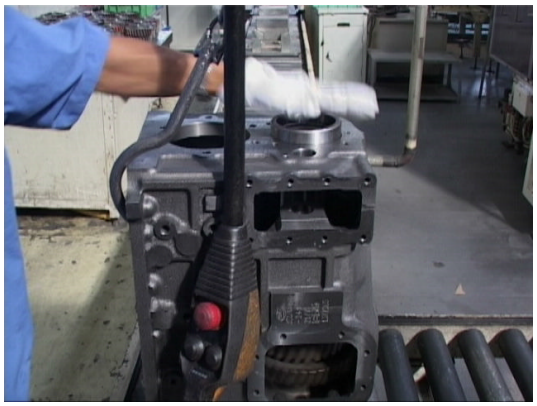
1. Assemble idle gear, idle gear shaft and idle gear needle bearing



2. Assemble idle gear shaft lock pin and screw

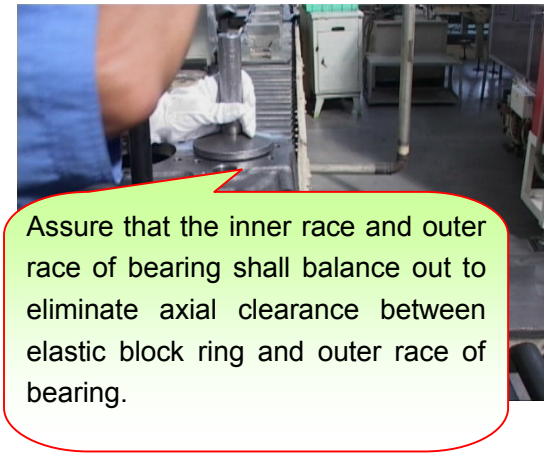


3. Install counter shaft ass'y

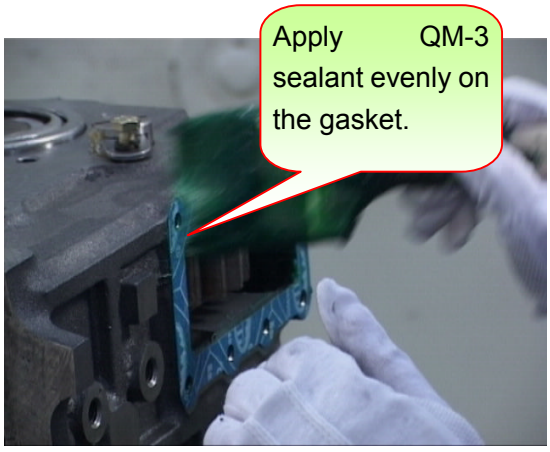


4. Put counter shaft rear bearing outer ring flatly onto rear bearing hole

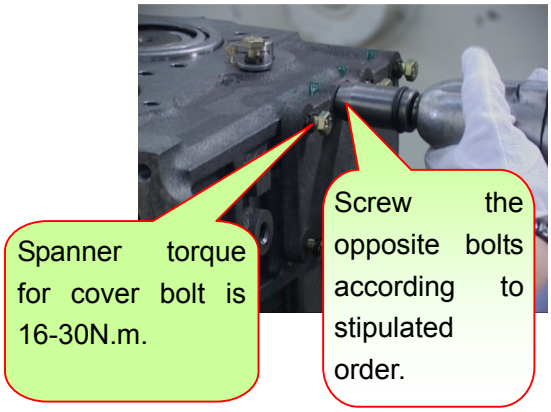
https://truckmanualshub.com/



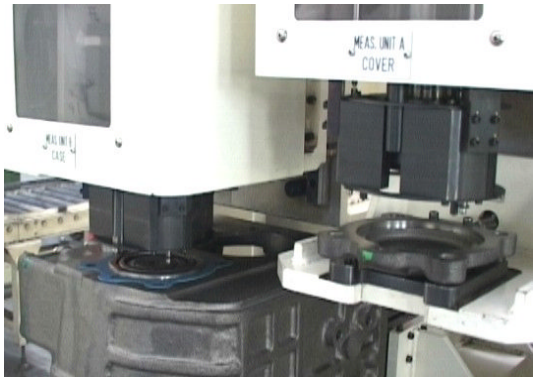
5. Install bearing outer ring into case using core shaft



6. Gelatinize idle gear cover plate evenly

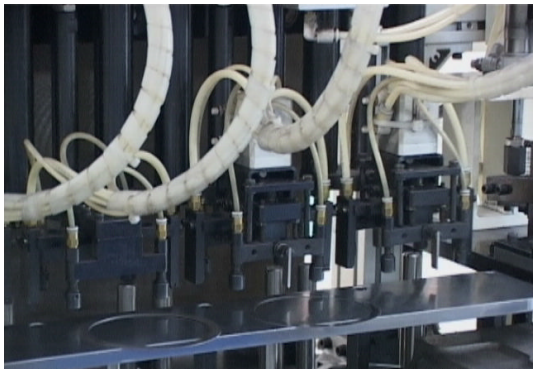


7. Install idle gear cover plate

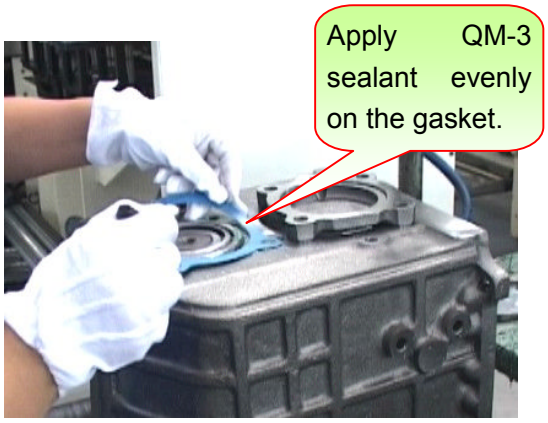


8. Measure the clearance between counter shaft rear cover plate and bearing outer ring

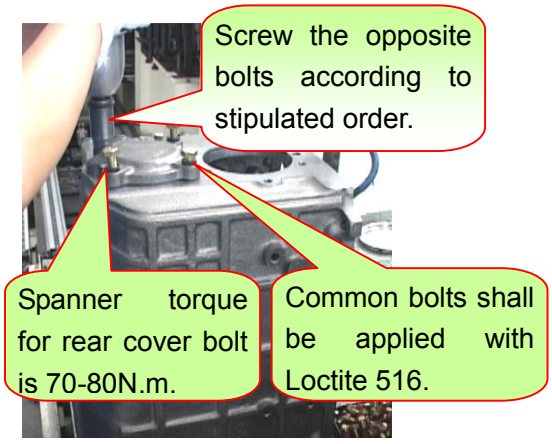
https://truckmanualshub.com/



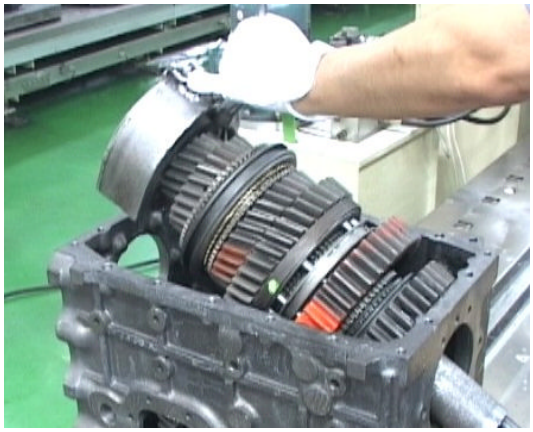
9. Choose adjusting shim between C/S rear cover plate and bearing outer ring



10. Install counter shaft rear bearing cover shim

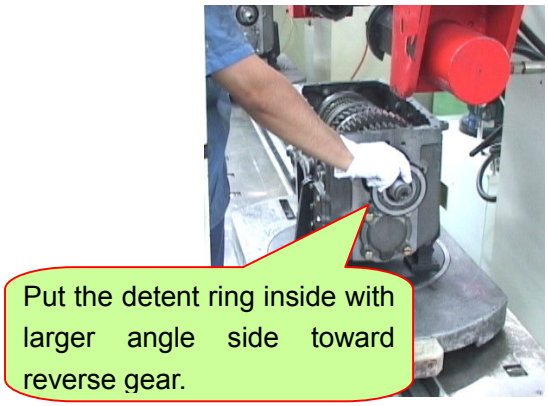


11. Install adjusting shim and counter shaft rear cover

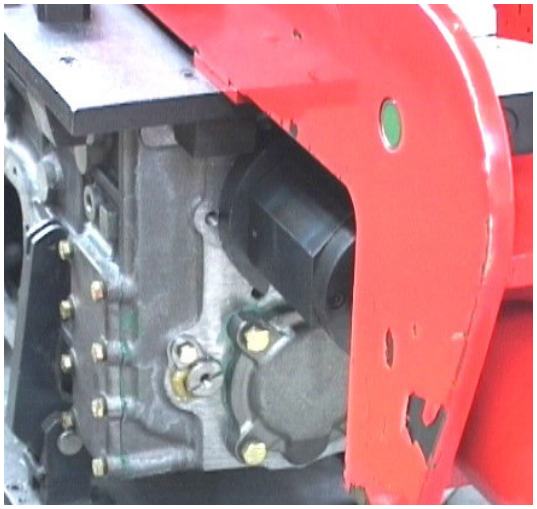


12. Assemble main shaft ass'y

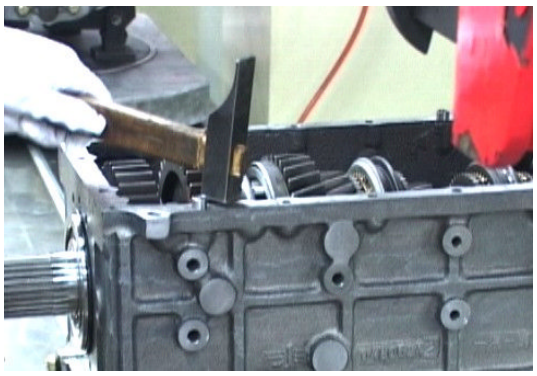
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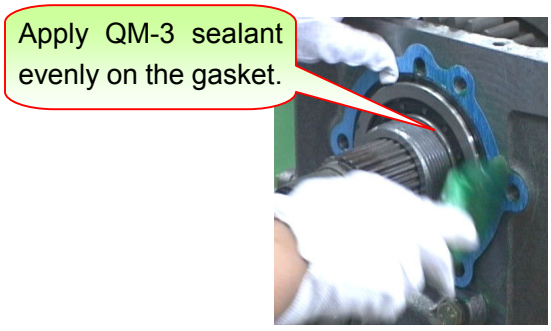
13. Put main shaft rear bearing on main shaft



14. Press rear bearing by bearing press machine



15. Install shift bar housing positioning ring

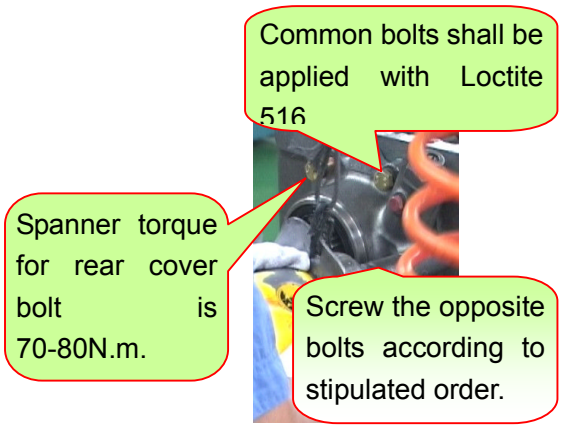


16. Install speedometer worm and rear bearing shim

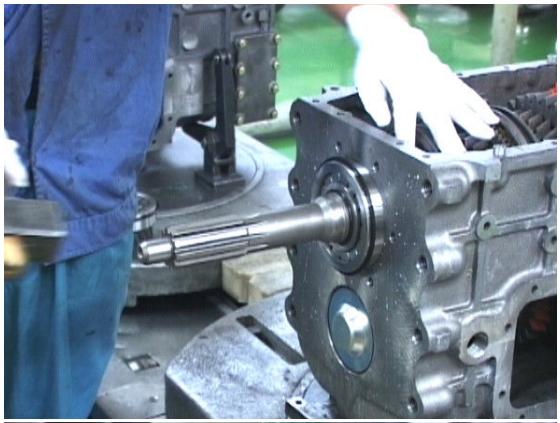
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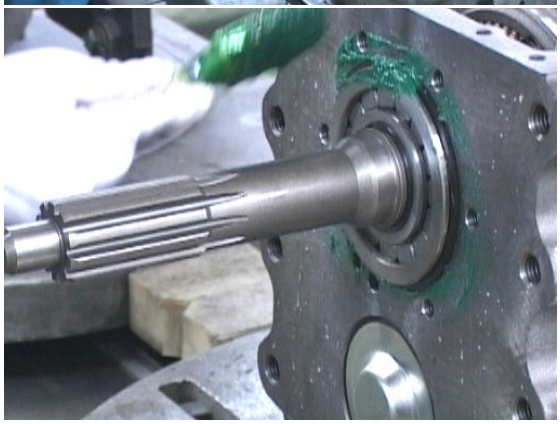
17. Install rear bearing cover and screw to the 2-3 thread



18. Tighten rear cover screw

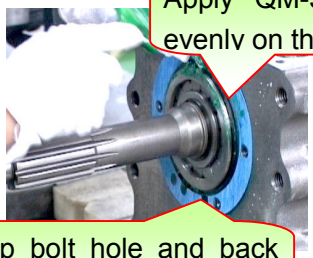


19. Install input shaft ass'y

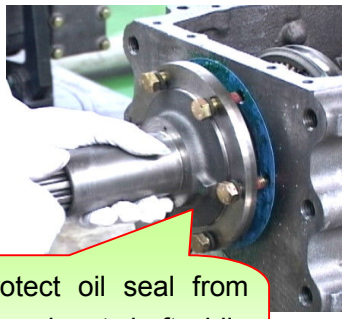


20. Put glue on the place installing input shaft cover

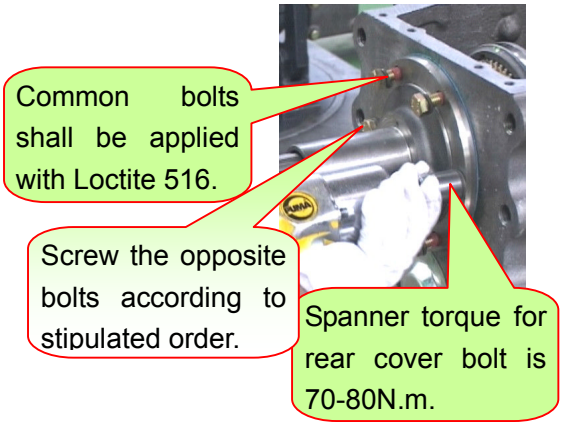
https://truckmanualshub.com/



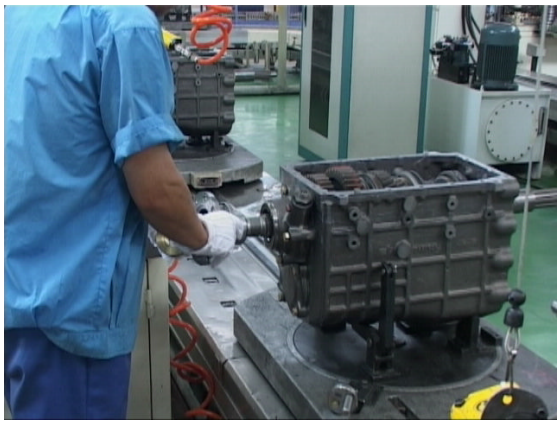
21. Install input shaft shim and put glue on the surface



22. Install input shaft cover plate and screw to 2-3 thread

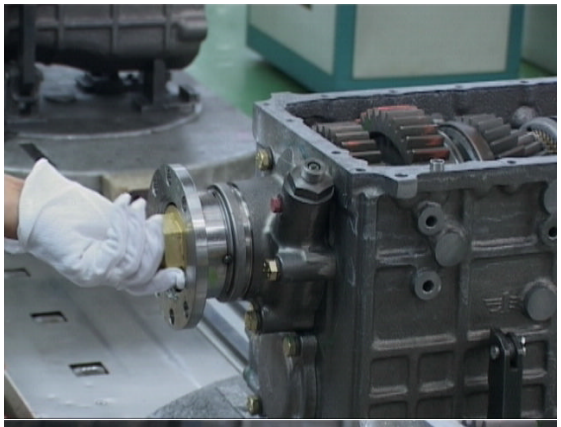


23. Fasten screw

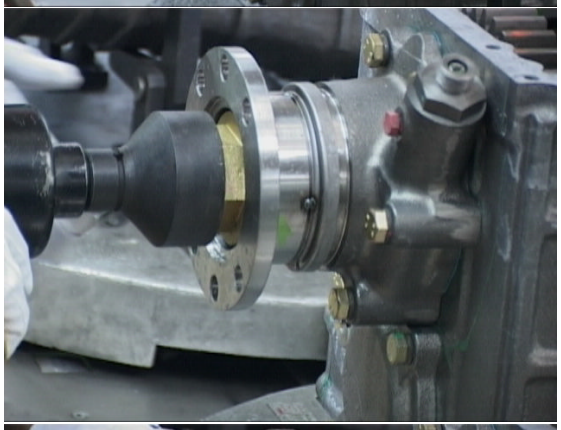


24. Install flange

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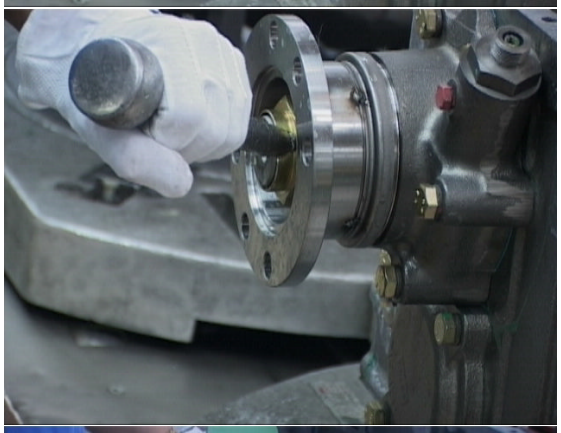
25. Screw main shaft lock nut to 2-3 thread



26. Tighten main shaft lock nut

The spanner torque for locknut is 588-784N.m.

Get two speeds when screw, lest mainshaft moves



27. Tighten main shaft lock nut by riveting

Rivet the locknuts along rivet groove after the locknut been tightly screwed. Depth of rivet is no less than 1.5 mm



28. Install PTO cover plate paper tray and put glue on both sides

Apply QM-3 sealant evenly on the gasket.

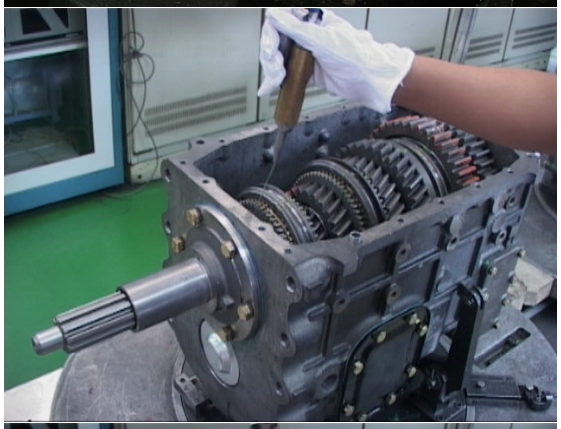
https://truckmanualshub.com/



29. Install Double head bolt – for PTO



30. Install PTO and Nut, Fasten Nut

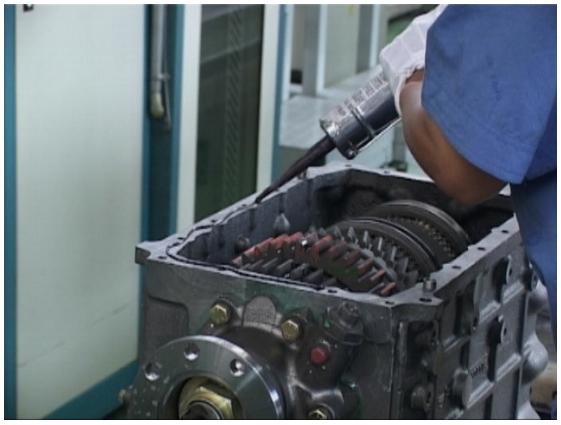


31. Pre-fill lubricant for main shaft needle bearing



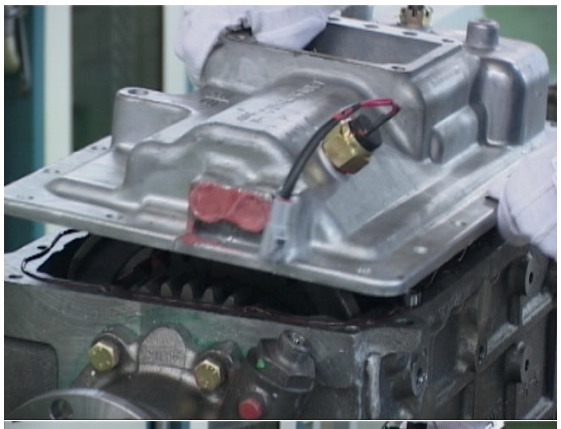
32. Check gear clearance and bearing clearance for main shaft

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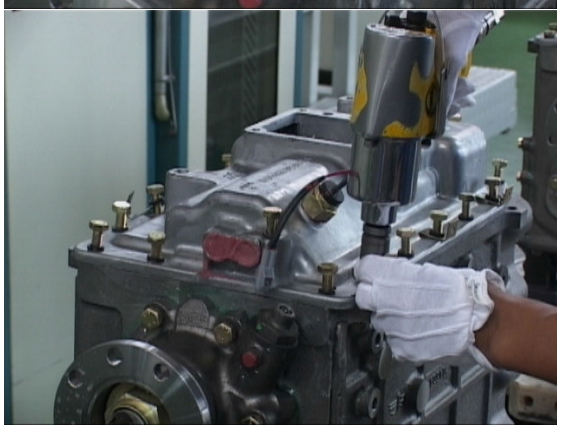


33. Put glue on the connecting surface between case and shift bar housing

Assure that squeezed sealant take the shape of Φ2-Φ4mm bar without stop, in the middle of the surface, inside of the hole position, do not drop in the case.



34. Assemble Shift bar housing ass'y



35. Fasten the screw for fixing shift bar housing and then tighten the SBH

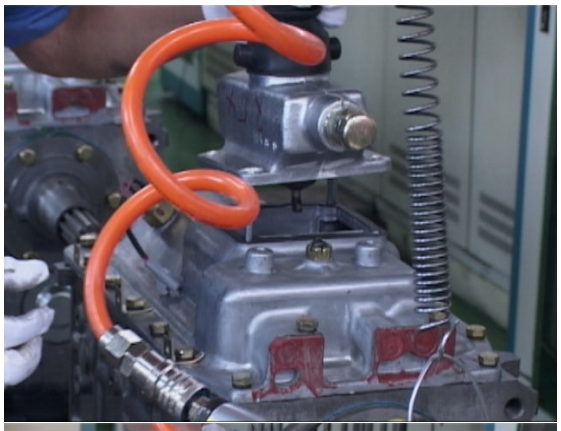
The spanner torque for top cover bolt is 37-49N.m.

Assure the clearance between shifting block within requirement.

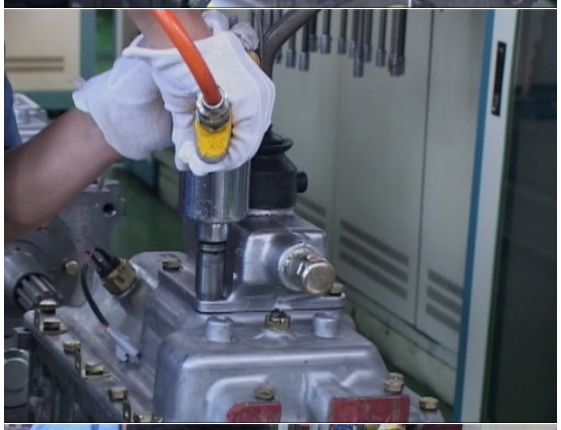


36. Install control tower shim

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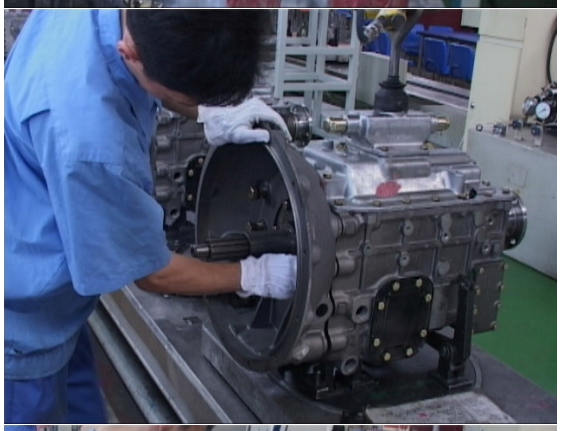


37. Assemble control tower ass'y

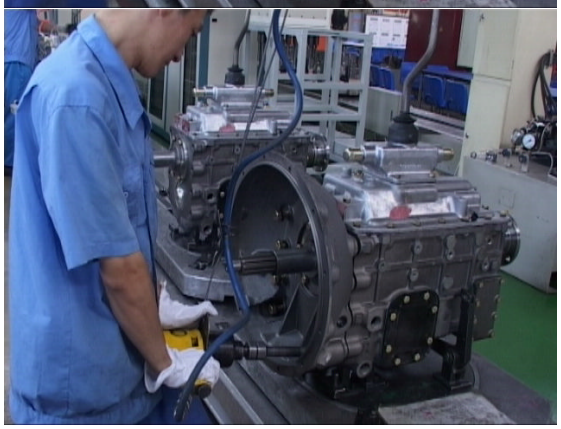


38. Fasten control tower screw

The spanner torque for top tower bolt is 37-49N.m



39. Assemble clutch housing



40. Install clutch housing screw，Fasten the screw

The spanner torque for PTO case bolt is 245-323N.m.

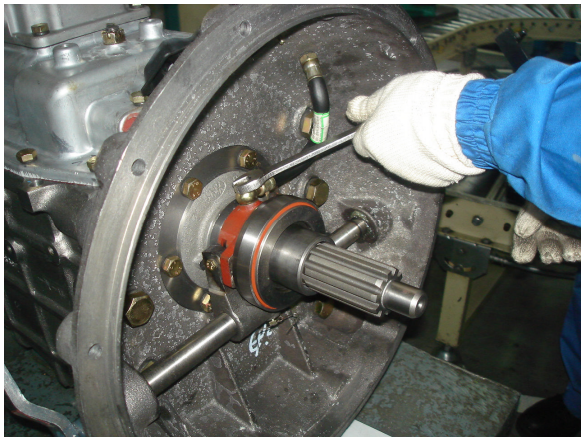
https://truckmanualshub.com/



41. Assemble release fork and thrust arm ass'y

Assemble lockable bolt and steel wire

The spanner torque for bolt is 24-37N.m.



42. Assemble release bearing ass'y

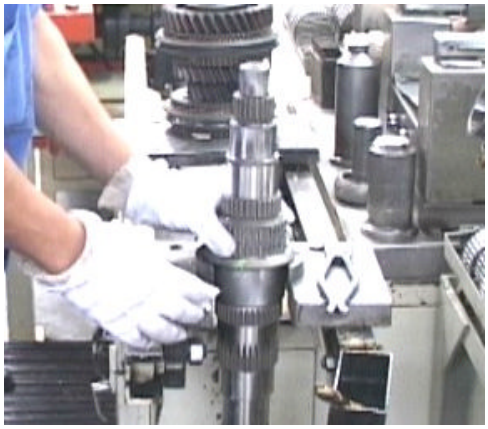
Assure that bearing assembly, release fork and neck of input shaft cover can fit well.

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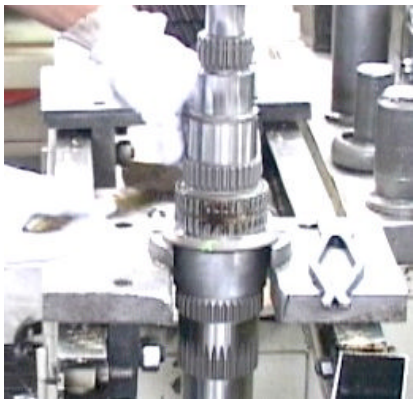
（Ⅳ）Main Shaft Assembling



1. Fix the front end on fixture



2. Assemble 3rd gear needle bearing



3. Coat lubricant



4. Install 3rd gear ass’y

Assure gear moves freely.

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5. Install 3rd synchro ring



6. Install 3/4 synchro ass'y

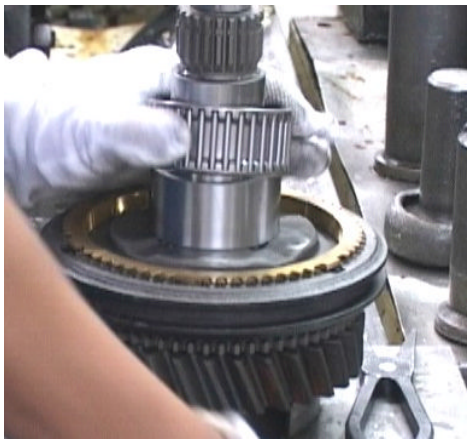


7. Install 4th synchro ring

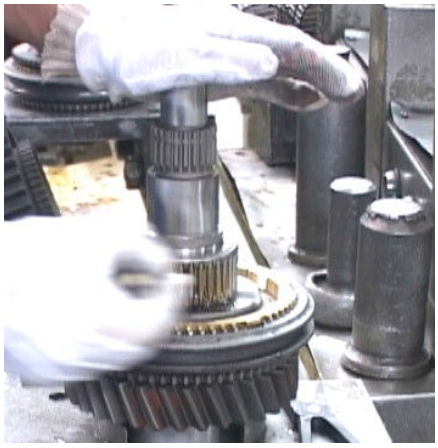


8. Install 4th gear bush

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9. Install 4th gear needle bearing

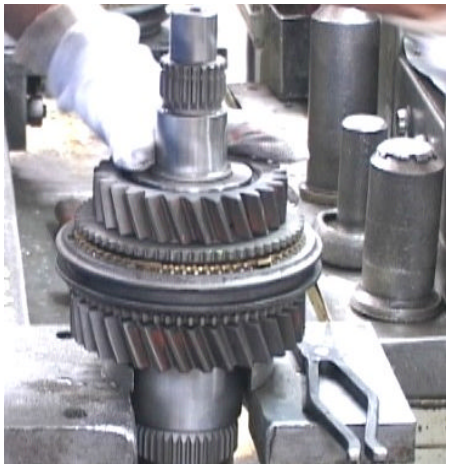


10. Coat lubricant



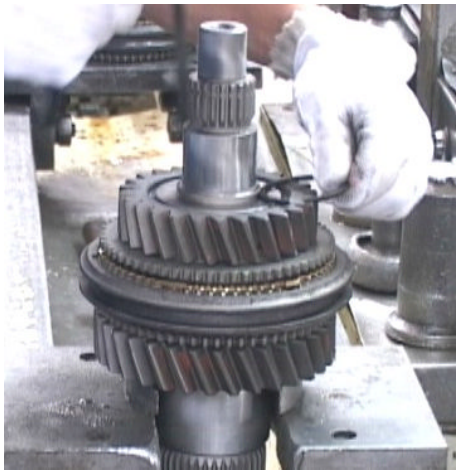
11. Install 4th gear ass'y

Assure gear moves freely.

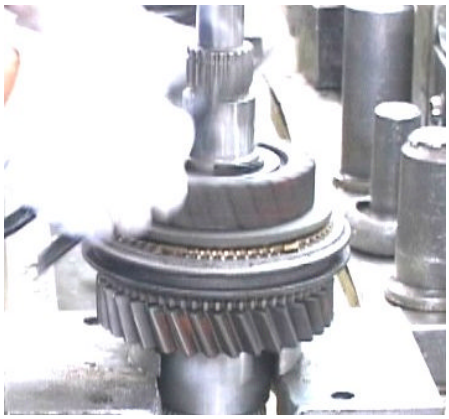


12. Install 4th gear bush retainer

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13. Choose circlip



14. Install the circlip into the slot

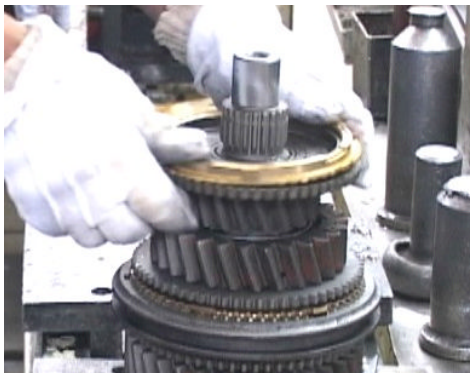


15. Install 6th gear needle bearing



16. Install 6th gear ass'y

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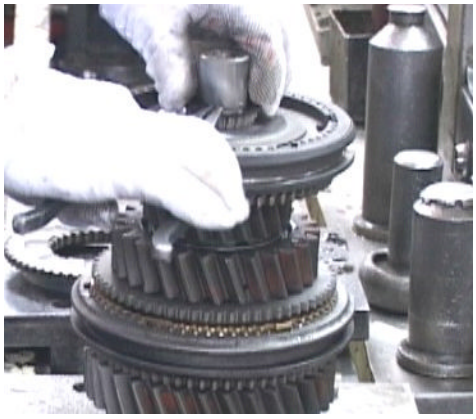
17. Install 6th synchro ring



18. Install 5/6 synchro ass'y



19. Choose circlip



20. Install the circlip into slot

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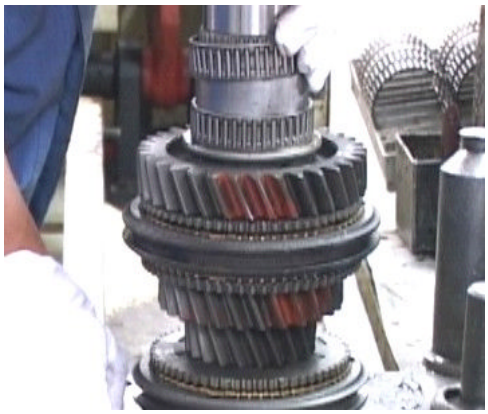
21. Install 5th synchro ring



22. Install 5th synchro cone



23. Turn the semi-finished M/S to the angle of 180°



24. Install 2nd gear needle bearing

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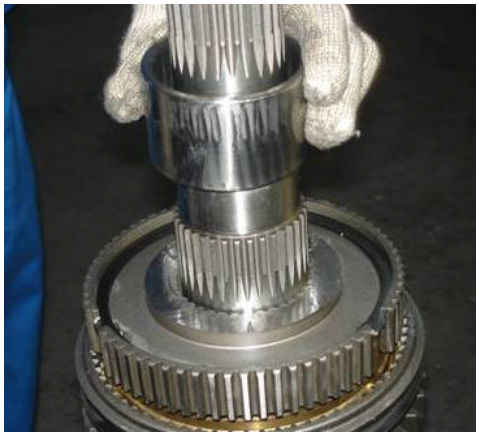
25. Coat lubricant



26. Install 2nd gear ass'y



27. Install 1/2 synchro ass'y



28. Install 1st gear bush

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29. Install 1st gear needle bearing



30. Install 1st gear ass'y



31. Install rev. hub and sleeve



32. Install reverse bush

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33. Install reverse needle bearing



34. Install reverse gear



35. Install reverse gear thrust shim



36. Fasten nut

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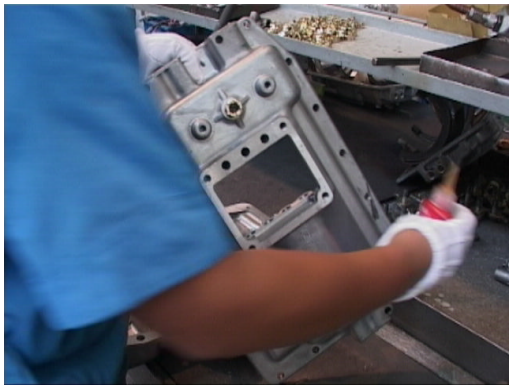
（Ⅴ）SBH Assembling



1. Mark assembly identificaion



2. Install guiding plate and pin bar



3. Coat glue on guiding plat pin bar thread



4. Install guiding plate pin bar screw cap

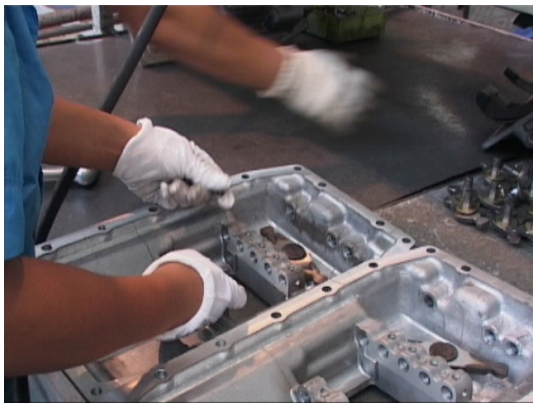
https://truckmanualshub.com/



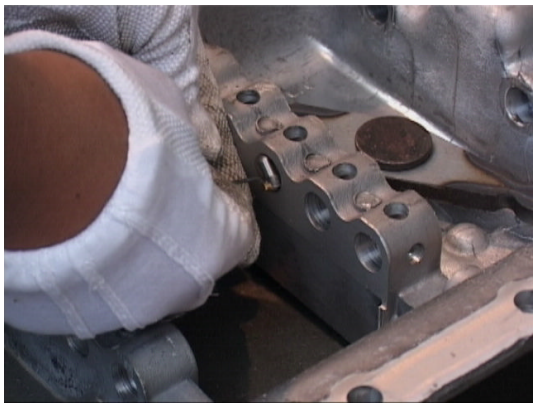
5. Fasten the screw cap



6. Install guiding plate pin bar screw pin



7. Install self lock spring

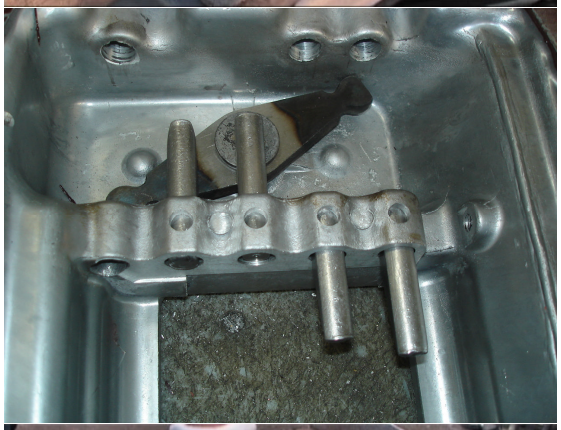


8. Install interlock pad

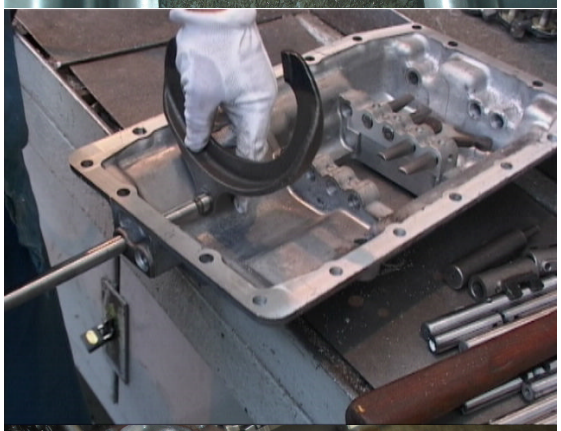
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9. Install interlock steel ball



10. Install wedge-shaped guiding pin

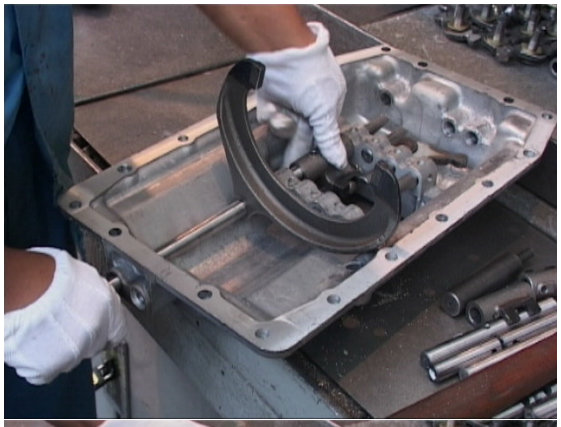


11. Install reverse shift bar

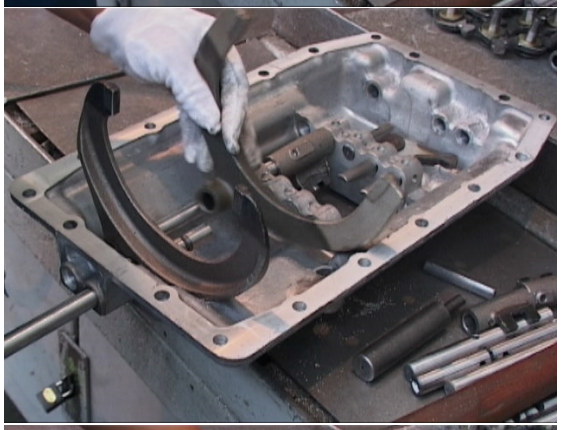


12. Install reverse fork

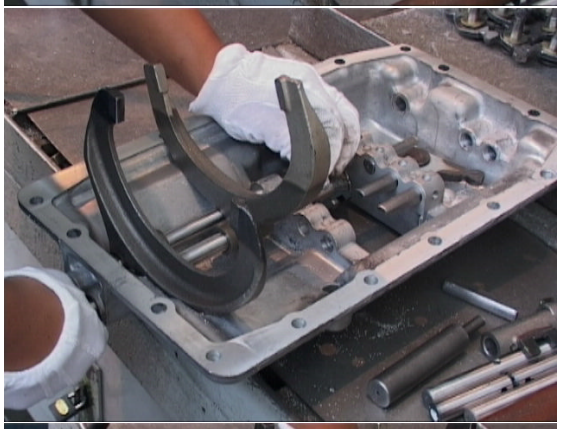
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13. Install reverse block



14. Install 1/2 shift bar and 1/2 fork



15. Install 1/2 shift block

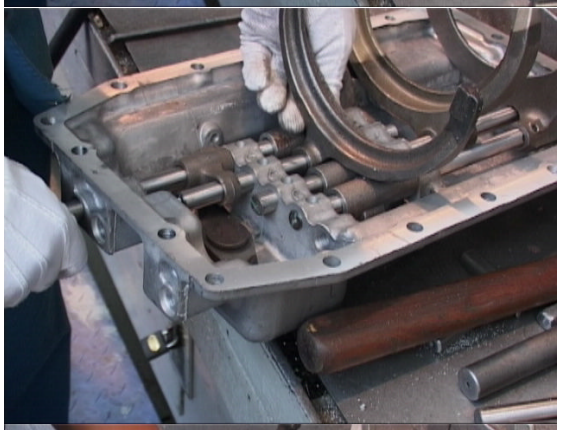


16. Install 1/2 shift bar and 1/2 fork

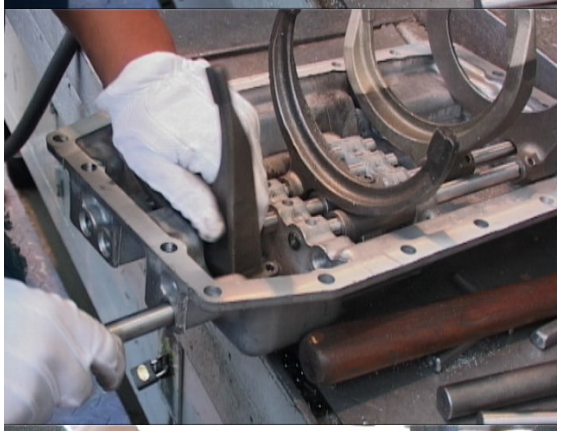
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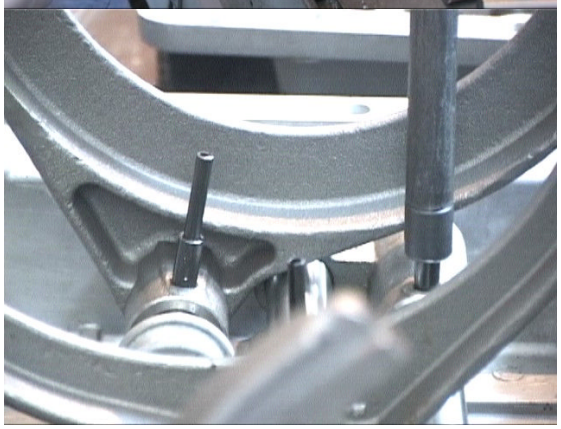
17. Install 3/4 shift bar and 3/4 fork



18. Install 5/6 guiding shift bar, block and guiding block



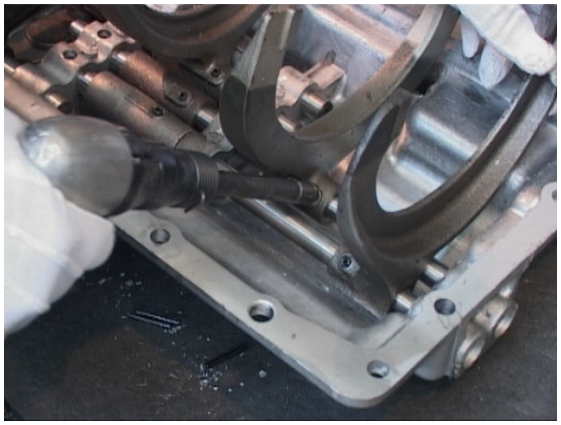
19. Install 5/6 shift bar and 5/6 fork



20. Install flexible pin and swelling pin

The hatch of two dowels is 180°

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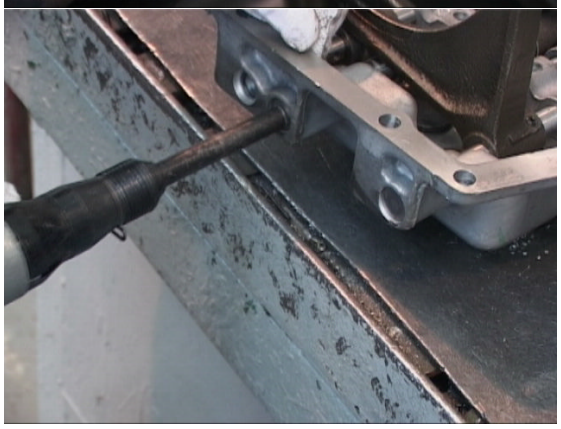
21. Flat the flexible pin and swelling pin



22. Install interlock stopper



23. Press interlock stopper



24. Install shift bar stopper and press it

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25. Coat glue on all stoppers

Apply glue along the circle of filler.



26. Install reverse light switch

Use hand to screw 2-3 rounds, then use spanner to fix it and torque is 26.5-31.4N.m

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Propeller Shaft

General

Disassembly and Assembly of the Propeller Shaft

Disassembly and Reassembly of Universal Joint

Disassembly and Assembly of Center Bearing

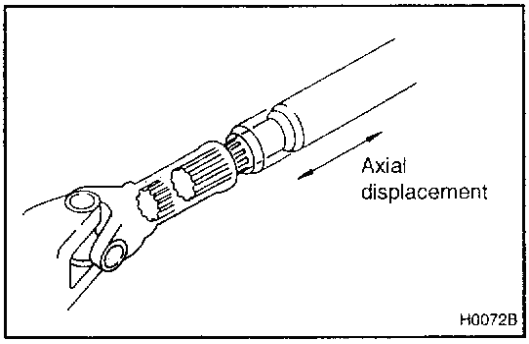
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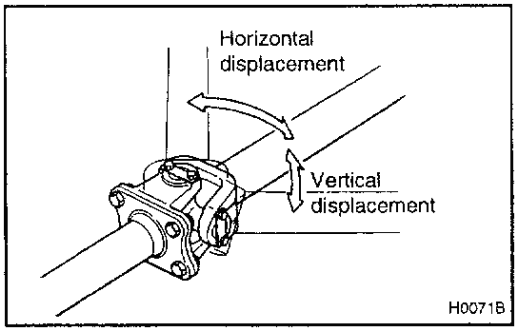
General

The propeller shaft, installed between the transmission and rear axle, transmits the engine power(rotation) changed by the transmission to the final gear of the rear axle.

The propeller shaft consists of two sections: the front and rear propeller shafts. Two or more sections are coupled together depending on the wheelbase. A propeller shaft consisting of two or more sections have a center bearing at the center, supported by the frame.

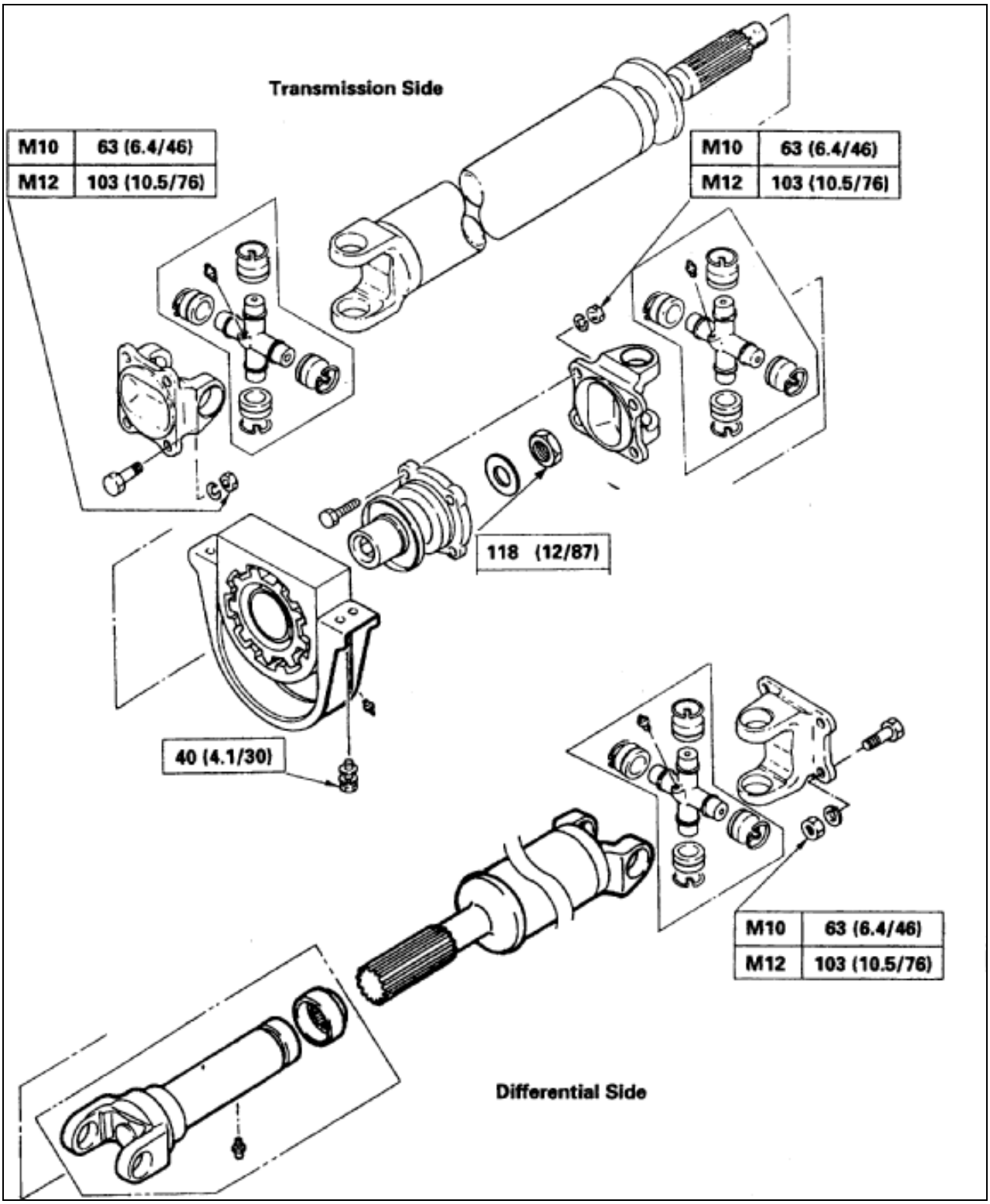
The positional relationship between the transmission and rear axle varies with road surface irregularities, vibration during operation and load changed. To cope with the variations, the propeller shaft has a universal joint and slip joint that absorb such variations.





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Tightening Torques Standard



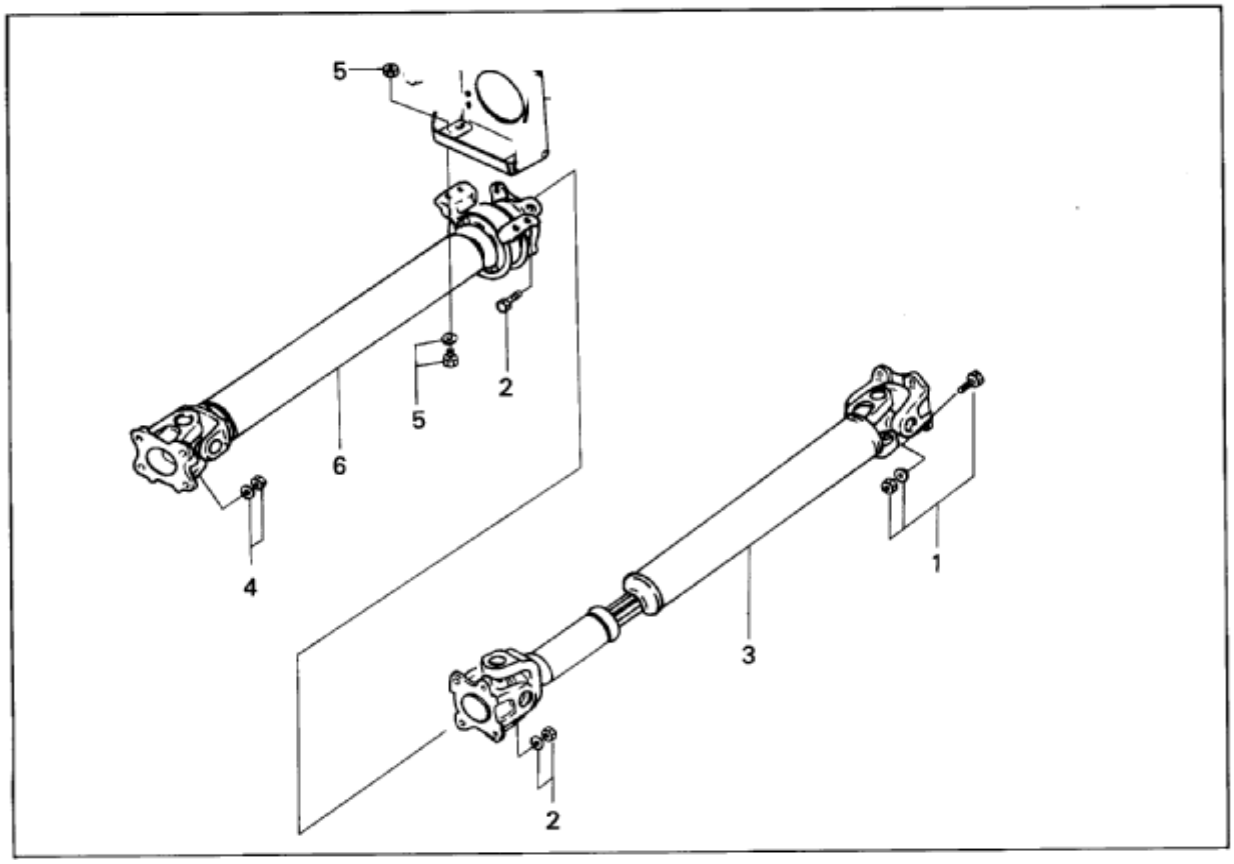
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Troubleshooting

Symptom		Probable cause	Remedy
Propeller shaft vibrates	At high speed	Yoke installed in wrong direction	Realign the match marks
		Worn universal joint needle roller bearing	Replace as a spider kit
		Bent propeller shaft	Replace the propeller shaft
		Propeller shaft out of dynamic balance	Adjust the dynamic balance
		Flange coupling bolts left loose	Retighten to specification
		Seized, worn or binding ball bearing	Replace the ball bearing
	At low speed	Transmission in the high speed range	Shift to the proper gear
		Excessive axial play in the spider of universal joint	Adjust the clearance with snap ring or shim
		Excessive play in the slip joint splines	Replace the yoke sleeve or propeller shaft
Propeller shaft develops unusual noise	When the vehicle is started or coasting	Flange coupling bolts left loose	Retighten to specification
		Center bearing mounting bolts left loose	Retighten to specification
		Center bearing cushion deteriorated or deformed	Replace the cushion
		Worn universal joint needle bearing	Replace as a spider kit
		Excessive play in the slip joint splines	Replace the yoke sleeve or propeller shaft
	At cruising speeds	Excessive axial play in the spider of universal joint	Adjust the clearance with snap ring or shim
		Worn universal joint needle roller bearing	Replace as a spider kit
		Seized, worn or binding ball bearing	Replace the ball bearing
		Bearing and splines improperly lubricated	Lubricate

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Disassembly and Assembly of the Propeller Shaft

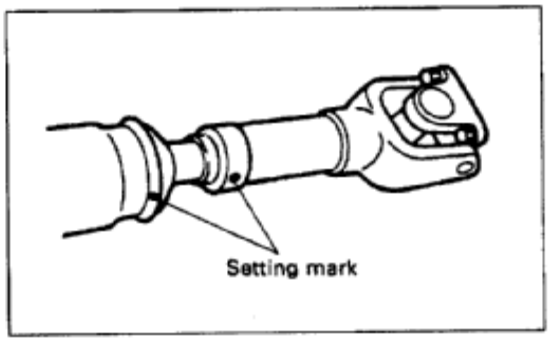


Disassembly procedure：

1. Bolt, nut and spring washer(near differential)
2. Bolt, nut and spring washer
3. Rear propeller shaft
4. Nut and spring washer(near transmission)
5. Bolt, nut and spring washer
6. Middle propeller shaft

Assembly procedure:

6. Middle propeller shaft
4. Nut and spring washer(near transmission)
5. Bolt, nut and spring washer
3. Rear propeller shaft
1. Bolt, nut and spring washer(near differential)
2. Bolt, nut and spring washer

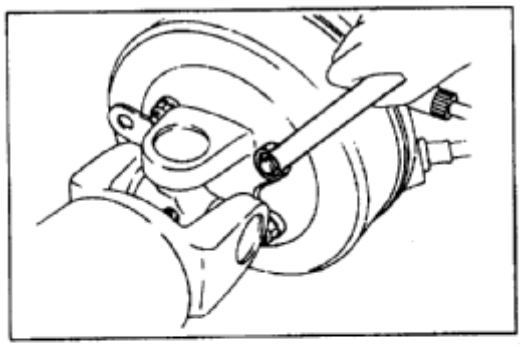


Disassembly preparation:

Align matching marks put at time of disassembly.

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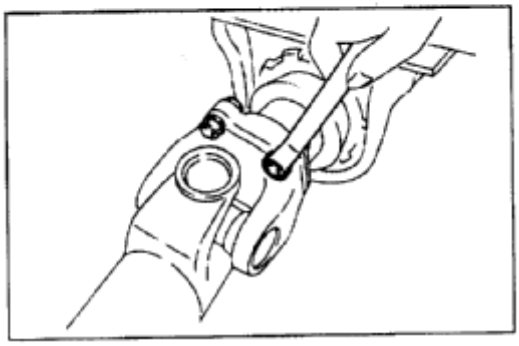
Reassembly



Reassembly procedure as described above

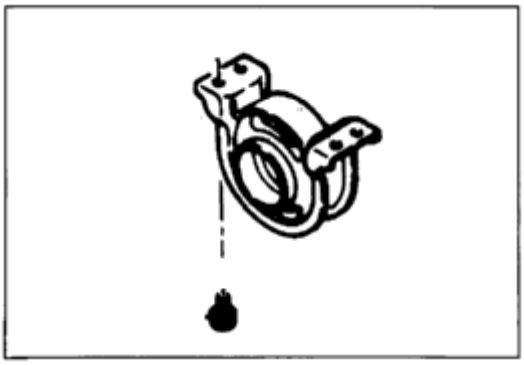
Tightening torque for nut(near transmission)

Torque	199-243Nm



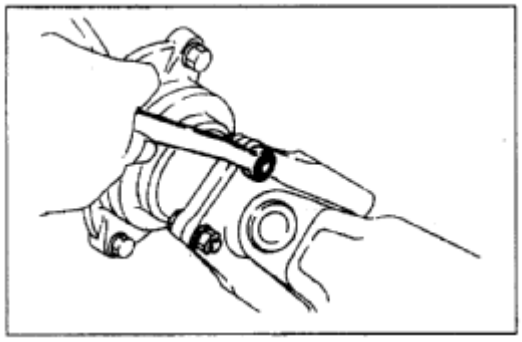
Tightening torque for nut(near the center bearing)

Torque	199-243Nm



Tightening torque for centre support

Torque	127-176 Nm

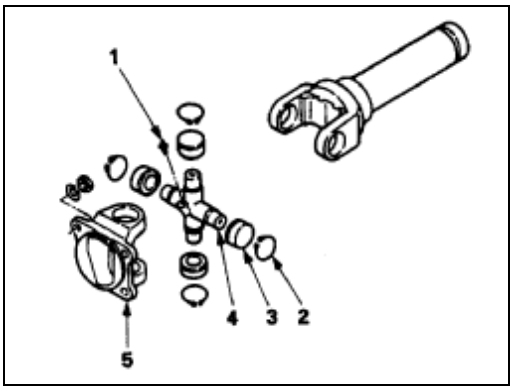


Tightening torque for nut(near the differential)

Torque	199-243Nm

https://truckmanualshub.com/

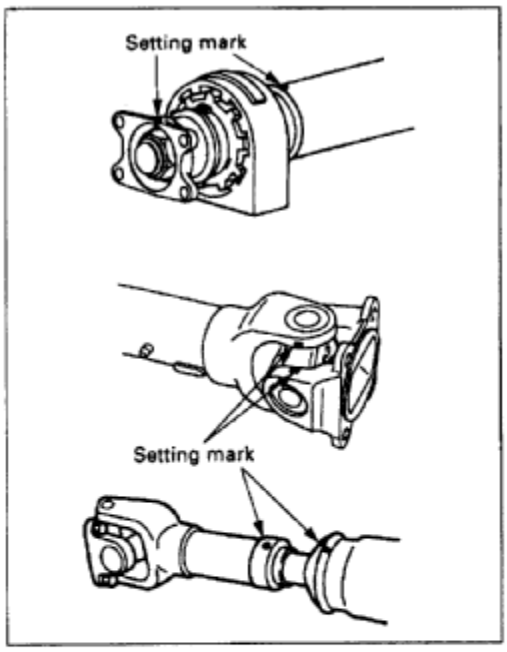
Disassembly and Reassembly of the Universal Joint



Disassembly procedure of the universal joint:

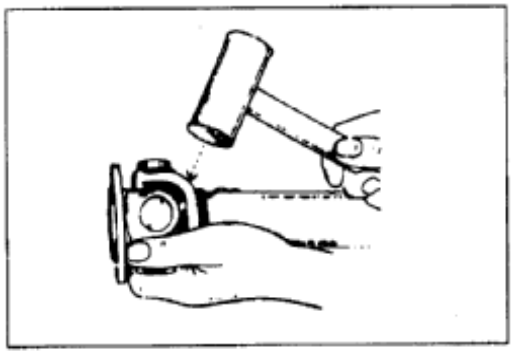
1. Grease nipple
2. Snap ring
3. Needle roller bearing
4. Spider
5. Flange yoke

The reassembly procedure is the reverse of disassembly.



Preparation work：

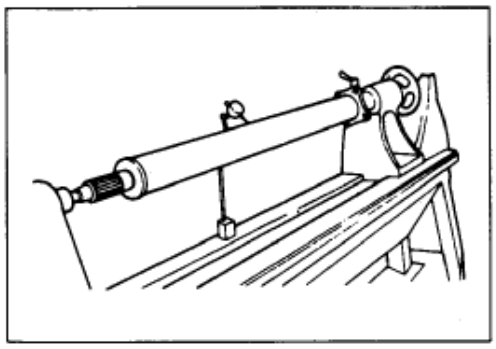
Align matching marks put at time of disassembly.



Disassembly of the needle roller bearing:

Tap the shoulder of the yoke with a wooden hammer to remove the needle roller bearing.

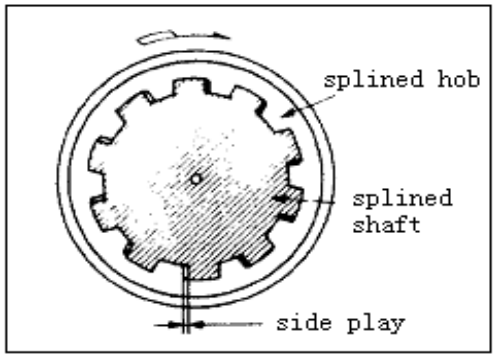
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The concentricity of the propeller shaft：
Measure the concentricity at the center of the propeller shaft.

（mm）

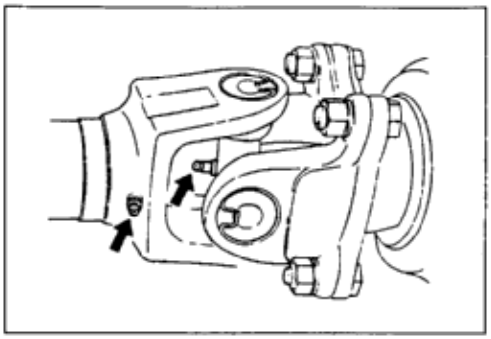
Standard	Limit
≤0.5	1.0



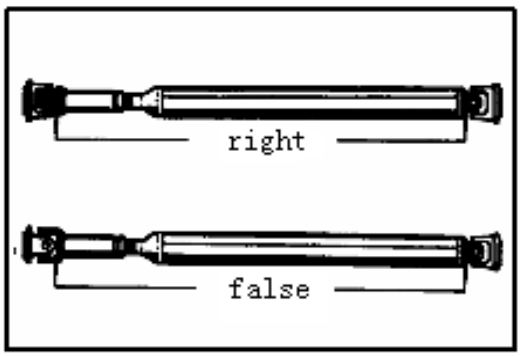
The clearance when the spline rotates in normally direction:
Check the clearance between the spline and sleeve in normal direction with clearance gauge.

（mm）

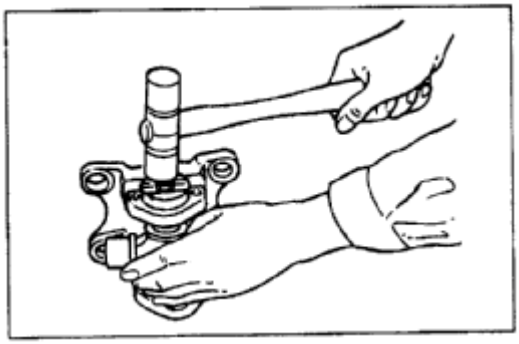
Standard	Limit
≤0.1	0.3



Lubricate universal joint of driveshaft and slip sleeve:
Lubricate with short lubricator until the grease overflows.(only for general grease)

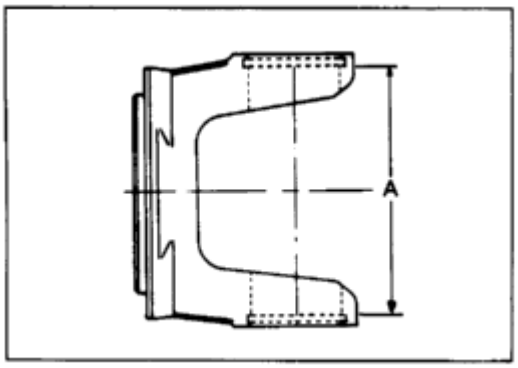


The assembly of the spline and slip joint:
Take notice at the arrow marks on the slide joint and rear propeller shaft, the arrow should be matched.



The assembly of the needle roller bearing：
Apply the grease on the oil seal and bearing, assemble the spider into the flange yoke, assemble the needle roller bearing into the flange yoke hole, and tap it with a soft hammer.

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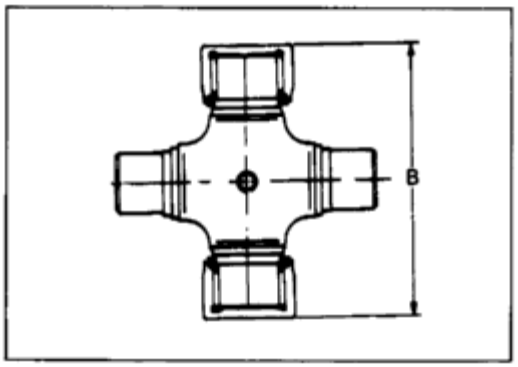


Clearance of the spider end:

1. Measure the width of the flange yoke" A".
2. Measure the width of the spider with needle roller bearings" B".

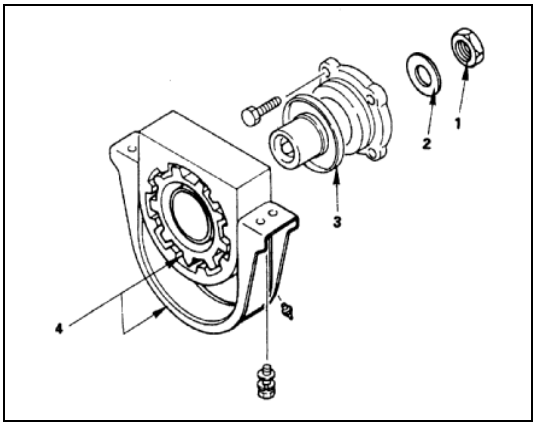
Clearance of the spider end=A－B

A－B（mm）	0.02~0.08



Choose the snap ring with appropriate width(Note: Use the rings with same width, never reuse the snap spring, it must be replaced)

Disassembly and Assembly of the Center Bearing

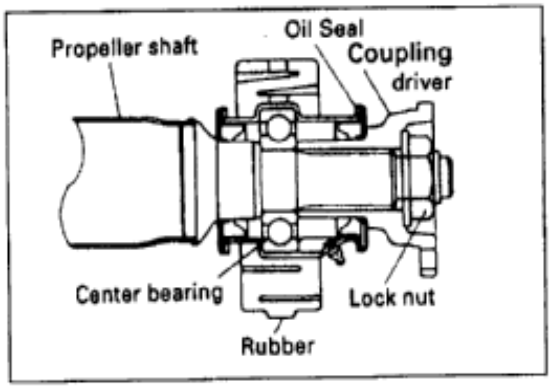


Disassembly procedure:

1. Lock nut
2. Washer
3. Flange
4. Center bearing

To reassemble, reverse the order of disassembly.

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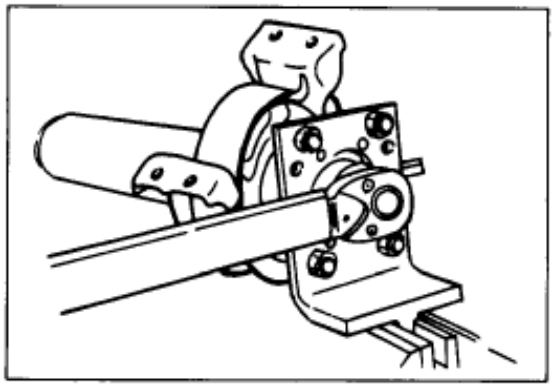
Assembly procedure:

As described above.

Use flange to press the center bearing to protect the bearing.

Grease quantity：

Grease quantity（g）	20~25

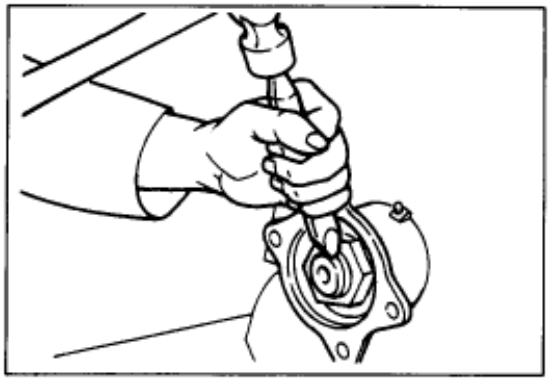


Assembly of flange nut：

Fix the flange with special tool, Tighten the flange nut to specification with spanner, rivet the flange nut to the V groove with riveting tool.

Tightening torque of the flange nut：

Torque	440



Note：Reusing the flange nut is forbidden.

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Front Axle

General

Specifications

Service Standards

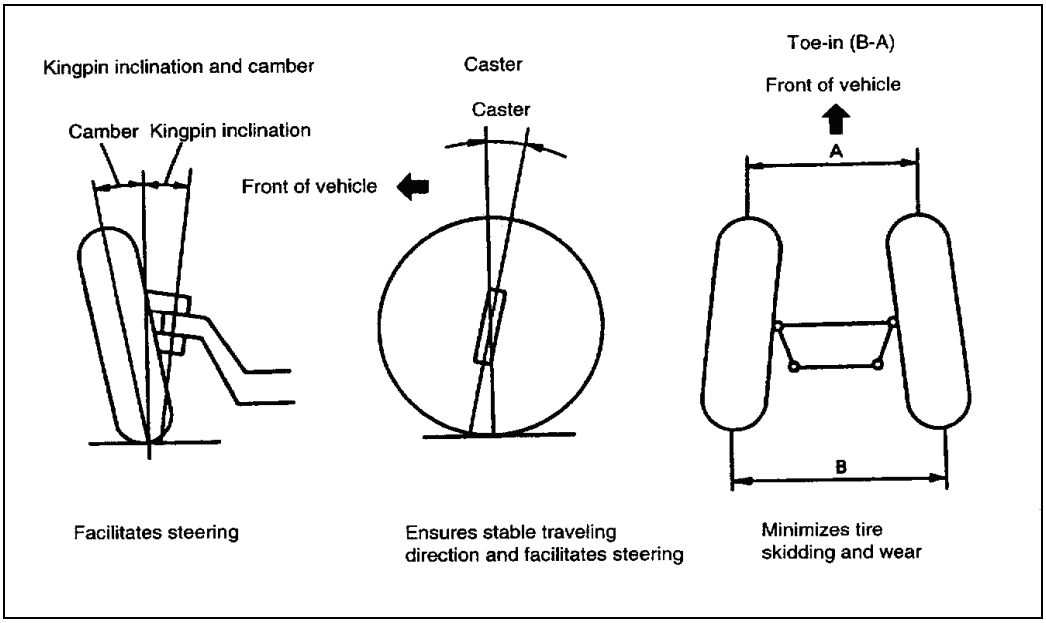
Troubleshooting

Service Procedure

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General

The front axle supports and transmits the weight of the front portion of vehicle to the tires and also services as part of the steering system and brake system. The front axle also has proper wheel alignment for stabilizing the vehicle as it is driven.



Specifications

Main technique parameters		**G1510**
Capacity axle load		
Curb weight		
Wheelbase		1920mm
Center distance between leaf springs		860mm
Max turning angle		39°±15′ /31°±15′
Caster		2°
Camber		1°
Kingpin angle		7°±10'
Toe-in		Radial tire: 0-3mm Bias tire: 1-3mm
Tires		9.00R20/9.00-20
The number of bolts in tires and distribution circle		8-M22×1.5/ Φ275
Wheel bearing grease(one-wheel)	Wheel hub	650±10g
	Hub cap	120±5g
Brake(diameter of brake drum ×width of friction lining ×thickness of friction lining)		

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Service Standards

Service Standard Table

Maintenance item			Nominal value (Basic diameter in[ ])	Limit	Remedy and remarks
Front axle	Kingpin angle		7°	7°30'	Correct or replace
	Bend	Vertical	3 or less	7	Replace
		Horizontal	3 or less	7	
Knuckle to front axle clearance in thrust direction			0.2 or less	0.3	Adjust with thrust washer
Kingpin	O.D.		[50]-0.002-0.015	49.9	Replace bushing
	Bushing I.D (after installation)		[50]+0.045+0.018	-	
Kingpin to bushing clearance			0.02 to 0.06	0.15	Replace bushing
Wheel bearing starting torque (standard wheel hub)			245 to 540 N·m	-	Adjust by tangential force on wheel O.D Standard wheel hub[8 studs] 18 to 38N {1.8 to 3.9 kgf} Hub bolt (P.C.D285)[10 studs] 15 to 32N {1.5 to 3.3kgf} Hub bolt (P.C.D 335)

Tightening Torque Table

Location tightened		Thread size O.D.×pitch (mm)	Tightening torque N·m(kgh·m)
Kingpin set bolt tightening nut		M10×1.25	29(3)
Knuckle arm attaching bolt tightening nut		M24×1.5	390 to 635 (40 to 65)
Tie rod arm attaching bolt tightening nut		M24×1.5	390 to 635 (40 to 65)
Front brake assembly to knuckle attaching bolt tightening nut		M16×1.5	215(22)
Wheel hub to brake drum tightening nut	Standard wheel hub [8 studs]	M22×1.5	320(32.8)
	Standard wheel hub [10 studs]	M24×1.5	420(43.0)
Hub bearing lock nut tightening (standard wheel hub)	Primary tightening	M45×1.5	195(20)
	Primary back off		Loosen fully until clearance is formed
	Secondary tightening		195(20)
	Secondary back off		Back off 22.5° (1/16 turn)
Hub bearing lock nut locking lock bolt(Standard wheel hub)		M6×1.0	6.9 to 11(0.7 to 1.1)
Chamber bracket to knuckle attaching bolt	Vehicle with air brake	M12×1.25	96(9.8)
Tie road end tightening nut		M12×1.25	78(8)
Tie road to tie arm attaching ball stud tightening nut		M24×1.5	270(27.6)
Wheel cover bolt		M10×1.25	19 to 27 (1.9 to 2.8)
Lower cover (lower part of kingpin)		M27×1.5	105 to 165 (11 to 17)
Knuckle stopper bolt		M14×1.5	59 to 83 (6 to 8.5)

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Troubleshooting

Symptom	Probable cause	Remedy
Steering wheel vibrates	Worn kingpin	Replace with a kingpin kit
	Clearance between kingpin and bushing to large	
	Seized worn or poorly turning wheel hub bearing	Replace
	Wheel misalignment	Adjust
	Excessively worn tie rod end ball stud	Replace tie rod end assembly
	Uneven tire inflation pressure	Adjust
	Loose knuckle arm and tie rod arm tightening castle nut	Tighten to specified torque
	Loose front suspension U-bolt tightening nut	Tighten to specified torque
	Vertical clearance between knuckle and front axle too large	Adjust with kingpin thrust washer
Steering wheel movement is hard	Clearance between kingpin and bushing too large	Replace with a kingpin kit
	Seized worn or poorly turning thrust bearing	
	Insufficient tire inflation pressure	Adjust to tire inflation pressure
	Wheel misalignment	Adjust
	Insufficient grease on kingpin	Apply grease
Steering wheel dose not return properly	Front axle part overtightened	Retighten to specified torque
	Wheel misalignment	Adjust
Steering wheel cannot be turned	Turning angle poorly adjusted	Adjust turning angle
	Bent tie rod	Replace
Vehicle pulls to one side	Differential tire sizes at right and left	Use tires of the same size
	Different tire O.D.s at right and left	Use tires of the same O.D
	Uneven tire pressure	Adjust
	Bent front axle	Replace
	One of the front springs losing tension or broken	Replace
Uneven or premature wear in front tires	Improper wheel alignment	Adjust or replace front axle
	Different tire sizes and types at left and right	Use tire of the same size and type
	Uneven tire pressure	Adjust
	Improper tire handing	Tire rotation

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Inspection items of front axle in using:

Front axle (not drive steering axle) is made up of beam axle、steering knuckle、kingpin、bracket、wheel hub and so on. The beam axle is a I type forged beam, connected with steering knuckle by kingpin in the two ends. Steering knuckle turns about the kingpin. Thrust bearing is installed in the underside of the two ends surfaces of beam axle.

Inspection of steering knuckle:

Mainly check whether the root of steering knuckles have cracks and the wearing of shaft neck. If any crack is found, replace it. Don't run with malfunction to avoid serious accidents. The wear allowance is 0.05mm.

Inspection of front shaft:

Front shaft endures bending stress and moment of torque in the process of vehicle running, distortion may happen easily. The place of distortion is on the outside of leaf spring base. If any distortion is found, replace it immediately.

Inspection of the clearance of kingpin and lining

Please replace kingpin and lining when the clearance of kingpin and lining exceeds 0.16mm. Larger clearance can cause the swing of front wheel, unstable of steering and the damage of steering knuckle and other parts. Replace the kingpin when the clearance exceeds 0.1mm

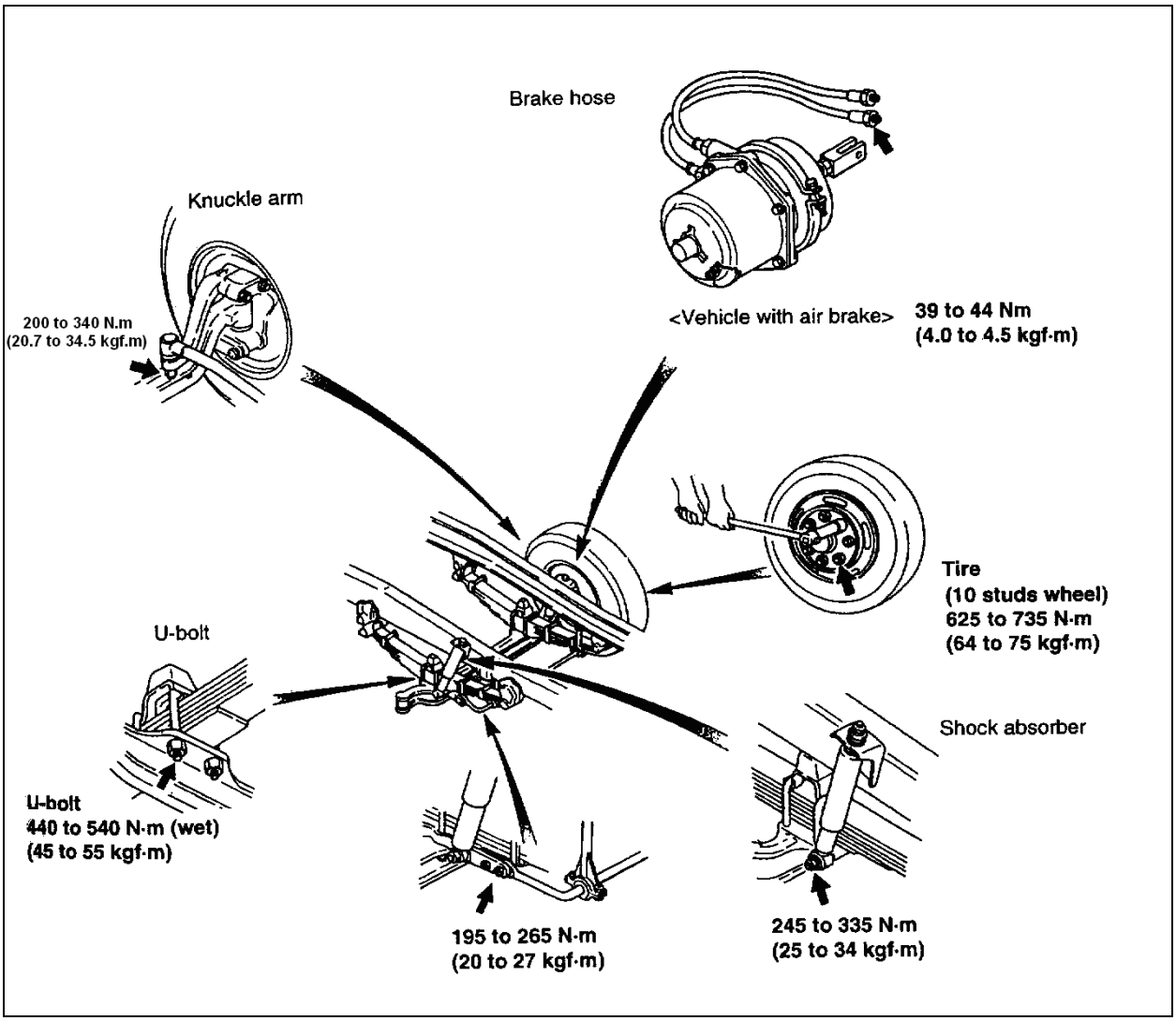
Inspection of thrust bearing:

Generally, if thrust bearings of front wheel(No. of parts: 880410049) is maintained and lubricated well, they can not be damaged. After running over water, please pump into lubricating grease, half of lubricant gun is suitable. If the turning of steering wheel result in noise and steering-wheel swing, there may have a problem in thrust bearing , replace the thrust bearing.

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Service Procedure

Removal and Installation



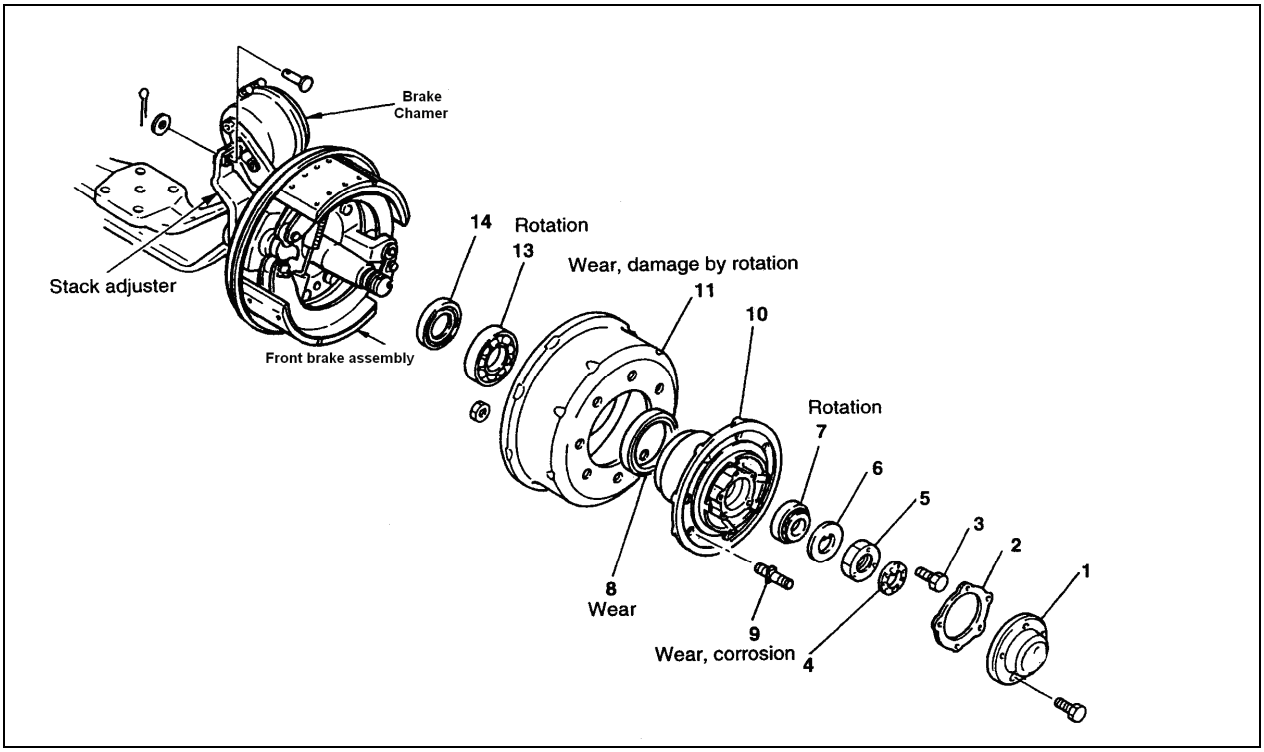
Note

1. **Remove the brake hose from the frame end first and install to the wheel brake end first. During the procedure, make sure that the hose is not twisted.**
2. **Plug the end of the brake hose removed to prevent entry of dust and dirt.**

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Wheel Hub

Disassembly and Inspection



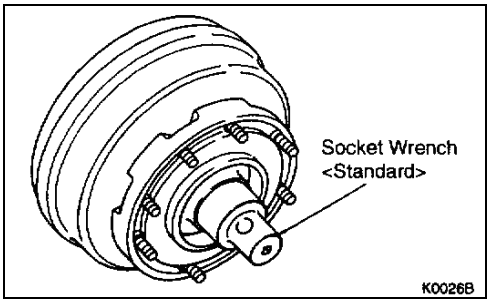
Disassembly sequence:

1.Front wheel hub cover 2.Hub cover gasket 3.Lock bolt 4.Lock plate 5.Lock nut
6.Lock washer 7.Outer bearing 8.Oil seal 9.Hub bolt 10.Front wheel hub
11.Front brake drum 12.Front brake assembly 13.Inner bearing 14.Knuckle retainer

Note

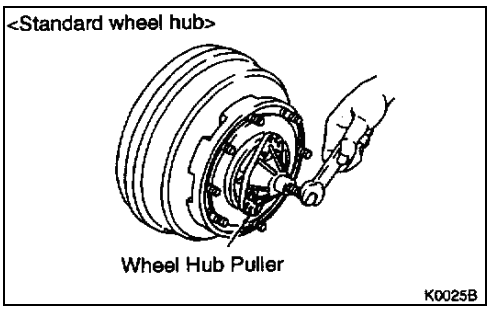
The connection between slack adjuster and brake chamber should be disconnected at the front brake assembly.

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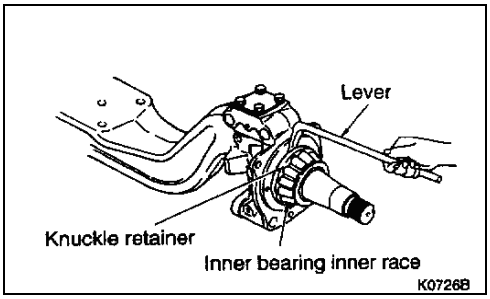


Disassembly Procedure

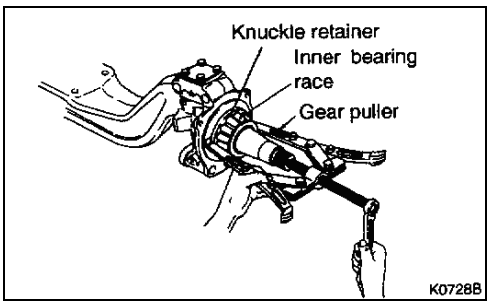
1. Removal of lock nut.



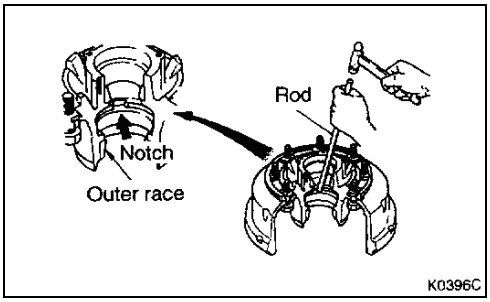
2. Removal of wheel hub and brake drum.



3. Removal of inner bearing inner race and knuckle retainer. Use the special tool(lever) to pry the knuckle retainer to obtain clearance.



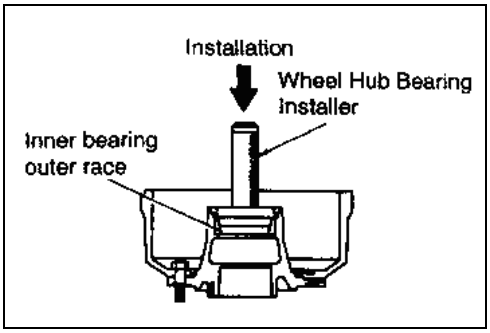
4. Install the claws of the special tool(gear puller) in knuckle retainer and remove.



5. Removal of inner and outer bearing outer races. Using a rod, strike with a hammer to force the outer race evenly out from the inside notched portion.

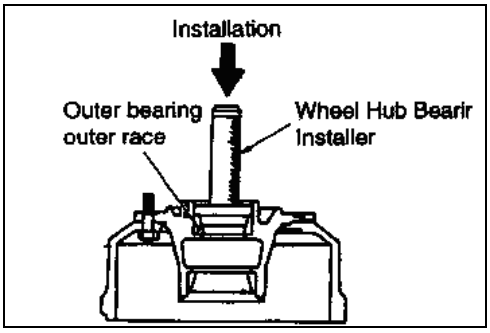
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Reassembly

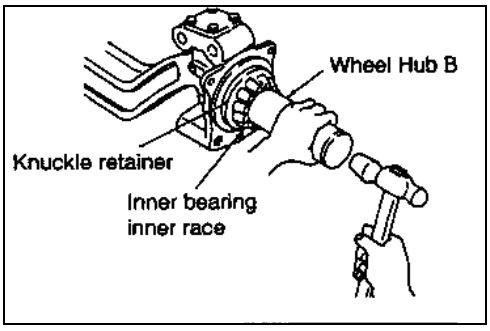


Reassembly Procedure

1. Installation of inner bearing outer race.



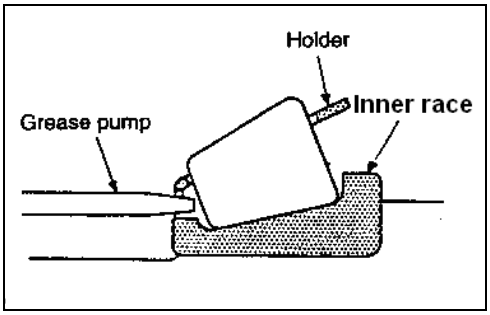
2. Installation of outer bearing outer race.



3. Installation of inner bearing inner race.

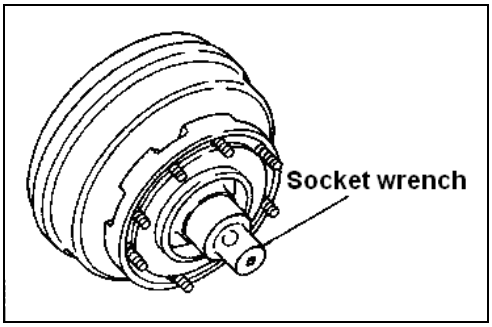
Note

Be sure to install the knuckle retainer.



4. Lubrication of bearing.

Using a grease pump or equivalent, pack grease amply, making sure that space between bearing rollers is filled with grease.

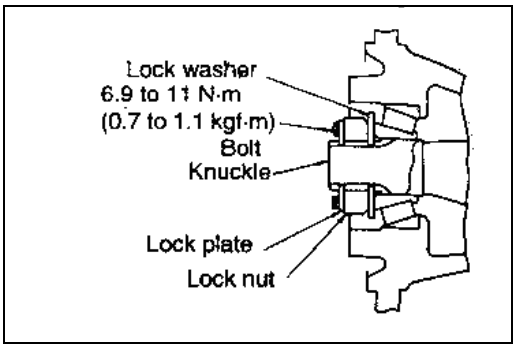


5. Adjustment of hub bearing starting torque.

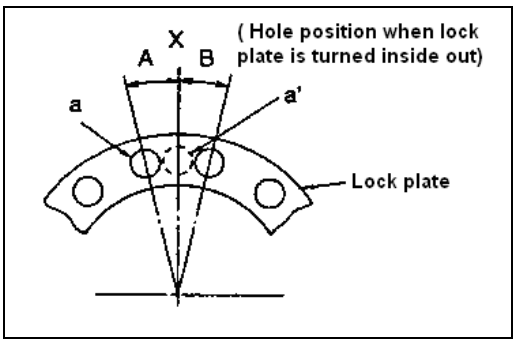
(a) Install the lock washers and lock nuts and while turning the wheel hub three times and more, tighten the lock nuts to 195 Nm(20 kgf.m). Then back off fully until a gap is produced between the lock nuts and lock washers.

(b) Tighten the lock nuts to 195 Nm(20 kgf.m) and then back off 22.5°(1/16 turn)

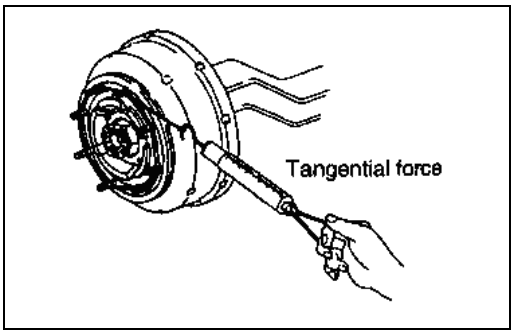
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（C）Install the lock plate and make sure that the lock nuts are all(three) aligned with the bolt holes of the lock plate. Then tighten the lock bolts to 6.9 to 11 Nm(0.7 to 1.1 kgf.m). If the lock nut and lock plate bolt holes are not aligned, proceed as follows:



1. If the lock nut hole is within ranges A, loosen the lock nut and align with hole a.
2. If the lock nut hole is within range B, turn the lock plate inside out and loosen the lock nut and align with hole a.
3. If the lock nut hole is on X-X axis, turn the lock plate inside out and the holes will be aligned.



(d) Perform the same procedure as in step(c)
(e) Measurement of wheel hub bearing starting torque.
Install a spring balancer to a hub bolt and pull slowly in the tangential direction to measure the tangential force as the wheel hub starts to turn. If the tangential force so measured is not as specified, repeat from(c).

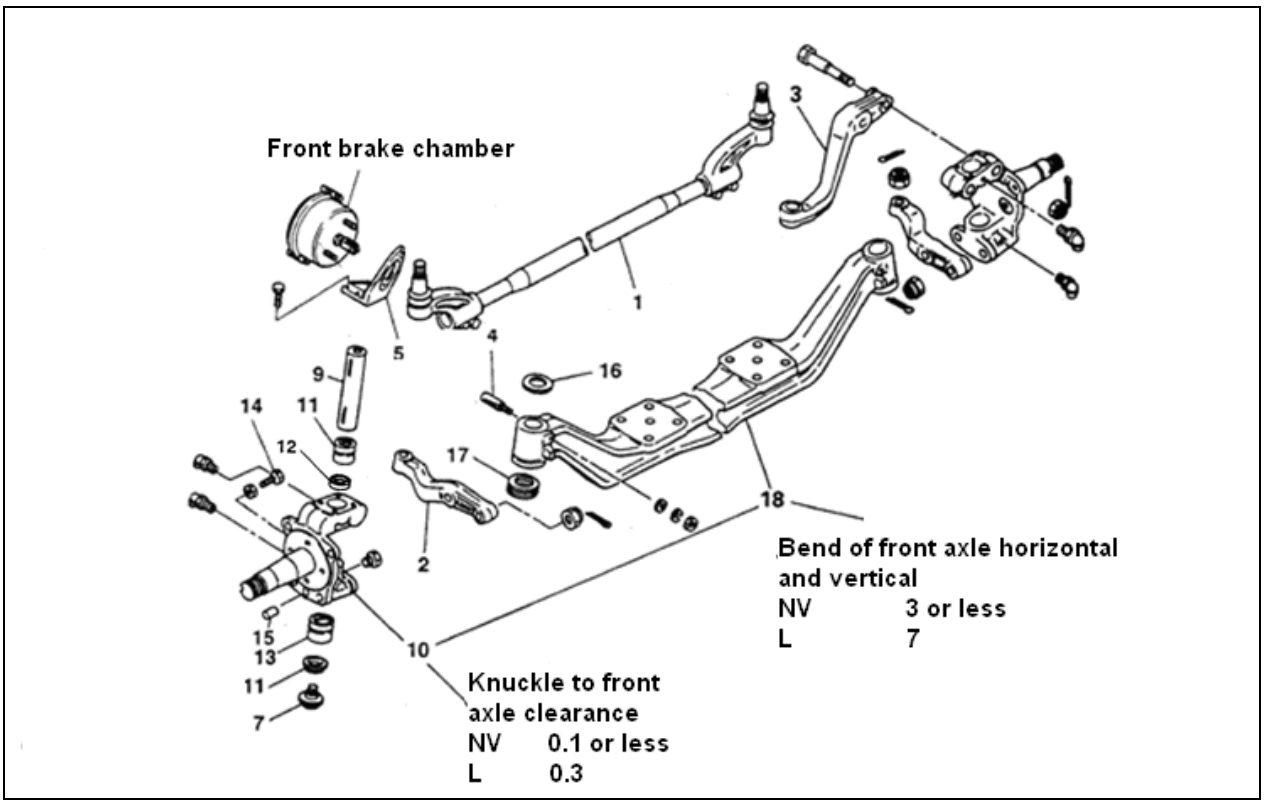
Note:

1. **If the tangential force is within nominal value range, the starting torque should be as specified. If the tangential force is out of specification, readjust the starting torque.**
2. **The starting torque must not exceed the upper limit of the nominal value.**
3. **Before taking measurement, make sure that the lining is not in contact with the drum.**

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Front Axle, Knuckle and Kingpin

Disassembly and Inspection

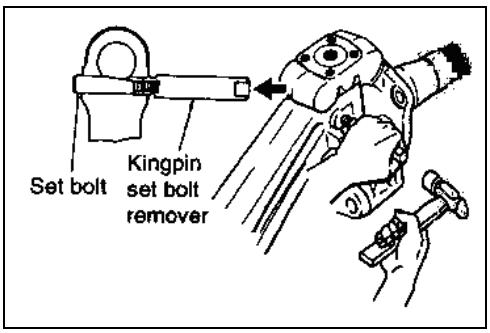


Disassembly sequence:

1. Tie rod assembly 2. Tie rod arm 3. Knuckle arm 4. St bolt 5. Chamber bracket 7. Kingpin lower cover 9. Kingpin 10 Knuckle 11. Upper bushing 12. Oil seal 13. Lower bushing 14. Stopper bolt 15. Knock pin 16. Thrust washer 17. Thrust bearing 18. Front axle

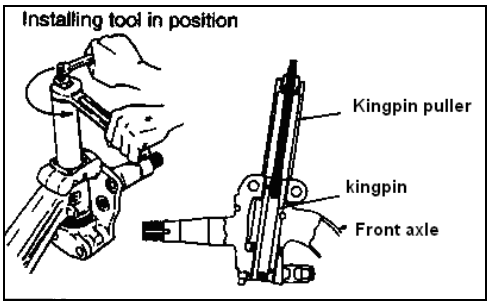
NV.....Nominal Value
L.....Limit

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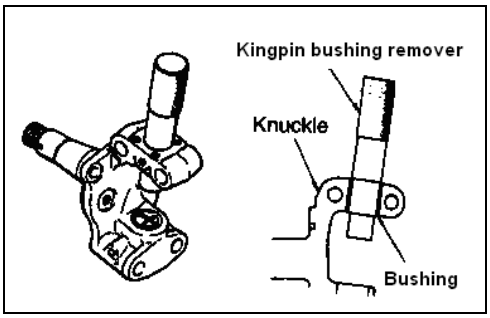


Disassembly Procedure

1. Removal of set bolt



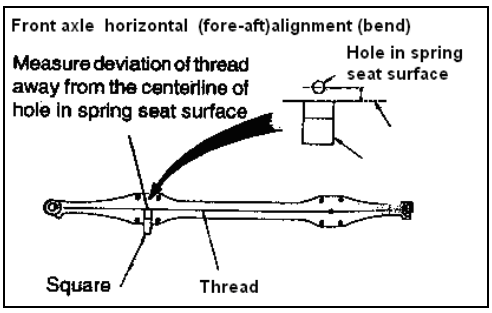
2. Removal of kingpin



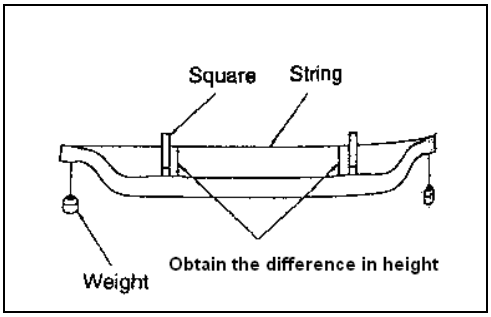
3. Removal of kingpin bushing

Note

Do not reuse removed bushings(upper and lower)



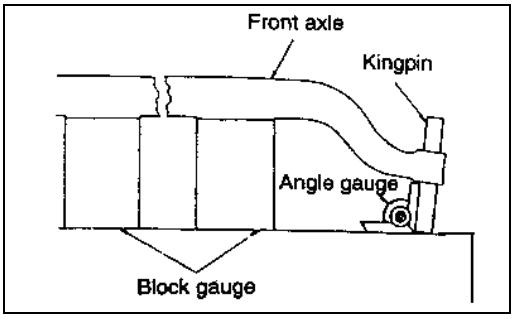
4. Measurement of front axle bend



Alignment (bend)

Item	Nominal value	Limit
Vertical	3 or less	7
Horizontal	3 or less	7

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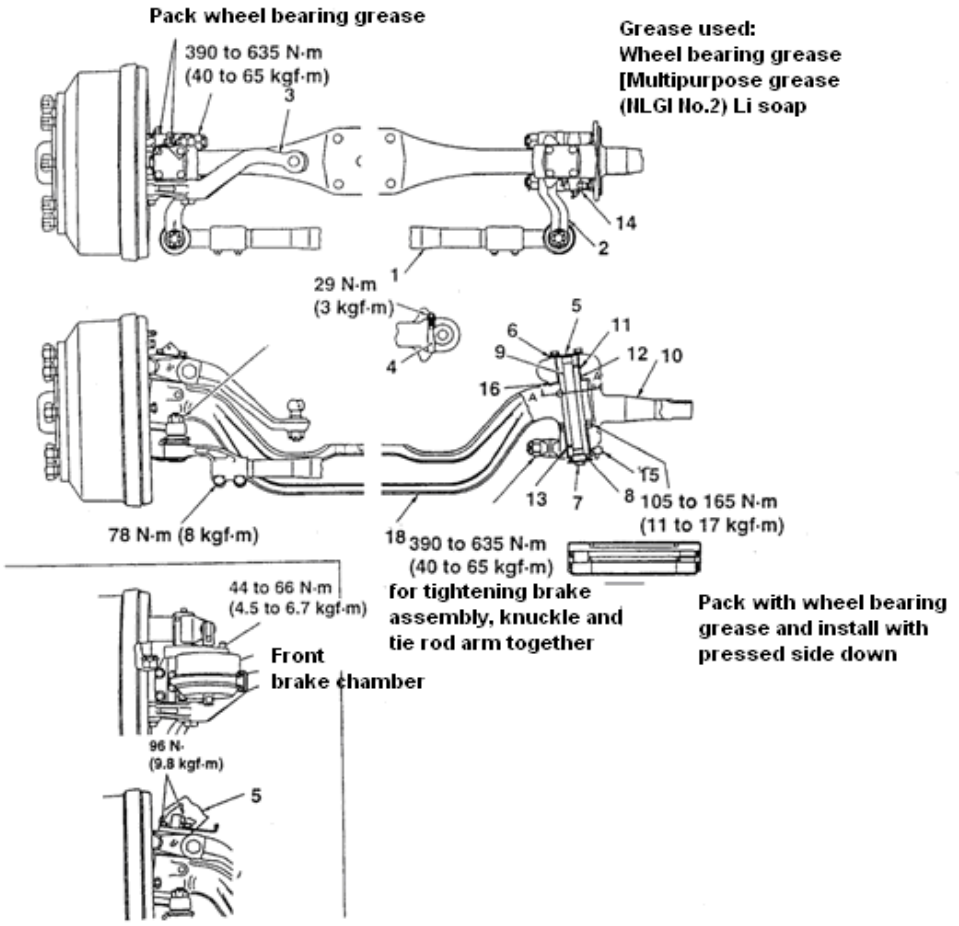


5. Measurement of kingpin inclination

Nominal value	7°
Limit	7°30'

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Reassembly

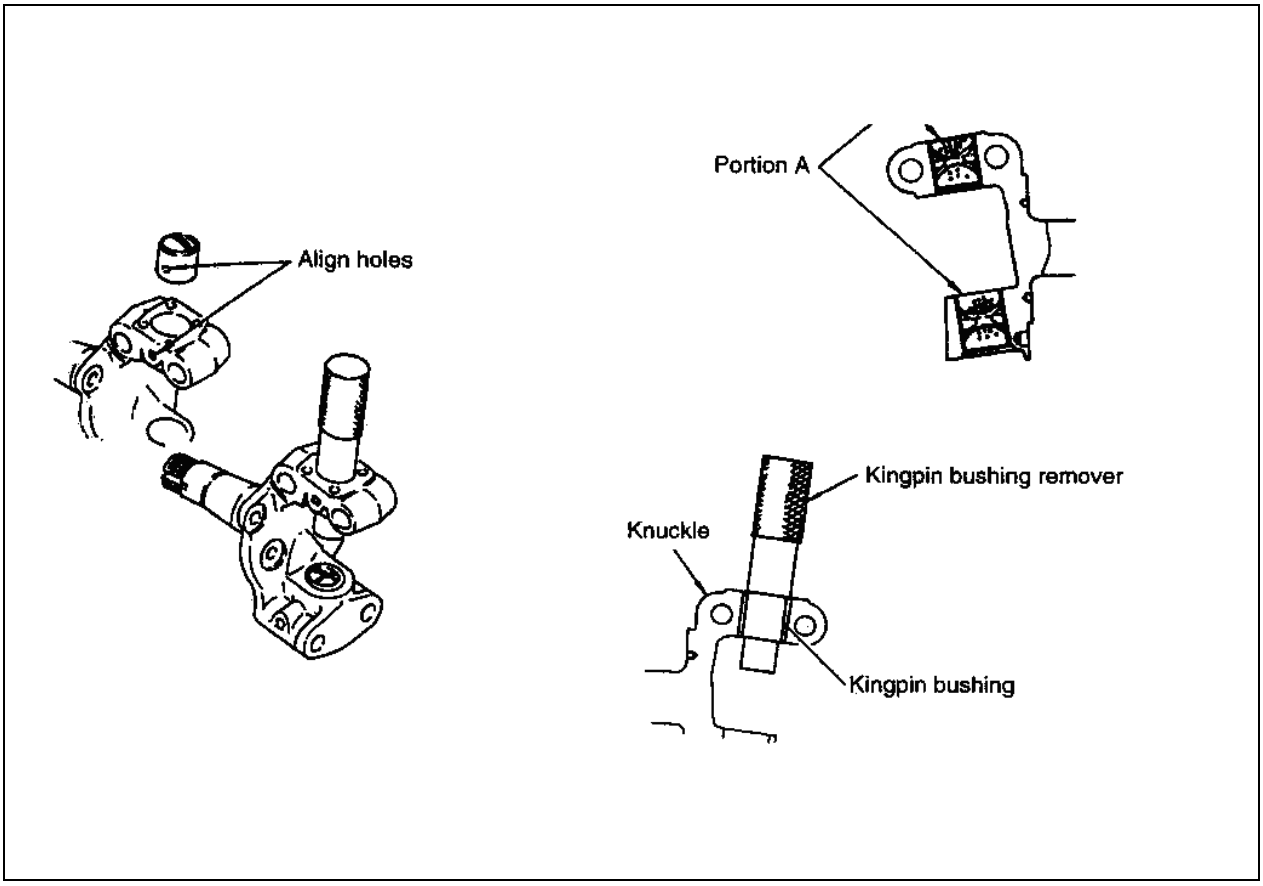


Note:

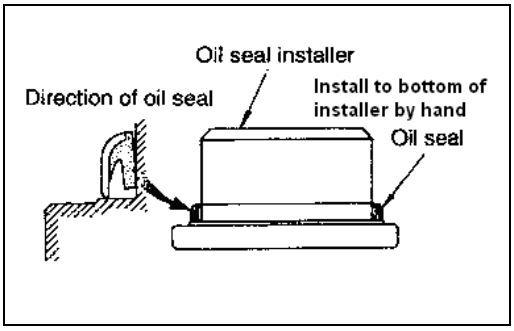
Before inserting the kingpin, apply wheel bearing grease to front axle kingpin hole and all through holes.

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Reassembly



1. Press fit the kingpin bushing into the knuckle using the special tool, Kingpin Bushing Remover. At this time, one end of each bushing should be flush with the surface A and the nipple holes in the knuckle should be aligned with the oil holes in the bearing.



Installation of oil seal

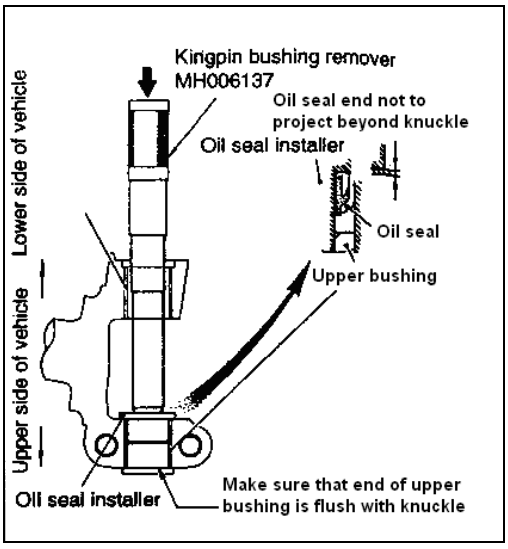
a) Apply grease to the oil seal lip and install the oil seal to the special tool (oil seal installer).

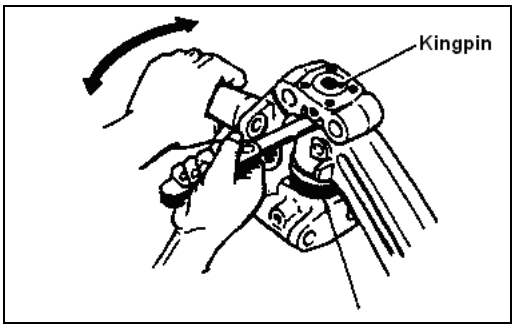
Note

1. Use new oil seal.

2. Be sure to install the oil seal in the correct direction.

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b) Turn the knuckle upside down.
Insert by hand the special tool (Oil Seal Installer) with the oil seal fitted in (a) above into the oil seal fitting portion of the knuckle upper bushing.
Then, inset the special tool (kingpin bushing remover) through the kingpin hole on the lower side of the vehicle. Strike the head of the kingpin bushing remover with a hammer until the flange of the oil seal installer comes into contact with the knuckle.

3. Adjustment of knuckle vertical clearance.
Installation the kingpin and thrust bearing temporarily and turn the knuckle two or three times to ensure smooth operation.
Measure the clearance between the upper surface of the front axle and knuckle. Based on this value, select a kingpin thrust washer which gives the specified clearance.

Nominal value	0.1 or less
Limit	0.3

Thrust washer thickness :

2.9 to 3.6 (8 types in 0.1 increments)

4. Application of grease.
After reassembly, pour grease into grease nipple of the knuckle.

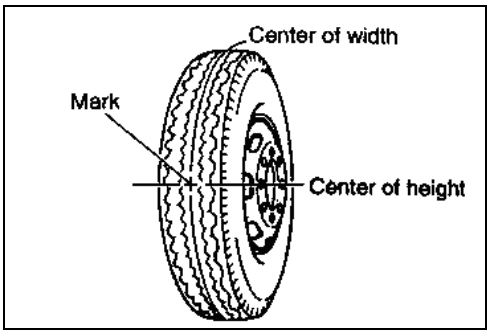
INSPECTION AND ADJUSTMENT AFTER INSTALLATION

Adjust the wheel alignment and steering angle.
Make sure that when making measurement, the vehicle is unloaded and kept in the horizontal position.
In addition, every part of the front axle has been thoroughly maintained before the adjustment described hero.

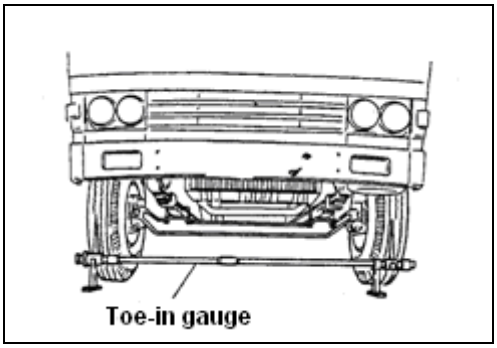
NOTE
Before adjustment, make one more check to be sure that the front axle is free from the following defects.

1. **Loose front wheel hub**
2. **Loose knuckle**
3. **Loose connection between knuckle flange and knuckle arm**
4. **Loose bolts, screws and nuts**
5. **Leaf spring broken or set in fatigue**
6. **Overinflated or underinflated tire**
7. **Improperly adjusted steering gear backlash**

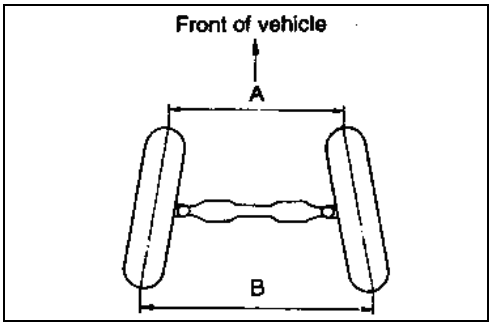
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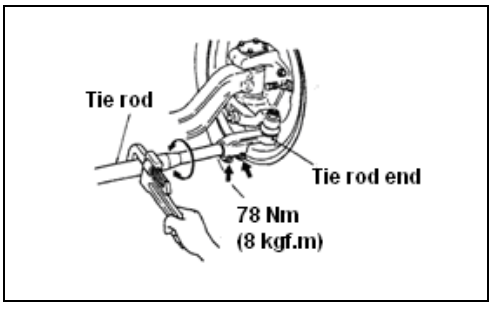
1. Measurement and adjustment of toe-in.
a) Place the front wheels in straight ahead position.
b) Make a mark on the front side of each front tire, at the center of the tire width and height.



c) Adjust the heights of the needle ends of the toe-in gauge to the same height as the marks made on the right and left front tires, and measure the distance between the marks.
d) Drive the vehicle slowly forward until the marks go round to the rear side and reach the same height previously measured by the toe-in gauge(180°of a tire rotation), and measure the distance between the marks on the rear side of the tires.



e) The difference between the front and rear side measurements (dimension B on rear side-dimension A on front side) is the toe-in.

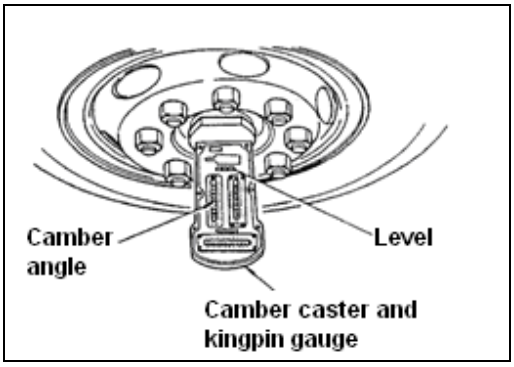


f) To adjust the toe-in, proceed as follows:
Loosen the clamp bolts on both ends of the tie rod and place the tie rod down toward rear so that the tie rod ends on both sides contact the ball studs at the same time. Then, turn the tie rod with a pipe wrench to obtain the specified toe-in.
After the adjustment, torque the clamp bolts to specification.

Toe-in(tires on ground)	1mm to 3mm

2. Measurement of camber
a) Place the front wheels in straight ahead position.
b) Remove wheel hub caps.

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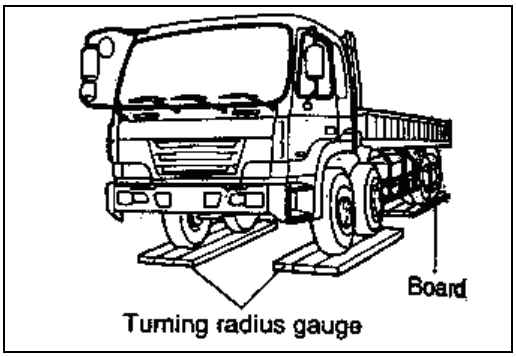


c) Wipe away grease from the end of the knuckle, and attach the camber caster and kingpin gauge tightly against the front wheel hub.
d) Place the air bubble of the level at the center. In this condition, read the center of the air bubble on the camber scale to measure the camber. Measure the right and left cambers by the same procedure.

Camber	1° ± 1°

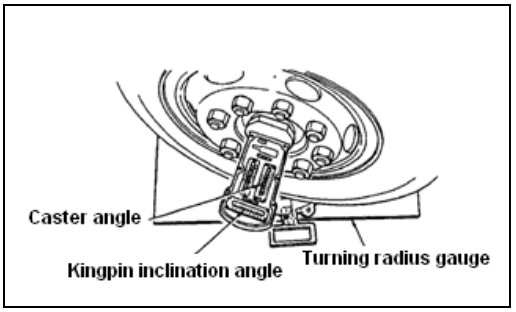
If the specification is not met, replace the front axle.

3. Measurement of caster and kingpin angle.
a) Obtain boards equal in height to the turning radius gauges to hold the vehicle in a level position.
b) Place the turning radius gauges in the locked state.
c) Slowly drive the vehicle in the straight ahead direction until the centers of the right and left front tires are placed at the centers of the turntables of the right and left turning radius gauges, and apply parking brake.



NOTE
If the vehicle is hard to move, raise it on jacks, and see the turning radius gauges and boards by the above mentioned procedure.
With the vehicle on the jacks, take complete steps to prevent the vehicle from moving.

d) Unlock the turning radius gauges and adjust the scales to 0°.
e) Following the same procedure as for measurement of camber, remove the hub cap, attach the camber caster and kingpin gauge tightly against the front wheel hub, and set it at a position where the air bubble of the level stays at the center.
f) Depress the brake pedal to apply brakes to the front wheels and slowly turn the steering wheel until the scale of the turning radius gauge changes its direction 20 in the right direction for the right front wheel or 20° in the left direction for the left front wheel, from the position adjusted to 0°.

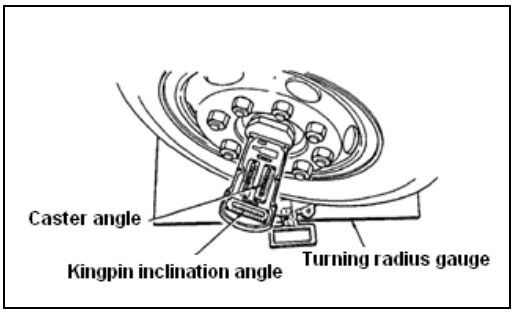


NOTE
Without applying brakes to the front wheels, accurate measurements cannot be made, because the tires might slightly turn.

g) After the tires have turned 20°, rotate the adjusters to adjust the centers of the air bubbles of the caster and kingpin scales to 0°.

NOTE
The kingpin scale has RIGHT and LEFT.
For the right front wheel, adjust the kingpin scale RIGHT.
For the left front wheel, adjust the kingpin scale to LEFT.

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h) Slowly turn the steering wheel in the reverse direction until the scale of the turning radius gauge leaves the position adjusted to 0°and changes its direction 20°in the right direction for the left front wheel. At this position, read the centers of the air bubbles of the caster and kingpin scales to measure the caster and kingpin angle.

Caster	0°
Kingpin inclination angle	7°

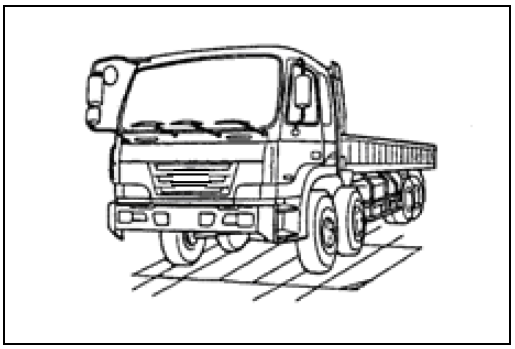
If the specification is not met, replace the front axle.

4. Adjustment of steering angle

Note

Completely finish adjustment of wheel alignment before attempting adjustment of the steering angle.

a) Following the same procedure as for measurement of caster and kingpin angle, set the turning radius gauges and boards under the vehicle.



b) Turn the steering wheel fully to the right or to the left. Adjust the knuckle stopper bolt on each side so that the inside turning angle, right wheel angle when turned to right and left wheel angle when turned to left, is the standard angle.

5. Measurement of side slip.

Note

Completely finish adjustment of wheel alignment before measurement of side slip.

a) Place the front wheels in straight ahead position.

b) While maintaining the front wheels in straight ahead position, drive over the side slip tester as slowly as possible.

Note

Make sure that the side tester is completely passed with the wheels in straight ahead position. Do not allow the wheels to steer or fall down from the sides of the tester

c) The value indicated by the tester is the side slip. If the side slip is over 3mm for 1m readjustment of wheel alignment is necessary.

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JAC G1510 rear axle

Workshop manual

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ITEM

Chapter Ⅰ Instruction of axle's construct

A Construct **b**rief introduction

B Driving axle's exploding chart and list

C Sealant and adhesive for driving axle

D The list of tightening force

E List of wearing parts

Chapter Ⅱ Inspection & maintenance

A Examine and repair parameter

B Check and maintenance

Chapter Ⅲ Assembly and adjust

A The driving axle's disassembly

B assembly and adjust

Chapter Ⅳ Use and maintenance

Chapter Ⅴ Resolve failure

Chapter Ⅵ Mark introducing

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Chapter Ⅰ instruction of axle's construct

A、BRIEF

DRIVING AXLE'S STYLE（N0. 1）

ITEM	CONTENT
The style of axle housing	stamping and wholly welding
Shaft holding's style	Full holding
gears' type of final reduction	Cone gear
spider gears' number	Two/four spider gears

This series drive axle is for two-wheel drive, rear suspension is not single suspension construct. it comprises reducer、bevel gear differential and drive axle housing and some of other parts. It is the last stage reducing speed mechanism in automotive driving system.

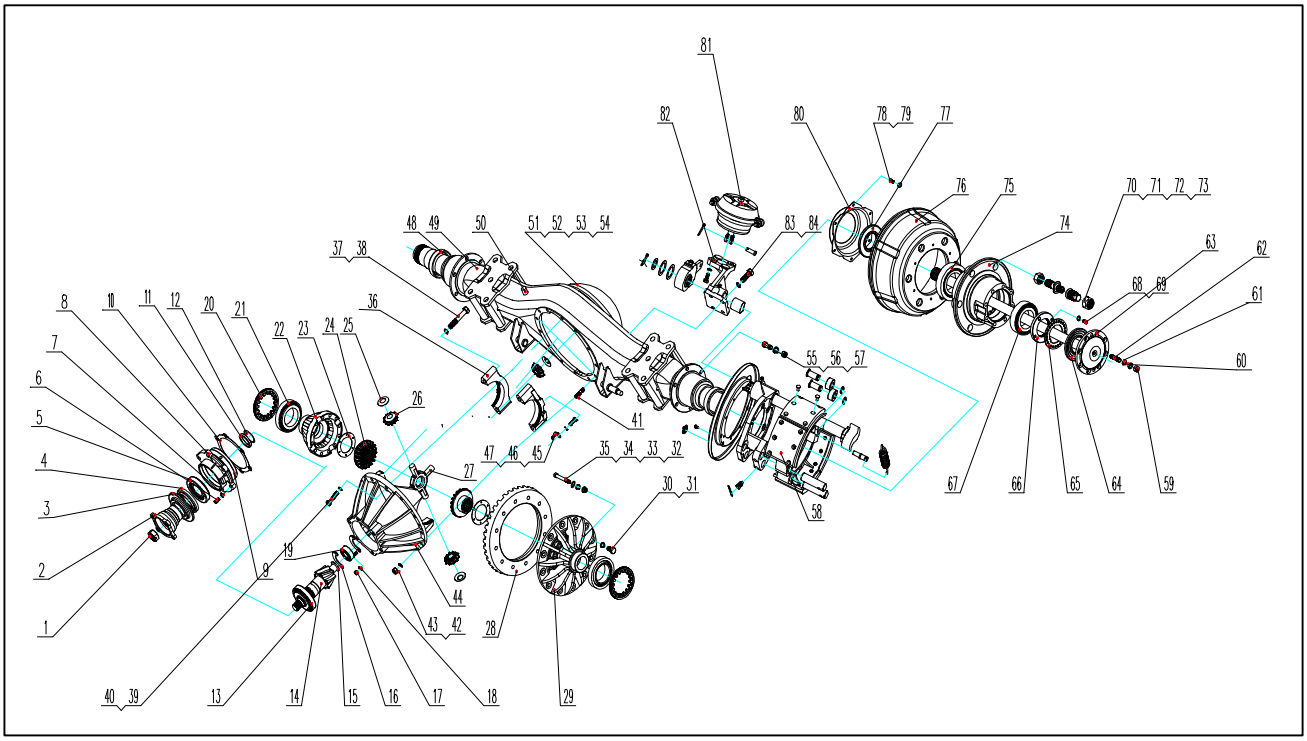
Final reduction can enlarge torque and reduce rev, at the same time change the direction. It is composed of driving gear and driven gear. Driving gear, in which side there is spine, connects with coupling assembly of driving axle by driving gear's flange. It is sustained by two cone bearings, which is reverse assembled, in its middle for supporting axial force and radial force. The axle neck on small end of driving gear, bearing radial force, is assembled columnar bearing. Driven gear is fastened to left housing of differential of some bolts.

Differential, which can make the right and left wheel's rev different, consists of the housing of differential, spider, four spider gears, and two side gears and some of other parts.

Drive axle's half-shaft is connected with half-shaft gear by spine in one side, and with hub by some bolts in flange in another side.

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B、the driving axle exploding and list：



1.	nut	2.	flange	3.	dust defender	4	oil seal
5	bearing	6	bolt	7	spring washer	8	separator
9	O seal	10	Cushion	11	Cushion	12	cushion
13	bearing	14	drive geaar	15	spring sprag	16	assembly of sprag
17	nut	18	spring washer	19	bearing	20	adjusting nut
21	bearing	22	Diff. carrier	23	cushion	24	shaft gear
25	cushion	26	Plate gear	27	crossing shaft	28	driven gear
29	Diff. carrier	30	nut	31	bolt	32	bolt
33	nut	34	spring washer	35	cushion	36	bearing cap
37	bolt	38	spring washer	39	bolt	40	spring washer
41	bolt	42	nut	43	spring washer	44	final reduction carrier
45	bolt	46	clip	47	spring washer	48	oil bush
49	assembly of axle	50	stopper	51	stopper	52	cushion
53	stopper	54	cushion	55	bolt	56	nut
57	spring washer	58	The brake assy	59	nut	60	taper cushion
61	spring washer	62	bolt	63	shaft	64	oil seal
65	cushion	66	nut	67	bearing	68	bolt
69	spring washer	70	bolt	71	nut	72	nut
73	nut	74	hub	75	bearing	76	brake drum
77	oil seal	78	bolt	79	spring washer	80	oil defender
81	brake gas cell	82	braket	83	bolt	84	spring washer

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C、Sealant and adhesive for driving axle（No. 2）

ITEM	SEALANT AND ADHESIVE
the surface of drive axle housing's assembly and final reduction assembly	515 adhesive
bolt for driven gear	GY-340 adhesive
bolts for differential	GY-340 adhesive
bolts for reducer	mechanism Sealant 605
hub's lumen	ZL-2 GB5671-85 lithuium greese
Final reduction 's parts assembly	10#oil

D、Wearing parts（No.3）

ITEM	NUMBER
Oil seal for drive gear	1
Inner oil seal for rear hub	2
Inner bearing for hub	2
Outer bearing for hub	2
Inner bearing for drive gear	1
Outer bearing for drive gear	1
oil seal for half-shaft	2
nut for drive gear	1
bearing for differential	2
Brake pad (right ,left)	per 2 pieces

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E、tightening force list（4）

ITEM	G1510(N.m)
nut for drive gear	550-600
bolt for separator of drive gear	178 ～ 235
bolt-driven gear	475 ～ 598
bolt for differential	178 ～ 235
bolt for reducer	178 ～ 235
bolt for bearing cap	450 ～ 568
bolt for adjusting nut clip	37 ～ 75
nut for brake soleplate	146 ～ 205
bolt for shaft	146 ～ 205
nut for hub	396~480
Bolt for locking cushion	6~15
Stopper for putting on steam	44.1~53.9
Oil drain	44.1~53.9
Tightening force for gas cell brake	199~270

Note: Mechanical features of the bolts and nuts marked in the bold-face is 10.9 grade ,the rest is 8.8 grade.

Chapter Ⅱ inspection & maintenance

A、list of inspection date

item	G1510
B/L of pinion & ring gear	0.3～0.4
B/L of planet & shaft gear	0-0.15 mm
preload of pinion gear	15-25 Kgf·cm
gear oil of rear axle	11L

B、inspection & maintenance of rear axle

1、 Check the parts with special inspection implement or tool

Decide whether one part can reuse or not according to maintenance standard table. Broke part must be repaired or replaced. If one of partner parts wore, leading to B/L out of set standard, we must change the partner parts whole.

2、 Some repairing parts which still in limited tolerance must be change according to pre-maintenance opinion.

3、 Check all parts' appearance through the way of red paint or eye-check.

abnormal phenomena

- asymmetry wear
- partial wear
- abrade
- crack
- abnormality
- invalidation or fail in(spring)
- bend distortion
- abnormal noise(for B/R)
- loose
- color changed or tight
- rust
- deteroprate (for brake plate)

4、 All rubber parts, such as O loop, oil seal, shim etc., can not be reused after disassembly.

5、 When there have noise or shake in transmission system, check the total B/L of rear axle firstly then decide whether to disassembly differential carrier assy'.

Stop the truck on flat ground, push the transmission or transfer into empty speed position, rise the truck after braking with hand brake rod, turn the flange clockwise to bottom, mark matching sign on dust cover & carrier, then turn the flange counterclockwise to bottom, measure the mark moving distance. The limit windage is 6mm，if measured date is bigger then the limit, we must disassembly rear axle and adjust it.

Abnormal noise, which belong to noise, such as clash or harshness etc. abnormal sound under different condition, some can die away after normal wear, some change much bigger, and

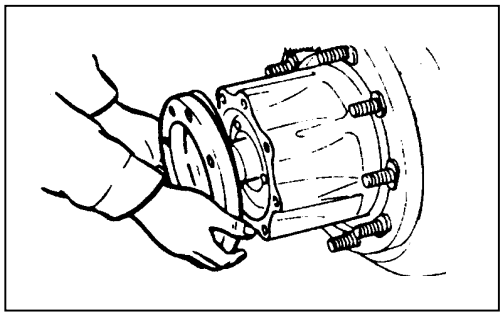
the main reason is adjustment N/G, we can solve them through adjusting the assembly B/L if all parts are good.

6、sometimes the plate cannot return after brake, we can solve it by adjusting brake B/L.

item	(maintenance standard)	(abrasion utmost)	(memo)
abrasion of rear axle spring seat orientation hole		**1mm**	
radial runout of axle spindle B/R neck(left/right)	**—**	**0.1mm**	
radial runout of non-cutted surface(medium section of shaft)	**—**	**1.5mm**	
runout of hub & shaft flange linking surface	**—**	**0.15mm**	

Chapter Ⅲ Assembly and adjust

A、disassembly



disassembly rear axle

1． Wedge the wheel's front & rear position of wheel with triangle templet

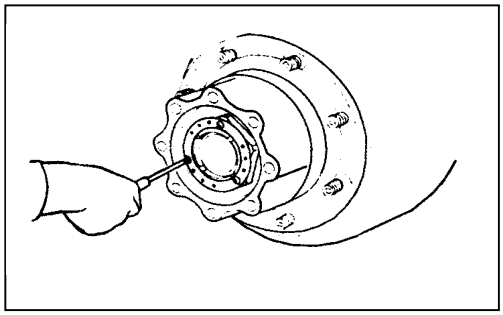
2．Loose the outside wheel nuts

3． Rise rear axle

disassembly shaft

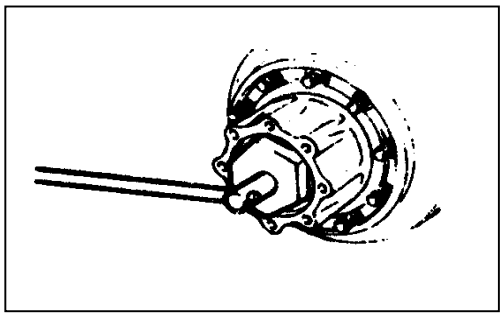
1． Loose shaft nuts

2．Disassembly shaft. if difficult, strike the shaft slightly with copper hammer until it loose



disassembly hub

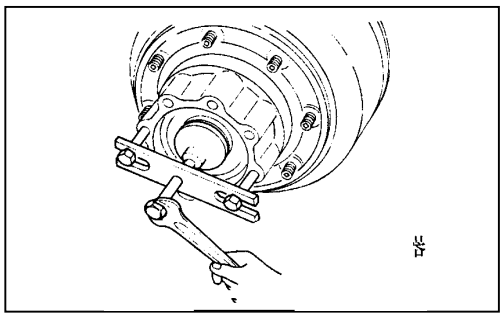
1． Disassembly the lock plate



2． Disassembly the lock nut hub B/R

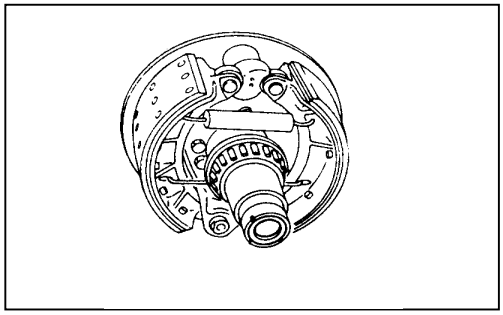
note

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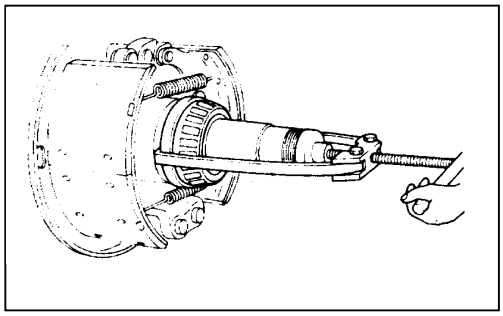
3. the hub assy'

Note: disassembly hub with hub pull tool.



3. Disassembly shaft oil seal from axle spindle.

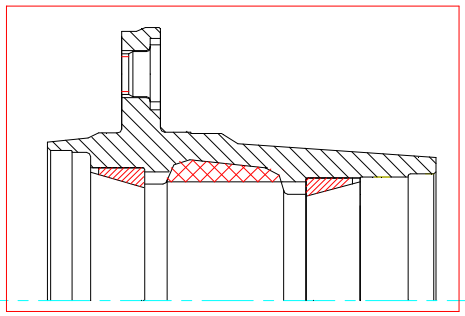
note: the outer loop must apply lubrication then press into hub.

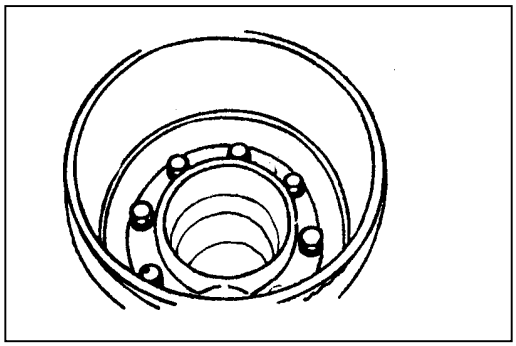


4. Disassembly oil seal bush and inner B/R loop.

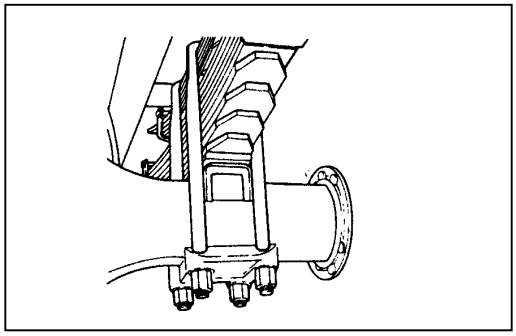
note: oil seal bush must be press into spindle with special tool after heat.

5. Disassembly oil seal from hub assy'.
7. Disassembly the outer loop of inner & outer B/R.





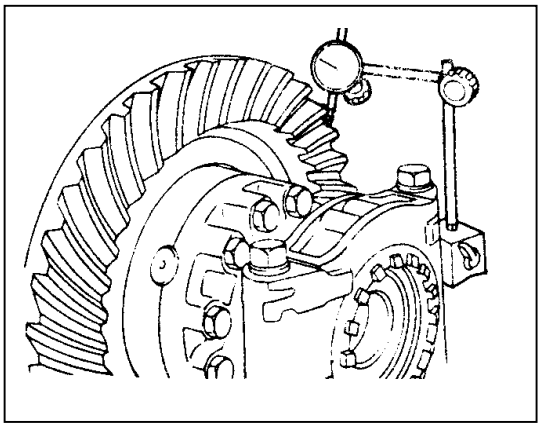
8. Disassembly the brake drum 。



Disassembly axle housing & differential carrier assy'.

1） Drain oil of differential carrier assy'
2） Disassembly the link between transmission shaft and differential carrier assy'.
3） Disassembly differential carrier assy' with jack.
4） Disassembly tube, steel pipe & wire bind.
5） Disassembly brake assy'.
6） Disassembly rear axle
·Rise axle housing with jack
·Disassembly U bolt & upper/below plate.

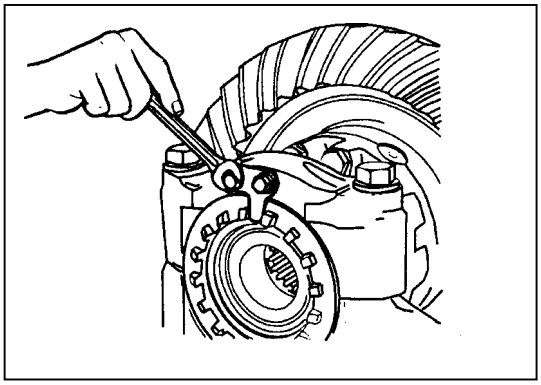
Pull the axle housing



Disassembly differential carrier assy'

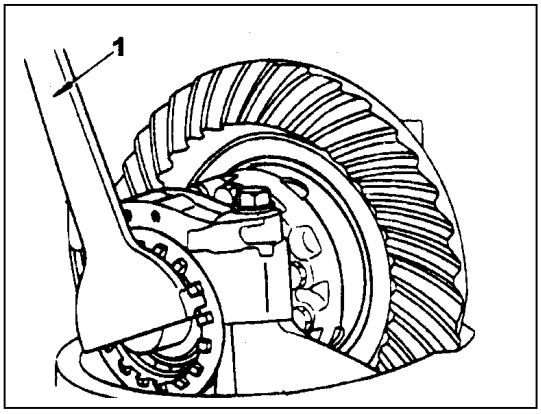
1）、check and record the B/L of pinion & ring gear before

Note: check the mesh condition of gears after adjust

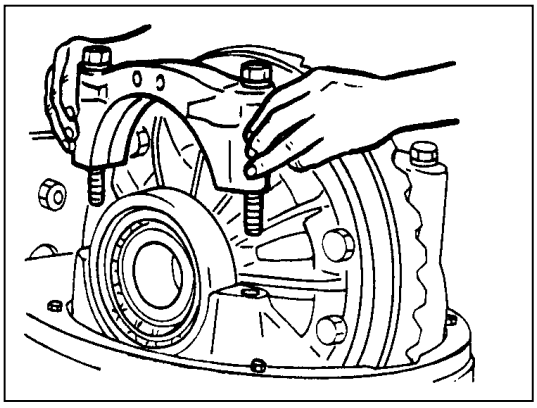


2）、Disassembly lock plate

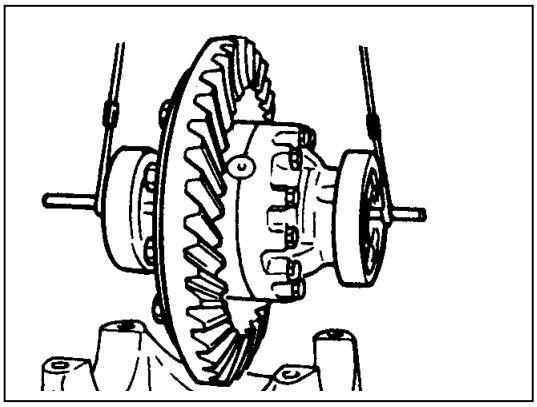
3）、Mark matching sign on the B/R cover & carrier



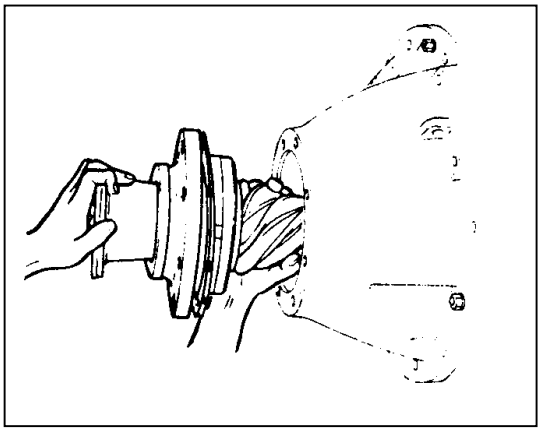
4）、loose bolt of B/R cover, then disassembly adjust nut with



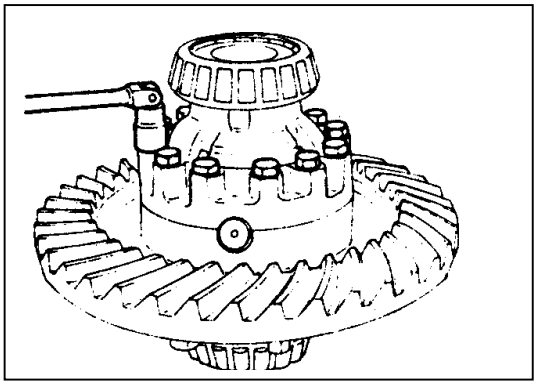
5）、disassembly B/R cover & bolt



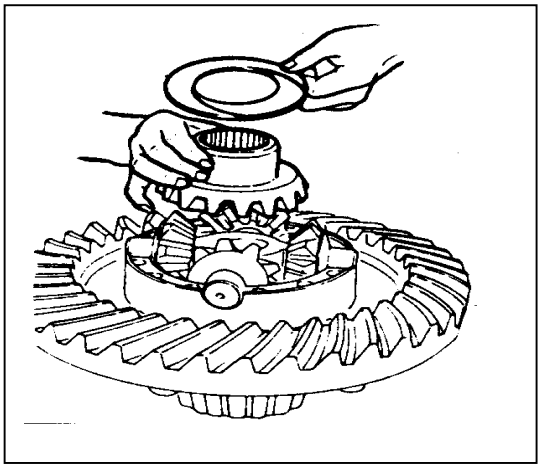
6）、disassembly the differential case assy'



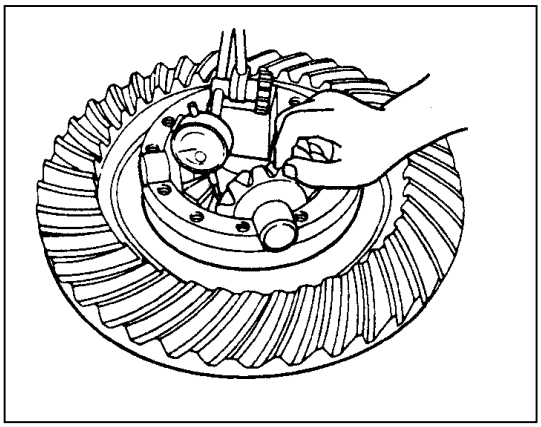
7）、
disassembly the pinion gear assy' with special disassembly implement, and disassembly the shim



disassembly differential case assy'
1）、disassembly right case

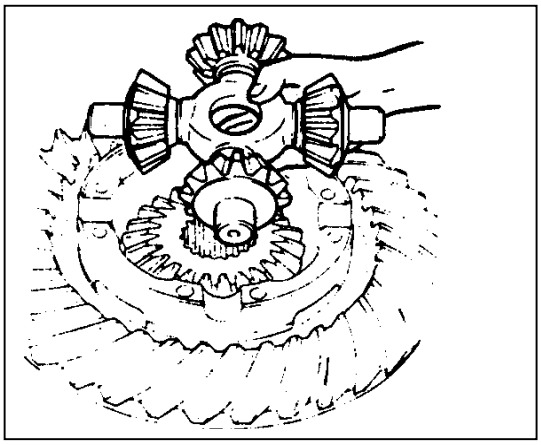


2）、disassembly shaft gear & shim

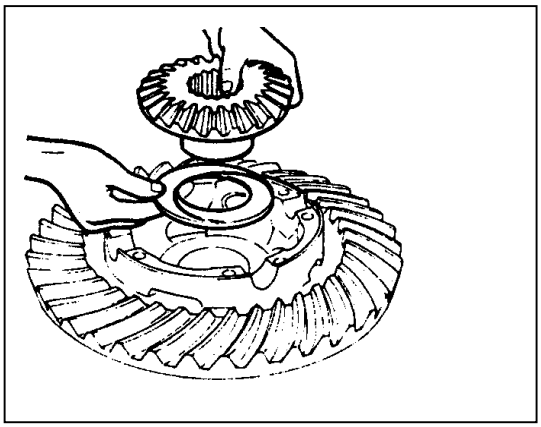


3）、Inspection and record the backlash of planet gear

Note: locking the cross shaft when check backlash

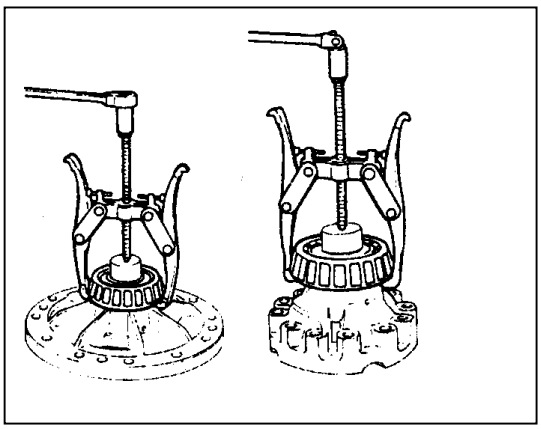


4）、disassembly the cross shaft & planet gear assy', then take out the planet gear and washer

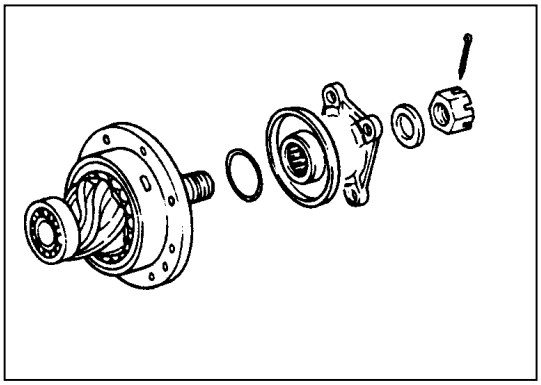


5）、take out shaft gear and shim

6）、remove the ring gear

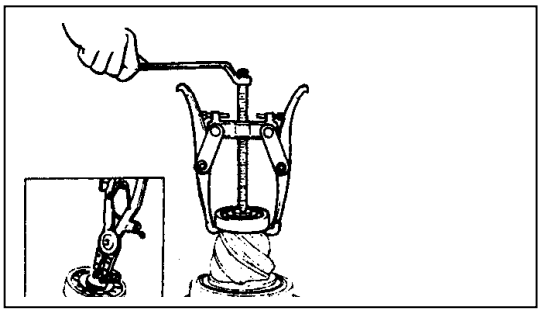


7）、disassembly differential case B/R

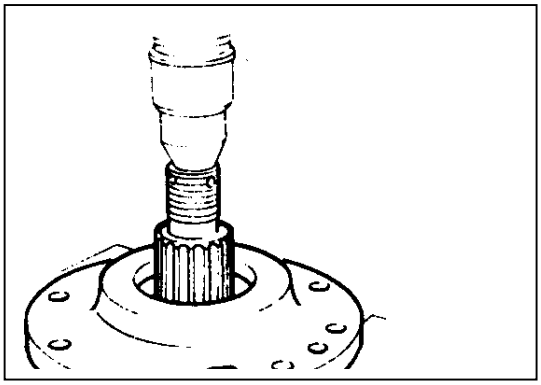


disassembly of pinion gear

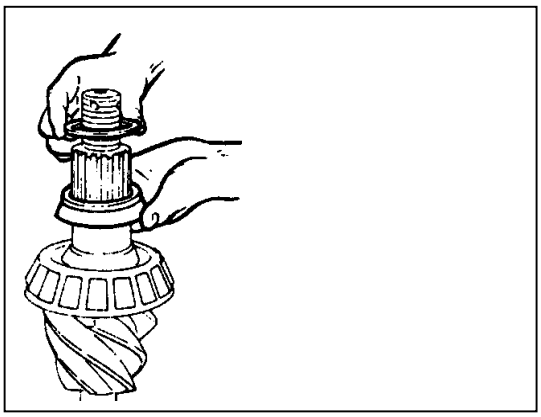
1）、Disassembly the nut of pinion gear flange



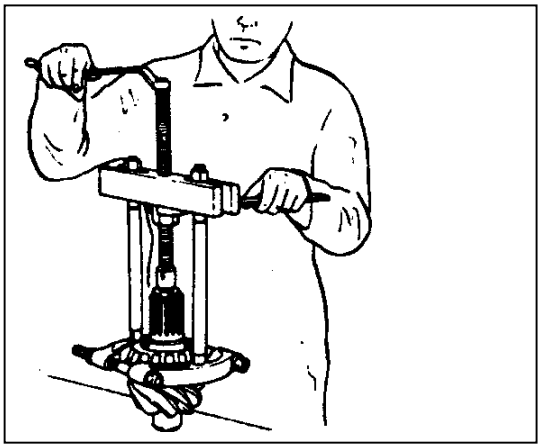
3）、Disassembly spring loop and take out the roller B/R



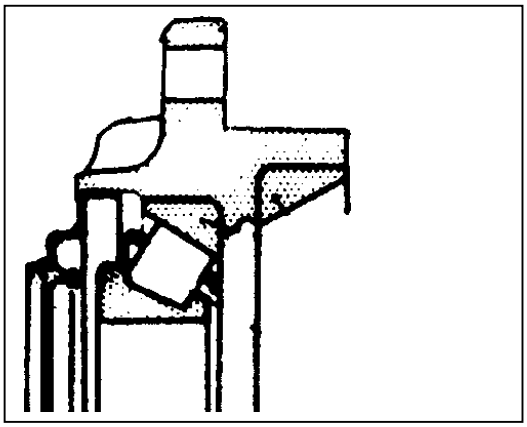
4）、push out the pinion gear



5）、disassembly adjust shim and distance washer



6）、disassembly B/R from pinion gear



7）、take out oil seal from B/R housing

8）、disassembly inner loop & outer loop of the B/R

key point in disassembly

1. Check whether the pinion flange worn or broke
2. Check whether B/R worn or color changed
3. Check whether gear have crack
4. Check whether the pinion & ring gear worn or crack.
5. Check whether the shaft gear, plant gear and & plant gear shaft worn or crack.
6. Check whether shaft gear worn or broken

B、assembly and adjustment of rear axle

A）、the assembly of differential carrier assy' is reverse with disassembly.

1、preload of pinion fear inner & outer B/R

1.1 The taper B/R must preload when assembly differential carrier assy', that is on the basis of removing B/L of B/R, press somewhat preload more, the aim is to decrease pinion gear axis

movement in transmission. But the preload can not press too much, or the B/R will be worn rapidly.

1.2 Adjustment of pinion gear preload: after tight pinion nut, assembly pinion oil seal and adjust the preload(without ring gear)(according to table 2) through remove or add shim between inner and outer B/R. adding shim, preload also add and remove shim, it will be decrease.

2、Adjustment of differential case B/R preload.

2.1 Adjust of differential B/R : differential B/R should have suitable preload, make two side over0.01-0.02mm. the B/R start torque is 0.686-1.586 N.m when lubricating the B/R with gear oil under pinion & ring gear non-match condition. It can get through tight side nut. Tight cover bolt, then adjust preload. After adjustment, the lock slot should align to lock plate and ring gear have no axis movement.

2.2 adjust B/L of differential case gear

Measuring planet gear B/L with gauge. Note: check more then 3 point, standard:0-0.15mm;

3、adjust of pinion & ring gear B/L and pattern.

3.1 adjust B/L

The standard B/L and vary (according to table 5), should check it along ring gear edge 4 points, and the gauge head should be perpendicularity to check point.

3.2 adjust pattern.

Applying red paint on the ring gear tooth, turning the ring gear come-and-go, then checking the print of tooth's both side. If the print lie in medium and near to small side, total to 60% of whole tooth surface, we can decide the pattern is good(according to attached picture1). We can get the pattern through adjusting the pinion gear housing shim(table 6) and adjusting differential case B/R nut.

One B/R nut out circle should equal to another side nut in circle, thus the preload of side B/R will not change. Recheck B/L and lock the lock plate.

B）Rear hub bearing play: Screw the nut in bearing as to you can't rotate brake drum or rotate it difficultly, then loose the bearing nut one sixth or one eighth turn, and rotate brake drum, in the condition of brake wafer can't connect with brake drum, pull the tire bolt in tangential direction by the force 3-5kg(HF15015、HF16016), or 3-6 kg（HF17030）68.6-78.4N, or when rotate brake drum by hand it can be rotate freely.

C)Adjusting the play of later brake:

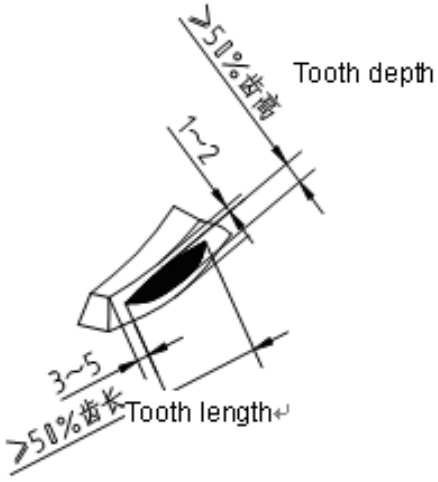
Hydraulic brake: according the direction of double direction balance brake plate beside the adjusting hole, first turn the two teeth by one direction, make the brake drum connect with brake

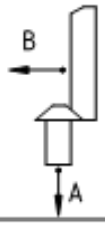
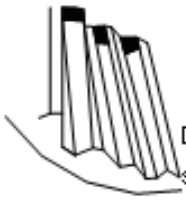
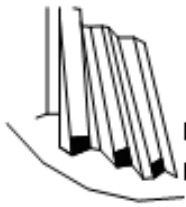
plate tighten, then turn the teeth by direction, make the brake drum rotate freely.

Air brake: rotate worm shaft of adjusting pole by wrench, make the brake drum connect with brake plate tighten, as to can't rotate the brake drum, then rotate worm shaft by different direction one second to one third turn, as to brake drum can rotate freely and no noise.

Table 6 plate spec.（mm）

G1510	
Adjusting plate for BRG seat of drive gear	Adjusting plate for drive gear BRG
0.1	1.3-2.25(0.05mm difference per step)
0.15	
0.2	
0.3	
0.4	
0.5	
1	
2	



Contact status of driven gear working tooth face	Causes	Adjusting method A-Adjust tooth face contact area
 Deviate to crest	Drive gear to too far from the driven gear	 1. Driven gear away from the drive gear. 2. Drive gear closer to driver gear to achieve correct backlash (add washer).
 Deviate to root	Drive gear is too close to the driven gear	 1. Driven gear closer to the drive gear. 2. Drive gear away from the driven gear to achieve correct backlash (reduce washer).
 Deviate to small end	Driven gear is too close to the drive gear	 1. Driven gear away from the drive gear. 2. Drive gear away from the driven gear to achieve correct backlash(reduce washer).
 Deviate to big end	Driven gear is too far from the drive gear	 1. Driven gear closer to the drive gear. 2. Drive gear closer to driver gear to achieve correct backlash (add washer).

Adjustment Method of Gear Meshing Backlash

Chapter Ⅳ Use and maintenance

1、As for the hypoid gear, the stated gear oil should be used other than common oil.

2、The taper gear of differential carrier mustn't be disassembled and adjusted randomly.

3、The dust on the axle housing should be cleaned periodically and make sure the ventilation inside and the lubrication should be checked as well.

①.As for the first second-class maintenance of the new vehicle, the lubrication should be changed .When the new car drives 40000km or for 24 months, the lubrication of rear axle should be changed. Firstly, discharge the gear oil and add kerosene , then discharge it and add new stated lubrication(GL-5,85W/90).After driving 80000km or for 24 months, change the lubrication. Then change the lubrication per 50000km.

After that, the quality of lubrication should be checked every four times of second-class maintenance. If abnormal, please change the new oil.

②.Please check the status of brake shoe lining and brake drum after driving 40000km or for 24 months and change the brake shoe lining in time.

4、As for the third-class maintenance, clean the the inner chamber and differential carrier assembly and screw up the bolts in different parts.

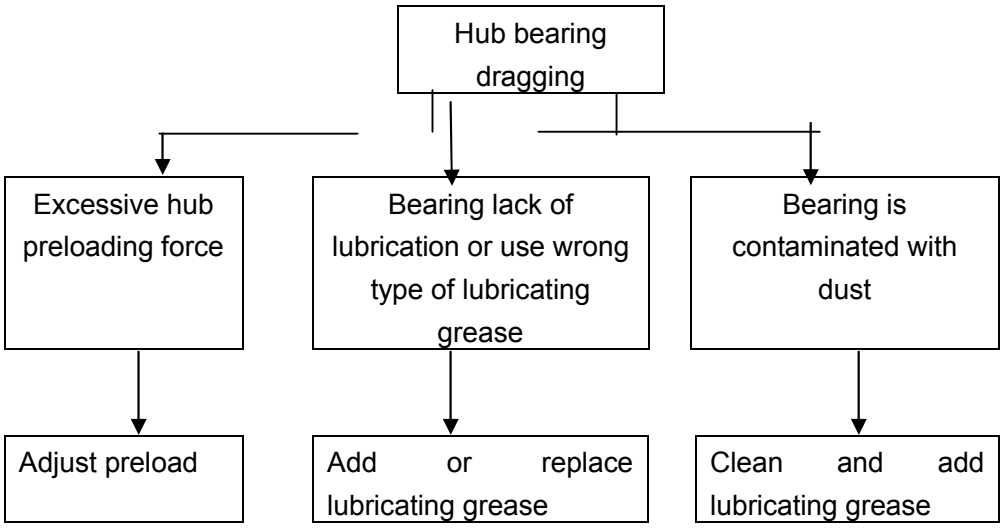
5、Attentions'

①When loading, please don't exceed the maximum load capacity.

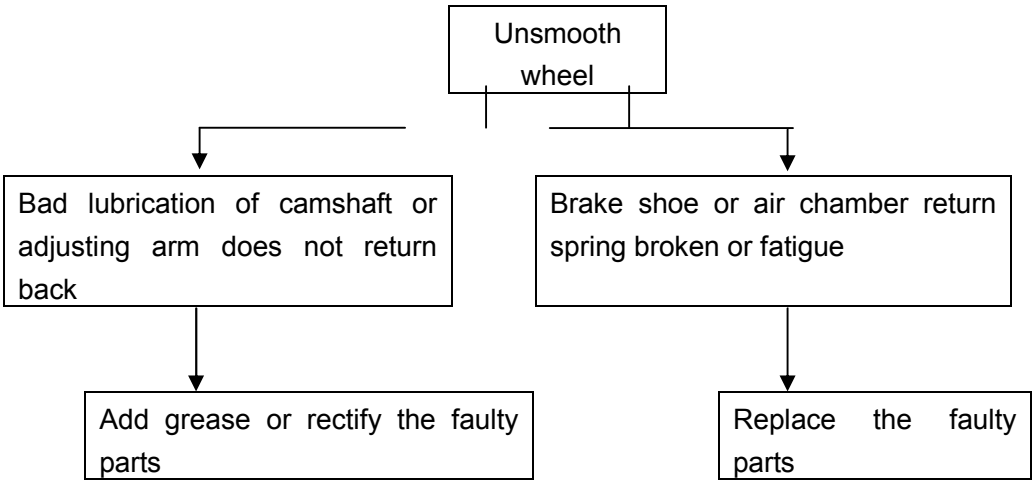
②When driving, please don't lift clutch with great force so as not to break the gears.

Ⅴ Trouble Shooting

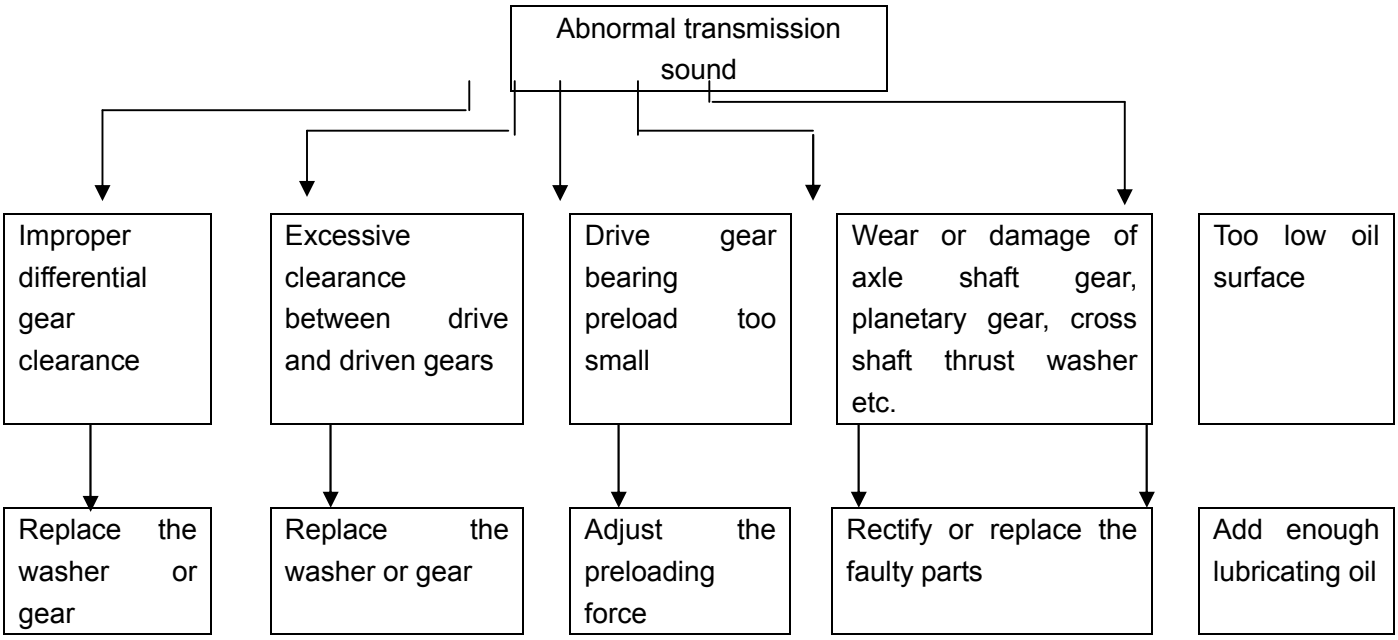
1 Hub bearing dragging



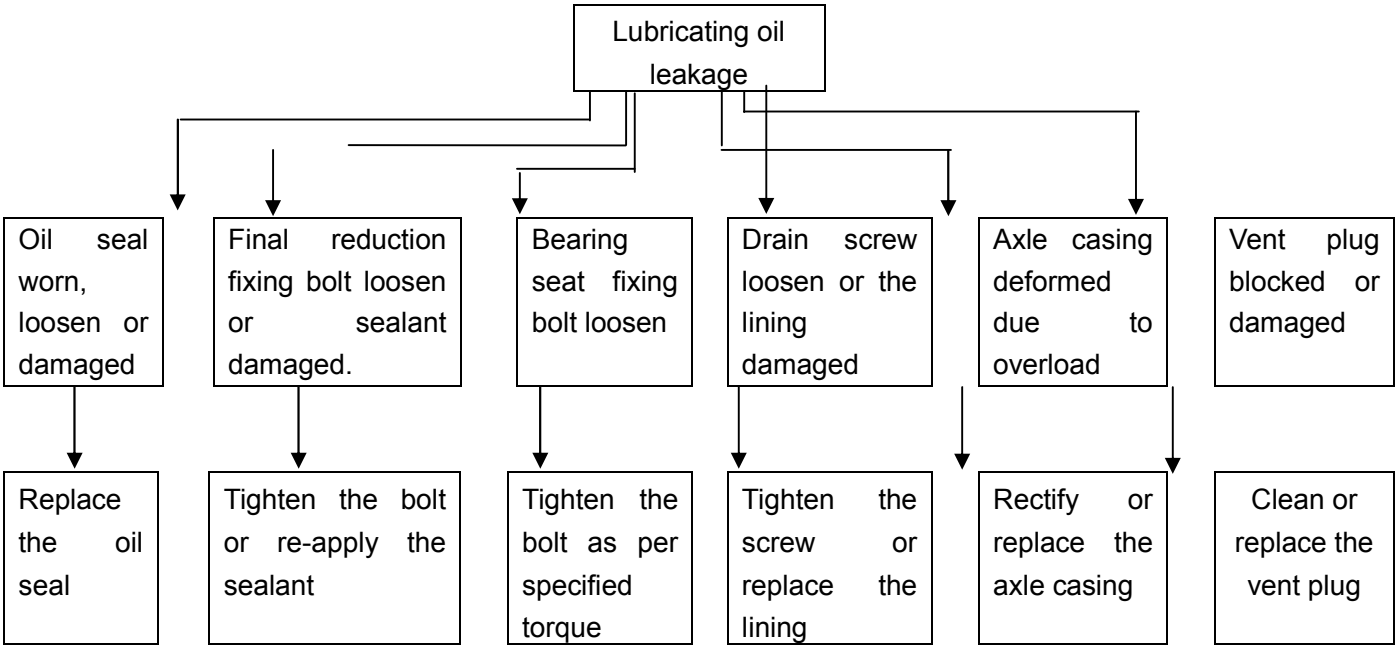
2 Unsmooth wheel



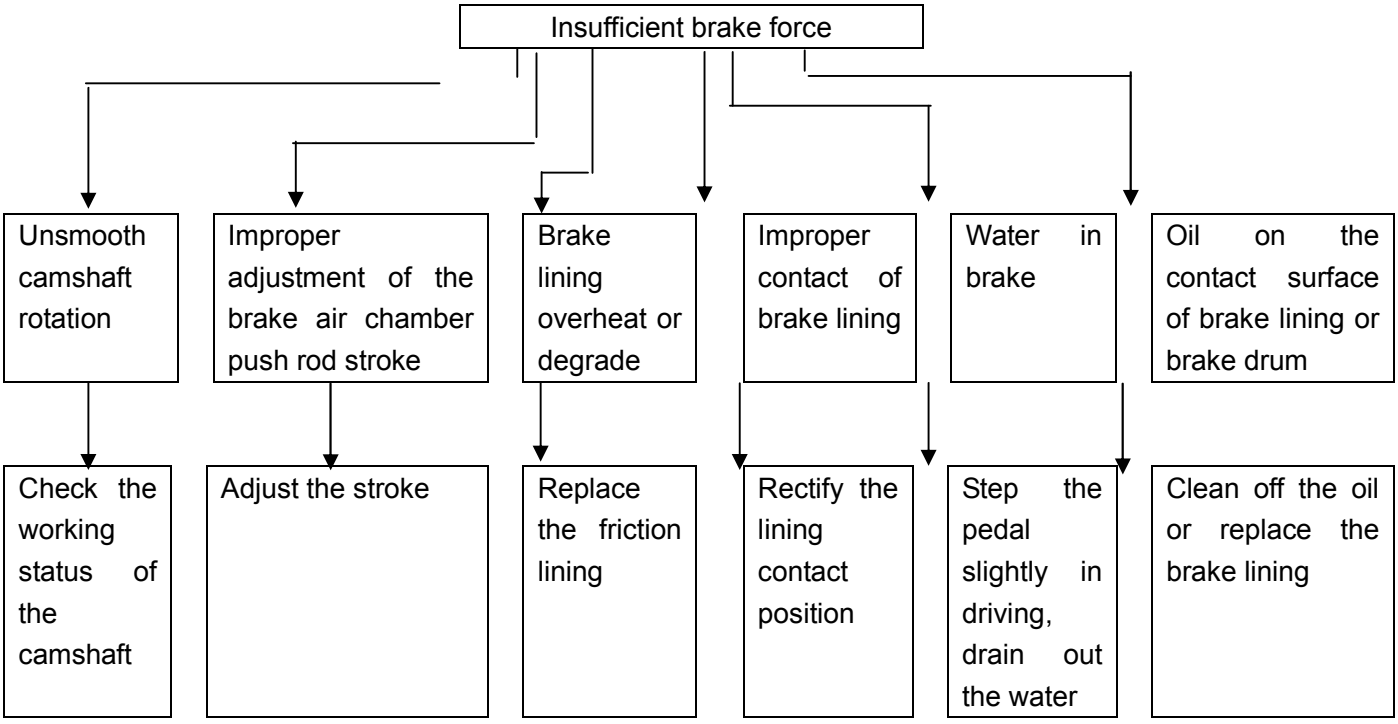
3 Abnormal transmission sound



4 Lubricating oil leakage



5 Insufficient brake force



Chapter Ⅵ Mark introducing

According to the regulation of mark of final product and spare parts' and requirement of Jianghuai Group, we need to provide mark of final product ,including bar code and mark on the axle housing.

1、 ark on the axle housing

①company code:JAC1018

②number of assembly line, 8 figures

The first two figures stand for year, and the third stands for month, using1-9、A、B respectively. The last 5 figures stand for the number of assembly line.

6、 material code(16 figures at most) show the information of the product

7、 The second line will be added if necessary: the model of the product in our company

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Suspension

Front suspension

Overview

Technical parameter

Disassembly

Reassembly

Front shock absorber assembly

Failure diagnosis of front suspension

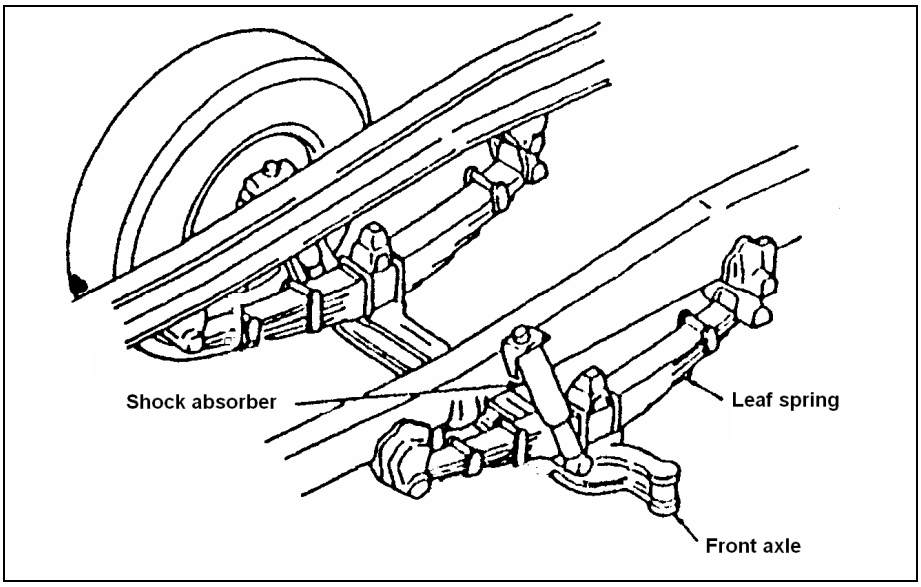
Rear suspension

Failure diagnosis of rear suspension

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General

The leaf springs and shock absorbers, installed between the frame and the front axle, support the weight of the vehicle body. They also absorb vibration and shock from the road surface, thereby preventing their direct transmission to the body for effective protection of the body, passengers, and cargo. Furthermore, they suppress irregular vibration of the wheels to ensure road stability.



Service Standards Table

Maintenance item		Nominal value	Limit	Remedy and remarks
Shackle link	Bushing to pin clearance	0.03 to 0.15	0.5	Replace bushing
	Link to pin clearance	0 to 0.05	0.3	Replace link or pin
Spring bracket to shackle pin clearance		0 to 0.05	0.3	Replace shackle pin
Spring bushing to shackle pin clearance		0.01 to 0.15	0.5	Replace bushing or shackle pin

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Troubleshooting

Note

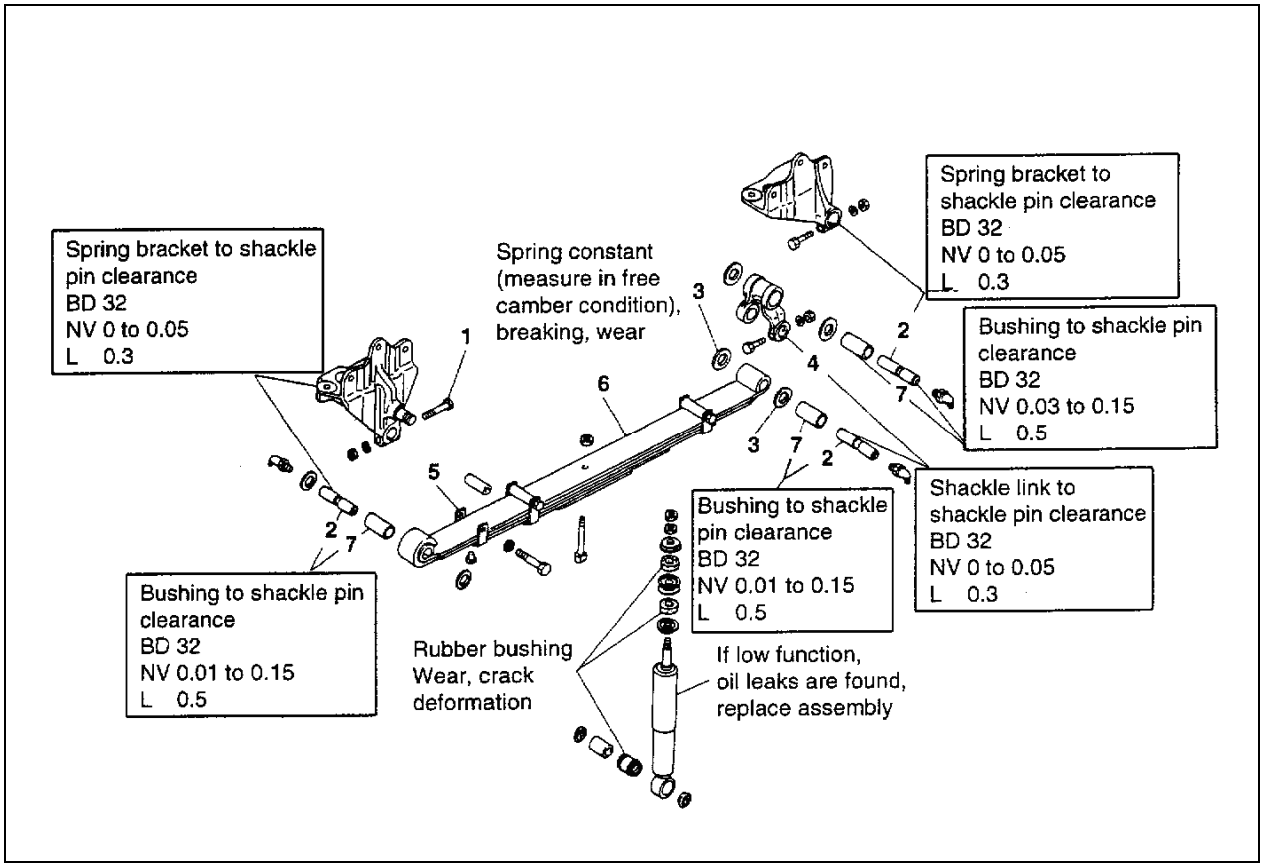
Inspect the front and rear suspension at the same time.

Symptom	Probable cause	Remedy
Spongy feel	Defective shock absorber	Replace
Cyclic bounce	Tire unevenly worn	Replace
	Wheels and tires out of balance	Correct balance
Bumps directly received	Tire inflation pressure too high	Adjust
	Cracked or broken leaf spring	Replace
Vehicles tends to develop noise when not loaded	Broken leaf spring	Replace
	Worn spring metal bushing	Replace
	Worn shock absorber rubber bushing	Replace
	Shock absorber left loose	Retighten
Vehicle tends to develop noise when loaded	Damaged spring bracket	Replace
	U-bolt left loose	Retighten

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Leaf Spring and Shock Absorber

Disassembly and Inspection



Disassembly sequence

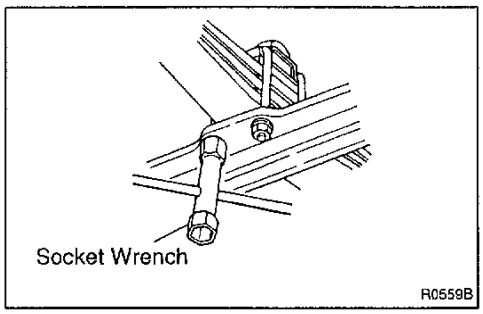
1. Lock bolt
2. Shackle pin
3. Side washer
4. Shackle link
5. Clip
6. Leaf spring
7. Bushing

Note

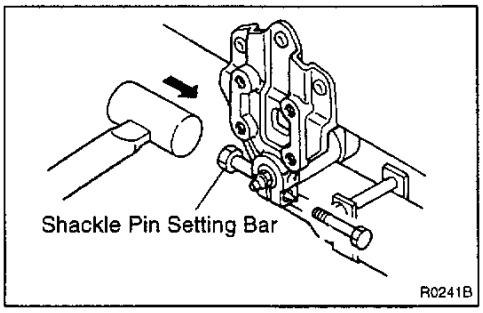
To reassemble, reverse the order of disassembly.

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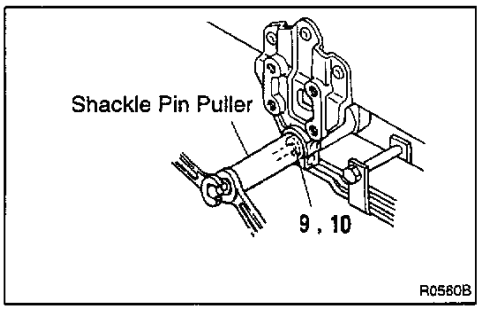
Removal Procedure



1. Removal of U-bolt



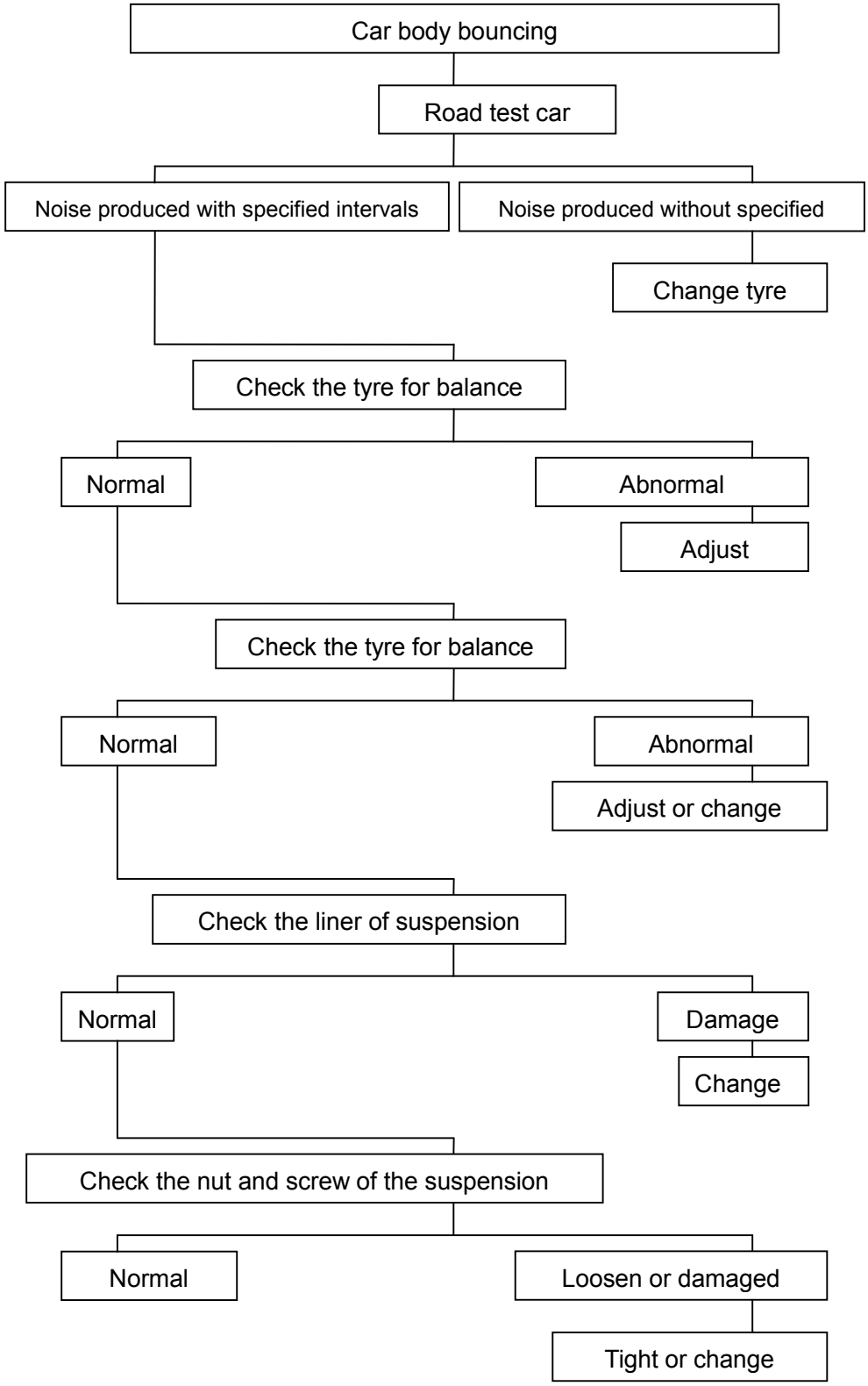
2. Removal of shackle pin lock bolt.



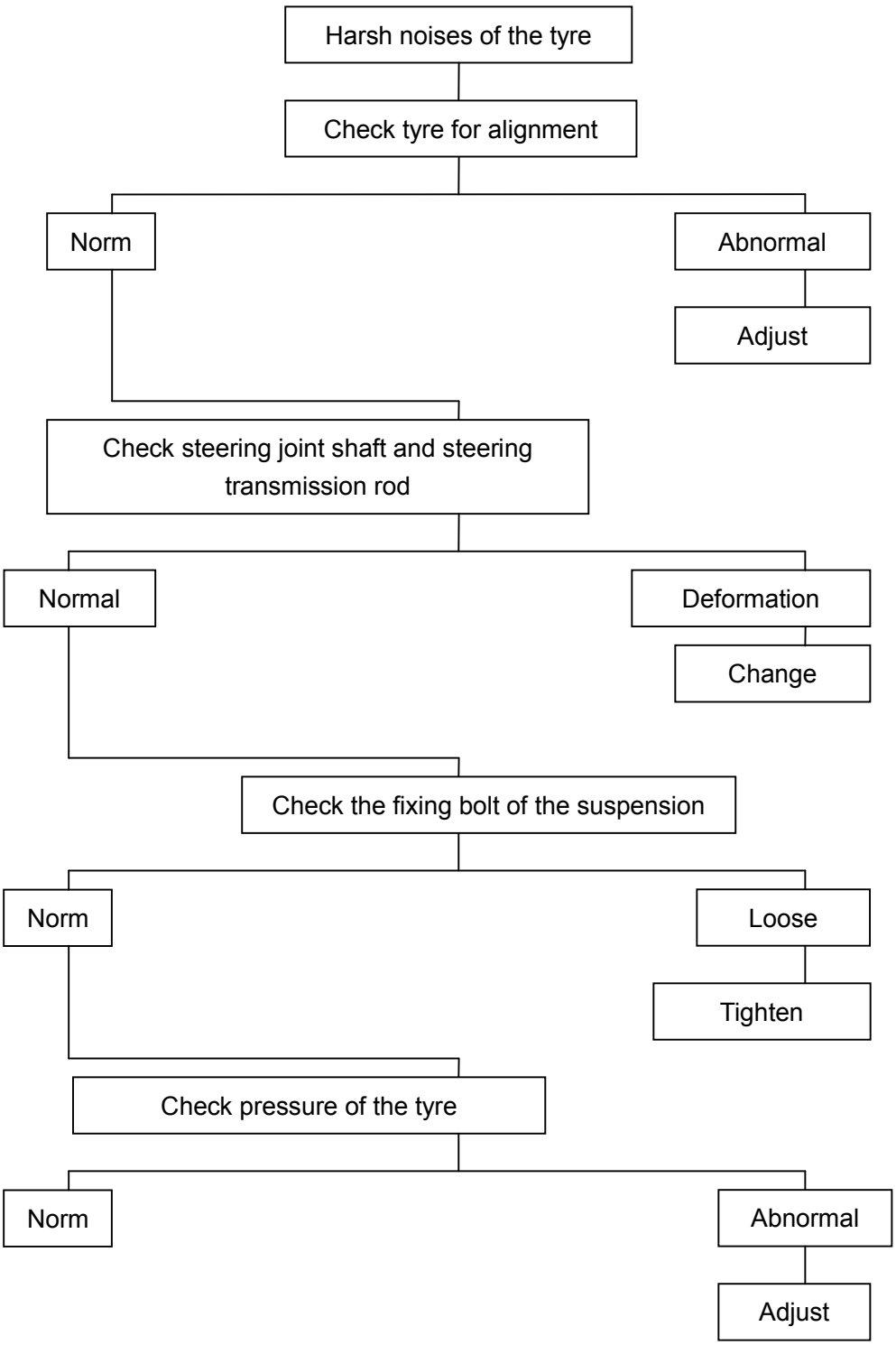
3. Removal of shackle pin
Remove the grease nipple from the shackle pin, then remove the shackle pin.

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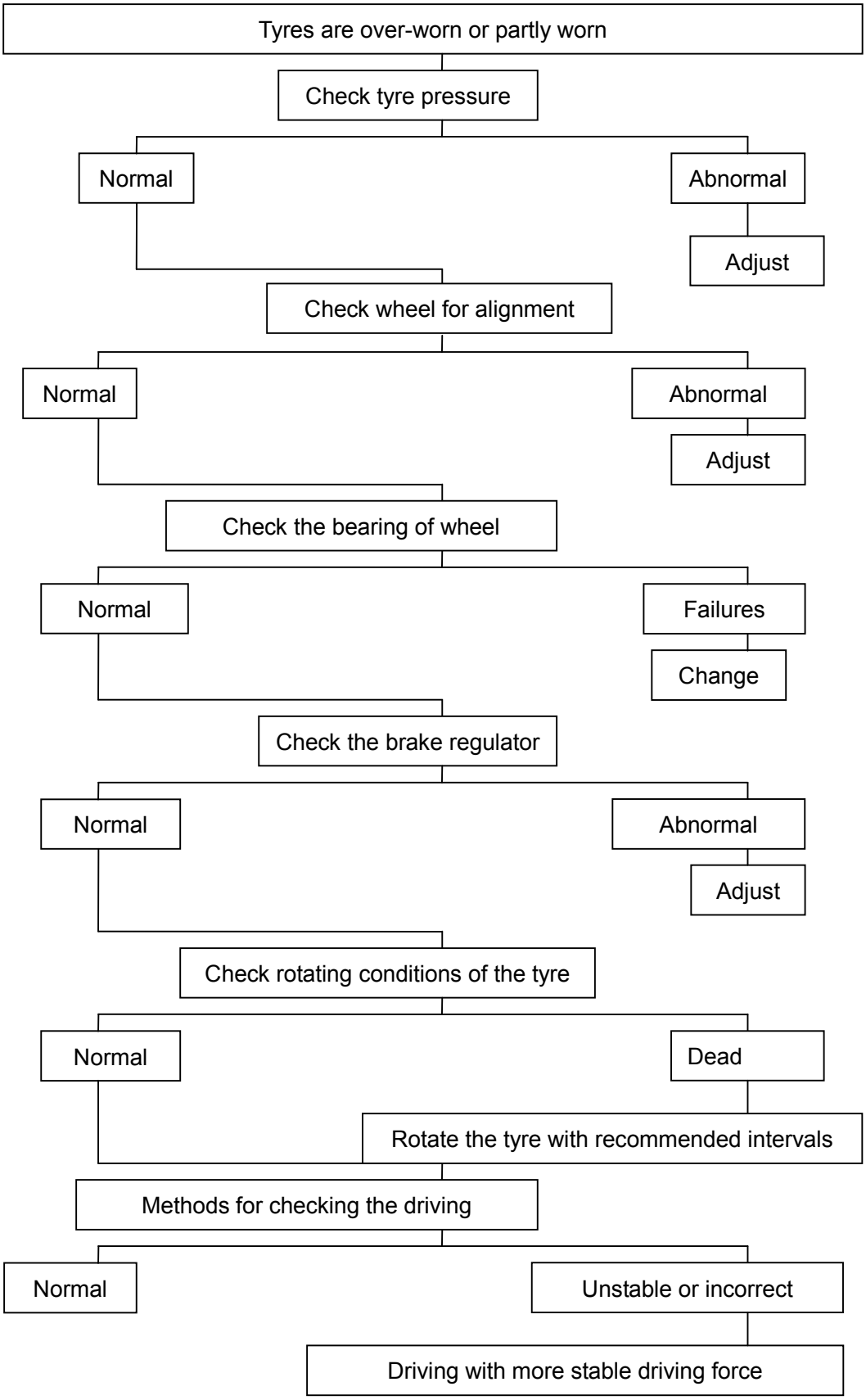
Failure diagnosis of front suspension



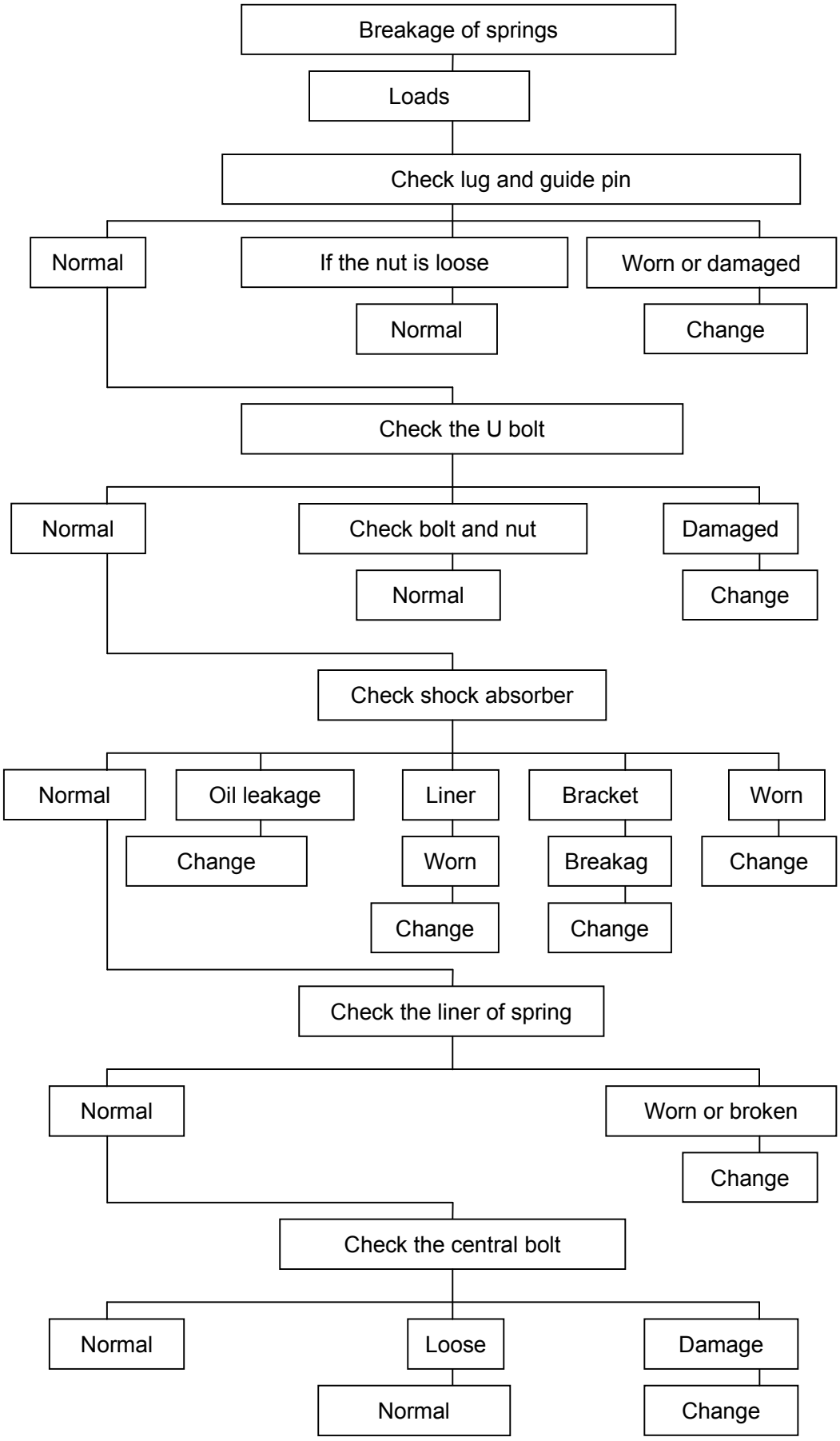
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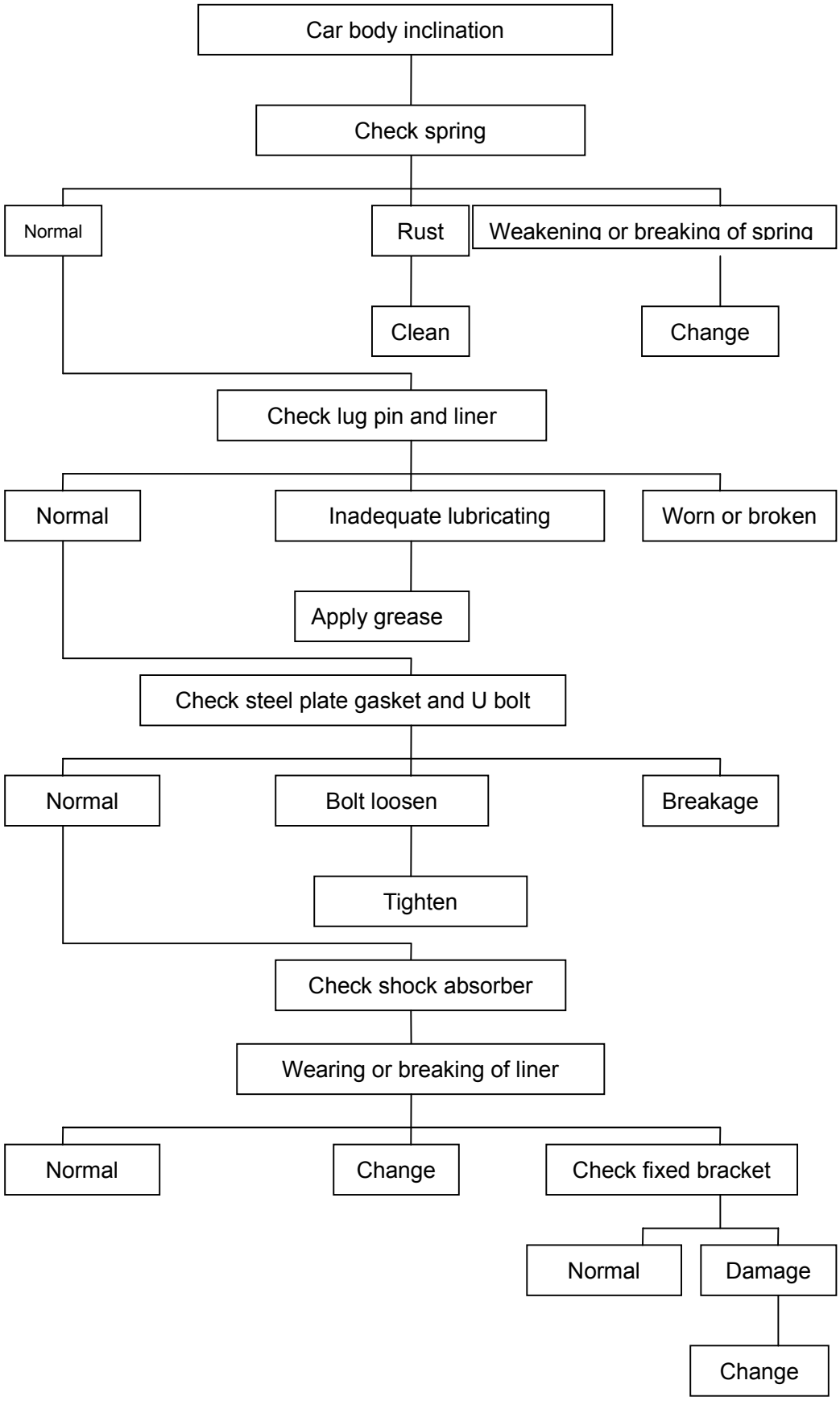
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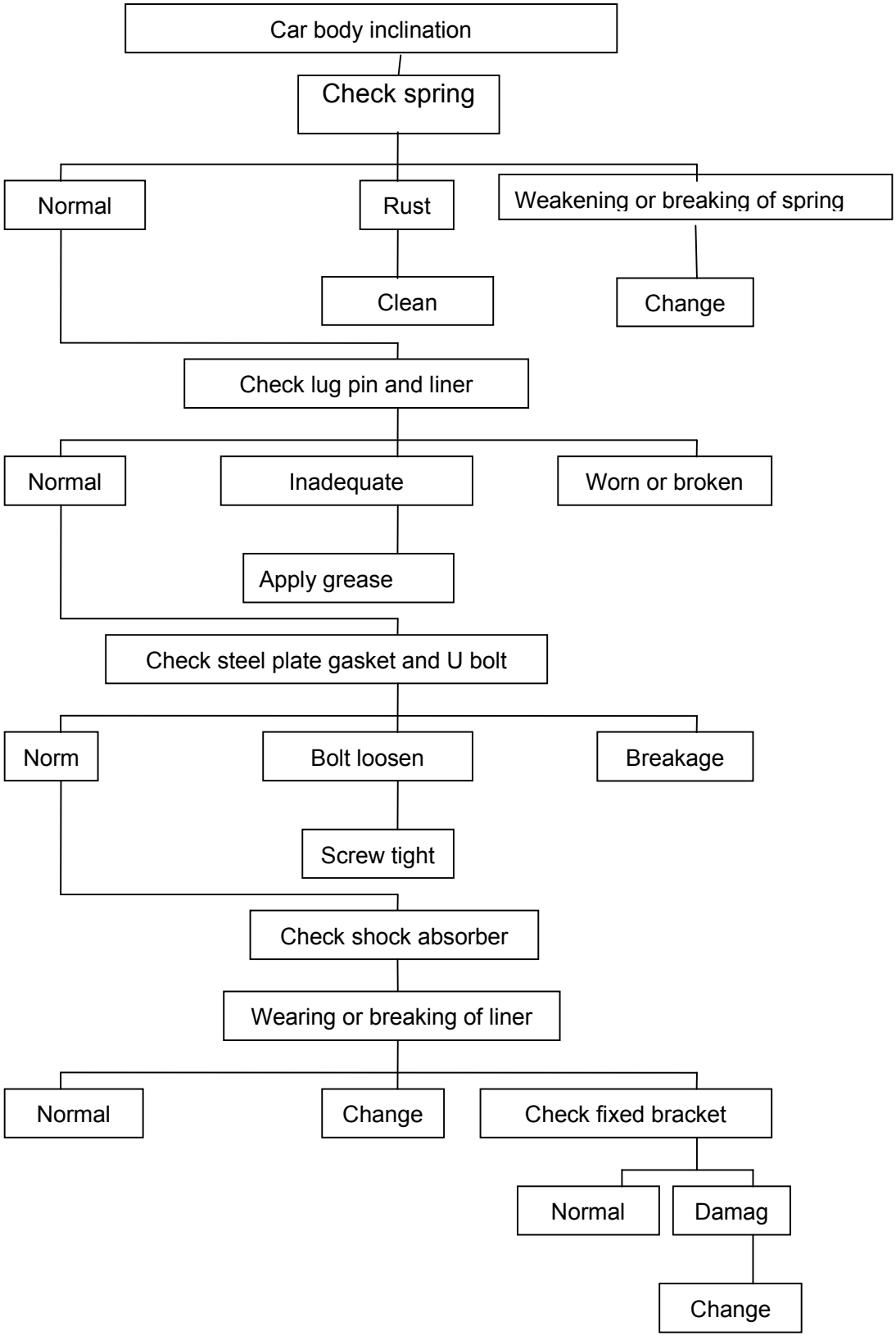


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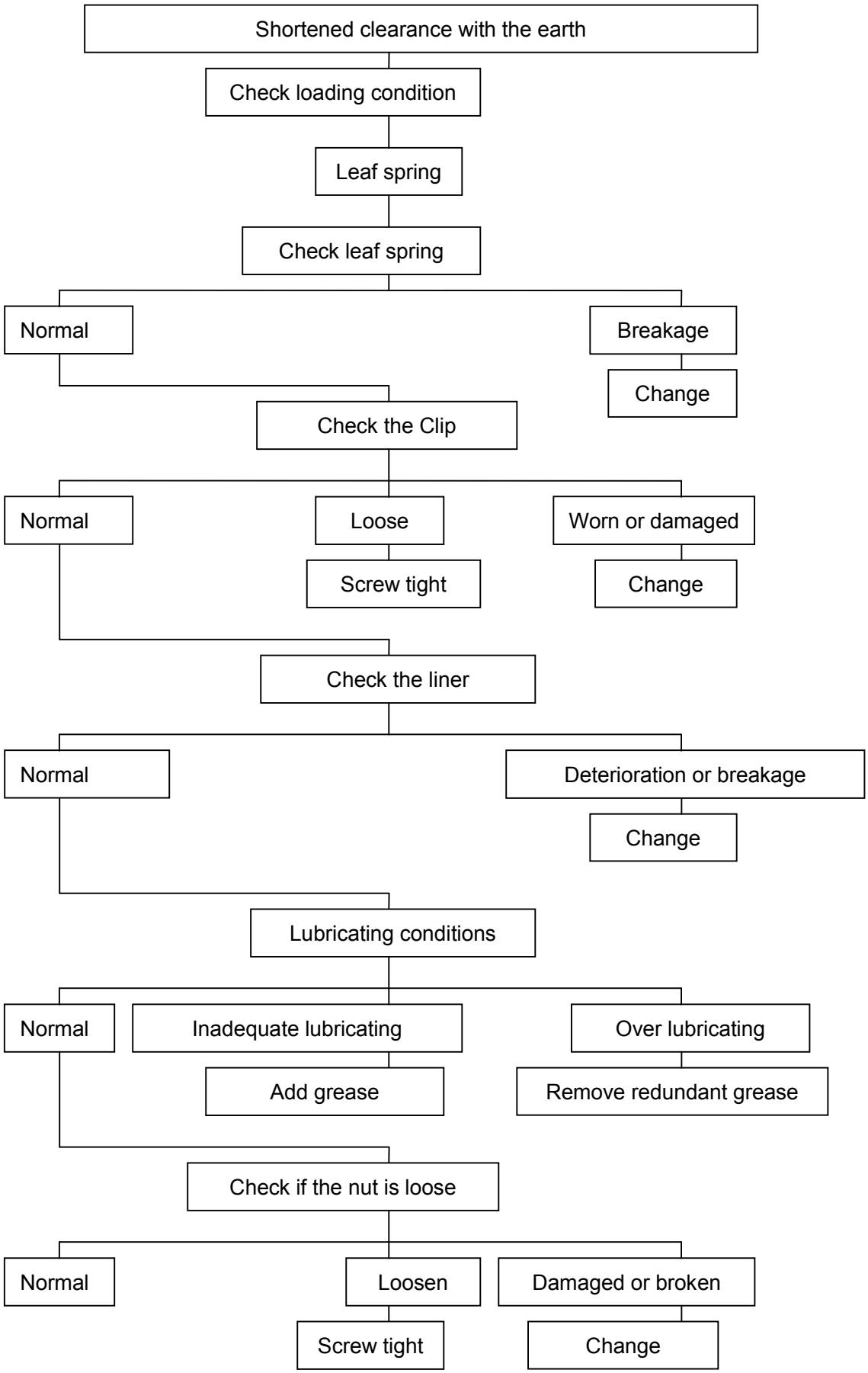


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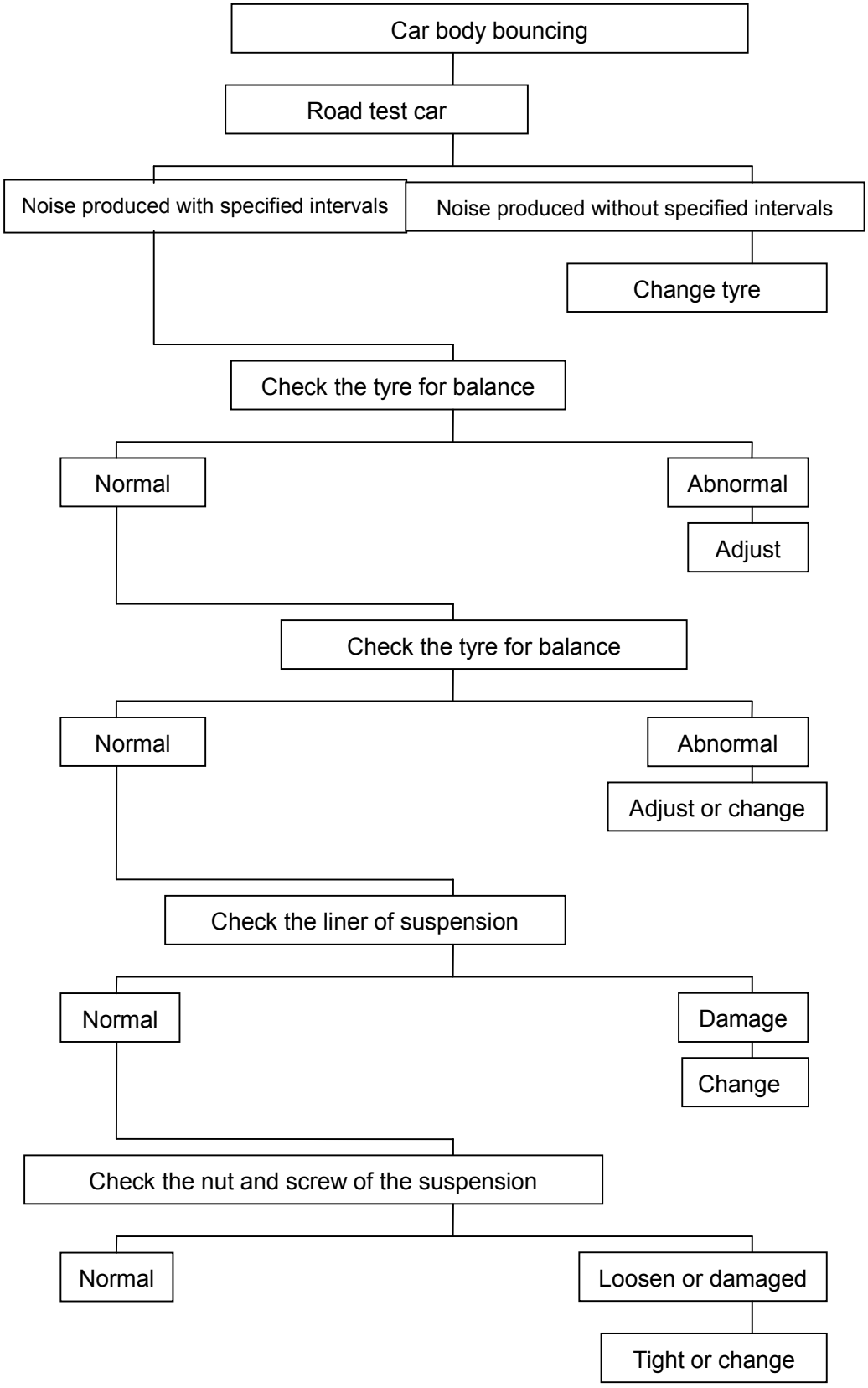
Failure diagnosis of rear suspension



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Air Brake

General

Wheel Brake

Valves

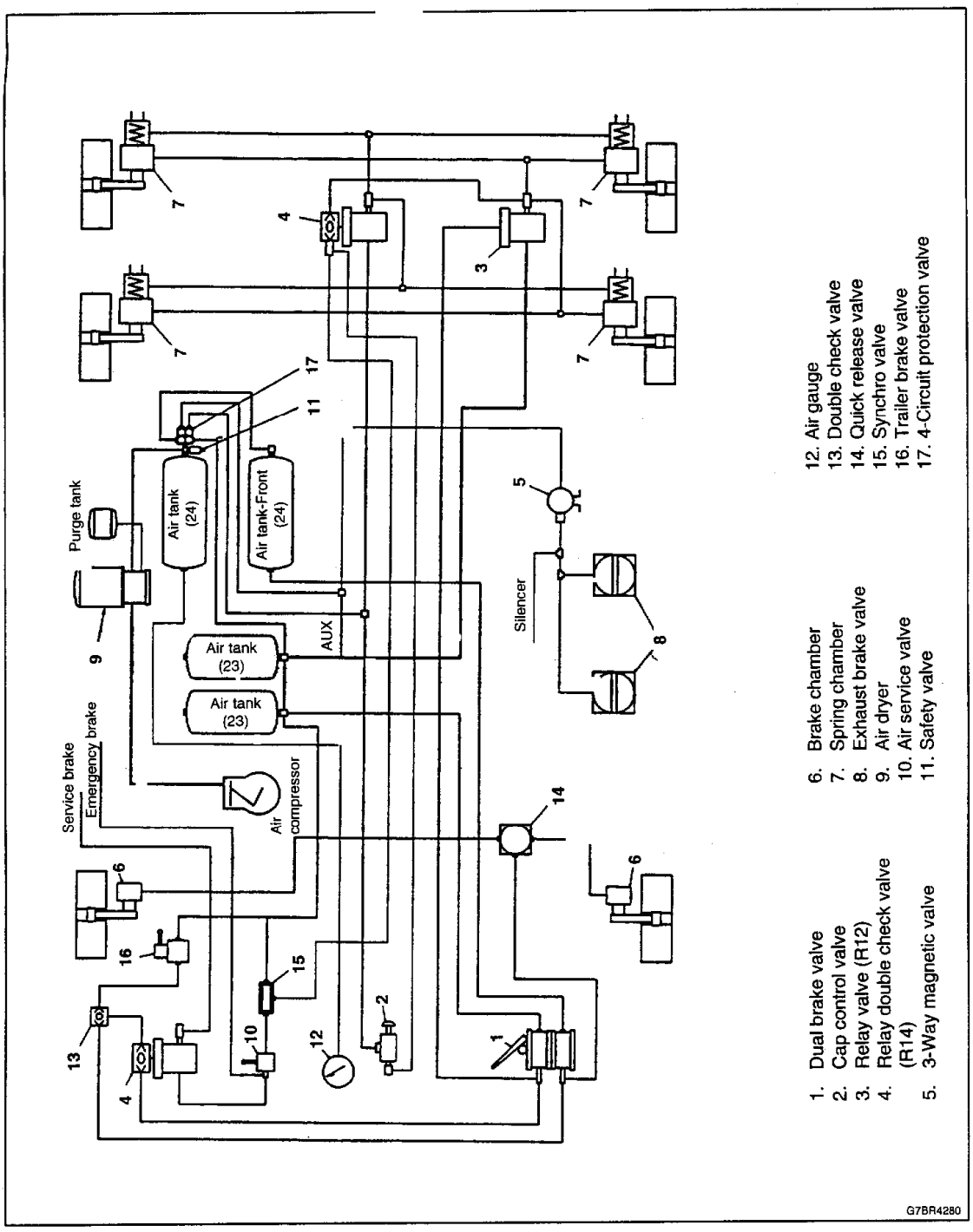
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General

表—参数

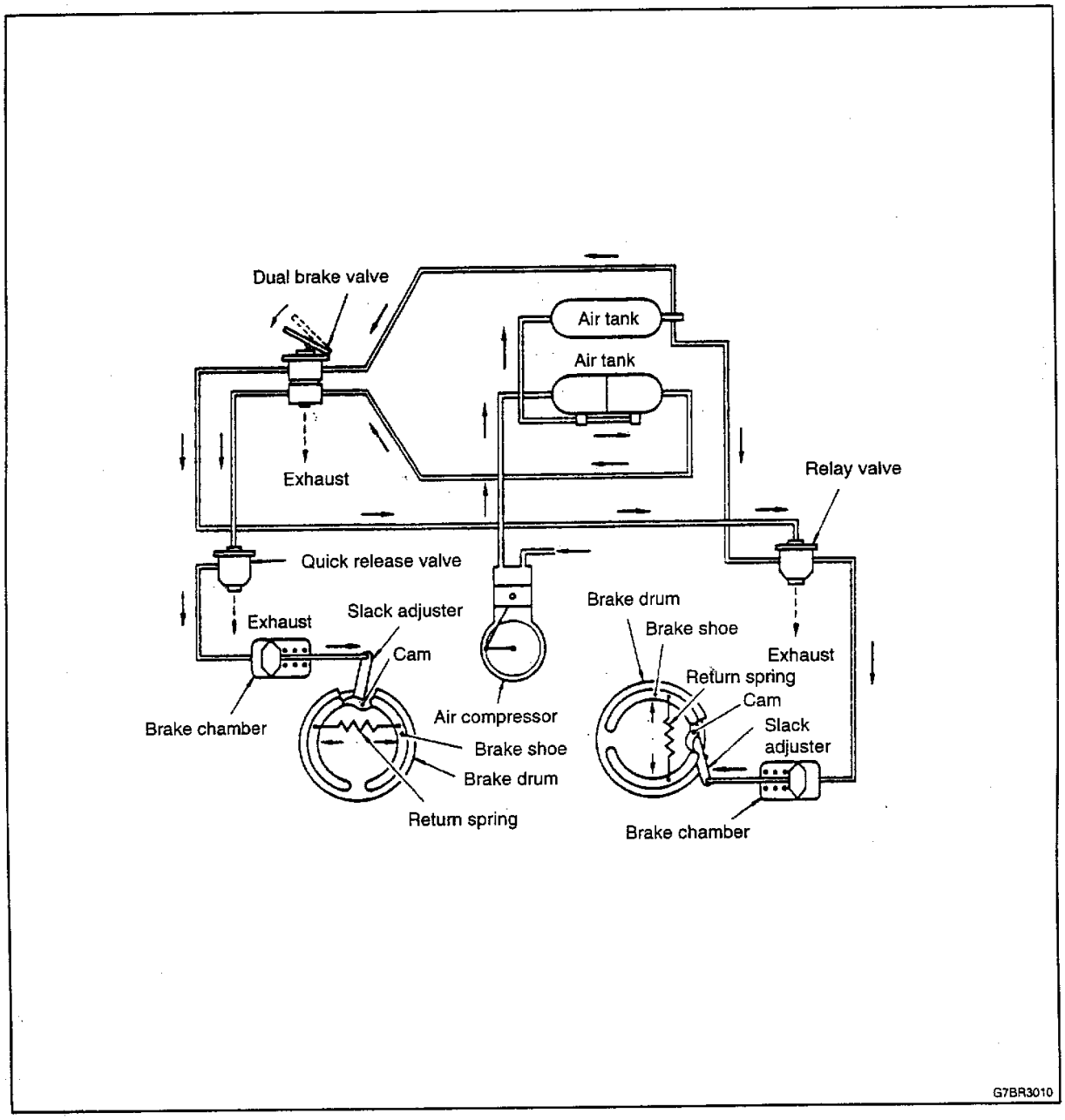
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Working Principle



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Inspection Principle

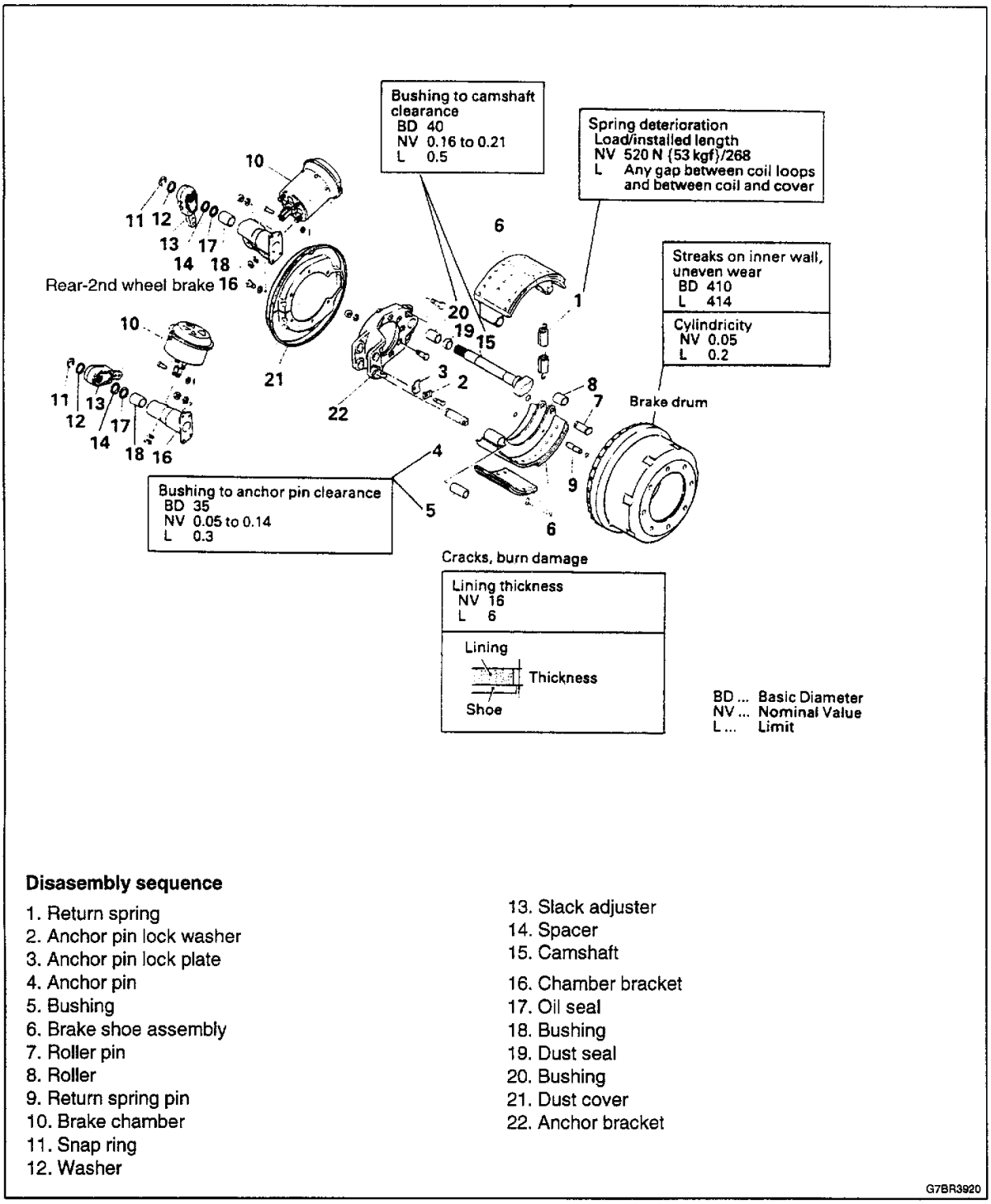


The compressed air is constantly supplied to the delivery port of the air brake.
When the pedal (dual brake valve) is depressed, the compressed air flows via the relay valve (quick release valve in the case of the front wheels) to the brake chamber to actuate the slack adjuster. The slack adjuster turns the cam which forces the brake shoes against the brake drum to decelerate or stop the vehicle.
When the pedal is released, the compressed air is released to atmosphere and the brake shoes return to the original position.

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Wheel Brake

Disassembly，Inspection



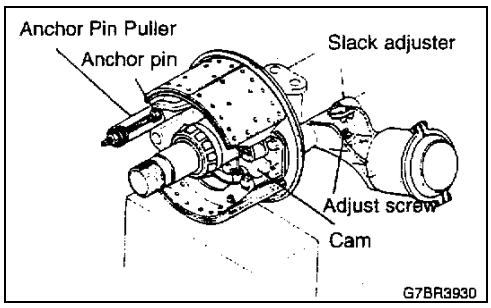
Disasembly sequence

1. Return spring
2. Anchor pin lock washer
3. Anchor pin lock plate
4. Anchor pin
5. Bushing
6. Brake shoe assembly
7. Roller pin
8. Roller
9. Return spring pin
10. Brake chamber
11. Snap ring
12. Washer
13. Slack adjuster
14. Spacer
15. Camshaft
16. Chamber bracket
17. Oil seal
18. Bushing
19. Dust seal
20. Bushing
21. Dust cover
22. Anchor bracket

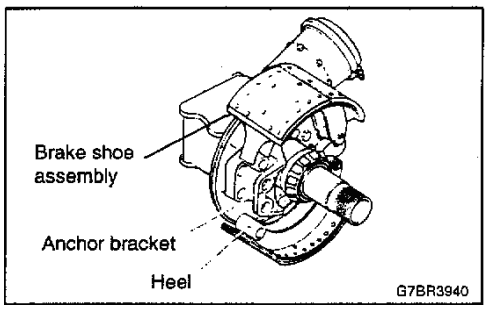
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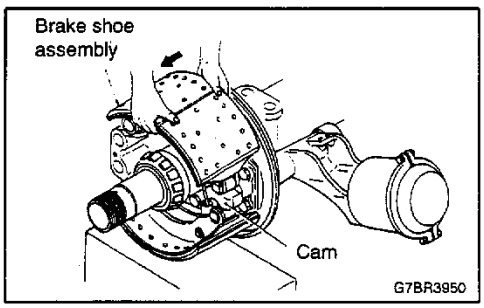
Disassembly Procedure



1. Removal of brake shoe assembly
   1) Turn the adjust screw of the slack adjuster so that the cam is not forcing the shoe expand. Using the special tool, remove the anchor pin.



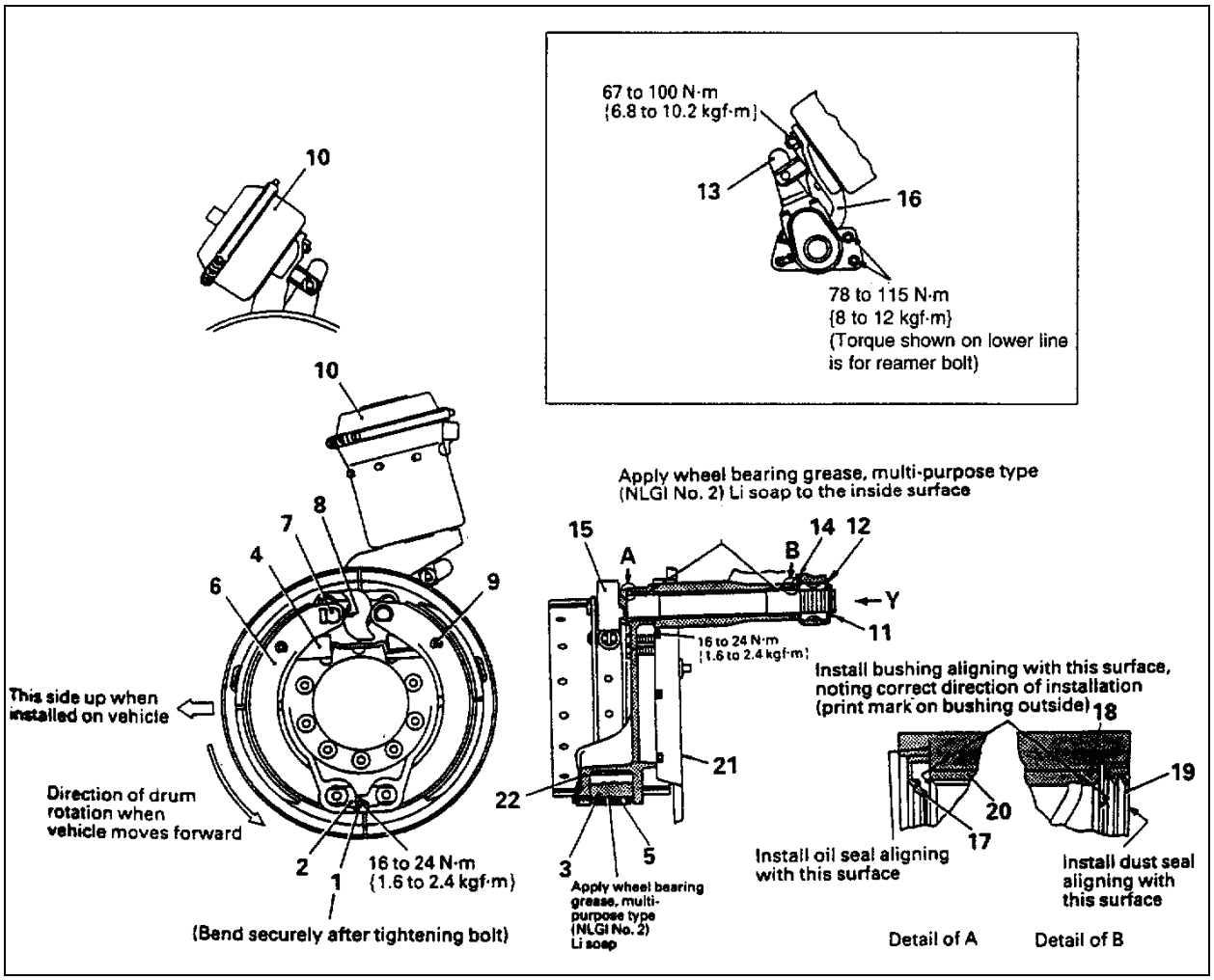
   2) Remove the lower brake shoe assembly heel from the anchor bracket. Similarly remove the upper brake shoe assembly.



   3) Holding the upper brake shoe assembly and sliding sideway, remove the assembly from the cam. Then remove the return spring.

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Reassembly



Reassembly Sequence

22 → 21 → 16 → 20 → 17 → 18 → 19 → 15 → 14 → 13 → 12 → 11 → 4 → 3 → 2 → ①

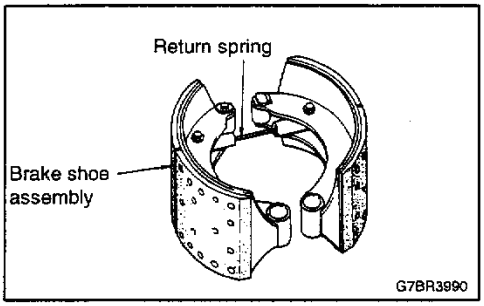
⑥ → 5 → 8 → 7 → 9

For reassembly of parts with an encircled number, see procedure given in the following.

NOTE

1. **Use 1.2 mm thick washer at the slack adjuster only when 2 mm thick washer cannot be installed.**
2. **Install bushing on the anchor bracket side of the camshaft after installation of the chamber bracket.**
3. **Keep the drum inside and lining surface free from oil and grease.**

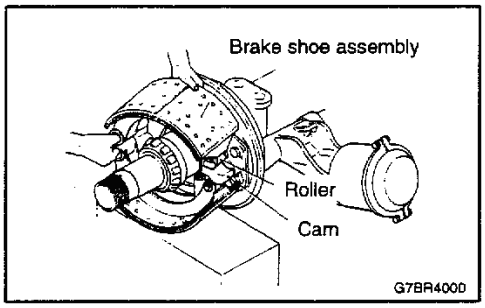
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Reassembly Procedure

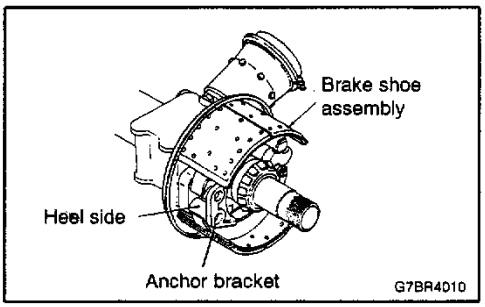
Installation of brake shoe assembly

1. Install the return spring to the brake shoes of both sides.

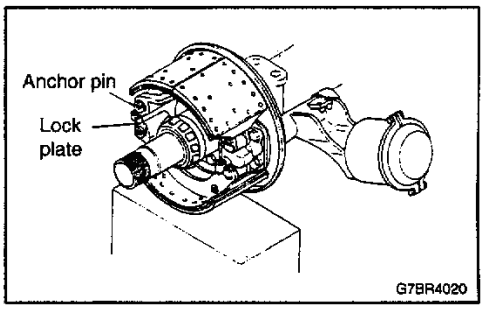


2. With the index finger and thumb of one hand inserted into the anchor pin bushing holes of both brakes, lift up the upper brake shoe assembly by the other hand.
   Assemble with the brake shoe assembly roller placed on the cam and slide.

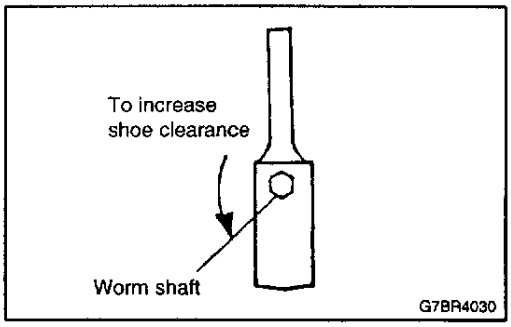
3. Install the heel side of the upper brake shoe assembly to the anchor bracket. Similarly, install the heel side of the lower brake assembly.

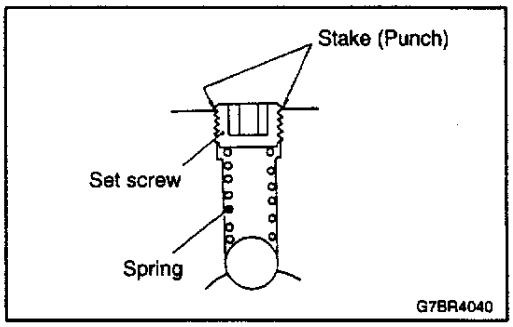


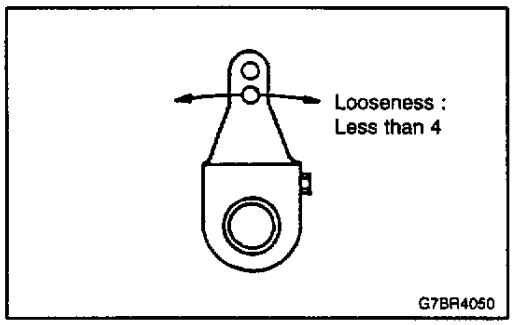
4. Drive in the anchor pin and fix with the lock plate.

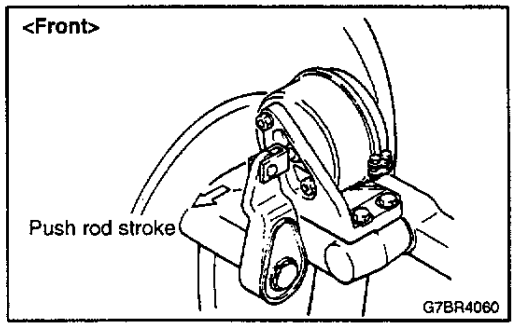


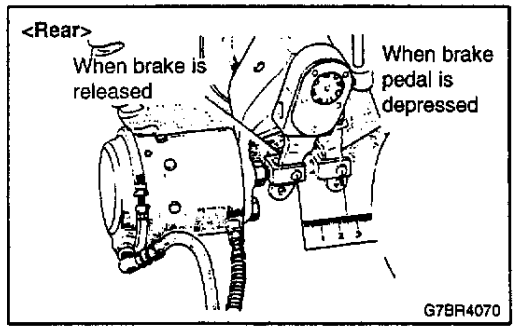
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ADJUSTMENT OF BRAKE SHOE CLEARANCE

1. Inspection before adjustment
   1) Perform the following checks after removing the clevis pin of brake chamber push rod.
   - Turn the worm shaft in the direction of arrow as shown in illustration to make sure that the turning torque is 4.9 Nm (0.5 kgf·m) or more.

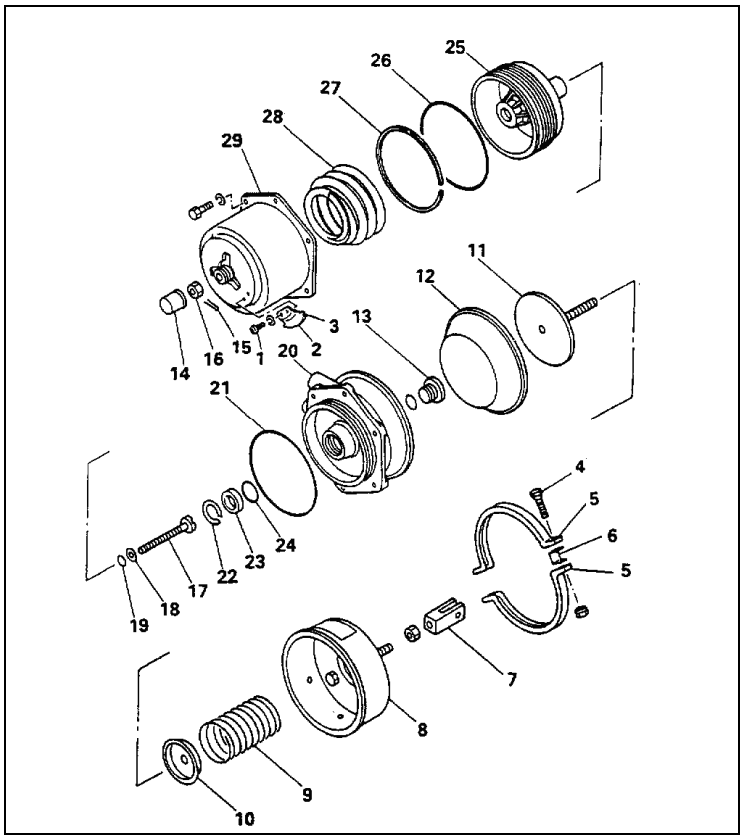
   2) If the torque is smaller than the specified, replace the spring and set screw of slack adjuster with new ones, adjust the set screw to obtain a turning torque of 9.8 to 11.5 Nm (1.0 to 1.2 kgf·m), then lock the screw by staking it at two points.

   3) Turn the slack adjuster to right and left to check for looseness.
   If the slack adjuster moves beyond the limits shown in illustration, replace it.

2. Connect the push rod and check the air line for leaks and the push rod for smooth movement.
3. Increase the air pressure to 785 kPa (8 kgf/cm²) and check that the fall of the air pressure gauge reading in 30 minutes does not exceed 78 kPa (0.8 kgf/cm²).
   Also check that the spring brake side of the spring brake chamber is filled with compressed air and that the brake chamber is free of air pressure.
4. To adjust the brake shoe clearance, force the brake shoe onto the brake drum until the slack adjuster adjust screw can no longer move. Then, with the brake pedal depressed fully, reverse the adjust screw for the brake chamber pushrod stroke as listed in the table below. This gives the normal shoe clearance.
5. If the brake chamber pushrod stroke has exceeded the limit, adjust again with the slack adjuster.

Maintenance item		Nominal value	Limit
Wheel	Front	25	40
	Rear	30	50

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Disassembly sequence

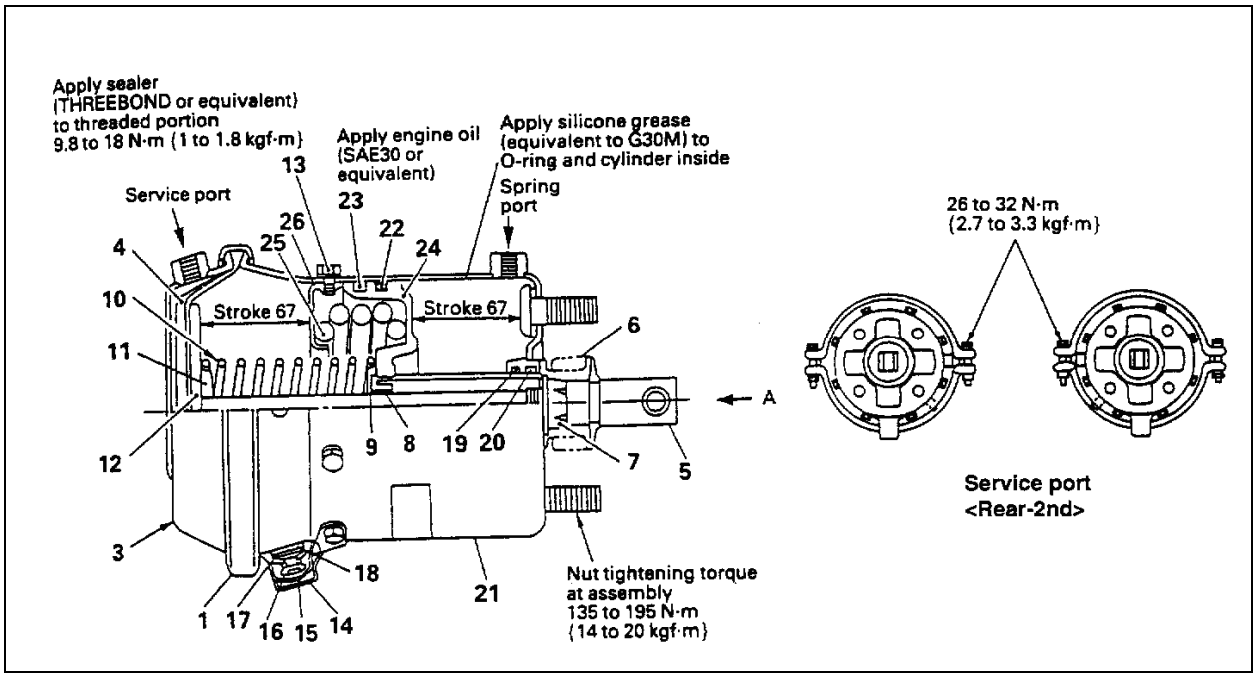
1. Tapping screw
2. Filter cover
3. Filter
4. Bolt
5. Clamp band
6. Spacer
7. Clevis
8. Chamber
9. Return spring
10. Spring retainer
11. Push rod
12. Diaphragm
13. Follower
14. Cap
15. Spring pin
16. Castle nut
17. Release bolt
18. Washer
19. Rubber ring
20. Bulkhead
21. O-ring
22. Snap ring
23. Nylon bushing
24. O-ring
25. Piston rod assembly
26. Seal ring
27. Felt wiper ring
28. Spring
29. Cylinder

NOTE

1. **Replace the diaphragm, springs and return spring in one axle unit.**
2. **Put mating marks on each mating parts (clamp band, chamber, bulkhead).**
3. **Hold in a vice or take other appropriate measured to prevent springs and return spring from popping out.**

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Brake Chamber for Vehicle with Spring Brake



Reassembly sequence

(24) → 23 → 22 → 26 → 21 → 20 → 19 → 8 → 9 → 10 → 11 → 12 → 7 → 6 → 5 → 4 → 3 → 2 → 1

18 → 17 → 16 → 15 → 14 → 13

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Troubleshooting

Symptom		Probable cause	Remedy
Poor braking action of wheel brake	Air leaks when brake pedal is depressed	Connector left loose	Tighten connectors
		Primary and secondary valves of the dual brake valve are not air-tight	Disassemble dual brake valve and remove foreign matter or replace inlet valve
		Damaged O-ring in dual brake valve	Disassemble dual brake valve and replace O-ring
	Air leaks while brake pedal is being released	Connector left loose	Tighten connector
		Primary and secondary valves of the dual brake valve are not air-tight	Disassemble dual brake valve and remove foreign matter or replace inlet valve
	Low air pressure	Air leak	Check air line and correct air leaks
		Air pressure governor improperly adjusted	Adjust air pressure governor
		Malfunctioning air compressor	Disassemble and correct air compressor
	Poor braking action despite there is no air leak	Oil or grease on brake lining or pad	Wash off oil or grease or replace brake lining or replace pad
		Hardened lining	Grind brake lining surface or replace lining
		Excessive brake shoe clearance	Adjust shoe clearance If brake lining has worn to limit, replace
Brake drum overheats	Brake shoe fails to return properly when brake pedal is released (wheel dragging)	Binding primary or secondary valve of the dual brake valve or plugged exhaust port	Disassemble, check, and clean dual brake valve ; correct faulty spots or replace
		Small brake shoe clearance	Adjust shoe clearance
		Weak or broken brake shoe return spring	Replace return spring
		Rusty anchor pin causes brake shoe to fail to return	Remove anchor pin and correct faulty spot
		Air pressure in brake chamber not released	Check dual brake valve and quick release valve
		Rusty camshaft	Correct faulty spot
		Spring brake being activated	Isolate the cause of spring brake being activated and release the brake

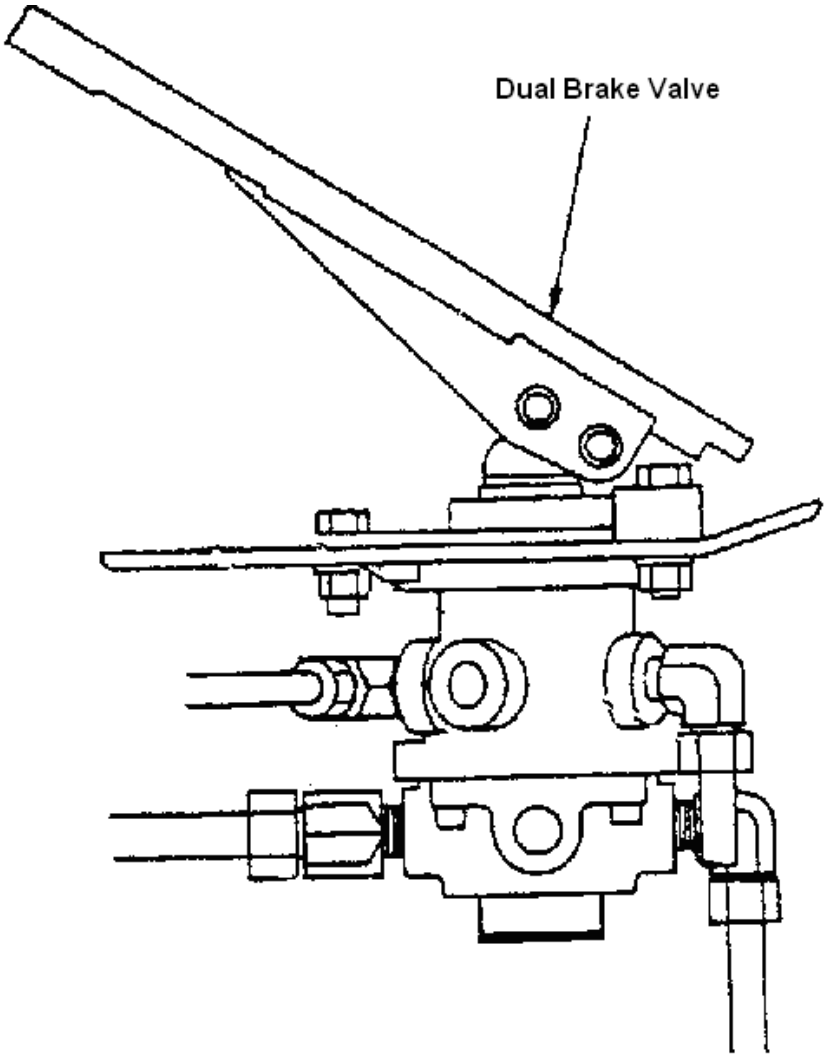
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Symptom	Probable cause	Remedy
Noise when brake pedal is depressed	Worn brake lining, exposing rivet head	Replace brake lining
	Hardened brake lining	Replace brake lining
	Unevenly worn brake drum inner surface	Grind drum or replace
	Brake shoe not in tight contact with brake lining	Use correct brake lining
	Brake drum left loose	Torque to specification
	Anchor pin left loose	Torque anchor pin lock nut to specification
Vehicle pulls to one side when braking	Improper brake shoe clearance or brake lining not in correct contact	Adjust shoe clearance For incorrect contact, correct or replace brake lining
	Oil or grease on brake lining or inner surface of brake drum	Wash off oil or grease or replace brake lining
	Brake drum runout, or drum left loose	Correct runout or torque to specification
	Tires not uniformly inflated	Inflate correctly
	Different brake lining materials used	Use lining of the same material
	Weak or broken brake shoe return spring	Replace return spring
	Chassis spring U-bolt left loose	Torque U-bolt nut to specification
	Air pressure sent to brake chambers not uniform	Check piping to brake chamber for air leak or check equipment for correct operation
Wheel brake suddenly applied	Small brake shoe clearance	Adjust shoe clearance

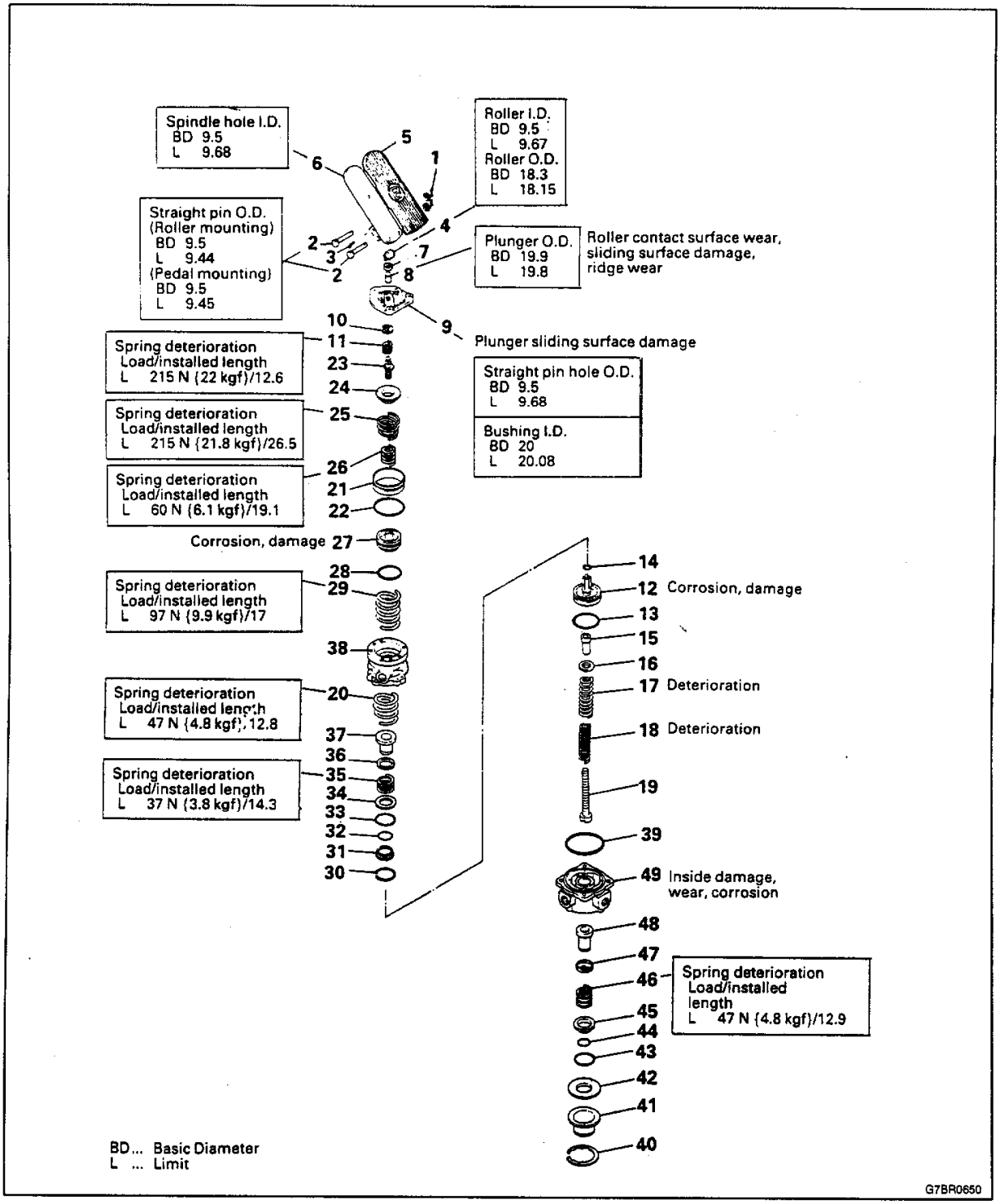
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Valves

Dual Brake Valve



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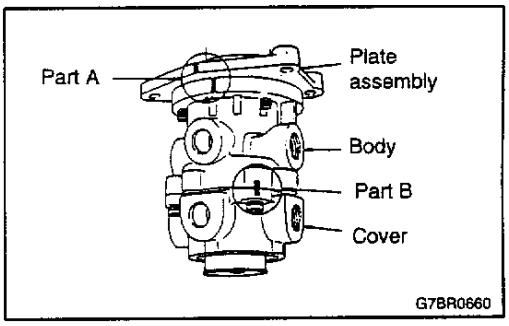
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Disassembly sequence

1. Spring pin
2. Straight pin
3. L-pin
4. Roller
5. Pedal cover
6. Pedal assembly
7. Boot
8. Plunger
9. Plate assembly
10. Retaining ring
11. Spring
12. Relay piston
13. O-ring
14. O-ring
15. Sleeve
16. Washer
17. Sleeve outer spring
18. Sleeve inner spring
19. Screw
20. Relay piston spring
21. Bushing
22. O-ring
23. Self-locking bolt
24. Spring seat
25. Primary piston outer spring
26. Primary piston inner spring
27. Primary piston
28. O-ring
29. Primary piston spring
30. Retaining ring
31. Primary inlet valve retainer
32. O-ring
33. O-ring
34. Washer
35. Primary inlet valve spring
36. Washer
37. Primary inlet valve
38. Body
39. O-ring
40. Retaining ring
41. Exhaust cover assembly
42. Washer
43. O-ring
44. O-ring
45. Secondary inlet valve retainer
46. Secondary inlet valve spring
47. Valve retainer
48. Secondary inlet valve
49. Cover

NOTE

1. **Before disassembly, remove dust, dirt, and other foreign matter from the surface. During the procedure, use utmost care to prevent entry of any foreign object.**
2. **Wipe or wash clean the disassembled parts using the following procedure:**
   1) **Rubber parts**
      For rubber parts seeming intact, wipe surfaces clean of deposits with a soft cloth dampened with alcohol or light oil.
      Never allow them to be dipped in trichloroethylene, Metalclen, other similar solution.
   2) **Metallic parts**
      (a) **Clean plates in light oil, then blow air to dry.**
      (b) **Use a cleaning solution (trichloroethylene, Metalclen) for metallic parts other than plates.**

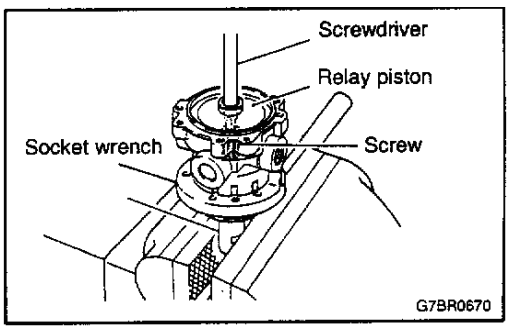


DISASSEMBLY PROCEDURE

Alignment marks

Make alignment marks on each joint before disassembly.

- Part A : Plate assembly and body
- Part B : Body and cover



Removal of relay piston

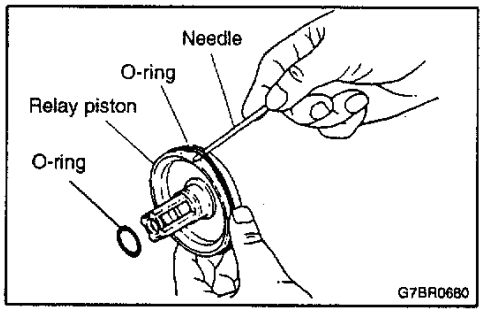
Clamp socket wrench in a vise. Secure the body so that the piston bolt is aligned with socket wrench. Then, gradually loose the screw.

NOTE

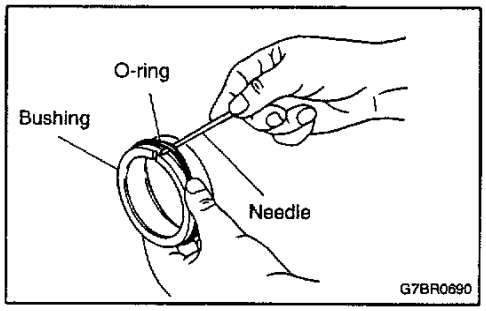
When the screw is loosened, the tension of the spring in the body may cause the piston and spring to jump out. Be sure to hold down the body, together with the relay piston, when loosening the screw.

Removal of O-ring

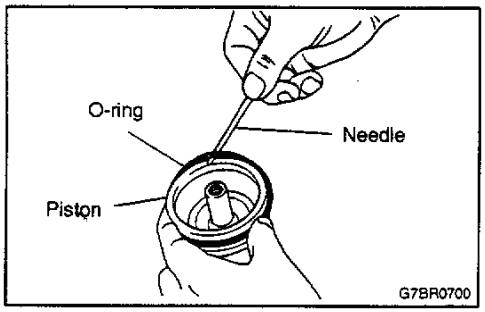
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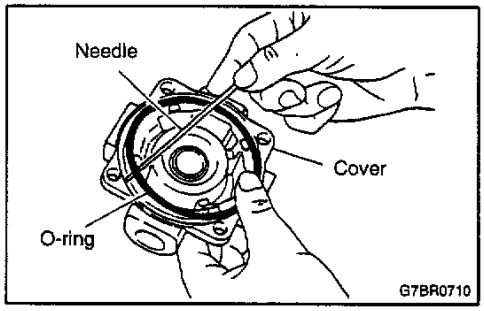
Using the special tool, Needle, remove the O-rings.
In relay piston:
At bushing:



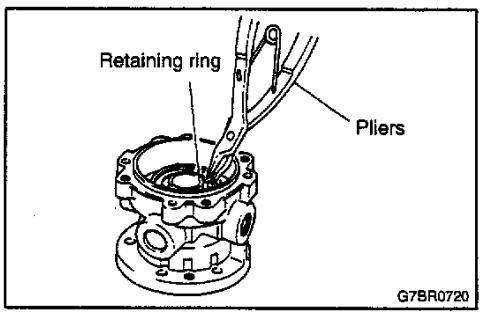
At piston:



In cover:



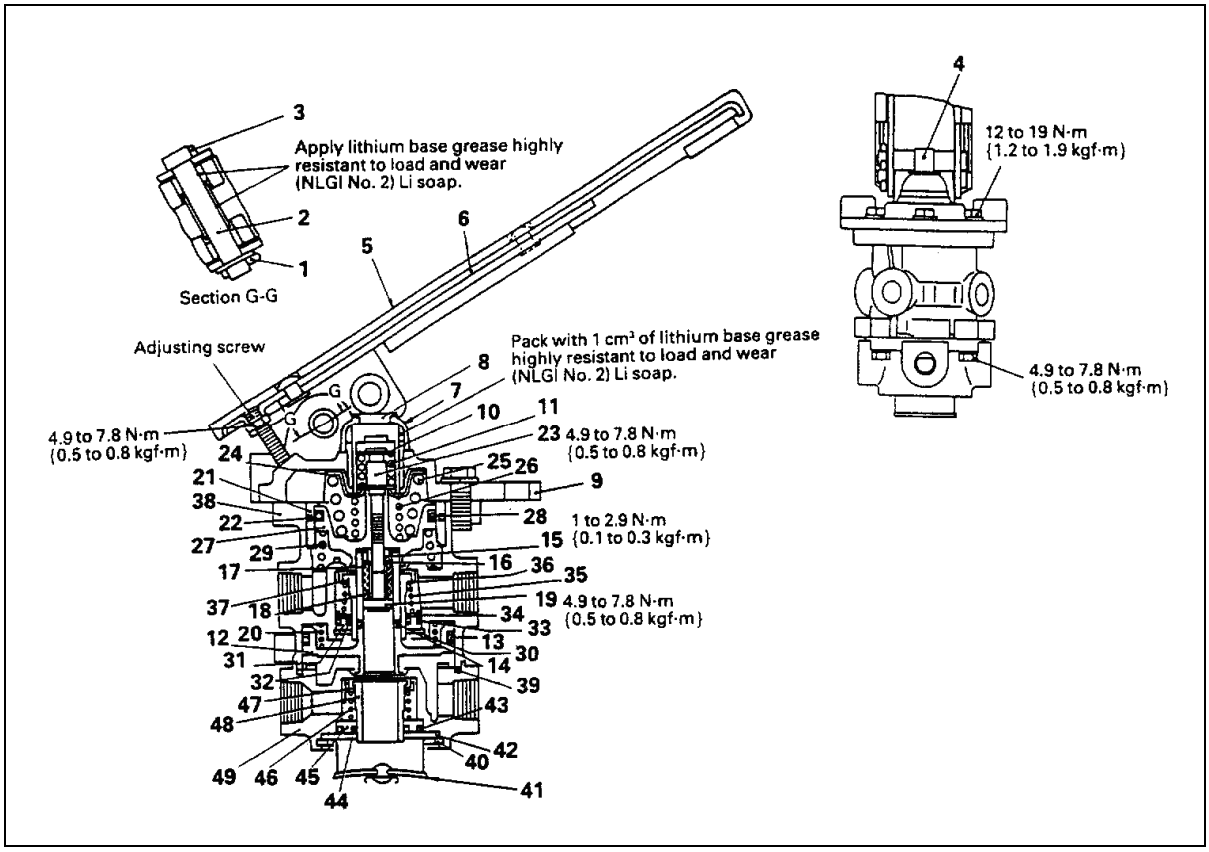
Removal of retaining rings



Using the special tool, Pliers, remove the retaining rings.
At inlet valve:
At exhaust cover assembly:

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Reassembly



NOTE

1. **Apply lithium base grease [multi-purpose type (NLGI No.2) Li soap] to the O-rings and their sliding surfaces, inter-metal sliding surfaces, and O-ring grooves.**
2. **Apply lithium base grease highly resistant to load and wear [(NLGI No.2)Li soap] to the plunger sliding surfaces.**

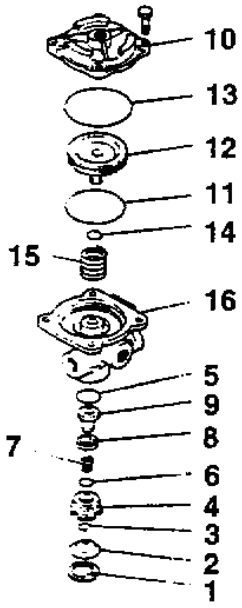
Assembly sequence

49 → 48 → 47 → 46 → 42 → 41 → (40) → 39
45 → 44 → 43
(27) → 28 → 21 → 22
38 → 37 → 36 → 35 → 34 → (30) → 29 → 26 → 25 → 24 → 23 → (20) → 11 → 10 → 9 → 8 → 7 → 6 → 4
31 → 32 → 33
5 ← 1 ← 3 ← 2
19 → 18 → 17 → 16 → 15 → (12) → (14) → 13

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Relay Valve

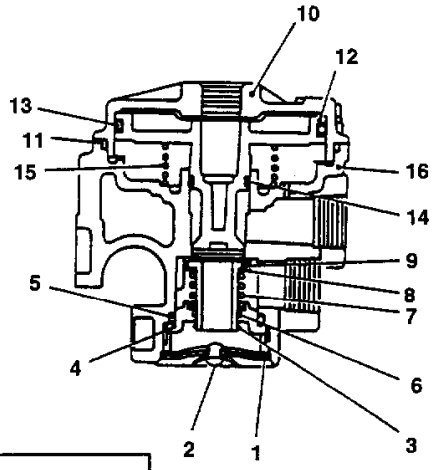
Disassembly, Inspection and Correction



Disassembly sequence

1. Retaining ring
2. Exhaust cover assembly
3. Retaining ring
4. Valve guide
5. O-ring
6. O-ring
7. Spring
8. Valve retainer
9. Inlet valve assembly
10. Cover
11. O-ring
12. Piston
13. O-ring
14. O-ring
15. Spring
16. Body

Reassembly



NOTE:
Apply multipurpose type grease Li soap to sliding O-rings, their sliding surfaces, metal-to-metal sliding surfaces, and O-ring grooves.

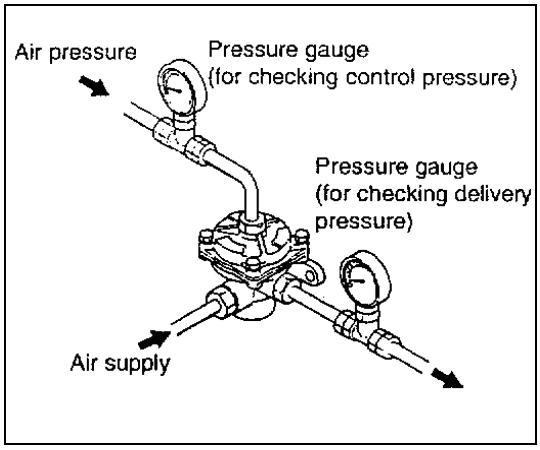
Assembly sequence

16 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1 → 11 → 15 → 10

12 → 14 → 13

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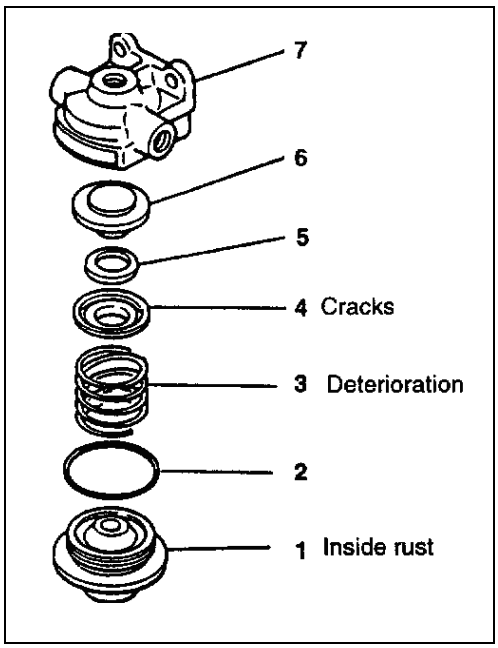
Inspection after Installation



In the above test setup, the difference in operating pressure between the control and delivery pressures should be 25 kPa (0.25 kgf/cm2) or less when air pressure is supplied to the air supply port and control port. If the specification is not met, replace each spring or the whole assembly.

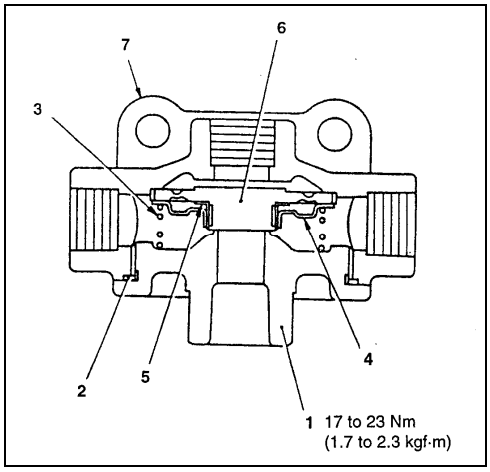
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Quick Release Valve



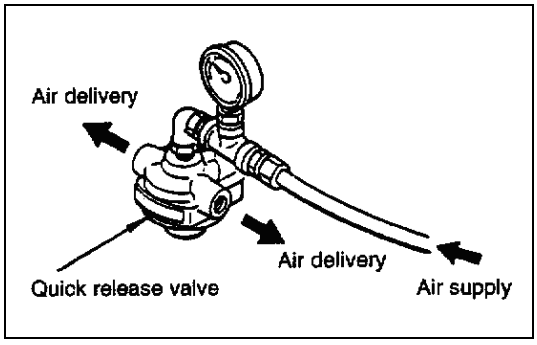
Disassembly sequence

1. Body
2. O-rings
3. Spring
4. Retainer
5. Ring
6. Diaphragm and ring assembly
7. Housing



Reassembly sequence

7 → 6 → 5 → 4 → 3 → 2 → 1

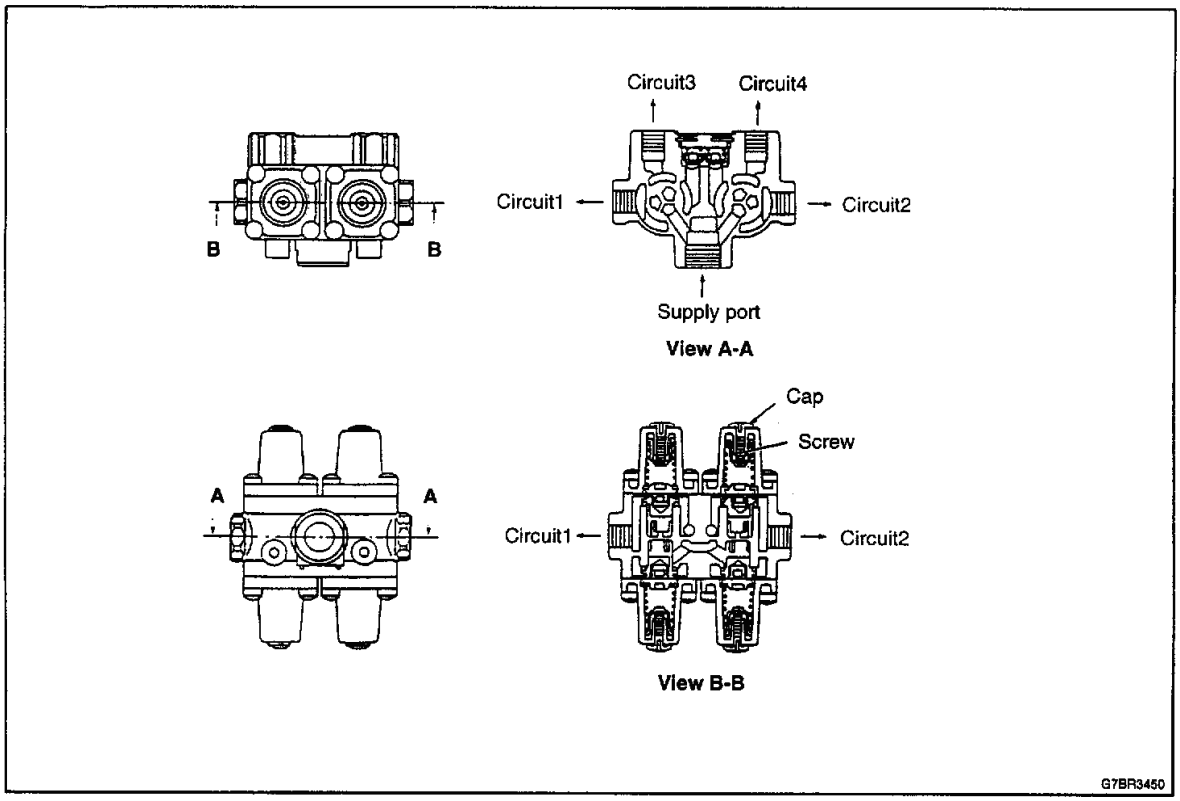


INSPECTION AFTER REASSEMBLY

Apply air pressure from the air supply port and gradually increase it. The air should come out of the delivery port when the air pressure reaches 9.8 ± 4.9 kPa {0.1 ± 0.05 kgf/cm²}.

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4-way Protection Valve



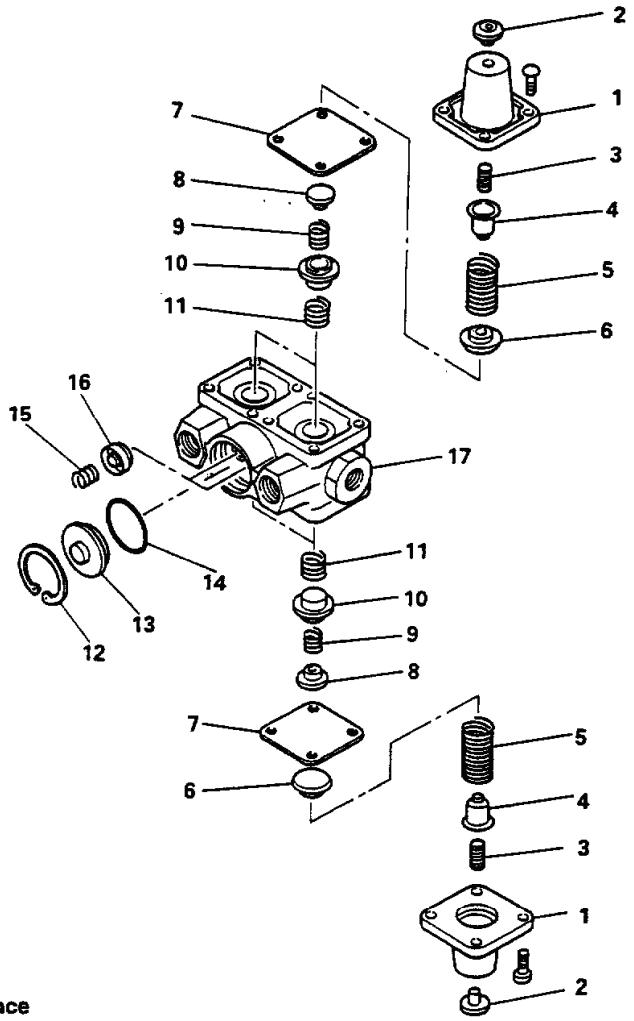
Apply air pressure from the supply port and check for valve opening and closing pressures according to the following table. If the specifications are not met, remove the cap and adjust with screw. If adjustment does not produce good results, replace springs as a kit.

Norminal value

Description	Circuit 1, 2	Circuit 3, 4
Valve opening pressure	590 $^{0}_{-29}$ kPa (6.0 $^{0}_{-0.3}$ kgf/cm²)	540 $^{0}_{-29}$ kPa (5.5 $^{0}_{-0.3}$ kgf/cm²)
Valve closing pressure	440 kPa (4.5 kgf/cm²) or more	390 kPa (4.0 kgf/cm²) or more

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Disassembly and Reassembly



Disassembly sequence

1. Cover
2. Cap
3. Screw
4. Spring seat
5. Spring
6. Spring seat
7. Diaphragm
8. Cap
9. Spring
10. Valve
11. Spring
12. Retaining ring
13. Retaining
14. O-ring
15. Spring
16. Valve
17. Body

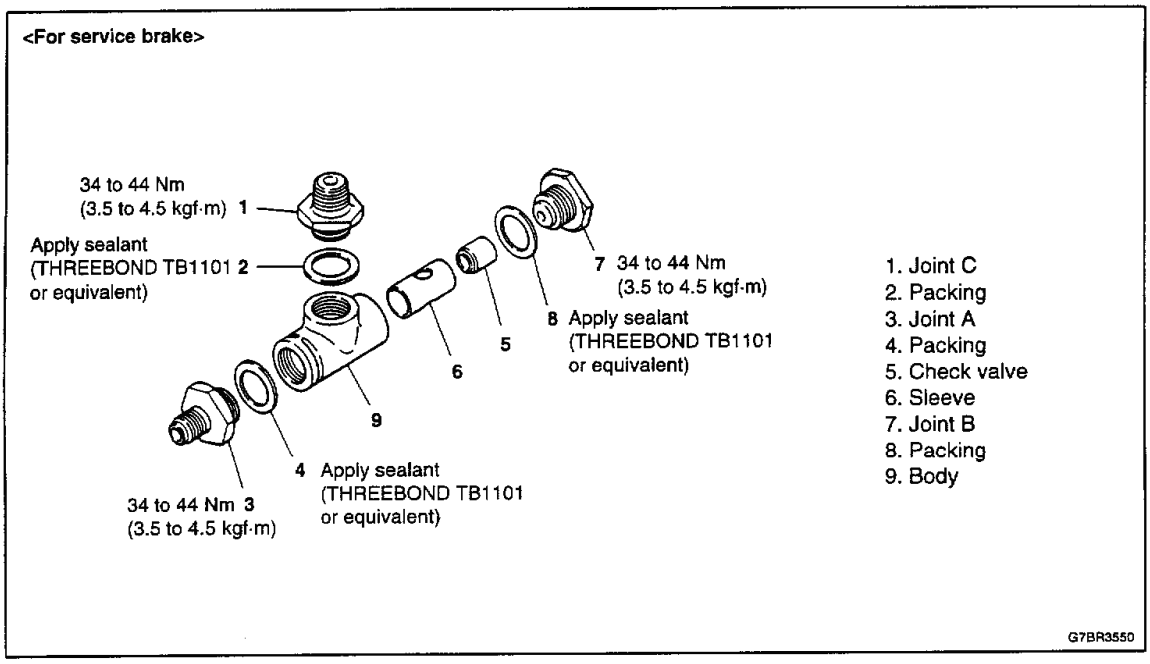
NOTE

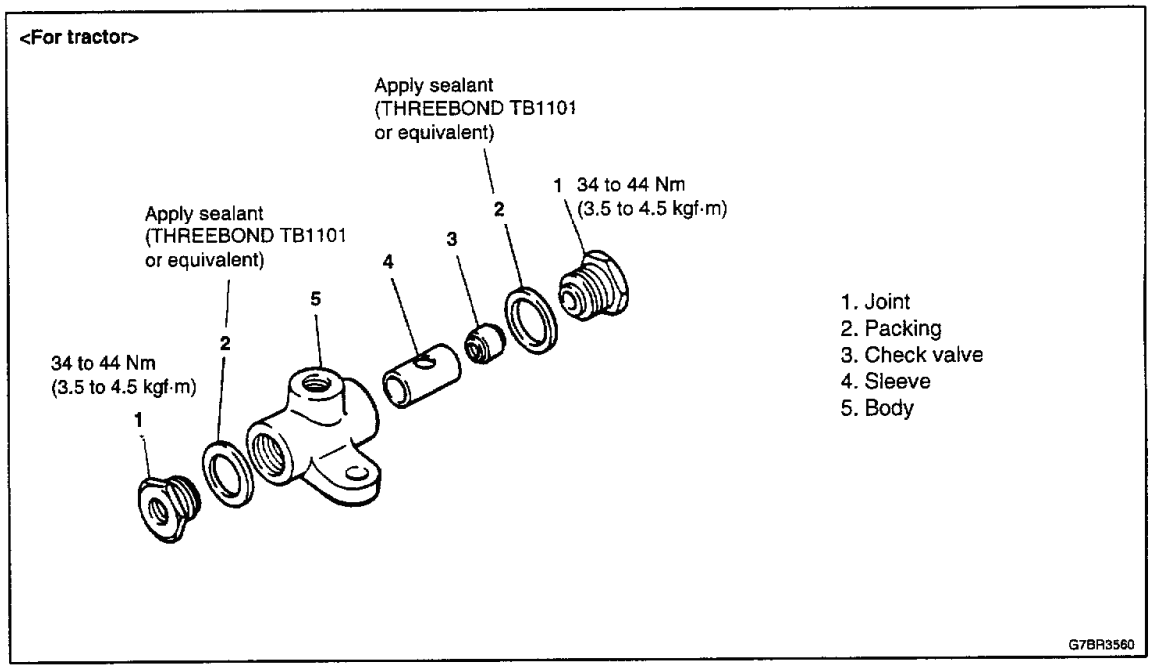
1. **Do not remove No.3 from No.1**
2. **For replacement of No.15 and 16, use ones of the same shape.**

G7BR3460

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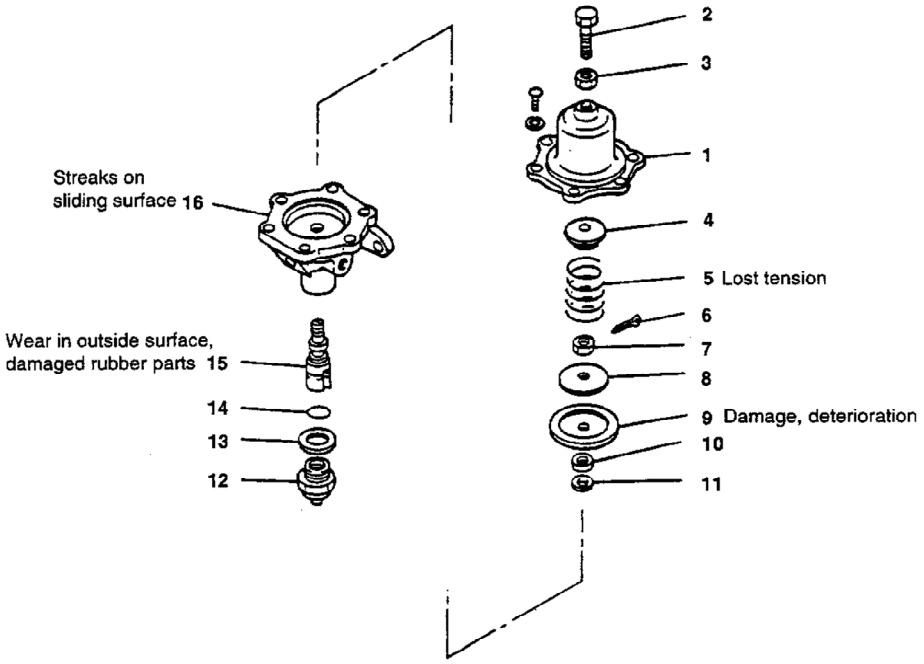
Double Check Valve





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Reducing Valve



Disassembly sequence

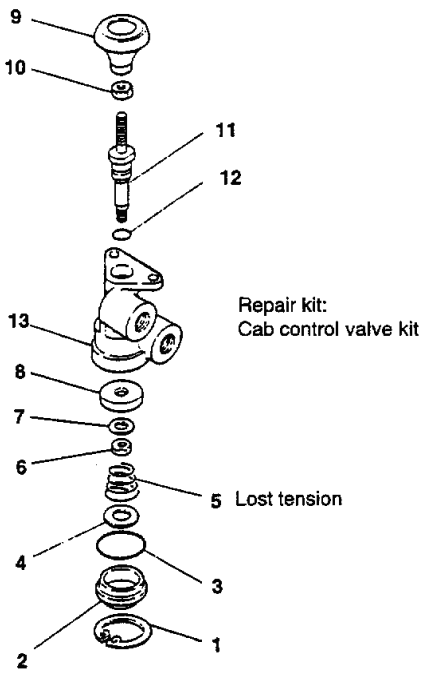
1. Spring cage
2. Adjusting bolt
3. Lock nut
4. Spring seat
5. Spring
6. Cotter pin
7. Nut
8. Diaphragm plate
9. Diaphragm
10. Diaphragm washer
11. Packing
12. Drain valve
13. Packing
14. O-ring
15. Valve
16. Body

NOTE
Remove parts 2 and 3 only for adjustment and replacement.

G6BR3590

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Cab Control Valve
Disassembly and Inspection



Repair kit:
Cab control valve kit

5 Lost tension

Disassembly sequence

1. Snap ring
2. End cap
3. O-ring
4. Shim
5. Valve spring
6. Nut
7. Washer
8. Valve assembly
9. Knob
10. Nut
11. Piston
12. Q-ring
13. Body

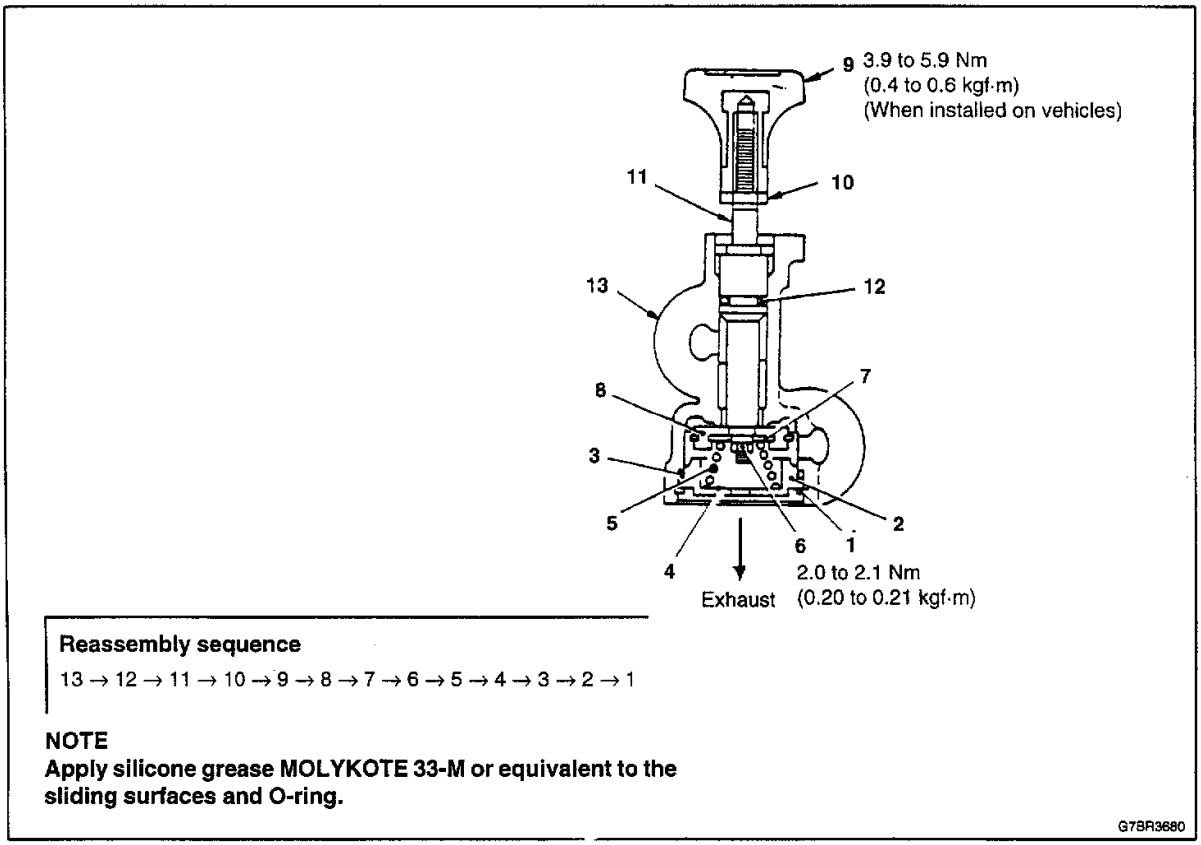
NOTE

1. **Wash metallic parts in a cleaning oil or gasoline and blow air to dry.**
2. **Wipe dirt off the rubber parts with a dry cloth.**
3. **Replace O-ring with a new one.**

G7BR3670

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Reassembly

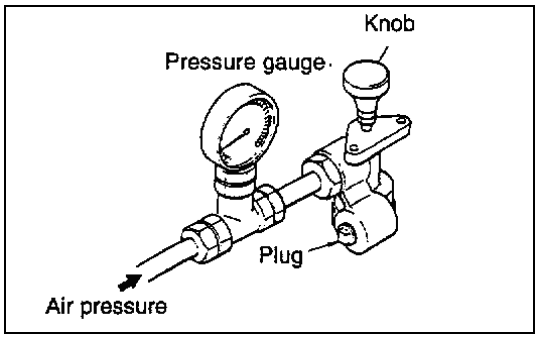


Reassembly sequence

13 → 12 → 11 → 10 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1

NOTE
Apply silicone grease MOLYKOTE 33-M or equivalent to the sliding surfaces and O-ring.

G78R3680



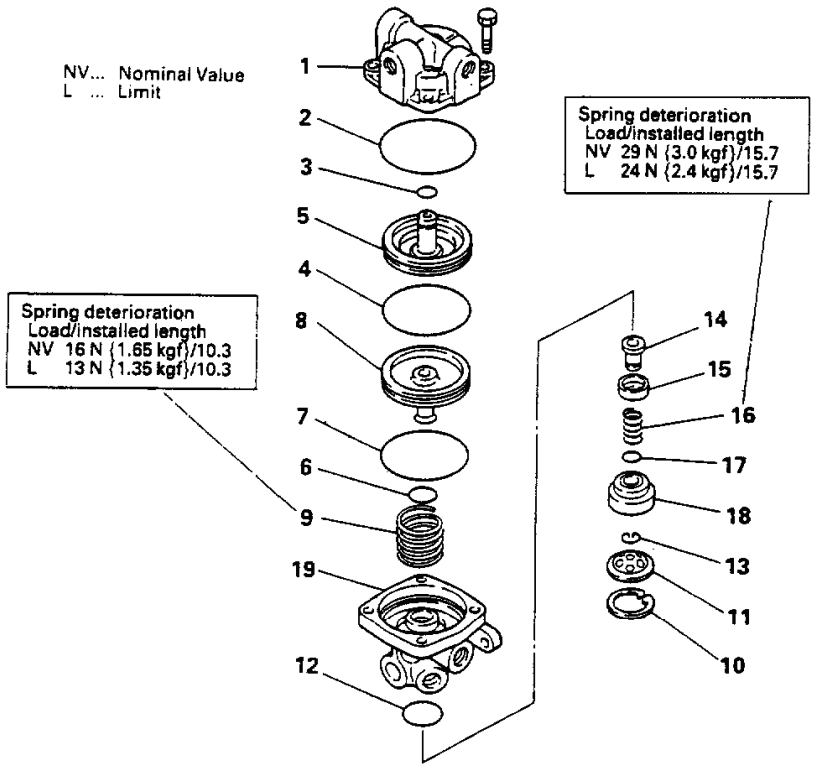
INSPECTION AFTER REASSEMBLY

In the test setup shown above, apply an air pressure of about 390 kPa (4 kgf/cm²) to the air supply port, while pushing the knob. Then, gradually decrease the air pressure being applied and make sure that the knob automatically springs out when the pressure gauge reads 1.8-2.3 kgf/cm². If the knob does not jump out, replace the valve spring or the whole assembly.

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Dual Relay Valve

Disassembly and Inspection

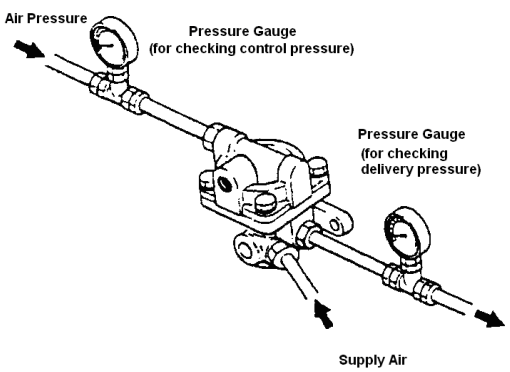


Disassembly sequence

1. Cover
2. O-ring
3. O-ring
4. O-ring
5. Piston
6. O-ring
7. O-ring
8. Piston
9. Spring
10. Retaining ring
11. Exhaust cover assembly
12. O-ring
13. Retaining ring
14. Inlet valve
15. Valve retainer
16. Spring
17. O-ring
18. Valve guide
19. Body

NOTE

1. **Wash the disassembly metallic parts in a cleaning solution and work carefully to prevent ingress of metal chips, dust, etc.**
2. **Never wash rubber parts in a cleaning solution.**
3. **Be sure to replace the O-ring with new ones.**



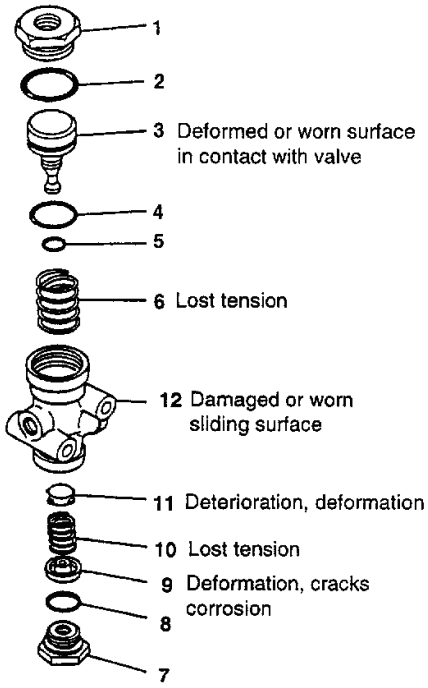
Inspection after Reassembly

In the test setup, the operating pressure difference between the control port and delivery port should be 25kpa(0.25kgf/ cm^2) or less when air pressure is applied to the air delivery port and control port. If the specification is not met, replace the spring or replace as an assembly.

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Synchro Valve

Disassembly and Inspection



Disassembly sequence

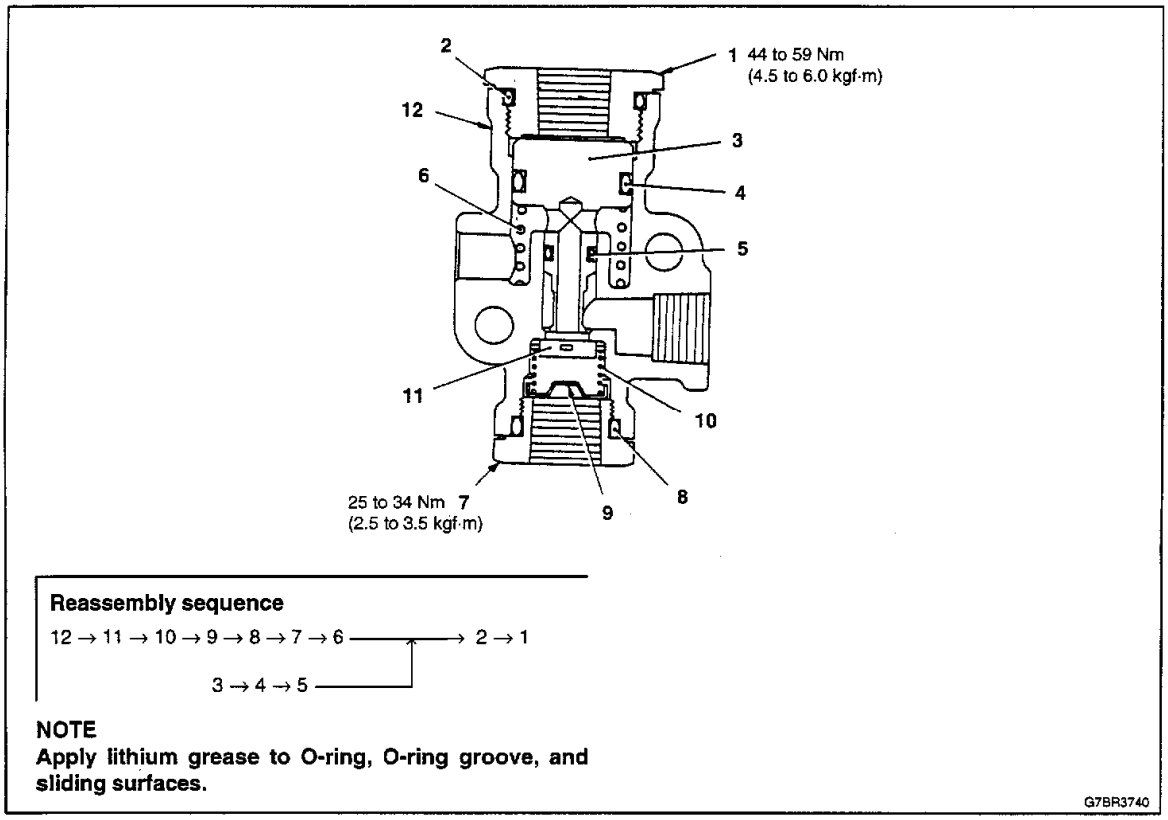
1. Cap nut
2. O-ring
3. Piston
4. O-ring
5. O-ring
6. Piston spring
7. Cap nut
8. O-ring
9. Valve stopper
10. Valve spring
11. Valve
12. Body

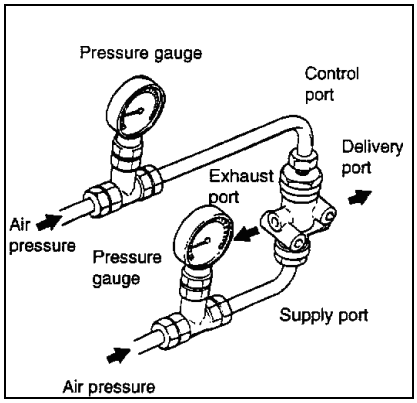
NOTE
Washer disassembled parts except rubber parts in a cleaning oil or gasoline and blow air to dry.

G7BR3730

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Reassembly





INSPECTION AFTER REASSEMBLY

1. In the test setup shown at the right, air must come out from the delivery port when an air pressure of 305 ± 29 kPa (3.1 ± 0.3 kgf/cm²) is applied to both the control and supply ports at the same time. (Inlet valve opening pressure)
2. When the control pressure and supply pressure are reduced to 215 ± 29 kPa (2.2 ± 0.3 kgf/cm²) in the above condition, no air should come out of the delivery port; and the delivery port and exhaust port are not blocked from each other. (Exhaust valve opening pressure)

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Body

General

Bumper

Front End Trim

Instrument Panel and Floor Consol

Headlining and Interior Trim

Door

Windshield Glass and Windows

Seat and Seat Belt

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General

Specifications

Items		Remarks
Front Panel		Upper hinged, lower opening type
Door	Construction	Front hinged, full door construction
	Regulator system	X-arm type
	Locking system	Pin-fork type
Glass thickness mm(in.)	Windshield glass	6.76（0.266）
	Door glass	3.2（0.126）
	Rear window	4.0（0.157）
	Side window	3.5（0.138）
Seat belt		E．L．R type

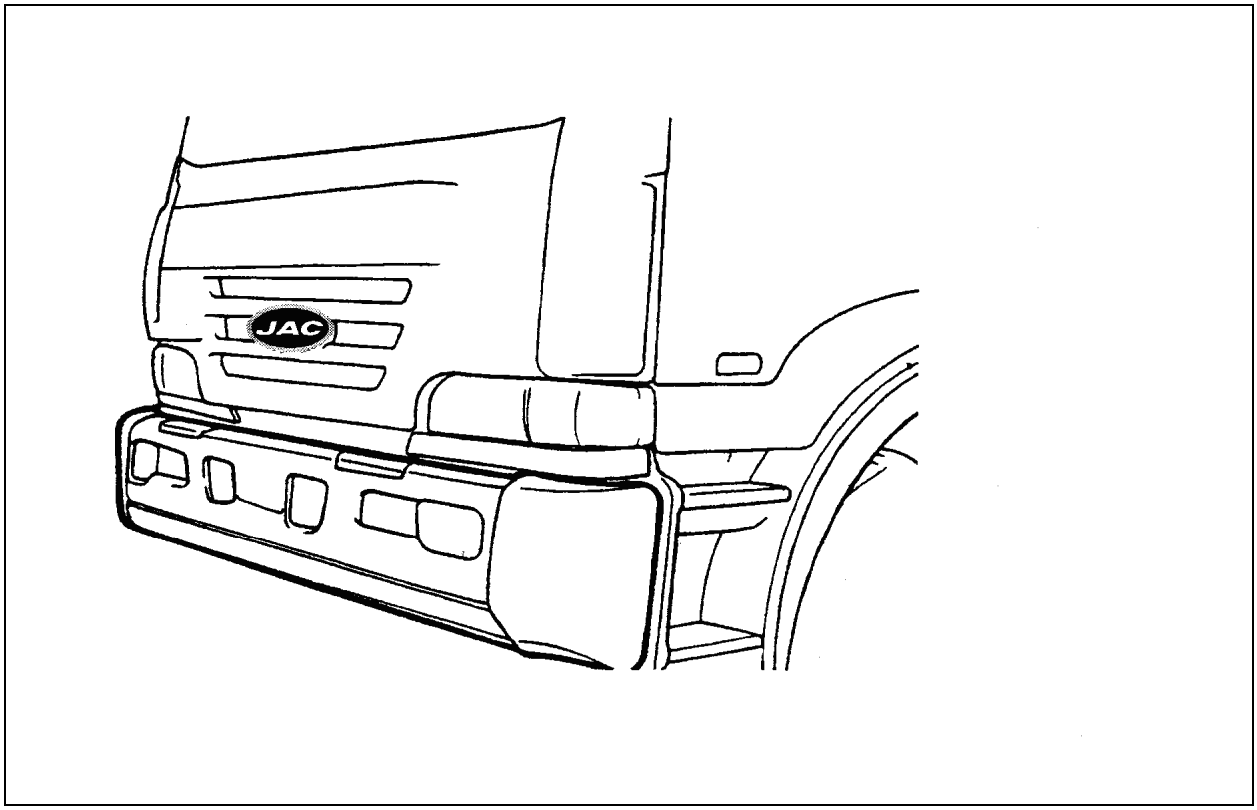
E．L．R：Emergency Locking Retractor

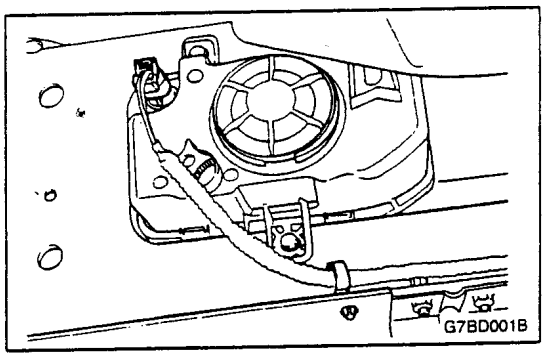
Tightening Torque

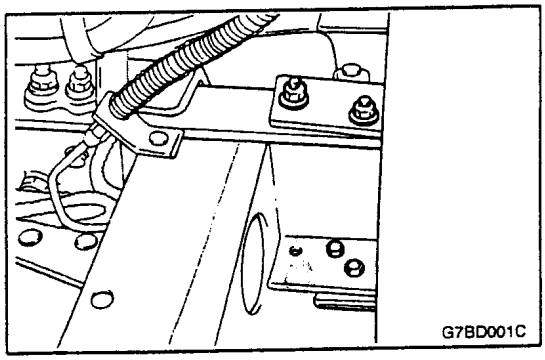
Items			Torque（kgf.m）
Front panel	Gas spring to body		0.7-1.1
	Front panel to gas spring		0.7-1.1
	Front to hinge		0.7-1.1
Door	Door hinge to body		3.5-4.2
	Door hinge to door		1.3-2.6
Seat belt	Upper anchor mounting bolt		4.0-5.5
	Seat belt height adjust mounting bolt		4.0-5.5
	Retractor mounting bolt		4.0-5.5
Seat support to body		Bolt	3.5-5.5
		Nut	2.1-3.1
Seat to seat support nut			0.9-1.4

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Bumper







Removal

1. Disconnect the fog lamp connector

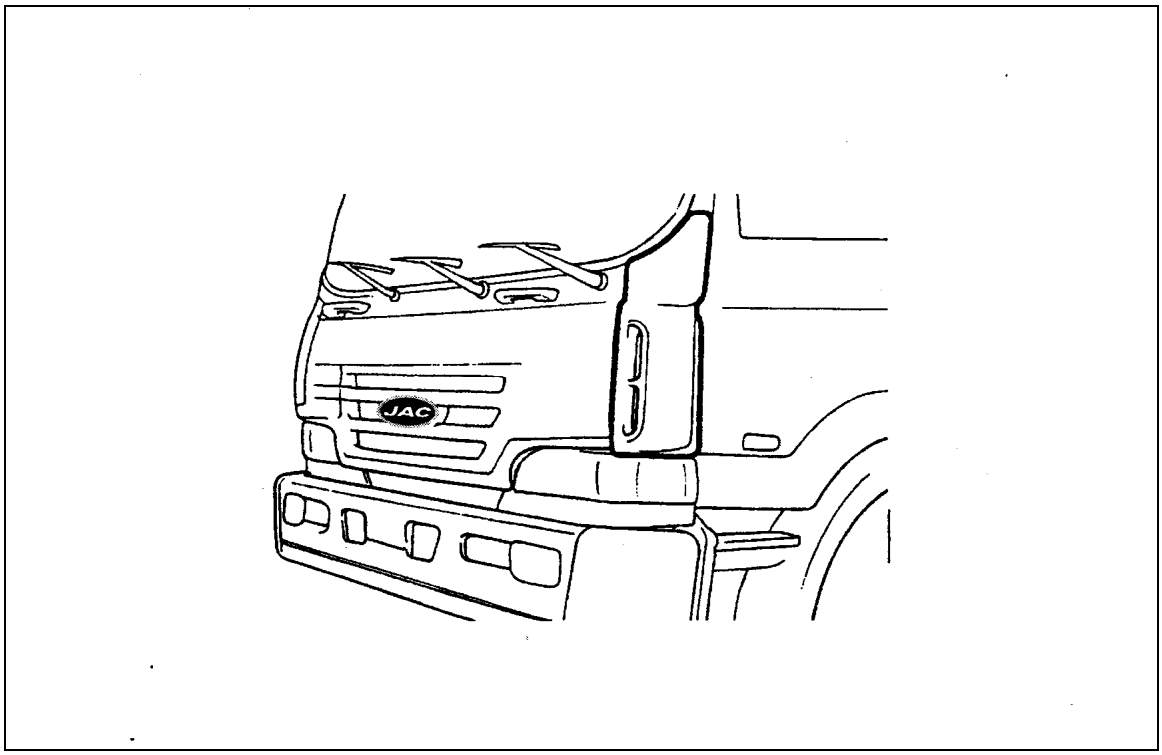
2. Loosen the bolts and remove the front bumper.

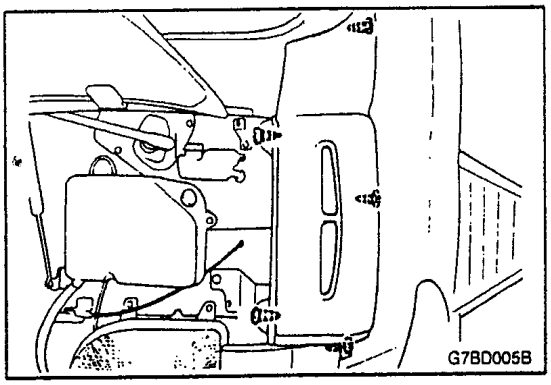
Installation

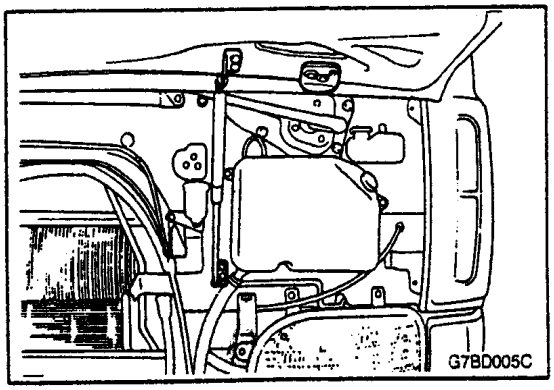
Installation is the reverse of removal procedure.

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Front End Trim







Removal

1. Remove screw(5EA)

2. Loosen bolts and remove the front panel.

Tightening torque

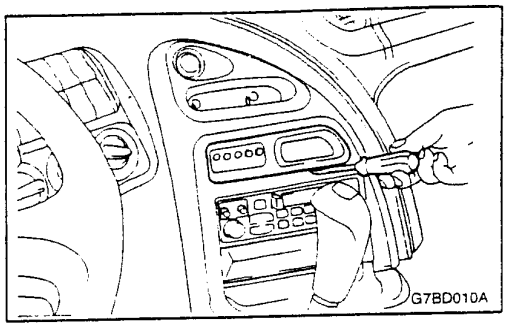
Gas spring to body	0.7-1.1kgf.m
Front panel to gas spring	0.7-1.1kgf.m
Front panel to hinge	0.7-1.1kgf.m

Installation

Installation is the reverse of removal procedure

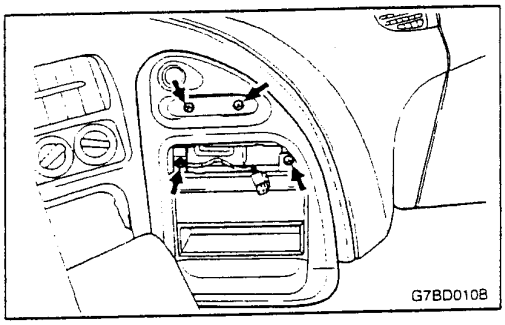
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Instrument Panel and Floor Console

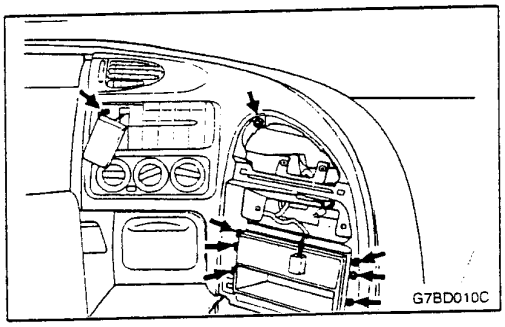


Removal

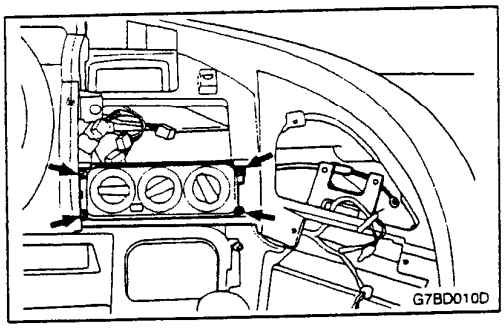
1. Removal the digital clock by using (-) screwdriver



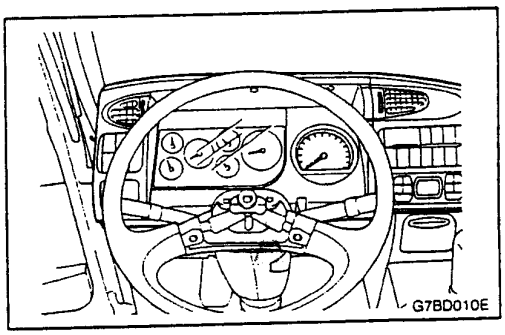
2. Loosen the screws and remove the cigarette lighter.



3. Loosen the screws and remove the switch panel and audio

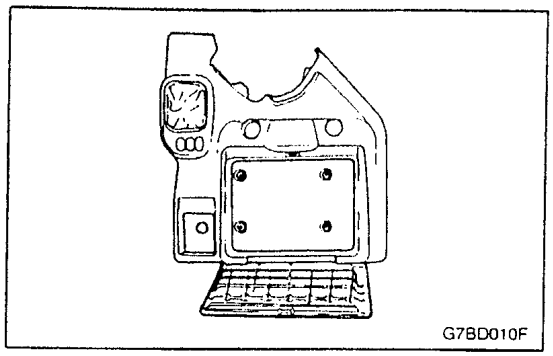


4. Remove the air temperature control lever.

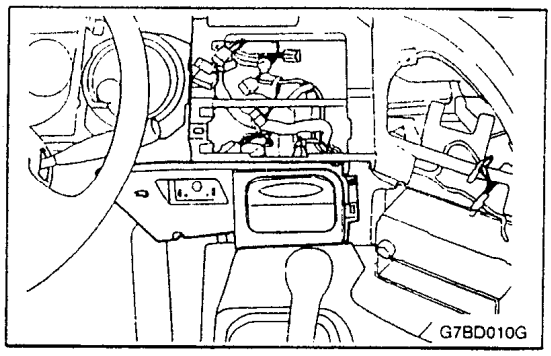


5. Remove the cluster instrument over.

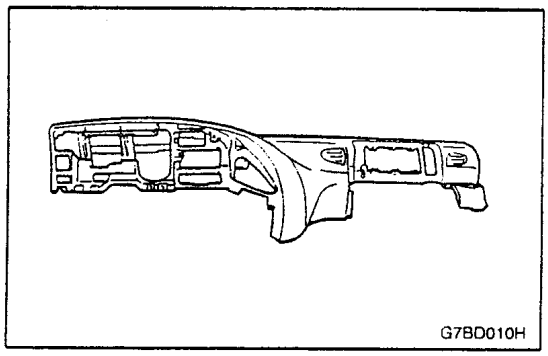
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6. Remove the shift knob and the floor console.



7. Remove the ash tray, lower trim.



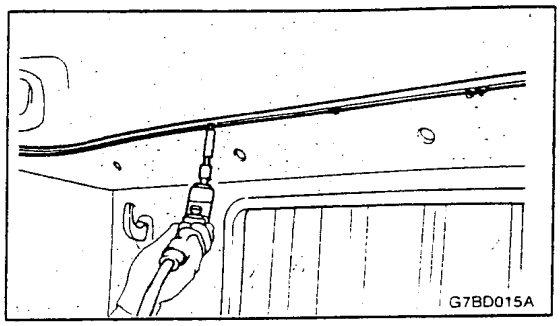
8. Remove the instrument panel.

Installation

Installation is the reverse of removal procedure.

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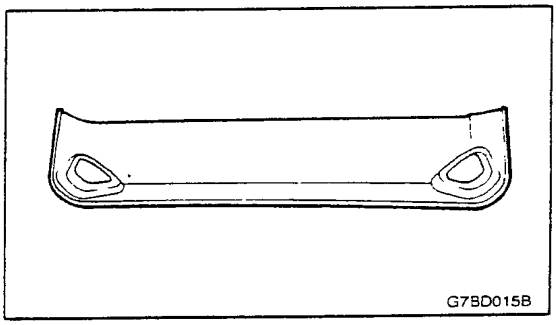
Headlining and Interior Trim



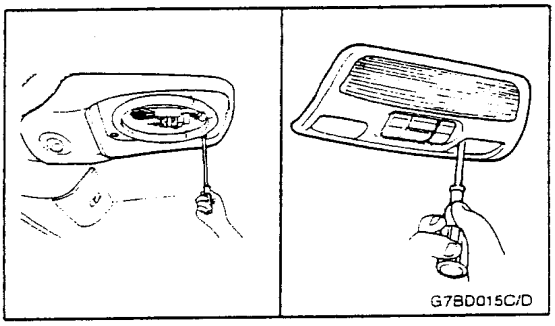
Removal

Headlining

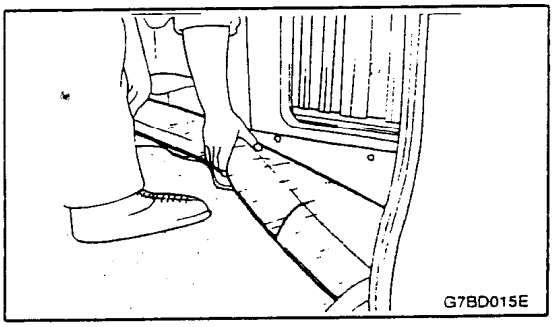
1. Loosen the screw and remove the curtain rails.



2. Remove the rear head lining.

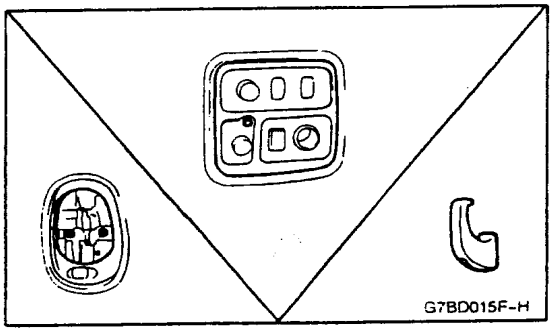


3. Remove the grip, sun visor, room mirror, map lamp, overhead console lamp and overhead console.



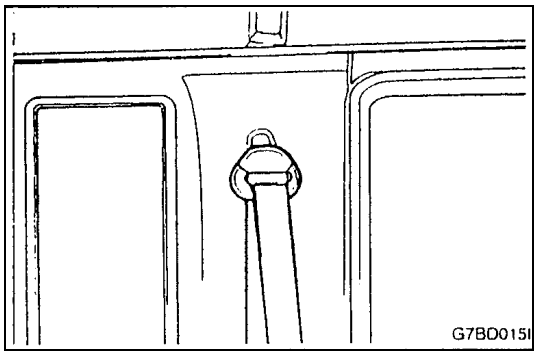
Interior Trim

1. Remove the scuff trim and disconnect the bed heating connect and remove the bed.



2. Remove the room lamp , remote switch, coat hooker and rear interior trim panel.

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3. Remove the seat belt upper anchor mounting bolt.

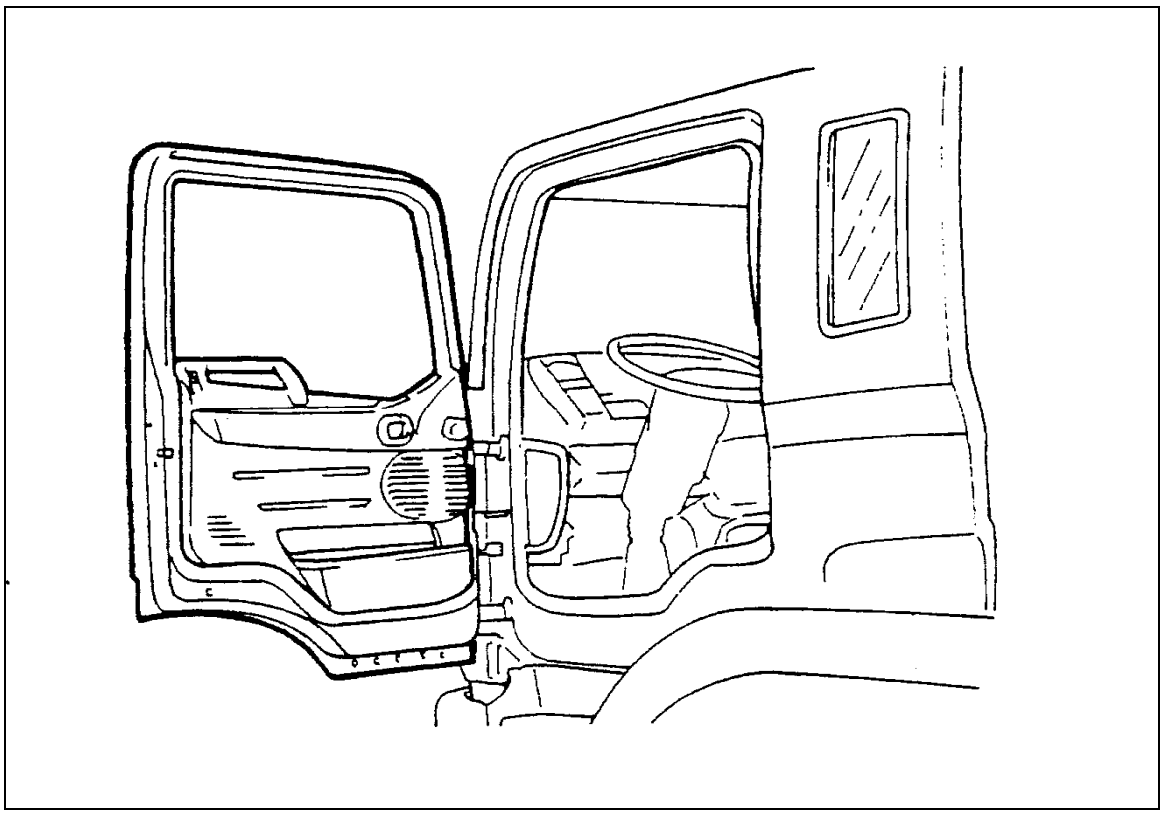
4. Rmove the side trim and front pillar trim.

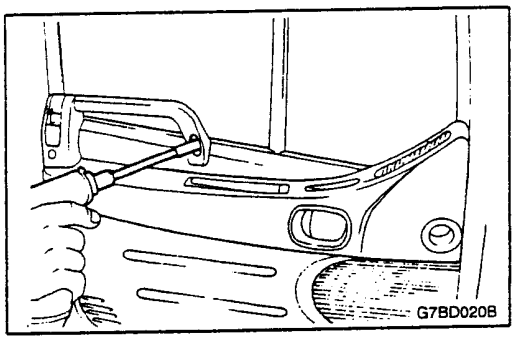
Installation

Installation is the reverse of removal procedure.

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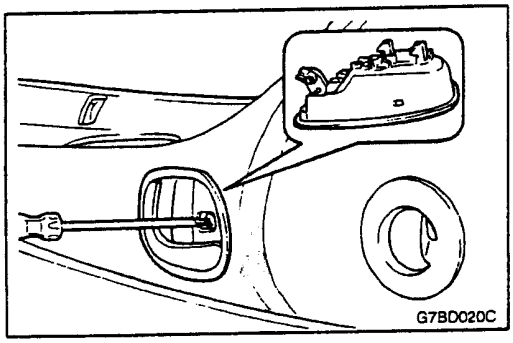
Door





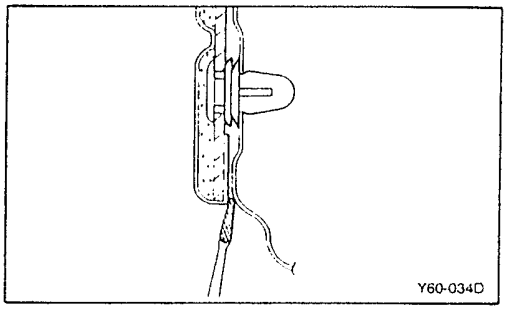
Removal

1. Remove the door pull handle and power window switch.

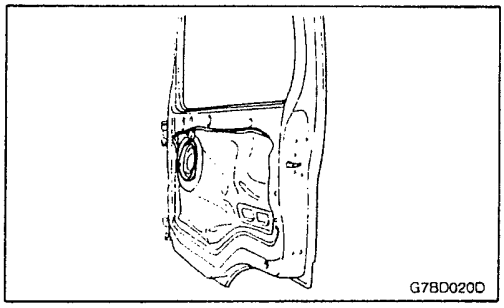


2. Remove the door inside handle.

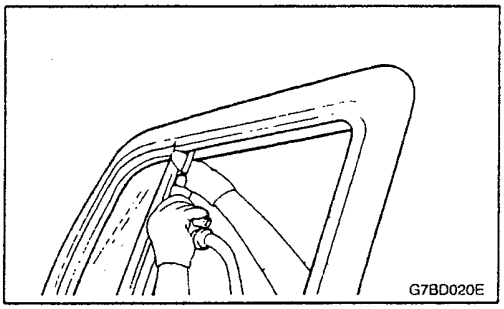
https://truckmanualshub.com/



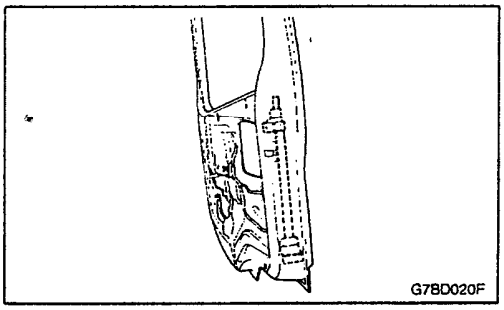
3. Remove the door trim panel.



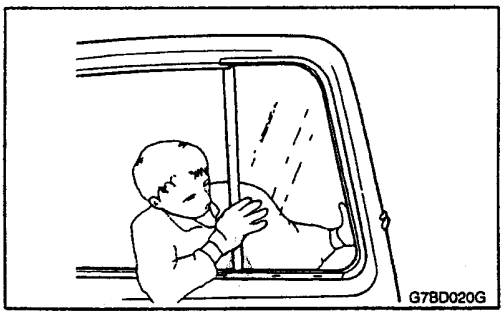
4. Remove speaker and door trim seal and weatherstrip.



5. Remove the door center sash(Upper: 2EA, Lower: 1EA).



6. Remove the window glass and lower sash.

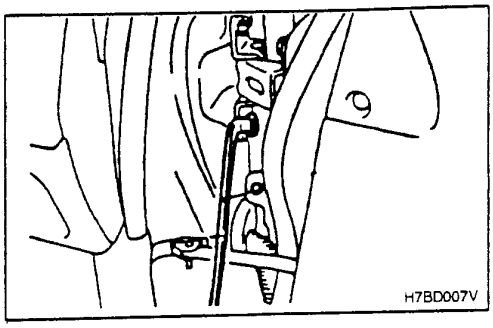


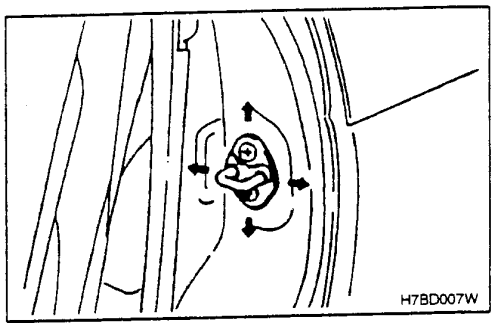
7. Remove the fixed glass and glass regulator.

Installation

Installation is the reverse of removal procedure.

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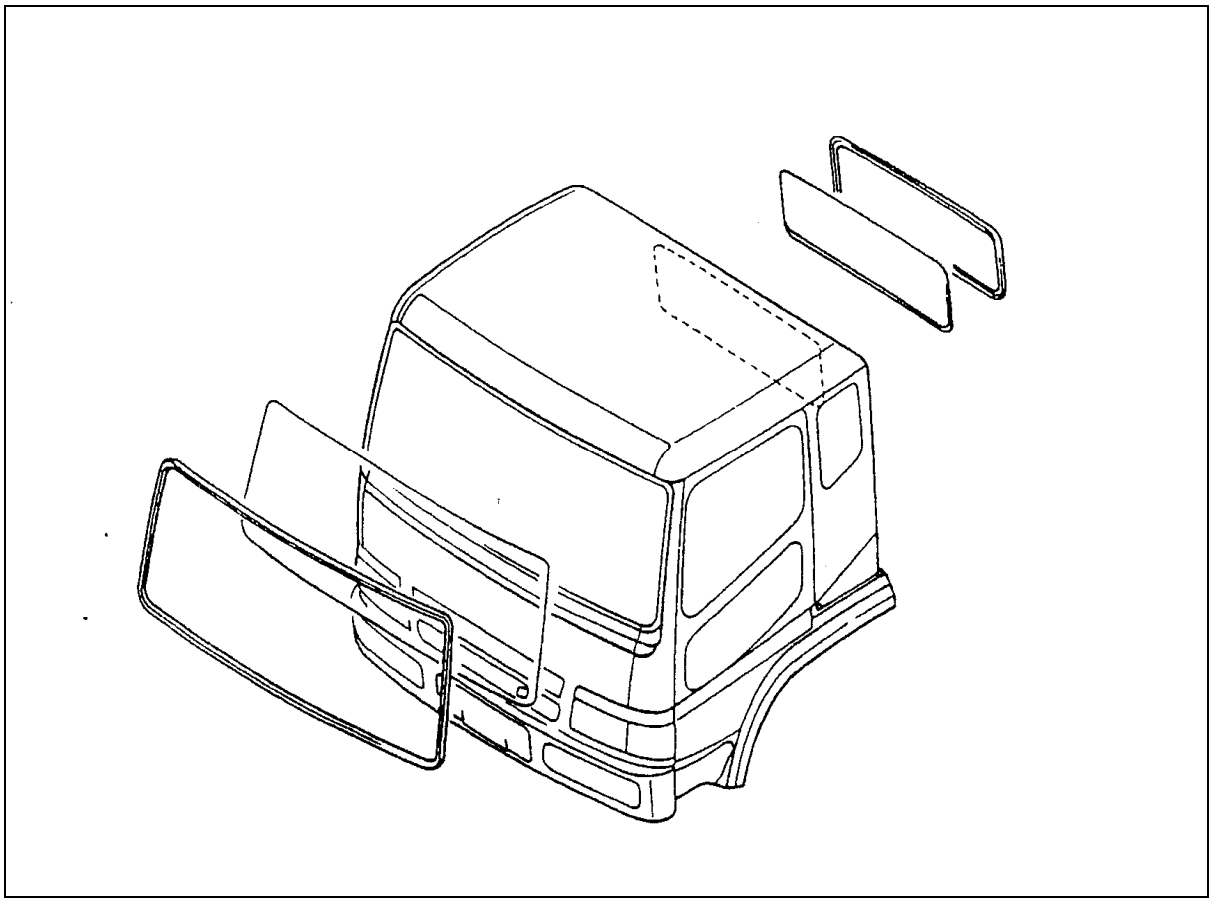
Adjustment

1. If the clearance between the door and the vehicle body is uneven, affix protective tape around the hinge and to the edge of the door. Then use the special tool to loosen the door hinge mounting bolts on the body and adjust the clearance around the door so that it becomes even.

2. If the door and the body are not flush with each other use the special tool to loosen the door hinge mounting bolts. Then align the door.
3. If the striker and latch do not mesh properly, adjust the position of the striker.

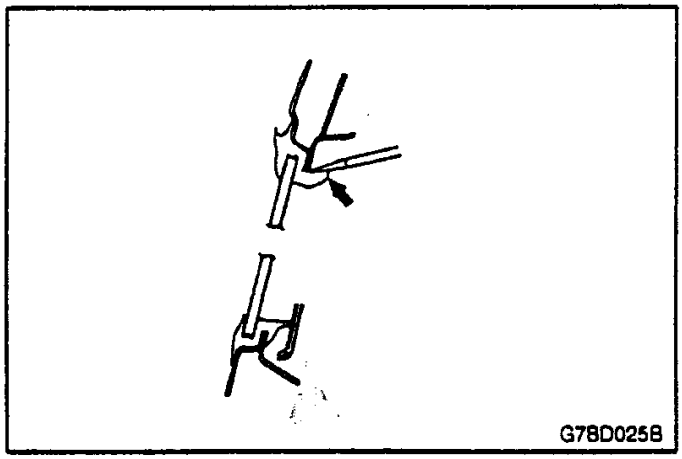
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Windshield glass and windows



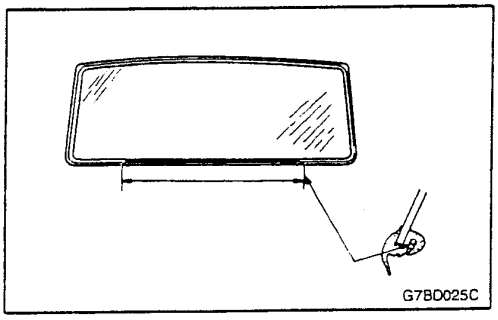
Removal

1. Use screwdriver or the like to pry up the lip of weatherstrip and remove the windshield glass or rear window glass.



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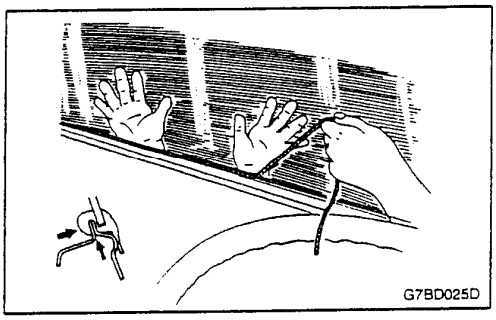
Installation



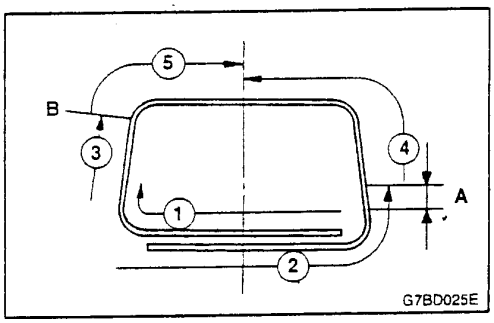
1. Set around strings in the weatherstrip groove.

Note

Make certain that the strings overlap each other at both ends.



2. Apply soap solution to the entire surface of the body flange.



3. With the aid of an assistant to push the windshield from outside, slowly pull one end of the string at right angles to the windshield as the order of illustration and fit the weatherstrip correctly on the flange.

A：To the 100 mm of straight portion

B：The end of straight portion

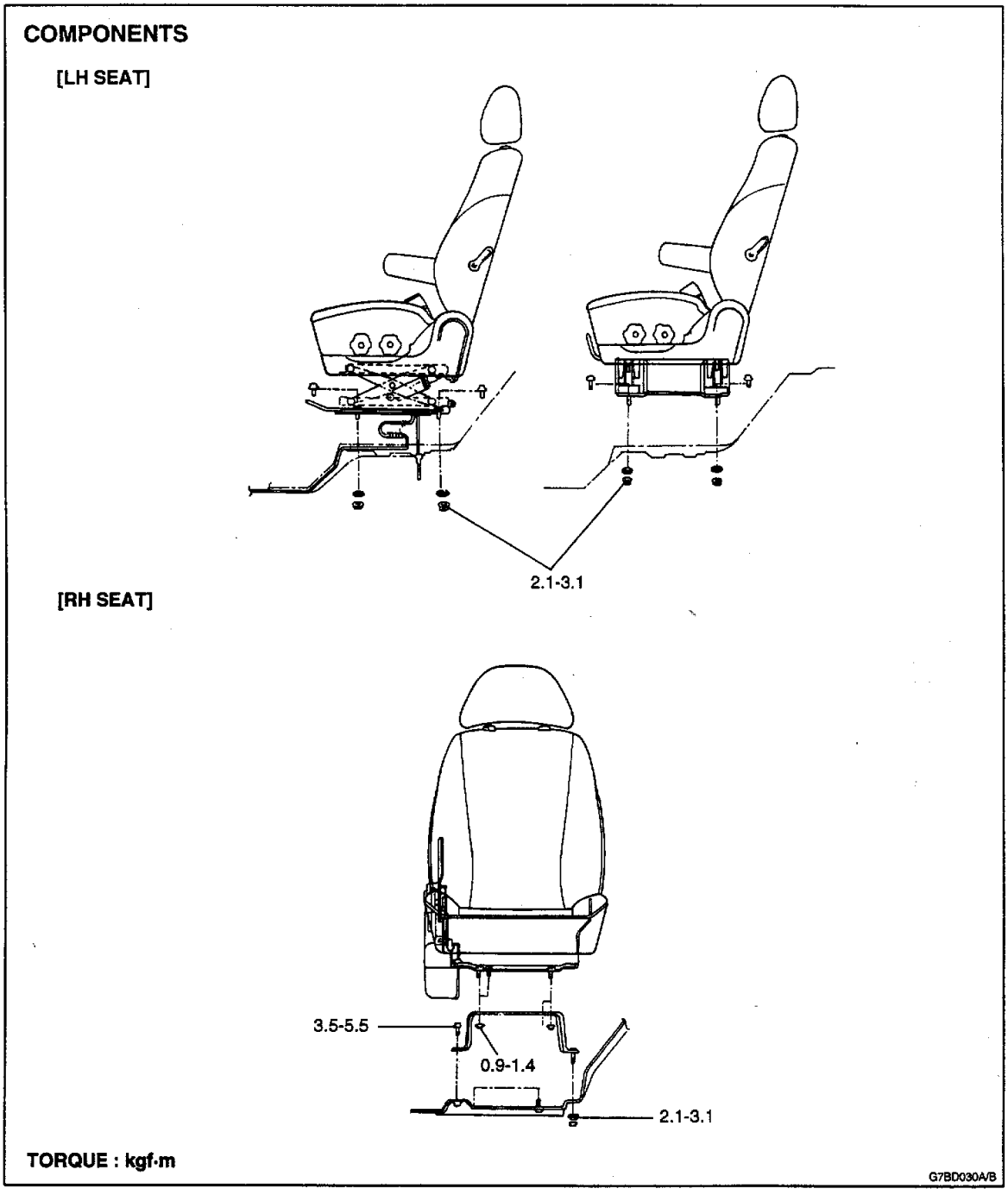
Note

Pull the strings, working from both sides of the windshield toward the center and pushing from the outside of the glass.

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Seat and Seat Belt

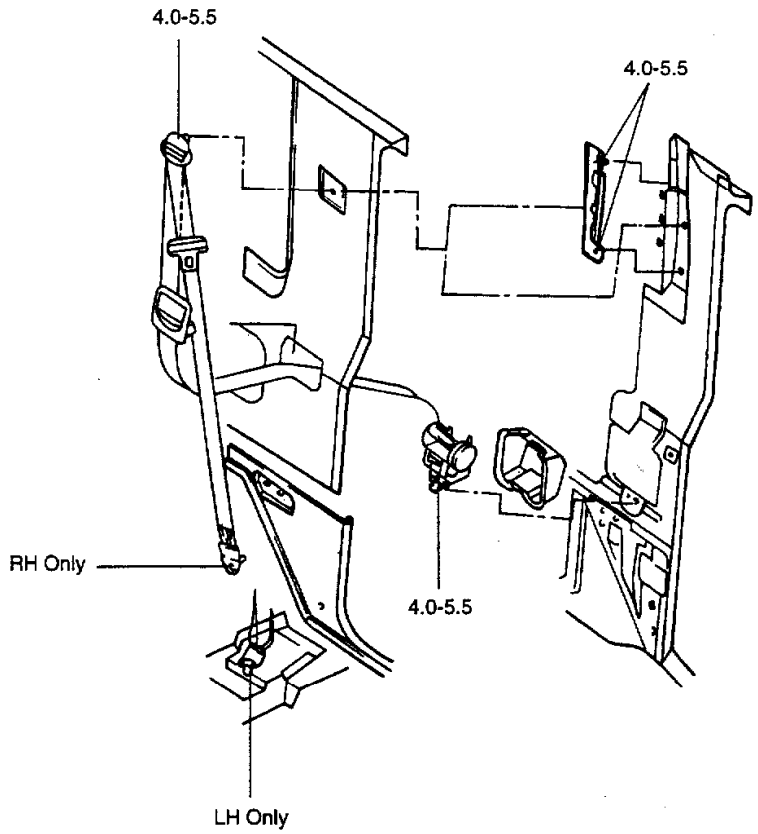
Seat



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Seatbelt

COMPONENTS



TORQUE : kgf·m

G7BD030C