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JAC

WORKSHOP MANUAL

HFC1035 SERIES TRUCKS

(EQUIPED WITH HFC4DA1-2C ENGINE AND LC5T28 TRANSMISSION)

（D8171）

Version No.[JAC-201208030172401]

JAC INTERNATIONAL

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JAC

HFC1035 SERIES

WORKSHOP MANUAL

Foreword

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

The workshop manual for the engine will be compiled separately.

This manual was prepared for HFC1035 series light duty trucks. Configurations as follows：

HFC4DA1-2C engine, LC5T28 transmission 5.375 gear ratio rear axle,

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

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GENERAL

SPECIFICATIONS

VEHICLE MODEL

VIN

THE MECHANIC PERFORMANCE TABLE OF BOLTS IN CHINA

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SPECIFICATIONS

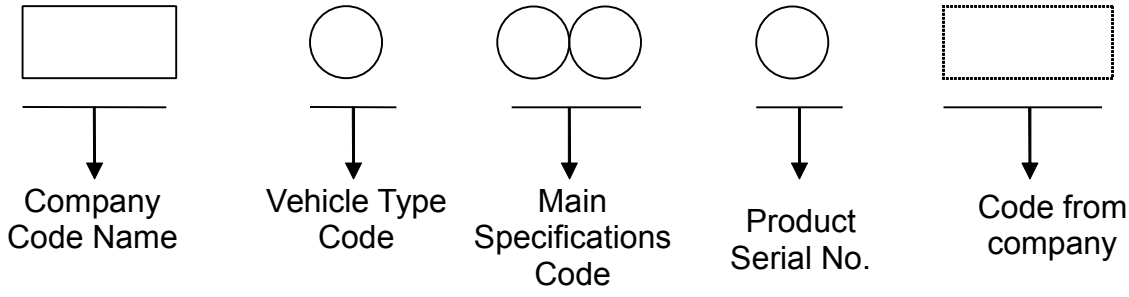
Main parameters of 1035 series trucks

Configurations： HFC4DA1-2C engine, 2771cc displacement, rated power (Kw/rpm) 85/3600 , torque (N.m/rpm) 250/1800-2800 ; LC5T28 transmission, 5.375 rear axle， hydraulic brake.

Vehicle model	Configuration code	Wheel Base (mm)	Overall dimension (mm)	Cargo dimension （mm）	Curb Weight （kg）	Gross weight Kg	Tire	Power steering	Remark	First 8 digits of VIN
HFC1035KD	D8171	2490	4850*1730*2240	3120*1620*400	2140	3490	7.00R16	Standard		LJ11KBAC

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Vehicle Model



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）

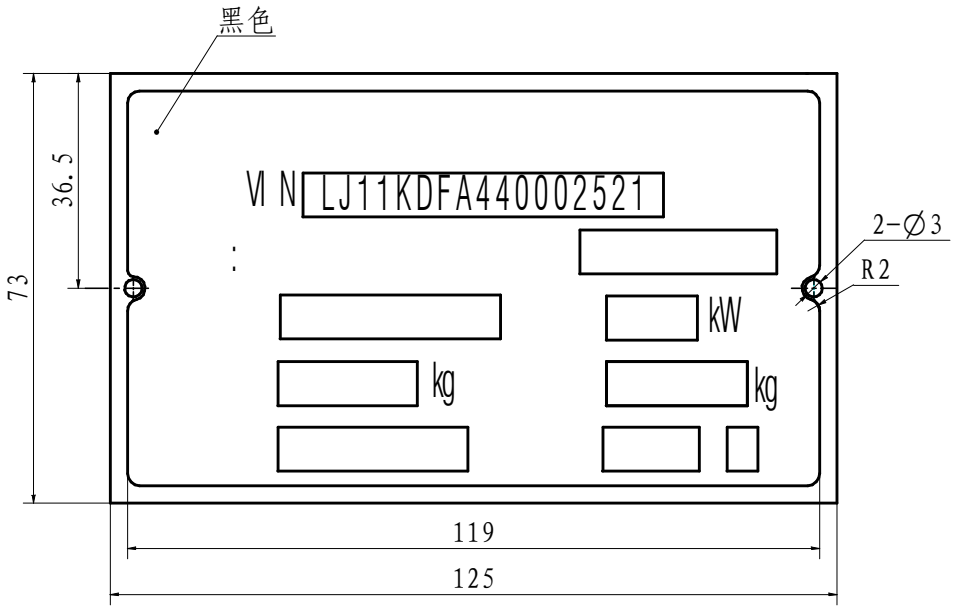
Code from company：K---Diesel R1---King cabin

For example：HFC1061KR1 represents JAC vehicle with king cab, 6 tons maximum gross weight, the first change.

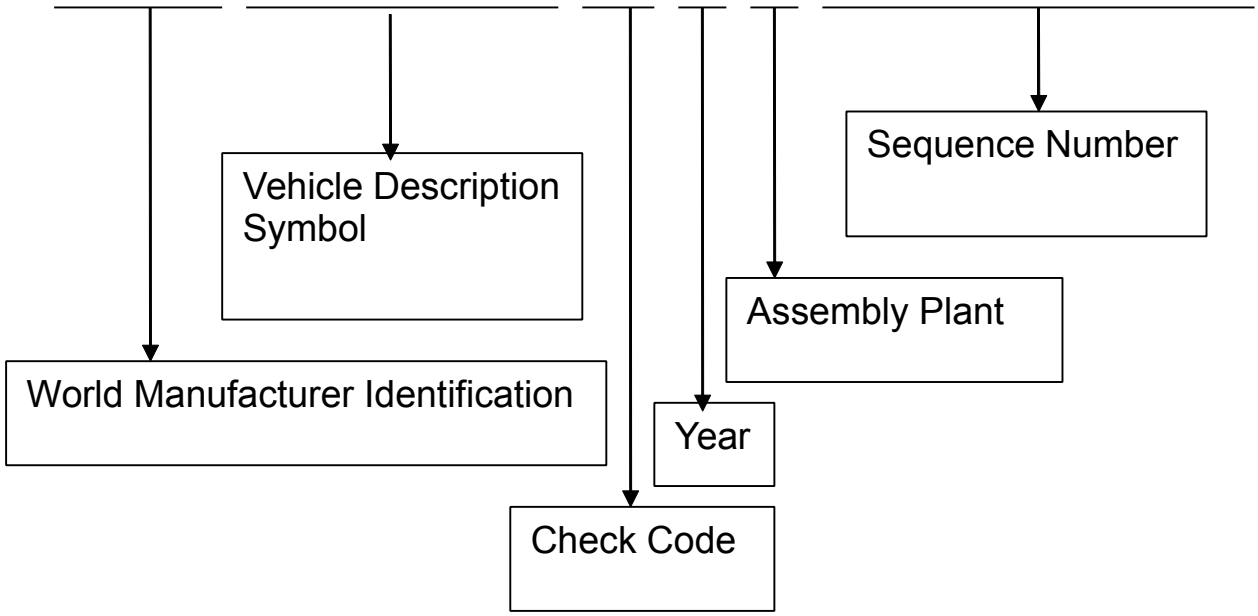
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VIN----Vehicle Identification Number

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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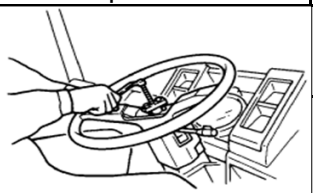
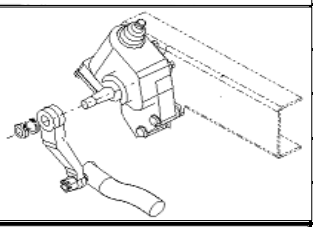
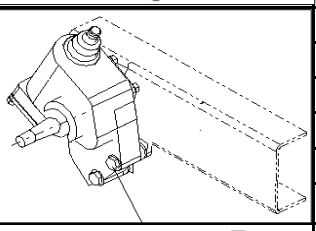
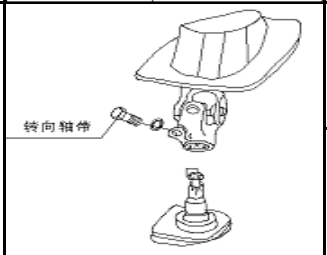
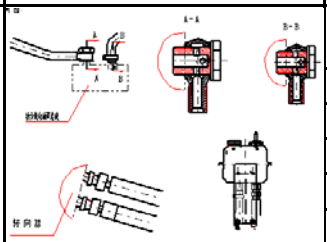
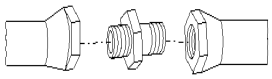
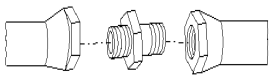
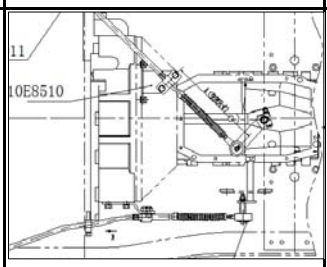
The mechanic performance table of bolts in China

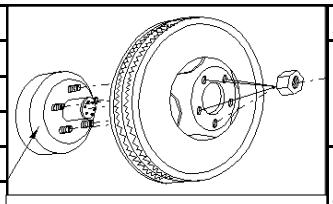
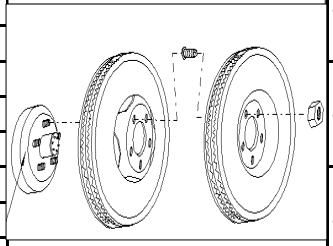
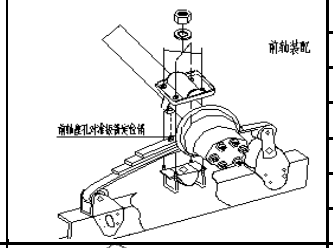
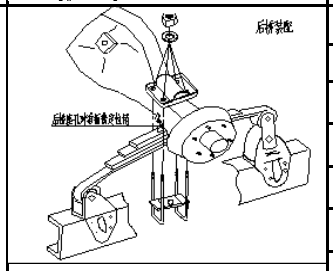
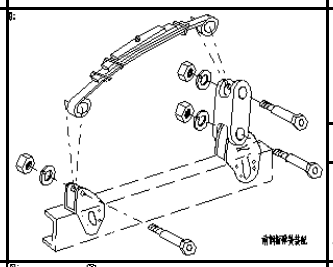
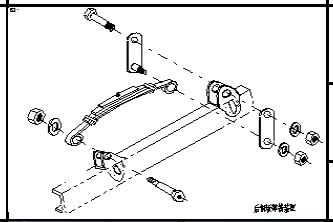
Quality Grade(mark)	6.8	8.8	9.8	10.9	12.9
Tensile strength limit $\sigma_{b\max}$ (MPa)	600	800	900	1040	1220
Yield limit $\sigma_{s\max}$ (MPa)	480	640	720	940	1100
Corresponding to Hyundai standards	4T	6T	7T	8T	10T

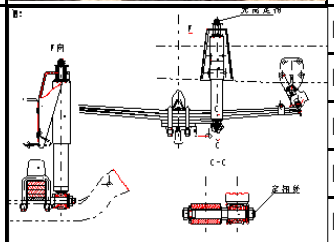
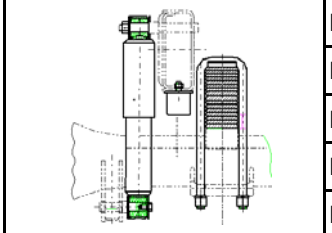
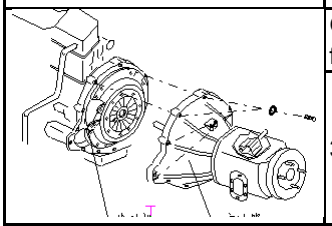
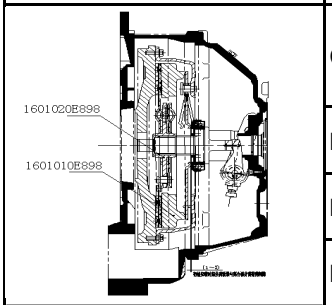
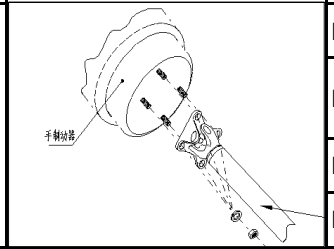
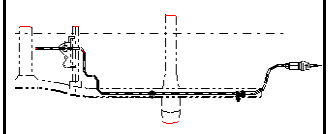
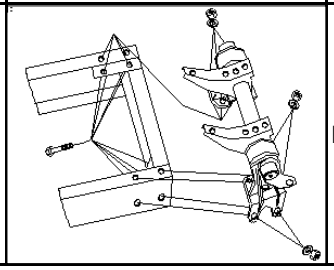
The number before the radix point represents one percent of the nominal tensile strength;

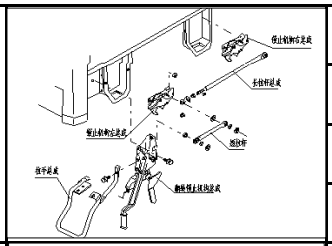
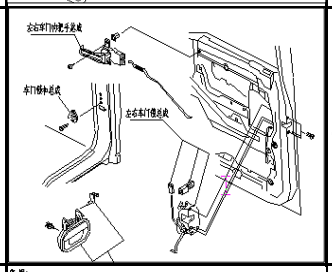
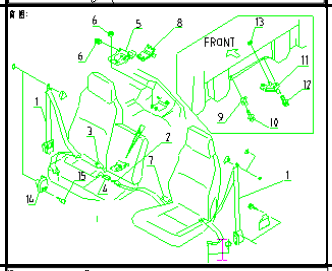
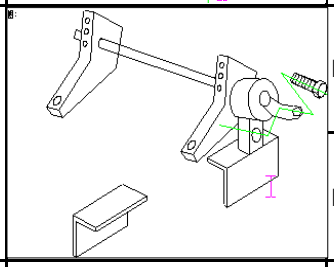
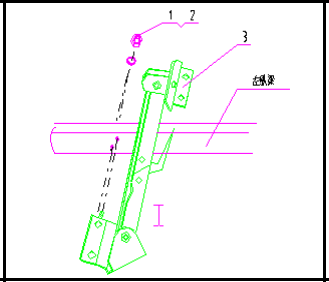
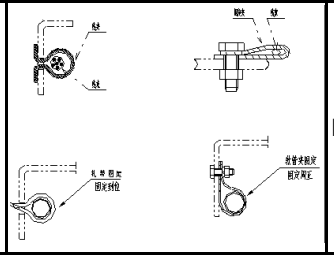
The number behind the radix point represents ten times of the ratio between the nominal yield limit and nominal tensile strength.

STANDARD TORQUE TABLE (JAC - All Models)

group	code	item	picture	Standard（N·m）
Steering system	1	steering wheel tightening nut		1020：54-69
				M20×1.5：60-79
	2	Connection of pitman arm and steering gear box		1020：54-69
				J1、E0、Z1、Z2：196-250
				A1、M1、Z15、E22CH：250-320
				M15、T0、T4：500-600
				M45×1.5:550-605
	3	connection of steering gear box,support and chassis		M10×1：65-95
				M12×1.25：108-161
				M14×1.5：146-205
				M16×1.5: 240-335
				M18×1.5: 397-507
				M20×1.5: 475-598
	4	connection of steering column steering gear box		M10：37-75
				M14×1.5: 50-55
	5	power steering pipe connection		Perforation bolt： according to the brake pipe system connection
				M14：53.9-73.5
				M16：88.3-118
				M18：100-130
				M20：100-130
				M22：130-160
				M24：160-200
Brake system	6	Brake pipe connection		Φ4.76 pipe：16-20
				Φ6 pipe：23-27
				Φ8 pipe：27-33
				Φ10 pipe：45-53
				Φ12 pipe：60-80
				Φ15 pipe：70-90
				Φ6 nylonpipe：22-25
				Φ8 nylonpipe：25-32
				Φ10 nylonpipe：37-42
				Φ12 nylonpipe：46-52
				Φ16 nylonpipe：59-67
				Φ20 nylonpipe：64-72
	7	brake draw bench equipment		by eyes, to make the spring mat flat

Tyre nut equipment	8	D series tyre nut（M18X1.5）		287-346
		3103104N\3103204N（M25X1.5）		343-441
		N series tire nut(inner)（M16X1.5）		
		N series tire nut(outer)（M25X1.5）		
		3103226J1\3103227J1（M20X1.5）		485-593
		E4 series tire nut(inner)（M20X1.5）		
		E4 series tire nut(outer)（M30X1.5）		
		3103203M1\3103204M1（M24X1.5）		485-593
		M1 series tire nut(inner)（M20X1.5）		
		M1 series tire nut(outer)（M30X1.5）		
		3103056A1\3103057A1（M20X1.5）		485-593
		A2 series tire nut(inner)（M20X1.5）		
		A2 series tire nut(outer)（M30X1.5）		
		3103104N\3103204N（M25X1.5）		485-593
		Z15AA series tire nut(inner)（M18X1.5）		
		Z15AA series tire nut(outer)（M27X1.5）		
		T206 series tire nut（M24X1.5）		518-598
		T206 series tire nut(inner)（M20X1.5）		
		T206 series tire nut(outer)（M30X1.5）		
		T4 series tire nut		540-670
		Heavy Truck series tire nut		M22x1.5: 590-680
suspension	9	Front U-bolt		M14：126-154
				M16:157-216
				M18:287-346
				M20:396-480
				M22:441-539
				M24:618-843
				heavy truck M20×1.5：440-550
	10	Rear U-bolt		M14：126-154
				M16:157-216
				M18:287-346
				M20:396-480
				M22:441-539
				M24:618-843
				M27、M27×3:850-950
	11	front leaf spring pin		E、C、B、K、Q、D、M：157-196 (for mexico E8510 belongs to E cateory for wide cabin truck)
				N、T、Z：190-260
				heavy truck(M14×1.5):85-110 (for mexico E8510 belongs to E cateory for wide cabin truck)
	12	Rear leaf spring pin		E、C、B、K、Q、D、M：157-196
				N、T、Z：190-260
				heavy truck(M14×1.5):85-110
	13	front spring pin locking bolt		M12:73-89
				M14:126-154

suspension	14	Rear spring pin locking bolt		M12:73-89
				M14:126-154
	15	Front shock absorber		M10:46-56
				M12×1.25:78-96
				M14：126-154
				M18:219-257
				M20×1.5:324-396
	16	Rear shock absorber		M10:46-56
				M12×1.25:78-96
				M14：126-154
				M18:219-257
				M20×1.5:324-396
engine	17	Engine and transmission connection		transmission and engine clutch shell connection：
				6782： 155.4-194.6
				1045： 80-110
				1061： 127.2-156.9
				Gearbox clutch shell with engine flywheel shell connection：
				37-75(aluminium alloy:36-44)
				Clutch platen bolt((10.9 class）：
				M10×1.5:74×(1±5%)；
				M12×1.5: 142×(1±5%)；
				M14×1.5:210×(1±5%)
Drive axle	18	Drive axle		M10×1：46-62
				M12×1.25：78-110
				M14×1.5: 130-180
				M16×1.5: 175-260
clutch	19	Clutch pipeline		According to the pipe drawing
	20	Cabin titling mechanism		M10:41-51 M12:75-96 M16:182-222

cabin	21	Cabin locking mechanism		M8:17-28 M10:37-75 M12:75-96 M16:182-222
	22	Door locks		9-11
	23	Safety belt		M12：75-96
	24	engine titling torsion arm		M16:182-222 M12：75-96
	25	cabin support rod		up M8:17-28 down M10:37-75
	26	cabin front support bolt		M14×1.5: 99-115
	27	connection bolt of Cabin titling mechanism torsion bearing bush and the cabin front support		M14×1.5: 99-115
Electric device	28	electric plugs		6-8(wide cabin)
	29	electric wire hraness		Make spring mat flat

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Chapter I Technical Characteristics of Engine

Section I Technical Requirements for Fuel, Oils, and Auxiliary Materials

I. Diesel

HFC4DA1-2C diesel engine adopts electronically controlled, high pressure common rail, fuel injection system and conforms to Euro-IV emission regulation and thus extends higher requirements over the fuel. To guarantee the reliability of the fuel supply system, make sure to use the qualified clean diesel produced by national well-established fuel company, in order to prevent the blockage or early wear of fuel injector due to poor fuel.

 **Add the fuel only at the well-established gas station. The use of poor diesel or other diesel intended for other than vehicle engine application is strictly prohibited.**

Make sure to use the fuel conforming to national standard GB 19147. The grade number of the diesel chosen is related to the temperature of working environment. When the environment temperature is reduced, the paraffins within the diesel will precipitate to block the fuel pipeline, leading to difficult fuel supply and start failure of the engine. Therefore, choose different grade number of diesel depending on the environment temperature in different seasons and regions, in accordance with the table shown below.

Environment temperature	Above 5℃	Above -5℃	Above -10℃	Above -25℃
Recommended grade number of diesel	0# light diesel	-10# light diesel	-20# light diesel	-35# light diesel

Notice!

The cam of the high pressure fuel pump is being lubricated by the fuel. Never cause engine flameout due to depletion of fuel in the fuel tank, or it will lead to serious wear of the high pressure fuel pump. After adding new fuel, make sure to firstly use manual fuel pump to bleed the air from the fuel pipe and high pressure fuel pump and thoroughly fill the fuel pipe and high pressure fuel pump with fuel before starting the engine, in order to prevent the wear of high pressure fuel pump due to fuel shortage.

Procedure for air bleeding and refueling:

1. Loosen the air bleeding screw;

2. Push down the manual fuel pump with hand and then release. Repeat above operation, till there is no air bleeding out from the air bleeding screw;

3. Tighten the air bleeding screw and pump the fuel with manual fuel pump, till the fuel injection pump is thoroughly filled with fuel.

The diesel filter embodies the fuel-water separation function:

The water content in the diesel will bring about great harm to the fuel system. Upon the detection that the diesel filter water level warning lamp on the instrument panel lights up, it indicates the presence of waste water in the diesel filter. The waste water shall be drained timely, or it will lead to the rusting and wear of high pressure fuel pump, high pressure fuel rail, and fuel injector and bring about unnecessary losses.

Procedure for water drainage:

1. Unplug the water level sensor connector;

2. Loosen the water level sensor to drain the waste water, till the diesel flows out.

3. Tighten the water level sensor and plug the water level sensor connector.

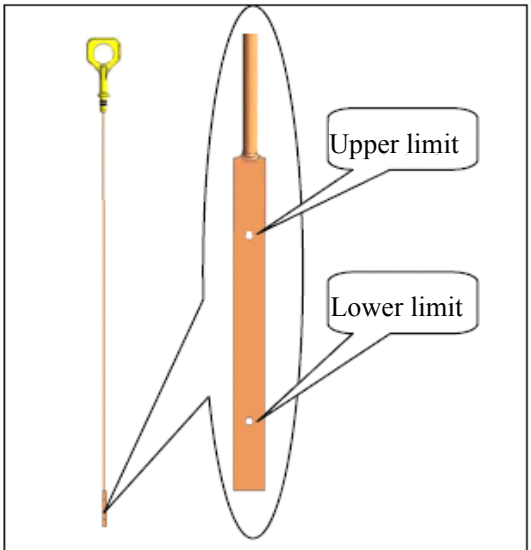
II. Engine Oil

HFC4DA1-2C diesel engine shall use the diesel engine oil with the quality grade at API CH-4 or above, of which the viscosity is related to the environment temperature. When the environment temperature is reduced, the viscosity of the engine oil is increased to increase the start resistance so that the diesel engine can't reach the start speed and cause difficult start. Therefore, in different seasons and regions, choose the correct engine oil with different viscosity grade under different environment temperature, in accordance with the table below.

Environment temperature	-15℃~40℃	-20℃~30℃	-30℃~25℃	Extreme cold region
Engine oil trademark	10W-40/50 or 15W-40	10W-30/40/50	5W-40/50	0W-40/50

Check engine oil level:

- Stop the engine and wait for several minutes;
- Pull out the engine oil dipstick;
- Wipe the oil dipstick with clean cloth and re-insert the oil dipstick to the end;
- Pull out the oil dipstick again and observe the engine oil level. Check whether the oil level is between the upper and lower limits of the oil dipstick. If insufficient, add the engine oil.



Notice: Make sure to horizontally park the vehicle while measuring the engine oil level. Stop the engine and wait for several minutes, till the engine oil can return to the oil sump.

Notice!

- Make sure to periodically check the engine oil level.
- The apparatus used for refueling shall be clean.
- In event of sudden rise or drop of engine oil level, check for cause immediately.

- Never mix different trademarks of engine oils.
- Periodically replace the engine oil as per the maintenance regulations.

III. Coolant

Make sure to use clean automotive antifreeze coolant featuring antifreeze in winter, anti-boiling in summer, and anti-corrosion, anti-rusting, and anti-scaling.

Take cautions during the operation:

a. Always use coolant throughout the year and pay attention to the use continuity of the coolant.

b. Depending on the temperature of the region in which the vehicle is used, choose the coolant with different freezing point. The freezing point of the coolant shall be at least 10ºC below the lowest temperature of the region, in order to maintain the antifreeze function.

c. Purchase the qualified coolant product, in order to prevent damaging the engine and causing unnecessary economic losses due to use of disqualified product.

d. Never mix different trademarks of coolants nor use such mixed coolant, in order to prevent the chemical reaction from impairing the respective comprehensive anti-corrosion performance.

e. Never add the hard water such as well water or running water. Upon the detection of suspended material, sediment, or smelliness phenomenon in the coolant, it indicates that the coolant is deteriorated and becomes ineffective due to chemical reaction. In such case, timely clean the cooling system and thoroughly replace the coolant.

f. The glycol coolant is one toxic substance and is harmful to the liver. Never swallow the coolant. In event of skin exposure to the coolant, thoroughly clean with water immediately. In addition, the nitrite anti-corrosion additive in the coolant is one carcinogenic substance. Do not dispose the used coolant randomly, in order to prevent contaminating the environment.

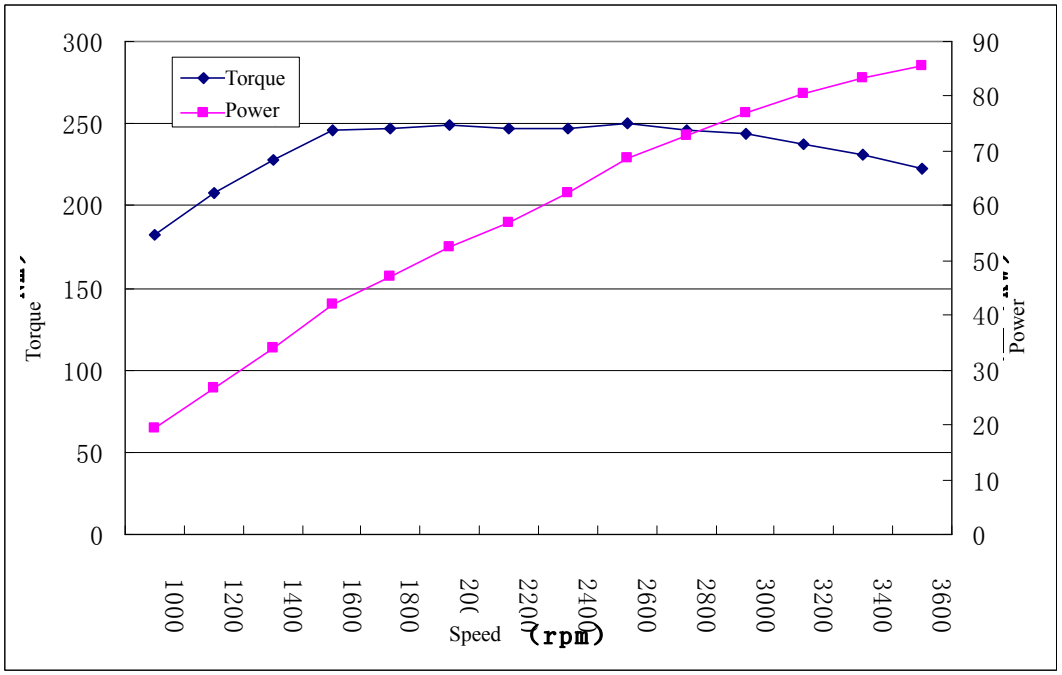
Notice!

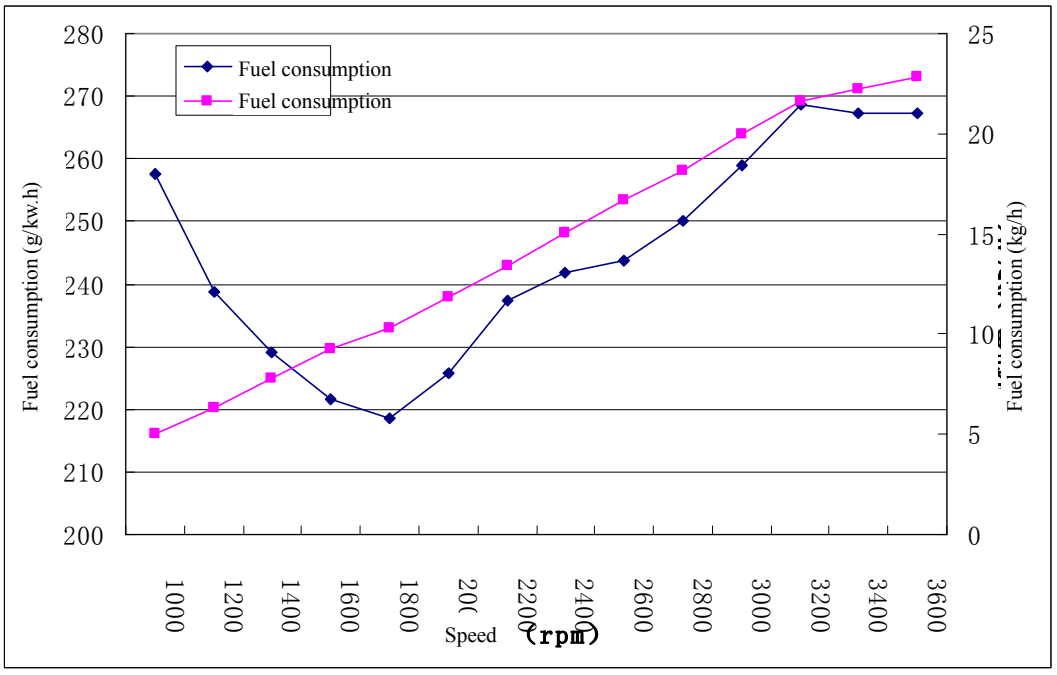
- Upon the detection of sudden drop in coolant level, check for cause immediately.
- The cooling system is under pressurized state! Never open the cap of the coolant compensation tank or radiator while the engine is still hot, or it will lead to scalding danger!

Section II Main Technical Specification of Engine

Model	HFC4DA1-2C		
Type	Inline 4-cylinder, longitudinal layout, water-cooled, 4-stroke, turbocharged inter-cooler, high pressure common rail, and direct injection engine		
Nominal power/speed	85/3600（kw/rpm）		
Top torque/speed	250/1800～2800(Nm/rpm)		
Minimum fuel consumption of external characteristic	≤ 218g/kw·h	Top idling speed	4000rpm
Exhaust temperature (before turbine)	≤ 700℃	Idling speed	800±50 rpm
Number of cylinders × bore × stroke:	4×93 mm×102 mm	Total piston displacement	2.771 L
Compression ratio	17 ： 1	Fuel grade	-10#
Working sequence	1-3-4-2	Fuel supply advance angle	Electronically controlled
Flameout mode	Fuel cut-off	Engine mass	270kg
Emission limit (test value)	China-IV emission standard compliant	Noise limit	≤ 95dB(A)
Engine oil trademark	Above grade CH-4	Engine oil capacity	7.2L
Engine oil/fuel consumption ratio (24h at full speed)	≤ 0.10%		
Temperature of engine oil in oil sump (under nominal working condition)	≤130℃		
Engine oil pressure	Idling: ≥98 kPa		
Coolant capacity	30L	Applicable altitude	≤3500m
Thermostat type	Wax type	Maximum outlet temperature of coolant	≤ 110℃
Thermostat opening temperature	82℃	Thermostat full open temperature	95℃
Applicable temperature of diesel engine	With heated cold starter and with heater plug in engine		
Overall dimensions (L×W×H)	728.9mm×715.6mm×753.3mm	Length of cylinder block	479mm

Section III Performance Curve of Engine





Section IV Main Checking and Adjustment Parameters

1、**At rated power:**	
(1) Exhaust temperature (master pipe) (ºC)	≤700
(2) Thermostat opening temperature (ºC)	82
(3) Thermostat full open temperature (ºC)	95
(4) Temperature of engine oil in main oil way (ºC)	≤130
(5) Engine oil pressure (kPa)	400～600
2. Engine oil pressure at minimum stable speed (kPa)	≥98
3. Timing phase (in rotation angle of crankshaft)	
(1) Open of intake valve (before top dead center)	24.5°
(2) Close of intake valve (after bottom dead center)	55.5°
(3) Open of exhaust valve (before bottom dead center)	54°
(4) Close of exhaust valve (after top dead center)	26°
4. Valve clearance (mm)	0.3～0.4

Section V Tightening Torque for Critical Bolts of Engine

☆ Comparison Table of Tightening Torque for Critical Bolts

No.	Description	N. m
1	Fixing bolt of rockshaft	55
2	Heater plug	25
3	Nut and washer for fuel injector body	40
4	Fuel injector	34
5	Fixing bolt of thermostat housing assembly	25
6	Installation torque of rocker arm assembly	55
7	Camshaft thrust plate bolt	25
8	Camshaft timing gear bolt	110
9	Fixing bolt of rockshaft	50
10	Fixing bolt of engine oil pump filter screen assembly	20
11	Engine oil pump fixing bolt	20
12	Oil sump bolt	23.5
13	Flywheel baffle bolt	85
14	Flywheel bolt	25 for first step 70 for second step 120 for third step
15	Crankshaft bearing cap bolt	20 for first step 110 for second step 170 for third step
16	Tightening bolt of engine oil pump	25
17	Socket nut of engine oil pump	30
18	Torque for cylinder head bolt:	65 for first step 85 for second step 105 for third step
19	Rockshaft support bolt	55
20	Main bearing cap bolt	170
21	Torque for drive shaft nut	66
22	Transmission bracket nut	69
23	Clutch cover – flywheel housing bolt	M10：46 M12：91
24	Engine rear bracket nut and bolt	M10：40 M12：69
25	Front exhaust pipe bolt	37
26	Clutch working cylinder bolt	19

No.	Description	N．m
27	Belt pulley bolt	210
28	Fan pulley	12.5
29	Crankshaft bearing cap bolt	170
30	Connecting rod bearing cap bolt	25 for first step 85 for second step
31	Camshaft timing gear	110
32	Fuel injection pump nut	30
33	Idler gear bolt	20
34	Engine oil pipe perforated bolt	20
35	Crankshaft belt pulley bolt	210
36	Fan silicone oil clutch	12.5
37	Connecting rod bearing cap	20 for first step 85 for second step
38	Piston cooling oil pipe bolt	M8×1.25 25 M6×1.00 7.5
39	Oil pressure regulation valve	M6×1.5　30
40	Socket nut of engine oil pump	30
41	Engine oil pump assembly bolt	25
42	Oil sump bolt	23.5
43	Cylinder head bolt	65 for first step 85 for second step 105±5 for third step
44	Rockshaft support bolt	55
45	Tightening bolt of water outlet pipe	19
46	Protrusion size of water pump impeller	24.6mm
47	Fan center distance	79.2～79.8 m
48	Open temperature of thermostat valve	82 ℃
49	Full open temperature of thermostat valve	95℃
50	Open pressure of vacuum valve at center of radiator cap valve seat	88．2～117．6 kPa
51	Water pump fixing bolt	25 N.m
52	Alternator fixing bolt	40 N.m
53	Alternator adjustment plate fixing bolt	25 N.m
54	Lock nut, A/C compressor idler gear	27 N.m
55	Nut of engine oil cooler water pipe	25
56	Oil drainage plug	80
57	Fixing bolt of oil pump assembly	20

No.	Description	N．m
58	Tightening socket nut	30
59	Bolt and nut of starter motor	81
60	Fixing nut of starter cable	9
61	Exhaust branch pipe bolt	30
62	Bolt of heat shield	25
63	Support bolt	40
64	Front exhaust pipe nut	40
65	Crankshaft belt pulley bolt	210
66	Exhaust pipe nut	67
67	Torque of engine bracket bolt	M10：40 M12：69
68	Cylinder head cover nut	13
69	Connecting nut between turbocharger and exhaust manifold	25
70	Connecting bolt between exhaust manifold and cylinder head	30
71	Bolt of exhaust pipe heat shield	25
72	Connecting bolt of turbocharger air bleeding pipe	25
73	Perforated bolt of lubricating oil pipe	M12：41 M14：55

☆ Comparison Table for Standard Bolt Specification and Tightening Torque

Bolt Identification / Torque (N.m) / Specification	Less than grade 8.8 (low carbon steel)	Grade 8.8 (High carbon steel)	Grade 10.9 (Alloy steel)
M6×1.0	4~8	5~10	.....
M8×1.25	8~18	12~23	17~31
M10×1.25	21~35	28~47	38~64
M10×1.5	20~34	28~46	37~61
M12×1.25	50~75	62~93	77~116
M12×1.75	46~70	58~86	73~109
M14×1.5	78~117	95~142	116~174
M12×2.0	73~109	90~134	109~163
M16×1.5	106~160	138~208	163~245
M16×2.0	102~152	132~198	156~234
M18×1.5	154~230	199~299	234~352
M20×1.5	210~316	275~413	323~485

M22×1.5	256~422	370~555	433~649
M24×2.0	360~550	439~725	565~847

Section VI Main Fitting Clearances and Allowable Wear Limits of Engine

No.	Name	Standard Size (mm)	Fitting nature	Assembly Clearance for New Engine (mm)	Wear Limit (mm)
1	Contact width between valve and seat ring				
	Intake valve	1.7		2.2	
	Exhaust valve	2		2.5	
2	Valve sinkage				
	Intake valve	0.73		1.28	
	Exhaust valve	0.71		1.2	
3	Backlash	0.05-0.13		0.3	
4	Axial run-out clearance of idler gear A	0.07		0.2	
5	Outside diameter of tappet	$\Phi 13^{-0.010}_{-0.028}$	Clearance	0.01～0.046	0.10
	Tappet bore	$\Phi 13^{+0.018}_{0}$			
6	Radial run-out of push rod			0.3	
7	Deflection of rockshaft			0.3	
8	Outside diameter of rockshaft	$\Phi 19^{0}_{-0.02}$	Clearance	0.01～0.05	0.20
	Rocker arm bore	$\Phi 19^{+0.03}_{+0.01}$			
9	Rod diameter of intake valve	$\Phi 8^{-0.039}_{-0.054}$	Clearance	0.039～0.071	0.20
	Valve guide bore	$\Phi 8^{+0.017}_{0}$			
10	Rod diameter of exhaust valve	$\Phi 8^{-0.064}_{-0.079}$	Clearance	0.064～0.096	0.25
	Valve guide bore	$\Phi 8^{+0.017}_{0}$			
11	Free height of valve spring	48			
	Perpendicularity of valve spring	Φ1.4			
12	Outside diameter of idler gear A shaft	$\Phi 55^{-0.025}_{-0.055}$	Clearance	0.025～0.080	0.2
	Inside diameter of idler gear A bearing	$\Phi 55^{+0.03}_{0}$			
13	Cylinder sleeve bore	$\Phi 93^{+0.065}_{+0.020}$			

No.	Name	Standard Size (mm)	Fitting nature	Assembly Clearance for New Engine (mm)	Wear Limit (mm)
	Name	Standard Size (mm)	Fitting nature	Assembly Clearance for New Engine (mm)	Wear Limit (mm)
13	Protrusion height of cylinder sleeve	0～0.08			
14	Axial run-out clearance of camshaft		Clearance	0.05～0.13	0.20
	Cam height of camshaft	42.02±0.05			0.38
15	Inside diameter of camshaft bush	$\Phi 50^{+0.025}_{0}$	Clearance	0.025～0.080	0.12
	Diameter of camshaft journal	$\Phi 50^{-0.025}_{-0.055}$			
16	Deflection of cam bush			0.02	0.1
17	Outside diameter of piston pin	$\Phi 34^{0}_{-0.005}$	Clearance	0.002～0.015	0.03
	Piston pin bore	$\Phi 34^{+0.010}_{+0.002}$			
18	Thickness of connecting rod large end	$\Phi 33^{0}_{-0.07}$	Clearance	0.175～0.320	0.35
	Opening of crankshaft connecting rod journal	$\Phi 33^{+0.250}_{+0.175}$			
19	Clearance of intake and exhaust valves (cold state)		Clearance	0.3～0.4	
20	Main journal	$\Phi 70^{-0.068}_{-0.086}$	Clearance	0.031～0.066	0.11
	Main bush bore (after assembly)	$\Phi 70^{-0.003}_{-0.033}$			
21	Outside diameter of piston pin	$\Phi 34^{0}_{-0.036}$	Clearance	0.008～0.026	0.05
	Inside diameter of connecting rod bush	$\Phi 34^{+0.020}_{+0.038}$			
22	Crankshaft connecting rod journal	$\Phi 53^{-0.070}_{-0.085}$	Clearance	0.029～0.069	0.1
	Connecting rod bush bore (after assembly)	$\Phi 53^{-0.016}_{-0.041}$			
23	Grouping of piston outside diameter		Grouping clearance	0.053～0.075	
	Group A	92.957～92.968			
	Group B	92.968～92.979			
	Group C	92.979～92.990			
	Group D	92.990～93.001			

No.	Name	Standard Size (mm)	Fitting nature	Assembly Clearance for New Engine (mm)	Wear Limit (mm)
	Grouping of cylinder sleeve inside diameter (after pressed-in)				
	Group A	93.021～93.032			
	Group B	93.032～93.043			
	Group C	93.043～93.054			
	Group D	93.054～93.065			
24	Opening of piston ring				
	1st compression ring			0.2～0.4	1.5
	2nd compression ring			0.65～0.85	1.5
	Oil control ring			0.25～0.50	1.5
25	End clearance of piston ring				
	1st compression ring			0.078～0.139	0.15
	2nd compression ring			0.045～0.09	0.15
	Oil control ring			0.03～0.07	0.15

Section VII Specification of Main Attachments and Accessories

Lubrication system	Engine oil pump type	Externally engaged gear pump
	Flow rate of engine oil pump	≥ 23L/m (at 1,000r/m and 0.4MPa) ≥ 23L/m (at 1,800r/m and 0.44MPa)
	Open pressure of engine oil pump relief valve	0.7±0.08MPa
	Engine oil filter type	Filter element type
Cooling system	Water pump type	Centrifugal type
	Flow rate and head of water pump (water temperature at 80±5ºC)	Head ≥6.5m (at 3,000r/m) at 100L/min flow rate; Head ≥12m (at 4,000r/m) at 120L/min flow rate;
	Thermostat type	Pellet thermostat
	Temperature of thermostat	Initial open: 82ºC; full open: 95ºC
	Fan type	Independent electric fan
Electric system	Preheating plug type	Ceramic type
	Voltage of preheating plug	12V
	Starter specification	12V，2.8kW
	Alternator specification	14V，90A
	Battery voltage	12V
Intake system	Turbocharger	Radial flow variable section turbocharger The top speed of turbocharger is ≤220,000r/m, with turbocharger ratio at ≤2.2.
EGR	Type of EGR valve	Position feedback type
	Voltage of EGR valve position sensor	5V
Electronically controlled common rail fuel system	Fuel filter type	Spin-on type, with fuel-water separator, manual fuel delivery pump, and diesel heater
	High pressure fuel pump	BOSCH CP1H, radial three-plunger pump, with fuel delivery fuel pump and solenoid valve control
	Fuel injector	BOSCH CRI2.2, solenoid valve control
	High pressure common rail	Maximum rail pressure: 160MPa
	Electronic control unit (ECU)	BOSCH EDC17, with working voltage at 12V
	Crankshaft speed sensor	Working clearance: 0.5～1.2mm
	Camshaft position sensor	Working clearance: 0.5～1.5
	Air flowmeter	HFM6, with working voltage at 12V and flow measurement range at 40~840kg/h.
	Water temperature sensor	NTC type
	Rail pressure sensor	Voltage output: 0.5~4.5V
	Accelerator pedal position sensor	Voltage: 5V

Chapter II Maintenance for Main Structures of Engine

Section I Disassembly of Engine Assembly

I. Special Notices:

a) Before overhauling the engine, make sure to firstly disconnect the negative cable of the battery, or it will damage the harness and other electric units;

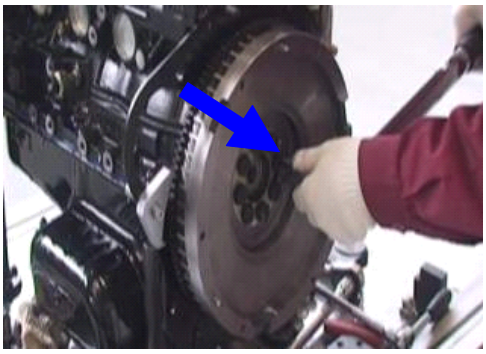
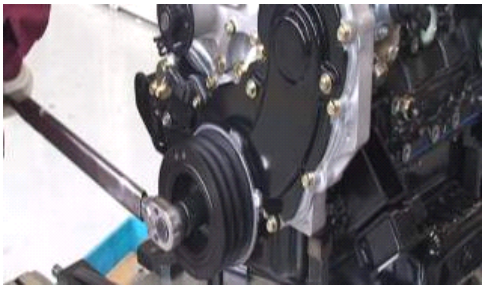
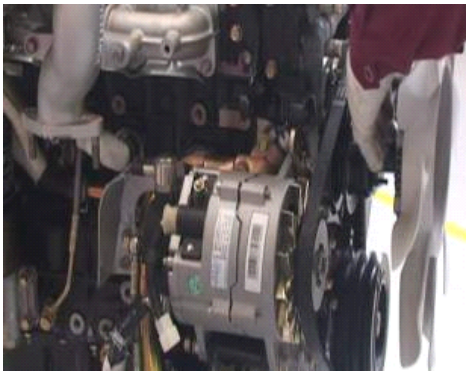
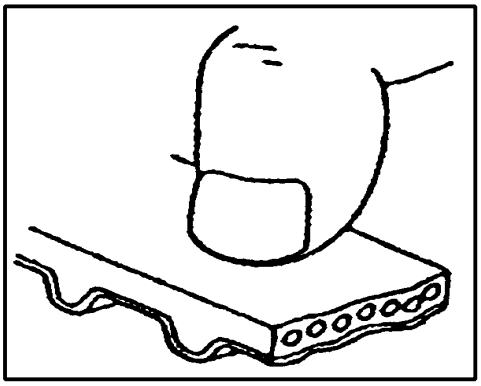
b) Unless otherwise specified, rotate the ignition switch to LOCK position;

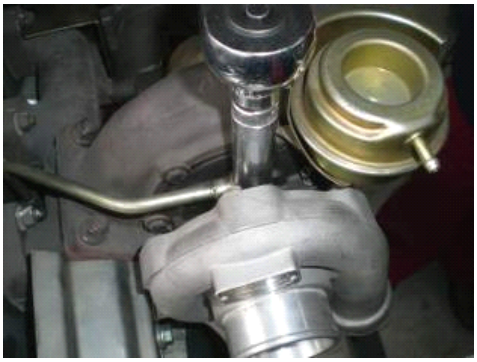
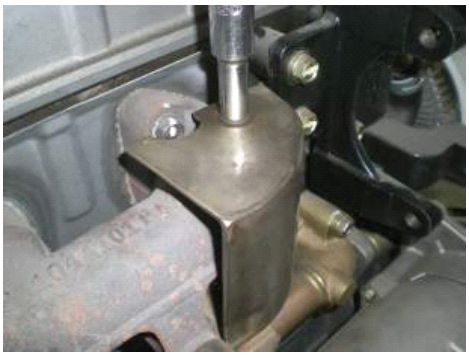
c) Whenever the air cleaner is disassembled, make sure to plug the intake port, in order to prevent the ingress of foreign material, which may enter into cylinder and cause serious damage.

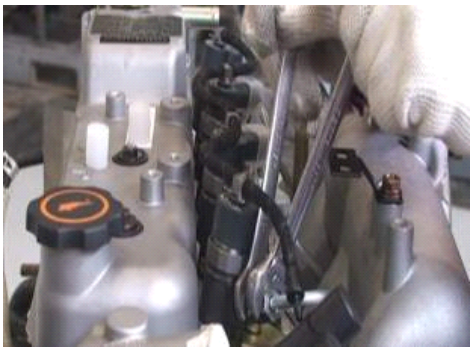
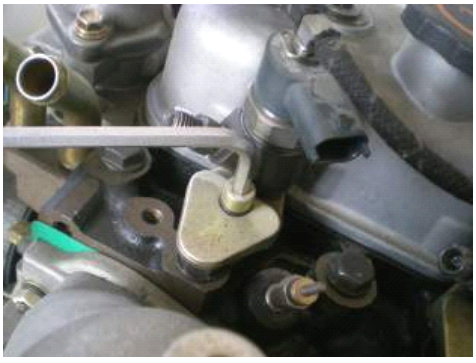
II. Disassembly Procedure

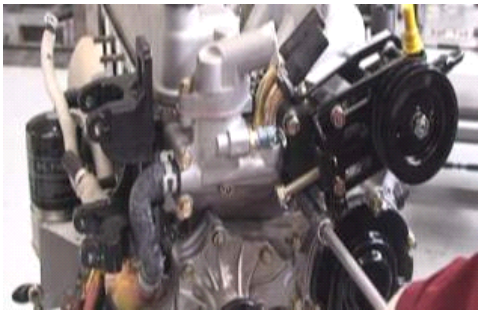
- Turn the ignition switch to LOCK position and disconnect the negative cable of the battery.
- Open the oil drainage bolt of the oil sump and fully drain and collect the oil.
- Fully drain the coolant.
- Disassemble the water inlet and outlet hoses of the engine.
- Disassemble the electronic control harness for engine ECU, engine, and complete vehicle.
- Disassemble the power supply wires for alternator, starter, and oil pressure and water temperature sensors.
- Remove the connecting hose between intake connecting pipe and air cleaner.
- Loosen the connecting pipe of inter-cooler.
- Shut off the fuel pipeline and unplug the fuel pipe and return pipe.
- Disconnect the power supply of the radiator fan and when necessary loosen the radiator bracket and take out the whole radiator.
- Loosen the clutch connecting pipe.
- Disassemble relevant connecting pipes of air conditioner and power steering pump.
- Disconnect the exhaust manifold and exhaust muffler pipe.
- Loosen the connecting mechanism between transmission and the complete vehicle.
- Loosen the fixing bolts between engine and transmission suspension bracket.
- Steadily lower the engine with elevator.
- Loosen the connecting bolts between engine and transmission and separate the transmission from the engine.

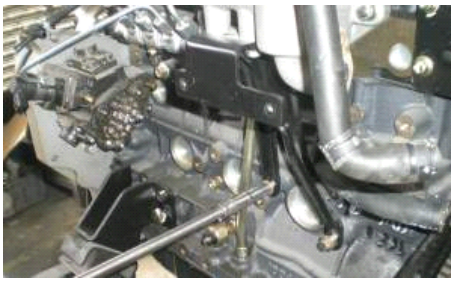
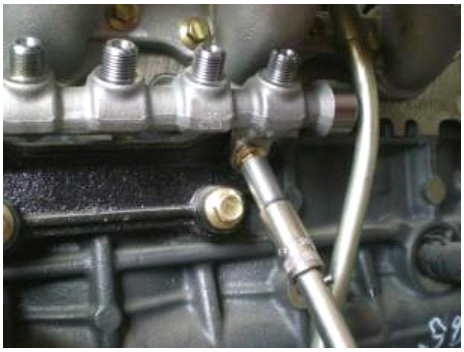
III. Illustration for Disassembly of Engine

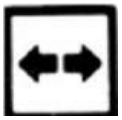
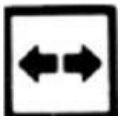
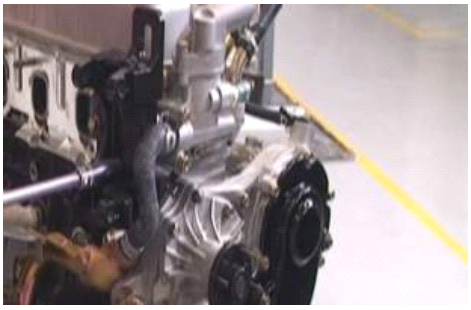
1. Disassemble the flywheel.		
 		a. Block the flywheel with flywheel clamp, loosen the fixing bolts between damping pulley and flywheel, and disassemble the flywheel assembly.
2. Disassemble the belt, air conditioner compressor, and alternator and water pump pulleys.		
 		a. Use an open-end wrench to remove the fixing nuts of engine fan and remove the cooling fan of the engine. b. Loosen the alternator adjustment bolts and fixing bolts, remove the fan clutch pulley and alternator belt, and check the side face and toothed face of the belt for normal state. c. Remove the oil and vacuum pump oil return pipe connectors. d. Loosen the alternator fixing bolts and adjustment bolts and disassemble the alternator belt. Check the alternator belt for presence of aging, cracking, and abnormal wear. If yes, replace the belt. Arrange the parts disassembled orderly on the part shelf, remove the alternator, use hand to rotate the alternator pulley, and check the inside for presence of noise, stagnation, and unbalance. Check the alternator for presence of ablation and check the shaft for presence of abnormal wear noise. e. Disassemble the water pump pulley.

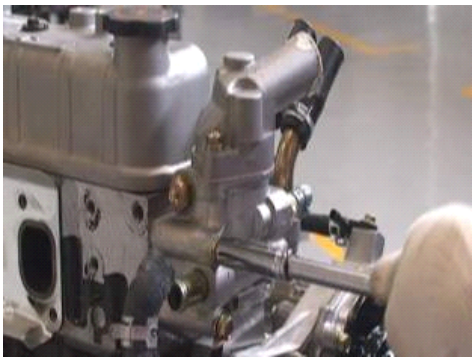
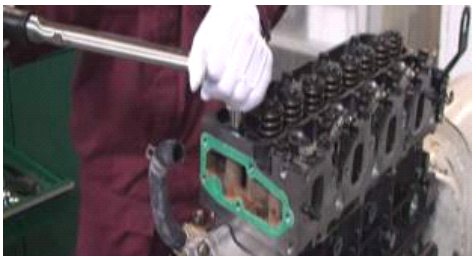
3. Disassemble the exhaust system.		
		a. Disassemble the fixing bolts of turbocharger lubricating oil pipe and disassemble the fixing clamp of return hose.
		b. Remove the exhaust pipe shield.
		c. Remove the EGR cooler.
		d. Remove the exhaust pipe and turbocharger assembly. e. Remove the fixing bolts and nuts of exhaust pipe, remove the exhaust manifold and turbocharger subassembly, and remove the exhaust manifold gasket. f. Check: A) Whether the rotor of turbocharger rotates flexibly. B) Whether the air compressor wheel is damaged, observed from the inlet of air compressor. C) Whether the air compressor interferences with the housing, observed from the inlet of air compressor.
4. Disassemble the relevant accessories of fuel system.		

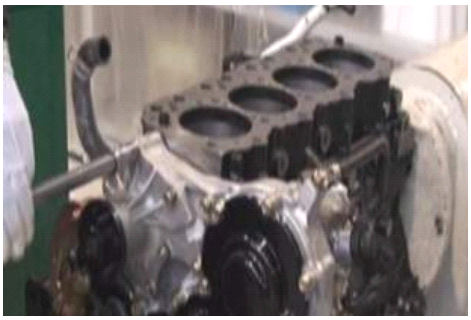
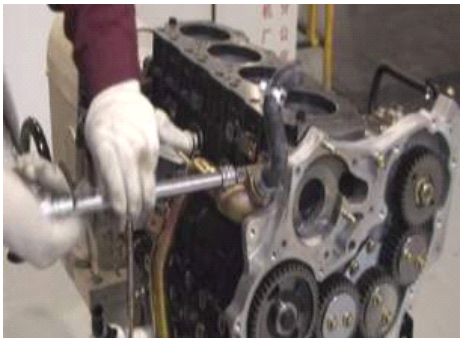
  		a. Loosen the conical nut at fuel injector end and the conical nut on fuel injection pump side (one is to reversely tighten the fuel inlet of fuel injector and one is to loosen the nut of high pressure fuel pipe); Loosen the conical nut on fuel injection pump side (Two wrenches are used mainly for disassembly, of which one is to reversely tighten the fuel outlet of fuel injection pump and one is to loosen the nut of high pressure fuel pipe, in order to prevent the fuel outlet of the fuel injection pump from follow-up rotation). Remove the high pressure fuel pipe and install the high pressure fuel pipe protective sleeve; b. Remove the fuel injector return hose. c. Remove the fixing bolts of fuel injector pressure plate, remove the fuel injector body along with its support, and install the fuel injector protective sleeve.
4. Disassemble the fuel-gas separator subassembly		
		a. Remove the crankshaft breathe hose and fuel-gas separator return hose. b. Disassemble the fixing bolts of fuel-gas separator. c. Remove the fuel-gas separator.

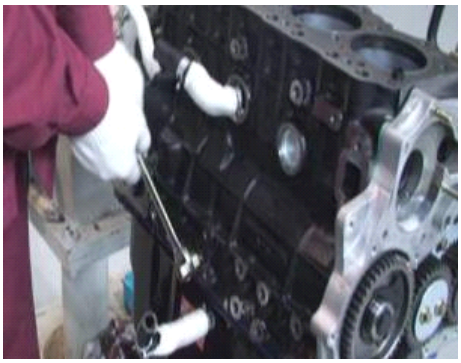
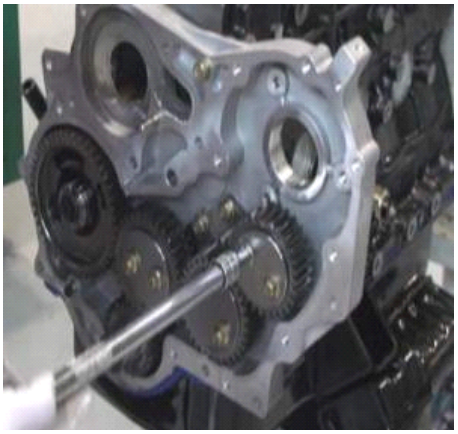
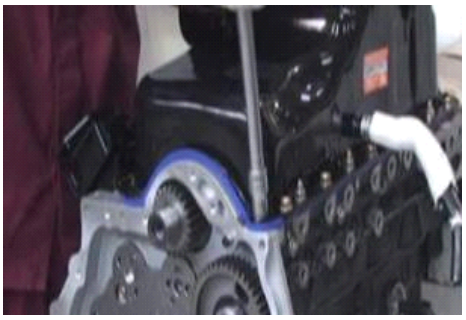
 		d. Remove the fixing bolts of fuel-gas separator housing and take out the fuel-gas separator filter element. Clean the fuel-gas separator housing, check the state of filter element, and when necessary replace the filter element.
		e. Disassemble the fixing bolts of fuel-gas separator bracket and remove the fuel-gas separator bracket.
4. Disassemble the intake manifold and other peripheral accessories.		
		a. Disassemble the fixing bolts of power steering pump and remove the power steering pump. b. Check the power steering pump for presence of oil leakage and check the belt pulley of power steering pump for presence of wear;

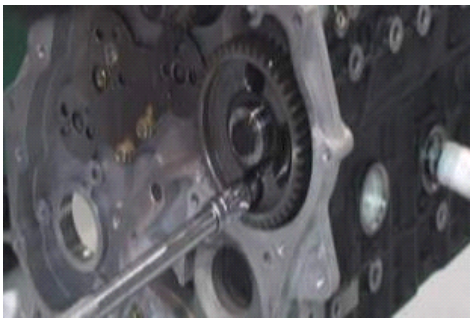
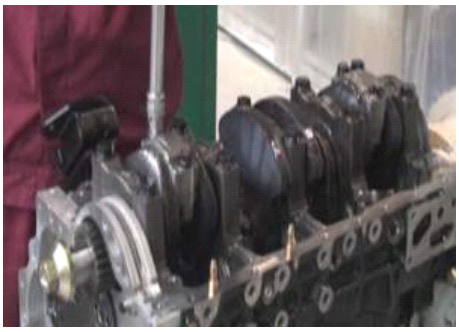
		c. Remove the EGR valve.
		d. Remove the fixing bolts of air intake pipe bracket.
		e. Remove the air intake pipe bracket and fuel-gas separator bracket.
		f. Remove the fuel rail and rail pressure sensor assembly and the rail bracket and install the fuel pressure rail protective sleeve; g. Disassemble

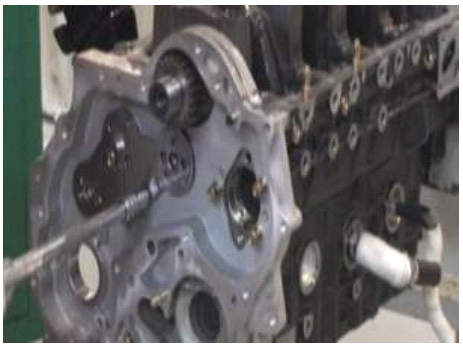
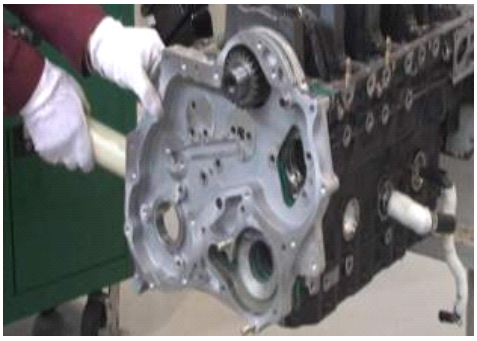
		
		h. Disassemble the fixing bolts of oil dipstick fixing sleeve and disassemble the oil dipstick conduit.
		i. Disassemble the fixing bolts and nuts of intake manifold. Remove the intake manifold;
		j. Remove the fixing bolts of compressor bracket and remove the compressor bracket;

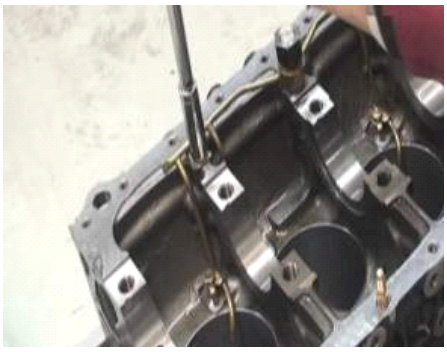
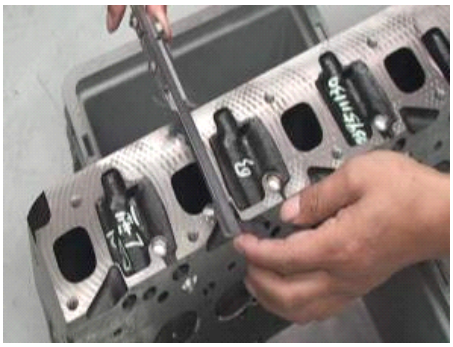
		k. Remove the bypass rubber pipe, remove the thermostat housing and water outlet assembly; Disassemble the fixing bolts of thermostat housing and remove the thermostat housing.
		l. Remove the fixing bolts of cylinder head shield and remove the cylinder head shield;
		m. Remove the bolts and nuts of rocker arm support as per specified sequence and remove the rocker arm assembly. Sequence: 4-1-3-2 n. Notice: The failure to loosen the bolts of rocker arm support as per the specified sequence will damage the rockshaft*. o. Take out the push rod;
		p. Remove the cylinder head bolts by several times as per the specified sequence (front circle drawing method). q. The failure to disassemble by several times as per specified sequence will damage the cylinder head and impair the deflection of lower surface of cylinder head*.

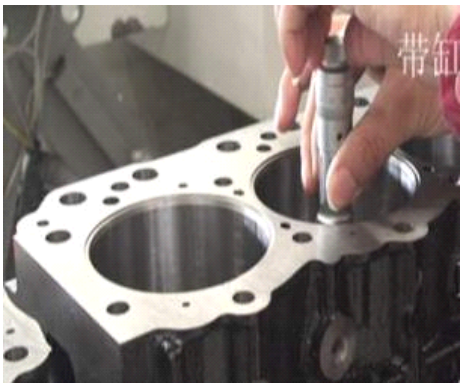
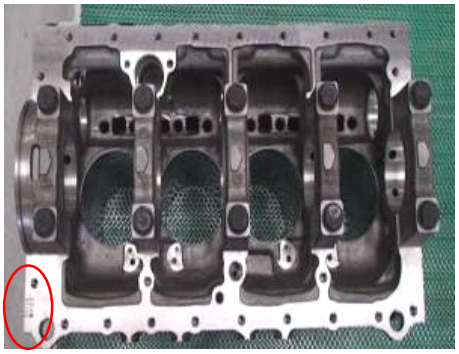
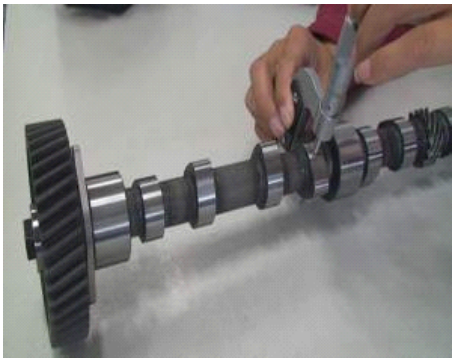
		r. Remove the damping pulley. Remove the fixing bolts of water pump, remove the water pump, and check the water pump blades for presence of cracking and corrosion and check the blade shaft for presence of wear.
		s. Disassemble the fixing bolts of timing gear chamber cover and remove the timing gear chamber cover and cover gasket.
		t. Remove the engine left bracket. u. Loosen the bypass rubber hose clamp, loosen the fixing bolts of water inlet pipe weldment, and remove the water inlet pipe weldment.
		v. Disassemble the fixing bolts of engine oil filter and remove the engine oil filter.

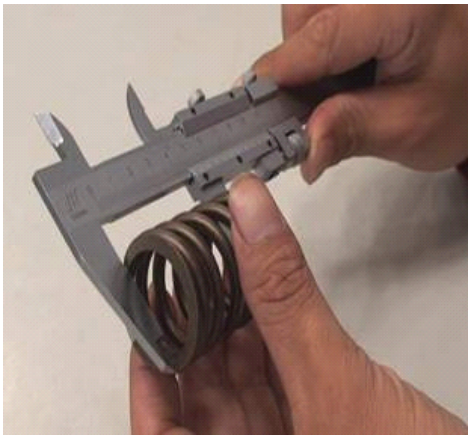
		w. Use an open-end wrench to disassemble the engine oil pressure connector and remove the connector and lubricating oil pipe.
		x. Loosen the fixing nuts of fuel injection pump gear, remove the hexagon socket fixing bolts of fuel injection pump and the fixing nuts of fuel injection pump gear, knock lightly the fuel injection pump gear shaft with rubber hammer, remove the fuel injection pump and fuel injection pump gear, and install the fuel injection pump protective sleeve. The fuel injection pump shall be insulated from the air and dust.
		y. Remove the fixing bolts of idler gear pressure plate and remove the idler gear pressure plate, idler gear, and idler gear shaft.
		z. Remove the fixing bolts and fixing nuts of oil sump by one time as per the specified sequence and remove the oil sump.

		aa. Remove the fixing bolts of engine oil pump and pull out the engine oil pump.
		ab. Remove the fixing bolts of camshaft.
		ac. Pull out the camshaft.
		ad. Remove the nuts of connecting rod large end as per specified sequence and use piston installation tool to push out the piston. Position the piston orderly. Visually observe each piston for presence of cracking, scratch, and other excessive wear.

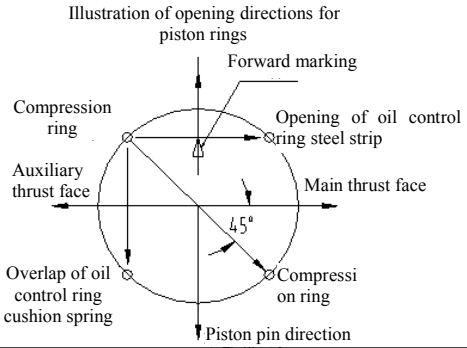
		ae. Disassemble the fixing bolts of timing gear chamber and the fixing bolts of idler gear lining plate and remove the idler gear lining plate.
		af. Use a rubber hammer to knock lightly the timing gear chamber from both sides to remove the timing gear chamber.
		ag. Take out the crankshaft timing gear.
		ah. Rotate the bolts of master bearing cap as per specified sequence to pull out the bolts of master bearing cap and remove the main shaft bushes (Position the main shaft bushes orderly). ai. Overturn the crankshaft to take out the crankshaft thrust plate and remove the crankshaft and the crankshaft lower bushes. aj. Check the wear state of the crankshaft thrust plates.

		ak. Disassemble the piston cooling fuel injection pipe subassembly.
5. Check the parts.		
 		a. Check the lower surface of the cylinder head. Strict planeness tolerance is required for the fitting surface of the intake and exhaust branch pipes. b. These surfaces can be repaired by grinding. If the surface planeness is out of the specified tolerance, grind the surface to meet the technical requirements. If the planeness is excessively out of the technical requirements, replace the cylinder head. Deflection of cylinder head lower surface 0.05 or less Limit 0.20 Cylinder head height Standard value 92 Limit 91.55 c. Use ruler and feeler gauge to measure the deflection of fitting surface between exhaust branch pipe and cylinder head. If the measurement is between limit and standard value, re-grind the fitting surface between exhaust branch pipe and cylinder head. If the measurement is out of the specified limit, make sure to replace the branch pipe.
		d. Use a multimeter to measure the outside diameter of piston at the position 73.9mm reach from the piston crown. Standard value: A: 92.971~92.980mm B: 92.981~92.990mm C: 92.991~93.000mm D: 93.001~93.010mm

		e. Use an inside micrometer to measure: Standard value for inside diameter of cylinder bore fitted with cylinder sleeve: A:93.021~93.030mm B:93.031~93.040mm C:93.041~93.050mm D:93.051~93.060mm
		**f.** Subtract the inside diameter of cylinder bore from the outside diameter of piston to obtain the piston clearance. The clearance range of piston: 0.041~0.059mm. If the piston clearance is out of the specified range, check and replace the cylinder sleeve or piston, depending on the cylinder bore grouping and the outside diameter of piston. (The second line of the stamped code at the rear end of lower surface of new cylinder block indicates the inside diameter group of the cylinder bore).
		g. Measure the cam height of the camshaft. The standard value is 42.02±0.05mm and the limit is 41.65mm. If the measurement is out of the limit, make sure to replace the camshaft. h. Use a multimeter to measure the outside diameter of each camshaft journal. If any measurement is out of the limit, replace the camshaft. The standard value for outside diameter of journal is 49.945-49.975mm and the limit is 49.60mm. If any measurement is out of the limit, replace the camshaft.
		i. Use a feeler gauge to measure the axial run-out clearance of the camshaft. The axial run-out clearance of camshaft is 0.05~0.114mm.

		j. Use a multimeter to measure the outside diameter of valve stem. If the measurement is less than the specified limit, make sure to replace the valve and valve guide in pair. (Intake valve: 7.946-7.961mm; limit: 7.880mm) (Exhaust valve: 7.921-7.936mm; limit: 7.850mm)
		k. Use a multimeter to measure the inside diameter of valve guide and subtract the outside diameter of valve stem from the measurement to obtain the valve guide clearance. If the clearance obtained is out of specified limit, make sure to replace the valve and valve guide in pair. (Limit of intake valve guide clearance: 0.200mm) (Limit of exhaust valve guide clearance: 0.250mm)
		l. Measure the free height of valve spring. If the measurement is out of specified limit, make sure to replace the spring. The standard value is 0.05mm or less and the limit is 0.20mm.
		m. Use a feeler gauge to measure the clearance between piston ring groove and piston ring. If the clearance between piston ring groove and piston ring is out of specified limit, make sure to replace the piston.

		n. Use a feeler gauge to measure the opening gap of piston ring. If the opening gap of the piston ring is out of specified limit, make sure to replace the piston.
		o. Install the steel-strip oil ring.
		p. Install the oil ring bush ring.
		q. Use a piston ring expander to install the 2nd compression ring and the 1st compression ring. While installing the compression rings, face upward the marking N (The lip of 2nd compression ring shall face downward). The overlap position of oil control ring cushion spring and the opening of oil control ring steel strip shall be 180º away from each other and shall be 90º away from the 2nd compression ring.

		
		r. Measure the outside diameter of main journal and the inside diameter of main shaft bore.
		s. Measure the outside diameter of connecting rod journal and the inside diameter of bush bore of connecting rod fitted with bush. Calculate the clearance between main journal of crankshaft and the main bush bore of crankshaft: The difference between the diameter of main journal and the inside diameter of crankshaft main bush bore measured above is the fitting clearance. The wear limit shall not exceed 0.11mm. **Notice: While measuring the inside diameter of crankshaft main bush bore, install the bearing cap and bush onto the bearing block and tighten the bolts to specified torque. Use an inside multimeter to measure the inside diameter.** Calculate the clearance between crankshaft connecting rod journal and connecting rod bush bore: The difference between the diameter of connecting rod journal and the inside diameter of connecting rod bush bore measured above is the fitting clearance. The wear limit shall not exceed 0.10mm.

Section II Assembly of Engine

I. Basic Technical Requirements for Assembly

The assembly of the engine is one important step for service of the engine. The service performance of the engine is closely related to the assembly accuracy, assembly technical requirements, and the assembly quality. Make sure to pay attention to following items:

Before the assembly, make sure to thoroughly clean and thoroughly blow dry all parts and components. All friction surfaces of the parts with relative movement are applied with lubricating oil (grade CE diesel engine oil or above). Carefully remove all oil dirt and carbon deposit, till the base metal is exposed. Never use electric wire brush to clean the sealing surfaces of any sealing gasket. Remove the residues from all used sealing gaskets. It's absolutely prohibited to use wire brush to clean the piston.

a. Remove the carbon deposit, oil dirt, and water scale and clean all lubricating oil pipes and pipelines.

b. Check the wear state of valve, push rod, and rocker arm contact surfaces and when necessary repair or replace.

c. Check the wear state of piston rings, cylinder sleeves, connecting rod small end bushes, and connecting rod bushes and when necessary replace.

d. Check the wear state of main bushes and thrust plates.

e. Check the wear state of engagement surfaces of transmission mechanism and drive gear and measure the engagement clearance and when necessary repair or replace.

f. Check the wear state of intake and exhaust valves and intake and exhaust valve seats and repair, grind, and test the leakage and when necessary replace.

g. Check the mist injection state of the fuel injector and when necessary grind or replace the fuel injector coupler. While installing the used fuel injector, clean the carbon deposit with ultrasonic and do not wipe with silk or scrape with knife, in order to prevent damaging the injector nozzle and blocking the injector orifice.

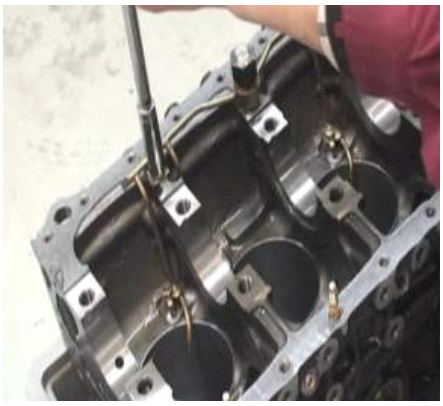
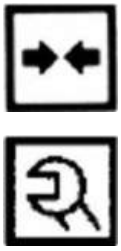
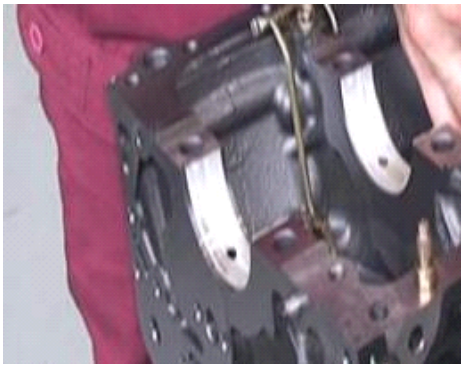
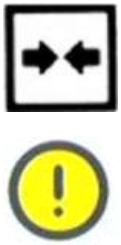
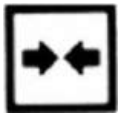
h. Check the engine oil pump and disassemble for checking or measure the wearing parts and adjust accordingly.

i. Check the cylinder gasket and intake and exhaust pipe gaskets and replace any damaged or failed gasket.

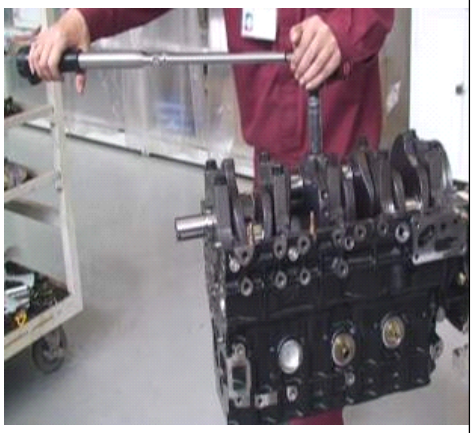
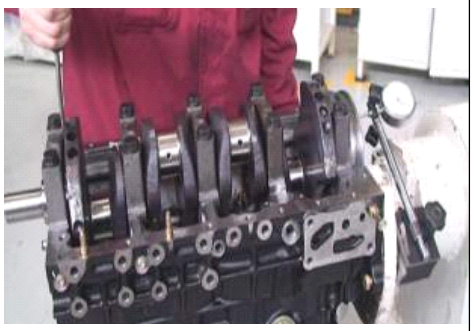
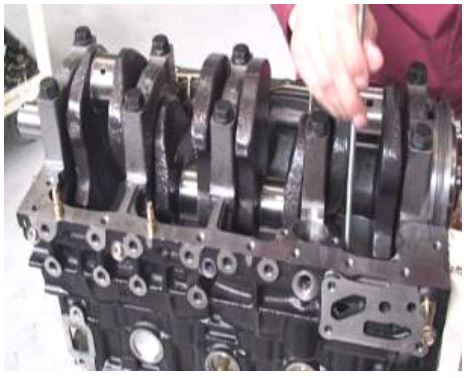
j. Check the alternator and starter, clean all parts and bearings, blow dry and apply new lubricating grease, and check the wear state of starter gear and check the transmission mechanism for flexible functioning.

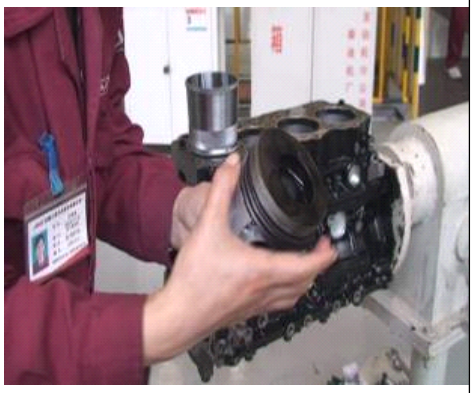
k. Check and clean the turbocharger.

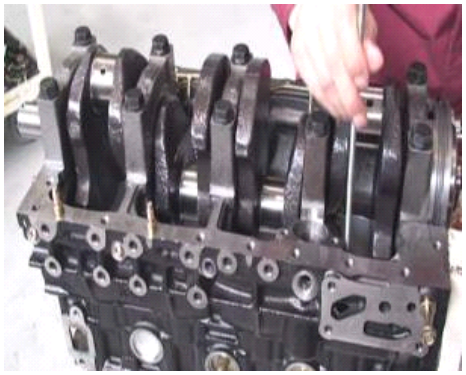
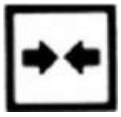
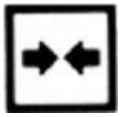
II. Illustration for Assembly of Engine

1. Install the piston cooling fuel injector subassembly.		
		a. Install the piston cooling fuel injector subassembly: Install the piston cooling fuel injector subassembly onto the engine block; b. Tighten the hexagon socket screws to 12.5±2.5N.m;
2. Install the crankshaft, thrust plates, and main bearing caps.		
		a. Install the upper and lower main bushes: Align the stop opening of upper main bush with the slip groove of the main bearing block bore of engine block and push 5 upper main bushes to place; **Notice: While installing the main bushes, make sure to differentiate the upper and lower bushes, of which the upper bush has oil grooves and the lower bush has not. Do not install the bushes reversely.**
		a. Apply an appropriate amount of clean engine oil onto the upper bearing bush; b. Lift up and place the crankshaft onto the engine block.

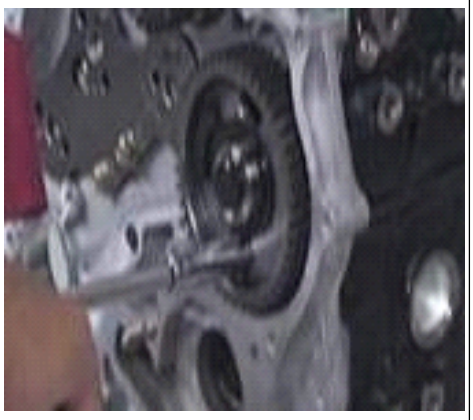
		c. Install the crankshaft thrust plates to the 3rd main journal portion (The surface with oil groove faces to crankshaft thrust surface and the oil groove shall be sprayed with lubricating oil).
 		d. Spray oil to the main journal portion and install the 1~4 main bearing caps of crankshaft as per the marked sequence. The arrow markings on the bearing caps shall face to the front of the engine. e. Apply the liquid sealant onto the fitting surface between 5th bearing cap and cylinder block and install the 5th bearing cap * text: Notice: 1) Before applying the sealant, the fitting surface of main bearing cap shall be thoroughly free of any engine oil; 2) Never block the cylinder threaded holes and bearings by the sealant.

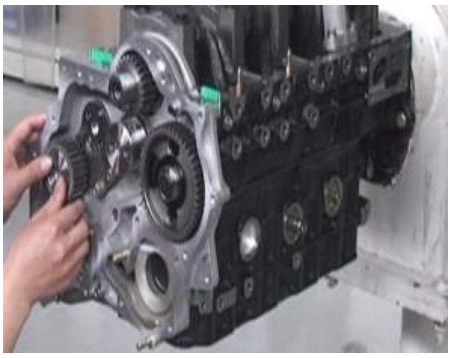
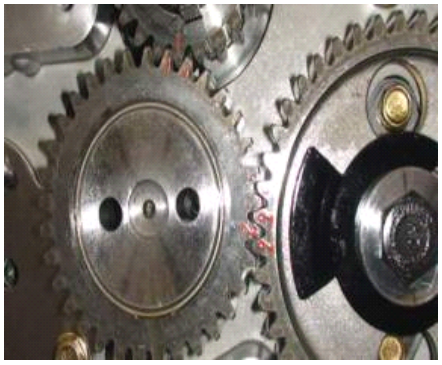
		f. Apply engine oil onto the threads of main bearing cap bolts, install into the main bearing caps, and tighten the bolts to 170 N.m torque as per the specified sequence. Tighten to 20 N·m for the 1st step, to 120 N·m for the 2nd step, and 170 N·m for the 3rd step. **Tightening sequence: (From center to two sides)** 8415 9 7326 10
		g. Adhere the magnetic dial gauge onto the cylinder block, position the pointer of the dial gauge to the rear end face of crankshaft, and use a straight screwdriver to pry lightly the crankshaft to check the axial clearance of crankshaft (or push the crankshaft left and right and measure with feeler gauge). If the thrust clearance is out of the limit, replace the thrust bearings in pair. Standard value: 0.040mm-0.201mm; Limit: 0.30mm
		h. Rotate the crankshaft and check for flexible rotation and presence of noise. Alternatively, use a digital wrench to measure the net torque of crankshaft, listen for presence of noise, and check whether the torque is ≤6N.m.
		a Insert the lubricated tappets in turn into the tappet holes.

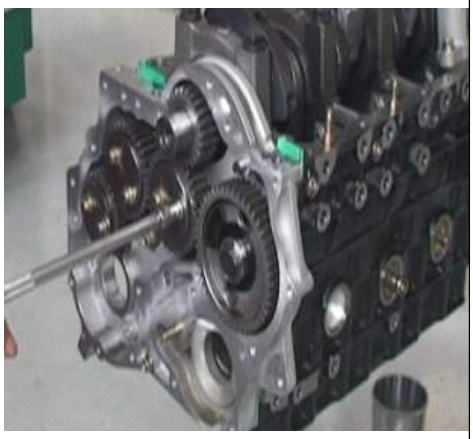
		b. Install the tappet anti-drop tool.
3. Install the piston connecting rod assembly.		
 		a. Spray one film of oil onto the cylinder bore. b. Spray oil onto the piston skirt, install the piston into the piston taper sleeve, insert into the cylinder bore, and use nylon bar and guide jig to install the piston. **Notice: (The connecting rod and bolts shall not come into contact with the cylinder bore and the large end bore of connecting rod shall be orthometric with the crankshaft journal.)** c. After installing the large end cap of the connecting rod, tighten the large end nut of connecting rod to 20N· m and 85N· m by two times. d. Use a feeler gauge to check the side play of large end of connecting rod. The side play range for large end of connecting rod: 0.175-0.29mm. e. After the installation of pistons for 1st and 4th cylinders, rotate the crankshaft for 180º and install the pistons for 2nd and 3rd cylinders.

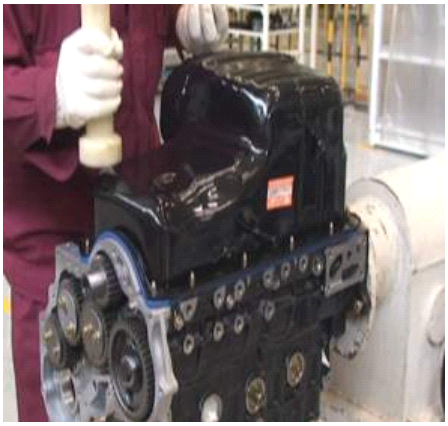
 		
4. Install the timing gear and related accessories.		
		a. Insert the lubricated tappets in turn into the tappet holes.
		b. Install the water manifold (The water manifold is paralleling with the cylinder block)

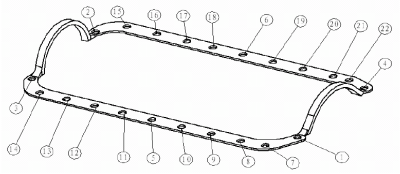
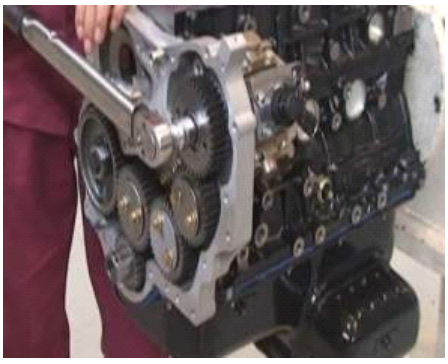
		c. Spray oil to the crankshaft gear and then install.
		d. Install the gasket of timing gear chamber.
		e. Install the timing gear chamber and idler gear lining plate and pre-tighten the fixing bolts.

		f. Spray lubricating oil onto the camshaft bush, add lubricating oil to the head of tappet, and spray lubricating oil onto the camshaft subassembly.
		g. Install the camshaft (with the bottom facing upward and the left facing forward).
		h. Tighten the fixing bolt subassembly of camshaft thrust plate to 25±5N.m.
		i. Install the engine oil pump outlet pipe subassembly and engine oil pump assembly with strainer.

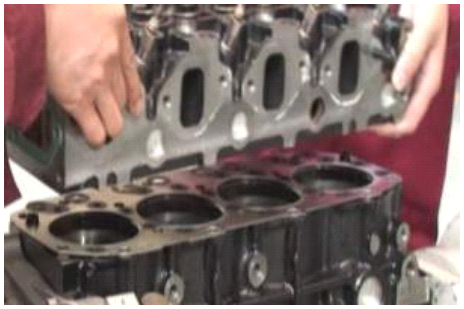
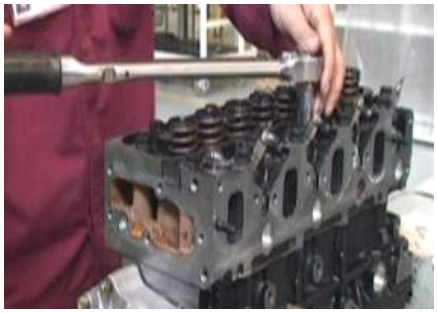
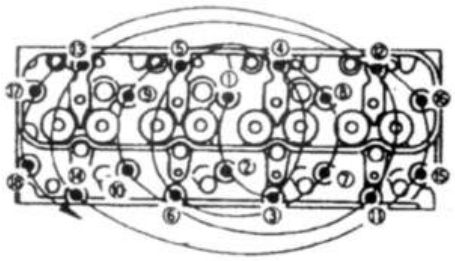
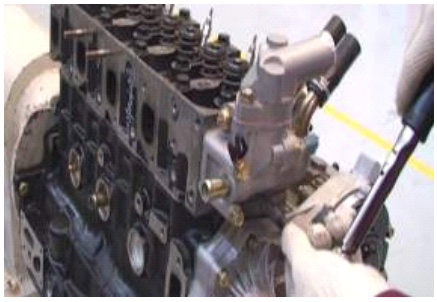
		j. Install the idler gear shafts A and C onto the idler gear lining plate and use nylon bar for idler gear shaft to lightly knock into the idler gear lining plate.
  		k. Apply oil onto the surface of idler gear C bush and lightly rotate into the idler gear shaft C. Then, apply oil onto the surface of idler gear A bush and use nylon bar to lightly knock into the idler gear shaft A. Take caution to apply the force lightly and uniformly, in order to prevent the abnormal wear of bush. l. While installing the idler gear A, take caution to adjust the installation position of idler gear A and "2 2" position of camshaft gear as per the "1 1" marking of crankshaft gear. (Timing photo)

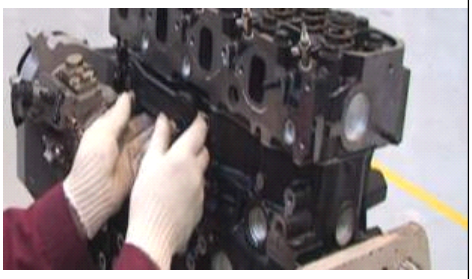
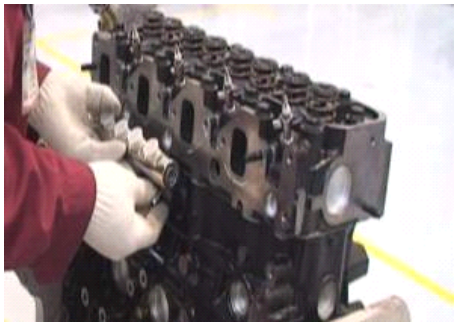
		m. Apply oil onto the surface of idler gear B bush and lightly rotate into the idler gear shaft B. In event of difficult installation, slightly rotate the crankshaft to help installation.
		n. Use the hexagon flange bolts to install the idler gear pressure plates A, B, and C onto the idler gear shaft and tighten the fixing bolts of pressure plate and fixing bolts of idler gear lining plate to 25±5N. m torque.
5. Install the oil sump.		
		a. Use a scraper to remove the excessive portion of the gear chamber. b. Install and pre-tighten the stud * 12 of oil sump.

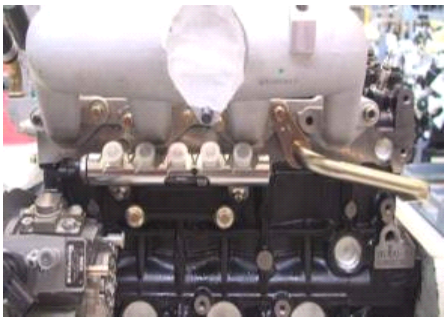
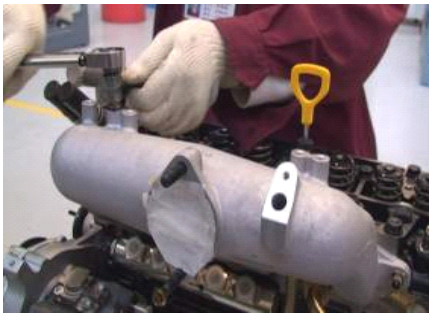
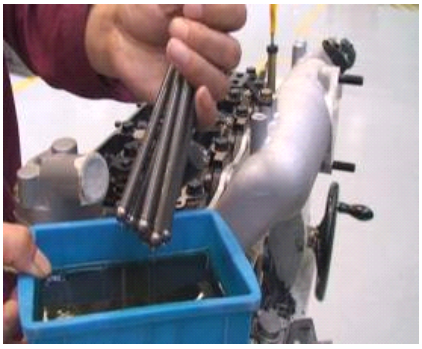
		c. Apply sealant to the lower end face of timing gear chamber and the lower rear end of engine block.
		d. Install the oil sump gasket. e. Apply the sealant for the second time to both sides of oil sump gasket.
		f. Install the oil sump assembly with oil drainage screw plug and use nylon bar to lightly knock the oil sump to ensure the steady installation of oil sump.

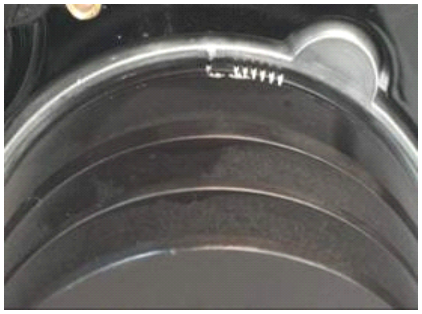
 		g. As per the specified sequence, tighten the fixing bolts *10 of oil sump and the fixing nuts * 12 of oil sump to 23.5±3.5N.m torque. h. Use a cotton cloth to wipe away excessive sealant.
5. Install the timing gear chamber.		
		i. Pre-install the flange O-ring of fuel injection pump onto the fuel injection pump. j. Place the fuel injection pump into installation position, install and pre-tighten the hexagon socket fixing bolts of fuel injection pump, and install the fuel injection pump gear and fixing nuts of fuel injection pump.
		k. Tighten large fixing nuts of fuel injection pump to 70±5 N·m and tighten hexagon socket fixing bolts of fuel injection pump to 30±5 N·m.
		l. Install the water pump O-ring onto the water pump and use hand to rotate the impeller for two turns to ensure that the water pump rotates flexibly. m. Install the water pump assembly to the gear chamber.

		n. Install and tighten the bolts and nuts of water pump in diagonal manner to 25±5N.m.
		o. Install the timing gear chamber cover subassembly and attach and tighten the fixing bolts of gear chamber cover to 20±5 N.m. p. Torque for hexagon socket fixing bolt: 60±10 N.m.
		q. Install the damping pulley and attach and tighten the fixing bolts of damping pulley to 210±15 N·m.
6. Install the cylinder head and related accessories.		
		a. Check whether the upper surface of cylinder block is normal and the cylinder gasket is normal and install the cylinder gasket.

		b. Install the cylinder head onto the cylinder block.
 		c. Immerse the thread portion of cylinder head bolts into oil and then install into the cylinder head and pre-tighten. d. Tighten the cylinder head bolts by steps from the center to two sides as per the specified sequence: 65N.m→85N.m→105N.m
		e. Install the thermostat housing and water outlet assembly and tighten the fixing bolts and hexagon socket fixing bolts.

7. Install the intake manifold and related accessories.		
		a. Use hexagon flange bolts to fix the fuel rail bracket onto the cylinder block and tighten to 37.5±9.5N.m.
		b. Use hexagon flange bolts to install the fuel rail assembly with rail pressure sensor onto the fuel rail bracket and tighten to 25±5N.m.
		c. Install the intake manifold gasket.
		d. Insert the oil dipstick into the cylinder block and tighten the fixing bolts and nuts of intake manifold as per the specified sequence.

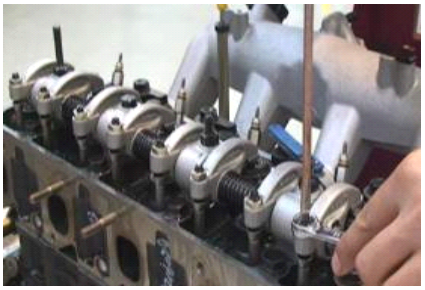
		e. Install the intake manifold and install and tighten the fixing bolts, plain washers, and fixing nuts.
		f. Install the intake manifold harness bracket and intake pressure and temperature sensor.
8. Install the push rod rocker arm subassembly and adjust the valve clearance.		
 		a. Dip the tip of push rod with oil and install into the cylinder head. Install the rocker arm and pre-tighten the rocker arm support bolts.
		b. Tighten the support bolts by steps. Sequence: 2-3-4-1; Torque: 55±5N.m



c. Rotate the crankshaft, till the top dead center (TDC) line of crankshaft damping pulley is aligned with the timing pointer. In such case, either 1st cylinder piston or 4th cylinder piston is at top dead center (TDC) of compression stroke.



d. Check the clearance of push rod for the intake valve and exhaust valve of 1st cylinder. If there is a clearance between 1st cylinder intake valve and valve push rod, the 1st cylinder piston is at top dead center of compression stroke (1236). If the 1st cylinder intake valve is pressed tightly by exhaust valve push rod, the 4th cylinder piston is at top dead center of compression stroke (4578).



e. Valve clearance (under cold state): 0.3-0.4 mm

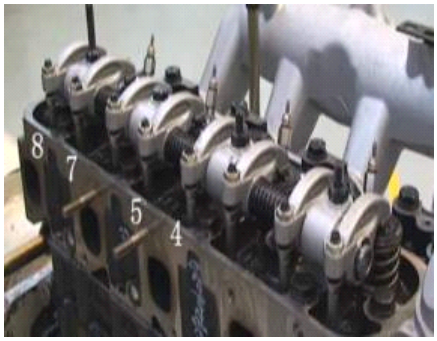
f. Loosen the clearance adjustment screws for the valves, as shown in the figure.

g. Insert the feeler gauge with appropriate thickness between rocker arm and valve rod end.



h. Rotate the valve clearance adjustment screw, till a light resistance is felt on the feeler gauge.

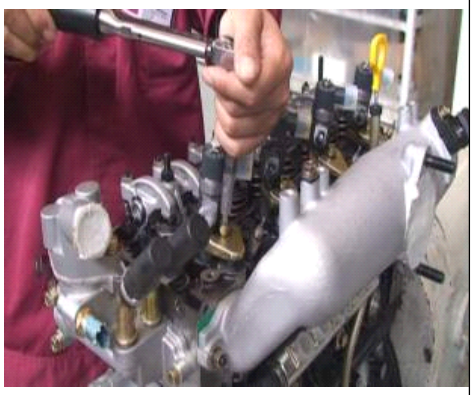
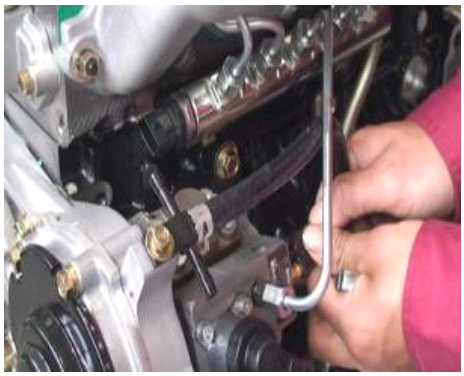
i. Securely tighten the lock nut.

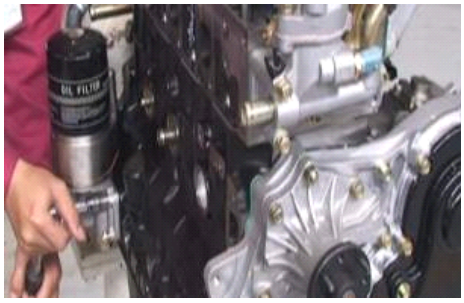
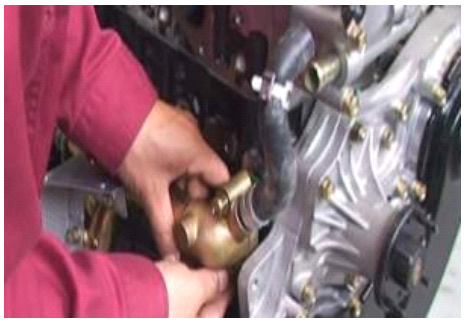
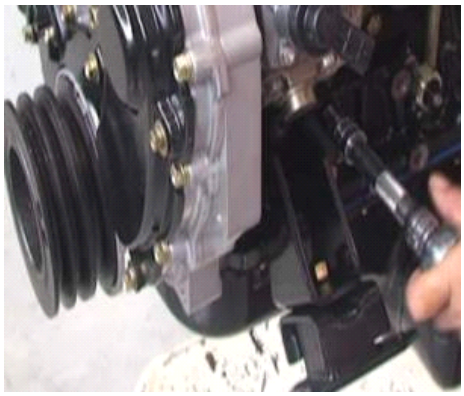


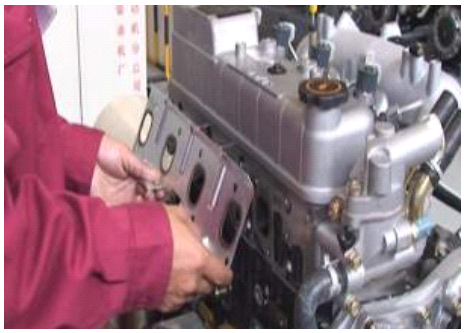
j. Rotate the crankshaft for 360º.

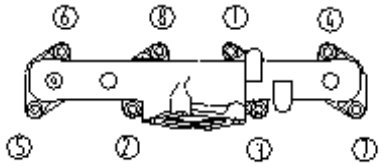
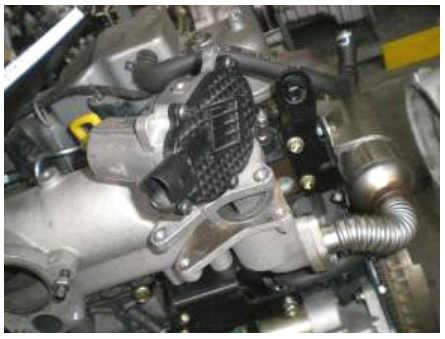
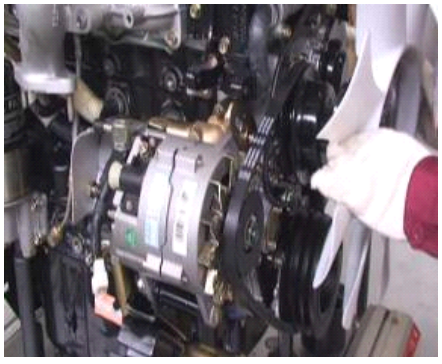
k. Align the TDC marking of crankshaft damping pulley with the timing pointer.

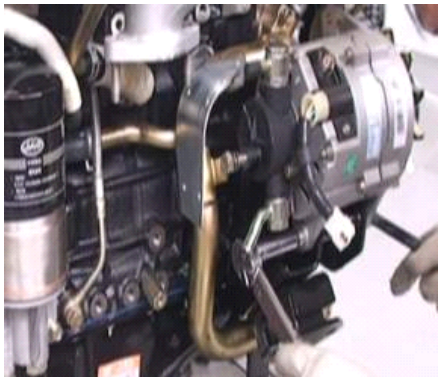
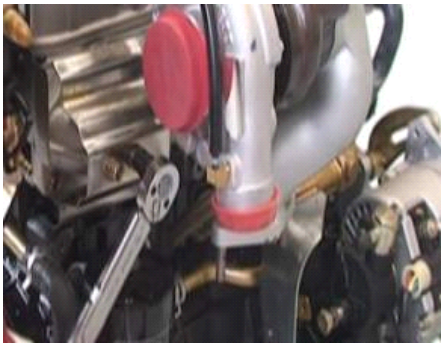
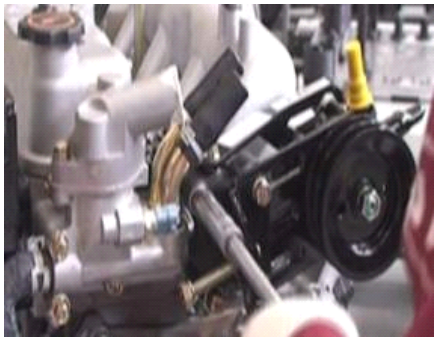
l. Adjust the clearance for other valves, as shown in the figure.

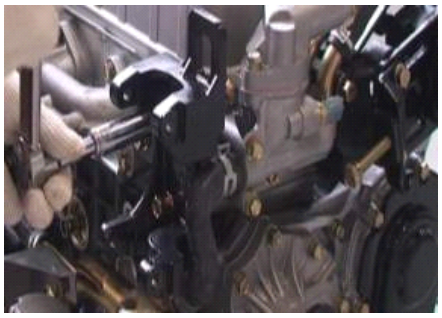
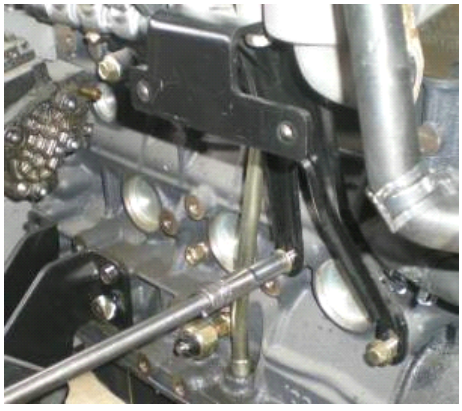
9. Install other peripheral accessories.		
		a. In turn install the fuel injection assembly with sealing gasket onto the cylinder head. b. Install the fuel injector fixing pressure plate and install and tighten the fuel injector pressure plate bolts to 8±2N.m+40～45°.
		c. Install the 1st cylinder high pressure fuel pipe assembly, 2nd cylinder high pressure fuel pipe assembly, fuel injection pump high pressure fuel pipe, 3rd cylinder high pressure fuel pipe assembly, and 4th cylinder high pressure fuel pipe assembly and tighten the corresponding nuts. Notice: 1. Notice the installation direction of high pressure fuel pipes; 2. The tightening torque for nuts at fuel injector end is 27±5N.m; 3. The tightening torque is 20±5N.m for nuts at high pressure fuel rail end, 27±2N.m for high pressure fuel pipe nuts at fuel pump end, and 20±2N.m for high pressure nuts at fuel rail end.
		d. Use accelerator cable bracket bolts to install the fuel return three-way valve onto the gear chamber and tighten to 7.5±2.5N.m.

		e. Install the engine oil filter and O-ring subassembly and tighten the fixing bolts of engine oil filter bracket to 25±5 N.m.
		f. Install the engine right bracket and shock absorber subassembly and install and pre-tighten the fixing bolts.
		g. Install the water inlet pipe gasket and water pump inlet pipe weldment subassembly, pre-tighten the bolt, spring, and plain washer subassembly (of water pump inlet pipe), and install and tighten the bracket fixing bolts at the lower end of water pump inlet pipe weldment.
		h. Install the engine left bracket and shock absorber assembly and tighten the fixing bolts.

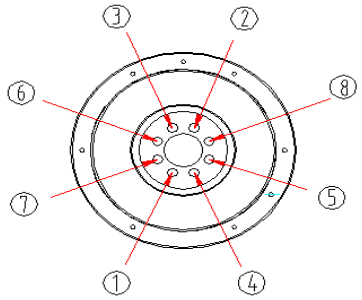
		i. Check the cylinder head shield O-ring.
		j. Install the cylinder head shield and install and tighten the cylinder head shield bolts to 13±5N.m.
		k. Install the exhaust manifold gasket and install the exhaust manifold and turbocharger subassembly.
		l. Install the spring washers and hexagon nuts and tighten the fixing nuts and fixing bolts as per specified sequence.

Tighten bolts as per sequence shown in figure.  		
		m. Install the EGR cooling steel pipe and tighten the fixing bolts.
		n. Install the EGR valve and tighten the fixing bolts.
		o. Apply sealant onto the thread of vacuum pump oil inlet pipe connecting bolts, install the connecting bolts onto the cylinder block oil outlet, and tighten to 18±2 N.m.
		p. Install the alternator belt and water pump pulley. q. Install the fan and clutch assembly and install and pre-tighten the clutch fixing nuts.

		r. Adjust the tension of alternator belt and tighten the alternator adjustment bolts and clutch fixing nuts. s. Tighten the alternator fixing nuts.
		t. Install the vacuum pump oil inlet pipe fixing bolts I (M8×20) and tighten the fixing bolts to 18±2N.m and 25±5N.m respectively.
		u. Install the exhaust pipe heat shield and install and tighten the fixing bolts.
		v. Install the power steering pump and tighten the fixing bolts of power steering pump.

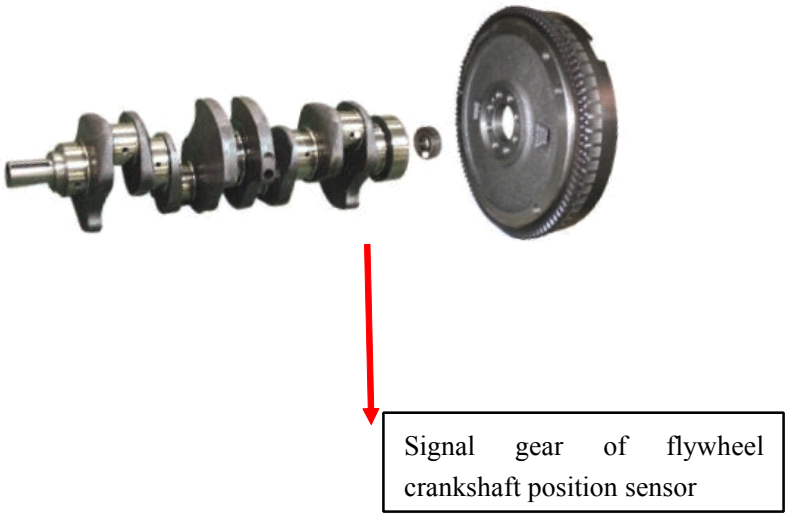
		w. Install the compressor bracket and tighten the bracket fixing bolts.
		x. Use perforated bolts II and copper washers II to install the turbocharger oil inlet pipe assembly onto the turbocharger oil inlet and use perforated bolts I and copper washers I to install another end onto the cylinder block oil hole and tighten the perforated bolts I and II. 1. Tightening torque for perforated bolts I is 55±10N.m; 2. Tightening torque for perforated bolts II is 41±6N.m.
		y. Install the fuel-gas separator bracket and intake manifold bracket.
		z. Install the fuel-gas separator assembly.

		aa. Install the VNT electromagnetic valve and connect various vacuum hoses.
10. Install the flywheel and related accessories.		
 		a. Apply oil to the outer ring and lip of the crankshaft rear oil seal and use installation jig I to push the rear oil seal into the oil seal groove. Then install the installation jig II and knock with steel hammer lightly and uniformly to install the crankshaft rear oil seal to place.
		b. Install the flywheel baffle and fixing bolts and tighten the fixing bolts of flywheel baffle to 85±10 N.m.

 		c. Install the flywheel. d. Install the flywheel fixing gasket and install and pre-tighten the fixing bolts of flywheel. e. As per the specified sequence, tighten the fixing bolts of flywheel to 25N.m→70N.m →140N.m by steps, in order to prevent the occurrence of false tightening torque. This tightening torque is really high and will easily lead to thread failure of the bolts.
		f. Install the lubricated guide ball bearings into the installation jig and knock with steel hammer uniformly into the rear end of crankshaft.
		g. Insert the clutch guide into the driven disc and install to the rear end of flywheel. Install the clutch cover and install and tighten the fixing bolts of clutch cover.

Section III Crankshaft and Flywheel System

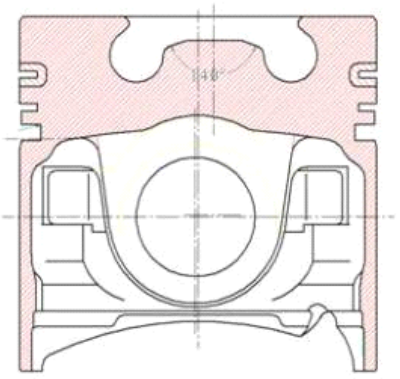
- It works along with the connecting rod to convert the gas pressure applied onto the piston into rotating power and transmit to the transmission mechanism of the chassis. At the same time, it drives the valve distribution mechanism and other accessories, such as fan, water pump, and alternator.
- The crankshaft is made of medium carbon steel alloy forging. To improve the wear resistance and fatigue resistance, the journal surface is treated with high-frequency hardening or nitriding treatment and high-precision grounded to meet the higher surface hardness and surface roughness requirements.
- With fully supported structure and 8 balance weights, the crankshaft is cast to an integral structure with balance weights to improve the rigidity and bending strength of the crankshaft.
- The crankshaft is made of high strength steel alloy forging, with fillet rolled journals.
- Its front end adopts rubber-embedded crankshaft torsional shock absorber to reduce the crankshaft torsional shock generated during the running of the engine. The signal wheel of crankshaft position sensor is installed at the last crank.
- There are two pieces of crankshaft thrust plates installed on two sides of the 3rd main bearing block, with the face with oil groove facing to the thrust surface of the crankshaft.
- The grouping numbers for crankshaft main journal and connecting rod journal are stamped on the first crank of the crankshaft.
- The flywheel assembly is installed at the rear end of crankshaft and the flywheel is located by locating pin and connected by flywheel bolts.
- The crankshaft, flywheel, and clutch assembly qualified the dynamic balance test before the factory leave.



Section IV Piston and Connecting Rod Group

- The piston crown is of ω type combustion chamber;

Depending on the performance and reliability requirements, the piston profile designed can guarantee the normal working of engine under high speed, high temperature, and high pressure conditions. The good skirt sizes can reduce the frictional power consumption of piston and improve the economic performance of the engine.



- The HFC4DA1-2C piston rings include two compression rings and one oil control ring:

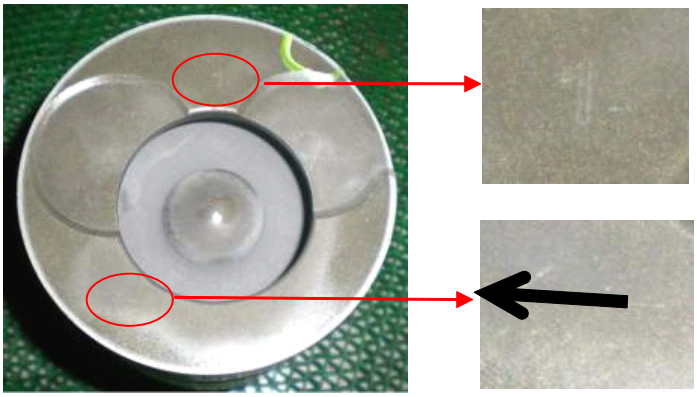
The first ring adopts the trapezoid tubbish ring, which can effective reduce the consumption of engine oil.

The second compression ring adopts the torsional trapezoid ring to increase the flexibility of piston ring and improve the capability of piston ring for adapting to deformation of cylinder sleeve.

The oil control ring is of coil spring expander type and adopts the combined oil ring composed of two side guide rings (upper and lower) and the middle expander, featuring the advantages of low mass and outstanding oil scraping effect. It can reduce the consumption of engine oil and the grain emission while meeting the Euro-IV emission standard.

40~50% of the frictional power consumption of the engine is attributed to the pistons and piston rings. The piston rings of 4DA1 engine can effectively arrange the engine oil, reduce the friction power of piston subassembly, and improve the fuel economy.

- The piston is stamped with mark, which shall face upward during assembly. During assembly, take caution to position the spring connector 180º away from the opening of oil control ring. Notice the opening direction of the ring while installing the cylinder sleeve. The openings of the piston rings shall separate 120º from each other and the ring opening shall not face towards the piston pin. Apply an appropriate amount of lubricating oil during the assembly. The piston rings shall rotate flexibly after being installed in the ring grooves.



a. The arrow on the piston crown shall point to the front of the engine.

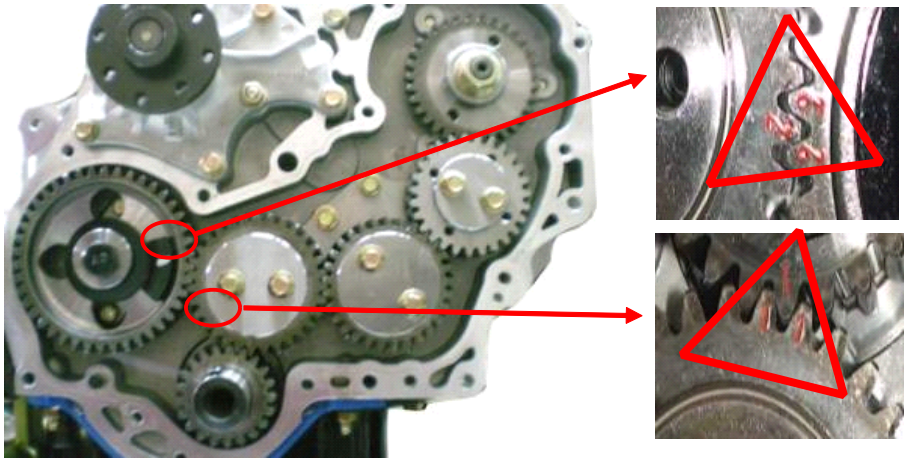
b. It adopts variable section connecting rod to effectively reduce the force applied onto the connecting rod.

c. The piston pin is of full-floating structure and adopts retainer ring for limiting. The piston pin can be directly assembled during installation.

d. The body of connecting rod adopts H-shaped cross section, featuring good bending strength and light weight.

Section V Valve Distribution Mechanism

- It's a device that opens and closes at fixed times the intake and exhaust valves of all cylinder to enable the ingress of fresh air into cylinders and the exhaust of exhaust gas from the cylinders.
- The front valve distribution timing adopts gear drive, featuring stability and reliability.

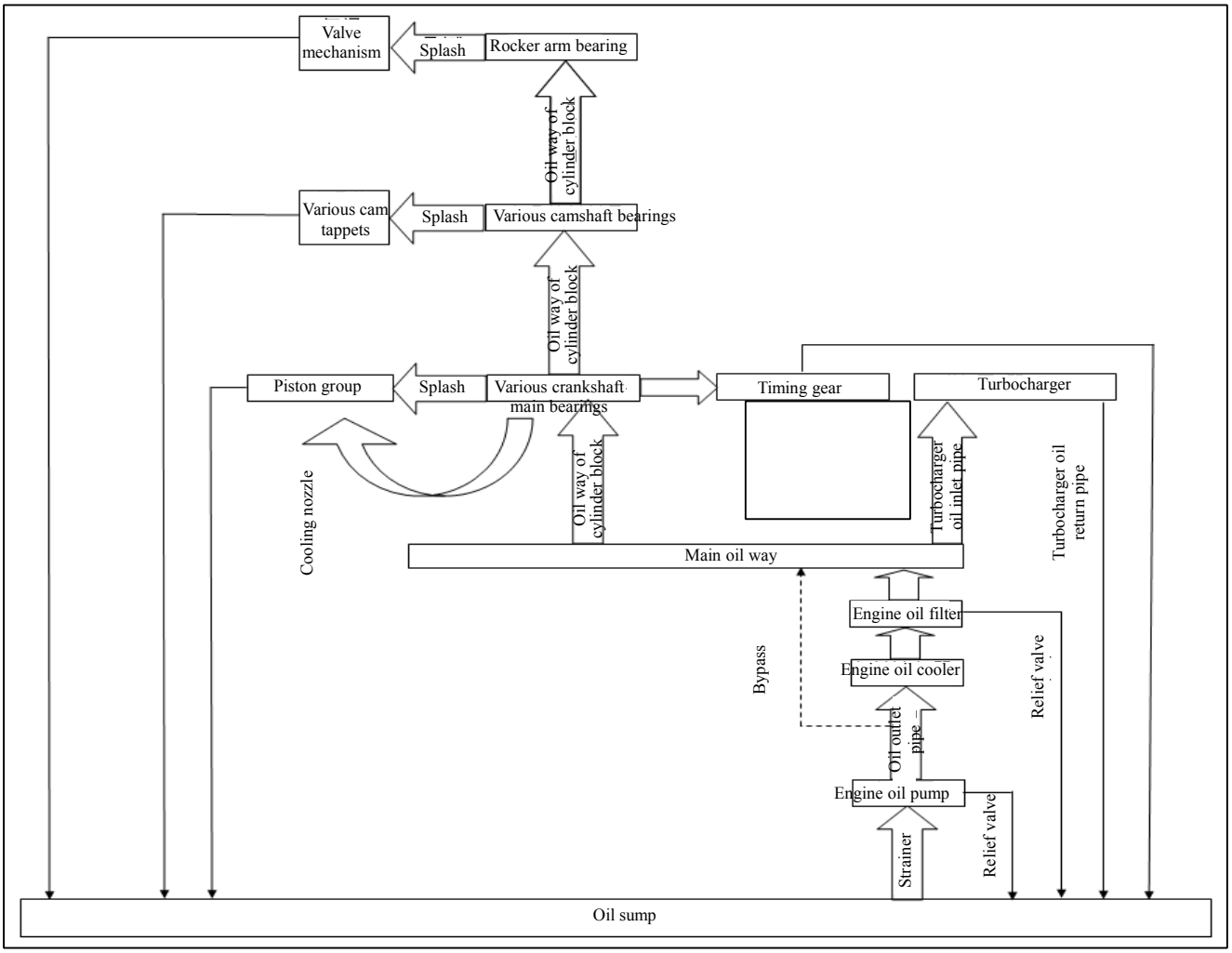


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Section VI Lubrication System

While the engine is working, all motion parts apply one specific force onto another part and generate relatively high speed motion. With the relative motion, the friction is necessarily generated on the part surfaces, which will accelerate the wear. Therefore, to relieve the wear, reduce the friction resistance, and prolong the service life, the engine must be fitted with lubrication system.

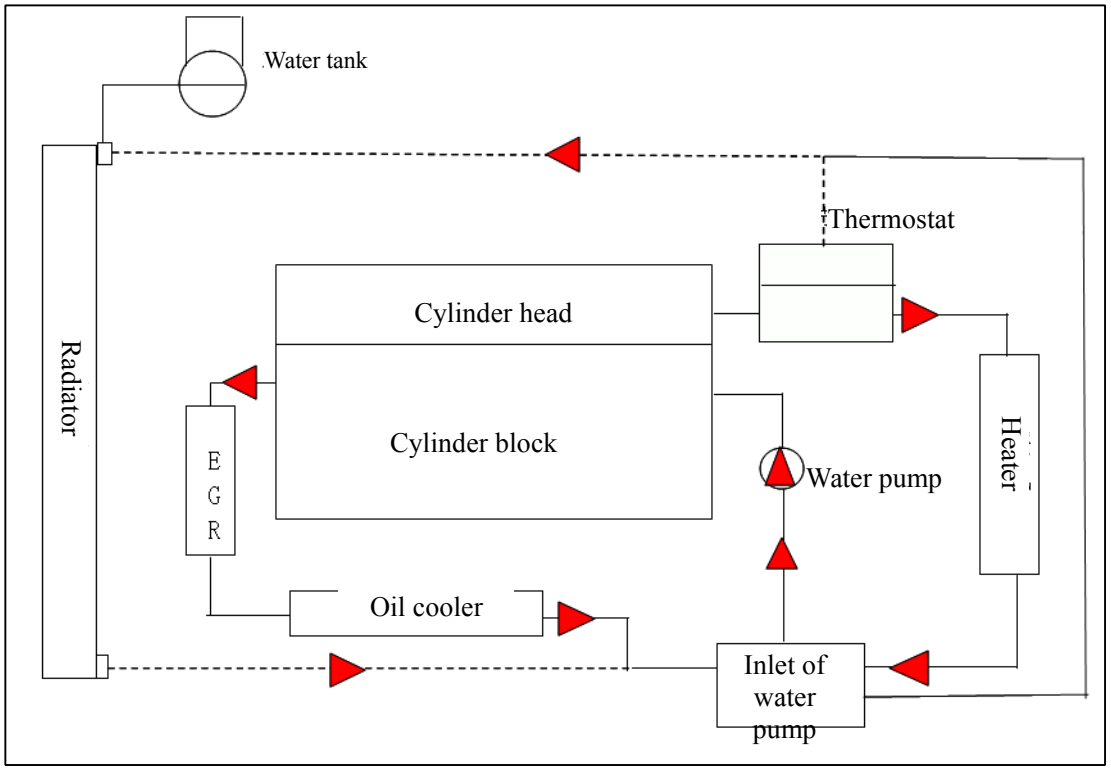
- The engine oil filter is functioned to filter out the metallic wear dust, mechanical impurity, and engine oil oxide from the engine oil. The ingress of these impurities into the lubrication system along with the engine oil will speed up the wear of engine parts and may block the oil pipe or oil passage.
- The engine oil pump is of externally engaged gear pump and is driven by the crankshaft.
- The cooling nozzle of piston is arranged on the main oil passage to realize the stable oil spray for cooling. The spray of engine oil into the cold oil passage within the piston can effectively reduce the thermal load of the piston.



Section VII Cooling System

- The cooling system is functioned to maintain the engine within an appropriate temperature range under all working conditions.
- The cooling system can prevent the engine against overheating and prevent the engine from being too cold in winter.
- After the cold start of the engine, the cooling system can guarantee the rapid temperature rise of the engine to reach normal working temperature as soon as possible.
- Composition: Water pump, cooling fan, silicone oil fan clutch, thermostat, engine cylinder block, water jacket in cylinder head, and other accessories.
- The cooling system is of enclosed forced recirculation water cooling type. Its structure is mainly composed of radiator (water tank), water pump, fan, thermostat, cooling water jacket, and pipeline.
- The cooling recirculation of the heater system and engine oil cooler is always under working state and is not subject to the restraints of large or small recirculation.

Dual thermostat control: When the water temperature is less than 82ºC, the thermostat is under natural state (namely the cooling water from the water tank is closed and the cooling water from the cooling module is opened). In such case, the cooling circuit works in the small recirculation circuit and the cooling water from the cooling module enters into the engine block and cylinder head for recirculation through the water pump so that the temperatures of the water and oil in the engine block and the cylinder head will rise. When the water temperature reaches 82ºC, the thermostat starts to open. When the thermostat is opened, the small valve closes the small recirculation circuit. As the thermostat is not fully opened, the cooling water from water tank enters into the cylinder block for large recirculation through water pump. If the water temperature continues to rise to 95ºC, the thermostat valve is fully opened.

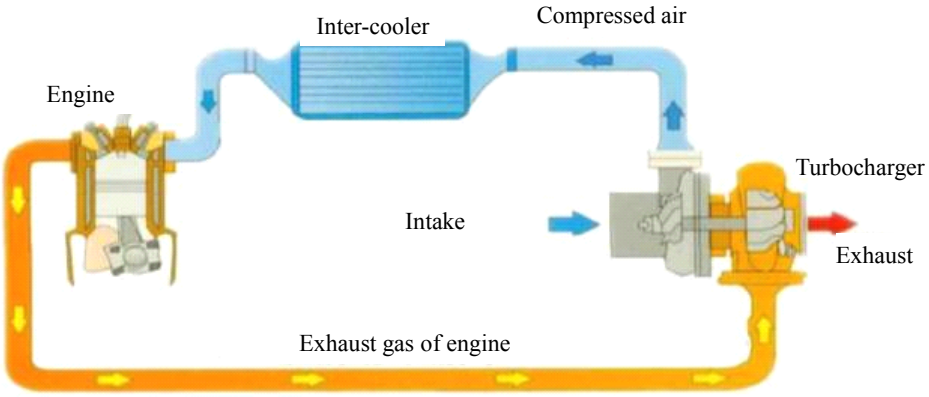


Section VIII Turbocharger and Inter-Cooler System

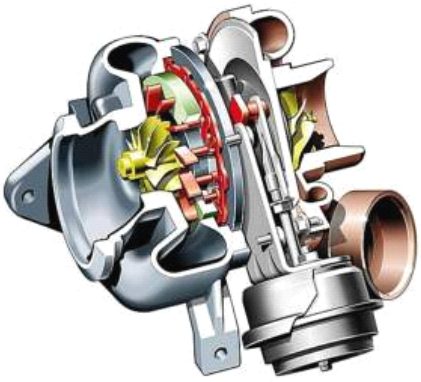
The turbocharger technology utilizes the motion energy of engine exhaust gas to drive the rotation of turbine. At the same time, the coaxial air compressor compresses the air and provides more air to the cylinder so that more fuel can combust to generate higher power, promote the engine torque, and reduce the fuel consumption.

The common turbocharger is of bypass valve turbocharger, which can't provide sufficient pressure while the engine is running at low speed and thus restrains the torque output at low speed and influences the engine performance. To change this situation, the 1.9CTI engine adopts variable nozzle turbocharger (VNT) control system to promote the turbocharger pressure at low speed of engine and at the same time adopts inter-cooler system to exert higher torque at low speed of engine and promote the engine performance.

Theory of inter-cooler: The temperature of the air compressed at high speed may reach 100~120ºC. The high temperature air will impair the intake efficiency of the engine and lead to power drop of the engine. Therefore, it's necessary to cool down the air to approximate 60ºC. The inter-cooler is located in front of the radiator or at windward position easily arranged, in order to reduce the temperature of air entering into the cylinder, further improve the combustion of diesel engine, and promote the performance and emission of the diesel engine.

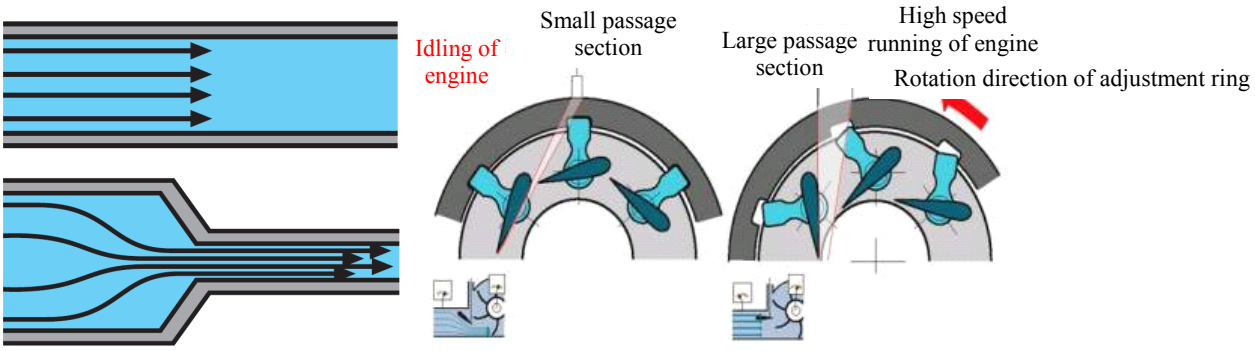


Variable nozzle turbocharger (VNT): The VNT is functioned similar to one turbine housing in which the size is varying steplessly. The VNT actuator can accurately control the nozzle area within the entire working condition range so that the engine can not only maintain the turbine efficiency at high speed, but also increase the turbine efficiency at low speed, promote the torques at low speed, maximum torque output, and nominal working condition, improve the cold start performance and low speed performance of turbocharged diesel engine, realize high specific power and low speed torque of the engine simultaneously, and greatly reduce the smoke intensity and improve the economy. Meanwhile, the VNT can reduce the turbine lag, improve the engine response, and enhance the braking capability and safety.



Adjustment theory for variable nozzle turbocharger (VNT): There are two passages, one is in constant section and one is in variable section. If the pressure is same for two passages, the speed of airflow passing through the variable section passage is greatly higher than that passing through the constant section passage.

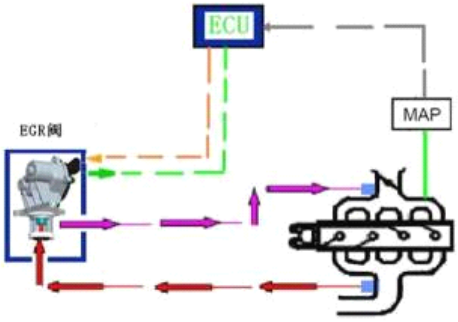
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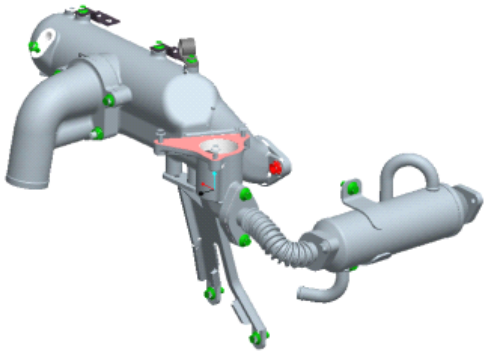


Section IX EGR System

The exhaust gas recirculation (EGR) introduces one small portion of exhaust gas from the exhaust pipe into the intake pipe that is mixed with the fresh intake air to artificially increase the exhaust amount in the fresh intake air and thus reduce the combustion temperature of engine and reduce the formation of NOx.

- The NOx is increased following the increasing of engine load and the EGR ratio shall increase accordingly.
- The EGR is not be performed when the engine coolant temperature is low;
- The EGR is not performed under idling or low load, as the NOx emission is not high in such case.
- The EGR is not performed under full load or acceleration;
- The water-cooled EGR further reduces the temperature of exhaust gas entering into the cylinder and further reduces the emission of NOx.





Maintenance manual for sunray hfc4da1-2c china-IV diesel engines

Section X Exhaust System

The exhaust pipe is composed of four exhaust manifolds leading to the exhaust master pipe and one manifold leading to the exhaust gas chamber of EGR valve. During the operation, the exhaust gas from the combustion chamber is introduced into the EGR valve by the manifold leading to the exhaust gas chamber of EGR valve through the EGR passage in the cylinder head. Under the control of the EGR valve, the exhaust gas is mixed with fresh air and enters into the combustion chamber to realize exhaust gas recirculation and reduce the emission.

4DA1-2C diesel engine real-time monitors the pressure drop of the exhaust gas post-treatment unit to determine whether the post-treatment system is working normally. Via two pressure ports on the sensor, the pressure on two sides of the exhaust gas post-treatment unit is introduced. The sensor converts the measurement into voltage value and feeds back to the control unit, which can guarantee the sufficient oxidization of grains and prevent the blockage of catalytic converter.

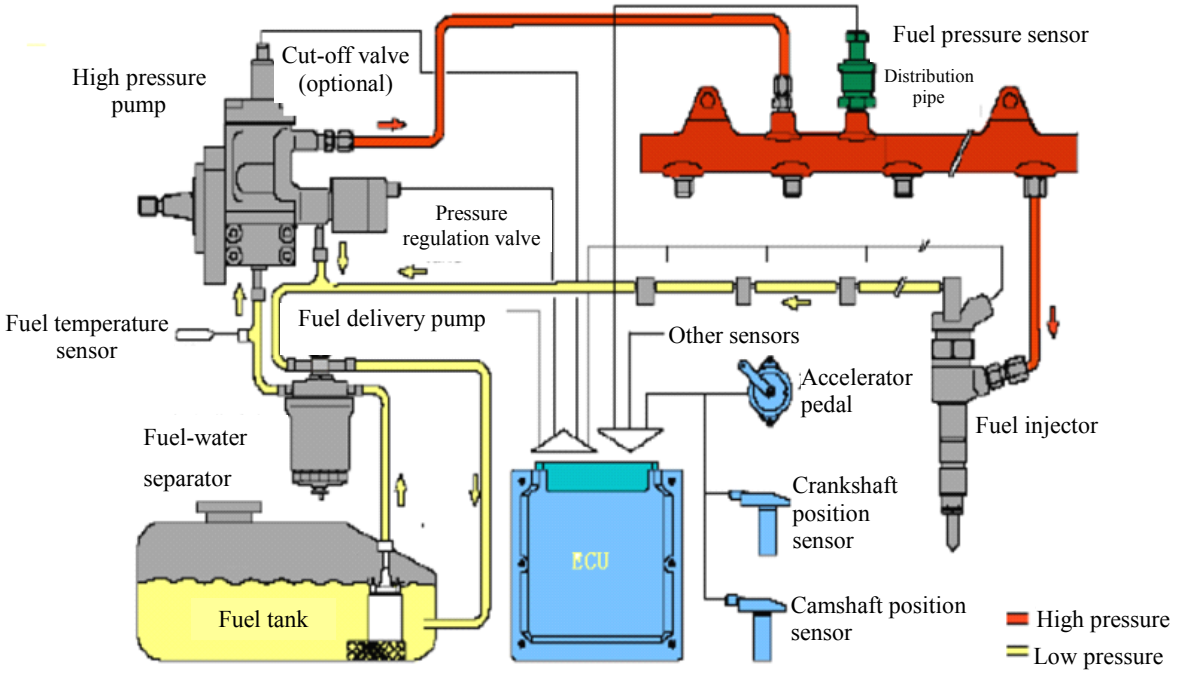




Chapter III Working Principle of Engine Control and Actuator Units

Section I Overview of Diesel Common Rail System

Diesel common rail injection system



The electronically controlled high pressure common rail system means one fuel supply mode in which the generation of injection pressure and fuel injection are completely separated in the closed-loop system composed of high pressure fuel pump, pressure sensor, and ECU. The high pressure fuel pump generates high pressure fuel and conveys to the common rail pipe to realize precise control of fuel pressure within the common rail pipe. This fuel injection system can ensure that the fuel injection pressure will not vary following the variation of the engine speed and thus relieve the defect of traditional diesel engines. Instead of the common pulse theory, this system adopts the pressure-time measuring theory and combines the high pressure common rail with the control of fuel injection solenoid valves of all cylinders, in which the last pulse of the control unit introduces the injection signal into the solenoid valve to trigger one injection cycle and the injection amount is controlled by the accumulated pressure and the open duration of the injector. The injection pressure of EDC17 control system adopted by this engine is up to 1,600bar.

The electronically controlled common rail fuel injection technology of diesel engine integrates the computer control technology, modern sensing and measuring technology, and advanced fuel injection mechanism. The main characteristic of this technology is as below: The main parameters (including speed, torque, power, oil temperature, oil pressure, water temperature, and turbocharger pressure of the diesel engine) under actual working conditions of the diesel engine are measured by modern sensing and measuring technology and transmitted to the ECU and the ECU compares these measurements with the pre-inputted optimized running MAPs of the diesel engine and processes and calculates out the best values to control the pressure of common rail pipe and the open moment, duration, and injection frequency of the high speed solenoid valves of the fuel injectors, in order to realize the best working state of the diesel engine. The electric pulses generated by the ECU trigger the solenoid valves of the fuel injector as per specified sequence to determine the open and close moments of each fuel injection cycle of the engine and flexibly control the fuel injection speed and frequency. The common rail fuel injection mechanism forms directly or indirectly constant high pressure fuel and distributes to each fuel injector. The electronically controlled common rail fuel injection technology of the diesel engine can guarantee that the diesel engine achieves the best air-combustion ratio and excellent atomization.

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The high pressure common rail system is composed of fuel tank, diesel filter, high pressure fuel pump, common rail pipe, electronically controlled fuel injector, high pressure fuel pipe, and low pressure fuel return pipeline.

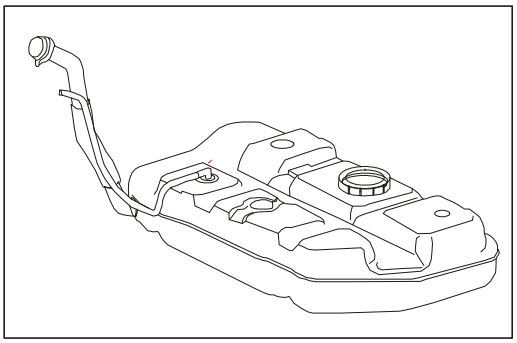
- It adopts direct injection combustion chamber system and common rail fuel supply system to realize high performance, clean emission, low noise, and low vibration;
- Single camshaft and four-valve technology brings about higher air charging efficiency and improves the combustion;
- High power per liter design and compact design;
- Variable nozzle turbocharger (VNT) control;
- Exhaust Gas Recirculation (EGR);
- Electronic throttle control.

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Section II Working Principle of Low Pressure Fuel Line System

I. Composition of low pressure fuel line:

The low pressure fuel line is functioned to supply sufficient fuel to the high pressure fuel line and is composed of:

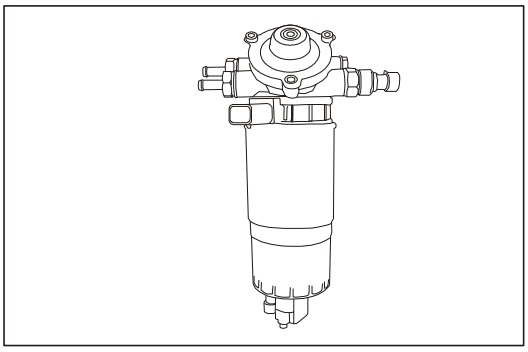


- Fuel tank (including filter screen)
- Fuel filter (including manual fuel delivery pump)
- Low pressure fuel delivery pump
- Other low pressure fuel hoses

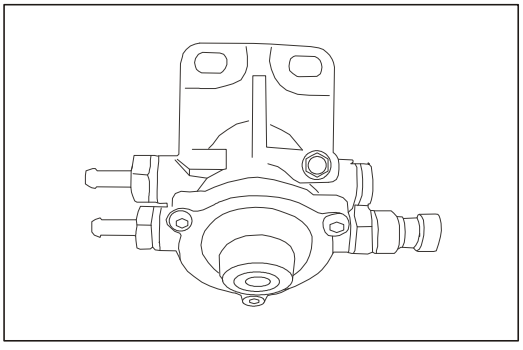
II. Fuel tank

The fuel tank shall be fabricated from anti-corrosion material and shall maintain 0.3bar pressure under all working conditions and be free of fuel leakage under the application of the doubled working pressure. The fuel tank shall also set up appropriate opening or safety valve or adopt appropriate measures to relieve the excessive pressure whenever it's needed. When the motor vehicle is subject to slight vibration, makes turns or travels or parks on a slope, the fuel in the fuel tank shall not leak from the fuel tank cap or the pressure balancing device.

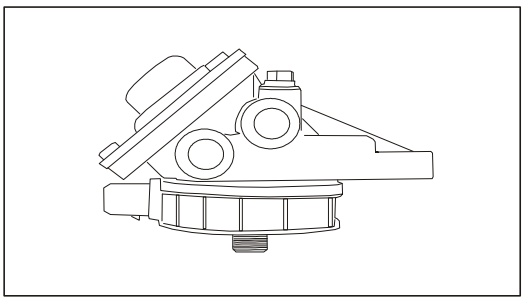
III. Fuel filter (including manual fuel delivery pump)



Sunray long-wheelbase model adopts two-stage diesel filter, including one primary filter and one fine filter. Compared with traditional diesel engines, it requires cleaner fuel supply. The impurities contained in the fuel will damage the fuel system including the high pressure pump, high pressure common rail, and fuel injector. The fuel filter purifies the fuel inputting into the high pressure fuel pump, in order to help the normal functioning of the high pressure pump. The contaminant, impurity, and particle in the fuel will lead to the damage of pump units, fuel supply valve, and fuel injector. Therefore, the use of fuel filter capable of meeting the fuel injector requirements becomes the premise for normal working of the engine and guarantee of service life. The water content in the diesel may exist in non-free radical form (emulsified fuel) or radical form (such as water condensate generated due to variation of temperature). If entering into the fuel injection system, this water content will lead to damage of parts due to corrosion. Similar to other fuel injection systems, common rail system requires the fuel filter with water collection chamber as well as the automatic water content alarm. When the alarm lamp lights up, make sure to drain the water from the water collection chamber.



The fuel filter is composed of fuel temperature sensor, fuel heater, manual fuel pump, fuel-water separator, and water level sensor.



The fuel leakage during traveling or the air ingress into fuel pipeline after replacement of fuel filter may lead to start failure or poor functioning of the engine. Therefore, make sure to bleed the air from the low pressure fuel pipeline after the installation of manual fuel delivery pump. Installed on the fuel filter, the manual fuel delivery pump is the device for supplying fuel to the fuel filter and the device required to guarantee the first start of the engine. In event of the following conditions, press the manual fuel delivery pump, till the manual fuel delivery pump can’t be further pressed, before starting the engine.

- After the fuel is used up.
- After the water drainage from the fuel-water separator.
- After the replacement of fuel filter

Replacement of fuel filter

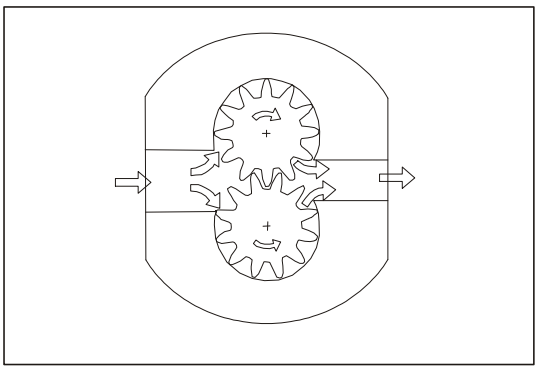
1. Replacement interval of fuel filter: Once every 7,000km;

2. Water separation interval: Once every 5,000Km;

3. It's prohibited to use any used fuel filter.

IV. Low pressure fuel delivery pump

The low pressure fuel delivery pump is one gear pump and is stalled at the rear end within the high pressure pump housing. The low pressure fuel delivery pump continually supplies the required fuel amount to the high pressure pump from the fuel tank.



The fuel delivery pump is functioned to supply sufficient fuel supply to the high pressure pump under following conditions:

(1) Under any working condition;

(2) Under necessary pressure;

(3) Throughout the entire service life.

The low pressure fuel delivery pump is one mechanical gear pump and is installed at the rear end of high pressure pump and driven by the high pressure pump shaft. Its main parts are two gears rotating in opposite direction. While rotating, two gears engages to vacuumize the fuel into the chamber formed between gears and pump walls and then conveys to the outlet (pressure end). The closing line of the rotating gears realizes the sealing between vacuumization end and pressure end of the pump and prevents the fuel backflow.
The fuel supply amount of the gear pump is approximately in proportion to the engine speed. This is why the fuel supply amount of the gear pump can be reduced by means of the throttle valve at the inlet end or can be restrained by means of the relief valve at the outlet end.
No maintenance is required for the gear pump. Charge the fuel from the fuel system before the first start. When the fuel in the fuel tank is used up, operate the manual fuel delivery pump to charge fully the low pressure fuel line.

V. Fuel pipeline

Besides the steel pipe, the low pressure fuel line can also adopt flame-retardant braided and armored fuel hose. The fuel pipes shall be arranged in such manner to prevent the mechanical damage and that the fuel dripped or evaporated will not concentrate nor burn.

In event of vehicle distortion, engine displacement, or similar conditions, the functions of the fuel pipeline shall not be impaired. All fuel delivery pipelines shall have the radiation shield measures.

VI. Common malfunctions and troubleshooting for low pressure fuel line

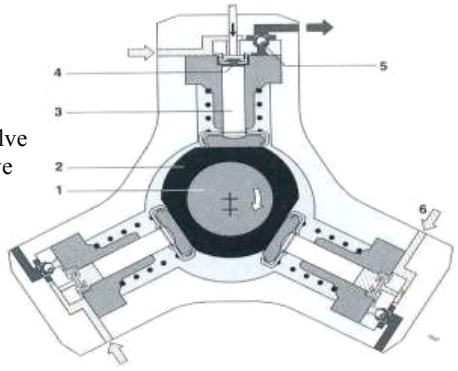
No.	Malfunction	Troubleshooting	Remarks
1	Weak pumping of fuel	Retighten the connectors (temperature sensor, plug, and pile connector), in order to prevent the pumping failure due to ingress of air. If ineffective, replace the manual pump.	The tightening torque for connectors is 30-35N.m. Higher torque will lead to thread failure.
2	Fuel leakage of air bleeding screw	Check the screw hole of manual pump for presence of thread failure. If yes, replace the transitional thread insert and air bleeding screw and washer.	The tightening torque is 7~9N.m. Higher torque will lead to thread failure. While assembling the transitional thread insert, add an appropriate amount of thread sealant onto the thread. Prevent the ingress of sealant into the manual pump.
3	Fuel leakage of manual pump	Replace the manual pump	The knocking or improper use will lead to fuel leakage of manual pump
4	Slow acceleration and difficult start due to difficult fuel supply	The filter is blocked. Replace the filter. If the malfunction still occurs after replacement of fuel filter, check other engine parts.	The blockage of fuel filter will increase the pressure difference.
5	Failure for timely water drainage	Make sure to drain the water when the water level sensor indicator lamp lights up.	If the water is not drained, the water content in fuel will increase to impair the engine performance.
6	Light-up failure of water level sensor indicator lamp at engine start	1. Water level sensor is damaged. 2. Indicator lamp is damaged. 3. Circuit malfunction	
7	Working failure of heater	1. The heater is damaged. 2. Circuit malfunction 3. Low battery current 4. The heater is punctured due to high current	
8	Working failure of temperature sensor	Damage o temperature sensor Circuit malfunction	

Section III Working Theory of High Pressure Fuel Line

I. High pressure fuel line parts

The high pressure fuel line generates and accumulates sufficient fuel pressure required for the fuel injectors. The parts include: High pressure pump, fuel rail, high pressure fuel pipe, and fuel injector.

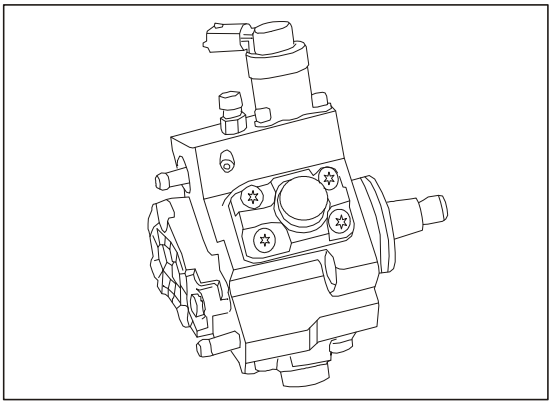
1. Drive shaft
2. Eccentric cam
3. Plunger pump
4. Fuel suction valve
5. Fuel outlet valve
6. Fuel inlet



II. High pressure pump

The high pressure pump compresses the fuel to a system pressure of up to 1,450bar and then the fuel is transmitted to the tubular high pressure fuel accumulator (rail) via the high pressure pipe.

The high pressure pump is the interface between low pressure stage and high pressure stage. Under all working conditions, it can reliably supply sufficient high pressure fuel throughout the entire service life of the vehicle, including supplying addition fuel required for rapid start and the rapid establishment of pressure in the common rail. The high pressure pump continually generates the system pressure required for the high pressure accumulator (rail). Therefore, it means that, compared with traditional system, it's unnecessary to compress the fuel for each individual injection cycle.



The fuel is compressed by three plunger pumps arranged radially at spacing of 120º from each other. As each rotation turn can generate three compression strokes and only generate low peak drive torque, the drive unit of the pump maintains uniform force application. As far as 16Nm torque is concerned, this torque is only 1/9 of the torque required for driving similar distribution pump. This means that, compared with traditional fuel injection systems, the common rail generates lower load onto the drive unit of the pump. The raising power of the drive pump is in proportion to the preset pressure of common rail and the speed of the fuel pump (fuel delivery amount).

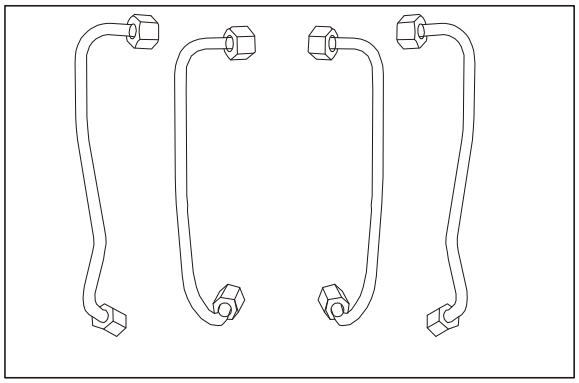
Working mode:

Through one water separator, the fuel delivery pump pumps out the fuel from the fuel tank and the fuel enters into the lubricating and cooling lines of high pressure pump via the fuel inlet. The drive shaft with eccentric wheel drives three pump plungers for upward and downward movements along with the profile of the cam. The pump plungers move downward under the application of the fuel delivery pressure (fuel suction stroke). When the plungers overpass the bottom dead center, the fuel inlet valve is closed so that the fuel in the pump chamber will not leak out. In such case, the fuel is compressed so that the fuel pressure exceeds the fuel delivery pressure of the fuel delivery pump. In such case, once the pressure established exceeds the pressure in the common rail, the fuel outlet valve opens so that the fuel enters into the high pressure line. The pump plungers will continue the fuel supply, till the top dead center is reached (fuel delivery stroke). Then the pressure drops and the fuel outlet valve closes. The residual fuel is pressure relieved: The pump plungers move downward. When the pressure in the pump chamber is less than the fuel delivery pressure, the fuel inlet valve re-opens and the pumping process is started again.

III. Fuel rail (Common rail)

The high pressure accumulator (rail) stores the high pressure fuel and at the same time restrains the pressure variation generated during the fuel supply and fuel injection of the high pressure pump. The high pressure accumulator is shared by all cylinders and therefore is referred to as "common rail". Even when a great amount of fuel is drained, the common rail can maintain its internal pressure basically unchanged. Therefore it maintains the constant fuel injection pressure of the fuel injector.

The space of the common rail is always filled with high pressure fuel. It utilizes the fuel compressed due to high pressure to achieve the accumulator effect. When the fuel is departed from the common rail for injection, the pressure in the high pressure accumulator is basically constant. At the same time, the pressure variation generated by the pulsed fuel supply of high pressure pump is balanced and the pressure information is provided to the ECU.

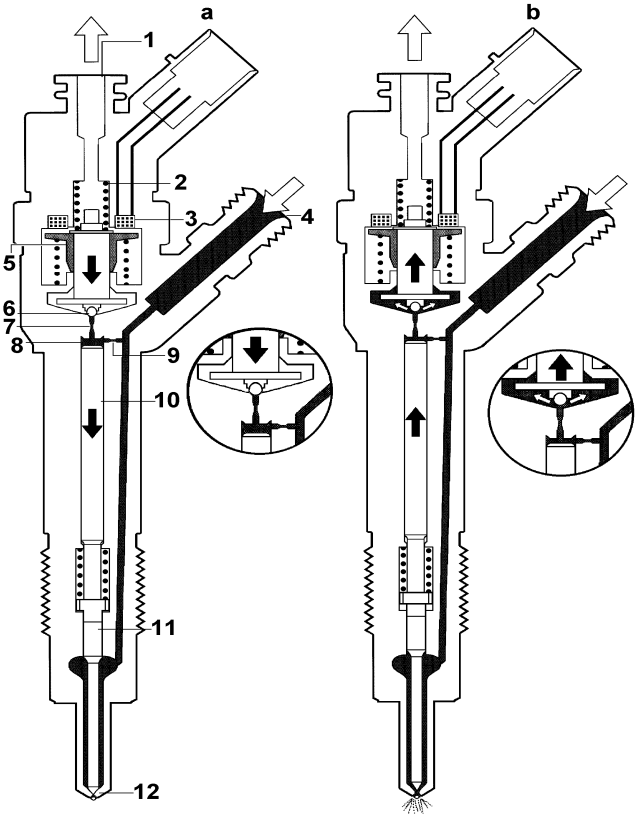


IV. High pressure fuel pipe

The high pressure fuel pipe is used to convey the high pressure fuel and is made of steel to endure the intermittent high frequency pressure variation under the maximum system pressure of the engine. The fuel pipe is generally 6mm in outside diameter and 2.4mm in inside diameter. All high pressure fuel pipes between fuel rail and fuel injectors are same in length, which means that the distances between the fuel rail and all fuel injectors are the same and the bending points compensate the corresponding length differences.

IV. Fuel injector

The fuel injectors are the core parts of the high pressure common rail and are installed on the high pressure common rail. In accordance with the directive of the ECU, the fuel injectors spray high pressure well-atomized fuel into the combustion chamber at specified moment and specified pressure for a specified duration.



The fuel injector is mainly composed of fuel injector nozzle, hydraulic servo unit, and solenoid valve. When the coil control valve acquires control signal through the ECU, the control valve will depart from its seat ring so that the fuel pressure in the needle valve control chamber drops rapidly. As the pressure at the injector nozzle holder is maintained at similar pressure with common rail, the needle valve opens and the injection starts. When the current of the solenoid control valve drops to zero, as the control valve returns to the seat cushion under the application of coil spring, the pressure of the needle control chamber will increase to lightly higher than he pressure at the injector holder so that the needle valve closes the injector and the injection stops. The sealing copper washer beneath the fuel injector must be replaced once the fuel injector is disassembled or loosened. During the disassembly, use the special tools recommended or designated by JAC Multifunctional Commercial Vehicle Company. Note: Never disassemble the fuel injector by self in any case. All maintenances and services of the fuel injector body shall be fulfilled by Bosch relevant service stations or JAC designated service stations.

Section IV Electronic Control Unit of High Pressure Common Rail System

The EDC17 system of HFC4DA1-2C engine belongs to electronically controlled diesel injection system and incorporates the dynamic fuel injection timing system and air and fuel management system. It adopts the BOSCH diesel high pressure common rail system, with the rail pressure up to 1,600bar, and applies new technologies including VNT, electronically controlled EGR, and POC pressure difference control to meet the Euro-IV emission standard, with potential compliance for Euro-V emission standard.

The characteristics of this system is one single ECU, one set of fuel injection control system, and one set of sensor system. It's functioned to inject the fuel into the engine cylinder, with accurate injection timing and fuel amount, so that the fuel is mixed with air in the cylinder to achieve best combustion efficiency.

The electronic control unit of the diesel common rail system is mainly composed of three parts: sensor, ECU, and actuator.

① Sensor part: The sensors and rated value transmitters collecting the running state and rated values of the engine and complete vehicle, which convert various types of physical parameters into electric signals.

② ECU: It's functioned to process the information as per definite mathematic calculation method and issue the electric signals of the directives.

③ Actuator: It's functioned to convert the electric signals of the directives issued by the ECU into mechanical parameters.

I. Sensor part

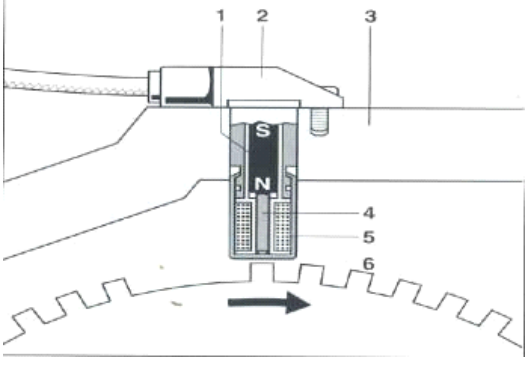
1. Crankshaft position sensor

1) Overview

- The crankshaft position sensor is one electromagnetic sensor.
- The position of piston in the combustion chamber determines the start moment of fuel injection. As the engine piston is connected with crankshaft through connecting rod, the crankshaft position sensor can provide all data information for the piston position and the engine speed determines the revolution per minute of the crankshaft.
- Generation of signal: The crankshaft is connected with one 60-tooth ferromagnetic actuation gear. The actuation gear actually in use has two teeth missing. This large gap corresponds to one specified crankshaft position of 1st cylinder. The crankshaft position sensor records the tooth sequence of the actuation gear. It's composed of one permanent magnet and soft iron core with copper coil. The magnetic flux in the sensor varies along with the gear and gap passing through and generates one sine AC voltage, of which the amplitude rapidly increases following the speed of the engine (crankshaft). It can achieve sufficient amplitude even when the speed is at 50r/min.
- The crankshaft position sensor is situated on the rear clutch housing of the engine;
- Wiring terminals: 1. Signal terminal of crankshaft position sensor; 2. Grounding terminal of crankshaft position sensor;
- Resistance: 860 Ohm;



Crankshaft speed sensor
1. Permanent magnet 2. Sensor housing
3. Engine outer cap 4. Soft iron core
5. Coil 6. Sensing gear



- Clearance between sensor and top of signal gear: 0.5~1.2mm.

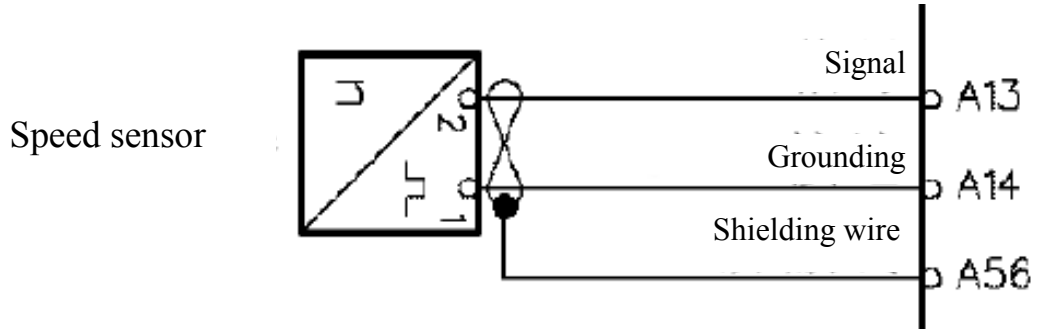
2) Working Principle

The electromagnetic sensor simulates the AC signal generator, namely such sensor generates AC signal, and is generally composed of a magnet wound by coil and two wiring terminals. These two coil terminals are the output terminals of the sensor. When the steel annular gear (sometimes referred to as magnetic resistance gear or target gear or signal gear) rotates to pass through this sensor, the magnetic flux of the magnet passing through the coil varies at certain level and the induction voltage is generated in the coil.

The same tooth profiles of the signal gear will generate continual pulses in same form. The pulses have consistent form amplitudes (peak-peak voltages) and are in proportion to the speed of crankshaft signal gear. The frequency of the output signal is based on the rotation speed of the magnetic resistance gear and the air gap between sensor magnetic pole and the magnetic resistance gear is of great influence over the amplitude of the sensor signal (Attention shall be paid to the backlash during the installation). During the production, removing the synchronous pulse generated by one tooth or two really close teeth from the sensor can determine the signal of top dead center, which will lead to the frequency variation of output signal. When the number of teeth is reduced, the voltage output amplitude will vary greatly. This pulse signal is transmitted to the ECU, based on which the ECU controls the fuel injection of the engine.

As the electromagnetic crankshaft position sensor is weak in signal and sensitive and is vulnerable to the electromagnetic interference by the electric devices such as car telephone, fan, and starter, it will lead to malfunction of traveling performance or generate trouble code. To prevent the occurrence of such phenomenon, two signal wires of the crankshaft position sensor adopt the twisted-pair structure in the manufacturing of engine harness, which can effectively guard the signal of crankshaft position sensor against the external signals and reduce the production cost.

3) Measurement analysis:



1 – Signal -; 2 – Signal +; Use a multimeter to measure the resistances for two signal terminals of the crankshaft position sensor. The resistance measurement shall be 860 Ohm.

4) Malfunction Mode:

- Short-circuit or open-circuit of sensor;
- Distorted, error, and suspicious signal;
- Unstable sensor signal;
- Sensor signal is out of range.

The crankshaft position and speed sensor is the main sensor of the engine electronic control system. In event of the malfunction of crankshaft position and speed sensor, the engine can’t start. If the malfunction occurs after the start of the engine, the engine will stop immediately.

5) Troubleshooting

Use diagnosis instrument to check the trouble code and determine the malfunction position. Mainly check whether the sensor is installed in place and whether the clearance is normal, check the sensor circuit whether there is short-circuit or open-circuit to grounding wire, check whether there is short-circuit or open-circuit to the power supply, and check whether the circuit is consistent with the given pin definition.



Notice: Take caution to install the sensor and make sure not to add any washer, or it may lead to signal distortion of sensor.

2. Camshaft position sensor

1) Overview

- The camshaft position sensor is one Hall sensor.
- The camshaft position sensor utilizes the Hall effect to determine the camshaft position. One steel actuation gear rotates along with the camshaft, the Hall effect integrated circuit is installed between actuation gear and permanent magnet, and the permanent magnet generates a magnetic field perpendicular to the Hall unit. If one tooth of actuation gear passes through the current-carrying linear sensor unit (semiconductor chip), it changes the strength of magnetic field perpendicular to the Hall unit. In such case, the electron driven by the voltage in major axis direction is offset in the direction perpendicular to the current direction to generate one temporary signal voltage (Hall voltage) so that the calculation circuit integrated with the sensor Hall integrated circuit will process the signal and output as square wave signal.
- The camshaft position sensor is installed on the cylinder head shield.
- Wiring terminals: 1. +5V power supply, 2. Signal output, 3. Grounding;
- The clearance between sensing end of sensor and the signal gear of camshaft: 0.5~1.5mm. Required torque: 8±0.5Nm

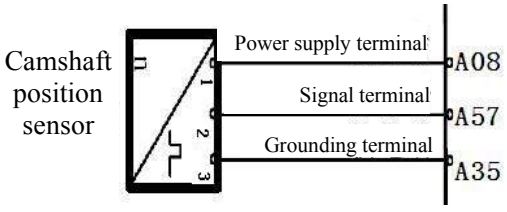
2) Working Principle

The camshaft controls the intake and exhaust valves of the engine, of which the speed is only half of the crankshaft speed. When the piston moves towards the top dead center, the camshaft position determines whether the piston is at compression stroke or the exhaust stroke and then judges the fuel injection or not. If the engine is under start stage, such data information can't be acquired from the crankshaft position. On the other hand, during the normal working of the engine, the data information generated by the crankshaft sensor is enough to determine the engine state. In other words, while the vehicle is traveling, even the camshaft sensor is failed, the ECU can still receive the data information of engine working state from the crankshaft sensor.

The camshaft sensor utilizes Hall effect to determine the camshaft position. One steel toothed part is fixed on the camshaft and rotates along with the camshaft. When this toothed part passes through the semiconductor chip of the camshaft sensor, its magnetic field will offset the electron of the semiconductor chip towards the current direction. Therefore, one temporary voltage signal (Hall voltage) is generated to remind ECU that the 1st cylinder enters into the compression stroke.

3) Measurement analysis

Wiring terminals: 1 - +5V, 2 – Signal +, 3 – Grounding



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4) Malfunction Mode

- Short-circuit or open-circuit of sensor;
- Distorted, error, and suspicious signal;
- Unstable sensor signal;
- Sensor signal is out of range.

5) Troubleshooting

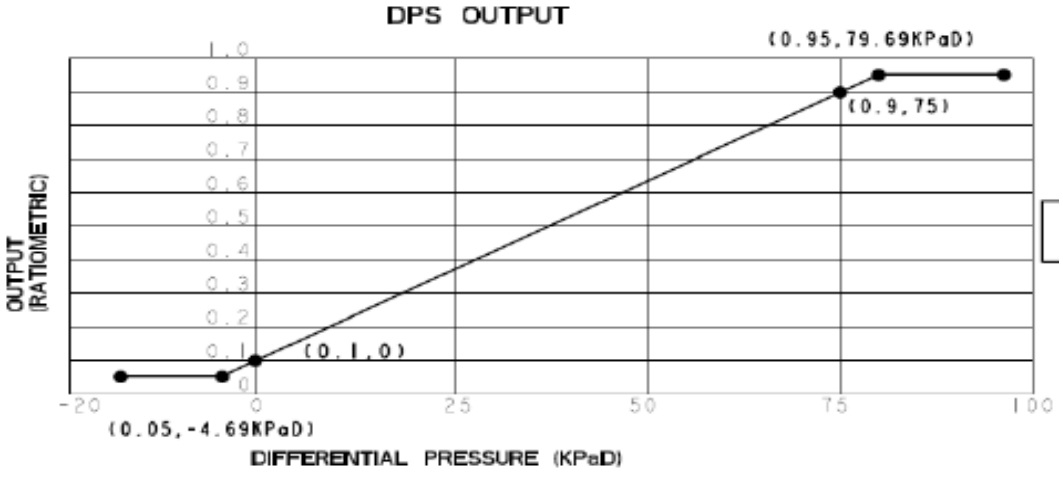
Use diagnosis instrument to check the trouble code and determine the malfunction position. Mainly check whether the sensor is installed in place and whether the clearance is normal, check the sensor circuit whether there is short-circuit or open-circuit to grounding wire, check whether there is short-circuit or open-circuit to the power supply, and check whether the circuit is consistent with the given pin definition.

3. Pressure difference sensor

1) Overview

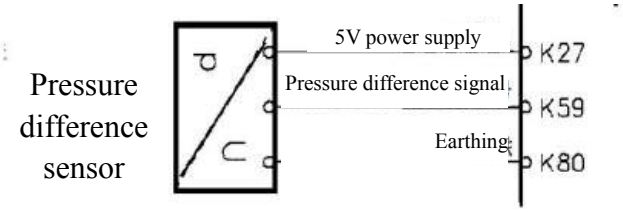
- The pressure difference sensor is functioned to real-time monitor the pressure drop of the POC and determine whether the after-treatment system is working normally. The pressure at two ends of the POC is introduced via two pressure ports of the sensor and then the sensor converts the measurement into voltage value and feeds back to control unit. This can not only guarantee the sufficient oxidization of grains, but also prevent the blockage of catalytic converter.
- The pressure difference sensor and the POC are connected via stainless steel pipe and high temperature rubber hose. The pressure is introduced via stainless steel pipe, which is at least 250mm in length, from two sides of POC and then is led to the pressure difference sensor via high temperature rubber hose, which is capable of enduring more than 150ºC.

2) Working Principle

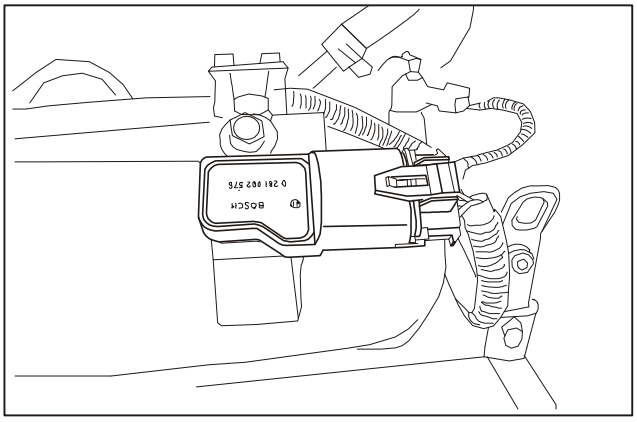


3) Test analysis

Wiring terminals: 1 - +5V, 2 – Signal +, 3 – Grounding



3. Turbocharger pressure sensor





1) Overview

The turbocharger pressure sensor is connected to the intake pipe and is functioned to measure the absolute pressure of the intake pipe. This sensor is composed of one pressure unit with two sensing units and one evaluation circuit chamber. The sensing units and evaluation circuit are mounted on common ceramic substrate. Each sensing unit incorporates one horn-shaped diaphragm embodying the benchmark capacity for determination of internal pressure. The diaphragm moves towards large or small open extent as a function of charging pressure. The pressure sensitive resistor is mounted on the diaphragm surface, of which the resistance varies under the application of pressure. These resistors are connected to form a resistor bridge. Therefore, any movement of the diaphragm will change the balance of resistor bridge, namely the voltage of the resistor bridge is one measurement of turbocharger pressure. The evaluation circuit is functioned to amplify the bridge voltage and compensate the linear variation of temperature influence and pressure characteristic. The output signal of evaluation circuit is transmitted to ECU and then the turbocharger pressure is obtained by means of the programming characteristic curve.

- The temperature sensor incorporates one negative temperature coefficient (NTC) thermistor that is connected in the voltage division circuit of 5V power supply.
- The voltage drop on the resistor is inputted to the ECU via one analog and one digital converters (ADC), which is one measurement for evaluating the temperature. The ECU micro-processor embodies one characteristic curve, which defines the temperature as a function of given voltage.
- It's installed on the pressure stabilizing chamber of intake manifold and take the priority to measure the pressure.
- Wiring terminals: 1 – Grounding, 2 – Temperature signal, 3 – +5V, 4 – Pressure signal.

2) Working Principle

The turbocharger pressure sensor is connected in the intake pipe and is capable of measuring the absolute pressure of intake pipe at 0.5~3bar. This sensor is composed of one pressure unit with two sensing units and one evaluation circuit chamber. The sensing units and evaluation circuit are mounted on common ceramic substrate. Each sensing unit incorporates one horn-shaped diaphragm embodying the benchmark capacity for determination of internal pressure. The diaphragm moves towards large or small open extent as a function of charging pressure. The pressure sensitive

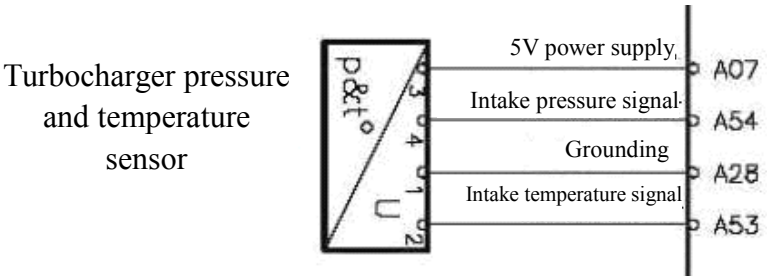
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resistor is mounted on the diaphragm surface, of which the resistance varies under the application of pressure. These resistors are connected to form a resistor bridge. Therefore, any movement of the diaphragm will change the balance of resistor bridge, namely the voltage of the resistor bridge is one measurement of turbocharger pressure. The evaluation circuit is functioned to amplify the bridge voltage and compensate the linear variation of temperature influence and pressure characteristic. The output signal of evaluation circuit is transmitted to ECU and then the turbocharger pressure is obtained by means of the programming characteristic curve.

The voltage drop on the resistor is inputted to the ECU via one analog and one digital converters (ADC), which is one measurement for evaluating the temperature. The ECU micro-processor embodies one characteristic curve, which defines the temperature as a function of given voltage.

3) Measurement analysis

Wiring terminals: 1 – Grounding, 2 – Temperature signal, 3 – +5V, 4 – Pressure signal.



4) Malfunction Mode

The light-up of the engine malfunction indicator lamp indicates the presence of malfunction in the engine system and it's necessary to diagnose with diagnosis instrument. Use Sunray special diagnosis instrument to communicate with ECU of electronic injection system and read out the malfunction data in the ECU.

5) Troubleshooting

Use Sunray special diagnosis instrument to check the trouble code and determine whether there is short-circuit or open-circuit between circuit of malfunction position and the grounding wire, whether there is short-circuit or open-circuit to power supply, and whether the circuit is consistent with the given pin definition.

4. Thermal diaphragm air flowmeter

1) Overview

- The thermal diaphragm airflow sensor is one air mass sensor fitted with logic output. To obtain the air flow, the sensor diaphragm on the sensor is heated by the heating resistor installed in the middle and the temperature distribution on the diaphragm is measured by the temperature resistors installed paralleling with the heating resistor. The air flow passing through the sensor changes the temperature distribution on the diaphragm to cause resistance difference between two temperature resistors. The resistance difference depends on the direction and flow rate of the airflow so that the airflow sensor has high requirements over the flow rate and direction of the airflow. The sensor manufactured by micro-machinery features small size, low thermal capacity, and <15ms response time.



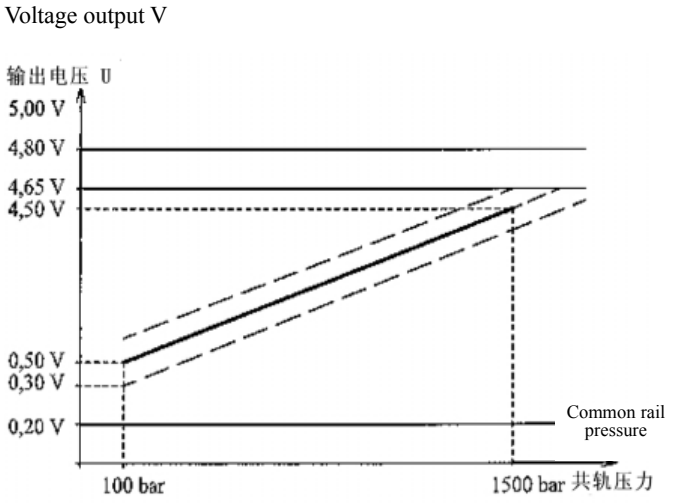
- The sensor is internally fitted with intake temperature sensor to measure the intake temperature.
- The air flowmeter is installed at the port of the air cleaner.
- Wiring terminals: 1. +12V power supply; 2. Grounding; 3. Air temperature signal; 4. Airflow rate signal.

2) Working Principle

This sensor is composed of two sensors, namely airflow sensor and intake temperature sensor, and is installed on the intake hose after the air cleaner. This type of sensor requires that there shall be free of air leakage from the sensor to the engine combustion chamber, or it will lead to unstable idling of engine or even engine flameout.

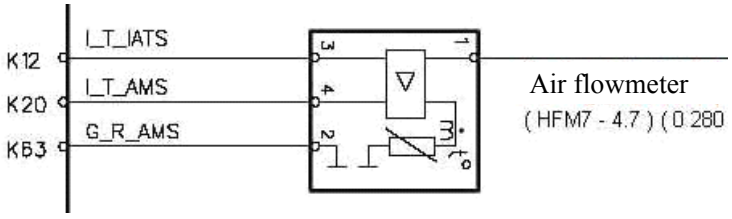
The airflow sensor integrates some micro-electronic units on a ceramic substrate. When the engine is working, the diaphragm will be heated. The intake airflow passing through the diaphragm will take away the heat and the Wheatstone bridge integrated on the diaphragm will increase the current to supplement the heat loss, which leads to the variation of electric signal. This signal is transmitted to the engine control unit ECU, based on which the ECU can obtain the load variation of the engine and thus control the fuel injection pulse width.

The intake temperature sensing unit is one negative temperature coefficient (NTC) thermistor. The sensor installs two same sensing units on two sides of the thermal diaphragm. When the intake airflow flows through the diaphragm, the temperature of the temperature sensing unit on the front of diaphragm is slightly lower than that of temperature sensing unit on the rear. Based on this characteristic, the ECU can judge the direction of airflow.



3) Measurement analysis

Wiring terminals: 1. +12V power supply; 2. Grounding; 3. Air temperature signal; 4. Airflow rate signal.



4) Malfunction Mode

The subsequent electronic device of the air flowmeter in the ECU can judge the malfunctions such as open-circuit or short-circuit of internal circuit and connecting circuit of air flowmeter and the damage of sensor. Upon the detection that the output signal of the sensor is out of its output characteristic curve, the ECU will judge as malfunction of sensor.

5) Troubleshooting

When the airflow sensor is failed, the engine cooling fan will run at high speed for one period after the ignition key is turned to Off. For instance: When the airflow rate is higher than the upper limit of airflow or less than the lower limit of airflow, the ECU will judge as malfunction of sensor (Though the intake airflow rate is less than lower limit (closing to zero) at the start of the vehicle, the ECU can judge the start condition) and at the same time light up the engine malfunction lamp and work under malfunction mode.

5. Rail pressure sensor

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1) Overview

The resistance of the metal film installed on the diaphragm will change accordingly following the change of shape. This change of shape generated by the established system pressure (approximate 1mm under 1,500bar pressure) will change the resistance and lead to the change of voltage between two sides of 5V bridge composed of resistor units. This voltage change range is 0~70mv (depending on the applied pressure) and is amplified to 0.5~4.5V by the evaluation circuit.
The accurate measurement of rail pressure is of great importance to the effective working of the system. This is one of the causes for very strict tolerance over the rail pressure sensor during the pressure measurement. Under the scope of main working conditions, the measurement accuracy is approximately ±2% of the full scale reading.

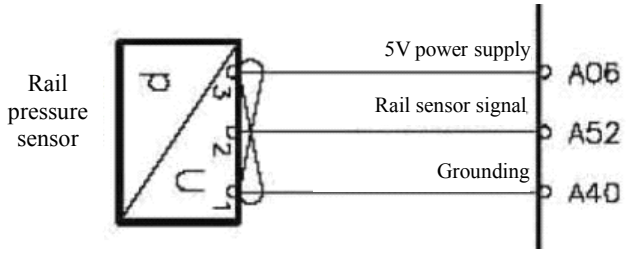
Wiring terminals: 1. Grounding; 2. Rail pressure sensor signal; 3. +5V power supply.

2) Working Principle

It transmits one voltage signal to the ECU, depending on the fuel pressure. The rail pressure sensor must measure the instant pressure in the fuel rail and embody sufficient accuracy and rapid response capability. The rail pressure sensor is composed of following parts:
①Integrated sensing unit welded onto the pressure device
② Printed circuit board (PCB) with electric evaluation circuit
sensor housing with electric connector. The fuel flows into the rail pressure sensor via one hole on the common rail and the end of this hole is sealed by one sensor diaphragm. The fuel under high pressure reaches the sensor diaphragm via one blind hole. One sensing unit (semiconductor unit) is arranged on this diaphragm and converts the pressure into electric signal. This signal generated is transmitted via wire to evaluation circuit, which will amplify this signal and transmit to the ECU.

3) Test analysis

Wiring terminals: 1 - Grounding; 2 - Rail pressure sensor signal; 3 - +5V power supply.



4) Malfunction Mode

The malfunction indicator lamp lights up if the voltage is higher or less than this limit. If the voltage is out of the normal working voltage range, but is not out of the limit, the malfunction indicator lamp will not light up.

5) Troubleshooting

The light-up of the engine malfunction indicator lamp indicates the presence of malfunction in the engine system and it's necessary to diagnose with diagnosis instrument. Use JAC special diagnosis instrument to communicate with ECU of electronic injection system and read out the malfunction data in the ECU.

6. Engine coolant temperature sensor

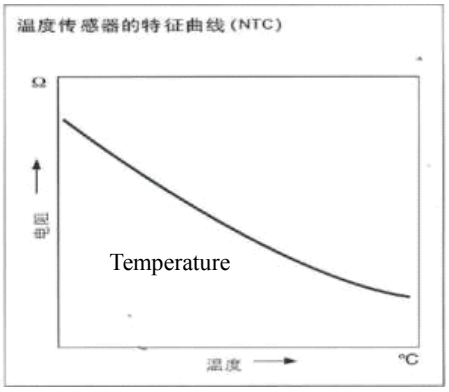
1) Overview

- The sensor is installed on the cylinder head, closing to the water outlet. The body is made of brass to protect the resistor unit fabricated from negative temperature coefficient (NTC) resistor;
- The temperature resistor of the temperature sensor is one part of the 5V vol[illegible] of the temperature sensor is connected with the voltage charged circuit. When the temperature resistor of the

Characteristic curve of temperature sensor

ance

temperature sensor changes along with the temperature, the voltage of the voltage charged circuit changes accordingly, which will be inputted to the analog/digital conversion circuit of ECU interface circuit. The relationship characteristic curve between voltage and temperature is stored in the ECU of engine management system;

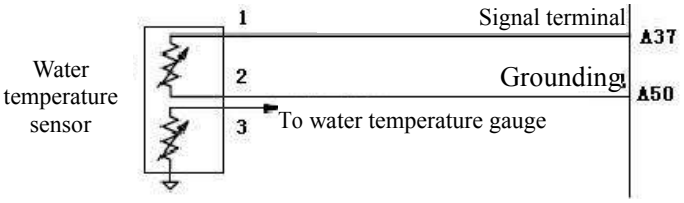


- Sunray is equipped with 3-wire water temperature sensor to save the cost and guarantee the system unity.

2) Working Principle

The coolant temperature sensor is used to measure the working temperature of the engine. The ECU will provide the engine with best control scheme, depending on different temperatures.

This sensor is one negative temperature coefficient (NTC) thermistor, of which the resistance reduces following the increasing of coolant temperature in a non-linear mode. The negative temperature coefficient thermistor is installed within one copper heat conducting sleeve. By means of one voltage division circuit, the ECU converts the resistance change of thermistor to one varying voltage and provides to the ECU and thus monitors the change of water temperature (internal structure of ECU).



3) Measurement analysis

Wiring terminals: 1 – Temperature signal; 2 – Grounding

Reference values: -10℃ 8.642---10.152 kΩ

20℃2.351---2.649 kΩ

80℃0.313---0.332 kΩ

4) Malfunction Mode

Upon the detection that the water temperature signal is higher or less than the limit range, the ECU will light up the malfunction indicator lamp.

5) Troubleshooting

Sunray is fitted with one independent coolant temperature sensor to transmit the water temperature signal to the instrument for display of instrument water temperature alarm. If the water temperature alarm indicator lamp lights up, stop for cooling immediately. If the water temperature alarm indicator lamp lights up frequently, drive to the authorized service station of JAC Multifunctional Commercial Vehicle Company for service.

7. Water level sensor

1) Overview

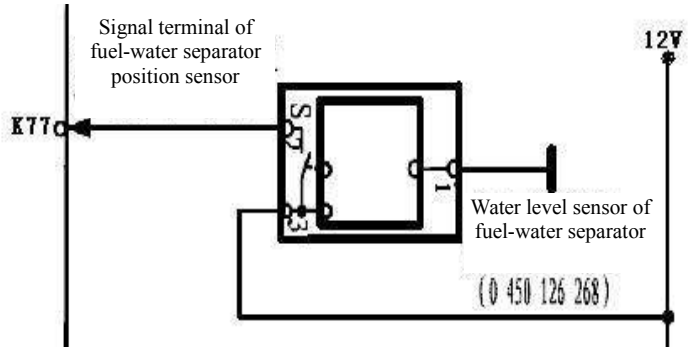
- The fuel-water separator position sensor is functioned to measure the water content in the fuel filter;
- When the water content reaches a predefined level, the ECU will control the working of the engine. This sensor is installed on the bottom of the fuel filter;
- The fuel-water separator position sensor is installed on the bottom of the fuel filter;

- Wiring terminals: 1. Water level sensor; 2. Water level signal; 3. +12V power supply.

2) Working Principle

The grain substances are high-accuracy filtered by means of the interception and absorption of the filter medium and the water concentrated on the filter medium is separated by gravity force. The water separated is deposited in the water chamber at the lower portion of filter housing.

The water level sensor is installed at the lower portion of water chamber. When the water level reaches the sensing point of the sensor, the internal circuit of sensor is actuated to output signal to the ECU. At the same time, the signal is transmitted to the instrument to light up the water level alarm lamp.



3) Measurement analysis

Wiring terminals: 1 - Water level sensor; 2 - Water level signal; 3 - +12V power supply.

4) Malfunction Mode

- Short-circuit or open-circuit of sensor;
- Unstable sensor signal;
- Sensor signal is out of range.

1) Troubleshooting

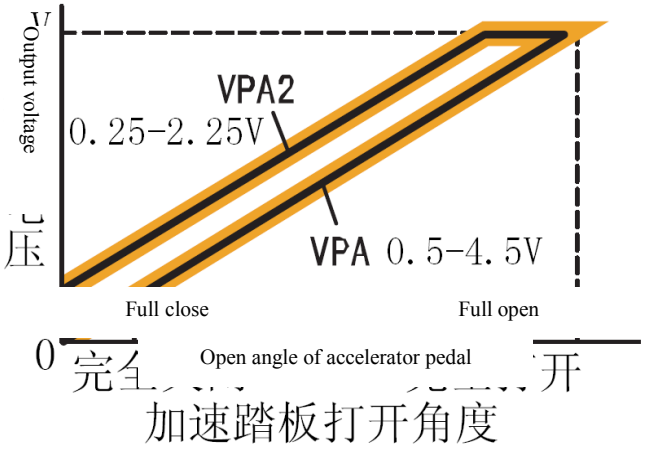
Use Sunray special diagnosis instrument to check the trouble code and determine the malfunction position. Mainly check the circuit of sensor and determine whether there is short-circuit or open-circuit between circuit and the grounding wire, whether there is short-circuit or open-circuit to power supply, and whether the circuit is consistent with the given pin definition.

8. Accelerator pedal position sensor

1) Overview

The accelerator pedal position sensor is mounted on the accelerator pedal.

The accelerator pedal position sensor and the accelerator pedal form one integral part. The accelerator pedal position sensor internally incorporates two same potentiometer sensors to provide the driver's driving demand signal to the ECU. This process is completely same with the presently mechanical pedal in terms of operation, in order to adapt to the years of driving habit of the driver. Two same sensors provide the accelerator signal to the ECU respectively, which guarantees more safety and reliability of the system.



Wiring terminals: 1. +5V; 2. +5V; 3. Grounding of accelerator pedal 1; 4. Signal of accelerator pedal 1; 5. Grounding of accelerator pedal 2; 6. Signal of accelerator pedal 2.

2）Working Principle

The accelerator pedal position sensor internally adopts the damping structure and internally incorporates two same potentiometer sensors. The signal pointers of the sensors are coaxial with the pedal. When the accelerator pedal is stepped down, the potentiometer pointer will rotate coaxially with the pedal and, following the sliding of the potentiometer pointer, the signal terminals output different voltage or resistance signal. Two movable potentiometer sensors with different resistances within the position sensor output different resistances. However, there is a defined relationship between the resistances outputted by two sensors. The ECU adopts the voltage signals, instead of the resistance signals of the sensor, in order to prevent the signal distortion caused by the voltage fluctuation of the alternator. A comparison circuit is adopted to compare the signal voltage outputted by the sensor with the standard voltage and the ECU adopts the comparison result to judge the movement amplitude of the pedal. The ECU compares the signals inputted by the sensor 1 and sensor 2 and considers other sensors (engine speed, load, etc.) to jointly judge the trueness of the signals outputted by the sensors. If the signal distortion is judged in any of two sensors, the ECU controls the engine to actuate malfunction mode and adopt restrained driving measures.

The accelerator pedal position sensor provides one signal voltage varying along with the accelerator pedal position. The engine control unit (ECU) will provide independent 5V reference voltage and low level reference voltage to each accelerator pedal position sensor. When the accelerator pedal is stepped down, the signal voltage of the accelerator pedal position sensor 1 is increased, namely from approximate 0.7V at the free position to above 4V at the fully stepped down position. When the accelerator pedal is stepped down, the signal voltage of the accelerator pedal position sensor 2 is increased, namely from approximate 0.3V at the free position to above 2V at the fully stepped down position. Two data monitor mutually via control system.

3) Measurement analysis

Wiring terminals: 1 - +5V; 2 - +5V; 3 - Grounding of accelerator pedal 1; 4 - Signal of accelerator pedal 1; 5 - Grounding of accelerator pedal 2; 6 - Signal of accelerator pedal 2.

Working voltage of sensor: 5V

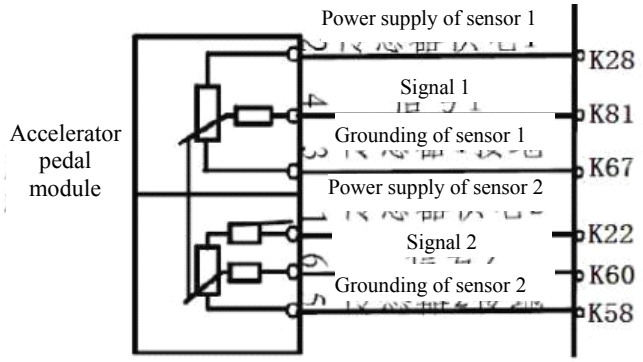
Malfunction Mode

Short-circuit or open-circuit of sensor 1;

Short-circuit or open-circuit of sensor 2;

Unstable sensor signal;

Sensor signal is out of range.



4) Troubleshooting

Use Sunray special diagnosis instrument to check the trouble code and determine the malfunction position. Mainly check the circuit of sensor and determine whether there is short-circuit or open-circuit between circuit and the grounding wire, whether there is short-circuit or open-circuit to power supply, and whether the circuit is consistent with the given pin definition.

Characteristic of sensor internal structure: Two potentiometer sensors within the sensor adopt independent power supply and independent grounding wire, which can guarantee the system safety. When one sensor is damaged, another sensor can still work. However, the engine system has already actuated the malfunction mode in such case and the electronic control system will adopt the restrained driving measures.

9. Vehicle speed sensor

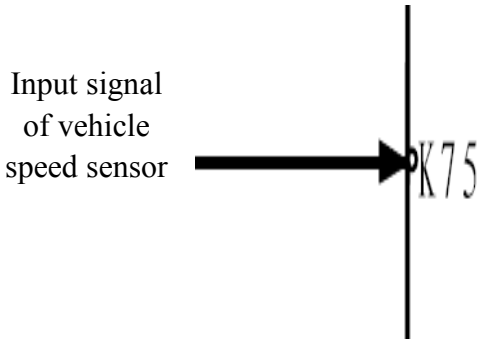
1) Overview

The vehicle speed sensor is located at the rear portion of the transmission and is mainly functioned to provide speed signal to the engine control unit and instruments.

2）Working Principle

The signal of vehicle speed sensor provides vehicle speed signal to the ECU, based on which the ECU calculates the vehicle speed. It's internally composed of one Hall speed sensor. Please refer to the camshaft position sensor for the working principle.

3）Measurement analysis



10. Clutch switch

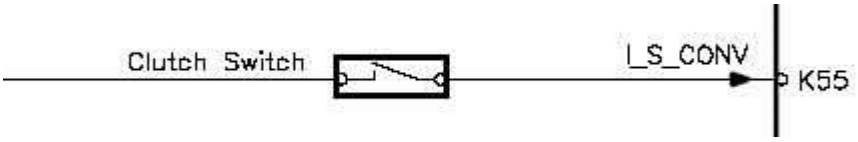
1) Overview

The clutch switch is located on the upper portion of the clutch pedal and is mainly functioned for cruise control and engine torque smoothness control.

2) Working Principle

The clutch switch is installed at the clutch pedal and transmits the operation signal of clutch pedal to the engine ECU. Its inside is one two-pin contact switch. When the clutch pedal is stepped down, the lower central position of the clutch switch springs out. In such case, two pins of the clutch switch are connected. When the clutch pedal is released, two pins of the clutch switch are disconnected. Therefore, the engine can learn the operation state of the driver by measuring the electric level (high or low) of the clutch switch signal wire.

3) Measurement analysis



4) Malfunction Mode

Short-circuit or open-circuit of sensor;

Unstable sensor signal;

Sensor signal is out of range.

5) Troubleshooting

Use Sunray special diagnosis instrument to check the trouble code and determine the malfunction position. Mainly check the circuit of sensor and determine whether there is short-circuit or open-circuit between circuit and the grounding wire, whether there is short-circuit or open-circuit to power supply, and whether the circuit is consistent with the given pin definition.

11.Dual brake switch

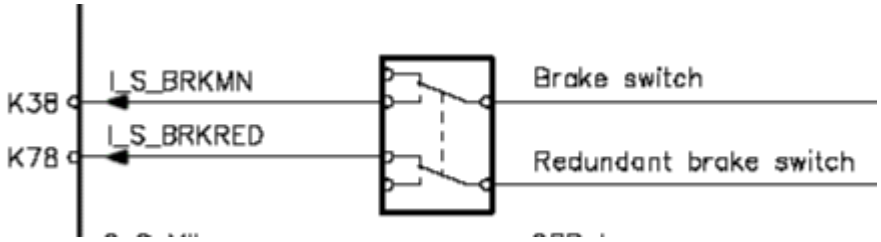
1) Overview

The dual brake switch is located on the upper portion of the brake pedal and internally incorporates two independent switches.

2) Working Principle

The brake switch monitors the action of the brake pedal and transmits the signal measured to the engine ECU. The brake switch is equipped with two switching mechanisms, which are the main and secondary units of the brake switch. When the signals from both units are inputted, the engine ECU will judge as normal braking signal. These switching signals are related to the accelerator pedal and are used to control the fuel amount during the braking. This means that the operation of accelerator pedal will not lead to malfunction when the brake pedal is stepped down, but the operation of accelerator pedal will reduce the fuel amount when the brake pedal is stepped down.

3) Measurement analysis



12. A/C switch

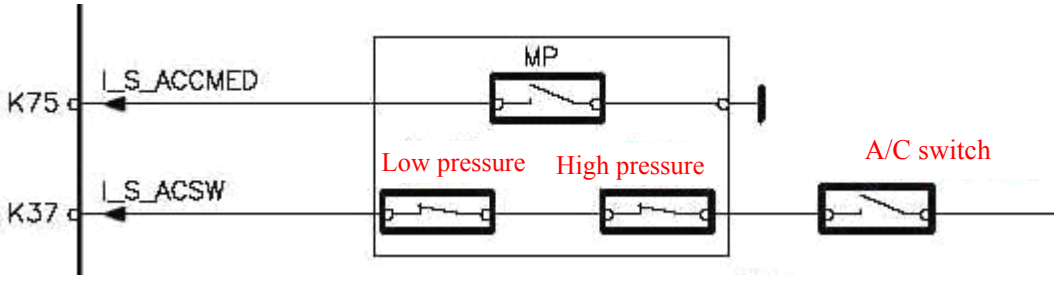
1) Overview

The A/C switch is located on the A/C control panel and is mainly functioned to transmit actuation directive of A/C compressor to the engine control unit.

2). Working Principle

A/C request is the input signal that the driver requests the working of A/C and controls the working of A/C relay as well as the speed promotion of the engine.

3) Measurement analysis



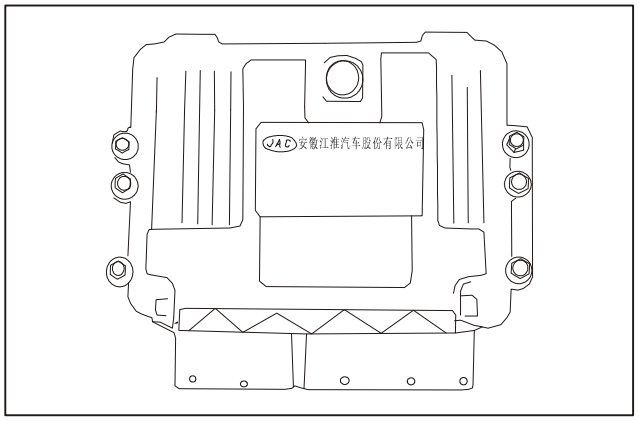
4) Malfunction Mode:

- Short-circuit or open-circuit of signal circuit;
- Unstable signal;
- The signal is out of range.

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5) Troubleshooting

Use Sunray special diagnosis instrument to check the trouble code and determine the malfunction position. Mainly check the circuit of sensor and determine whether there is short-circuit or open-circuit between circuit and the grounding wire, whether there is short-circuit or open-circuit to power supply, and whether the circuit is consistent with the given pin definition.



II. Engine control unit (ECU)

1) Overview

The engine control unit is located on the firewall on the back of the bottom of the glove box.

2) Working Principle

The ECU has one metal housing and the sensors, actuators, and power supply are connected to the ECU via multi-pole plug. The power supply parts for direct control of actuators are integrated in the ECU so that their heat can be effectively expanded to the ECU housing.

Requirements for ECU are as below:

- Surrounding (ambient) temperature: -40ºC~+85ºC

- Resistance to fuel, lubricating oil, etc.

- Resistance to moisture.

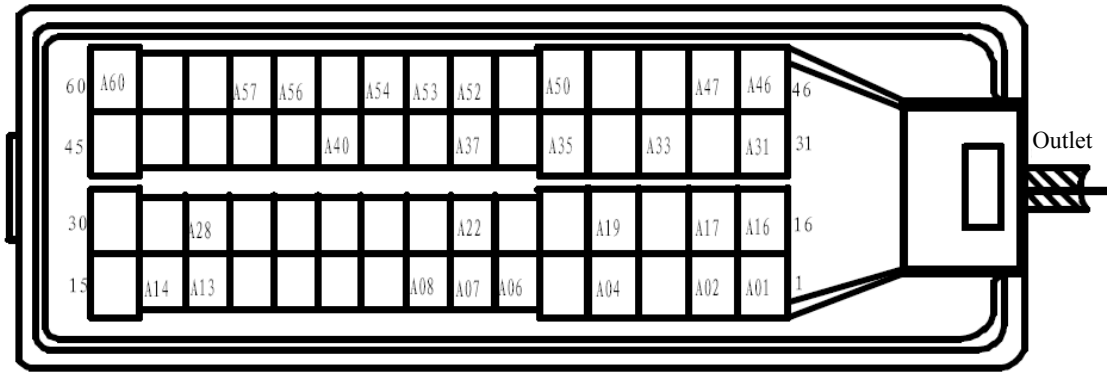
- The mechanical load has high requirements of the exposure to electromagnetic compatible (EMC) signal.

The ECU is used to calculate the signal received from the external sensors and control at the allowable voltage level. Based on these input data and stored characteristic graph, the microprocessor can calculate out the duration and accurate moment for fuel injection and convert into time-signal curve. The specific accuracy requirement and high dynamic response of engine require high level calculation capability.
The driver stage is actuated by means of the output signal and supplies proper power to the actuators to control the common rail pressure and the high pressure pump units. In addition, the actuators can control the engine functions (such as relays for exhaust gas recirculation actuator, turbocharger pressure actuator, and electronically controlled fuel pump) and other auxiliary functions (such as fan relay, auxiliary heater relay, and electric heating plug relay, and air conditioner). The driver stage has the short-circuit protection and the protection against damage due to current overload. These types of malfunctions and the open-circuit will be reported to the microprocessor. The diagnosis function of the fuel injector driver stage can identify the error signal curve occurred. In addition, one series of output signal can be transmitted to other vehicle systems via different interfaces. Within the specific safety concept framework, the ECU can monitor the entire injection system.
The actuation of fuel injector advances special requirements over the driver stage. Within the fuel injector, the current from the driver stage generates one magnetic field force in the magnetic coil that applies onto the hydraulic high pressure system. To ensure the accurate tolerance and high repeatability of the fuel injection amount, this coil must be actuated in front of a steep current wave. This requires ECU to form high voltage.

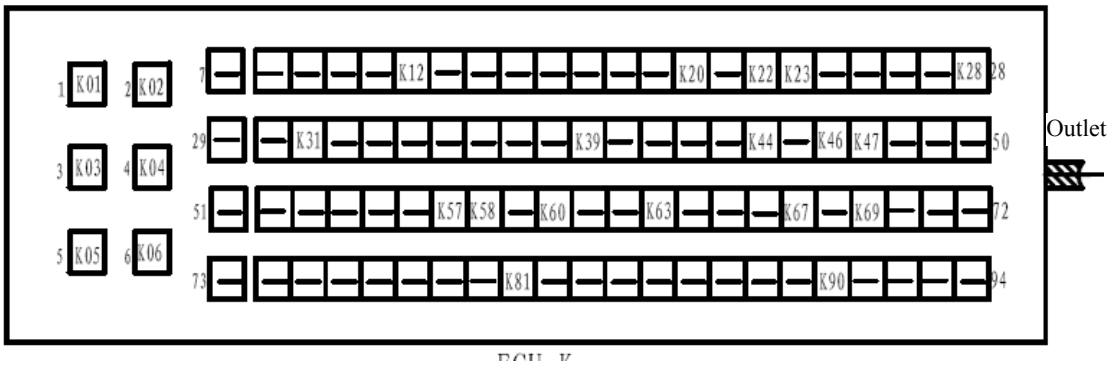
The actuation time (fuel injection duration) can be classified by the current control circuit into start current stage and holding stage. It must work accurately to ensure that the fuel injectors can guarantee the repeatability of fuel injection under all working conditions. In addition, it must reduce the energy loss in the ECU and the fuel injectors.

Maintenance manual for sunray hfc4da1-2c china-IV diesel engines

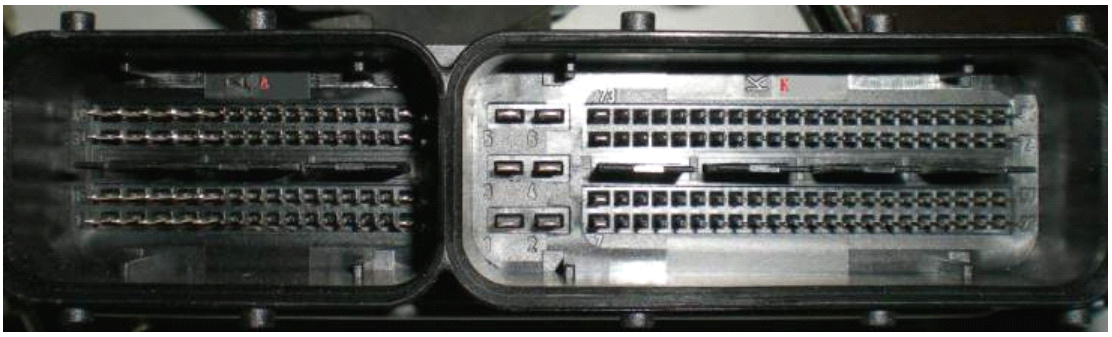
3) Measurement analysis



Interface A



Interface K



Definition for ECU pins of EDC17 control system:

Terminal No.	Description	Terminal No.	Description
Interface A			
A01	High fuel injector of 3rd cylinder	A31	Low fuel injector of 2nd cylinder
A02	High fuel injector of 2nd cylinder	A32	
A03		A33	Low fuel injector of 4th cylinder
A04	Power supply of EGR actuator	A34	
A05		A35	Earthing of camshaft position sensor
A06	5V power supply of rail pressure sensor	A36	
A07	5V power supply of absolute pressure sensor	A37	High coolant temperature signal

Terminal No.	Description	Terminal No.	Description
A08	5V power supply of camshaft position sensor	A38	
A09		A39	
A10		A40	Earthing of rail pressure sensor
A11		A41	
A12		A42	
A13	Signal of crankshaft position sensor	A43	
A14	Earthing of crankshaft position sensor	A44	
A15		A45	
A16	High fuel injector of 1st cylinder	A46	Low fuel injector of 3rd cylinder
A17	High fuel injector of 4th cylinder	A47	Low fuel injector of 1st cylinder
A18		A48	
A19	Earthing of EGR actuator	A49	
A20		A50	Low coolant temperature signal
A21		A51	
A22	Air conditioner relay control	A52	Rail pressure sensor signal
A23		A53	Temperature signal of absolute pressure sensor
A24		A54	Pressure signal of absolute pressure sensor
A25		A55	
A26		A56	Shielding wire of crankshaft position sensor
A27		A57	Signal of camshaft position sensor
A28	Earthing of absolute pressure sensor	A58	
A29		A59	
A30		A60	Control of fuel metering unit
Interface K			
K01	Positive pole of battery	K48	Vehicle speed sensor output
K02	Negative pole of battery	K49	
K03	Positive pole of battery	K50	
K04	Negative pole of battery	K51	Cruise control lamp
K05	Positive pole of battery	K52	Cruise control mode
K06	Negative pole of battery	K53	Cruise control mode
K07		K54	Anti-theft cable
K08		K55	Clutch switch control
K09		K56	
K10		K57	Preheating feedback signal
K11		K58	Grounding of accelerator pedal sensor 2
K12	Intake temperature signal of air flowmeter	K59	Pressure difference sensor signal

Terminal No.	Description	Terminal No.	Description
K13		K60	Accelerator pedal sensor signal 2
K14		K61	
K15		K62	
K16		K63	Earthing signal of air flowmeter
K17		K64	
K18		K65	
K19	Vehicle speed signal input	K66	CAN communication
K20	Intake flow signal of air flowmeter	K67	Grounding of accelerator pedal sensor 1
K21	Exhaust brake switch control	K68	
K22	Power supply 2 of accelerator pedal sensor	K69	Control signal of turbocharger actuator
K23	5V power supply of EGR	K70	Malfunction indicator lamp
K24		K71	OBD indicator lamp
K25		K72	
K26		K73	
K27	5V power supply of pressure difference sensor	K74	Cruise control mode
K28	Power supply 1 of accelerator pedal sensor	K75	
K29	Exhaust brake relay control	K76	
K30	Anti-theft cable	K77	Water level signal
K31	Position signal of EGR	K78	Auxiliary brake switch
K32		K79	
K33		K80	Earthing of pressure difference sensor
K34		K81	Accelerator pedal sensor signal 1
K35		K82	
K36		K83	
K37	Air conditioner switch signal	K84	
K38	Main brake switch	K85	
K39	Earthing of EGR position sensor	K86	
K40	Cruise control mode	K87	CAN communication
K41		K88	
K42		K89	
K43	Engine speed signal output	K90	Preheating control signal
K44	Line K diagnosis	K91	Preheating indicator lamp
K45		K92	
K46	Ignition switch power switch control	K93	
K47	Main relay control	K94	

4) Malfunction Mode

Unstable idling, poor acceleration, start failure, high idling, out-of-tolerance of emission, difficult start, failure of air conditioner, control failure of fuel injector, engine flameout, etc.

Failure arising from the burnout of ECU internal parts due to electric overload of external devices; rusting of circuit

board due to water ingress of ECU.

5) Troubleshooting

Connect the plug and use engine data diagnosis cable to read the engine malfunction records; disconnect the plug and check whether the ECU connecting wire is intact. Mainly check whether ECU power supply and grounding circuit are normal, whether the external sensors are working normally, whether the output signal are reliable, and whether the circuit is intact.

Check whether the actuators are working normally and whether their circuits are intact. Finally replace the ECU for test.

III. Actuators

1. Fuel injector

1) Overview

The fuel injectors are located on the engine cylinder head and are mainly functioned to provide accurate fuel injection for the engine at the correct moment.

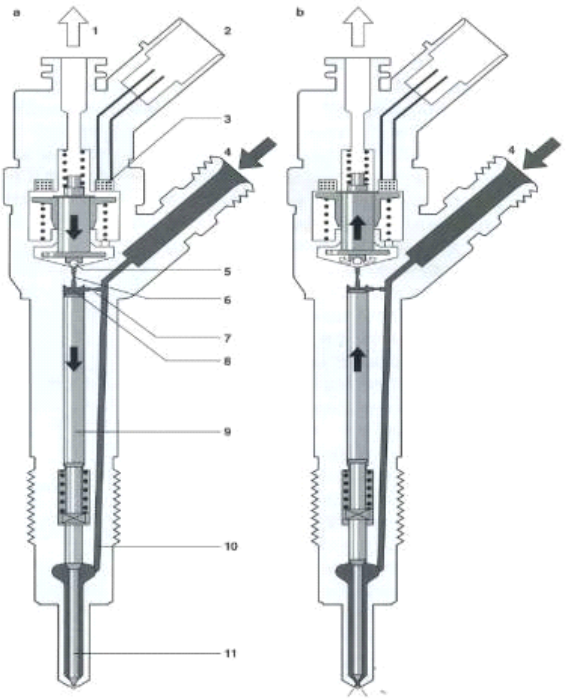
2) Working Principle

To realize effective fuel injection start point and accurate injection amount, the common rail system adopts the special fuel injector with hydraulic servo system and electronic control unit (solenoid valve). At the start of fuel injection process, the fuel injector needs to adopt a relatively high current to rapidly open the solenoid valve. Till the needle valve of the fuel injector nozzle reaches the maximum travel and the fuel injector nozzle is fully opened, the control current is reduced to a relatively low constant current. In such case, the fuel injection amount depends on the open moment and the pressure in the common rail. When the solenoid valve is no longer working and is closed, the fuel supply process is completed.

Fuel injector

a. Close of fuel injector (Still state) b. Open of fuel injector (Fuel injection)

1. Fuel return pipe 2. Electric connector 3. Control unit (electromagnetic field) 4. Rail fuel inlet (high pressure) 5. Ball valve 6. Fuel drainage hole 7. Fuel inlet hole 8. Valve control chamber 9. Valve control plunger 10. Fuel inlet groove to injector nozzle 11. Injector nozzle needle valve



The fuel injection start moment and the fuel injection amount are regulated by the electronically controlled fuel injector. These fuel injectors substitute the fuel injector assembly (injector nozzle and fuel injector body). Similar to the fuel injector assembly of modern direct injection diesel engine, the holders are used to install the fuel injector on the cylinder head. In other words, it's unnecessary to make any large modification to the cylinder head to install the common rail fuel injectors onto the modern direct injection diesel engine.

Design structure

The fuel injector (figure) can be divided into several functional blocks:

- Injector nozzle

- Hydraulic servo system

- Solenoid valve

As shown in the figure, the fuel enters into nozzle through high pressure connecting pipe (4) and fuel inlet groove (10) and enters into the valve control chamber (8) through fuel inlet (7). The control chamber is connected with fuel return pipe (1) via fuel drainage hole (6) and the fuel drainage hole

is opened by solenoid valve. After the fuel drainage hole is closed, the hydraulic force applied onto the valve controlled plunger (9) exceeds the pressure on the pressure shoulder of injector nozzle needle valve (11). Therefore, the needle valve is pushed into the needle valve seat to block the high pressure passage to the combustion chamber.
When the solenoid valve of the fuel injector is actuated, the fuel drainage hole opens. In such case, the pressure in the control chamber drops and thus the force applied onto the plunger reduces. Once the hydraulic pressure is less than the force applied onto the pressure shoulder of the needle valve, the injector nozzle needle valve opens and the fuel injects into the combustion chamber via the injection hole. The cause to indirectly control the injector nozzle needle valve by hydraulic gain system is that the solenoid valve can't directly generate the force required to rapidly open the needle valve. The control amount required to open the injector nozzle needle valve is not included from the actual fuel injection amount and is conveyed to the fuel return pipe through the fuel drainage hole of the control chamber. Besides the control amount, the loss control fuel and the leak fuel at the injector nozzle needle valve and the valve plunger chamber are conveyed to the fuel tank via the fuel return pipe and the fuel collection pipe connecting the relief valve.
Depending on the working condition of the engine and the pressure generated by the high pressure fuel pump, the fuel injector can be classified to 4 working conditions:

- Close of fuel injector (due to application of high pressure)

- Open of fuel injector (start of fuel injection)

- Full open of fuel injector

- Close of fuel injector (complete of fuel injection)

These working conditions are generated by means of the pressure distribution applied onto the fuel injector parts. When the engine is stopped and there is no pressure in the common rail, the injector nozzle spring will close the fuel injector.

Close of fuel injector (still state):

The solenoid valve is not actuated under still state and thus the fuel injector is closed (a). When the fuel drainage hole is closed, the valve spring will press the ball vale of armature onto the fuel return orifice. The high pressure of common rail is formed in the valve control chamber. Afterwards, a similar pressure is formed within the injector nozzle chamber. The pressure applied onto the end face of control plunger by the rail pressure and the injector nozzle spring force work together against the open force applied onto the conical pressure bearing face of needle valve by fuel to maintain the needle valve at close state.

Open of fuel injector (start of fuel injection):

While the injector nozzle is at still state, the solenoid valve is actuated by the start current to ensure rapid open (b). The force generated by the actuated solenoid valve overcomes the spring force so that the armature opens the fuel drainage hole. Almost at the same time, the high start current drops to the low holding current required by the electric magnet. This is possible as the air cap of the magnetic circuit becomes really small. When the ball valve of the fuel drainage hole opens, the fuel flows from the valve control chamber to the empty chamber above and then returns to the fuel tank via the fuel return pipe. The fuel drainage hole makes the pressure not completely balanced so that the pressure in the valve control chamber drops. Therefore, the pressure in the valve control chamber is less than the pressure of the fuel rail, which is still maintained in the fuel injector chamber, and the pressure drop in the valve control chamber reduces the force applied onto the control plunger so that the injector nozzle needle valve opens and the fuel injection starts.

The open speed of the injector nozzle needle valve depends on the flow difference between the fuel drainage hole and the fuel inlet hole. The control plunger reaches its top dead center and then is held by one film of fuel, which is formed by the fuel flow between the fuel drainage hole and the fuel inlet hole. In such case, the injector nozzle completely opens and the fuel is injected into the combustion chamber at a pressure almost equaling to the fuel pressure in the common rail. The pressure distribution in the injector nozzle is similar to that at the open stage.

Close of fuel injector (complete of fuel injection):

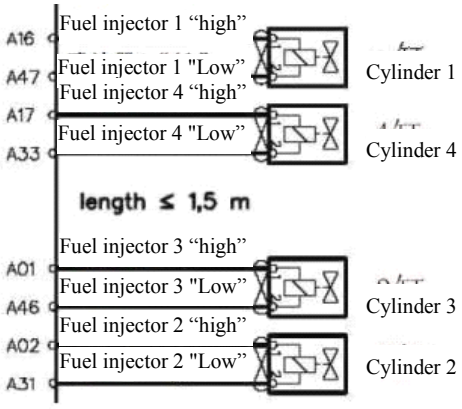
When the solenoid valve is no longer actuated, the valve spring pushes down the armature so that the ball of the valve

closes the fuel drainage hole. The armature is of two-part design. Though the armature block is guided by the pressure shoulder during the downward movement, it can bounce back following the return spring and thus will not apply downward force onto the armature and the ball valve.

The close of fuel drainage hole enables the entry of fuel via fuel inlet hole into the control chamber for pressure establishment. This pressure is equivalent to the rail pressure and applies additional force onto the end face of the control plunger. The resultant force from this force and spring force overcomes the pressure in the injector nozzle chamber to close the injector nozzle needle valve.

The close speed of the injector nozzle needle valve depends on the flow passing through the fuel inlet hole. Once the injector nozzle needle valve hits its lower seat again, the fuel injection stops.

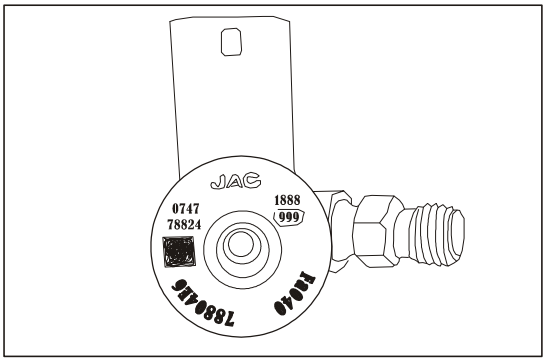
3) Measurement analysis



4) Matching of fuel injector

The matching of fuel injector must be performed in event of any of the following conditions:

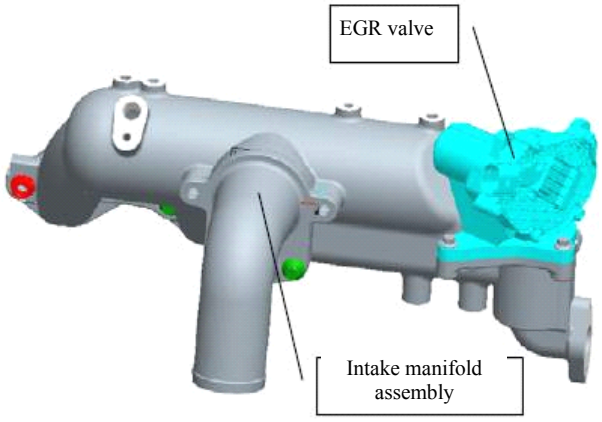
- Replacement of fuel injector.
- Replacement of ECU
- Confusion of installation serial number before and after the maintenance.



While performing the matching, input the matching code on the fuel injector (as shown in the figure) in order into the diagnosis instrument for matching.

2. EGR valve control system

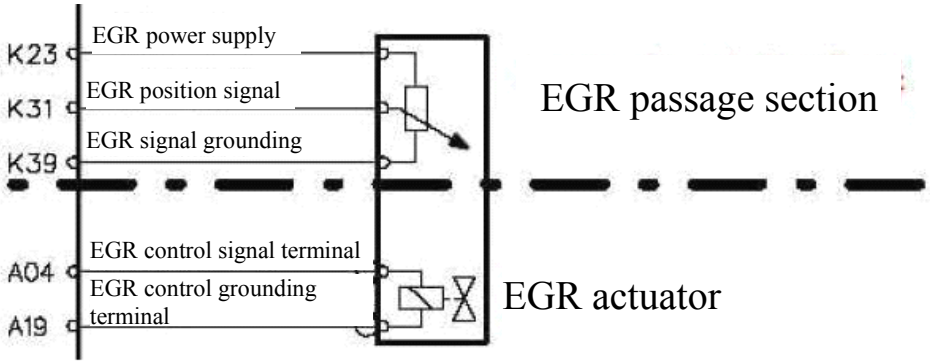
1) Overview



- The electronically controlled EGR valve controls the open extent of the valve by means of the positive and reverse rotation of the DC motor and performs the close-loop control as per the feedback signal of the position sensor.
- To guarantee the NOx emission of the engine, the ECU measures and calculates the EGR percentage as per the input parameters of the engine (such as speed and intake pressure) and the calibrated MAPs), issues control signal to the EGR valve, and performs the close-loop control via the position sensor.
- The EGR valve is installed on the intake manifold. The constant temperature of the EGR valve inlet emission

can't exceed 260ºC, with the peak temperature no more than 300ºC.

2) Measurement analysis

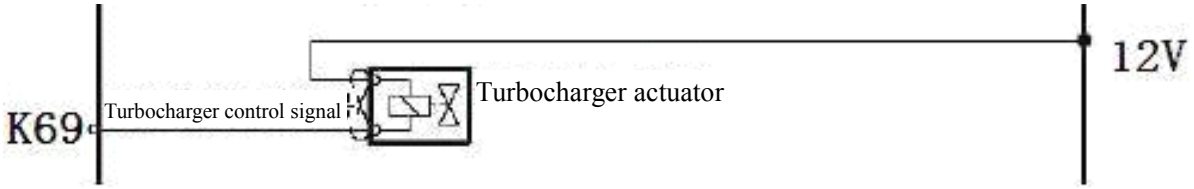


3. Variable nozzle turbocharger (VNT) control

1) Overview

- HFC4DA1-2C adopts variable section turbocharger technology so that the turbocharger and the engine are well matched under all working conditions to realize best engine performance.
- The blades of the VNT are connected to the control tie rod and the displacement of the control tie rod is controlled by the vacuum pressure of the vacuum chamber on the VNT. Changing the vacuum pressure of the vacuum chamber can change the position of VNT blades and control the flow area of the turbine. The vacuum pressure of the vacuum chamber is controlled by VNT solenoid valve, of which one port is connected to the vacuum chamber on the VNT, one port is connected to the vacuum pump, and another port is connected to the air. This connector in the engine is additionally fitted with filter to prevent the ingress of contaminant (such as dust) into the valve. The open extent of the VNT solenoid valve is regulated by the PWM wave issued by ECU and the solenoid valve is installed on the crossbeam of the body water tank.

2) Measurement analysis



4. Fuel metering unit

1) Overview

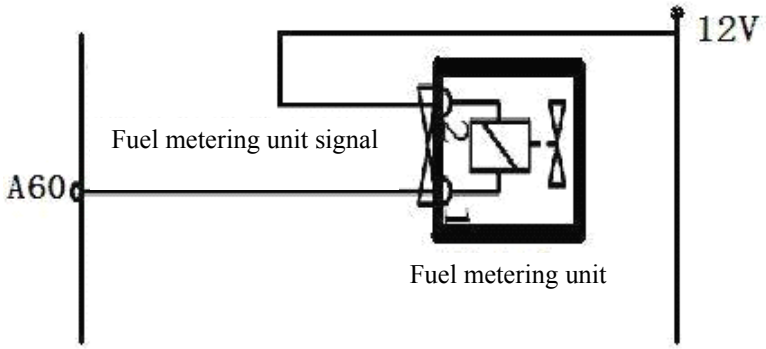
The fuel metering unit is located on the high pressure fuel pump and is functioned to control the fuel amount from the low pressure pump to the high pressure pump.

2) Working Principle

The fuel metering valve is installed at the high pressure fuel inlet of high pressure fuel pump and is functioned to regulate the fuel supply amount and fuel pressure, of which the regulation requirement is subject to the control of ECU. The control coil of the metering valve is closed when not electrified, which cuts off the fuel supply to the plunger of high pressure fuel pump. The ECU changes the fuel inlet section area of metering unit by means of pulse signal to increase or reduce the fuel supply amount.

3) Measurement analysis

Wiring terminals: 1 – Signal terminal; 2 – 12V voltage.



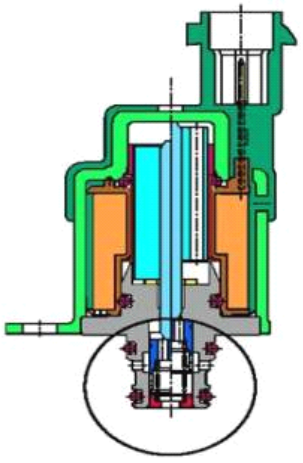
4) Malfunction Mode

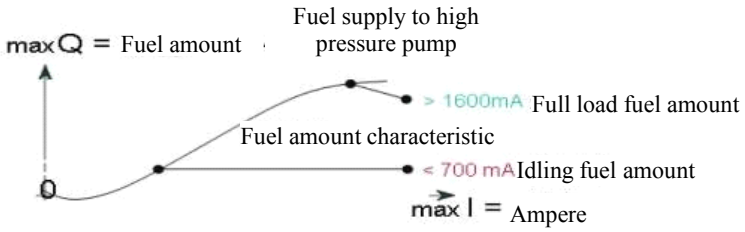
Short-circuit or open-circuit of metering valve; damage of metering valve; contamination of metering valve.

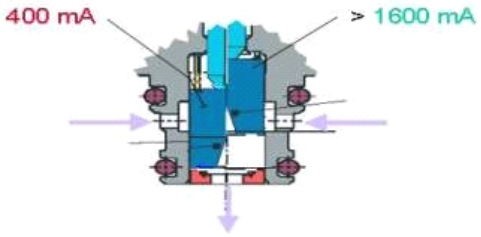
5) Troubleshooting

Use Sunray special diagnosis instrument to check the trouble code and determine the malfunction position. Mainly check the circuit of metering valve and determine whether there is short-circuit or open-circuit between circuit and the grounding wire, whether there is short-circuit or open-circuit to power supply, and whether the circuit is consistent with the given pin definition.

CP1H and CP4.x metering unit







5. Preheating control unit

1) Overview

The preheating control unit is located in the engine compartment and is mainly functioned for the rapid start of engine under cold state.

2) Working Principle

The preheating control unit is functioned to ensure effective cold start and shorten the warm-up time, which is closely related to the exhaust emission. The preheating time is a function of coolant temperature. At the start of the engine or during the actual running, the turn-on duration of the electric heating plug depends on one series of parameters, including the fuel injection amount and engine speed. The control of the electric heating plug is realized by one power relay (GCU).

The main part of the electric heating plug is the tubular heating unit. The heating unit is firmly and air-tightly installed within the electric heating plug housing to guard against corrosion and thermal gas impact. The heating unit is one

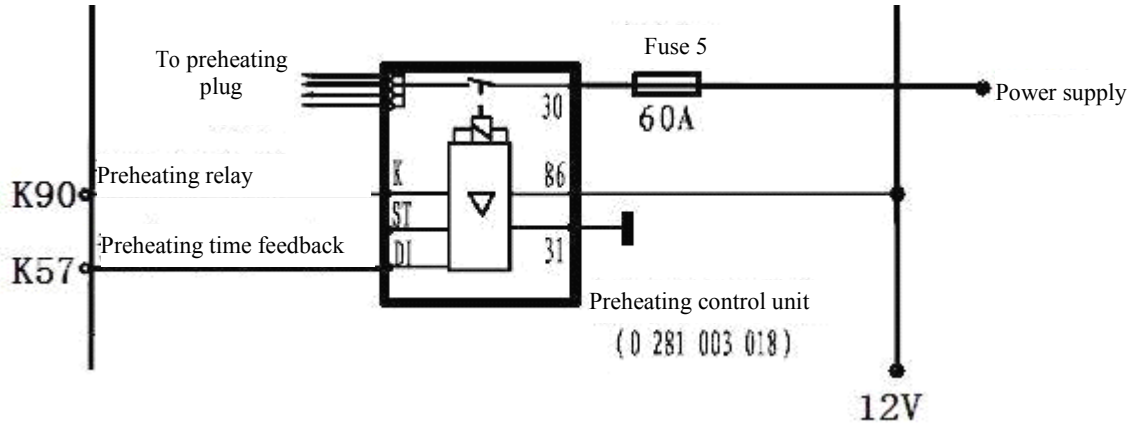
helical metal wire embedded within the magnesium oxide powder (Figure). This helical metal wire is composed of two resistors in series connection and one heating oil and one control coil are installed on the tip of the heating tube. The heating coil maintains one resistance almost irrelevant to the temperature and the control coil is made of positive temperature coefficient (PTC) material. In the new generation heating plug (GSK2), the rise amplitude in the resistance of control coil is larger than common electric heating plug. With capability of rapidly reaching the temperature required for ignition (up to 850ºC within 4s) and relatively low constant temperature, new electric heating plug GSK features outstanding performance. Therefore, the temperature of the electric heating plug is restrained at one critical value. Therefore, after the start of the engine, the GSKZ electric heating plug can continue to maintain electrified for 3min. This after-combustion performance improves the noise and exhaust emission of start and warm-up stages.

The control instrument of the electric heating plug adopts one power relay and the electric switch set to control the electric heating plug, which control the heating time of electric heating plug and feature the protection and monitoring functions. Thanks to its diagnosis function, higher grade of electric heating plug control instrument can identify the malfunction of single electric heating plug and display to the driver. The control input terminal of the electric heating plug control instrument is connected to the electronic control unit (ECU) via multi-pole plug. To prevent the voltage drop, the series connection circuit connected to the electric heating plug adopts the threaded pin or connector.

The controlled preheating process and the start process are controlled by the electric heating plug starter switch. The preheating process is started when the key is turned to “ON” position. When the heating control lamp goes out, the electric heating plug reaches sufficient temperature and the start process can be conducted. In the subsequent start process, the fuel drips injected will be atomized and get combusted in the compressed hot air so that the heat released starts the combustion process.

The after-heating after the successful start can help the warm-up process to form one speed promotion and idle run with no interruption and little smoke. This can reduce the combustion noise at the cold start. In event of non-successful start, the protection circuit of the electric heating plug is turned off to prevent the excessive discharge of the battery.

3) Measurement analysis



4) Malfunction Mode:

Short-circuit or open-circuit of preheating control unit;

Damage of preheating control unit;

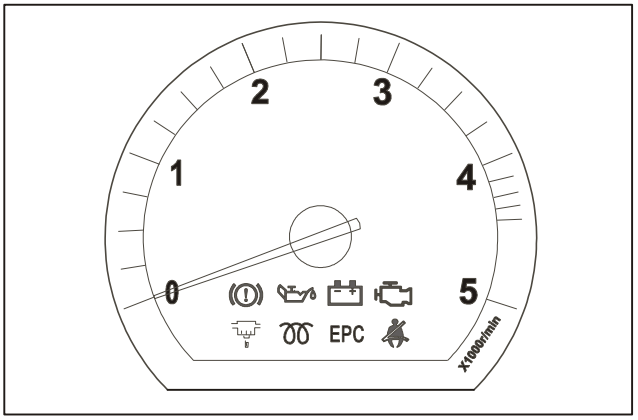
5) Troubleshooting:

Use special diagnosis instrument to check the trouble code and determine the malfunction position. Mainly check the circuit of preheating control unit and determine whether there is short-circuit or open-circuit between circuit and the grounding wire, whether there is short-circuit or open-circuit to power supply, and whether the circuit is consistent with the given pin definition.

6. Malfunction indicator lamp

1) Overview

The malfunction indicator lamp is located on the instrument. In event of malfunction of engine control system units, the engine malfunction indicator lamp will light up to remind the driver for checking and service by the service station as soon as possible.



2) Working Principle

The malfunction indicator lamp (MIL) is located on the instrument panel and is directly powered by the voltage of battery. The engine control unit (ECU) lights up the malfunction indicator lamp by grounding the control circuit of malfunction indicator lamp. When the ignition switch is turned on but the engine is not started, the malfunction indicator lamp (MIL) shall light up for 5s and then go out.

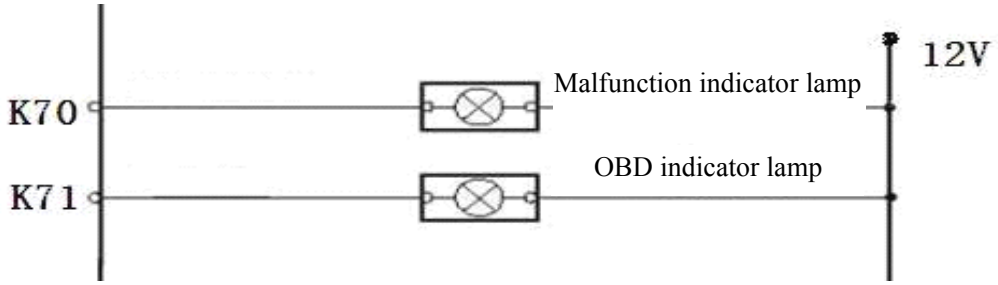
Functions of malfunction indicator lamp:

- The malfunction indicator lamp reminds the driver of the occurrence of malfunction. The vehicle shall be serviced as soon as possible.
- The malfunction indicator lamp lights up during the test of the malfunction indicator lamp.
- If the diagnosis procedure requests to light up the malfunction indicator lamp, one diagnosis trouble code will be stored.

Light-up of malfunction indicator lamp

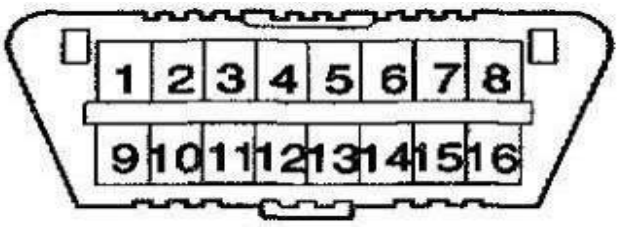
- When the ignition switch is turned on but the engine is not started, the malfunction indicator lamp will light up for 5s and then go out.
- The malfunction indicator lamp goes out after the engine is started.
- If any malfunction is detected by the self-diagnosis system, the malfunction indicator lamp will keep lighted up.
- If no malfunction is detected, the malfunction indicator lamp will go out.

3) Measurement analysis



4) Malfunction Mode

Short-circuit or open-circuit between engine control unit to instrument circuit.



5) Troubleshooting:

Use Sunray special diagnosis instrument to check the trouble code and determine the malfunction position. Mainly check the circuit from engine control unit to

instrument circuit and determine whether there is short-circuit or open-circuit between circuit and the grounding wire, whether there is short-circuit or open-circuit to power supply, and whether the circuit is consistent with the given pin definition.

7. Diagnosis interface

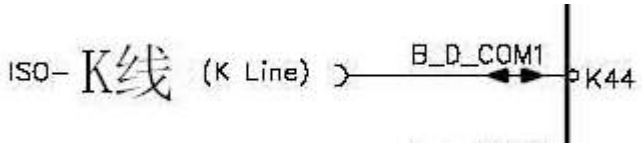
1) Overview

The diagnosis interface is located in the electric box beneath the driver's side instrument panel and is used to connect the special diagnosis instrument.

2) Working Principle

This is one data transmission interface for communication with ECU and is one standard OBD interface.

3) Measurement analysis



4) Malfunction Mode

Short-circuit or open-circuit between engine control unit and diagnosis interface.

Working failure of engine control unit.

5) Troubleshooting:

Use Sunray special diagnosis instrument to check the trouble code and determine the malfunction position. Mainly check the circuit from engine control unit to diagnosis interface circuit and determine whether there is short-circuit or open-circuit between circuit and the grounding wire, whether there is short-circuit or open-circuit to power supply, and whether the circuit is consistent with the given pin definition.

Chapter IV Engine Diagnosis

Section I. Precautions

1. Removal/Installation Requirements for Electronic Control Unit (ECU):

- Remove the controller before welding or baking finish;
- When removing the controller, turn off the ignition switch and disconnect the battery from the system at the same time, in order to avoid damaging the ECU.
- It is not allowed to remove power cord from the battery when the engine or the electrical system is working.
- Large-current equipment such as charger is not allowed to be directly connected to the starting motor.
- Note: The ambient temperature of ECU should not be greater than 75 degree.

2. Cleaning Requirements:

Please observe the following rules before the operation of fuel supply system and fuel injection system:

- The removed components should be placed at clean field and properly covered by the cloth other than fiber type (cotton cloth or gauze cloth)

3. All types of harness connectors and the connector for diagnostic instrument should be connected and disconnected only when the ignition switch is turned off:

- When measuring the power voltage or ground wire of the ECU, please ensure the wiring sequence and method is correct.
- Disconnecting the power cord or the ground wire of the battery from the system or removing ECU harness connector will result in the loss of diagnosis and self-learning information stored in ECU. (If the vehicle model is different, the time of retaining Pleas of the ECU is also different after the loss of power.)

4. Please pay attention to the following points when maintaining the fuel supply system (fuel supply pipe, fuel pump and fuel injection system):

- Please be very careful during installation/removal of fuel pump on the fuel tank with fuel.
- Prepare proper materials around the fuel tank opening to absorb a lot of fuel leaked from it timely..
- Avoid the fuel contacting your body.
- Thoroughly clean the part and its surrounding before loosening a connector.
- Please prevent any fuel from splashing from the loose part and place a rug around the connector.
- If the disassembled parts could not be timely repaired or properly treated, store the parts properly.
- Take the spare parts out of the package only when they are needed to be installed. Do not use unpacked spare parts and the spare parts in severe damaged package
- Do not damage the O-ring of return pipe when assembling fuel injector return pipe. Coat a little diesel oil on the O-ring for assembling convenience.
- Do not use the compressed air and do not move the vehicle after the fuel supply system is disassembled.

5. Safety Measures

To prevent the maintenance technicians from being injured and the fuel and ECU being damaged, please pay attention to the following points:

- If the engine is working or at the starting speed, it is not allowed to check for any single cylinder failure by the way of disconnecting the fuel injector harness.
- If the engine needs to be dragged but not started by the starter, such as when you check the engine cylinder pressure, the harness plug should be disconnected from the crankshaft position (engine speed) sensor and camshaft position (phase) sensor. After inspection, all sensors should be well connected and system DTCs should be cleared by using the special diagnostic instrument for JAC commercial vehicles.
- It is not allowed to touch the engine gear train and rotating parts when the engine is at high speed;
- When the engine reaches normal operating temperature, the coolant temperature and pressure of cooling system is very high; therefore, stop the engine and let the cooling system fully cool down if it is needed to repair the engine cooling system.
- If the engine compartment relevant maintenance is necessary to be conducted in repairing engine fuel system, please do it after the engine compartment is fully cooled down.
- Don’t touch the engine cooling fan at any time when the system is normally electrified, for the cooling fan is likely to be started suddenly.

Section II. Maintenance Procedures

Fuel system of common rail engine consists of low-pressure delivery pipes and high-pressure oil pipes and maximum pressure of it is over 1800bar. Some components of fuel injector and HP pump are machined with accuracy of 0.1mm. Pressure regulation and fuel injection are controlled by engine ECU. In the case of stuck internal needle valve, fuel injector will maintain open and HP pump keeps operating to supply high-pressure fuel oil. Therefore, excessive fuel will be sprayed into combustion chamber and this will lead to rapid increase of combustion chamber internal pressure (over 250bar) and even serious engine damage.

Core component of fuel system possesses very high accuracy and will be easily influenced by dust or tiny foreign matters. Therefore, the following preparations and procedures should be carried out or there will be a lot of system failures.

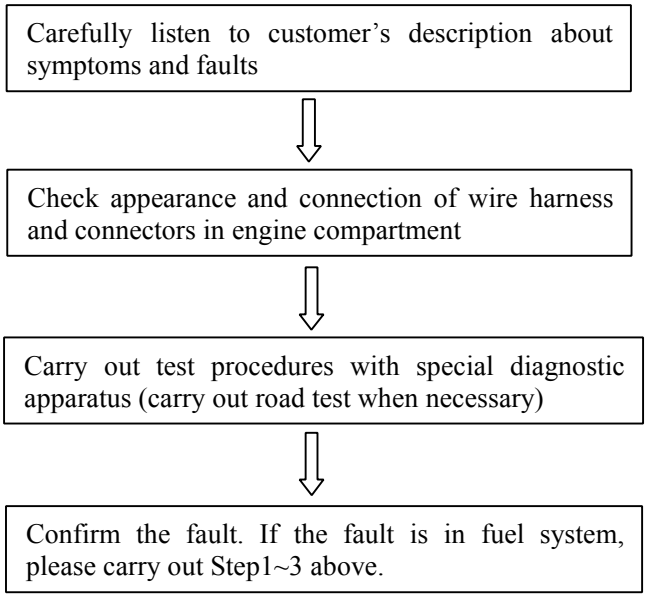
Operation Procedures:

1. It is necessary to keep maintenance site clean (it should be free of dust especially);

2. It is necessary to keep maintenance tools clean (they should be free of oil and foreign matters);

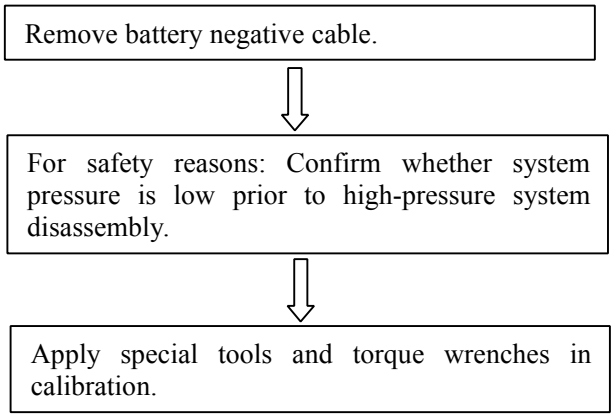
3. Wear ethylene pinafore to prevent hairs, dust and foreign matters from entering engine fuel system. Wash your hands instead of wear gloves;

4. Prior to fuel system maintenance, carry out the following procedures:



5. If the fault is in HP pump, fuel delivery line or fuel injector, prepare clean special tools and sealing covers and carry out relevant procedures for engine fuel system. Prior to maintenance, clean relevant areas to engine compartment completely;

6. Find out faulted parts according to the above operation procedures and replace these parts with parts from OEM;



In disassembly or replacement of fuel injector, it is necessary to apply new copper washers and tighten fixing bolts for fuel injector according to fixed torque at the same time. Otherwise, injection position of fuel injector will deviate from correct position and this will make engine operation out of control.

7. Apply clean and intact sealing covers on disassembled components and keep them well;

8. After fuel injector replacement, carry out fuel injector matching with special diagnostic apparatus;

9. Keep pressing manual oil delivery pump on oil-water separator to provide low-pressure line with fuel oil until the pump can not be pressed any longer.

Attention: Do not start the engine before the pump is filled up.

10. Recheck installed components, connect battery cable and start the engine for engine operation condition inspection;

11. Apply special diagnostic apparatus to check current faults for existence and eliminate historical faults.

Section III. Fault Diagnosis

1. Fault Information Record

Electronic control unit continually monitors sensors, actuators, relevant circuits, MILs, battery voltage and even its self and carries out reliability tests to sensor output signals, actuator drive signals and internal signals. Once there are faults in certain link or certain signal is unreliable, electronic control unit sets fault information record in RAM fault memory immediately. Fault information record is stored in the form of diagnostic trouble code (DTC) and shown in the sequence of fault occurrence.

Faults can be divided into “steady fault” and “random fault” (such as faults caused by temporary open circuit of harness or poor contact of connectors) according to fault occurrence frequency.

2. Fault Condition

If duration of an identified fault exceeds set stabilization time for the first time, ECU identifies it as a steady fault and stores it as a “steady fault”. If the fault disappears, ECU identifies it as a “random fault” and “nonexistent”. If the fault is identified once again, it is still a “random fault”. However, “existent” historical faults will not influence normal application of engine.

3. Fault Type

Short to power supply positive pole

Short or open to ground (In the case of pull-up or pull-down resistor for input stage, ECU will identify open circuit failure of input port as the fault of input port short to power supply positive pole or short to ground)

Unreliable signal

4. Fault Frequency Counter

For every identified fault, there is an individual frequency counter value (HZ). Frequency counter value (Hz) determines storage time of corresponding fault information record in the memory after fault disappearance (fault elimination).

For the first time fault identification, it (Hz) is set to be its initial value as 40. If fault condition does not change, this value will maintain the same forever.

Once identified fault has disappeared and then the condition has been maintained for certain period of time, the value (Hz) is reduced by 1 after every successful engine start (engine speed exceeds that of engine start completion). At this moment, ECU recognizes the fault has disappeared but fault information record still exists.

If the fault (such as fault caused by poor contact) appears and disappears frequently, the value (Hz) is increased by 1 but the value will not exceed set upper limit of 100.

When the value (Hz) becomes zero, all fault information records in the fault memory are cleared completely.

5. Fault Alarm

In the case of electronic control system, when there are faults in some important components such as ECU, coolant temperature sensor, phase sensor, boost pressure sensor, revolution speed sensor, air flow meter, fuel injector, fan relay and etc, ECU will give alarms via MIL flashing until faults are eliminated.

6. Fault Reading

Fault information records can be brought out from electronic control unit via fault diagnostic apparatus. However, some faults can be detected only when vehicle reaches corresponding operation condition.

7. Elimination of Fault Information Record

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Fault information records in memory should be cleared after fault elimination. DTC can be cleared with ways as follows:

When value of ECU frequency counter (Hz) becomes 0, fault information records in fault memory are all cleared automatically.

In the case of “Fault memory zero clearing” command, fault information records can be cleared with the application of fault diagnostic apparatus.

8. Fault Detection

After obtaining fault information records with means above, only suspicious positions for fault occurrence are known. However, this does not mean faults have been detected. Therefore, cause for one fault may be damaged electrical component (like sensor or actuator or ECU, etc), wire in open circuit, wire short to ground or battery positive pole and even mechanical failure.

Faults are internal with their external expressions as various symptoms. When symptoms are detected, check fault information record for existence with fault diagnostic apparatus or flash code first of all and then eliminate corresponding faults. Finally, detect faults according to engine symptoms.

Section IV. DTC List

S/N	DTC	Meaning
1	P0030	The linear oxygen sensor heater circuit is open.
2	P0031	The linear oxygen sensor heater circuit is short to ground.
3	P0032	The linear oxygen sensor heater circuit is short to battery.
4	P0045	EGR valve circuit is open.
5	P0046	Overtemperature of EGR valve bridge-H chip
6	P0047	EGR valve circuit is short to ground.
7	P0048	EGR valve circuit is short to power supply.
8	P0068	Short-term drifting error in the process of throttle offset self-adaption
9	P0069	The absolute difference between intercooler downstream air pressure and ambient pressure is unreliable.
10	P0070	Reliability check function for ambient temperature
11	P0072	Too low ambient temperature
12	P0073	Too high ambient temperature
13	P0087	The minimum rail pressure is below the lower limit.
14	P0088	The maximum rail pressure is above the upper limit.
15	P0097	The signal level of intercooler downstream temperature is too low.
16	P0098	The signal level of intercooler downstream temperature is too high.
17	P00BE	The original value of fuel rail pressure is incoherent.
18	P0100	The supply voltage of air flow sensor exceeds the limit.
19	P0101	Timeout error of air flow sensor hardware signal
20	P0102	The sensitivity deviation of air flow sensor is below the lower limit.
21	P0103	The sensitivity deviation of air flow sensor is above the upper limit.
22	P010C	The signal level measured by air flow sensor is too low.
23	P010D	The signal level measured by air flow sensor is too high.
24	P0112	The voltage is below the lower limit of intake air temperature sensor.
25	P0113	The voltage is above the upper limit of intake air temperature sensor.
26	P0116	Error reported in dynamic reliability test of coolant temperature sensor
27	P0117	Coolant temperature signal level is too low (downstream).
28	P0118	Coolant temperature signal level is too high (downstream).
29	P0119	Error reported in static reliability test of coolant temperature sensor
30	P0122	The signal level of accelerator pedal position sensor 1 is relatively low.
31	P0123	The signal level of accelerator pedal position sensor 1 is relatively high.
32	P0127	The signal level of air temperature sensor is relatively high.
33	P0128	Closed-loop control is actuated due to too low coolant temperature.
34	P0131	Oxygen sensor IAIPUNVG point is short to ground.

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S/N	DTC	Meaning
35	P0132	Oxygen sensor IAIPUNVG point is short to battery.
36	P0168	The signal level of fuel temperature sensor is relatively high.
37	P0182	The signal level of fuel temperature sensor is below the lower limit.
38	P0183	The signal level of fuel temperature sensor is above the upper limit.
39	P0191	The uncorrected rail pressure value is above the upper limit of drift.
40	P0192	The voltage of fuel rail pressure sensor is below the lower limit.
41	P0193	The voltage of fuel rail pressure sensor is above the upper limit.
42	P0194	The uncorrected rail pressure value is below the lower limit of drift.
43	P0195	Engine oil temperature signal fault on CAN
44	P0196	The oil temperature signal is unreliable.
45	P0197	The oil temperature signal level is too low.
46	P0198	The oil temperature signal level is too high.
47	P0201	The 1st cylinder fuel injector circuit is open.
48	P0202	The 2nd cylinder fuel injector circuit is open.
49	P0203	The 3rd cylinder fuel injector circuit is open.
50	P0204	The 4th cylinder fuel injector circuit is open.
51	P0205	The 5th cylinder fuel injector circuit is open.
52	P0206	The 6th cylinder fuel injector circuit is open.
53	P020A	An error is reported when the time for electrifying the 1st cylinder reaches to the maximum.
54	P020B	An error is reported when the time for electrifying the 2nd cylinder reaches to the maximum.
55	P020C	An error is reported when the time for electrifying the 3rd cylinder reaches to the maximum.
56	P020D	An error is reported when the time for electrifying the 4th cylinder reaches to the maximum.
57	P020E	An error is reported when the time for electrifying the 5th cylinder reaches to the maximum.
58	P020F	An error is reported when the time for electrifying the 6th cylinder reaches to the maximum.
59	P0215	Avoid resonance of double mass flywheel when stopping.
60	P0219	Overspeed protection for engine parts
61	P0222	The signal level of accelerator pedal position sensor 2 is relatively low.
62	P0223	The signal level of accelerator pedal position sensor 2 is relatively high.
63	P022A	EGR valve circuit is open.
64	P022B	EGR valve circuit is short to ground.

S/N	DTC	Meaning
65	P022C	EGR valve circuit is short to power supply.
66	P022E	The signal level at the output position of EGR cooling bypass valve position sensor is below the lower limit.
67	P022F	The signal level at the output position of EGR cooling bypass valve position sensor is above the upper limit.
68	P0234	The actual air intake flow is greater than the target set by system.
69	P0237	The original voltage of intercooler downstream air pressure sensor is below the lower limit.
70	P0238	The original voltage of intercooler downstream air pressure sensor is above the upper limit.
71	P023D	The long-term jitter of EGR valve exceeds the limit.
72	P023E	The short-term jitter of EGR valve exceeds the limit.
73	P024A	An error is reported when the temperature of EGR cooler bypass valve in electrifying phase is too high.
74	P024E	The signal level measured by EGR cooler bypass valve position sensor is below the limit.
75	P024F	The signal level measured by EGR cooler bypass valve position sensor is above the limit.
76	P0251	The fuel metering unit circuit is open.
77	P0252	The temperature of fuel metering unit driver module is too high.
78	P0253	The fuel metering unit circuit is short to ground.
79	P0254	The fuel metering unit circuit is short to power supply.
80	P0255	Poor contact between ECU and fuel metering unit
81	P025C	The voltage of fuel metering unit is below the lower limit.
82	P025D	The voltage of fuel metering unit is above the upper limit.
83	P0263	An error is reported when the electrifying time reaches to the maximum.
84	P0266	An error is reported when the electrifying time reaches to the maximum.
85	P0269	An error is reported when the electrifying time reaches to the maximum.
86	P0272	An error is reported when the electrifying time reaches to the maximum.
87	P0275	An error is reported when the electrifying time reaches to the maximum.
88	P0278	An error is reported when the electrifying time reaches to the maximum.
89	P0299.	The positive deviation of pressure controller is above the upper limit.
90	P0335	No signal from crankshaft
91	P0336	Crankshaft speed signal is irrational.
92	P0339	Camshaft speed signal is irrational.
93	P0340	No signal from camshaft
94	P0341	The offset angle of camshaft is too large.

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S/N	DTC	Meaning
95	P0380	The preheating indicator light output circuit is high.
96	P0382	The preheating indicator light output circuit is low.
97	P0383	EGR valve circuit is short to ground.
98	P0384	EGR valve circuit is short to power supply.
99	P0401	The actual air intake flow is greater than the target set by system.
100	P0402	The actual air intake flow is less than the target set by system.
101	P0403	Overtemperature of EGR valve bridge-H chip
102	P0404	The short-term jitter of EGR valve exceeds the limit.
103	P0405	The original voltage of EGR valve sensor signal is below the lower limit.
104	P0406	The original voltage of EGR valve sensor signal is above the upper limit.
105	P0409	EGR valve circuit is open.
106	P040C	The signal level of EGR cooler downstream temperature sensor is relatively low.
107	P040D	The signal level of EGR cooler downstream temperature sensor is relatively high.
108	P0426	Upstream temperature fault of oxidation catalytic converter
109	P0427	The signal level of upstream temperature of oxidation catalytic converter is relatively low.
110	P0428	The signal level of upstream temperature of oxidation catalytic converter is relatively high.
111	P0480	EGR valve circuit is open.
112	P0481	EGR valve circuit is open.
113	P0483	Overtemperature of EGR valve bridge-H chip
114	P0484	Overtemperature of EGR valve bridge-H chip
115	P0487	CJ945 Power level no-load fault
116	P0488	CJ945 Overheating fault
117	P0489	EGR valve circuit is short to ground.
118	P0490	EGR valve circuit is short to power supply.
119	P0500	Wheel fault
120	P0501	Unreliable vehicle speed
121	P0503	Signal of speed sensor exceeds the upper limit.
122	P0504	Unreliable brake signal
123	P0520	Engine oil pressure signal fault on CAN
124	P0521	The maximum oil pressure signal is unreliable.
125	P0522	The signal level of oil pressure sensor is relatively low.
126	P0523	The signal level of oil pressure sensor is relatively high.
127	P0524	The minimum oil pressure signal is unreliable.

S/N	DTC	Meaning
128	P0532	The signal level measured by A/C coolant pressure sensor is too low.
129	P0533	The signal level measured by A/C coolant pressure sensor is too high.
130	P0537	The signal level of A/C evaporator's temperature is relatively low.
131	P0538	The signal level of A/C evaporator's temperature is relatively high.
132	P0562	The signal level of battery voltage sensor is too low.
133	P0563	The signal level of battery voltage sensor is too high.
134	P0571	False brake signal
135	P0575	The analog cruise control signal is unreliable.
136	P0576	The analog cruise control signal level is too low.
137	P0577	The analog cruise control signal level is too high.
138	P0578	The analog cruise control button is stuck.
139	P0607	Cy320 Hardware error reported
140	P060A	Error reported in monitoring too high voltage
141	P060D	The accelerator pedal voltage signal is unreliable.
142	P0611	The injection frequency is limited by system.
143	P061B	Error reported in torque comparison
144	P061C	The deviation difference between the engine speed signals obtained from the 1st level and the 2nd level is too large.
145	P061D	The set value of air system is limited by the torque limit of the function control unit.
146	P061F	Error reported in the process of throttle offset self-adaption
147	P0627	The control line of priming fuel pump is open.
148	P0628	The control line of priming fuel pump is short to ground.
149	P0629	The control line of priming fuel pump is short to power supply.
150	P062A	Overheating of priming pump
151	P062B	The set value of fuel injection amount is limited by the torque limit of the function control unit.
152	P062F	Error reported in EEP read-write
153	P0643	The sensor power supply monitoring fault 1
154	P0645	The compressor circuit is open.
155	P0646	The compressor circuit is short to ground in electrifying phase.
156	P0647	The compressor circuit is short to power supply in electrifying phase.
157	P0650	EGR valve circuit is open.
158	P0653	The sensor power supply monitoring fault 2
159	P0660	The positive deviation of throttle controller exceeds the upper limit for a long time.
160	P0661	The Port 1 of EGR valve bridge-H chip is short to ground.

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S/N	DTC	Meaning
161	P0662	The Port 1 of EGR valve bridge-H chip is short to power supply.
162	P0663	Short circuit / overload of EGR valve bridge-H
163	P0664	The Port 2 of EGR valve bridge-H chip is short to ground.
164	P0665	The Port 2 of EGR valve bridge-H chip is short to power supply.
165	P0668	The voltage of ECU temperature sensor is below the lower limit.
166	P0669	The voltage of ECU temperature sensor is above the upper limit.
167	P0670	EGR valve circuit is open.
168	P0686	The main relay opens too early.
169	P0687	The main relay opens too late.
170	P0691	EGR valve circuit is short to power supply.
171	P0692	EGR valve circuit is short to ground.
172	P0693	EGR valve circuit is short to power supply.
173	P0694	EGR valve circuit is short to ground.
174	P0699	The sensor power supply monitoring fault 3
175	P0704	Clutch signal error
176	P0737	Then engine speed output signal circuit is open.
177	P0738	Then engine speed output signal circuit is short to ground.
178	P0739	Then engine speed output signal circuit is short to power supply.
179	P0A32	Parking counter error
180	P1000	The long-term jitter of EGR valve exceeds the limit.
181	P1001	The relief valve reaches to the maximum permissible opening position.
182	P1002	The relief valve reaches to the maximum permissible opening time.
183	P1003	The average fuel rail pressure regulated by relief valve is out of the range.
184	P1004	Check the flow equilibrium if the relief valve is opened normally.
185	P1005	The relief valve opens.
186	P1006	The relief valve is forced open to implement the pressure shock.
187	P1007	The torque in MAP for torque and fuel conversion does not increase along the fuel direction strictly and monotonically.
188	P1008	PhyMod_trq2qBas_MAP contains non-strict and non-monotonic Q curve.
189	P1011	The positive deviation of rail pressure is above the upper limit.
190	P1012	The negative deviation of rail pressure is below the lower limit.
191	P1013	The maximum negative deviation of rail pressure is below the lower limit.
192	P1020	The heating drive circuit of fuel filter is open.
193	P1021	The heating drive circuit of fuel filter is short to power supply.
194	P1022	The heating drive circuit of fuel filter is short to ground.

S/N	DTC	Meaning
195	P102A	The signal level of ambient pressure sensor is relatively high.
196	P102B	The signal level of ambient pressure sensor is relatively low.
197	P102C	The signal level of ambient temperature sensor is relatively high.
198	P102D	The signal level of ambient temperature sensor is relatively low.
199	P1030	Overtemperature of EGR valve bridge-H chip
200	P1031	Short circuit / overload of EGR valve bridge-H
201	P1032	Overcurrent of EGR valve bridge-H based on temperature
202	P1033	Under-voltage of EGR valve bridge-H
203	P1034	The EGR valve in closed status is stuck.
204	P1035	The EGR valve in open status is stuck.
205	P1036	The long-term jitter of EGR valve exceeds the limit.
206	P1037	An error is reported when the EGR valve is stuck in closing or opening.
207	P1038	The physical value of EGR valve position sensor is too high.
208	P1039	The physical value of EGR valve position sensor is too low.
209	P103A	The signal level of intercooler downstream temperature is relatively high.
210	P103B	The signal level of intercooler downstream temperature is relatively low.
211	P103C	EGR valve offset is unreliable.
212	P103D	The positive deviation of regeneration controller is above the limit.
213	P103E	The positive deviation of regeneration controller is below the limit.
214	P1040	Overheating of throttle bridge-H
215	P1041	Short circuit / overload of throttle bridge-H
216	P1042	Overtemperature caused by overcurrent of throttle bridge-H
217	P1043	Long-term deviation in the process of throttle self-adaption
218	P1044	Output circuit 2 of throttle bridge-H is short to ground.
219	P1045	Under-voltage of throttle bridge-H
220	P1046	Output circuit 2 of throttle bridge-H is short to power supply.
221	P1047	The physical value of throttle position is below the lower limit.
222	P1048	The throttle circuit is short to ground.
223	P1049	The physical value of throttle position is above the upper limit.
224	P104A	The throttle circuit is short to power supply.
225	P1060	OBD General fault 1
226	P1061	OBD General fault 10
227	P1062	OBD General fault 11
228	P1063	OBD General fault 12

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S/N	DTC	Meaning
229	P1064	OBD General fault 13
230	P1065	OBD General fault 14
231	P1066	OBD General fault 15
232	P1067	OBD General fault 16
233	P1068	OBD General fault 2
234	P1069	OBD General fault 3
235	P106A	OBD General fault 4
236	P106B	OBD General fault 5
237	P106C	OBD General fault 6
238	P106D	OBD General fault 7
239	P106E	OBD General fault 8
240	P106F	OBD General fault 9
241	P1070	Blockage of particulate filter
242	P1100	The regulated idling value of air flow sensor is above the upper limit.
243	P1102	The duty cycle of air temperature sensor on the air flow meter is above the upper limit.
244	P1103	The duty cycle of air temperature sensor on the air flow meter is below the lower limit.
245	P1106	The time interval measured by the air temperature sensor on the air flow meter is above the upper limit.
246	P1107	The time interval measured by the air temperature sensor on the air flow meter is below the lower limit.
247	P110A	System degradation 0
248	P110B	Level-1 degradation
249	P110C	Level-2 degradation
250	P110D	Level-3 degradation
251	P110E	Vehicle performance limit function is activated.
252	P1110	The detected signal within physical range is relatively high.
253	P1111	The engine coolant temperature signal level is relatively low.
254	P1120	The correction of air flow sensor load exceeds the maximum deviation limit.
255	P1121	The physical value of air flow meter is above the upper limit.
256	P1122	The physical value of air flow meter is below the lower limit.
257	P1123	The signal level of intake air temperature sensor (integrated inside the air flow sensor) is relatively low.
258	P1130	The signal level of fuel temperature sensor is relatively low.
259	P1131	The signal of fuel temperature is unreliable.

S/N	DTC	Meaning
260	P113A	The signal of too high oil temperature is unreliable.
261	P113B	The signal level of oil temperature sensor is relatively high.
262	P113C	The signal level of oil temperature sensor is relatively low.
263	P1200	Short circuit between the high end and low end of the 1st cylinder fuel injector
264	P1201	Short circuit between the high end and low end of the 2nd cylinder fuel injector
265	P1202	Short circuit between the high end and low end of the 3rd cylinder fuel injector
266	P1203	Short circuit between the high end and low end of the 4th cylinder fuel injector
267	P1204	Short circuit between the high end and low end of the 5th cylinder fuel injector
268	P1205	Short circuit between the high end and low end of the 6th cylinder fuel injector
269	P1207	1st cylinder special error
270	P1208	2nd cylinder special error
271	P1209	3rd cylinder special error
272	P120A	4th cylinder special error
273	P120B	5th cylinder special error
274	P120C	6th cylinder special error
275	P1210	An error is reported when the time for electrifying the 1st cylinder reaches to the minimum.
276	P1211	An error is reported when the time for electrifying the 2nd cylinder reaches to the minimum.
277	P1212	An error is reported when the time for electrifying the 3rd cylinder reaches to the minimum.
278	P1213	An error is reported when the time for electrifying the 4th cylinder reaches to the minimum.
279	P1214	An error is reported when the time for electrifying the 5th cylinder reaches to the minimum.
280	P1215	An error is reported when the time for electrifying the 6th cylinder reaches to the minimum.
281	P1216	Maximum deviation error in the inner control circuit of electronic throttle
282	P1217	Minimum deviation error in the inner control circuit of electronic throttle
283	P1218	Maximum deviation error in the outer control circuit of electronic throttle
284	P1219	Minimum deviation error in the outer control circuit of electronic throttle
285	P121A	1st cylinder IQA error
286	P121B	2nd cylinder IQA error
287	P121C	3rd cylinder IQA error
288	P121D	4th cylinder IQA error
289	P121E	5th cylinder IQA error

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S/N	DTC	Meaning
290	P121F	6th cylinder IQA error
291	P1220	The signal level of intercooler downstream temperature sensor is relatively high.
292	P1221	The signal level of intercooler downstream temperature sensor is relatively low.
293	P122A	The positive deviation of throttle controller exceeds the upper limit for a long time.
294	P122B	The negative deviation of throttle controller is below the lower limit for a long time.
295	P1230	Error reported in monitoring the OBDII maximum threshold correction
296	P1231	Error reported in monitoring the OBDII minimum threshold correction
297	P1245	System degradation information
298	P1250	An error is triggered when the ET time of the 1st cylinder reaches the maximum limit (when the ZEL comes into effect).
299	P1251	An error is triggered when the ET time of the 2nd cylinder reaches the maximum limit (when the ZEL comes into effect).
300	P1252	An error is triggered when the ET time of the 3rd cylinder reaches the maximum limit (when the ZEL comes into effect).
301	P1253	An error is triggered when the ET time of the 4th cylinder reaches the maximum limit (when the ZEL comes into effect).
302	P1254	An error is triggered when the ET time of the 1st cylinder reaches the minimum limit (when the ZEL comes into effect).
303	P1255	An error is triggered when the ET time of the 2nd cylinder reaches the minimum limit (when the ZEL comes into effect).
304	P1256	An error is triggered when the ET time of the 3rd cylinder reaches the minimum limit (when the ZEL comes into effect).
305	P1257	An error is triggered when the ET time of the 4th cylinder reaches the minimum limit (when the ZEL comes into effect).
306	P1400	EGR valve circuit is open.
307	P1401	Overtemperature of EGR valve bridge-H chip
308	P1402	EGR valve circuit is short to power supply.
309	P1403	EGR valve circuit is short to ground.
310	P140A	The signal level of the EGR cooler downstream temperature is relatively high.
311	P140B	The signal level of the EGR cooler downstream temperature is relatively low.
312	P1410	The positive deviation of throttle controller exceeds the upper limit for a long time.
313	P1411	The negative deviation of throttle controller is below the lower limit for a long time.
314	P1415	The time for transforming from RGN to NRM mode is too long.
315	P1418	The indicator actuator circuit for EGR bypass regulating valve is open.
316	P1419	Overheating of indicator actuator for EGR bypass regulating valve
317	P141A	The indicator actuator circuit for EGR bypass regulating valve is short to battery.
318	P141B	The indicator actuator circuit for EGR bypass regulating valve is short to ground.

S/N	DTC	Meaning
319	P141C	The relay actuator circuit for EGR bypass regulating valve is open.
320	P141D	Overheating of relay actuator for EGR bypass regulating valve
321	P141E	The relay actuator circuit for EGR bypass regulating valve is short to battery.
322	P141F	The relay actuator circuit for EGR bypass regulating valve is short to ground.
323	P1420	The maximum exhaust temperature signal of the 1st cylinder is too strong.
324	P1421	The maximum exhaust temperature signal of the 2nd cylinder is too strong.
325	P1422	The maximum exhaust temperature signal of the 3rd cylinder is too strong.
326	P1423	The maximum exhaust temperature signal of the 4th cylinder is too strong.
327	P1424	The maximum exhaust temperature signal of the 5th cylinder is too strong.
328	P1425	The maximum exhaust temperature signal of the 6th cylinder is too strong.
329	P1426	The minimum exhaust temperature signal of the 1st cylinder is too strong.
330	P1427	The minimum exhaust temperature signal of the 2nd cylinder is too strong.
331	P1428	The minimum exhaust temperature signal of the 3rd cylinder is too strong.
332	P1429	The minimum exhaust temperature signal of the 4th cylinder is too strong.
333	P142A	The minimum exhaust temperature signal of the 5th cylinder is too strong.
334	P142B	The minimum exhaust temperature signal of the 6th cylinder is too strong.
335	P1430	The exhaust temperature T0 in cold start is unreliable.
336	P1431	The exhaust temperature T1 in cold start is unreliable.
337	P1432	The exhaust temperature T2 in cold start is unreliable.
338	P1433	The exhaust temperature T3 in cold start is unreliable.
339	P1434	The exhaust temperature T4 in cold start is unreliable.
340	P1435	The exhaust temperature T5 in cold start is unreliable.
341	P1436	The exhaust temperature signal is unreliable.
342	P1437	Unreliable monitoring of the 1st cylinder exhaust temperature
343	P1438	Unreliable monitoring of the 2nd cylinder exhaust temperature
344	P1439	Unreliable monitoring of the 3rd cylinder exhaust temperature
345	P143A	Unreliable monitoring of the 4th cylinder exhaust temperature
346	P143B	Unreliable monitoring of the 5th cylinder exhaust temperature
347	P143C	Unreliable monitoring of the 6th cylinder exhaust temperature
348	P1440	Negative deviation error of oxygen sensor regulator
349	P1441	Positive deviation error of oxygen sensor regulator
350	P1442	Conversion failure of oxygen sensor regulator
351	P1450	The particulate filter upstream temperature is unreliable.
352	P1451	The signal level of particulate filter upstream temperature is relatively high.

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S/N	DTC	Meaning
353	P1452	The signal level of particulate filter upstream temperature is relatively low.
354	P1453	The signal level of particulate filter upstream temperature sensor is relatively high.
355	P1454	The signal level of particulate filter upstream temperature sensor is relatively low.
356	P1455	Connection failure of particulate filter differential pressure sensor hose
357	P1456	The particulate filter differential pressure sensor is unreliable.
358	P1457	Maximum characteristic differential pressure of particulate filter
359	P1458	Minimum characteristic differential pressure of particulate filter
360	P1459	Minimum deviation of particulate filter
361	P145A	The signal level of particulate filter flow impedance is high.
362	P145B	Maximum deviation of particulate filter smoke mass
363	P145C	Minimum deviation of particulate filter smoke mass
364	P145D	Maximum value of particulate filter smoke mass
365	P145E	The signal level of particulate filter flow impedance is relatively high.
366	P145F	The signal level of particulate filter flow impedance is relatively low.
367	P1460	The maximum differential pressure signal of particulate filter is enhanced.
368	P1461	The minimum differential pressure signal of particulate filter is enhanced.
369	P1462	The dynamic differential pressure of particulate filter is unreliable.
370	P1463	The differential pressure self-adaption of particulate filter hose is unreliable.
371	P1464	Particulate filter differential pressure error
372	P146A	The physical value of differential pressure sensor for particulate oxidation catalyst exceeds the upper limit.
373	P146B	The physical value of differential pressure sensor for particulate oxidation catalyst falls below the lower limit.
374	P146C	CAN Signal error
375	P146D	CAN Signal error
376	P1470	Nernst signal error of oxygen sensor
377	P1471	The oxygen sensor is virtually grounded.
378	P1472	The dynamic signal level of oxygen sensor is relatively low.
379	P1473	Oxygen sensor heater coupling signal fault
380	P1474	The oxygen sensor heater signal is unreliable.
381	P1475	The oxygen sensor battery voltage is relatively low.
382	P1476	The calibration signal level of oxygen sensor is relatively high.
383	P1477	The calibration signal level of oxygen sensor is relatively low.
384	P1478	The oxygen concentration of oxygen sensor exceeds the maximum threshold.
385	P1479	The oxygen concentration of oxygen sensor exceeds the minimum threshold.

S/N	DTC	Meaning
386	P147A	Relatively high oxygen concentration is unreliable.
387	P147B	Relatively high oxygen concentration is unreliable.
388	P147C	Relatively high oxygen concentration is unreliable.
389	P147D	Relatively low oxygen concentration is unreliable.
390	P147E	Relatively low oxygen concentration is unreliable.
391	P147F	Relatively low oxygen concentration is unreliable.
392	P1480	The calibration value of oxygen sensor internal impedance is too high.
393	P1481	The calibration value of oxygen sensor internal impedance is too low.
394	P1482	The SPI battery voltage of oxygen sensor is too low.
395	P1483	The SPI signal of oxygen sensor is unreliable.
396	P1484	The oxygen sensor temperature is above the upper limit.
397	P1485	The oxygen sensor temperature is below the lower limit.
398	P1486	The oxygen sensor voltage in shunting exceeds the threshold.
399	P148A	The signal level of turbocharger upstream temperature sensor is relatively high.
400	P148B	The signal level of turbocharger upstream temperature sensor is relatively low.
401	P1500	The voltage signal level of vehicle speed sensor is relatively high.
402	P1501	The voltage signal level of vehicle speed sensor is relatively low.
403	P150A	Power supply diagnosis is disabled in electrifying phase due to overvoltage of battery.
404	P150B	Power supply diagnosis is disabled in electrifying phase due to under-voltage of battery.
405	P1510	The signal level measured by A/C coolant pressure sensor is too low.
406	P1511	The signal level measured by A/C coolant pressure sensor is too low.
407	P1512	The signal level measured by A/C coolant pressure sensor is too high.
408	P1513	The signal level measured by A/C coolant pressure sensor is too high.
409	P1514	Overtemperature of compressor torque reduction command circuit in electrifying phase
410	P1515	A/C switch CAN input signal is unreliable.
411	P1516	The compressor torque reduction command circuit in electrifying phase is short to ground.
412	P1517	The compressor torque reduction command circuit in electrifying phase is short to power.
413	P1520	Short circuit of turbocharger bridge-H
414	P1521	Under-voltage of turbocharger bridge-H
415	P1522	Overcurrent of turbocharger bridge-H
416	P1523	Overtemperature of turbocharger bridge-H

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S/N	DTC	Meaning
417	P1524	Overcurrent of turbocharger bridge-H temperature sensor
418	P1525	The valve is stuck in deviation learning process.
419	P1526	Output circuit 1 of turbocharger bridge-H is short to ground.
420	P1527	Output circuit 1 of turbocharger bridge-H is short to ground.
421	P1528	Output circuit 1 of turbocharger bridge-H is short to battery.
422	P1529	Output circuit 2 of turbocharger bridge-H is short to battery.
423	P1601	EGR valve circuit is open.
424	P1602	Too high downstream temperature of coolant temperature sensor is unreliable.
425	P1603	EGR valve circuit is short to power supply.
426	P1604	EGR valve circuit is short to ground.
427	P1608	EGR valve circuit is short to power supply.
428	P1609	EGR valve circuit is short to ground.
429	P160A	EGR valve circuit is open.
430	P160B	Overtemperature of EGR valve bridge-H chip
431	P160C	Overcurrent of turbocharger bridge-H temperature sensor
432	P1610	Execute closing fuel injection under standard ICO mode.
433	P1613	The electrifying time detected by galloping prevention monitor is too long.
434	P1614	Several faults occur during SPI communication.
435	P1615	Time-out when trying to set up or cancel alarm task
436	P1617	Error reported in monitoring under-voltage
437	P1618	WDA works abnormally.
438	P1619	EGR valve circuit is short to power supply.
439	P161A	EGR valve circuit is short to ground.
440	P161B	EGR valve circuit is open.
441	P161C	EGR valve circuit is open.
442	P161D	Failure in software reset visibility
443	P161E	Failure in software reset visibility
444	P161F	Failure in software reset visibility
445	P1620	TTLAMP drive circuit is open.
446	P1621	The drive circuit for fuel consumption display is short to power supply.
447	P1622	The drive circuit for fuel consumption display is short to ground.
448	P1623	The drive circuit for fuel consumption display is open.
449	P1624	Overtemperature of the drive circuit for fuel consumption display
450	P1625	TTLAMP drive circuit is short to power supply.

S/N	DTC	Meaning
451	P1626	TTLAMP drive circuit is short to ground.
452	P1627	Overheating of TTLAMP drive circuit
453	P1633	The signal level of ECU temperature sensor is relatively high.
454	P1634	The signal level of ECU temperature sensor is relatively high.
455	P1635	The signal level of ECU temperature sensor is relatively low.
456	P1636	The signal level of ECU temperature sensor is relatively low.
457	P1637	The power supply voltage is too high.
458	P1638	The power supply voltage is too low.
459	P1639	The physical value of ECU temperature sensor exceeds the upper limit.
460	P163A	The physical value of ECU temperature sensor falls below the lower limit.
461	P163B	ECU temperature sensor SPI fault (LM71)
462	P1640	Compressor overtemperature in electrifying phase
463	P1643	Signal safety checkout error
464	P1645	The injection frequency is limited by the boosting electric quantity charging balance.
465	P1646	The injection frequency is limited by the high pressure fuel pump fuel quantity balance.
466	P1647	The injection frequency is limited by the runtime.
467	P164C	EGR valve circuit is open.
468	P164D	EGR valve circuit is short to power supply.
469	P164E	EGR valve circuit is short to ground.
470	P1650	EEP Clear Error
471	P1651	EEP Clear Error
472	P1652	An error is reported when the module’s data-writing is disabled for three times.
473	P165A	Null dataset identifier
474	P165B	Dataset switchover fault
475	P165C	EEPROM data-reading error
476	P1660	ADC open circuit pulse test fault
477	P1662	The voltage being transformed by ADC module exceeds the set range of test voltage.
478	P1663	The radiometry correction exceeds the set range.
479	P1664	Monitoring control communication fault
480	P1665	SPI Monitoring control communication fault
481	P1666	Several faults occur when testing the whole ROM zone.
482	P1667	The number of responsive bytes obtained from CPU in monitoring mode is too small / Error of the set response time of monitoring mode
483	P1668	Error of the set response time of monitoring mode

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S/N	DTC	Meaning
484	P166A	OFF-route test time-out
485	P166B	The electrifying time for injection is unreliable.
486	P166C	The initial electrifying angle (SO E) is unreliable.
487	P166D	ZFC is unreliable.
488	P166E	Fuel injection monitoring mode 1
489	P166F	Fuel injection monitoring mode 2
490	P1670	Error reported in fuel injection correction
491	P1671	Unreliable rail pressure
492	P1672	The torque limit is set once any error is detected before the MoCSOP's error is generated.
493	P1673	Monitoring OFF-route forward test fault
494	P1674	Monitoring fault mode 3
495	P1675	The negative deviation of throttle controller is below the lower limit for a long time.
496	P1676	Open circuit of EGR valve bridge-H
497	P1677	Overload of EGR valve bridge-H
498	P1678	Overtemperature of EGR valve bridge-H chip
499	P167B	CY33X fault
500	P167C	The set value of rail pressure is limited by the torque limit of the function control unit.
501	P1680	The cruise indicator drive circuit is open.
502	P1681	Overtemperature of cruise indicator drive circuit
503	P1682	The cruise indicator drive circuit is short to power supply or high level.
504	P1683	The cruise indicator drive circuit is short to ground.
505	P1684	The grill heater is always ON.
506	P1685	DFC mechanical fault when turning on ignition switch
507	P1686	Fuel filter heating power level temperature fault
508	P1687	CJ945 Power level no load fault
509	P1688	CJ945 Power level no load fault
510	P1689	Overheating of intake air heater drive circuit
511	P168A	CJ945 Overheating fault
512	P168B	CJ945 Power level is short to battery.
513	P168C	CJ945 Power level is short to battery.
514	P168D	CJ945 Power level is short to ground.
515	P168E	CJ945 Power level is short to ground.
516	P1700	Unreliable clutch signal / Clutch signal error

S/N	DTC	Meaning
517	P1710	Overheating of engine speed sensor
518	P1720	Transmission neutral position signal
519	P2002	The particulate oxidation catalyst device is removed.
520	P2004	Overcurrent of EGR valve bridge-H based on temperature
521	P2008	EGR valve circuit is open.
522	P2009	EGR valve circuit is short to ground.
523	P2010	EGR valve circuit is short to power supply.
524	P2014	Under-voltage of EGR valve bridge-H
525	P2015	The turbocharger control valve is stuck.
526	P2072	The throttle valve is frozen.
527	P2076	An error is reported when the EGR valve is stuck in closing or opening.
528	P2077	The signal level of swirl valve position sensor is relatively low.
529	P2078	The signal level measured by the variable swirl valve position sensor is above the limit.
530	P207A	Overtemperature of EGR valve bridge-H chip
531	P207B	The short-term jitter of EGR valve exceeds the limit.
532	P2100	Open circuit of throttle bridge-H
533	P2101	Overcurrent of throttle bridge-H
534	P2102	Output circuit 1 of throttle bridge-H is short to ground.
535	P2103	Output circuit 1 of throttle bridge-H is short to battery.
536	P2135	Signals of accelerator pedal position sensor 1 and 2 are unreliable.
537	P213A	Open circuit of EGR valve bridge-H
538	P213B	Overload of EGR valve bridge-H
539	P213C	The Port 2 of EGR valve bridge-H chip is short to ground.
540	P213D	The Port 2 of EGR valve bridge-H chip is short to ground.
541	P2141	The Port 1 of EGR valve bridge-H chip is short to ground.
542	P2142	The Port 1 of EGR valve bridge-H chip is short to power supply.
543	P2146	Short circuit
544	P2149	Short circuit
545	P2157	Unreliable vehicle speed signal
546	P2173	False positive deviation of throttle regulator
547	P2175	False negative deviation of throttle regulator
548	P2226	Fault of signal obtained from CAN by air pressure sensor
549	P2228	The signal value of ambient pressure is below the lower limit.
550	P2229	The signal value of ambient pressure is above the upper limit.

S/N	DTC	Meaning
551	P2264	EGR valve circuit is open.
552	P2265	An error is reported when the moisture content in fuel is detected.
553	P2266	EGR valve circuit is short to ground.
554	P2267	EGR valve circuit is short to power supply.
555	P2268	EGR valve circuit is open.
556	P2269	The sensor self-checking signal level is above the upper limit.
557	P2290	The rail pressure is below the minimum set value.
558	P242F	The particulate filter smoke load exceeds the maximum.
559	P2454	The signal level of particulate filter differential pressure sensor is relatively low.
560	P2455	The signal level of particulate filter differential pressure sensor is relatively high.
561	P2458	Particulate filter regeneration permanent fault
562	P245A	EGR cooler bypass valve fault
563	P245B	Too low EGR cooling efficiency
564	P245D	The signal level of EGR cooler sensor is relatively high.
565	P250F	Danger is caused by too low fuel level and air ingress into hydraulic system.
566	P2519	A/C switch CAN input signal error
567	P2522	The compressor torque reduction command circuit in electrifying phase is open.
568	P2562	The turbocharger bridge-H chip circuit is open.
569	P2563	The turbocharger control valve is stuck.
570	P2564	The original voltage of EGR valve sensor signal is below the lower limit.
571	P2565	The original voltage of EGR valve sensor signal is above the upper limit.
572	P2621	The throttle signal level is relatively low.
573	P2622	The throttle signal level is relatively high.
574	P2626	The oxygen sensor pump current terminal IP is in open circuit.
575	B0020	Airbag collision status
576	U0121	ABS ECU main data loss
577	U0400	CAN received frame BCM1 message length error
578	U0415	CAN received frame ABS1 message length error

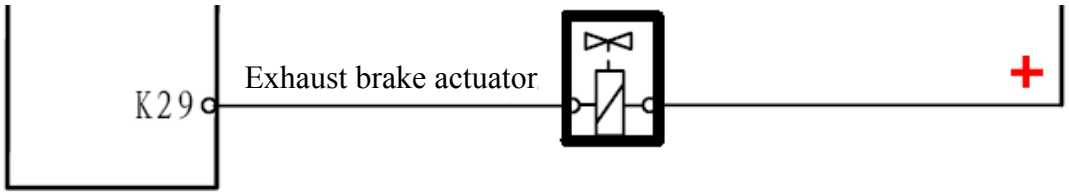
Section V. Fault Diagnosis for Electronic-Controlled Common Rail Diesel Engines

- Prior to disconnecting or reconnecting the power cord of engine control module (ECM), be sure to turn off the ignition switch, in order not to damage the ECM.
- All types of engine DTCs are stored in the ECM memory.
- The engine DTCs should be cleared after the maintenance.

Common DTCs and Troubleshooting Methods for Electronic Control Systems of Diesel Engines

1.

DTC	**P0475**	**The exhaust brake valve control line is open.**
	P0476	**The ECU internal driver module of exhaust brake valve control line is overheating.**
	P0477	**The exhaust brake valve control line is short to ground.**
	P0478	**The exhaust brake valve control line is short to high level.**



Fault Description: The engine control unit (ECU) shall actuate the exhaust braking after processing the signal received from the exhaust brake switch and also check if the exhaust brake feedback signal matches with the ECU control command. If not, DTC shall be reported.

Diagnosis Hint: The intermittent failure may be caused by poor contact of wire, abrasion of the insulation or damage of the wire inside insulation.

Check for the following conditions:

- Poor contact of ECU or exhaust brake valve – Check the harness connector

– Loose terminal

– Poor matching and connection

– Breakage of keeper

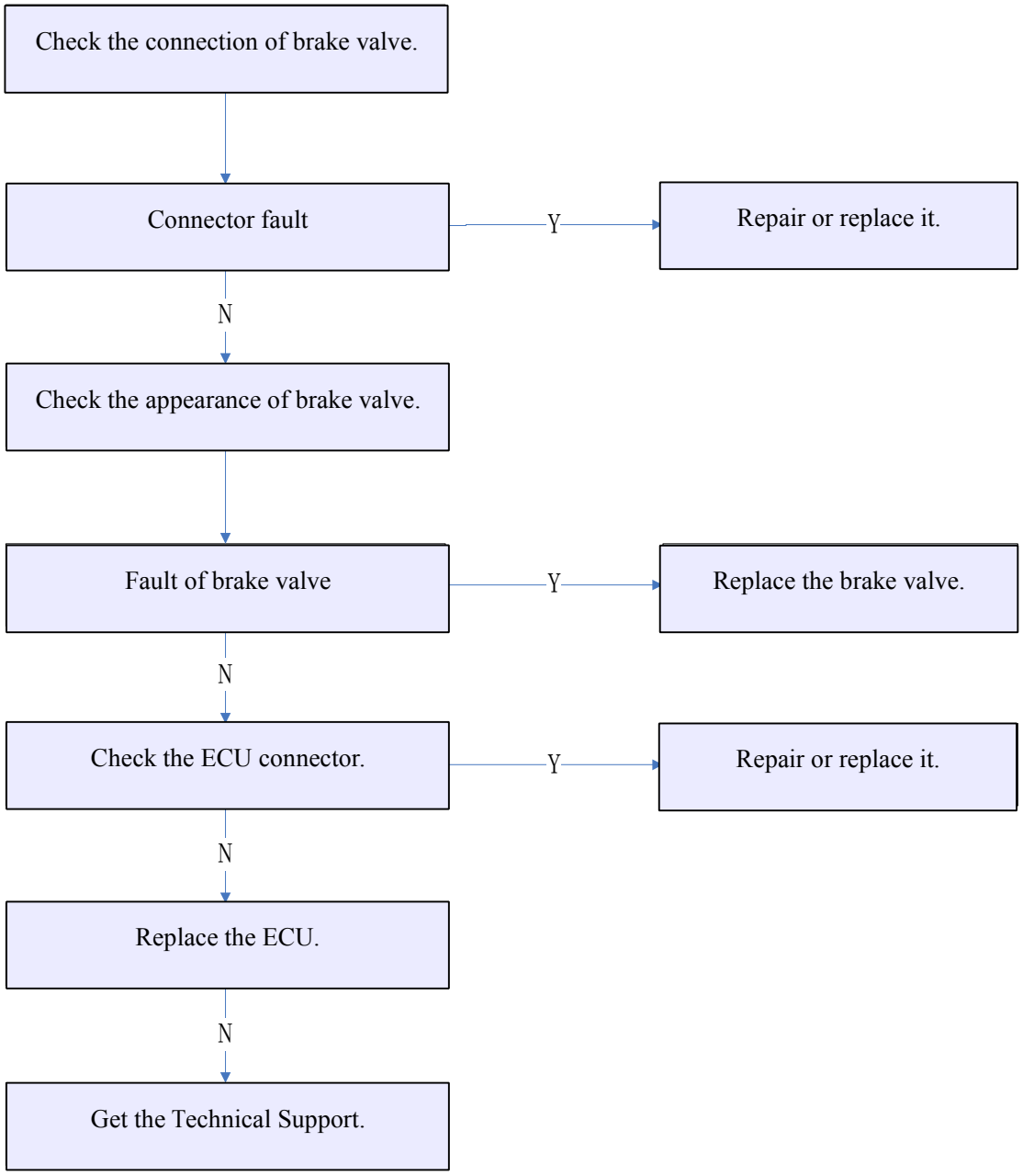
– Distortion or damage of terminal

– Poor contact between terminal and wire

- Damage of harness – Check the harness for any damage

Terminal	ECU	
	K29	Exhaust brake actuator

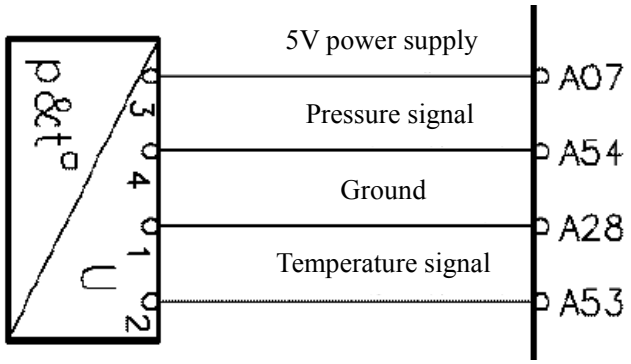
Fault Tree:


Check the connection of brake valve.
Connector fault
Y
Repair or replace it.
N
Check the appearance of brake valve.
Fault of brake valve
Y
Replace the brake valve.
N
Check the ECU connector.
Y
Repair or replace it.
N
Replace the ECU.
N
Get the Technical Support.

2.

DTC	P0069	The boost pressure sensor drift
	P0237	The boost pressure sensor output voltage is below the lower limit (the wiring is short to ground).
	P0238	The boost pressure sensor output voltage is above the upper limit (the wiring is open or short to high level).
	P0097	The voltage of intake air temperature sensor is too low (the wiring is short to ground).
	P0098	The voltage of intake air temperature sensor is too high (the wiring is open or short to high level).

Boost pressure / intake air temperature sensor



Fault Description: The boost pressure sensor shall make response to the pressure change of intake manifold. The pressure changes with the engine load. The ECU shall supply 5V voltage to the 5V reference voltage circuit of boost pressure sensor and also supply grounding for the low reference voltage circuit. The boost pressure sensor shall provide a signal that is related to the pressure change of intake manifold to ECU via the boost pressure sensor signal circuit. When the intake manifold pressure is relatively low (for example: during idling period), the low level signal voltage shall be detected by the ECU. When it is relatively high (for example: with the accelerator pedal fully open (WOT)), the high level signal voltage shall be detected. The boost pressure sensor is also for determining the barometric pressure (BARO). When the ignition switch is turned on without starting the engine, the following condition shall occur. As long as the accelerator pedal position sensor signal is more than 28%, the barometric pressure reading shall be updated. The boost pressure sensor includes the following circuits:

- A 5V reference voltage circuit
- A low reference voltage circuit
- A MAP sensor signal circuit

If the boost pressure sensor signal detected by ECU is beyond the set range, relevant DTC shall be generated.

The intake air temperature (IAT) sensor is a kind of variable resistor that can measure the temperature of air into the engine. The ECU shall supply 5V voltage to the signal circuit of IAT sensor and also supply grounding for the reference voltage circuit of IAT sensor. When the IAT sensor is in cold state, the sensor resistance is relatively high. When the air temperature increases, the sensor resistance shall decrease. When the sensor resistance is relatively high, the voltage of IAT sensor signal circuit detected by ECU shall be relatively high. With the decrease of sensor resistance, the voltage of IAT sensor signal circuit detected by ECU shall decrease also. If the signal voltage of IAT sensor detected by ECU is too low (indicating the temperature is too high), or too high (indicating the temperature is too low), relevant DTC shall be generated.

Diagnosis Hint:

Maintenance manual for sunray hfc4da1-2c china-IV diesel engines

The normal boost pressure sensor shall make quick response to the change of accelerator pedal position, so its slow action should not appear or it should not act slower than the change of accelerator pedal position.

For poor contact inspection between ECU and IAT sensor, please check the ECU harness connector for the following conditions:

− Loose terminal

− Poor matching and connection

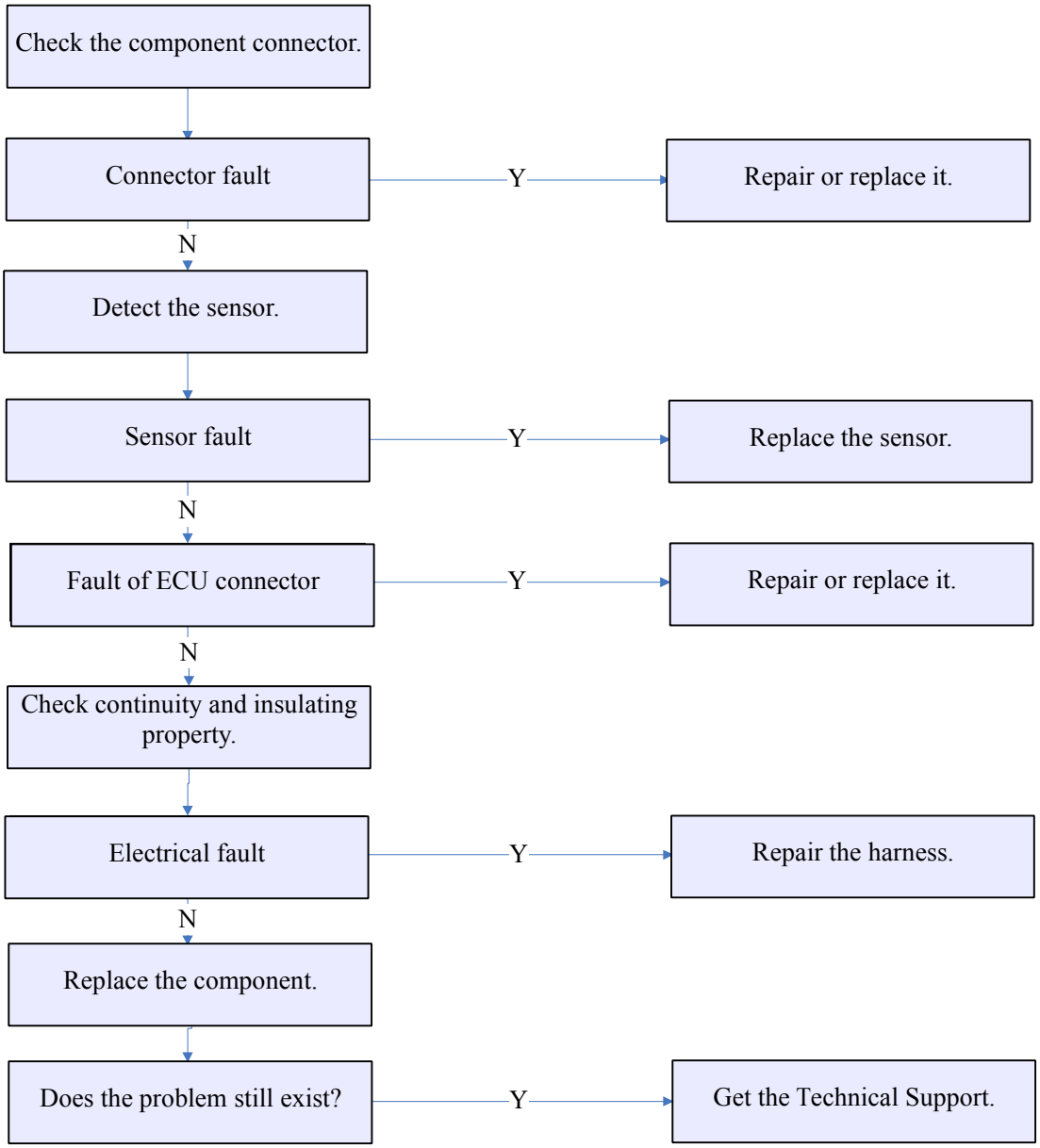
− Breakage of keeper

− Distortion or damage of terminal

− Poor contact between terminal and wire

Terminal	ECU	
	A07	Power supply terminal of sensor
	A53	Temperature signal terminal
	A54	Pressure signal terminal
	A28	Ground terminal of sensor

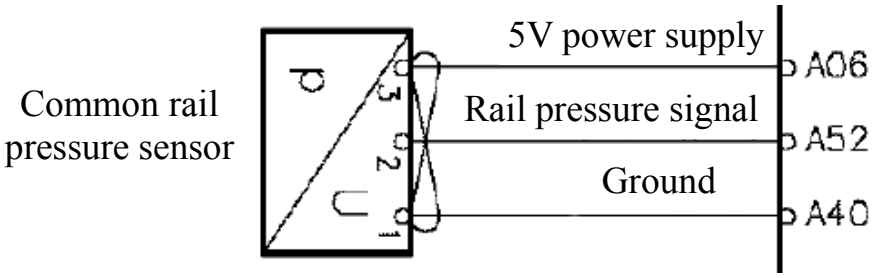
Fault Tree:


Check the component connector.
Connector fault
Y
Repair or replace it.
N
Detect the sensor.
Sensor fault
Y
Replace the sensor.
N
Fault of ECU connector
Y
Repair or replace it.
N
Check continuity and insulating property.
Electrical fault
Y
Repair the harness.
N
Replace the component.
Does the problem still exist?
Y
Get the Technical Support.

3.

Maintenance manual for sunray hfc4da1-2c china-IV diesel engines

DTC	**P0087**	**The fuel pressure is below the lower limit.**
	P0088	**The fuel pressure is above the upper limit.**
	P0191	**The forward drift of common rail pressure sensor is too large.**
	P0192	**The common rail pressure sensor output voltage is below the lower limit (the wiring is short to ground).**
	P0193	**The common rail pressure sensor output voltage is above the upper limit (the wiring is open or short to high level).**
	P0194	**The reverse drift of common rail pressure sensor is too large.**
	P1011	**The positive deviation of rail pressure control is above the upper limit.**
	P1012	**The positive deviation of rail pressure control exceeds the upper limit greatly.**
	P1013	**The negative deviation of rail pressure control is below the lower limit.**



Fault Description: The common rail pressure sensor shall make response to the change of fuel pressure in common rail pipe. The pressure changes with the engine load. The ECU shall supply 5V voltage to the 5V reference voltage circuit of common rail pressure sensor and also supply grounding for the low reference voltage circuit. The common rail pressure sensor shall provide a signal that is related to the change of fuel pressure in common rail pipe to ECU via the common rail pressure sensor signal circuit. When the fuel pressure in common rail pipe is relatively low (for example: during idling period), the low level signal voltage shall be detected by the ECU. When it is relatively high (for example: with the accelerator pedal fully open (WOT)), the high level signal voltage shall be detected. The common rail pressure sensor provides an important parameter for determining engine operation. When its signal is lost, the engine shall stop operation. The common rail pressure sensor includes the following circuits:

- A 5V reference voltage circuit
- A low reference voltage circuit
- A common rail pressure sensor signal circuit

If the common rail pressure sensor signal detected by ECU is beyond the set range, relevant DTC shall be generated.

Diagnosis Hint: When the ignition switch is turned on with engine off, the pressure in common rail pipe is zero and the signal voltage level is low. By comparing the readings with those of the same sensor that is known good, the accuracy of the suspicious sensor can be checked. Their difference should be no more than 0.4V. Perform overall inspection for common rail pressure sensor to see if it is damaged.

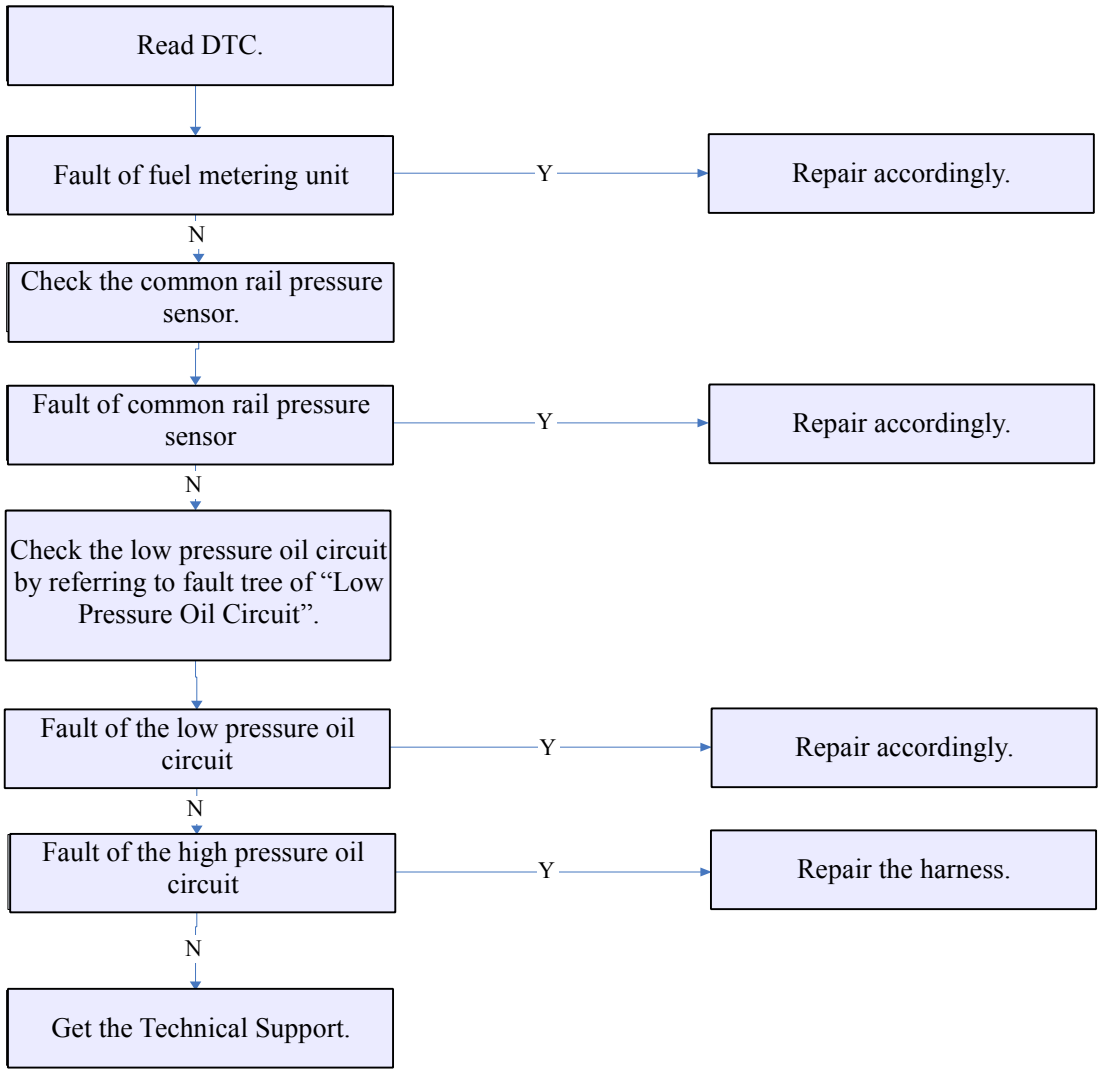
During engine starting, any pressure change in the common rail pipe should be detected by the common rail pressure sensor, through which, we can determine if the sensor is stuck at a certain value.

The normal common rail pressure sensor shall make quick response to the change of accelerator pedal position, so its slow action should not appear or it should not act slower than the change of accelerator pedal position.

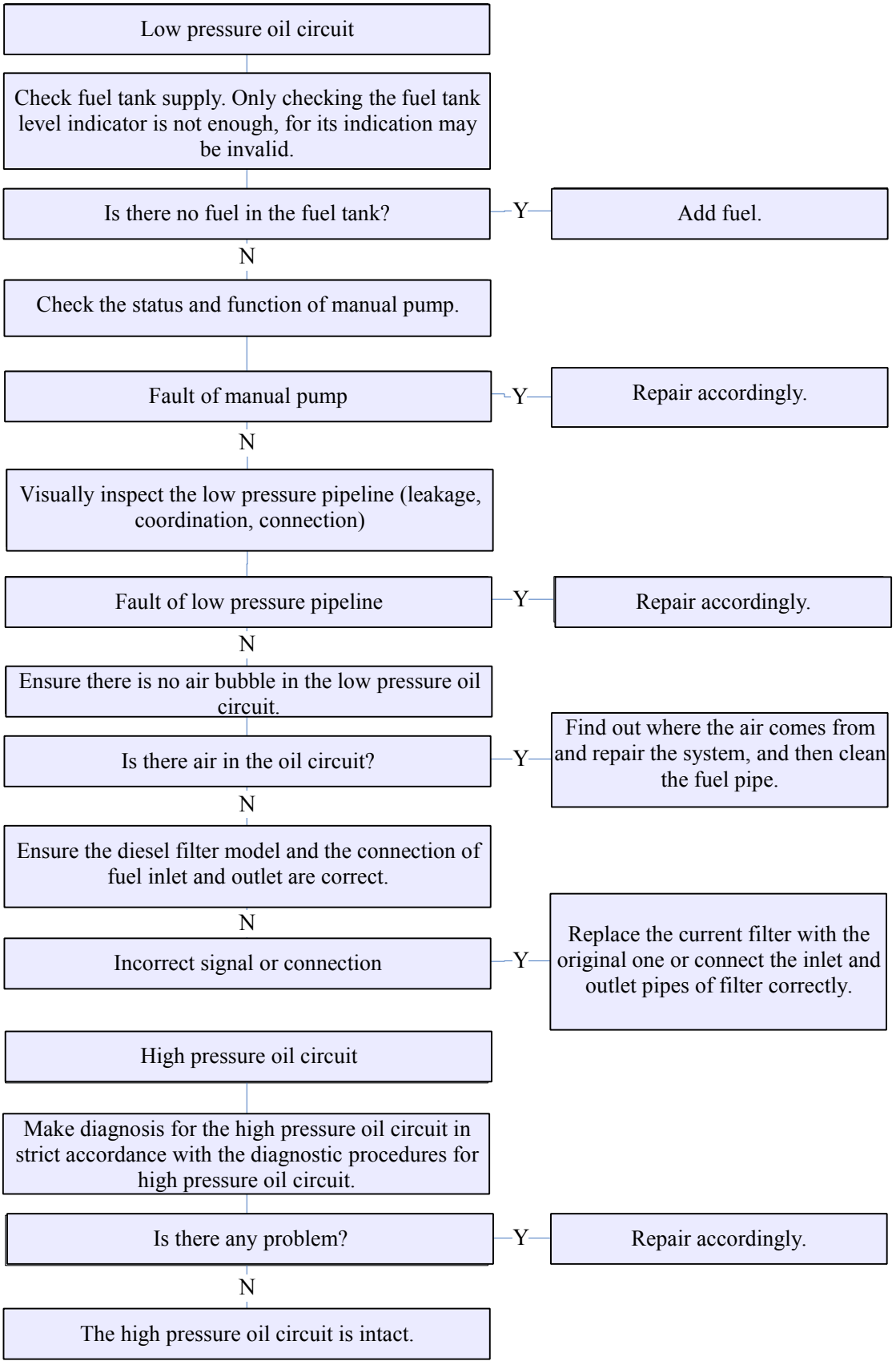
Terminal	ECU	
	A06	Power supply terminal of common rail pressure sensor

	A52	Signal terminal of common rail pressure sensor
	A40	Ground terminal of common rail pressure sensor

Fault Tree:



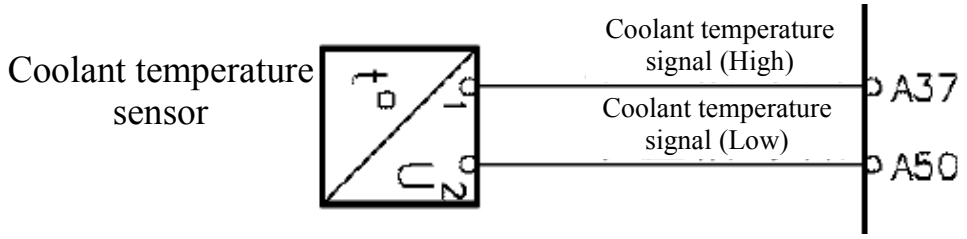
Inspection for Low Pressure/High Pressure Oil Circuit:


Low pressure oil circuit
Check fuel tank supply. Only checking the fuel tank level indicator is not enough, for its indication may be invalid.
Is there no fuel in the fuel tank?
Y
Add fuel.
N
Check the status and function of manual pump.
Fault of manual pump
Y
Repair accordingly.
N
Visually inspect the low pressure pipeline (leakage, coordination, connection)
Fault of low pressure pipeline
Y
Repair accordingly.
N
Ensure there is no air bubble in the low pressure oil circuit.
Is there air in the oil circuit?
Y
Find out where the air comes from and repair the system, and then clean the fuel pipe.
N
Ensure the diesel filter model and the connection of fuel inlet and outlet are correct.
N
Incorrect signal or connection
Y
Replace the current filter with the original one or connect the inlet and outlet pipes of filter correctly.
High pressure oil circuit
Make diagnosis for the high pressure oil circuit in strict accordance with the diagnostic procedures for high pressure oil circuit.
Is there any problem?
Y
Repair accordingly.
N
The high pressure oil circuit is intact.

4.

Maintenance manual for sunray hfc4da1-2c china-IV diesel engines

DTC	**P0116**	**The dynamic characteristics of coolant temperature sensor are unreliable.**
	P0117	**The coolant temperature sensor output voltage is below the lower limit (the wiring is short to ground).**
	P0118	**The coolant temperature sensor output voltage is above the upper limit (the wiring is open or short to high level).**
	P0119	**The static characteristics of coolant temperature sensor are unreliable.**



Fault Description: The engine coolant temperature (ECT) sensor is a kind of negative temperature coefficient variable resistor, which can measure the engine coolant temperature. Its resistance shall decrease with the increase of temperature, so the signal value input into ECU in the form of voltage shall decrease accordingly. The voltage signal range is 0-5V. The ECU searches the characteristic curve of the sensor and converts it into engine coolant temperature. The diagnostic module of engine coolant temperature sensor shall make fault judgment based on this temperature value. The ECU shall supply 5V voltage to the signal circuit of engine coolant temperature sensor and also supply grounding for the low reference voltage circuit. If the signal voltage of engine coolant temperature sensor detected by ECU is too low (indicating the temperature is too high), or too high (indicating the temperature is too low), relevant DTC shall be generated.

The following table illustrates the difference among temperature, resistance and voltage.

Engine coolant temperature	Resistance of coolant temperature sensor	Signal voltage of coolant temperature sensor
Low	High	High
High	Low	Low

Diagnosis Hint:

Overheating may result in generation of this DTC. After the engine is started, the temperature of engine coolant temperature sensor should increase steadily and become stable after the thermostat is disconnected. Test the engine coolant temperature sensor under different temperature to check for any error of sensor. If any, the error may result in failure of control performance. After the engine is laid up for a night, the indication difference between IAT sensor and engine coolant temperature sensor should be within 3°C (5°F). Refer to “Temperature and Resistance”.

Check for the following conditions:

Poor contact between ECU and engine coolant temperature sensor – Check the harness connector for:

− Loose terminal

− Poor matching and connection

− Breakage of keeper

− Distortion or damage of terminal

− Poor contact between terminal and wire

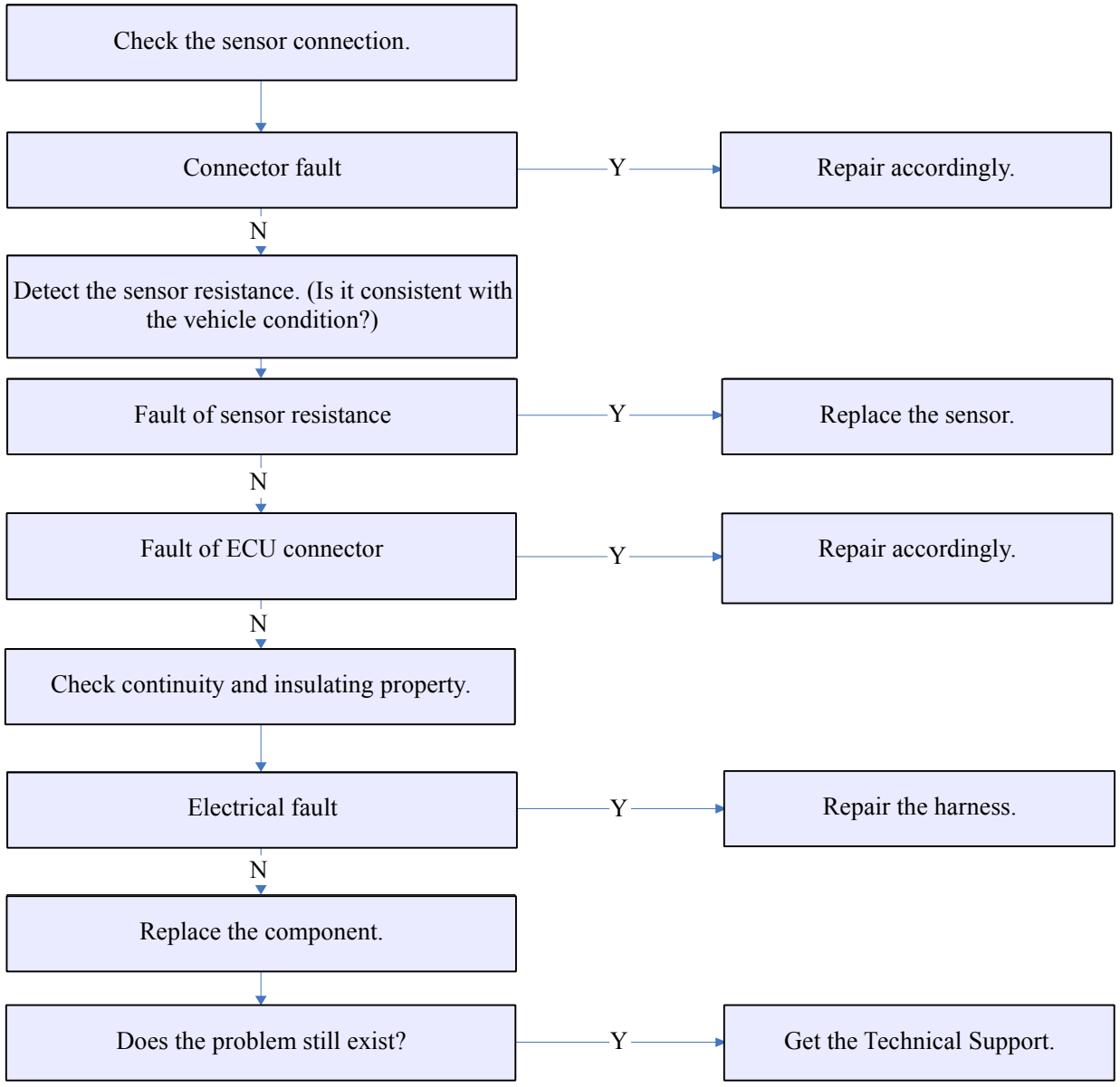
Check the harness for any damage. If the harness appears normal, observe the ECT indication on the diagnostic tool

while moving relevant connector and harness of ECT sensor. If the ECT indication changes, there must be failure in that part. If the DTC won't appear again, the fault record data can be used for determining the self-diagnostic code and the running mileage after the previous setting can be used for determining the occurrence frequency of that condition, which can facilitate the troubleshooting for overheating.

After the engine is started, the engine coolant temperature shall increase steadily to about 90°C (194°F) and then become stable after the thermostat is disconnected.

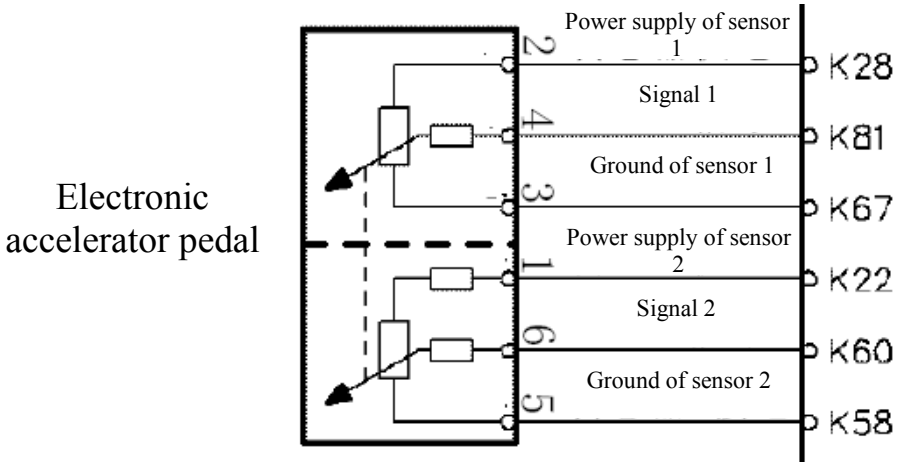
Terminal	ECU	
	A37	Signal terminal of ECT sensor
	A50	Ground terminal of ECT sensor

Fault Tree:


Check the sensor connection.
Connector fault
Y
Repair accordingly.
N
Detect the sensor resistance. (Is it consistent with the vehicle condition?)
Fault of sensor resistance
Y
Replace the sensor.
N
Fault of ECU connector
Y
Repair accordingly.
N
Check continuity and insulating property.
Electrical fault
Y
Repair the harness.
N
Replace the component.
Does the problem still exist?
Y
Get the Technical Support.

5.

DTC	**P0122**	**The output voltage of accelerator pedal potentiometer 1 is below the lower limit.**
	P0123	**The output voltage of accelerator pedal potentiometer 1 is above the upper limit.**
	P0222	**The output voltage of accelerator pedal potentiometer 2 is below the lower limit.**
	P0223	**The output voltage of accelerator pedal potentiometer 2 is above the upper limit.**



Fault Description: The accelerator pedal assembly consists of two accelerator pedal position (APP) sensor. The APP sensors are installed on the pedal assembly and are not repairable. The APP sensor shall supply a signal voltage that changes with the accelerator pedal position. The ECU shall supply an individual 5V reference voltage circuit and a low level reference voltage circuit to each APP sensor. With the pedal depressed, the signal voltage of APP sensor 1 shall increase, viz. increasing from about 0.7V (at the released position) to above 4V (at the fully depressed position). With the pedal depressed, the signal voltage of APP sensor 2 shall increase, viz. increasing from about 0.3V (at the released position) to above 2V (at the fully depressed position).

APP sensor 1 and 2 are installed in the accelerator pedal assembly. Each one consists of the following circuits:

- A 5V reference voltage circuit
- A low reference voltage circuit
- A signal circuit

With those circuits, the APP sensors can provide the signal voltage that is proportional to the displacement of accelerator pedal to the ECU. Two processors, located in the ECU, are adopted to monitor the data of throttle actuator control system. Each signal circuit shall provide the signal voltage that is proportional to the displacement of accelerator pedal to two processors. Those two processors shall monitor each other to verify whether the indicated value of pedal position is correct or not. The test method of ECU is: making the signal of APP sensor 2 lower instantaneously to see if the signal of APP 1 is also made lower.

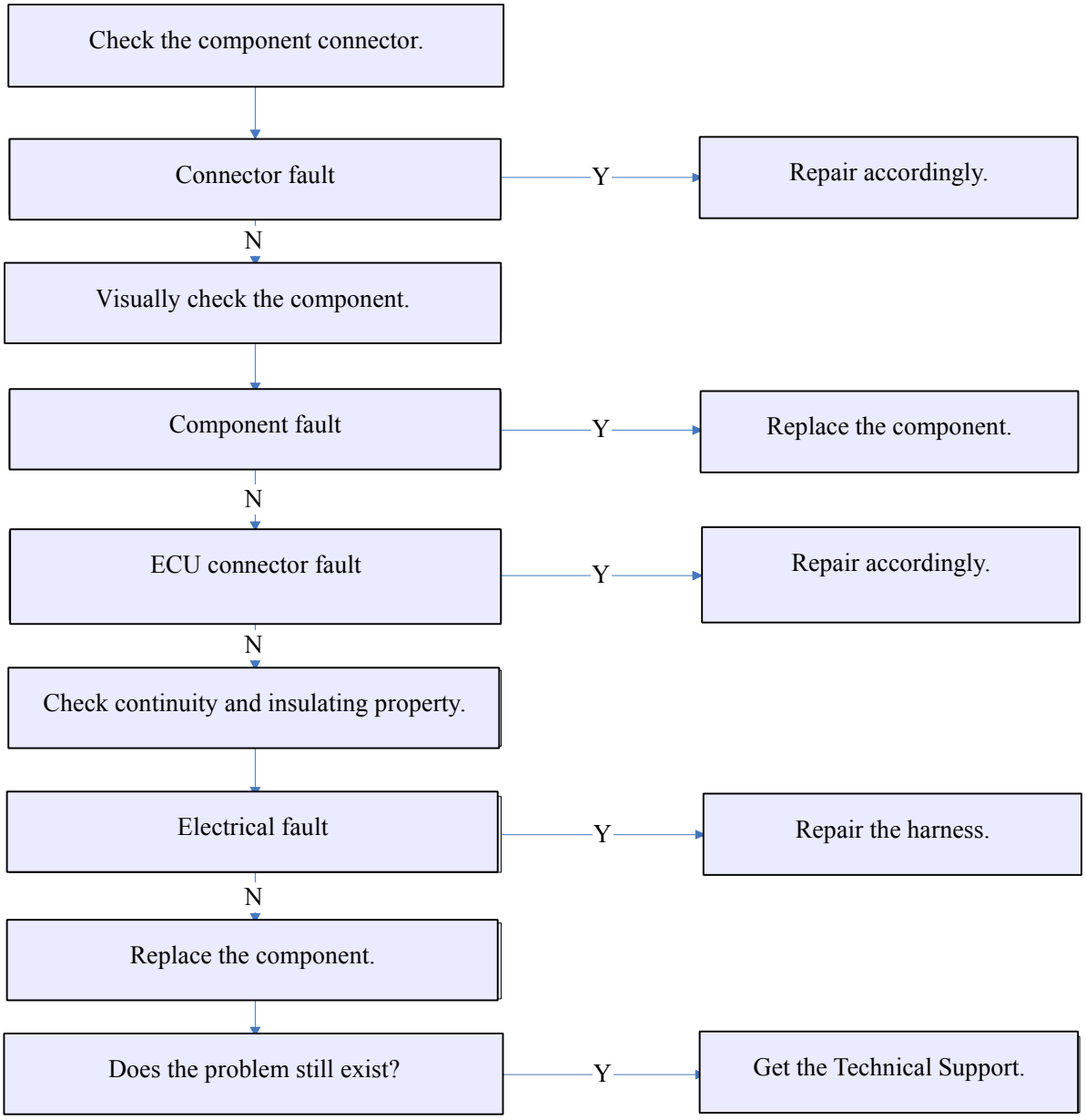
Diagnosis Hint: During testing, if it is necessary to detect the ECU harness connector or component harness connector, a diagnostic connector should be adopted to test the adapter component.

If several DTCs appear simultaneously, please check if the signal circuits for APP sensor 1 and 2 are short to each other.

Terminal	ECU	
	K28	Power supply terminal of APP sensor 1

	K81	Signal terminal of APP sensor 1
	K67	Ground terminal of APP sensor 1
	K22	Power supply terminal of APP sensor 2
	K60	Signal terminal of APP sensor 2
	K58	Ground terminal of APP sensor 2

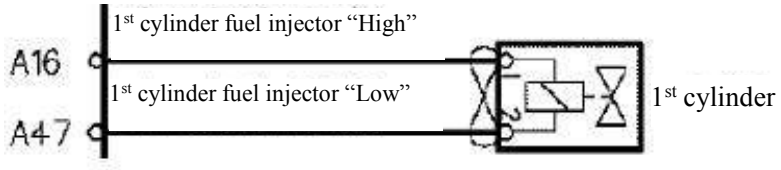
Fault Tree:


Check the component connector.
Connector fault
Y
Repair accordingly.
N
Visually check the component.
Component fault
Y
Replace the component.
N
ECU connector fault
Y
Repair accordingly.
N
Check continuity and insulating property.
Electrical fault
Y
Repair the harness.
N
Replace the component.
Does the problem still exist?
Y
Get the Technical Support.

6.

Maintenance manual for sunray hfc4da1-2c china-IV diesel engines

DTC	**P0201**	**The 1st cylinder fuel injector circuit is open.**
	P0263	**Other errors of the 1st cylinder fuel injector**
	P1200	**The forward error correction of the 1st fuel injector is too large.**
	P1201	**The reverse error correction of the 1st fuel injector is too large.**
	P120C	**The dynamic forward error correction of the 1st fuel injector is too large.**
	P120D	**The dynamic reverse error correction of the 1st fuel injector is too large.**
	P1233	**Other errors of the 1st cylinder fuel injector**
	P1234	**Other errors of the 1st cylinder fuel injector**
	P1235	**Other errors of the 1st cylinder fuel injector**
	P1613	**The electrifying time detected by galloping prevention monitor is too long.**



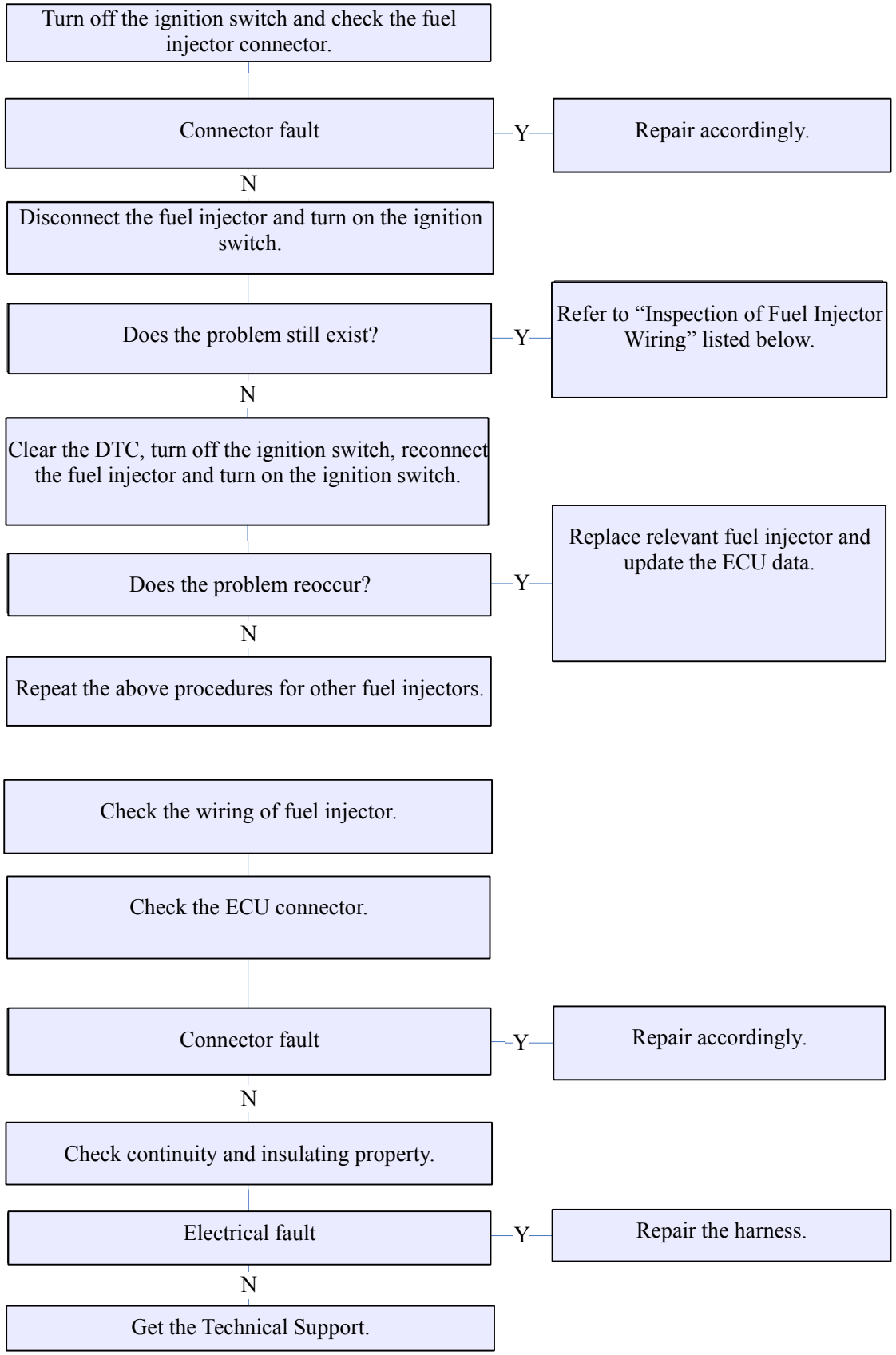
Fault Description: The ECU controls the switching-on circuit of fuel injector directly. The ECU controls the time for switching on each fuel injector via adopting a device named "Driver" to supply PWM current to each fuel injector control circuit. The driver owns a feedback circuit, which is monitored by ECU to verify if the control circuit is open or short. If any failure in the fuel injector control circuit is detected by ECU, the fuel injector control circuit DTC shall be generated.

Diagnosis Hint: For the failure in wire connector shall trigger the setting of DTC, be sure to check the connectors relevant to this diagnostic procedure for short circuit of terminal or poor contact of wire, prior to replacement of any component. Observe the state parameter of relevant fuel injector on the diagnostic tool while shaking the wire and connector relevant to the test. If any intermittent failure is existed in the tested wire or connector, the relevant failure shall be displayed on the diagnostic tool.

Performing compression test is helpful for locating the intermittent failure.

Terminal	ECU	
	A16	1st fuel injector "High"
	A47	1st fuel injector "Low"

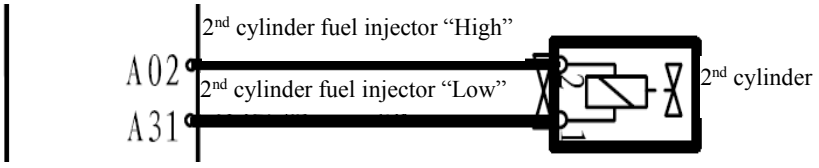
Fault Tree:


Turn off the ignition switch and check the fuel injector connector.
Connector fault
Y
Repair accordingly.
N
Disconnect the fuel injector and turn on the ignition switch.
Does the problem still exist?
Y
Refer to “Inspection of Fuel Injector Wiring” listed below.
N
Clear the DTC, turn off the ignition switch, reconnect the fuel injector and turn on the ignition switch.
Does the problem reoccur?
Y
Replace relevant fuel injector and update the ECU data.
N
Repeat the above procedures for other fuel injectors.
Check the wiring of fuel injector.
Check the ECU connector.
Connector fault
Y
Repair accordingly.
N
Check continuity and insulating property.
Electrical fault
Y
Repair the harness.
N
Get the Technical Support.

7.

Maintenance manual for sunray hfc4da1-2c china-IV diesel engines

DTC	**P0202**	**The 2nd cylinder fuel injector circuit is open.**
	P0264	**The low end of the 2nd fuel injector is short to the high end.**
	P0265	**The low end of the 2nd fuel injector is short to the high level.**
	P0266	**Other errors of the 2nd cylinder fuel injector**
	P1202	**The forward error correction of the 2nd fuel injector is too large.**
	P1203	**The reverse error correction of the 2nd fuel injector is too large.**
	P120E	**The dynamic forward error correction of the 2nd fuel injector is too large.**
	P120F	**The dynamic reverse error correction of the 2nd fuel injector is too large.**
	P1236	**Other errors of the 2nd cylinder fuel injector**
	P1237	**Other errors of the 2nd cylinder fuel injector**
	P1238	**Other errors of the 2nd cylinder fuel injector**



Fault Description: The ECU controls the switching-on circuit of fuel injector directly. The ECU controls the time for switching on each fuel injector via adopting a device named "Driver" to supply PWM current to each fuel injector control circuit. The driver owns a feedback circuit, which is monitored by ECU to verify if the control circuit is open or short. If any failure in the fuel injector control circuit is detected by ECU, the fuel injector control circuit DTC shall be generated.

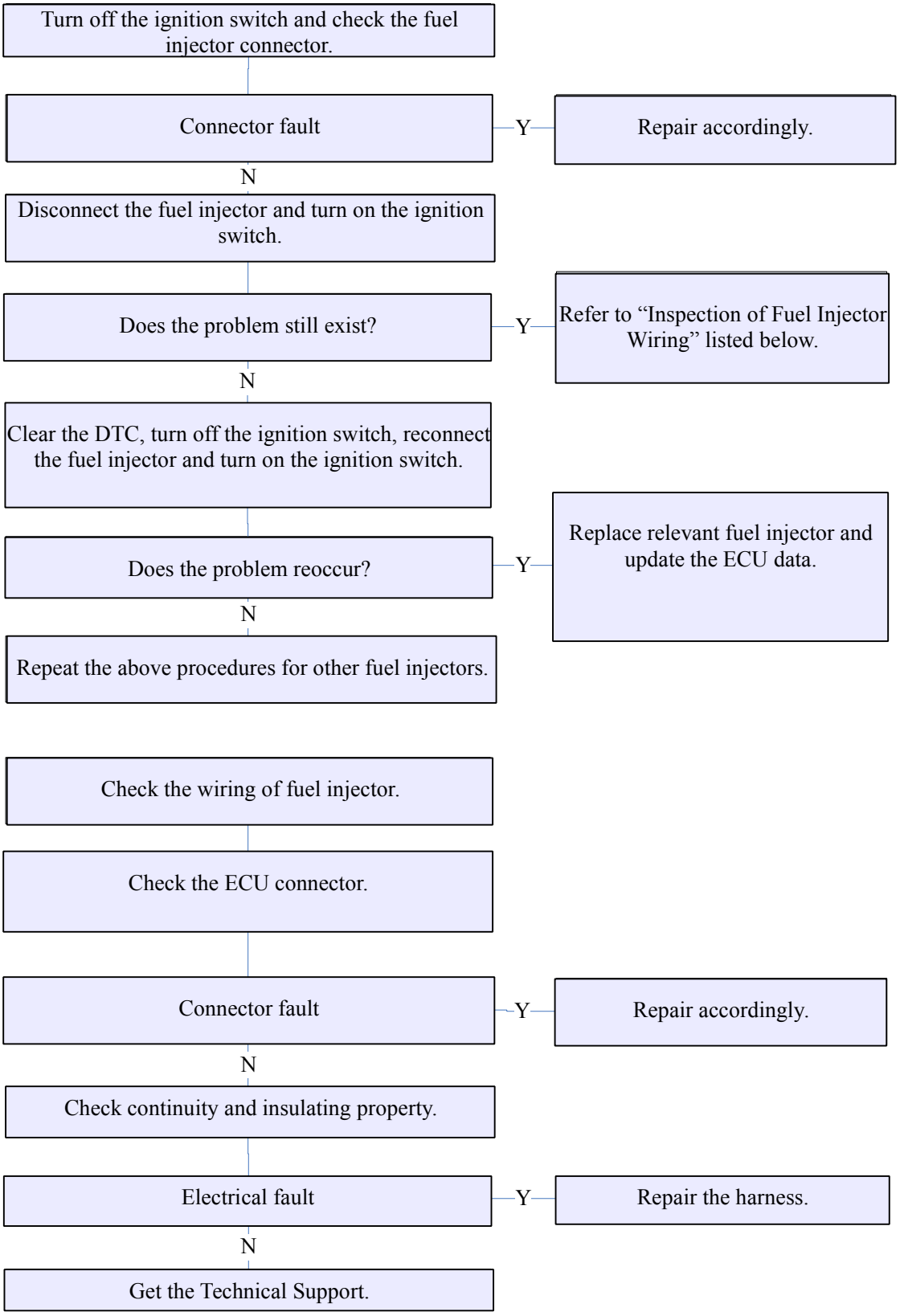
Diagnosis Hint:

For the failure in wire connector shall trigger the setting of DTC, be sure to check the connectors relevant to this diagnostic procedure for short circuit of terminal or poor contact of wire, prior to replacement of any component. Observe the state parameter of relevant fuel injector on the diagnostic tool while shaking the wire and connector relevant to the test. If any intermittent failure is existed in the tested wire or connector, the relevant failure shall be displayed on the diagnostic tool.

Performing compression test is helpful for locating the intermittent failure.

Terminal	ECU	
	A02	2nd fuel injector "High"
	A31	2nd fuel injector "Low"

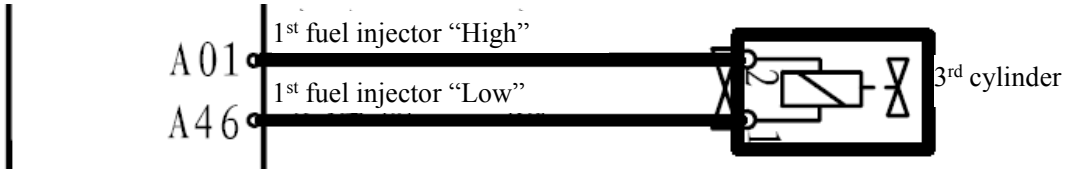
Fault Tree:


Turn off the ignition switch and check the fuel injector connector.
Connector fault
Y
Repair accordingly.
N
Disconnect the fuel injector and turn on the ignition switch.
Does the problem still exist?
Y
Refer to “Inspection of Fuel Injector Wiring” listed below.
N
Clear the DTC, turn off the ignition switch, reconnect the fuel injector and turn on the ignition switch.
Does the problem reoccur?
Y
Replace relevant fuel injector and update the ECU data.
N
Repeat the above procedures for other fuel injectors.
Check the wiring of fuel injector.
Check the ECU connector.
Connector fault
Y
Repair accordingly.
N
Check continuity and insulating property.
Electrical fault
Y
Repair the harness.
N
Get the Technical Support.

8.

Maintenance manual for sunray hfc4da1-2c china-IV diesel engines

DTC	**P0203**	**The 3rd cylinder fuel injector circuit is open.**
	P0267	**The low end of the 3rd fuel injector is short to the high end.**
	P0268	**The low end of the 3rd fuel injector is short to the high level.**
	P0269	**Other errors of the 3rd cylinder fuel injector**
	P1204	**The forward error correction of the 3rd fuel injector is too large.**
	P1205	**The reverse error correction of the 3rd fuel injector is too large.**
	P1210	**The dynamic forward error correction of the 3rd fuel injector is too large.**
	P1211	**The dynamic reverse error correction of the 3rd fuel injector is too large.**
	P1239	**Other errors of the 3rd cylinder fuel injector**
	P123A	**Other errors of the 3rd cylinder fuel injector**
	P123B	**Other errors of the 3rd cylinder fuel injector**



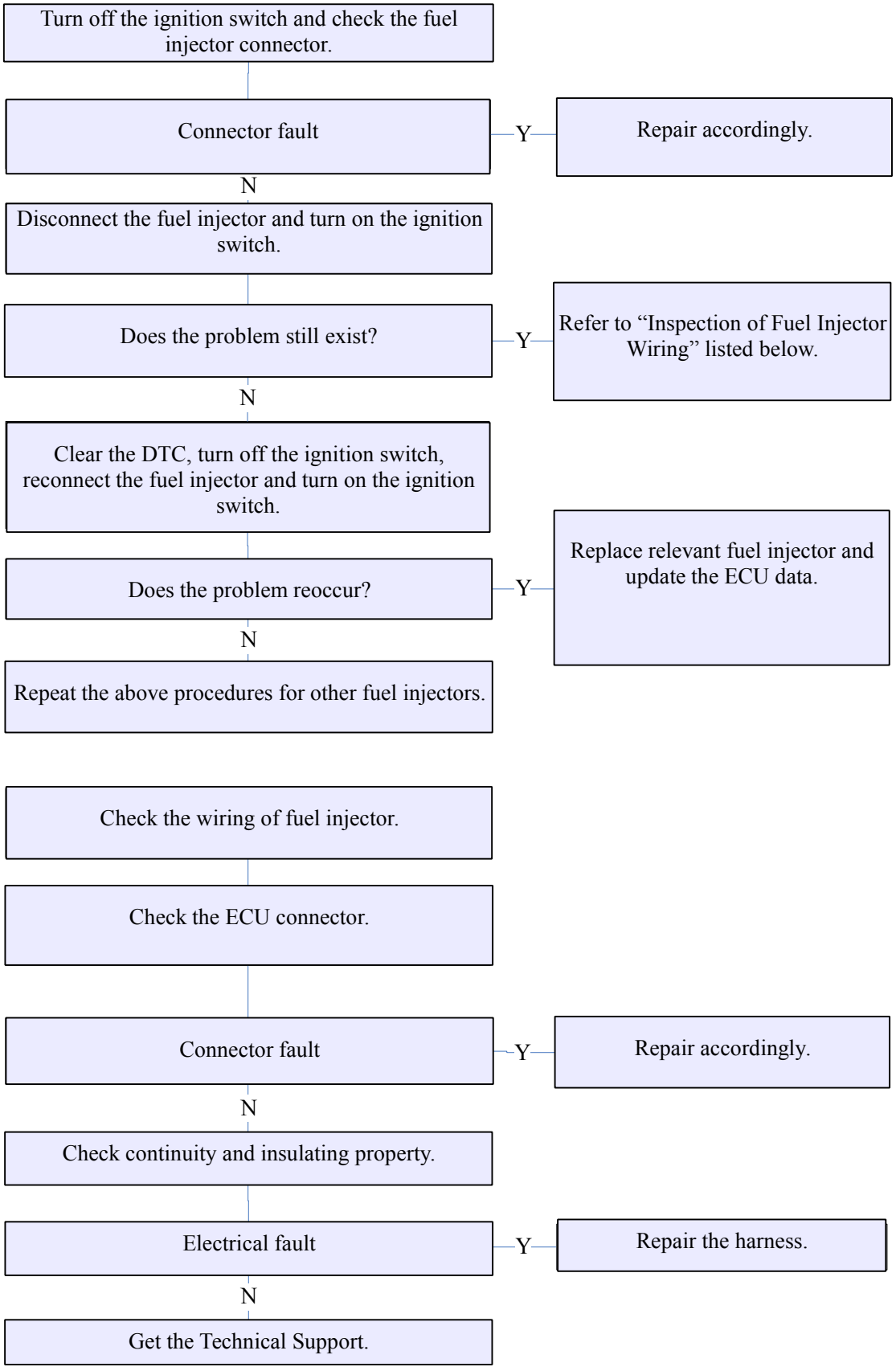
Fault Description: The ECU controls the switching-on circuit of fuel injector directly. The ECU controls the time for switching on each fuel injector via adopting a device named "Driver" to supply PWM current to each fuel injector control circuit. The driver owns a feedback circuit, which is monitored by ECU to verify if the control circuit is open or short. If any failure in the fuel injector control circuit is detected by ECU, the fuel injector control circuit DTC shall be generated.

Diagnosis Hint: For the failure in wire connector shall trigger the setting of DTC, be sure to check the connectors relevant to this diagnostic procedure for short circuit of terminal or poor contact of wire, prior to replacement of any component. Observe the state parameter of relevant fuel injector on the diagnostic tool while shaking the wire and connector relevant to the test. If any intermittent failure is existed in the tested wire or connector, the relevant failure shall be displayed on the diagnostic tool.

Performing compression test is helpful for locating the intermittent failure.

Terminal	ECU	
	A01	1st fuel injector "High"
	A46	1st fuel injector "Low"

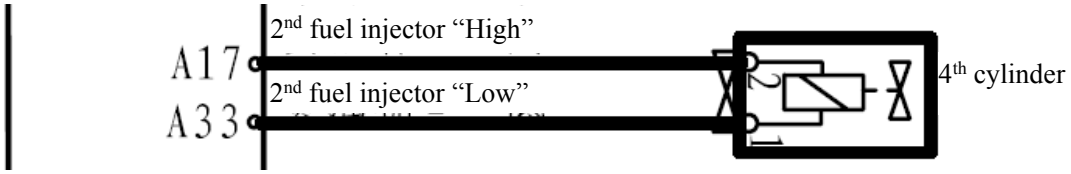
Fault Tree:


Turn off the ignition switch and check the fuel injector connector.
Connector fault
Y
Repair accordingly.
N
Disconnect the fuel injector and turn on the ignition switch.
Does the problem still exist?
Y
Refer to “Inspection of Fuel Injector Wiring” listed below.
N
Clear the DTC, turn off the ignition switch, reconnect the fuel injector and turn on the ignition switch.
Does the problem reoccur?
Y
Replace relevant fuel injector and update the ECU data.
N
Repeat the above procedures for other fuel injectors.
Check the wiring of fuel injector.
Check the ECU connector.
Connector fault
Y
Repair accordingly.
N
Check continuity and insulating property.
Electrical fault
Y
Repair the harness.
N
Get the Technical Support.

9.

Maintenance manual for sunray hfc4da1-2c china-IV diesel engines

DTC	**P0204**	**The 4th cylinder fuel injector circuit is open.**
	P0270	**The low end of the 4th fuel injector is short to the high end.**
	P0271	**The low end of the 4th fuel injector is short to the high level.**
	P0272	**Other errors of the 4th cylinder fuel injector**
	P1206	**The forward error correction of the 4th fuel injector is too large.**
	P1207	**The reverse error correction of the 4th fuel injector is too large.**
	P1212	**The dynamic forward error correction of the 4th fuel injector is too large.**
	P1213	**The dynamic reverse error correction of the 4th fuel injector is too large.**
	P123C	**Other errors of the 4th cylinder fuel injector**
	P123D	**Other errors of the 4th cylinder fuel injector**
	P123E	**Other errors of the 4th cylinder fuel injector**



Fault Description: The ECU controls the switching-on circuit of fuel injector directly. The ECU controls the time for switching on each fuel injector via adopting a device named "Driver" to supply PWM current to each fuel injector control circuit. The driver owns a feedback circuit, which is monitored by ECU to verify if the control circuit is open or short. If any failure in the fuel injector control circuit is detected by ECU, the fuel injector control circuit DTC shall be generated.

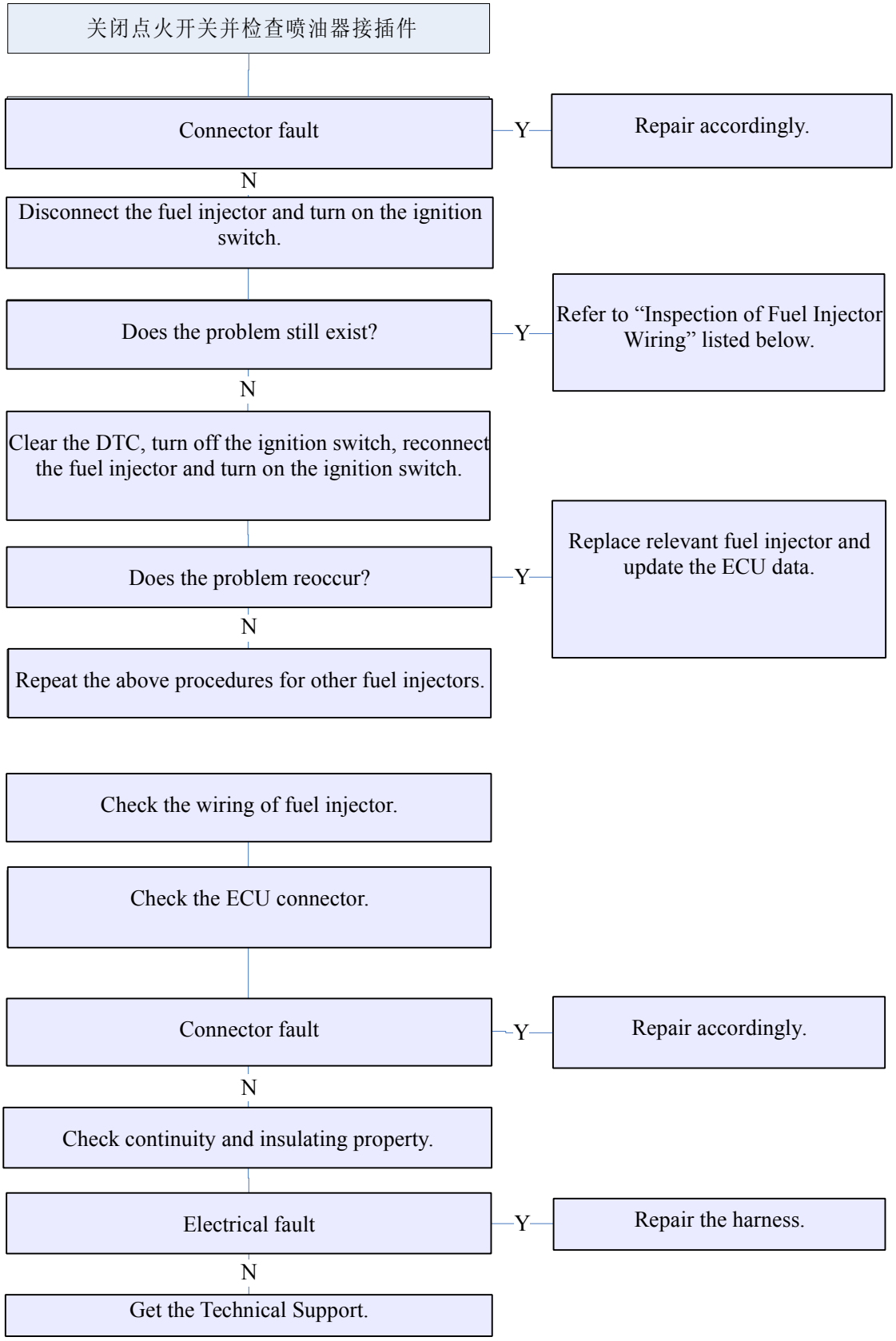
Diagnosis Hint: For the failure in wire connector shall trigger the setting of DTC, be sure to check the connectors relevant to this diagnostic procedure for short circuit of terminal or poor contact of wire, prior to replacement of any component. Observe the state parameter of relevant fuel injector on the diagnostic tool while shaking the wire and connector relevant to the test. If any intermittent failure is existed in the tested wire or connector, the relevant failure shall be displayed on the diagnostic tool.

Performing compression test is helpful for locating the intermittent failure.

Terminal	ECU	
	A17	2nd fuel injector "High"
	A33	2nd fuel injector "Low"

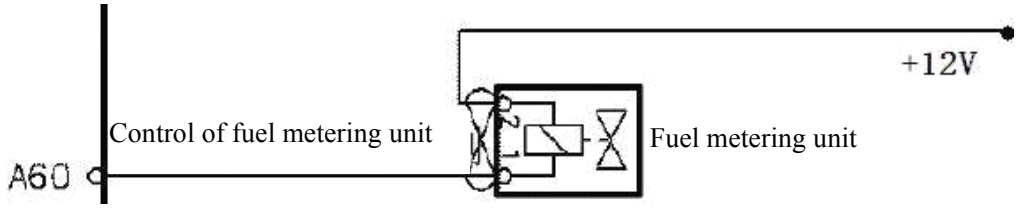
Fault Tree:

Turn off the ignition switch and check the fuel injector connector.


关闭点火开关并检查喷油器接插件
Connector fault
Y
Repair accordingly.
N
Disconnect the fuel injector and turn on the ignition switch.
Does the problem still exist?
Y
Refer to “Inspection of Fuel Injector Wiring” listed below.
N
Clear the DTC, turn off the ignition switch, reconnect the fuel injector and turn on the ignition switch.
Does the problem reoccur?
Y
Replace relevant fuel injector and update the ECU data.
N
Repeat the above procedures for other fuel injectors.
Check the wiring of fuel injector.
Check the ECU connector.
Connector fault
Y
Repair accordingly.
N
Check continuity and insulating property.
Electrical fault
Y
Repair the harness.
N
Get the Technical Support.

10.

DTC	**P0251**	**The control line of fuel level control unit is open.**
	P0252	**The ECU internal driver module of fuel level control unit is overheating.**
	P0253	**The control line of fuel level control unit is short to ground.**
	P0254	**The control line of fuel level control unit is short to high level.**



Fault Description: The fuel metering unit is for adjusting the fuel supply and the fuel pressure. When the control coil of metering unit is off, the inlet fuel metering proportional valve of the unit shall be closed, cutting off the fuel supplied to the high pressure fuel pump plunger component. When the control coil of metering unit is electrified, the ECU shall change the fuel inlet sectional area of metering component via pulse signal according to the actual demand, through which, the fuel supplied to the high pressure fuel pump plunger component shall be changed. If the fuel metering control signal voltage detected by ECU is abnormal, the DTC shall be generated.

Diagnosis Hint: The metering component is mounted at the fuel inlet of high pressure pump. The engine's fuel supply shall be affected directly by the opening sectional area of the fuel metering unit control valve. Provided that the fuel metering unit control line is normally connected, monitor the engine fuel supply amount and pressure while moving relevant connector and wire to check if any fault is triggered. If any, the indication of fault diagnostic unit shall change. This is help for locating the intermittent failure.

The intermittent failure may be caused by poor contact of control part. As for poor contact between ECU and fuel metering unit, please check the ECU harness connector for the following conditions:

− Loose terminal

− Poor matching and connection

− Breakage of keeper

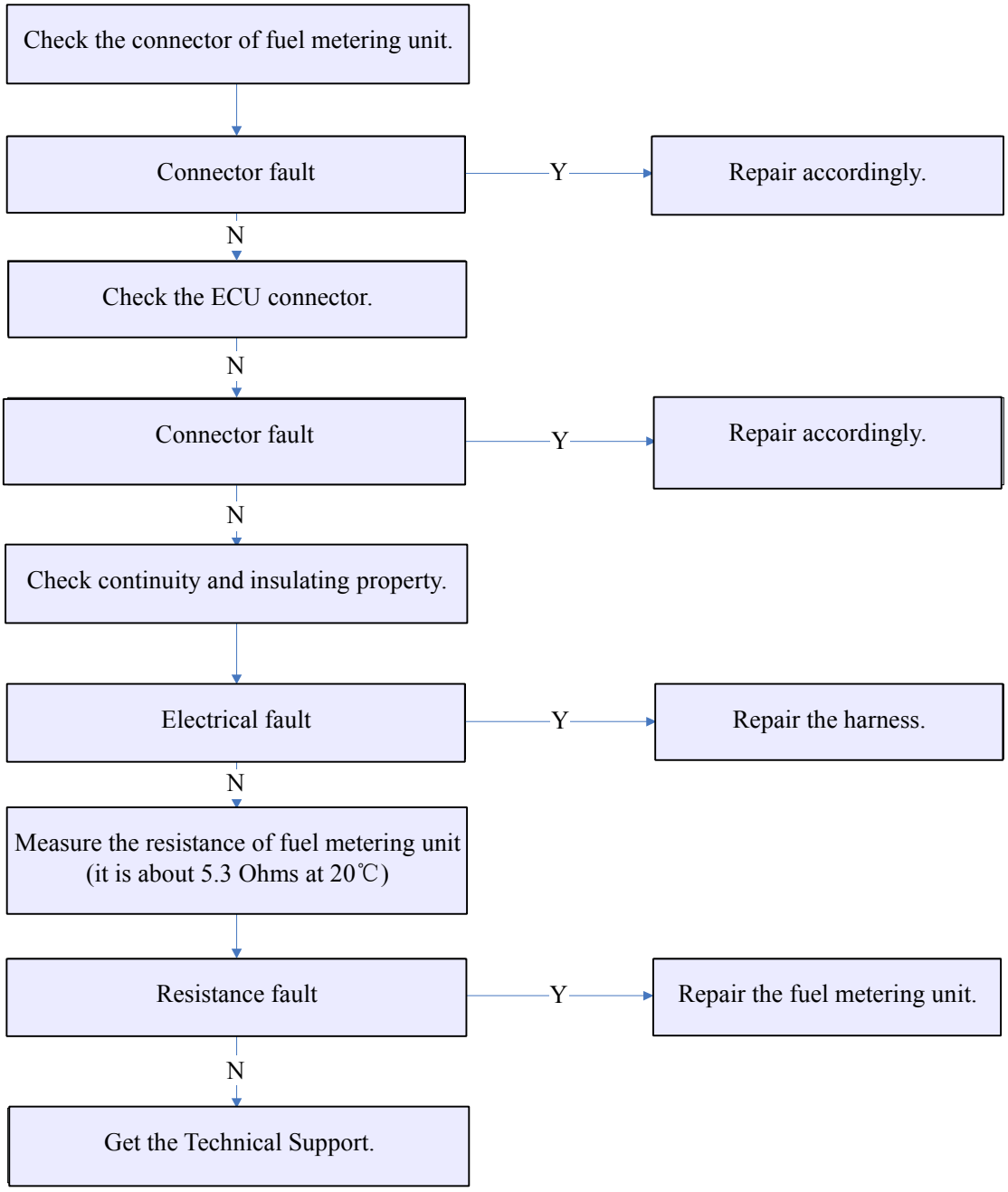
− Distortion or damage of terminal

− Poor contact between terminal and wire

Check the harness for any damage. If the harness appears normal, observe the fuel pressure indicated on the diagnostic tool while moving relevant connector and harness of fuel metering unit. If the pressure indication changes, there must be failure in that part.

Terminal	ECU	
	A19	Power supply terminal of fuel metering unit
	A49	Signal terminal of fuel metering unit

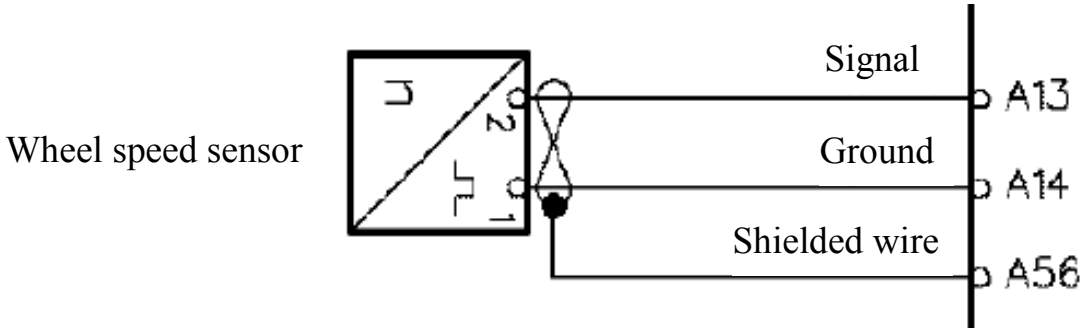
Fault Tree:


Check the connector of fuel metering unit.
Connector fault
Y
Repair accordingly.
N
Check the ECU connector.
N
Connector fault
Y
Repair accordingly.
N
Check continuity and insulating property.
Electrical fault
Y
Repair the harness.
N
Measure the resistance of fuel metering unit (it is about 5.3 Ohms at 20℃)
Resistance fault
Y
Repair the fuel metering unit.
N
Get the Technical Support.

11.

Maintenance manual for sunray hfc4da1-2c china-IV diesel engines

DTC	**P0335**	**No signal from crankshaft sensor**
	P0336	**False signal from crankshaft sensor**



Diagnosis Hint: The signal of crankshaft position (CKP) sensor is used for indicating the rotary speed and position of crankshaft. The CKP sensor shall generate an AC voltage of different amplitude and frequency. The frequency relies on the rotary speed of crankshaft and the output AC voltage relies on the crankshaft position. The CKP sensor shall coordinate with a 58X variable reluctance rotor fixed on the crankshaft. The ECU can synchronize the timing control for fuel injectors according to the input signals of CKP sensor and camshaft position sensor. The CKP sensor can also be applied for testing misfire and tachometer indication. The signal circuit and the low reference voltage circuit of CKP sensor are directly connected to ECU. The shielded and grounded circuit should be grounded. In addition, when the 1st and the 4th cylinders are at TDC, the CKP sensor shall also send a signal to ECU. The ECU shall monitor the signals of CKP sensor and camshaft position sensor to determine whether the 1st cylinder is in compression stroke or not. The circuits between CKP sensor and ECU include:

Signal circuit of CKP sensor

Low reference voltage circuit of CKP sensor

Shielded and grounded circuit

If the number of crankshaft position pulses sent out by the CKP sensor detected by the ECU is incorrect, the DTC shall be generated.

Diagnosis Hint: There is failure in camshaft position sensor circuit.

CKP sensor variable reluctance rotor is dislocated or incorrectly installed.

Large crankshaft end play leads to dislocation of variable reluctance rotor.

There is blockage between CKP sensor and variable reluctance rotor.

Check connectors of CKP sensor and ECU for any corrosion.

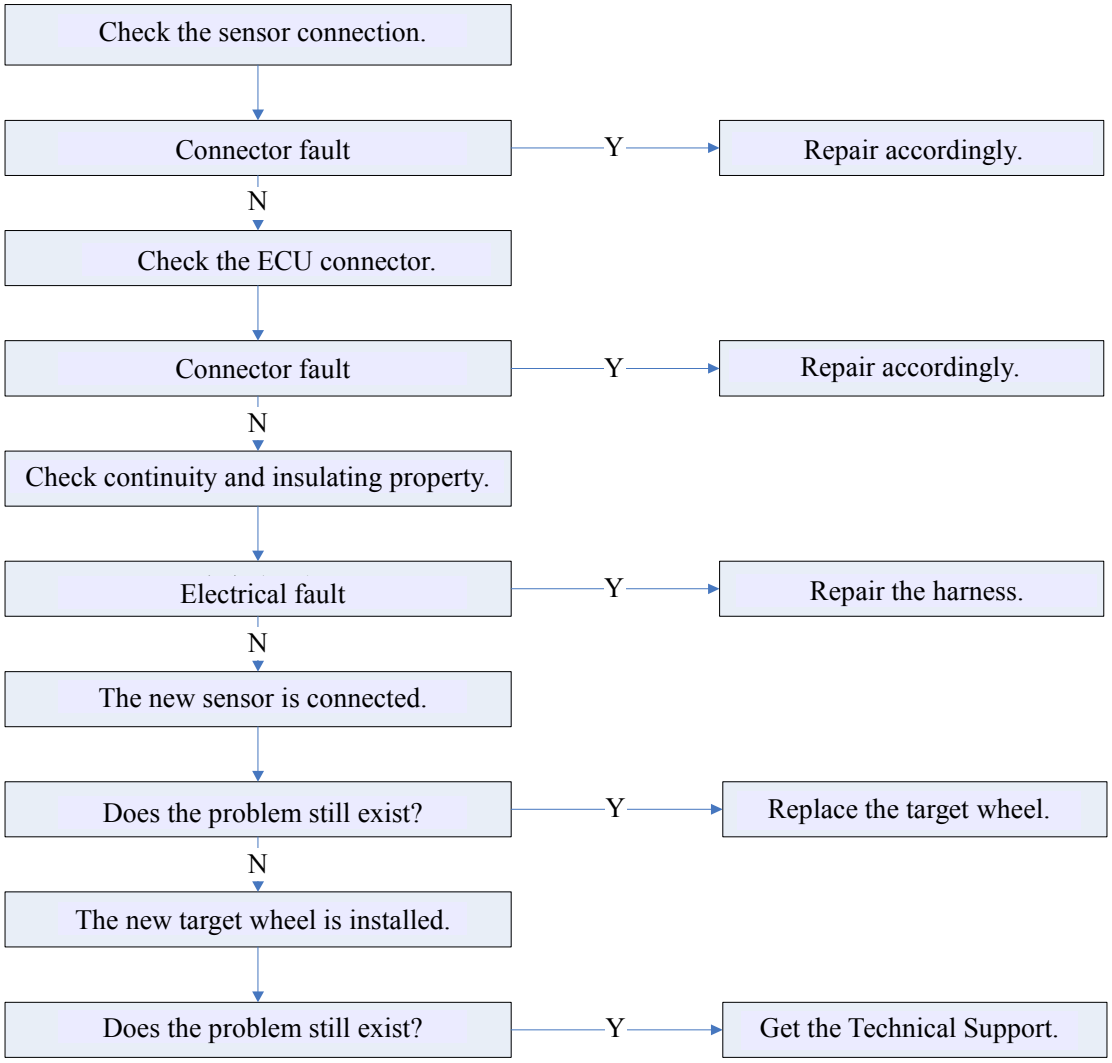
Prior to maintenance, all fragments should be removed from the connector surfaces. Prior to diagnosis or replacement, please check the connector gaskets to ensure they are properly installed to avoid ingress of any pollutant.

- Poor terminal connection – Check the harness connector for any loose terminal, mismatching, damaged keeper, improper form or damage, poor contact between terminal and wire. Check if the matched terminal is adopted. Check if the test tension is appropriate.
- Harness damage – Check the harness for any damage. If the harness appears normal, observe the indication on the diagnostic tool while moving relevant connector and harness of the sensor. If the indication changes, there must be failure in that part.

- Check if the ground and connection of ECU and engine is reliable and clean. If the DTC is determined to be intermittent failure, please refer to the fault records to find out when the previous DTC is set.

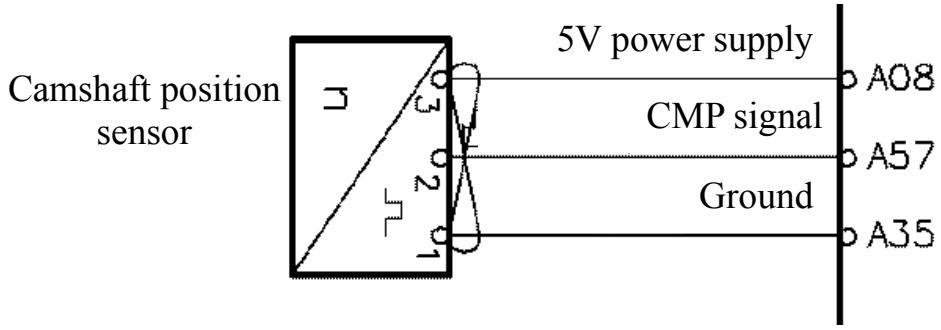
Terminal	ECU	
	A13	Signal terminal of CKP sensor
	A14	Negative signal terminal of CKP sensor
	A56	Shielded terminal of CKP sensor

Fault Tree:


Check the sensor connection.
Connector fault
Y
Repair accordingly.
N
Check the ECU connector.
Connector fault
Y
Repair accordingly.
N
Check continuity and insulating property.
Electrical fault
Y
Repair the harness.
N
The new sensor is connected.
Does the problem still exist?
Y
Replace the target wheel.
N
The new target wheel is installed.
Does the problem still exist?
Y
Get the Technical Support.

12.

DTC	**P0340**	**No signal from phase sensor**
	P0341	**False signal from phase sensor**



Fault Description: The camshaft position (CMP) sensor is a Hall Effect switch. The ECU shall supply 5V voltage to the 5V reference voltage circuit and also supply grounding for the low reference voltage circuit. The CMP sensor shall provide a signal voltage to ECU by coordinating with 1X variable reluctance rotor. The ECU shall make use of this signal voltage to determine the camshaft position. The CMP sensor links the crankshaft with the camshaft position to facilitate ECU to determine which cylinder the fuel should be injected to. During the rotation of camshaft, the variable reluctance rotor changes the magnetic field generated by the magnet in sensor and send a signal to ECU via the signal circuit. The CMP sensor circuit is directly connected to ECU. The CMP sensor can also be adopted to tell which cylinder has misfire. The circuits between CMP sensor and ECU include:

High reference voltage circuit of CMP sensor

Ground circuit

Camshaft position signal circuit

When no occurrence of minimum camshaft position synchronization is detected by ECU or there is failure in CMP sensor signal circuit, DTCs shall be generated.

Diagnosis Hint: Prior to maintenance, all fragments should be removed from the connector surfaces. Prior to diagnosis or replacement, please check the connector gaskets to ensure they are properly installed to avoid ingress of any pollutant.

Poor terminal connection – Check the harness connector for any loose terminal, mismatching, damaged keeper, improper form or damage, poor contact between terminal and wire. Check if the matched terminal is adopted. Check if the test tension is appropriate.

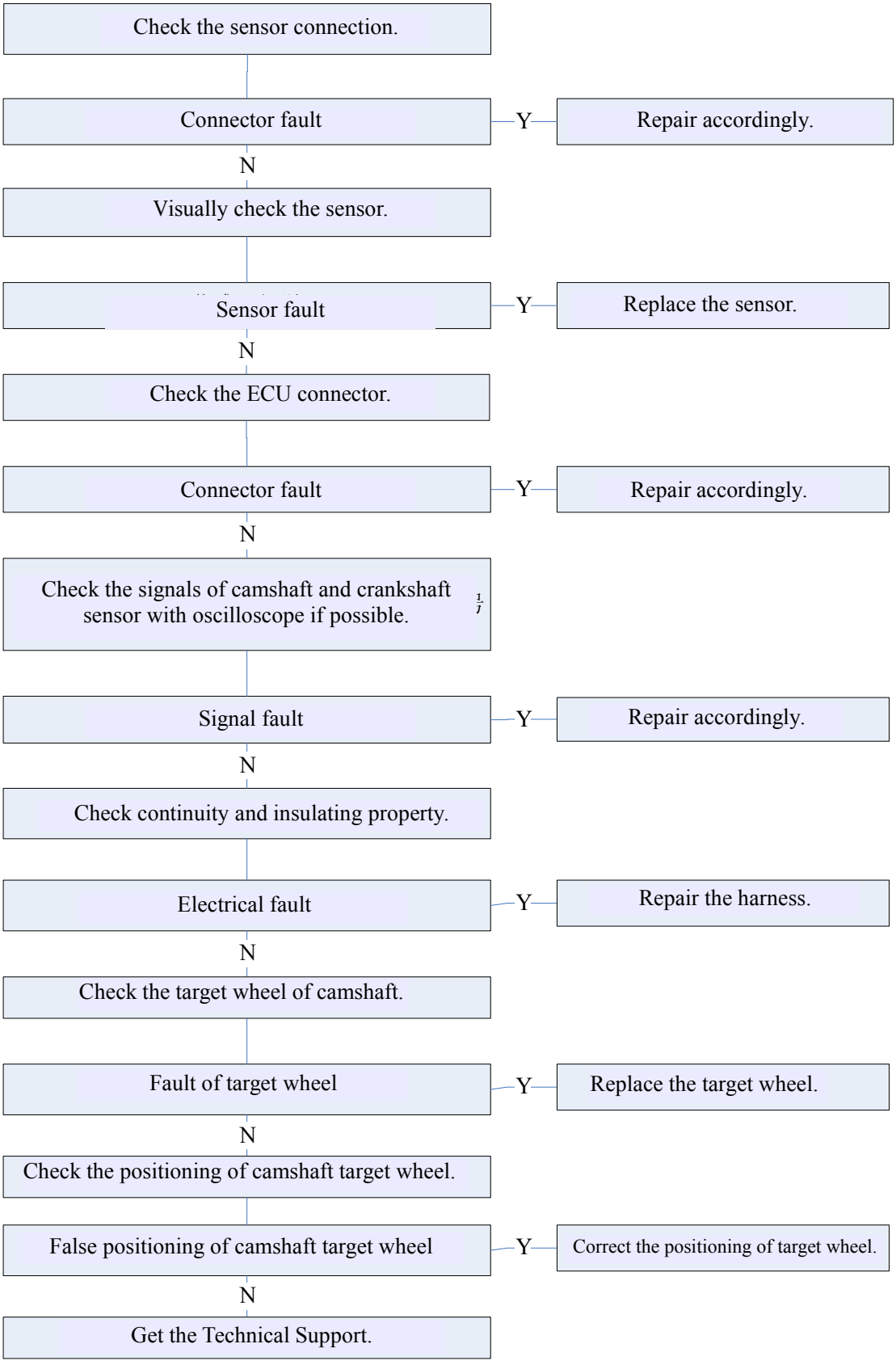
Harness damage – Check the harness for any damage. If the harness appears normal, observe the indication on the diagnostic tool while moving relevant connector and harness of the sensor. If the indication changes, there must be failure in that part.

Check if the ground and connection of ECU and engine is reliable and clean. If the DTC is determined to be intermittent failure, please refer to the fault records to find out when the previous DTC is set.

Terminal	ECU	
	A08	Signal terminal of phase sensor
	A57	Negative signal terminal of phase sensor
	A35	Shielded terminal of phase sensor

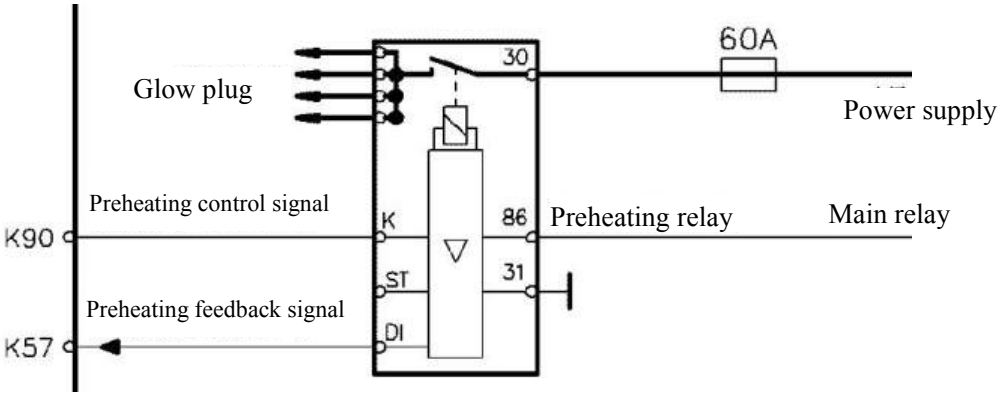
Fault Tree:

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13.

DTC	**P0380**	**The glow plug works without the command from ECU.**
	P0382	**The glow plug doesn't work with the command from ECU.**
	P0383	**ECU control line for glow plug is short to ground.**
	P0384	**ECU control line for glow plug is short to high level.**
	P0670	**ECU control line for glow plug is open or its driver module is overheating.**



Fault Description: The main part of glow plug is tubular heating element, which is securely and tightly installed inside the glow plug shell, making it resistant to corrosion and thermal shock. The heating element is composed of two resistance elements connected in series; they are installed in the top of heat pipe forming respectively a heating coil and a control coil. The glow plug controller controls over the glow plug via a power relay and electrical switch group. It can control the heating time of glow plug and also serve as a protection and monitoring device. The higher level glow plug controller has diagnosis function, so it can distinguish an individual fault of glow plug and indicate it to the driver. A multilevel socket is equipped on the control input terminal of glow plug controller for connecting with ECU. To avoid voltage drop, screw pins or plugs should be equipped in the series circuit that is connected with the glow plug. The post-heating upon a success start can facilitate the uninterrupted speed increase and idling with little smoke in the process of heating, which can reduce the combustion noise in cold starting. If it fails, the glow plug protection circuit shall open to avoid overdischarging of battery. If no preheating control signal is detected by ECU or the detected control signal is inconsistent with the actual, relevant DTCs shall be generated.

Diagnosis Hint: The failure may be caused by poor contact of wire or loose connector. As for poor contact of ECU or preheating control unit, check the harness connector for the following conditions:

Loose terminal

Poor matching and connection

Distortion or damage of terminal

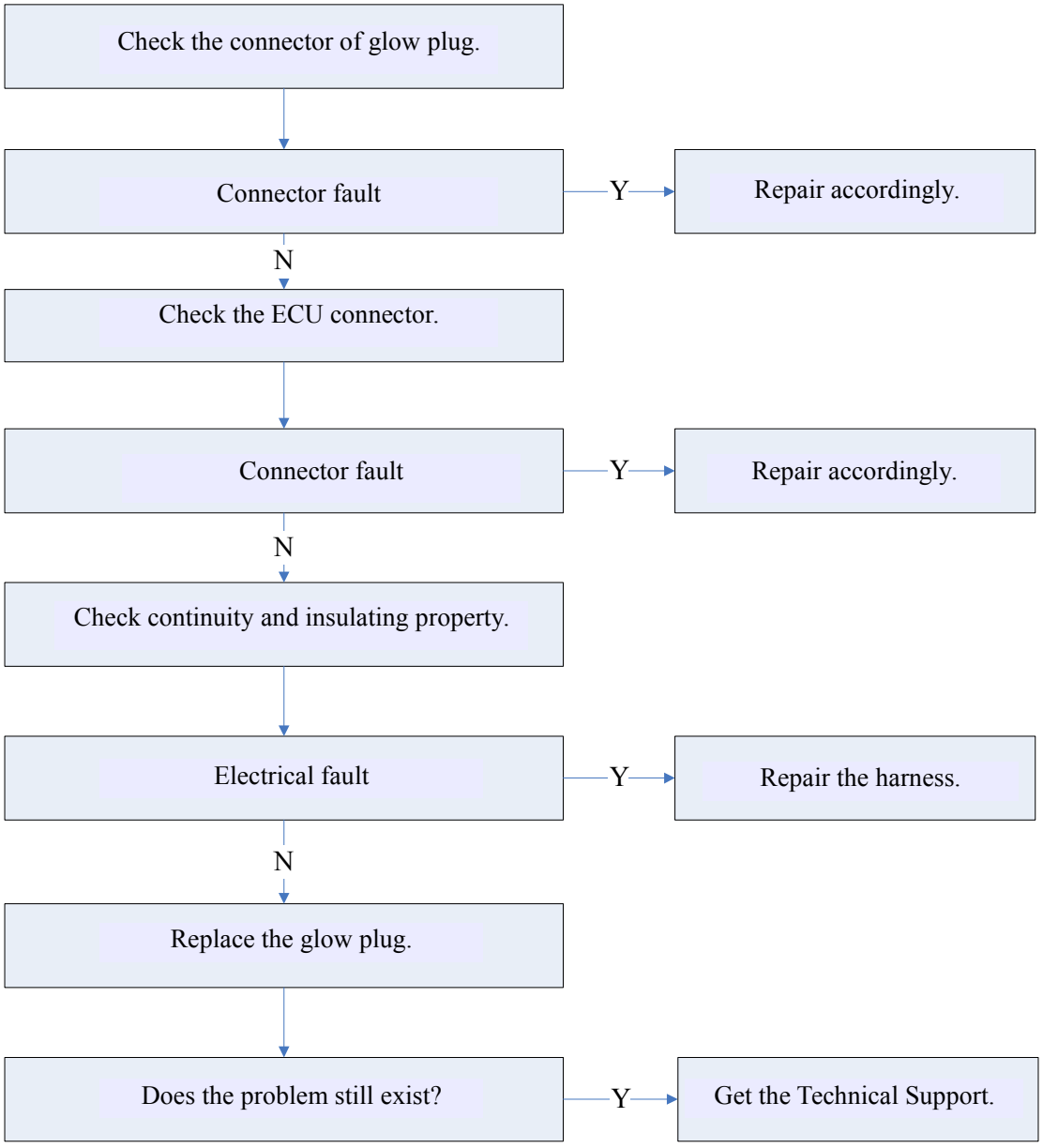
Poor contact between terminal and wire

Damage of harness – Check the harness for any damage

Terminal	ECU	
	K90	Control signal of preheating relay
	K57	Preheating time feedback signal

Fault Tree:

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14.

DTC	**P0500**	**Error of vehicle speed sensor acquisition hardware**
	P0501	**The vehicle speed sensor signal is unreliable.**

Fault Description: Vehicle speed sensor (VSS) provides vehicle speed signals to ECU. It is a kind of Hall Effect sensor. When the rotor gear tooth of transmission output shaft passes through the magnetic field of sensor, the VSS shall generate a signal voltage, whose frequency shall increase with the vehicle speed. The ECU shall convert the signal voltage into vehicle speed and make use of the vehicle speed signal to determine the working status of vehicle. If this signal is lost or abnormal, relevant DTCs shall be generated.

Diagnosis Hint: Check the harness for any damage. If the harness appears normal, observe the indication on the digital multimeter while moving relevant connector and harness of the actuator. If the indication changes in testing, there must be failure in that part. The intermittent failure may be caused by poor contact, abrasion of wire insulation or breakage of the wire inside insulation. Make sure the vehicle speed sensor is correctly fixed onto the transmission housing.

Terminal	ECU	
	K75	VVS input signal

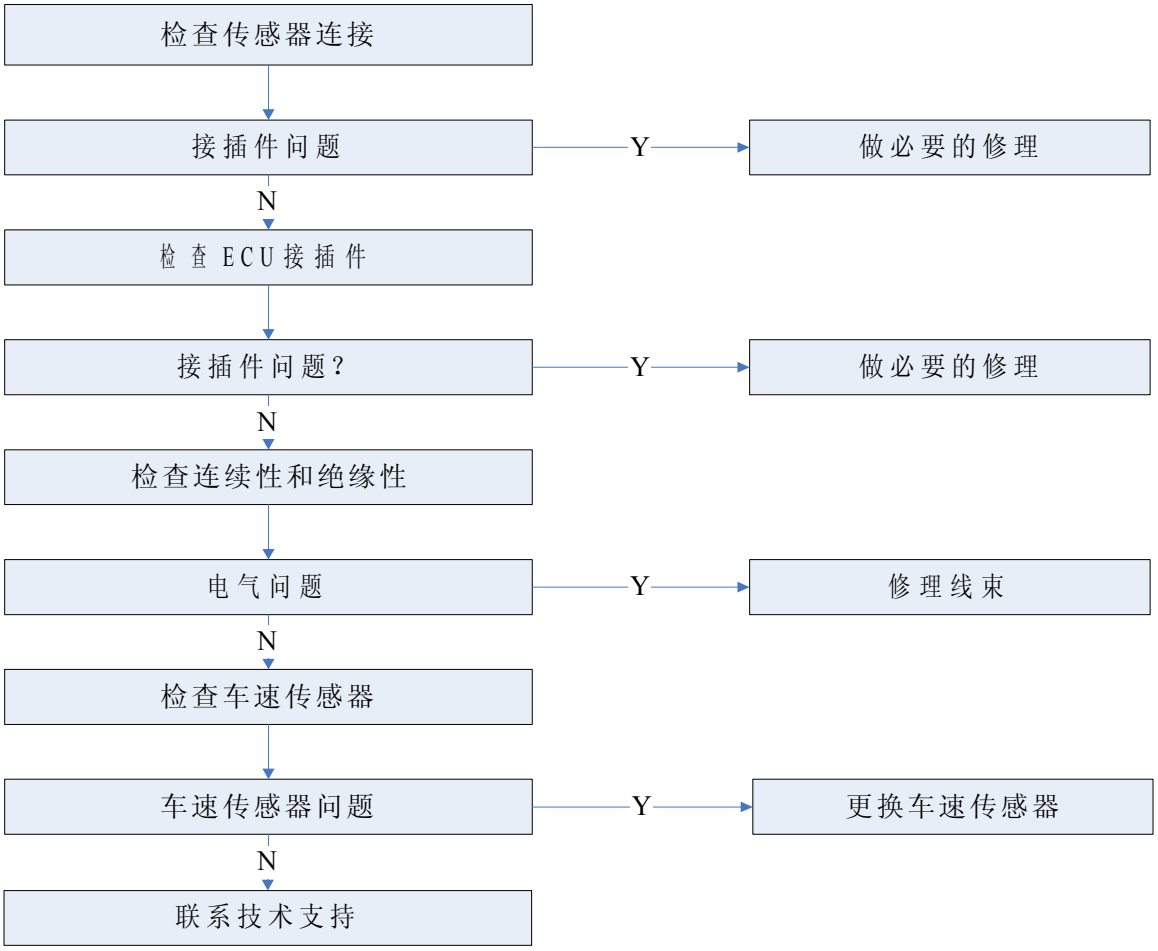
Fault Tree:

Check the sensor connection.

Connector fault

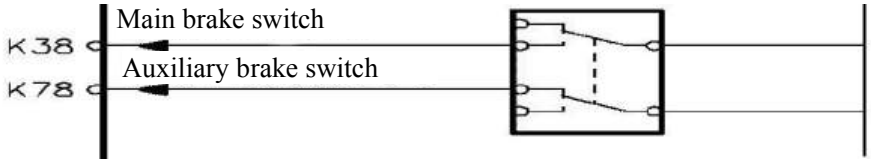
Repair accordingly.

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15.

DTC	P0504	Unreliable comparison between main and auxiliary brake pedal signals



Fault Description: The brake switch detects the brake pedal action and sends the signal to ECU. The brake switch is equipped with two switches, viz. main and auxiliary brake switches. When these two signals are input, these signals are determined by ECU to be normal brake signals. The switch signals are relevant to the accelerator pedal, for controlling the fuel amount during braking. There should be no failure when you operate the accelerator pedal at the point of depressing the brake pedal, but the fuel amount shall be reduced when you operate the accelerator pedal with the brake pedal depressed. If the voltage signal of brake switch is inconsistent with the actual, the DTC shall be generated.

Diagnosis Hint: Check the wiring connector for poor contact, distorted or damaged terminal.

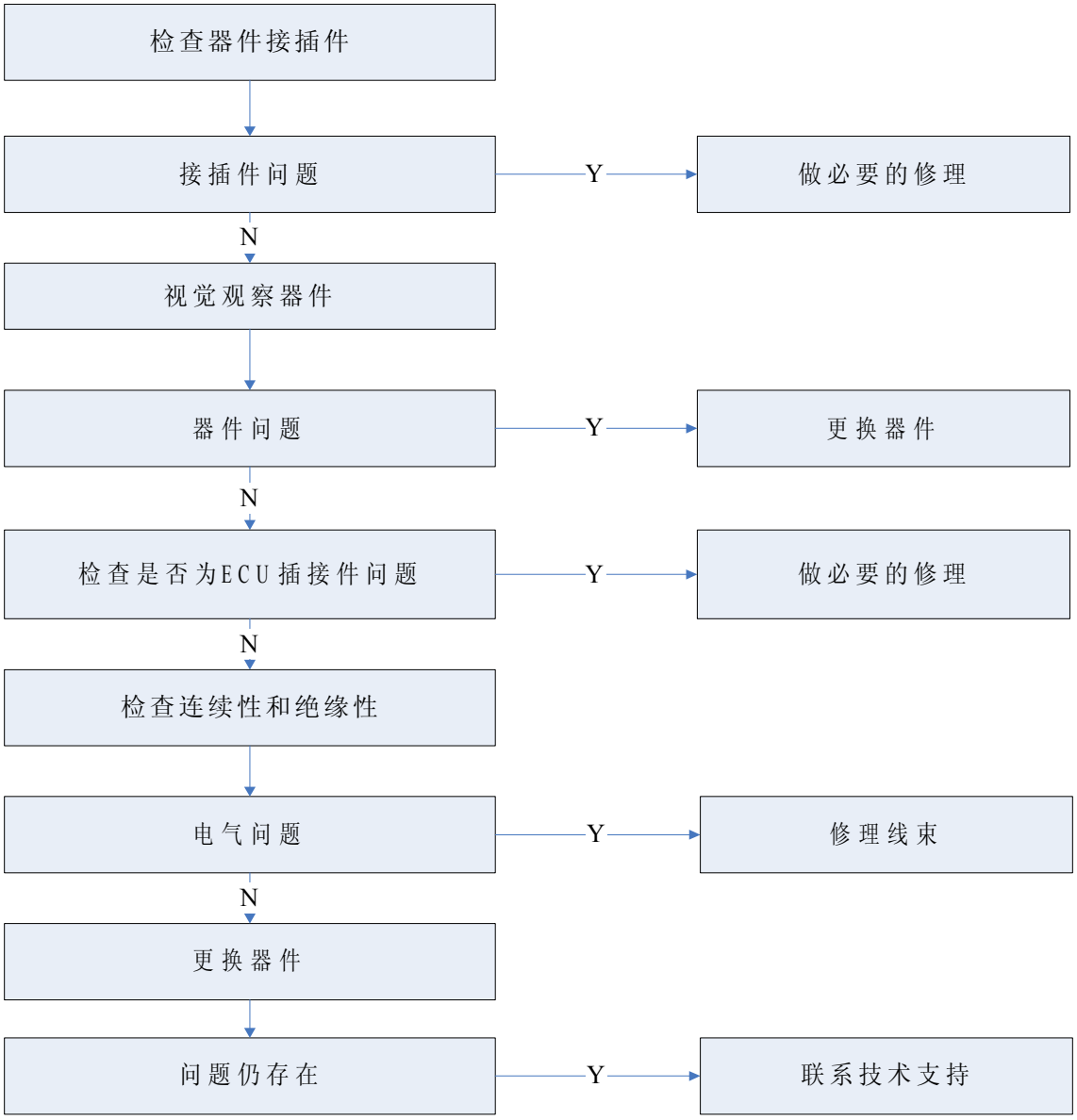
Terminal	ECU	
	K17	Main brake switch signal
	K80	Auxiliary brake switch signal

Fault Tree:

Check the component connector.

Connector fault

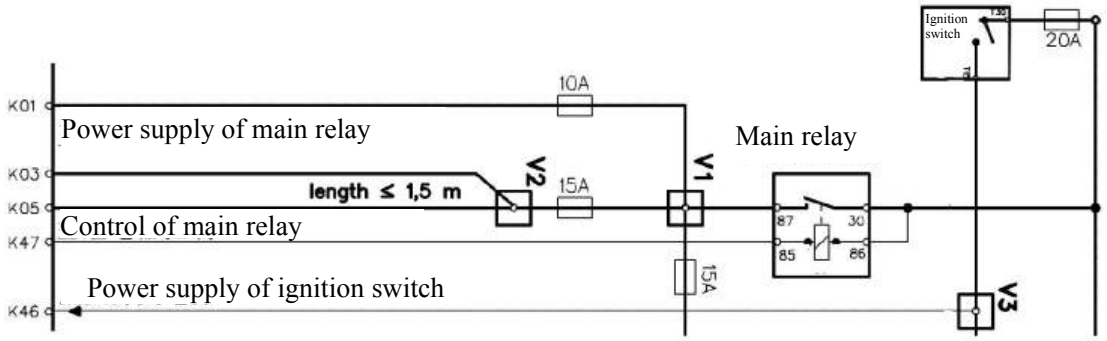
Repair accordingly.



16.

DTC	**P0562**	**Too low battery voltage**

	P0563	**Too high battery voltage**
	P1617	**The engine cannot be shut down with too high internal supply voltage.**
	P1618	**The engine cannot be shut down with too low internal supply voltage.**
	P1637	**Too high voltage in ECU internal power supply module**
	P1638	**Too low voltage in ECU internal power supply module**



Fault Description: The ECU monitors the system voltage via the ignition voltage circuit. When the voltage exceeds the set range, the parts may be damaged and the input reading may be incorrect. When the system voltage detected by ECU is too low (below 11V) or too high (above 16V), relevant DTCs shall be generated.

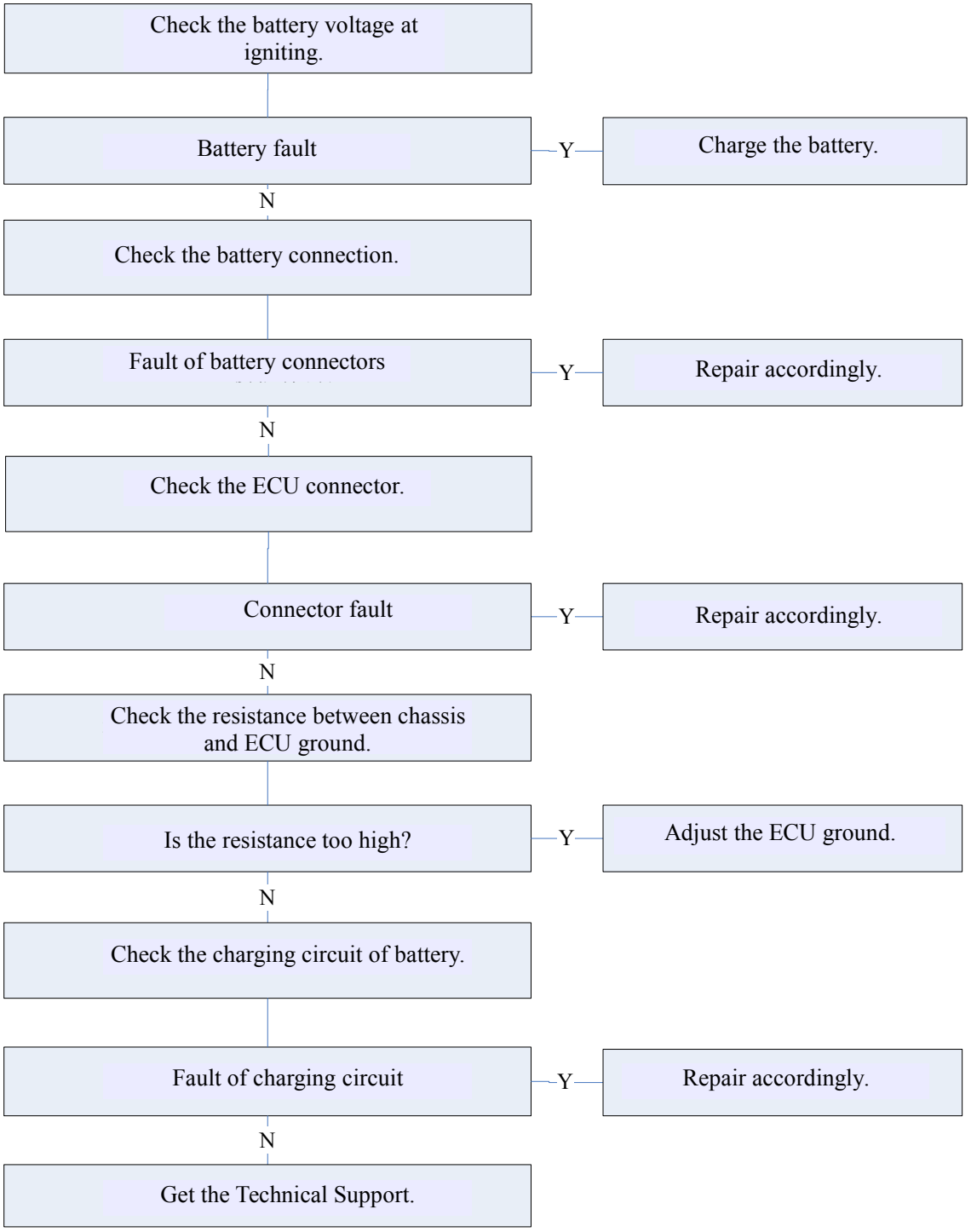
Diagnosis Hint: Check if the diagnostic system is normal.

Check if the charging system is normal.

Perform relevant test for intermittent failure or poor contact.

Terminal	ECU	
	K01	Positive battery terminal +Ra
	K03	Positive battery terminal +Rb
	K05	Positive battery terminal +Rc
	K47	Main relay control
	K46	Ignition switch power supply

Fault Tree:


Check the battery voltage at igniting.
Battery fault
Y
Charge the battery.
N
Check the battery connection.
Fault of battery connectors
Y
Repair accordingly.
N
Check the ECU connector.
Connector fault
Y
Repair accordingly.
N
Check the resistance between chassis and ECU ground.
Is the resistance too high?
Y
Adjust the ECU ground.
N
Check the charging circuit of battery.
Fault of charging circuit
Y
Repair accordingly.
N
Get the Technical Support.

17.

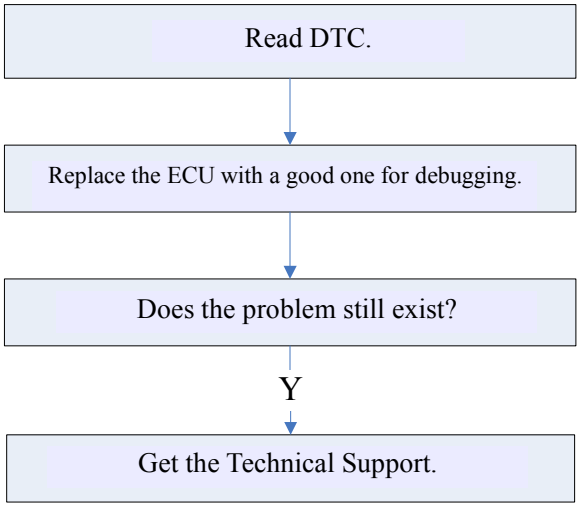
DTC	P060A	Communication failure of ECU internal chip CJ940

Fault Description: It is mainly used for monitoring the internal microprocessor integrity failure in ECU to determine whether the ECU program is executed. With engine OFF and ignition switch ON, the ECU shall perform self-diagnosis. If the self-diagnosis process is not finished, the control module shall record the corresponding operating condition and store this information into “Fault Records” to set DTC.

Diagnosis Hint: If the self-diagnosis process is finished smoothly, the current DTC shall be cleared.

If this diagnostic instrument and other diagnosis irrelevant to exhaust pass the test in 40 continuous preheating processes, the history DTC shall be cleared.

Fault Tree:



18.

DTC	P0642	Sensor supply voltage 1 is too low.

	P0643	**Sensor supply voltage 1 is too high.**
	P0652	**Sensor supply voltage 2 is too low.**
	P0653	**Sensor supply voltage 2 is too high.**

Fault Description: Due to the nature of sensor, some sensors require a voltage to finish the required function and operation. The supply voltage of sensor is supplied by ECU. The ECU shall calculate the required voltage of sensor according to its characteristic and supply the voltage to the sensor via control circuit. In the process of voltage signaling, DTCs may occur due to virtual connection or poor connection of control circuit, etc.

Sensor supply voltage 1: The power supply for accelerator pedal 1 and CMP sensor

Sensor supply voltage 2: The power supply for accelerator pedal 2, absolute pressure sensor and common rail pressure sensor.

Diagnosis Hint: Check the ECU power voltage for any fault. The power voltage detected by multimeter should generally be 5V. Check the voltage signal supplied to relevant sensor. The fault may be caused by virtual connection, poor contact of wire, abrasion of insulation or damage of the wire in insulation. Check the circuit for the following conditions:

– Loose terminal

– Poor matching and connection

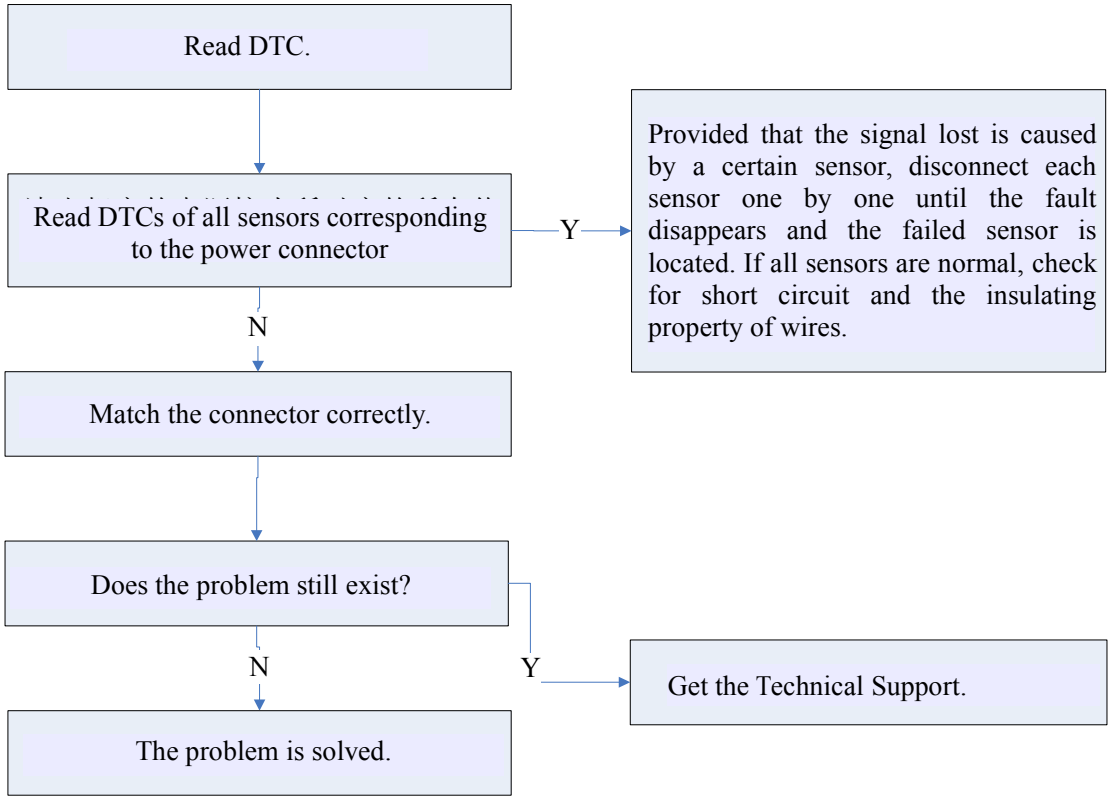
– Breakage of keeper

– Distortion or damage of terminal

– Poor contact between terminal and wire

– Damage of harness – Check the harness for any damage

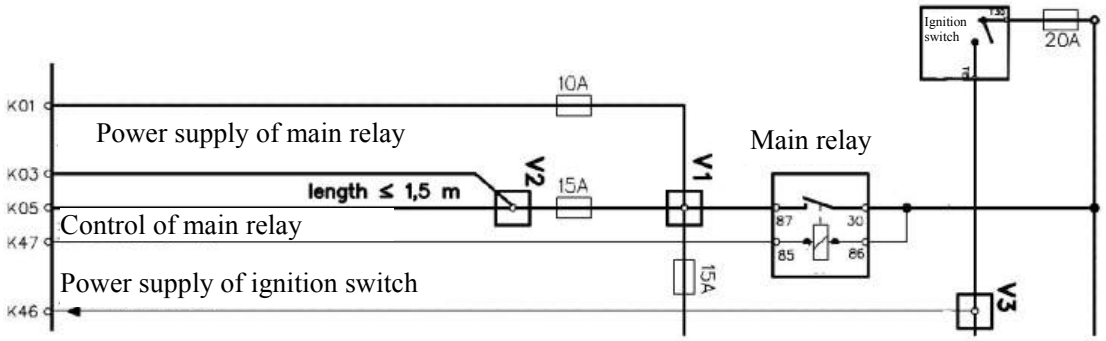
Fault Tree:


Read DTC.
Read DTCs of all sensors corresponding to the power connector
Y
Provided that the signal lost is caused by a certain sensor, disconnect each sensor one by one until the fault disappears and the failed sensor is located. If all sensors are normal, check for short circuit and the insulating property of wires.
N
Match the connector correctly.
Does the problem still exist?
N
Y
Get the Technical Support.
The problem is solved.

19.

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DTC	**P0686**	**The main relay opens too early.**
	P0687	**The main relay opens too late.**

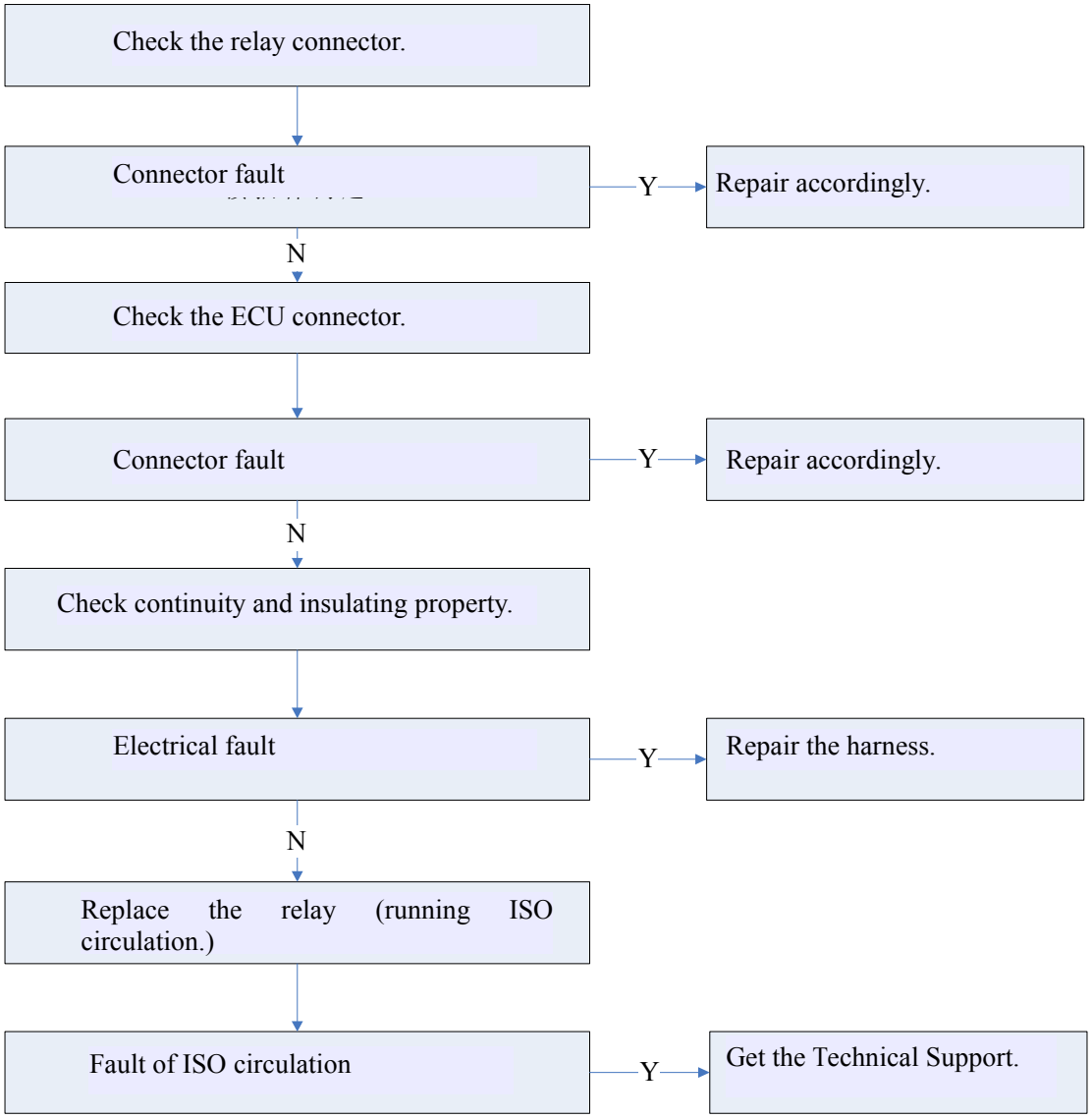


Fault Description: With the ignition switch OFF, the input circuit of main relay through K47 is actuated by V3 and ECU Pin K46 and the electromagnet picks up the contact of output circuit, so the output circuit of main relay is in continuity. Then, the power supply into the internal control module via ECU Pin K01, K03 and K05. If the ECU signal for relay control is distorted, DTC shall be generated.

Diagnosis Hint: The intermittent failure may be caused by poor contact, abrasion of wire insulation or breakage of the wire inside insulation. The ignition 1 relay fault shall lead to the failed starting of engine, for there is no voltage in the ignition coil or fuel injectors in electronic ignition system and they cannot work without being electrified.

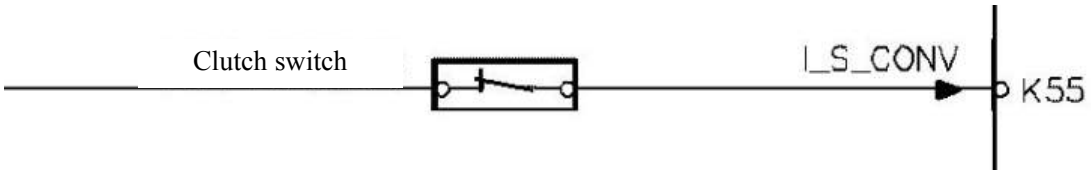
Terminal	ECU	
	K47	Main relay control signal

Fault Tree:



20.

DTC	**P0704**	**Clutch signals are unreliable.**



Fault Description: Transmission control unit (TCU) is integrated with engine control unit (ECU) and calculates optimal time and speed for clutch engagement according to feedback information from sensors of accelerator pedal, transmission gear position, transmission input/output shaft speed, engine speed, throttle opening and etc. Automatic transmission (AT) actuating mechanism consists of electric oil pump, solenoid valve and clutch cylinder. When ECU gives command to drive electric oil pump, high-pressure fluid generated in the pump goes through solenoid valve and gets into clutch cylinder. ECU controls magnitude of current of solenoid valve for the control of fluid flow and fluid passage change. Thus piston movement of clutch cylinder is realized in order to complete clutch operation during vehicle starting and shift. In the case of inconformity between clutch signal and actual condition, DTC occurs.

Diagnosis Hint: clutch switch fault

Check switch wire harness (Check Terminal 58 of ECU for open circuit, short circuit and poor contact.)

Check switch power supply voltage and operation condition.

Determine ECU replacement according to actual condition.

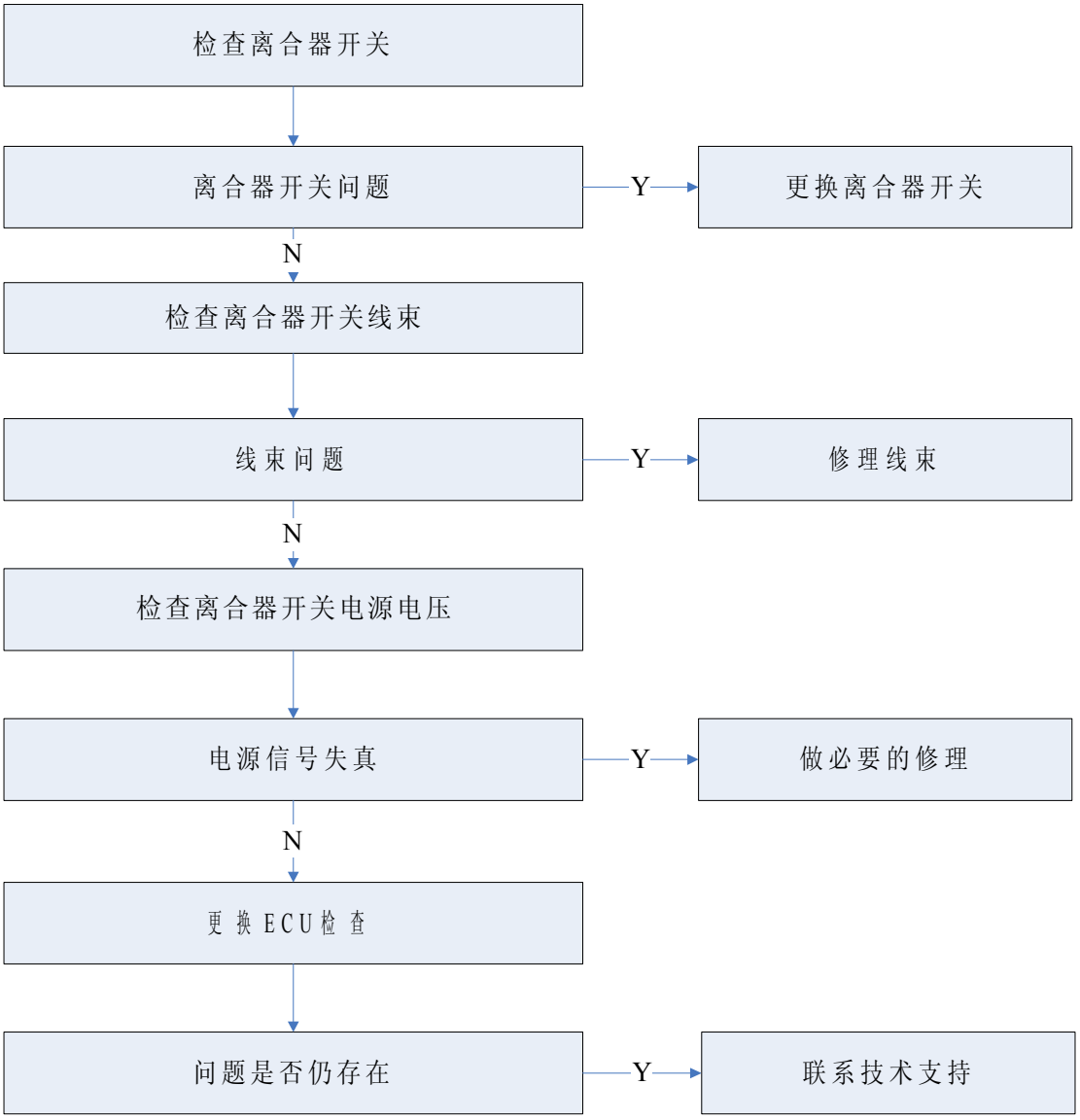
Terminals	ECU	
	K55	Clutch switch signal

Fault Tree:

Check clutch switch.

Clutch switch fault

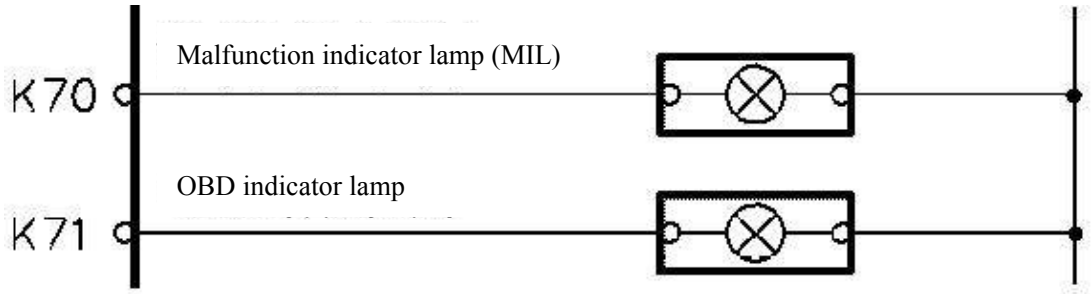
Replace the clutch switch.


检查离合器开关
离合器开关问题
Y
更换离合器开关
N
检查离合器开关线束
线束问题
Y
修理线束
N
检查离合器开关电源电压
电源信号失真
Y
做必要的修理
N
更换ECU检查
问题是否仍存在
Y
联系技术支持

21.

Maintenance manual for sunray hfc4da1-2c china-IV diesel engines

DTC	**P0650**	**There are faults (short circuit or open circuit) in ECU OBD malfunction indicator lamp (MIL) output connecting wire.**
	P1619	**Connection of ECU system MIL output connecting wire is short to high level.**
	P161A	**Connection of ECU system MIL output connecting wire is short to ground.**
	P161B	**ECU system MIL output connecting wire is open.**
	P161C	**ECU system MIL drive module is overheated.**



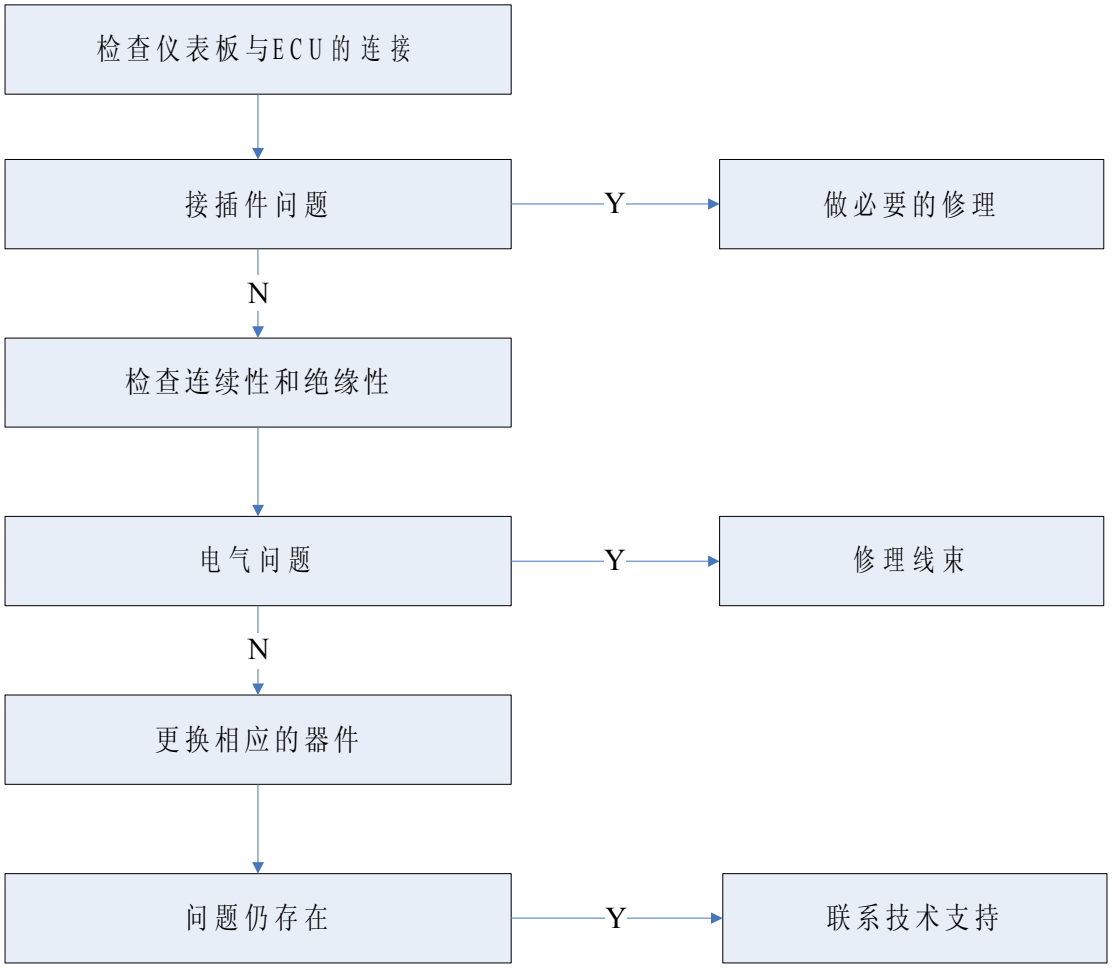
Fault Description: Malfunction indicator lamps (MIL) are located on instrument panel cluster (IPC). MILs inform driver about fault generation and necessary maintenance for engine control system. Control module monitors MIL control circuit for inconformity of commands for MILs. For example, when MIL is disconnected by command, control module monitors low voltage or when MIL is connected by command, control module monitors high voltage. This is indicated that there are faults. When control module discovers incorrect voltage or overhigh temperature of MIL control circuit, DTC occurs. In the case of 20 samplings for output status of MIL drive, open circuit or overhigh temperature faults are detected in 15 samplings at least. There are 100msec for each sampling. ECU detects incorrect output status or overlarge current of MIL drive and such status lasts for more than 2sec; for every 10 samplings of MIL drive output status, there are short circuit faults in 5 samplings at least with time consumption for each sampling process as 12.5msec and ECU detects short circuit for more than 1sec under MIL drive output status. In the case of conditions above, DTCs occur.

Diagnosis Hint: When short circuit fault is detected, control module should stop starting MIL drive within remained travel. Control module records operation condition when diagnosis is failed. For the first diagnosis failure, control module will keep this information in fault record. If diagnosis failure occurs during the second continuous ignition cycle, control module records operation condition under diagnosis failure and writes the operation condition in frozen fault condition and updates fault record.

Terminal	ECU	
	K70	System MIL output signal
	K71	OBD indicator lamp

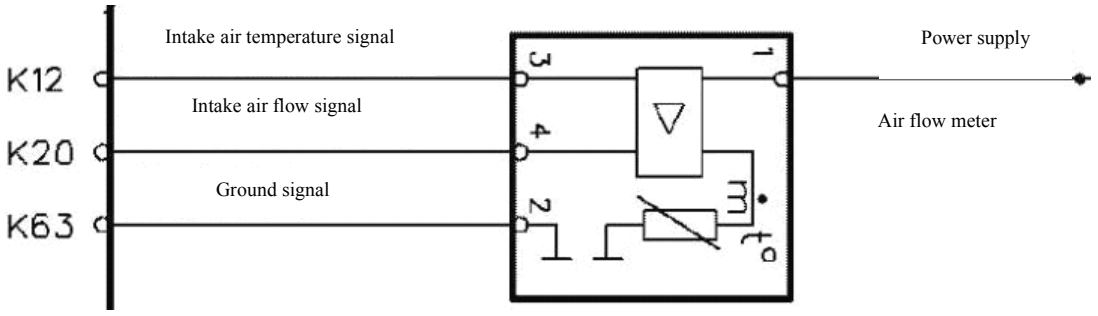
Fault Tree:

Check connection between instrument panel and ECU.


检查仪表板与ECU的连接
接插件问题
Y
做必要的修理
N
检查连续性和绝缘性
电气问题
Y
修理线束
N
更换相应的器件
问题仍存在
Y
联系技术支持

22.

DTC	**P0100**	**Mass air flow (MAF) signals measured by air flow meter without correction are too strong or too weak (Connection is in open circuit or short circuit).**
	P0101	**Mass air flow (MAF) signals measured by air flow meter with correction are too strong or too weak (Connection is in open circuit or short circuit).**
	P0102	**Mass air flow sensor negative drift**
	P0103	**Mass air flow sensor positive drift**
	P0104	**Mass air flow sensor zero drift**
	P1100	**Air mass flowmeter software correction is excessive.**



Fault Description: Mass air flow (MAF) sensor is an air flow meter which is used in measurement of air inflow of engine. ECU correctly supplies fuel supply with the use of signals from mass air flow sensor for all engine speeds and loads. In the case of small air inflow of engine, it is indicated there is vehicle deceleration or engine idling. In the case of large air inflow of engine, it is indicated there is vehicle acceleration or high engine load. Mass air flow (MAF) sensor possesses circuits as follows:

One ignition 1 voltage circuit

One ground circuit

One signal circuit

ECU applies a voltage to sensor via signal circuit. The sensor uses the voltage to generate a corresponding frequency for air inflow which gets through the sensor. During idle running, the frequency changes in the range around 2000Hz. ECU calculates predicted air flow value with input signals from sensors as follows:

Atmosphere pressure in the case of ignition key connection

Intake manifold absolute pressure sensor

Intake air temperature sensor

Engine coolant temperature sensor

Engine speed

ECU compares mass air flow sensor frequency signal with predicted air flow valve and verify signal lag (lack of change), too low or too high signal level under given operation condition with the comparison. When D-value between actual mass air flow sensor frequency signal which is detected by ECU and air flow meter calculated value is not in preconcerted range, DTC occurs.

Diagnosis Hint: Check mass air flow sensor harness and verify whether harness arrangement is too close to components as follows:

— Additional accessories after sale

— Secondary ignition wires or coils

— Solenoid valve

— Relay

— Motor

In the case of idle running or deceleration, air flow goes through sensor may reach its minimum and this may lead to DTC occurrence. Check down stream of mass air flow sensor for vacuum leaks. Check mass air flow sensing elements for affixed dirt or scraps. Check intake system for water penetration. Once there is water in mass air flow sensor, it will lead to sensor deviation and DTC occurrence.

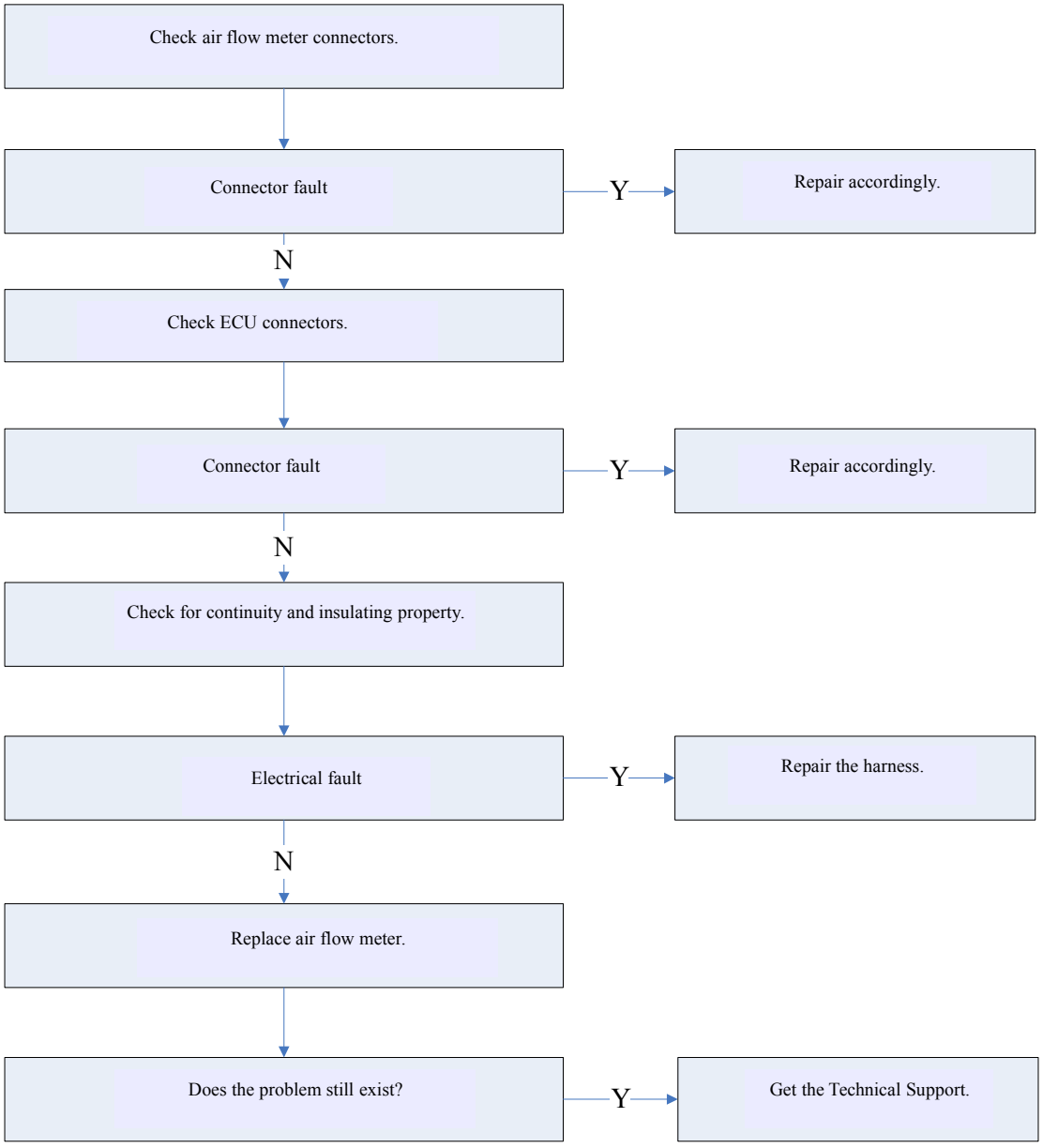
Wide open throttle during vehicle acceleration for starting may lead to rapid parameter increase of mass air flow sensor on fault diagnostic apparatus. In other words, 3-10g/sec during idle running will increase to 150g/sec for shift from the 1st gear to the 2nd. If parameters do not increase, check intake system and exhaust system for clogging.

Check engine coolant temperature sensor for deviation or lag.

In the case of too high resistance in ignition 1 voltage circuit (i.e. equals to or more than 15Ω), DTC occurs.

Terminal	ECU	
	K12	Intake air temperature signal
	K20	Intake air flow signal
	K63	Ground signal

Fault Tree:


Check air flow meter connectors.
Connector fault
Y
Repair accordingly.
N
Check ECU connectors.
Connector fault
Y
Repair accordingly.
N
Check for continuity and insulating property.
Electrical fault
Y
Repair the harness.
N
Replace air flow meter.
Does the problem still exist?
Y
Get the Technical Support.

23.

DTC	**P0110**	**Connection for additional air temperature sensor of air mass flowmeter is short or open.**
	P0112	**Temperature for additional air temperature sensor of air mass flowmeter is too low.**
	P0113	**Temperature for additional air temperature sensor of air mass flowmeter is too high.**
	P1101	**Analog output voltage for additional air temperature sensor of air mass flowmeter is too high or too low.**
	P1102	**Output duty ratio signal level of additional air temperature sensor of air mass flowmeter is too high or too low.**
	P1106	**Output duty ratio signal cycle of additional air temperature sensor of air mass flowmeter is too long.**
	P1107	**Output duty ratio signal cycle of additional air temperature sensor of air mass flowmeter is too short.**

Fault Description: Intake air temperature (IAT) sensor is a variable resistance for measurement of engine intake air temperature. Air temperature sensor possesses a signal circuit and a low reference voltage circuit. ECU provides air temperature sensor signal circuit with 5V voltage and provides air temperature sensor reference voltage circuit with grounding. When air temperature sensor is under cold status, sensor resistance value is high. When air temperature increases, sensor resistance value decreases. In the case of high sensor resistance, voltage of air temperature sensor signal circuit detected by ECU is high. With decrease of sensor resistance, voltage of air temperature sensor signal circuit detected by ECU reduces. In the case of too low detected air temperature signal voltage by ECU (it is indicated that temperature is too high) or too high signal voltage (it is indicated that temperature is too low), DTC for this occurs.

Differences among temperature, resistance and voltage are shown as the table below:

Temperature	Temperature Sensor Resistance	Temperature Sensor Signal Voltage
Low	High	High
High	Low	Low

Diagnosis Hint: Test air temperature sensor under different temperatures for evaluation of sensor errors. In the case of sensor error, there will be control performance fault. Lay the engine up for one night, D-value between air temperature sensor and engine coolant temperature sensor displayed values should be within 3°C (5°F). Please refer to “Temperature and Resistance”. In the case of too high resistance of temperature sensor signal circuit or low reference voltage circuit, DTC may not occur.

Check for the following conditions:

Check ECU harness connector for poor contact between ECU and temperature sensor

− Terminal looseness

− Poor fit of matching parts

− Locking plate fracture

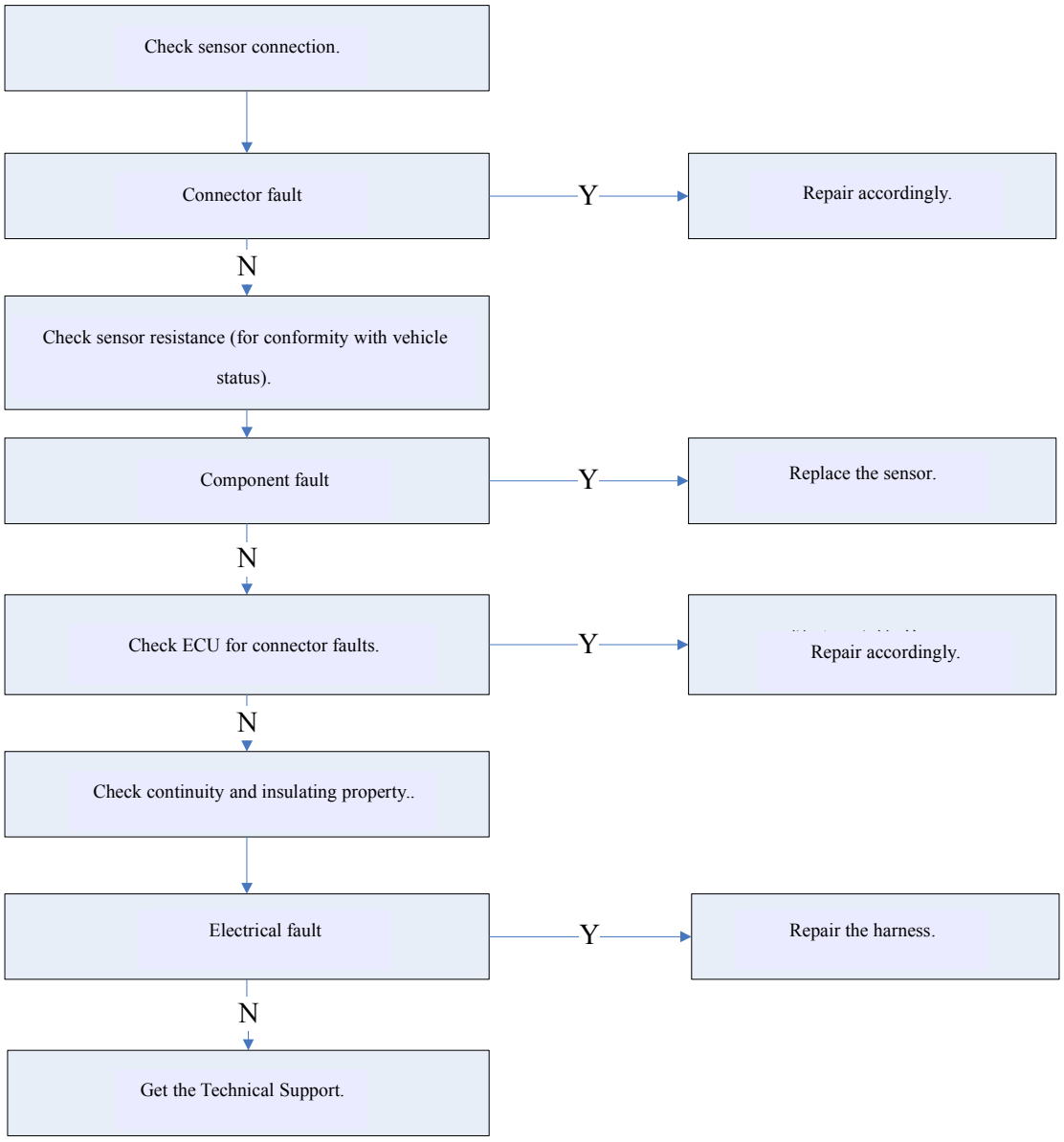
− Terminal deformation or damage

− Poor contact between terminal and wire

Check harness damage. If the harness seems to be normal, move relevant connector and harness for intake air

temperature (IAT) sensor and check display about IAT on diagnostic tool. If display of IAT changes, it is indicated that there is fault in the part.

Fault Tree:



24.

DTC	**P0300**	**Multi-cylinder misfire**

	P0301	**The 1st cylinder misfire**
	P0302	**The 2nd cylinder misfire**
	P0303	**The 3rd cylinder misfire**
	P0304	**The 4th cylinder misfire**

Fault Description: ECU determines when engine misfire occurs with the help of information from ignition control (IC) module and camshaft position (CMP) sensors. ECU can detect single misfire via crankshaft speed change for each cylinder. In the case of some vehicle running condition, too high misfire rate will lead to three way catalytic converter (TWC) overheating. In the case of three way catalytic converter overheating, MIL will flash. If misfire rate detected by ECU is enough to make emission level to exceed mandatory standard, DTC occurs. If diagnosis operation fails in two continuous ignition cycle, control module lightens MIL. Control module records operation condition when diagnosis is failed. For the first diagnosis failure, control module will keep this information in fault record. If diagnosis failure occurs during the successive ignition cycle, control module records operation condition under diagnosis failure and writes the operation condition in frozen fault condition and updates fault record.

Diagnosis Hint: Influence factors for misfire diagnosis—In the case of misfire diagnosis, it is required that all vehicle parts are under mass production or equivalent. All changes which may influence engine crankshaft speed will interfere with correct diagnosis for misfire.

In the case of faults in components as follows, misfire diagnosis will pause to avoid incorrect diagnostic results—intake pressure/throttle position rationality fault; low voltage or open circuit of intake pressure sensor circuit; high voltage of intake pressure sensor circuit; low voltage or open circuit of coolant temperature sensor circuit; high voltage of coolant temperature sensor circuit; high voltage of throttle position sensor; low voltage of throttle position sensor; signal interference of crankshaft position sensor circuit; no signals in crankshaft position sensor circuit; no signals in camshaft position sensor circuit; camshaft position sensor rationality fault; high voltage or open circuit of intake air temperature sensor circuit; low voltage of intake air temperature sensor circuit; no signals in vehicle speed sensor.

Severe vibration which is not caused by engine may lead to setting fault (vibration source may lead to wears or damages to brake discs with different thicknesses and additional drive belts).

Fault Tree:

Connector fault	Repair accordingly.

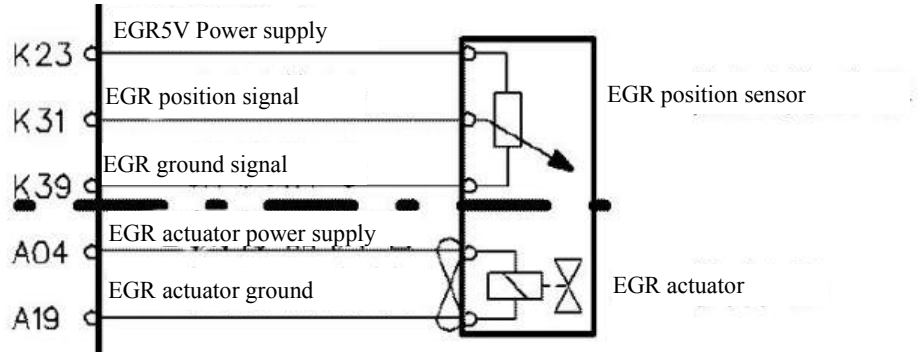
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25.

DTC	**P0401**	**Actual fresh air inflow is larger than target air inflow set by EGR system.**

	P0402	**Actual fresh air inflow is smaller than target air inflow set by EGR system.**
	P0403	**ECU internal drive module of EGR valve actuator control wire is overheated.**
	P0404	**EGR valve actuator control wire is open.**
	P0405	**Voltage of EGR valve position sensor is below the lower limit (Connection is short to ground).**
	P0406	**Voltage of EGR valve position sensor is above the upper limit (Connection is open short to high level).**
	P0489	**EGR valve actuator control wire is open.**
	P0490	**EGR valve actuator control wire is short to high level.**



Fault Description: Exhaust gas recirculation system is applied in reduction of Nitrogen oxides emission due to high temperature combustion. Main component of the system is electronic control exhaust gas recirculation valve. Exhaust gas recirculation valve delivers a small amount of exhaust gas into intake manifold to reduce combustion temperature. Recirculation gas flow is controlled by ECU according to changes in engine load. In the case of deceleration, gas flow test for exhaust gas recirculation (EGR) system is carried out by ECU. Therefore, ECU gives a transient command to open exhaust gas recirculation valve and simultaneously monitors signals of intake manifold air pressure (MAP) sensor and exhaust gas recirculation position sensor. In the case of inconformity of intake manifold absolute pressure signals with exhaust gas recirculation valve spool shaft position, ECU records measured D-value of intake manifold absolute pressure and adjust calibrated failure counter to failure technical threshold value. For error quantities of detected exhaust gas recirculation flow are different, required test times for exhaust gas recirculation flow concerned excessive failure technical threshold value of may be different, too. When ECU detects incorrect control signals, DTC occurs.

Diagnosis Hint: Carry out inspection to engine control system; check engine for historical faults; check exhaust gas recirculation system for faults as follows—vacuum leaks between exhaust gas recirculation valve and intake manifold. In the case of carbon deposition or exhaust gas noise around component faying surface, it is indicated there is external leakage. Check passage and exhaust gas recirculation valve for clogging; check exhaust system for relevant faults (such as leakage due to exhaust component damage, clogging due to excessive back pressure and too low engine vacuum and etc.); finally, carry out inspection to mechanical system.

Terminal	ECU	
	K23	EGR position sensor 5V power supply

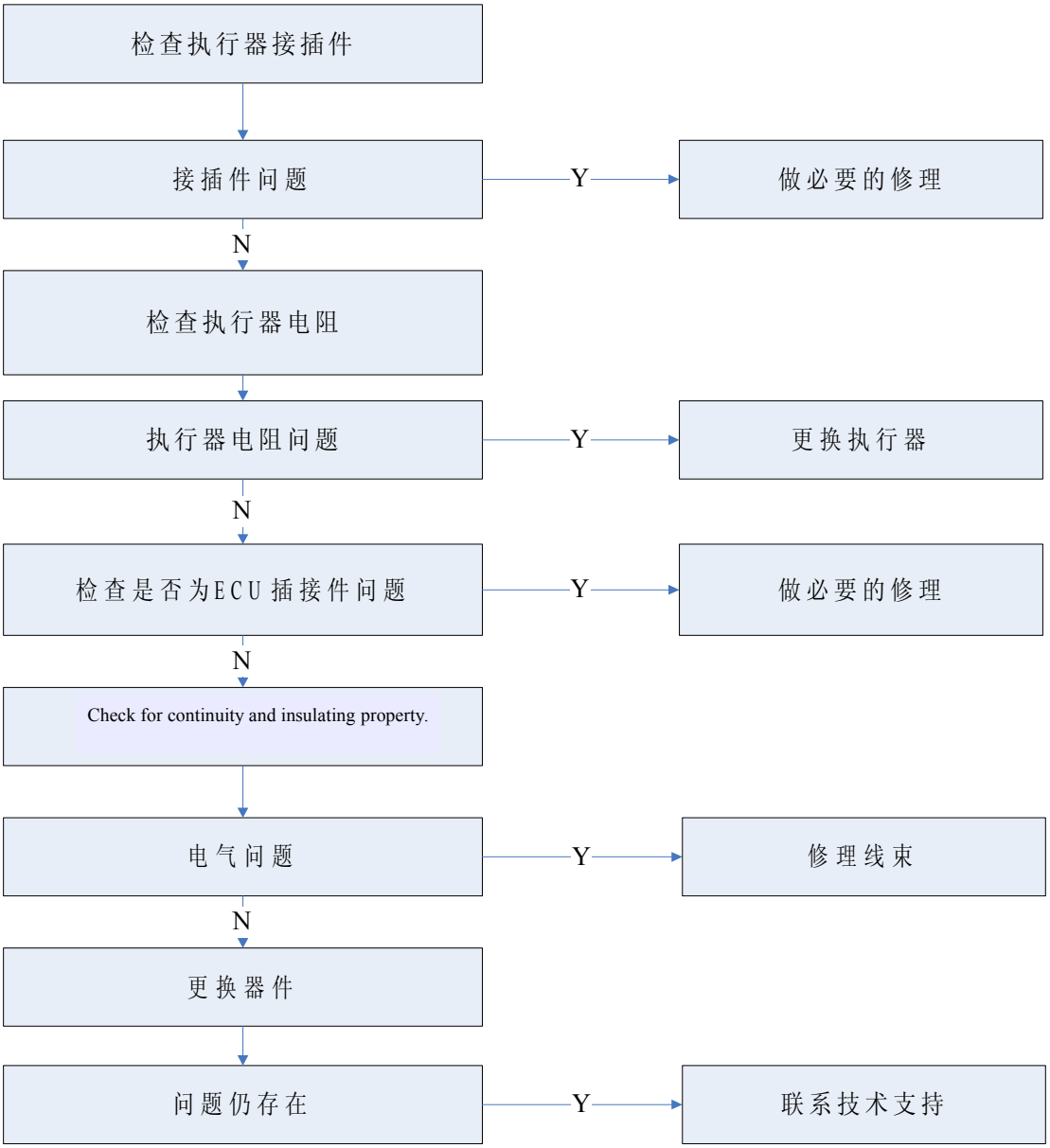
	K31	EGR position sensor position signal
	K39	EGR position sensor ground
	A04	EGR actuator power supply
	A19	EGR actuator ground

Fault Tree:

Check actuator connectors.

Connector fault

Repair accordingly.


检查执行器接插件
接插件问题
Y
做必要的修理
N
检查执行器电阻
执行器电阻问题
Y
更换执行器
N
检查是否为ECU插接件问题
Y
做必要的修理
N
Check for continuity and insulating property.
电气问题
Y
修理线束
N
更换器件
问题仍存在
Y
联系技术支持

26.

DTC	P0480	ECU Fan I control wire is open
	P0481	ECU Fan II control wire is open.
	P0483	ECU Fan I control wire internal drive module is overheated.
	P0484	ECU Fan II control wire internal drive module is overheated.
	P0691	ECU Fan I control wire is short to ground.
	P0692	ECU Fan I control wire is short to high level.
	P0693	ECU Fan II control wire is short to ground.
	P0694	ECU Fan II control wire is short to high level.

Fault Description: ECU provides low-speed relay with grounding via so-called “drive” internal solid component in order to control cooling fan low speed operation. For cooling fan high speed operation, ECU adopts the method of high speed and S/P replay control circuit grounding with simultaneous low-speed control circuit grounding. Battery positive voltage is provided to low-speed, high-speed and S/P fan relays. When ECU commands fan relay to be connected, control circuit voltage is low level which is close to 0V. When ECU commands fan relay to be disconnected, control circuit voltage should be high level which is close to battery voltage. ECU monitors relay control circuit for conditions as follows:

It is short to ground.

It is short to voltage.

It is open.

When ECU detects incorrect voltage in low-speed or high-speed drive circuit, DTC occurs and corresponding drive will stop operating.

Cooling Fan Relay I control circuit controls low-speed cooling fan relay.

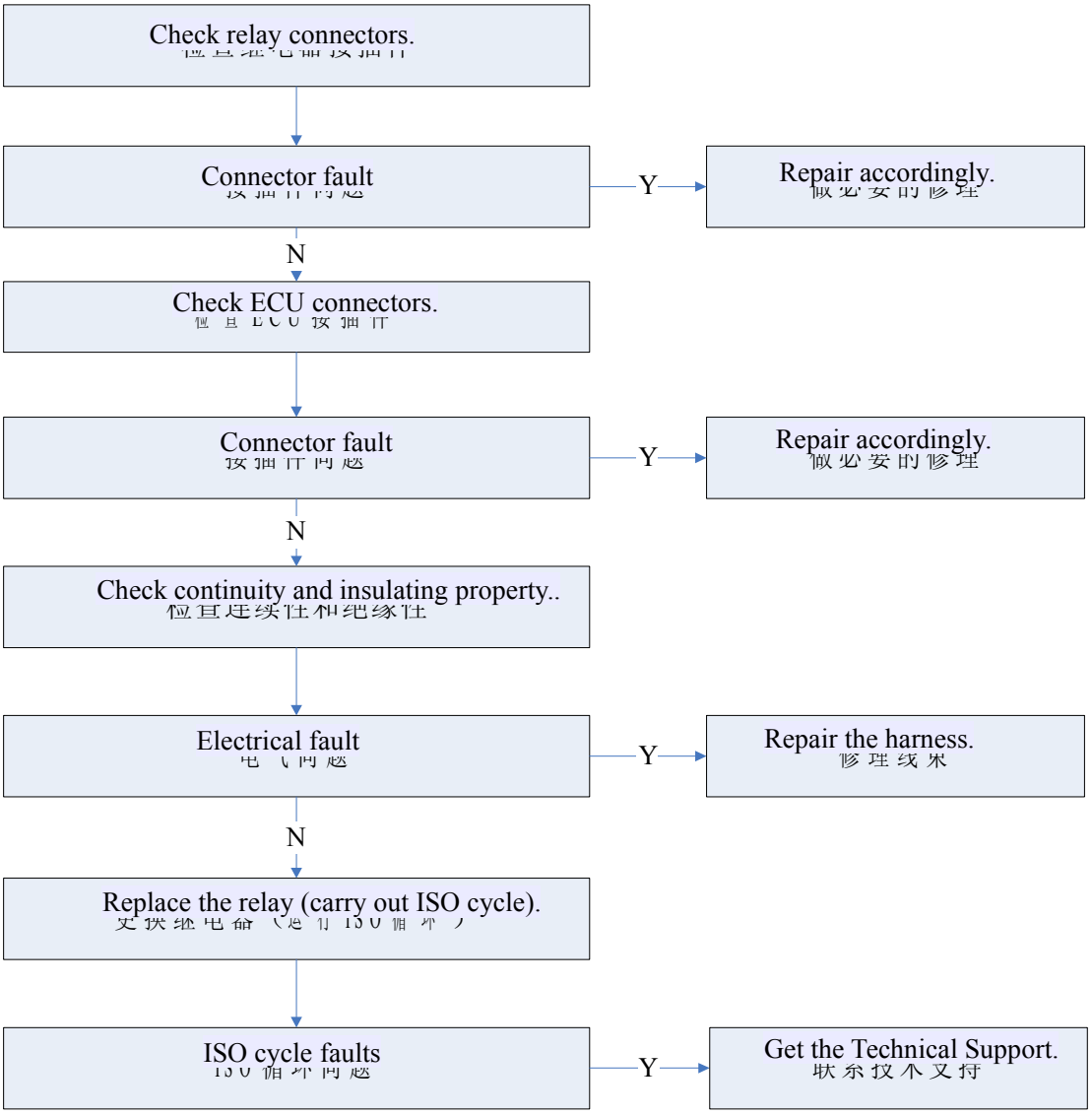
Cooling Fan Relay II control circuit controls high-speed cooling fan relay.

Diagnosis Hint: Check harness for intermittency and good contact.

Prior to maintenance, remove all fragments from connector surface. Check connector pads for correct installation to prevent contamination from entering prior to diagnosis and component replacement.

- Poor terminal connection—Check harness connectors for looseness, mismatching, retainer damage, improper shape or damage and connection failure with wires. Apply corresponding matching terminals for test of proper tension.
- Harness damage—Check wire harness for damage. In the case of no harness faults, move relevant connectors and wire harness and observe display of fault diagnostic apparatus. Fault diagnostic apparatus displays changes to indicate fault positions.
- Check ECU and engine ground connection for reliability and cleanness. If it is determined that DTC is an intermittent fault, please refer to Fault Record to check the time of last DTC occurrence.

Fault Tree:


Check relay connectors.
Connector fault
Y
Repair accordingly.
N
Check ECU connectors.
Connector fault
Y
Repair accordingly.
N
Check continuity and insulating property..
Electrical fault
Y
Repair the harness.
N
Replace the relay (carry out ISO cycle).
ISO cycle faults
Y
Get the Technical Support.

27.

Maintenance manual for sunray hfc4da1-2c china-IV diesel engines

DTC	P0487	Throttle valve actuator control wire is open.
	P0488	ECU internal drive module of throttle valve actuator is overheated.
	P2141	Throttle valve actuator control wire is short to ground.
	P2142	Throttle valve actuator control wire is short to high level.

Fault Description: ECU is the control center for throttle valve actuator control system. ECU can judge driver's intention and then calculate corresponding throttle valve response. ECU realizes throttle valve positioning via providing throttle valve actuator control motor with pulse width modulation (PWM) voltage. Throttle valve actuator control system adopts circuits as follows:

Motor control 1

Motor control 2

Besides, two processors are applied in throttle valve actuator control system data monitoring. These two processors are located in ECU, testing data of each other to prove correctness of throttle valve position.

Diagnosis Hint: Check for connection and disconnection faults or seizures due to temperature. Under extremely hot or cold condition, existed contaminations or freeze may lead to unsmooth component movement.

If it is an intermittent fault, the possible causes may be poor contact, worn wire insulating layer or damaged wire in insulating layer.

Check for the following conditions:

- Poor contact of ECU or exhaust brake valve—Check harness connectors.

– Terminal looseness

– Poor fit of matching parts

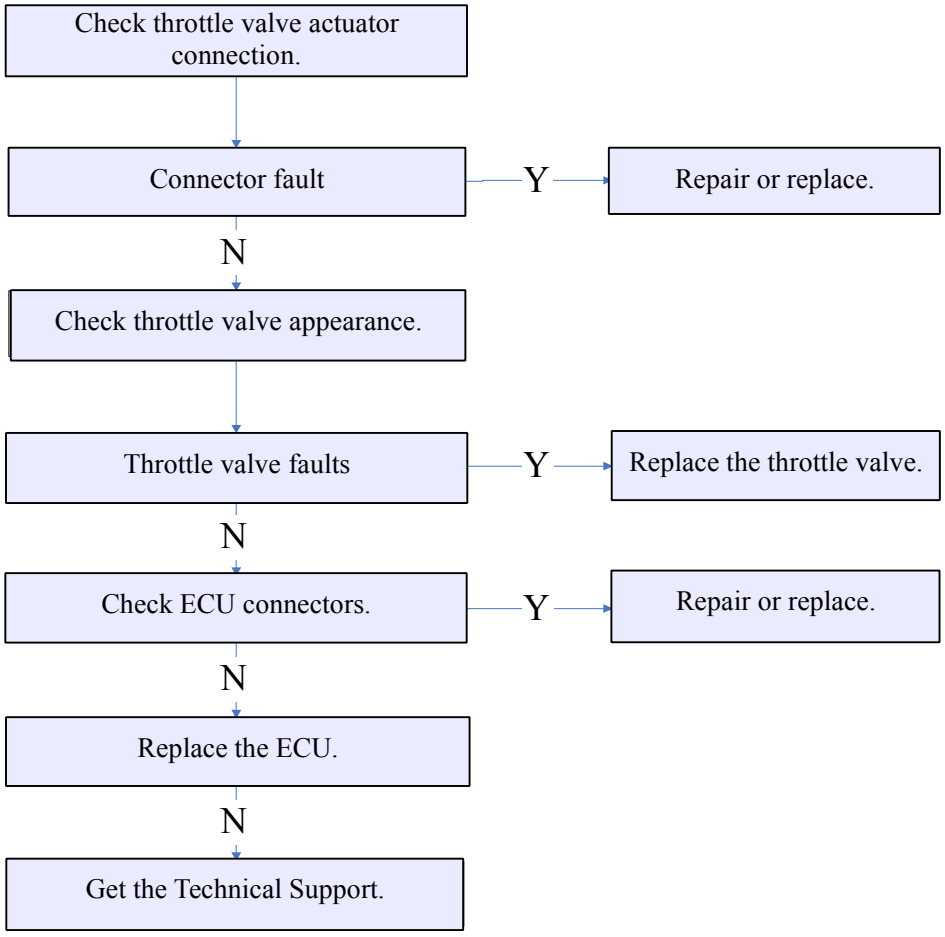
–Locking plate fracture

–Terminal deformation or damage

–Poor contact between terminal and wire

- Harness damage—Check harness for damage.

Fault Tree:


Check throttle valve actuator connection.
Connector fault
Y
Repair or replace.
N
Check throttle valve appearance.
Throttle valve faults
Y
Replace the throttle valve.
N
Check ECU connectors.
Y
Repair or replace.
N
Replace the ECU.
N
Get the Technical Support.

28.

DTC	P0615	ECU starting motor control wire is open or drive module is overheated.
	P0616	ECU starting motor control wire is short to ground.
	P0617	ECU starting motor control wire is short to high level.

Fault Description: ECU provides starting motor with grounding via so-called “drive” internal solid component in order to control starting motor operation. Under starting motor control circuit command, when fault diagnostic apparatus is connected, it is indicated that starting motor circuit is grounded via control module in order to provide starting motor with voltage; when fault diagnostic apparatus is disconnected, it is indicated that starting motor circuit is not connected via control module command currently. ECU monitors starting motor circuit for conditions as follows:

It is short to ground.

It is short to voltage.

It is open.

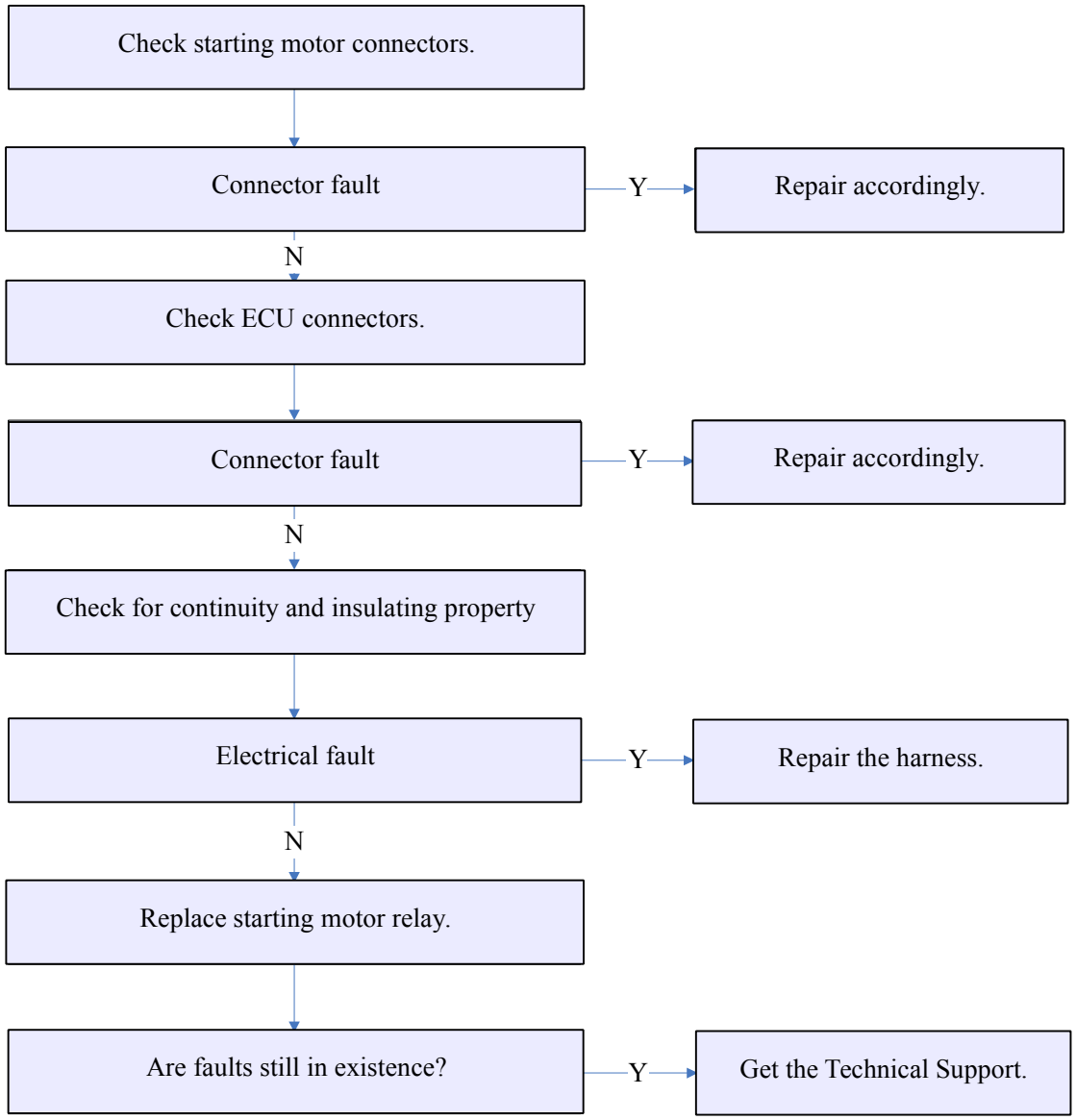
When ECU detects incorrect voltage signals, DTC occurs and corresponding drive will stop operating.

Diagnosis Hint: Check harness for intermittency and good contact.

Prior to component maintenance, remove all fragments from connector surface. Check connector pads for correct installation to prevent contamination from entering prior to diagnosis and component replacement.

- Poor terminal connection—Check harness connectors for looseness, mismatching, retainer damage, improper shape or damage and connection failure with wires. Apply corresponding matching terminals for test of proper tension.
- Harness damage—Check wire harness for damage. In the case of no harness faults, move relevant connectors and wire harness and observe display of fault diagnostic apparatus. Fault diagnostic apparatus displays changes to indicate fault positions.
- Check ECU and engine ground connection for reliability and cleanness. If it is determined that DTC is an intermittent fault, please refer to Fault Record to check the time of last DTC occurrence.

Fault Tree:



29.

DTC	**P1605**	**ECU instrument panel engine speed output connecting wire is short to high**

		level.
	P1606	**ECU instrument panel engine speed output connecting wire is short to ground.**
	P1607	**ECU instrument panel engine speed output connecting wire is open.**

Fault Description: Vehicle speed sensor (VSS) provides ECU with vehicle speed information. When rotor teeth on transmission output shaft go through sensor magnetic field, vehicle speed sensor generates signal voltage. Frequency of this signal voltage increases with vehicle speed increase. ECU transforms the signal voltage into vehicle speed and displays the speed on instrument panel via control circuit. ECU determines vehicle operation condition with vehicle speed signals in order to guide driver operation. ECU monitors the circuit between ECU and instrument panel for conditions as follows:

It is short to ground.

It is short to voltage.

It is open.

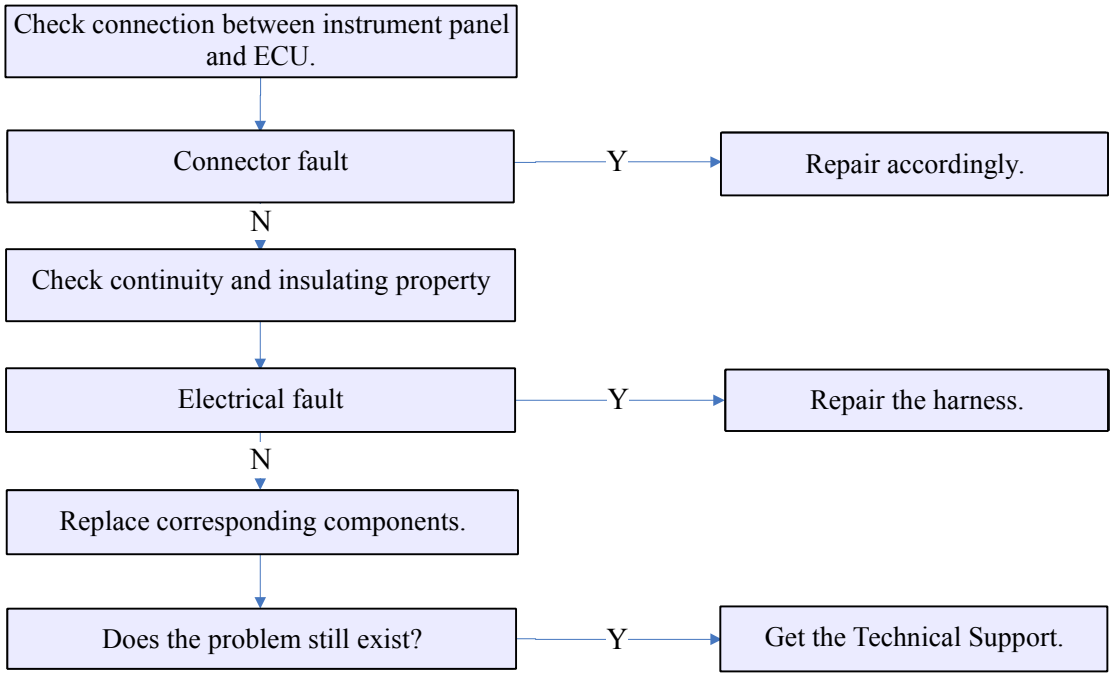
When ECU detects incorrect voltage signals, DTC occurs

Diagnosis Hint: Check harness for intermittency and good contact.

Prior to component maintenance, remove all fragments from connector surface. Check connector pads for correct installation to prevent contamination from entering prior to diagnosis and component replacement.

- Poor terminal connection—Check harness connectors for looseness, mismatching, retainer damage, improper shape or damage and connection failure with wires. Apply corresponding matching terminals for test of proper tension.
- Harness damage—Check wire harness for damage. In the case of no harness faults, move relevant connectors and wire harness and observe display of fault diagnostic apparatus. Fault diagnostic apparatus displays changes to indicate fault positions.
- Check ECU and engine ground connection for reliability and cleanness. If it is determined that DTC is an intermittent fault, please refer to Fault Record to check the time of last DTC occurrence.

Fault Tree:


Check connection between instrument panel and ECU.
Connector fault
Y
Repair accordingly.
N
Check continuity and insulating property
Electrical fault
Y
Repair the harness.
N
Replace corresponding components.
Does the problem still exist?
Y
Get the Technical Support.

30.

DTC	**P1608**	**ECU instrument panel preheating indicator lamp output connecting wire is short to high level.**
	P1609	**ECU instrument panel preheating indicator lamp output connecting wire is short to ground.**
	P160A	**ECU instrument panel preheating indicator lamp output connecting wire is open.**
	P160B	**ECU instrument panel preheating indicator lamp output wire drive module is overheated.**

Fault Description: During glow plug operation, preheater relay will send a signal to ECU. Then, ECU sends command to preheating indicator lamp on instrument panel via control circuit. Driver carries out the next operation via observing preheating indicator lamp status. ECU monitors the circuit between ECU and instrument panel for conditions as follows:

It is short to ground.

It is short to voltage.

It is open.

When ECU detects incorrect voltage signals, DTC occurs.

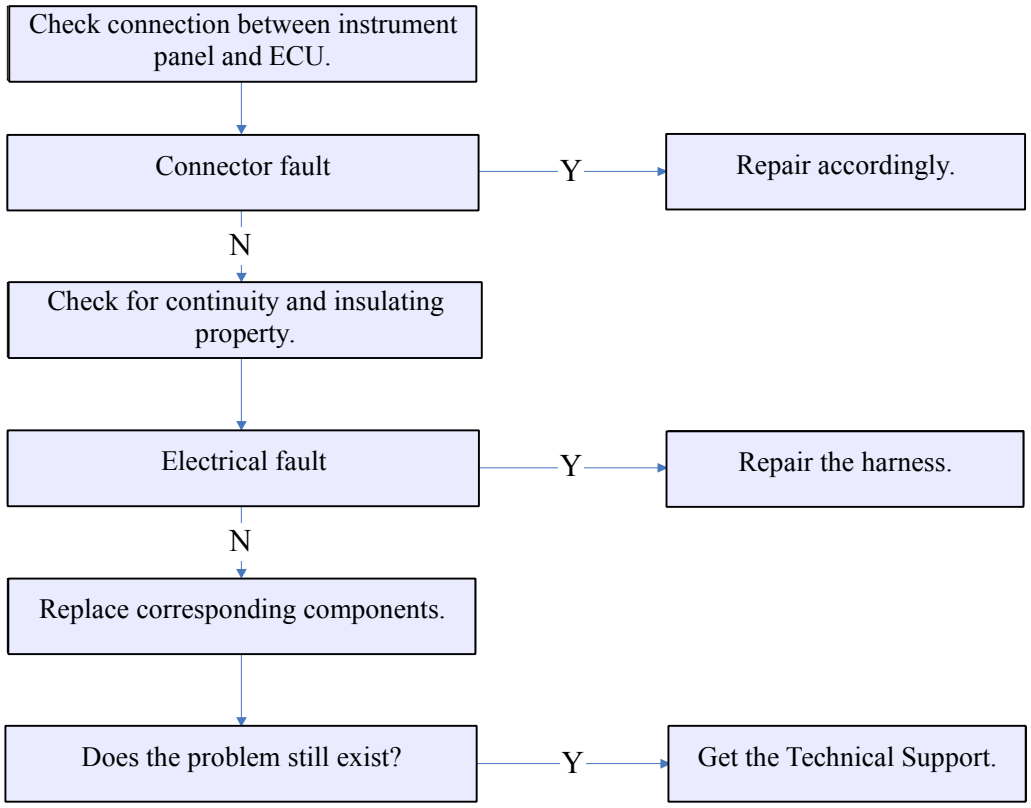
Diagnosis Hint: Check harness for intermittency and good contact.

Prior to component maintenance, remove all fragments from connector surface. Check connector pads for correct installation to prevent contamination from entering prior to diagnosis and component replacement.

- Poor terminal connection—Check harness connectors for looseness, mismatching, retainer damage, improper shape or damage and connection failure with wires. Apply corresponding matching terminals for test of proper tension.
- Harness damage—Check wire harness for damage. In the case of no harness faults, move relevant connectors and wire harness and observe display of fault diagnostic apparatus. Fault diagnostic apparatus displays changes to indicate fault positions.
- Check ECU and engine ground connection for reliability and cleanness. If it is determined that DTC is an intermittent fault, please refer to Fault Record to check the time of last DTC occurrence.

Terminal	ECU	
	K92	Preheating time indicator lamp

Fault Tree:


Check connection between instrument panel and ECU.
Connector fault
Y
Repair accordingly.
N
Check for continuity and insulating property.
Electrical fault
Y
Repair the harness.
N
Replace corresponding components.
Does the problem still exist?
Y
Get the Technical Support.

31.

Maintenance manual for sunray hfc4da1-2c china-IV diesel engines

DTC	P2228	**Atmosphere pressure sensor output voltage is too low.**
	P2229	**Atmosphere pressure sensor output voltage is too high.**

Fault Description: Atmosphere pressure indicates connection of ignition switch. When engine stops operation, control module calculates atmosphere pressure with signals sent by intake manifold absolute pressure sensor. Intake manifold absolute pressure sensor responses to internal pressure changes of intake manifold and the pressure changes according to different engine loads. Intake manifold absolute pressure sensor possesses circuits as follows:

5V reference voltage circuit

Low reference voltage circuit

Intake manifold absolute pressure sensor signal circuit

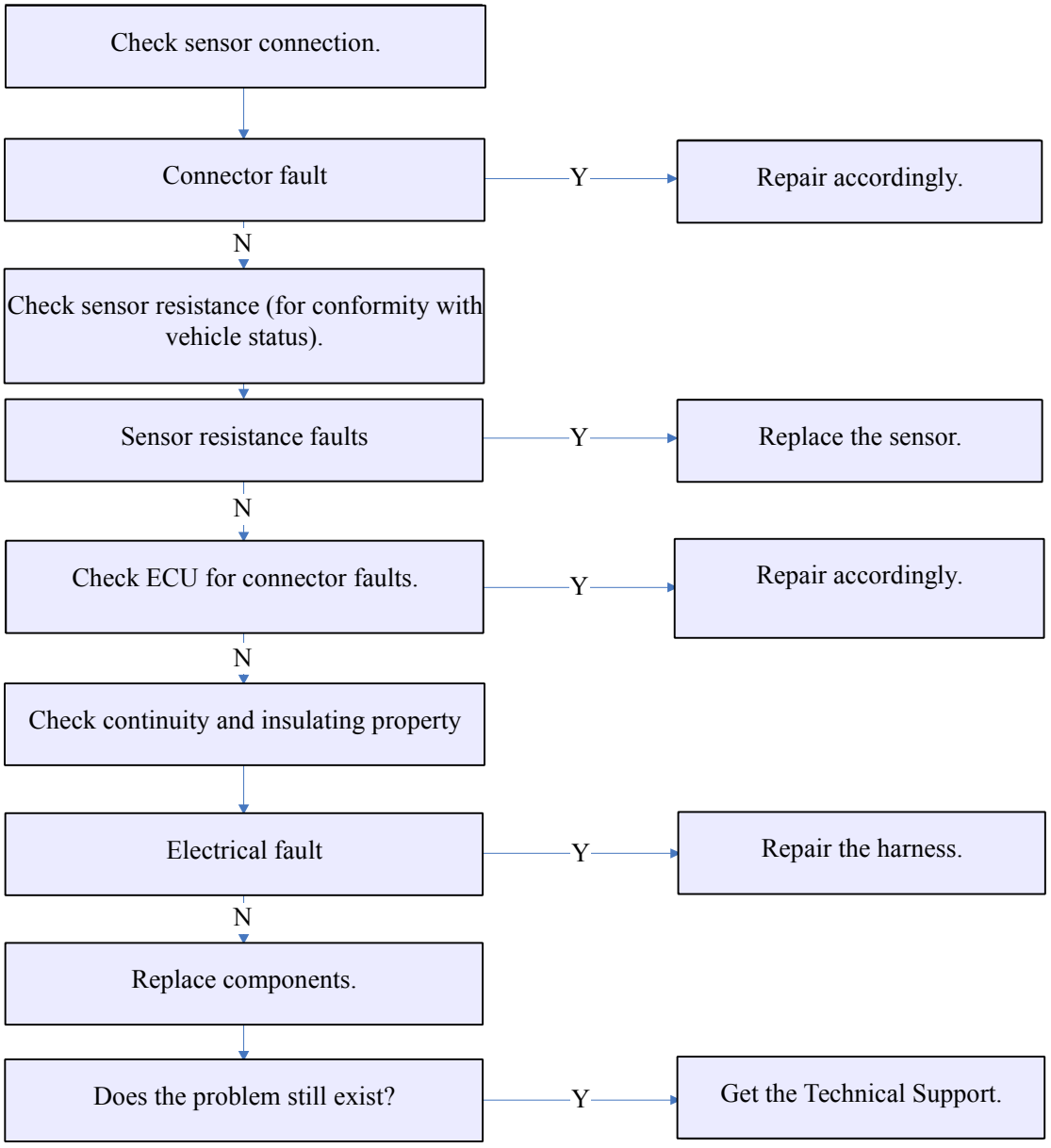
ECU provides intake manifold absolute pressure sensor with 5V voltage via 5V reference voltage circuit. ECU supplies grounding via low reference voltage circuit and intake manifold absolute pressure sensor provides ECU with a signal via signal circuit. This signal is related to intake manifold internal pressure changes. When ignition switch is connected and engine is shut down, intake manifold absolute pressure sensor displays signals of atmosphere pressure. In the case of engine running with wide open throttle, reading of atmosphere pressure will be renewed. ECU determines whether voltage exceeds normal range via detecting intake manifold absolute pressure sensor signals. When intake manifold absolute pressure sensor displays atmosphere pressure, if sensor signal voltage is not in specified range, DTC occurs.

Diagnosis Hint: When ignition switch is connected and engine is shut down, intake manifold pressure equals to atmosphere pressure and signal voltage is low level. ECU takes this information as vehicle elevation indication. Moreover, to make comparison between this reading with that of an intact vehicle which possesses the same sensor is a good method for sensor accuracy inspection. D-value of two readings should not exceed 0.4V. It is necessary to carry out comprehensive inspection to pressure source of supercharger pressure sensor in order to check intake system for clogging.

In the case of engine start, intake manifold absolute pressure sensor can detect any change of manifold pressure. This test is carried out to determine sensor lag at a certain value.

In the case of normal intake manifold absolute pressure sensor, it will make rapid response to changes of acceleration pedal positions and it should not be “lagged” or slower than changes of acceleration pedal position.

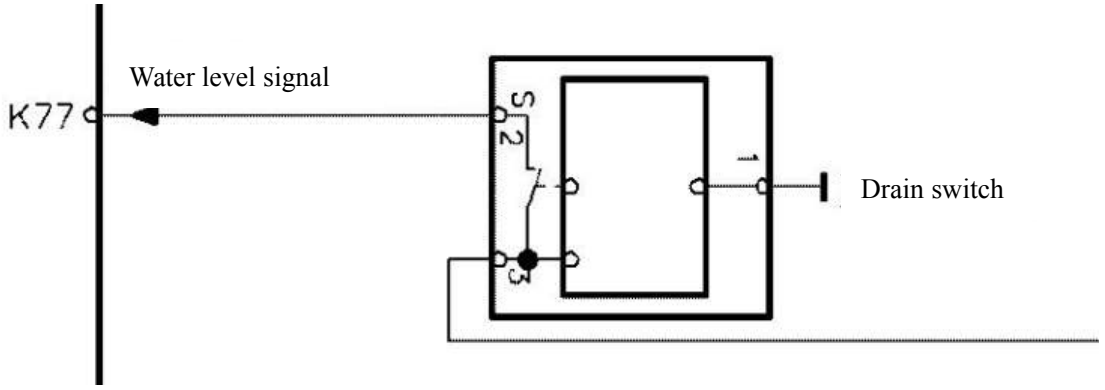
Fault Tree:


Check sensor connection.
Connector fault
Y
Repair accordingly.
N
Check sensor resistance (for conformity with vehicle status).
Sensor resistance faults
Y
Replace the sensor.
N
Check ECU for connector faults.
Y
Repair accordingly.
N
Check continuity and insulating property
Electrical fault
Y
Repair the harness.
N
Replace components.
Does the problem still exist?
Y
Get the Technical Support.

32.

Maintenance manual for sunray hfc4da1-2c china-IV diesel engines

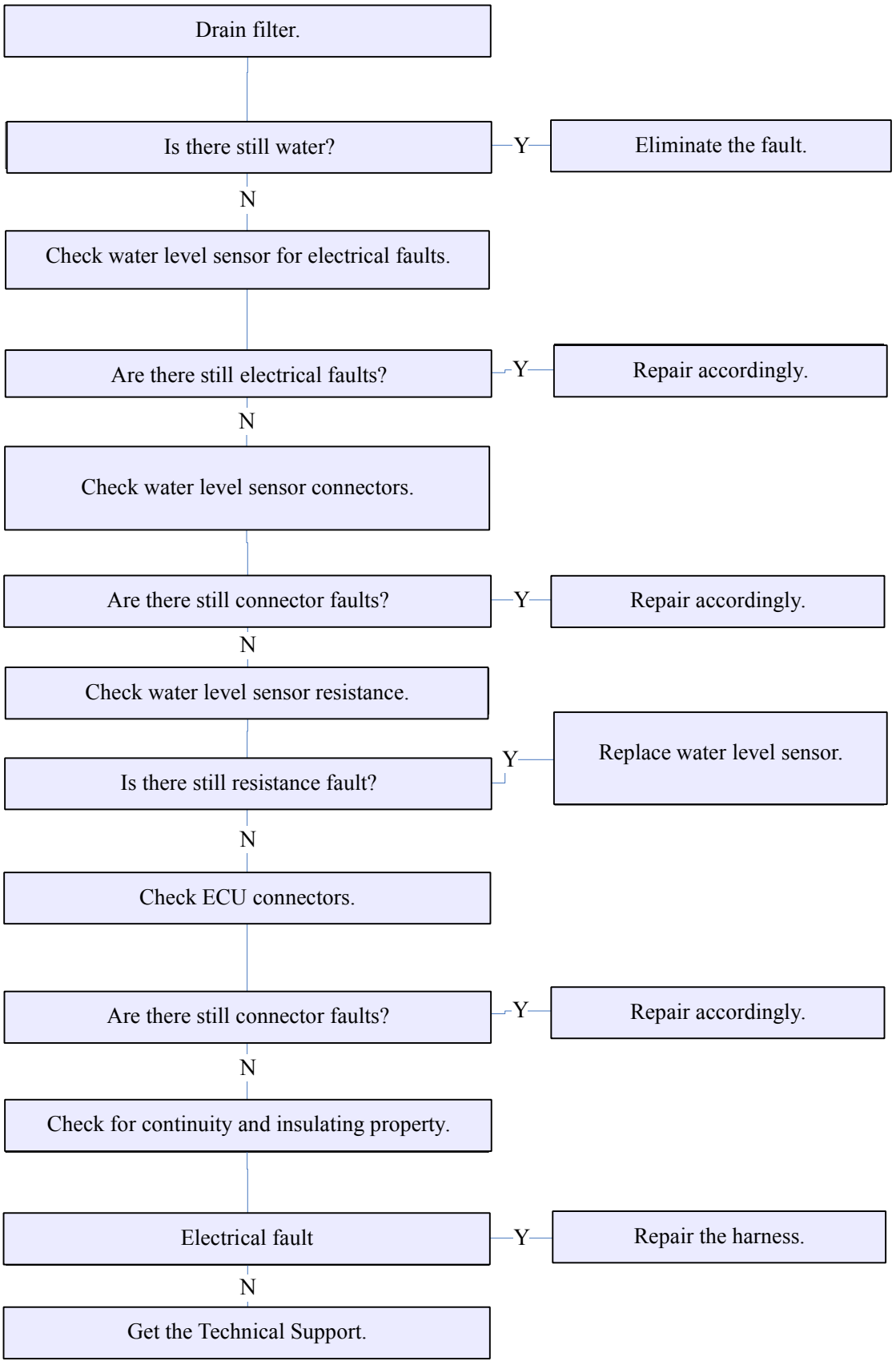
DTC	P2264	There are faults in water level sensor of diesel filter oil-water separator.
	P2267	Water in diesel filter oil-water separator is overflowed.



Fault Description: Main function of oil-water separator is to separate moisture from oil in fuel to ensure combustion quality of fuel. When fuel oil goes through oil-water separator, oil content and moisture content in the fuel are separated. For water density is larger than that of oil, separated water is stored in “water tank” under filter element. Fuel filter lower water level sensor is applied in water level detection in “water tank”. When accumulated water reaches certain level, warning lamp on instrument panel will be lightened to remind driver to carry out draining. In the case of delayed water drainage, DTC occurs.

Diagnosis Hint: In the case of DTC existence, it is necessary to check water level first of all. Normally, carry out water drainage for every 8000-10000km engine running. For oil quality problems, water drainage should be carried out ahead of time for fuel which contains much moisture. Besides, test relevant connectors for this diagnostic procedure for short circuit of terminals or poor contact of wire, avoiding water level sensor signal distortions caused by short circuit or poor contact.

Fault Tree:


Drain filter.
Is there still water?
Y
Eliminate the fault.
N
Check water level sensor for electrical faults.
Are there still electrical faults?
Y
Repair accordingly.
N
Check water level sensor connectors.
Are there still connector faults?
Y
Repair accordingly.
N
Check water level sensor resistance.
Is there still resistance fault?
Y
Replace water level sensor.
N
Check ECU connectors.
Are there still connector faults?
Y
Repair accordingly.
N
Check for continuity and insulating property.
Electrical fault
Y
Repair the harness.
N
Get the Technical Support.

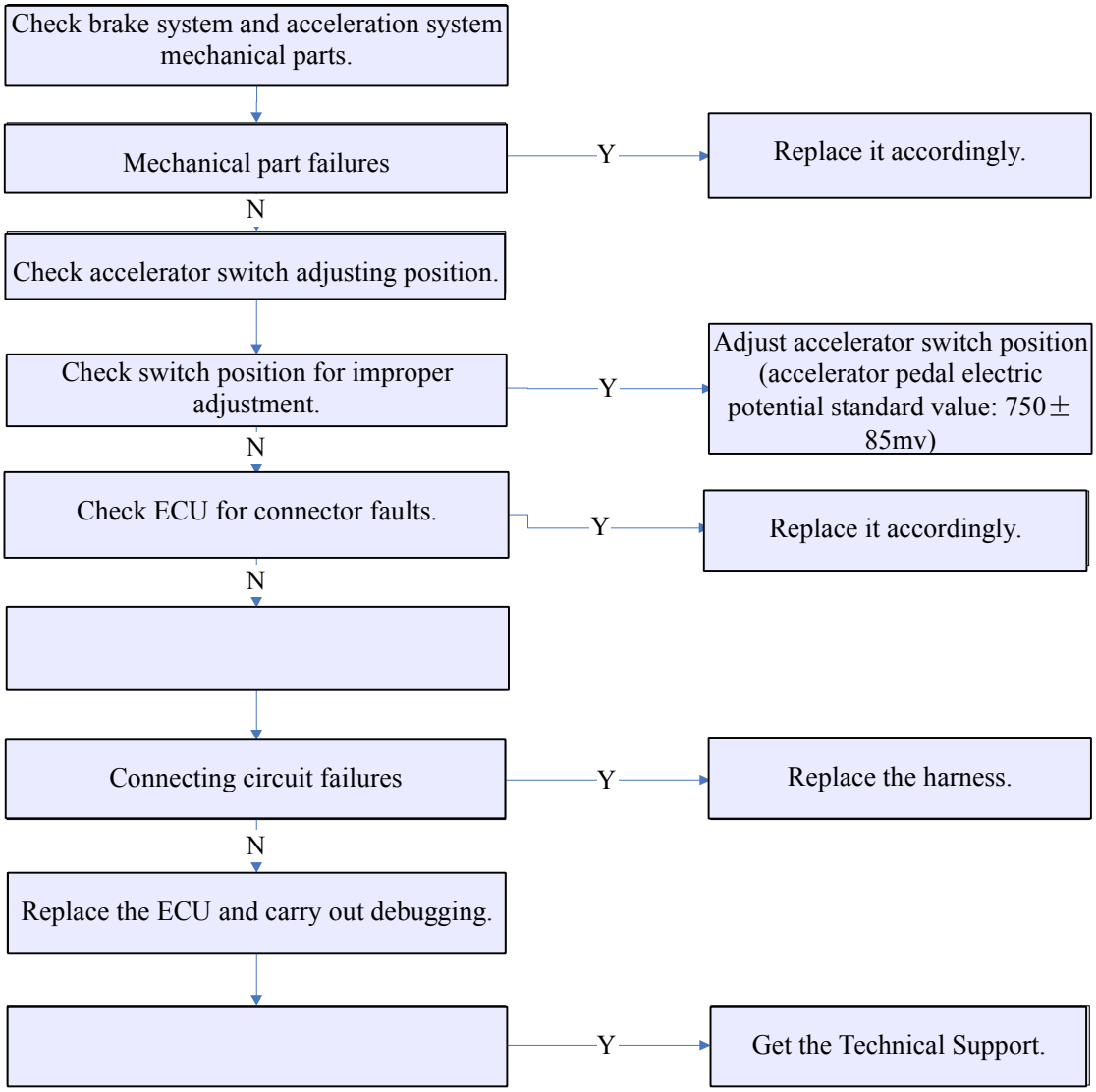
33.

DTC	P2299	Depress accelerator pedal and brake pedal at the same time.

Fault Description: Accelerator pedal assembly consists of two accelerator pedal position (APP) sensors. Accelerator pedal position sensors are installed on pedal assembly and they are not maintainable. When driver depresses accelerator pedal, air inflow of cylinder is increased and ECU increases fuel injector pulse width in order to supply additional fuel during acceleration process for engine demand. Brake switch is a normally open one. When brake pedal is depressed, this switch is closed in order to provide TCU with voltage for brake application. In the case of misoperation of driver during driving, brake system will be locked after depressing brake pedal and brake pedal can not return to its original position. Under such condition, depressing accelerator pedal will lead to DTC occurrence due to conflict between acceleration and brake signals in the case of engine braking status. In addition, improper maintenance or ECU control circuit failures will lead to such faults.

Diagnosis Hint: Check brake system and acceleration system for stuck pedal position without pedal returns. Check the circuit between ECU and components for good contact of connection and good harness insulating property. For connection test for ECU and components, diagnostic connectors should be applied.

Fault Tree:


Check brake system and acceleration system mechanical parts.
Mechanical part failures
Y
Replace it accordingly.
N
Check accelerator switch adjusting position.
Check switch position for improper adjustment.
Y
Adjust accelerator switch position (accelerator pedal electric potential standard value: 750±85mv)
N
Check ECU for connector faults.
Y
Replace it accordingly.
N
Connecting circuit failures
Y
Replace the harness.
N
Replace the ECU and carry out debugging.
Y
Get the Technical Support.

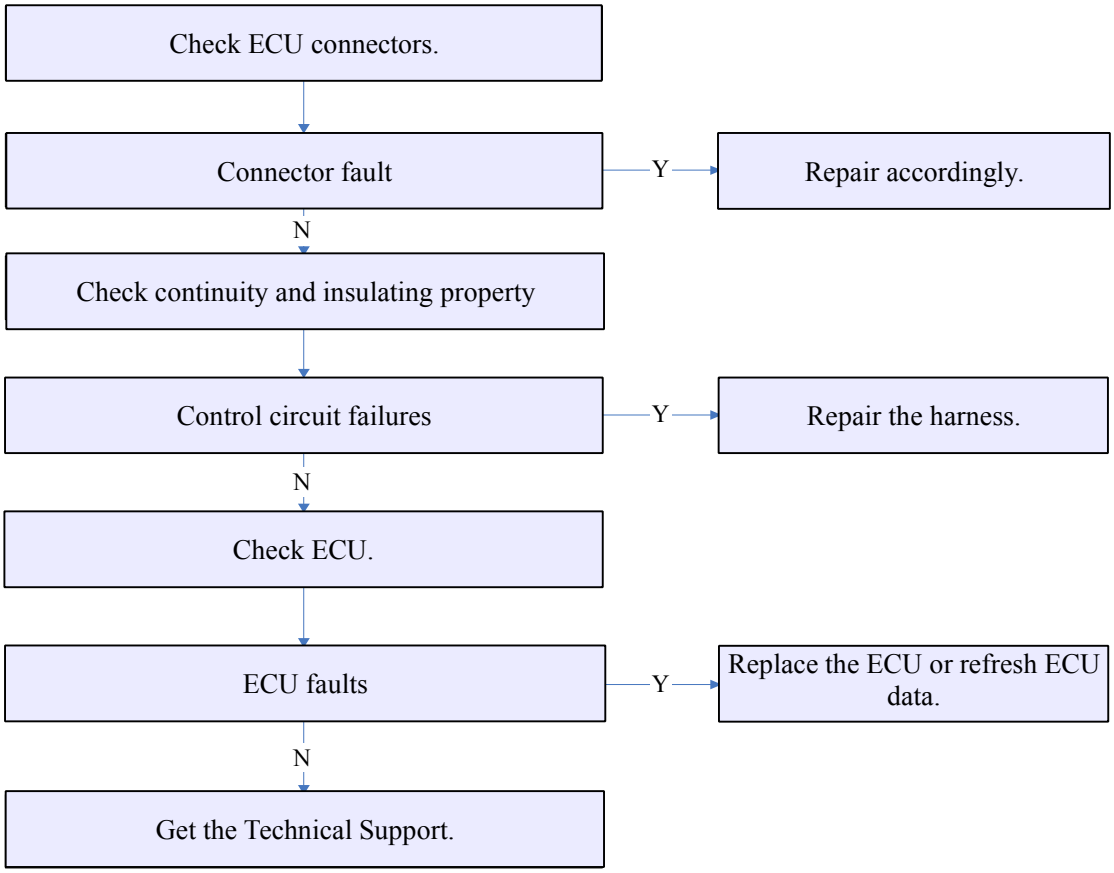
34.

DTC	**U0167**	**In the case of the maximum fault reading, there are EEPROM errors/ICM time-out communication failures.**

Fault Description: They are mainly taken as integrity failures for ECU internal microprocessor, being applied in determination of ECU programming procedure implementation. In the case of engine shutdown and ignition switch connection, ECU carries out self-diagnosis. In the case of diagnosis failure, control module records operation condition under diagnosis failure and stores this information in “Fault Record”, DTC occurs. During engine operation, when there is deviation between ECU detected signals and standard signals, the fault will be stored and expressed as DTC via internal communication module of ECU. In the case of external signal intrusion, this will lead to system disorder and DTC occurs. When various faults occur at the same time under the same operation condition, there will be multiple DTCs. For there is a process for ECU response to each fault, ECU response time will be longer in the case of multiple simultaneous faults in existence. During response process, DTC may occur due to ECU internal communication errors or hardware faults.

Diagnosis Hint: In the case of fault occurrence, relevant test can be carried out after ECU replacement for possible fault cause may be too long ECU internal response time. Check ECU circuit to verify whether it is circuit failure that leads to fault occurrence.

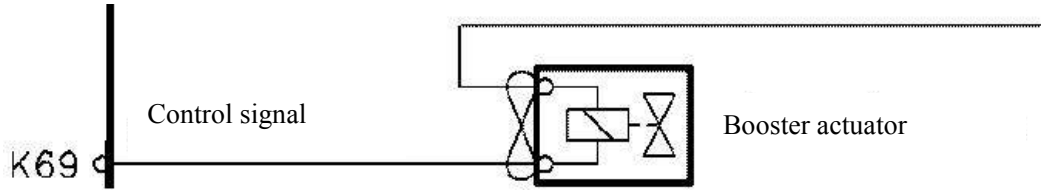
Fault Tree:



35.

DTC	**P0045**	**Supercharger actuator control wire is open.**

	P0046	**ECU internal drive module of supercharger actuator control wire is overheated.**
	P0047	**Supercharger actuator control wire is short to ground.**
	P0048	**Supercharger actuator control wire is short to high level.**



ECU is the control center fro supercharger actuator control system. ECU calculates corresponding supercharger actuator response according to engine operation condition. ECU realizes actuator positioning via providing supercharger actuator control motor with pulse width modulation voltage.

Diagnosis Hint: Check for connection and disconnection faults or seizures due to temperature. Under extremely hot or cold condition, existed contaminations or freeze may lead to unsmooth component movement.

If it is an intermittent fault, the possible causes may be poor contact, worn wire insulating layer or damaged wire in insulating layer.

Check for the following conditions:

- Poor contact of ECU or exhaust brake valve —Check harness connectors.

– Terminal looseness

– Poor fit of matching parts

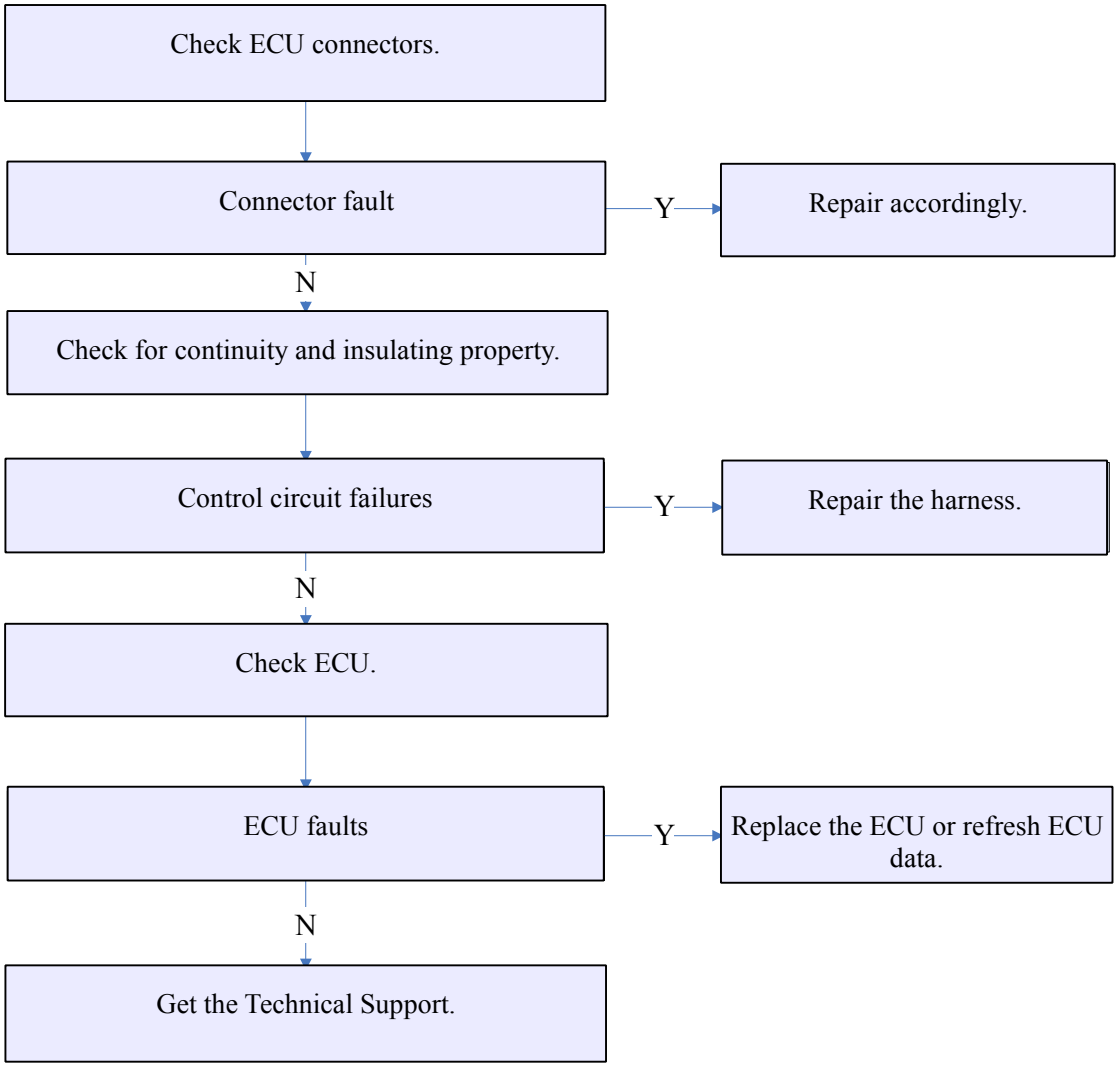
–Locking plate fracture

–Terminal deformation or damage

–Poor contact between terminal and wire

- Harness damage—Check harness for damage.

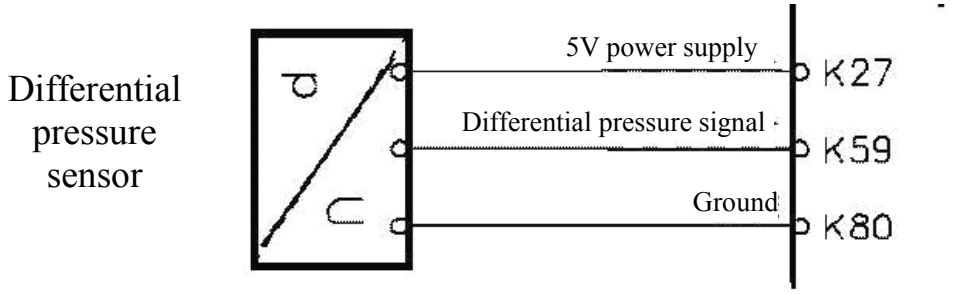
Fault Tree:


Check ECU connectors.
Connector fault
Y
Repair accordingly.
N
Check for continuity and insulating property.
Control circuit failures
Y
Repair the harness.
N
Check ECU.
ECU faults
Y
Replace the ECU or refresh ECU data.
N
Get the Technical Support.

36.

Maintenance manual for sunray hfc4da1-2c china-IV diesel engines

DTC	**P1070**	**Catalytic converter is clogged.**
	P2002	**Catalytic converter is removed.**
	P2454	**Catalytic converter front and rear differential pressure is too low.**
	P2455	**Catalytic converter front and rear differential pressure is too high.**



Differential pressure sensor is a Hall Effect switch. ECU provides differential pressure sensor with 5V voltage via 5V reference voltage circuit and provides the sensor with grounding via low reference voltage circuit. Differential pressure sensor provides ECU with signal voltage according to front and rear differential pressure changes of catalytic converter. ECU determines catalytic converter differential pressure with this signal voltage. Differential pressure sensor circuit is connected to ECU directly. Moreover, differential pressure sensor can be applied in determination of catalytic converter damages. Circuits between differential pressure sensor and ECU include the followings:

Differential pressure sensor high reference voltage circuit

Ground circuit

Differential pressure signal circuit

When ECU detects incorrect sensor signals or no signals, DTC occurs.

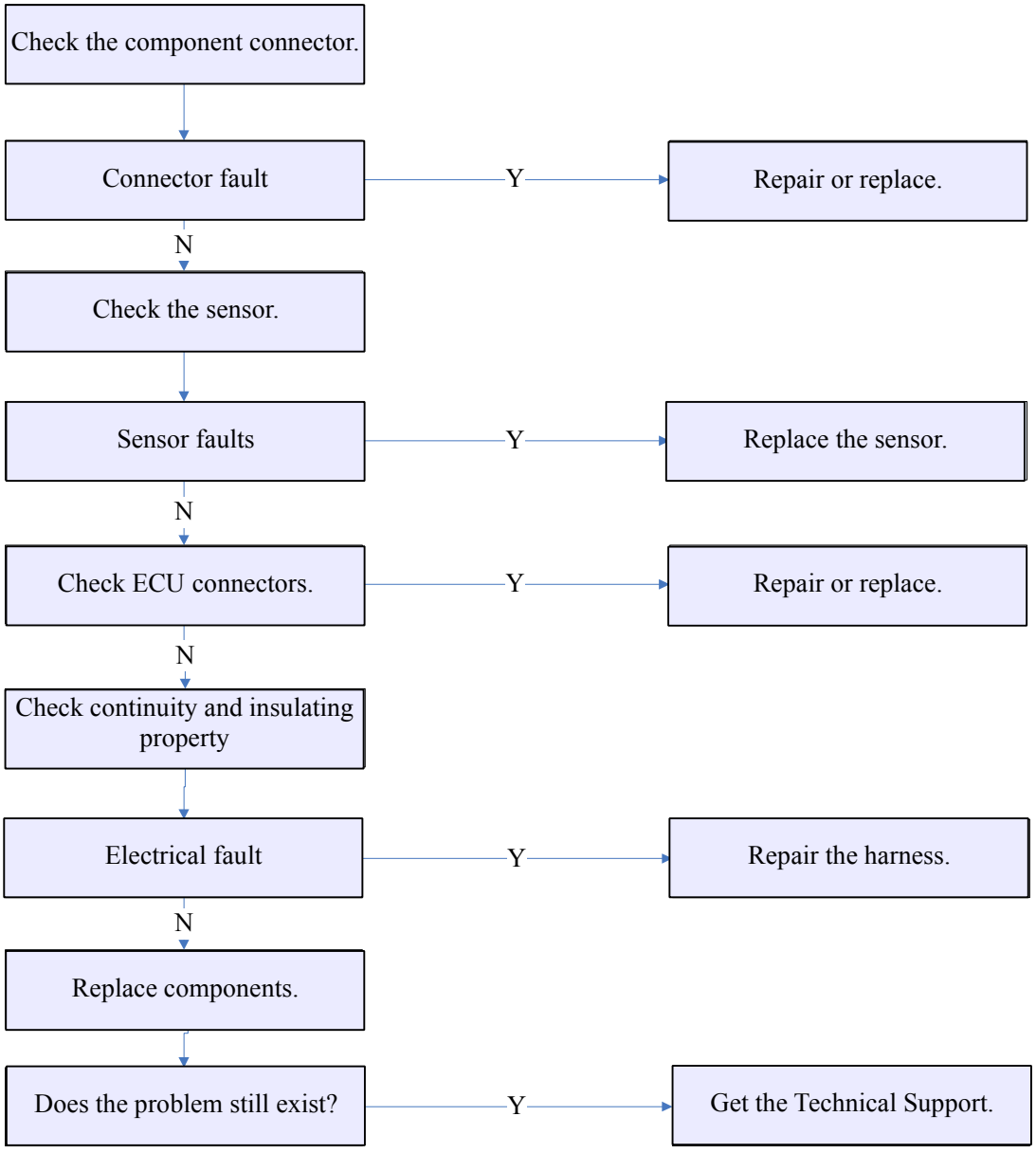
Diagnosis Hint: Poor terminal connection—Check harness connectors for looseness, mismatching, retainer damage, improper shape or damage and connection failure with wires. Apply corresponding matching terminals for test of proper tension.

Harness damage—Check wire harness for damage. In the case of no harness faults, move relevant connectors and wire harness and observe display of fault diagnostic apparatus. Fault diagnostic apparatus displays changes to indicate fault positions.

Check ECU and engine ground connection for reliability and cleanness. If it is determined that DTC is an intermittent fault, please refer to Fault Record to check the time of last DTC occurrence.

Terminal	ECU	
	K27	Differential pressure sensor power supply
	K59	Differential pressure sensor signal terminal
	K80	Ground

Fault Tree:


Check the component connector.
Connector fault
Y
Repair or replace.
N
Check the sensor.
Sensor faults
Y
Replace the sensor.
N
Check ECU connectors.
Y
Repair or replace.
N
Check continuity and insulating property
Electrical fault
Y
Repair the harness.
N
Replace components.
Does the problem still exist?
Y
Get the Technical Support.

Replacement oil-gas separator

Due tothe improper maintenance, it will make the oil-gas separator filter blocked and the crankcase vent system poorly work. Sometime it may even make crankcase vent system blocked. It may make block the valve because of the dust bonding after the engine runs long time. This leads to the pressure in the crankcase increase sharply, have the risk of engine runaway

Repair Procedure:

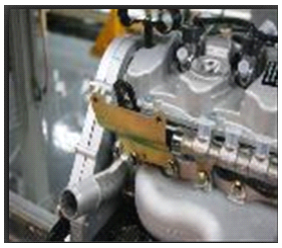
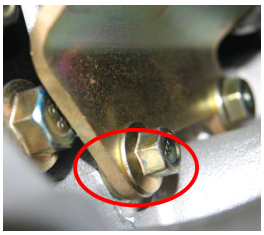
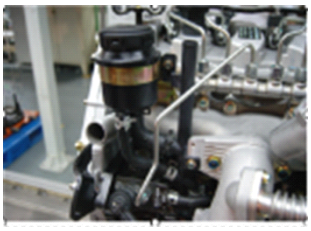
1. Open the engine cover and remove the oil filler cap，
2. Remove the old oil-gas separator system:
3. Remove the oil-gas separator fixing bolts;
4. Loosen the oil-gas separator air intake hose 、 outlet hose 、oil return hose clamp. Take out the oil-gas separator assemblies with intake hose and outlet hose.
5. Lifting the vehicle or parking the vehicle on the trench;
6. Unplug separator's oil-return hoses, then quickly install the new one.

Attention：Must quickly install the new oil return hose assembly to avoid leaking too much oil.

7. Remove the oil-gas separator bracket .

Install the maintenance-free oil-gas separator system:

1. Pre-install the three-way intake hose, oil return one-way hose assembly, intake connecting hose on the oil-gas separator.
2. Install the new oil-gas separator bracket and tighten fixed bolts with gasket. The gasket should be placed between the bracket and intake hose(as the picture shown)
3. Fixing the above-mentioned assembly on the the bracket clamp(the intake hose should face the engine side).
4. Tighten the three-way intake hose with bolts.
5. Install the new intake hose assembly, outlet hose assembly and the oil return hose assembly.

Operating requirements:

1. Tighten torque of the bracket mounting bolts is 20-25N.m.
2. Tighten torque of the three-way intake hose mounting bolts is 10-25N.m.
3. Ensure the clamp installed in the right position, no loose, slip or interfere.

Checking and adjustment

1. Adjust the position of these hoses, in order to avoid excessive force
2. Check the oil level, add oil if it is necessary. Then put on the oil filler cap.

3. Start engine, check whether there is oil or air leakage etc.

New oil-gas separator system installation specifications

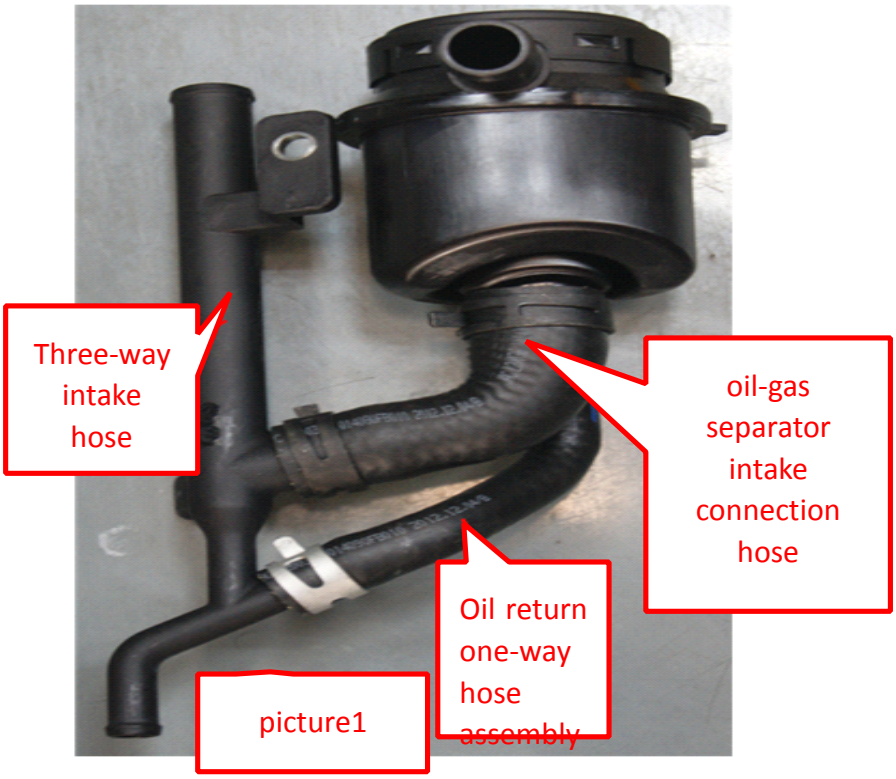
1. Pre-install oil-gas separator and related hoses

The pre-installation position of the separator, three-way pipe, intake connection hose assembly, oil return one-way hose can refer to picture 1.

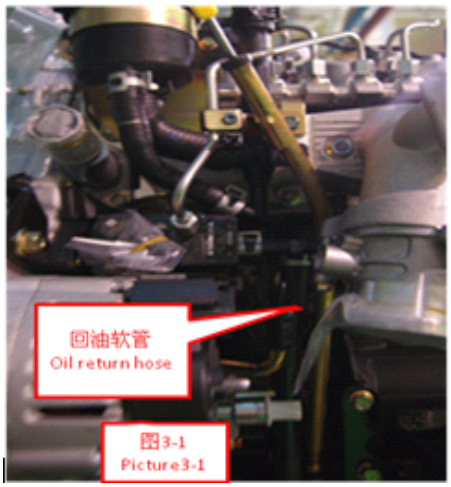
There is one way valve inside the one-way hose, the position can be seen at picture 2(you can feel the one-way vale when you touch the hose).The function of one-way valve is to ensure one-way flow. If reverse install the direction of the one-way hose by mistake, it will prevent oil returning. You can use the blowing method to test the continuity of one-way hose(the white arrow show the direction of airflow),blowing from the one-way valve side(separator end) to the other side(three-way intake hose end), if it is through, OK.

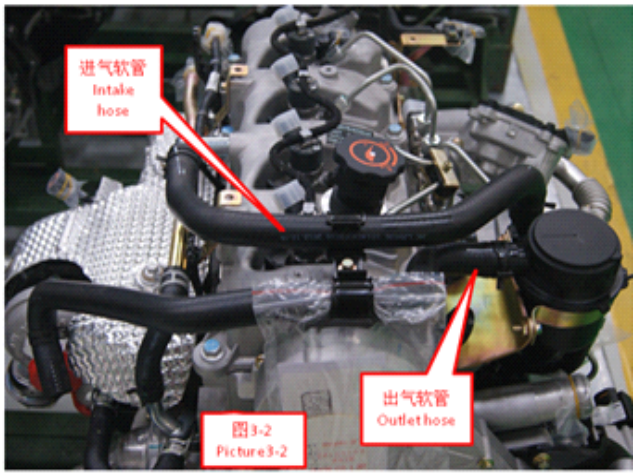
2.Other hoses installation specifications

There are many types hoses involved in exchange process , the detailed position can refer to picture 3.






回油软管
Oil return hose
图3-1
Picture3-1


进气软管
Intake
hose
出气软管
Outlet hose
图3-2
Picture3-2

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CLUTCH

General

Main data and specifications

Clutch assembly

Clutch control equipment

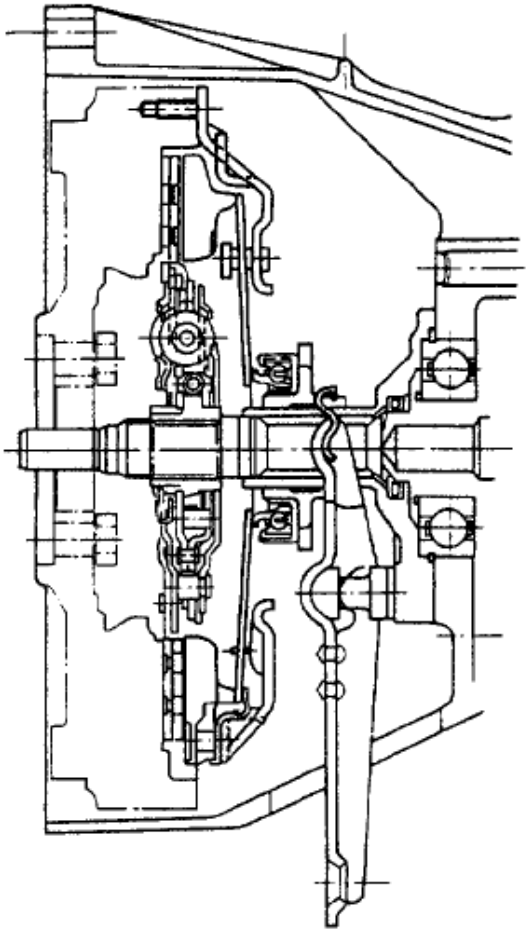
Clutch main cylinder

Clutch cylinder

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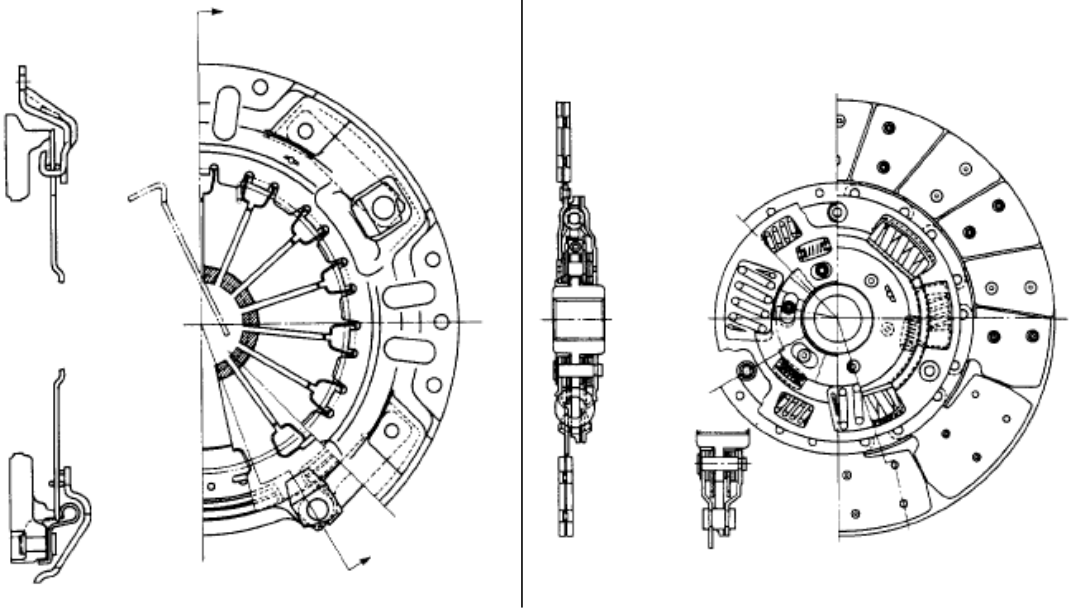
General

Clutch assembly

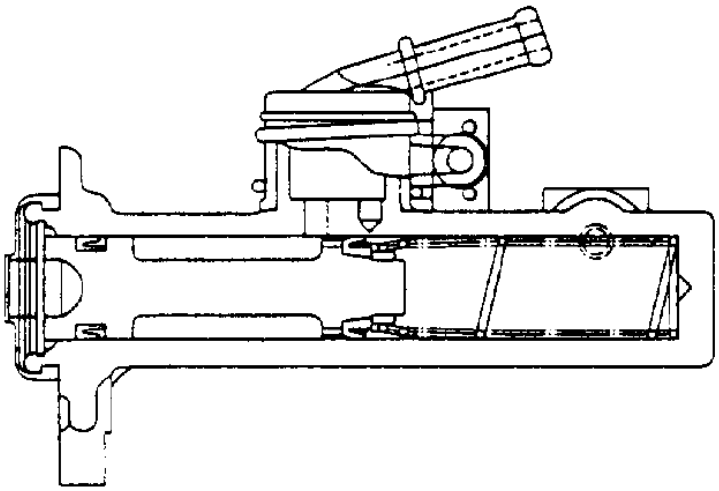


CLUTCH

Clutch driven plate assembly



Clutch main cylinder



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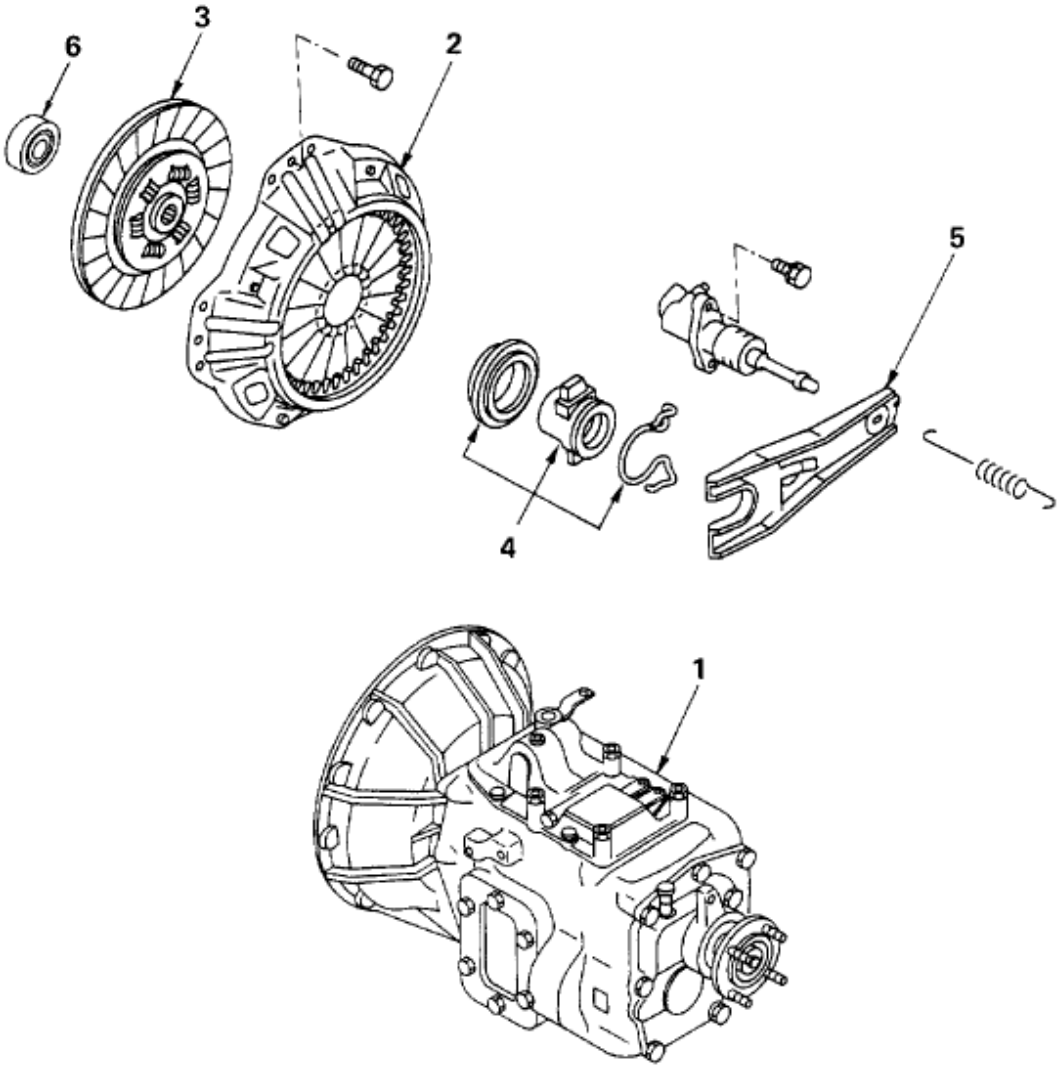
Main data and specifications

Type of clutch：	Single-sheet dry type film-sheet spring clutch
Exterior diameter of driven plate	Φ275mm
Cylinder diameter of clutch main pump	Φ19.05mm
Diameter of clutch cylinder	Φ24mm
Travel of clutch panel	160mm
Free travel of clutch panel	3—5mm

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Clutch assembly

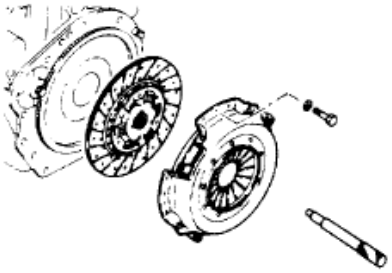
Disassembly



Disassembly sequence

(1) Transmission assembly
(2) Clutch pressure plate
(3) Clutch drive plate
(4) Release sleeve
(5) Release fork

CLUTCH



Disassembly steps:

Support vehicle and hold it safely.

Note: do not let brake liquid flow on painted surface in disassembly process.

If having, wipe off immediately.

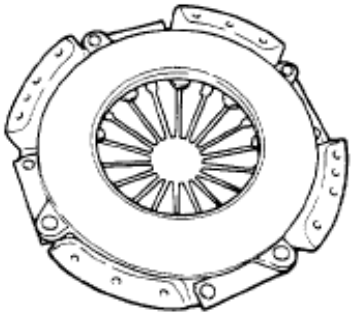
1. Dismantle gearbox (referring to the operation about gearbox in this manual).
2. Pressure plate assembly
3. Driven plate assembly

Prevent driven plate assembly from sliding with a guiding shaft.

Make marks on flywheel and pressure plate, and head these marks in re-assembly.

4. Dismantle clutch separator fork.
5. Separate sleeve assembly

Dismantle separator sleeve together with return spring.



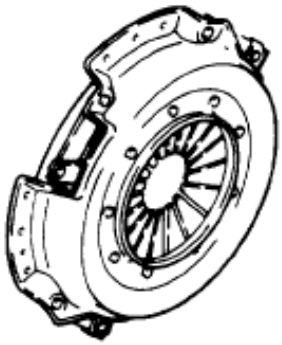
Inspection and repair

If excessive abrasion and damage have been found in checking process, it is necessary to adjust, repair or change parts.

Check abrasion and heat crack of pressure plate with eyes, if there is any excessive abrasion or too-deep heat crack, it is necessary to change pressure plate.

Distortion of pressure plate

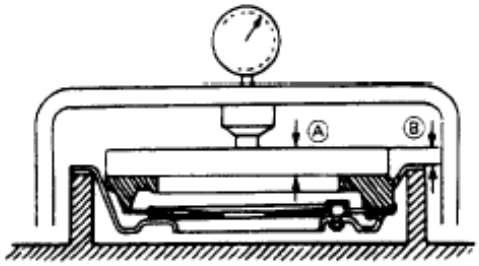
Measure plane degree of friction surface of pressure plate, if it exceeds limit, change pressure plate assembly. Using limit: 0.3mm



Clutch cover

Check the abrasion, crack and other damages on whole clutch cover with eyes, if there is any excessive abrasion, crack or other damages, change the cover.

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Assembly pressure of clutch

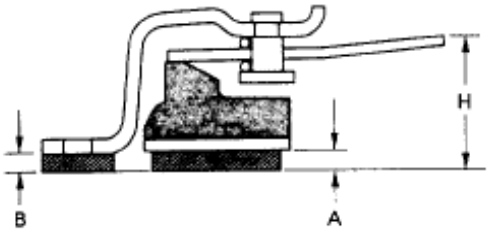
1） Reverse clutch pressure plate.

2） Put a metal block with depth of 8.3mm on pressure plate.

3） Press down pressure plate until distance “B” has reached 0 mm.

4） Record pressure reading on meter.

Standard pressure：**480** kg



Height of film-sheet spring separator finger

1) Put a metal block with depth of 8.3mm under pressure plate.

2) 2) Press down pressure plate until distance “B” has reached 0 mm.. Two methods could be used:

a. Press down it from the top of pressure plate.

b. Screw assembly bolts of pressure plate.

3) Measure the height from base surface to separator finger end. Standard height



Driven plate assembly

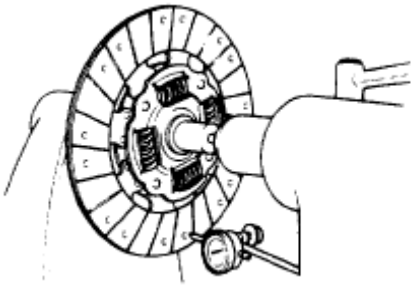
Check whether torsion spring has been loosened, softened or ruptured with eyes.

If there is any situation above, it is necessary to change driven plate assembly.

Check whether there is any crack, grease or excessive scorch on friction surface with eyes.

If there is any situation above, it is necessary to clean or change driven plate assembly. Check whether driven plate assembly could slide on spline of one shaft of gearbox.

CLUTCH



Distortion of driven plate

Insert guiding shaft in spline hub.

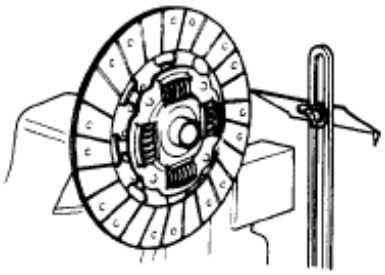
Guiding shaft should be level and straight.

Install a scale meter on exterior circle of driven plate.

Turn driven plate assembly slowing, and read the scale on meter.

If measured value exceeds limit, it is necessary to change driven plate assembly.

Limit 1.0mm



Abrasion of driven plate spline hub

Clean inner part of spline hub.

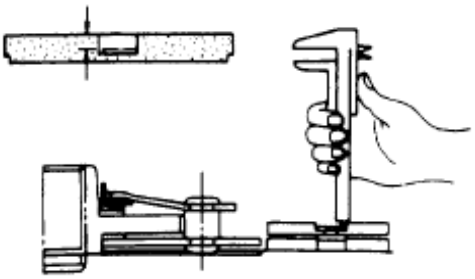
Install driven plate on spline of one shaft of gearbox.

Install a surface measuring meter on exterior circle of driven plate.

Turn driven plate slowly, and measure the change of exterior circle.

If measured value exceeds limit, it is necessary to change driven plate assembly.

Abrasion limit of driven plate slpine hub 1.0mm



Depth of rivet head of driven plate

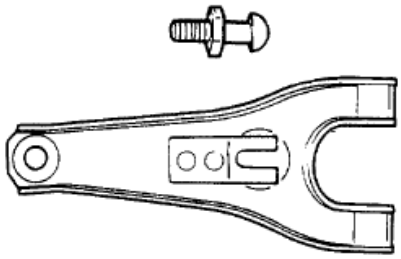
Measure the distance from rivet head to friction surface with a depth gauge.

Measure two sides.

If measured value exceeds limit, it is necessary to change driven plate assembly.

Depth limit of rivet head of driven plate 0.2mm

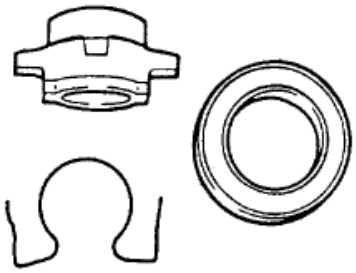
CLUTCH



Release fork and supporting

Check the surface contacting with release sleeve and supporting on release fork with eyes.

If there is any excessive abrasion or surface roughness, it is necessary to change parts.



Release sleeve assembly

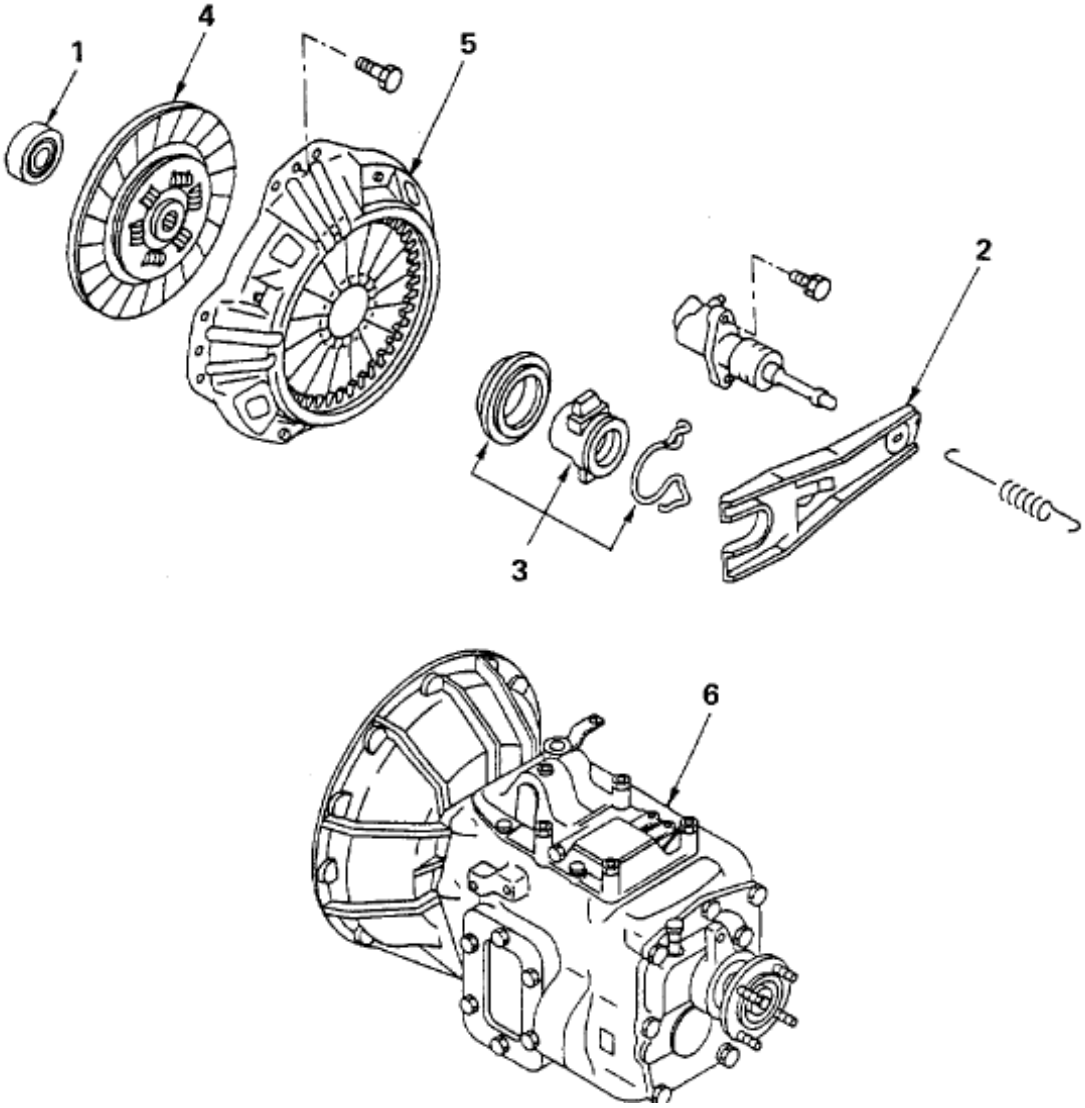
Check the abrasion and roughness of release sleeve assembly before separating sleeve assembly.

a. There is any surface roughness of release bearing or noise caused by rotation under light press.
b. There is surface roughness or damage. (With contacting surface of release fork and front cover surface of release bearing)

Warning: for release bearing has been installed with lubricant, do not put it in solvent to wash, this could dissolve lubricant. Note if there is any problem, do not disassemble the sleeve. Check whether return spring has been ruptured or softened. If there is any situation above, it is necessary to change parts.

CLUTCH

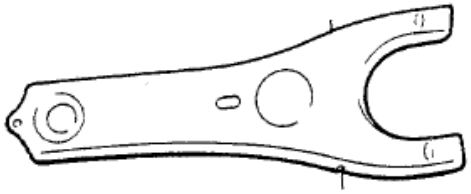
Re-assembly



Re-assembly sequence

1. Clutch release fork 2；
2. Release sleeve assembly 3；
3. Driven plate assembly 4；
4. Pressure plate assembly 5；
5. Gearbox 6.

CLUTCH





Re-assembly step

1. Release fork

Apply multi-purpose lubricating grease (molybdenum disulfide) on the surface which contacts with release sleeve assembly and supporting on release fork.

2. Release sleeve assembly

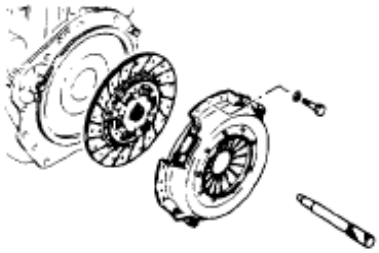
Install release sleeve together with return spring.

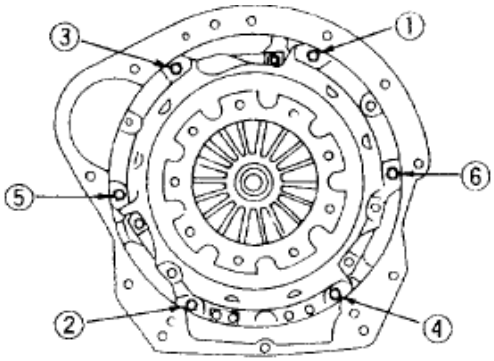
3. Driven plate assembly

4. Pressure plate assembly

Apply multi-purpose lubricating grease (molybdenum disulfide) in spline hub of driven plate.

Install driven plate assembly with guiding shaft.





Screw assembly bolts of pressure plate tightly by numeric sequence.

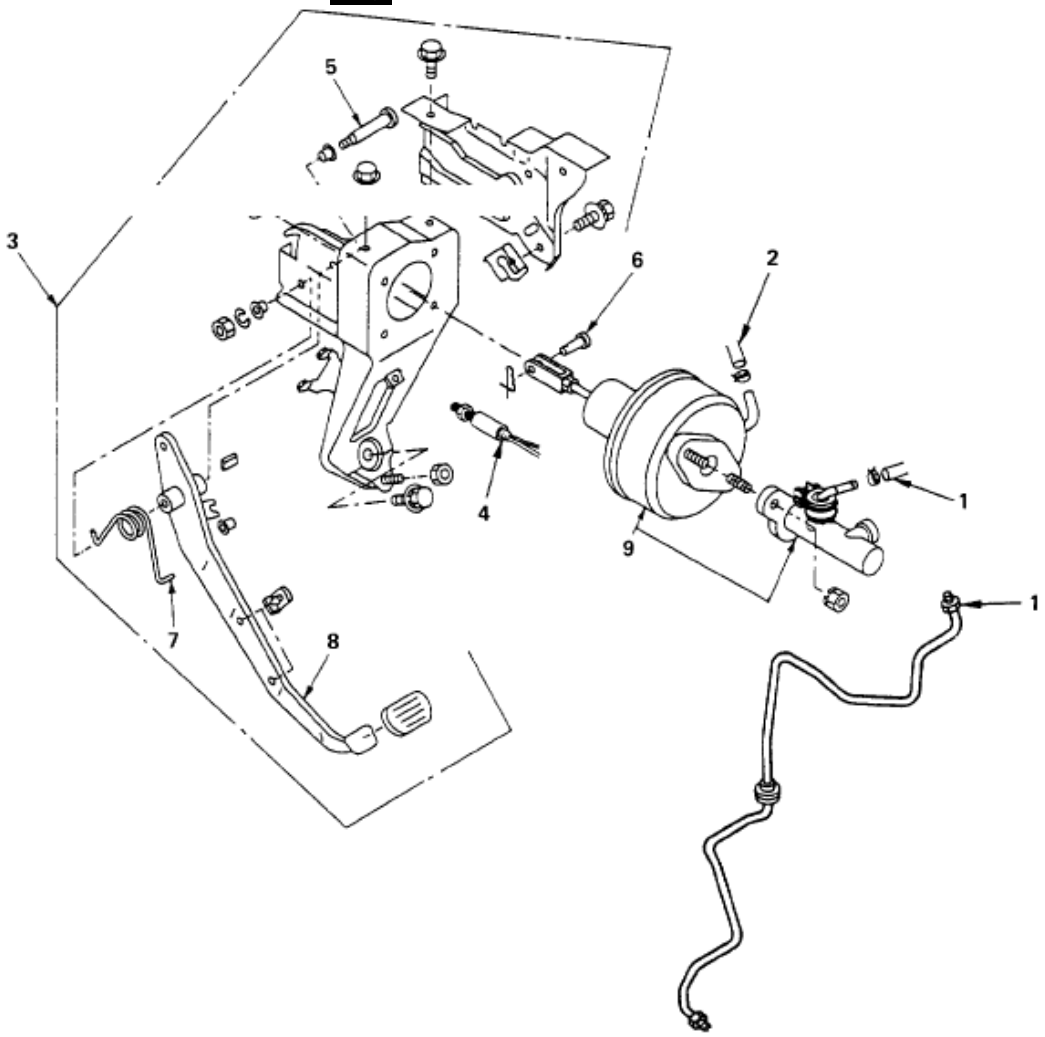
Tightening torque of assembly bolts of pressure plate 1.8kgf.m.

Warning: after screwing assembly bolts of pressure plate, take off steel wires used for protecting diaphragm spring.

CLUTCH

Clutch control equipment

Disassembly



Disassembly sequence

1. Clutch pipe and soft pipe 2. Oil-intake soft pipe of main pump 3. Clutch panel and bracket assembly 4. Clutch switch or limit bolt 5. Shaft 6. Pin 7. Return spring 8. Clutch panel 9. Clutch main pump assembly 10. Soft pipe 11. Clutch cylinder

Preparation

Dismantle instrument shell and instrument.

Disassembly step of clutch control equipment

Drain out brake liquid in hydraulic pressure pipeline of clutch.

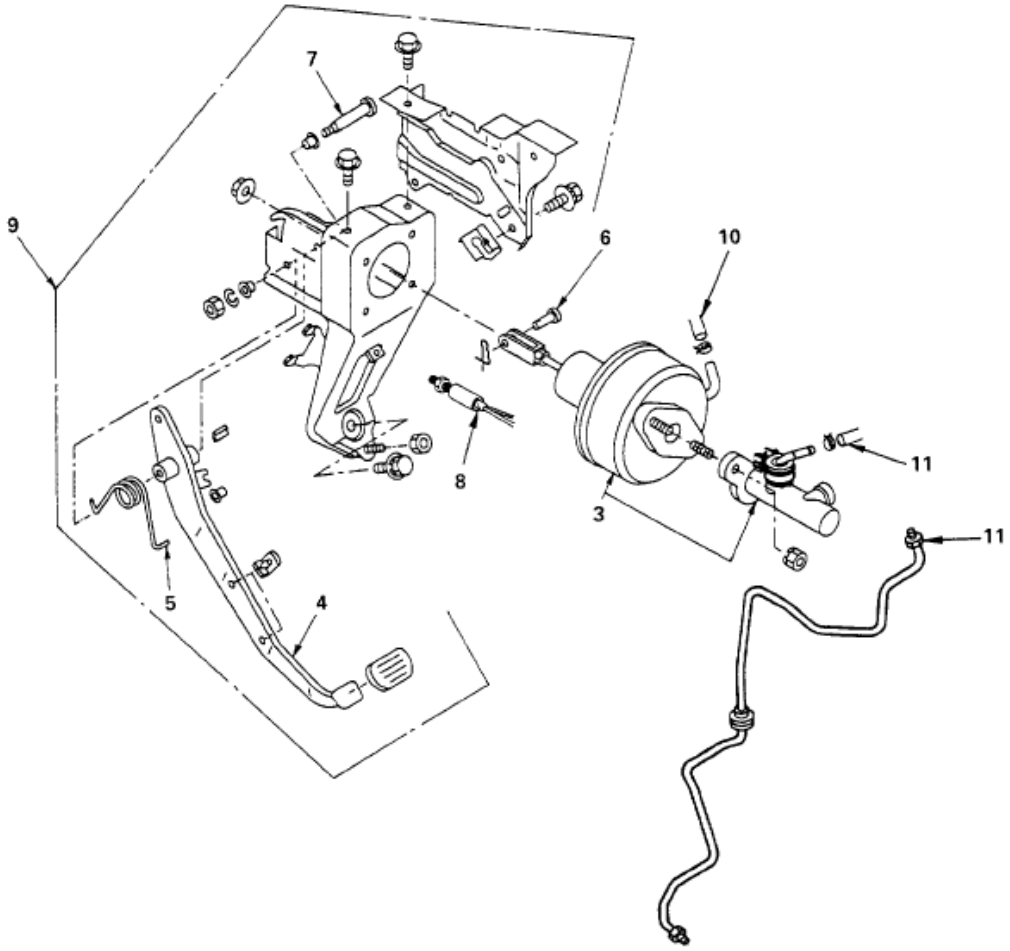
Warning: do not let brake liquid remain on the surface with paint, if having, wipe off immediately.

Inspection and repair

If there is any excessive abrasion or damage about parts in checking process, it is necessary to adjust, repair or change those parts.

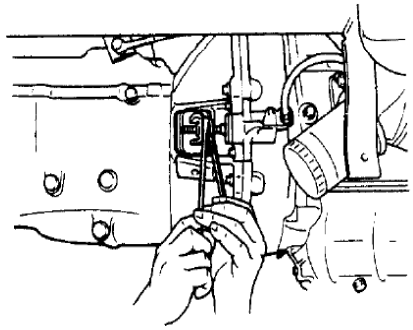
CLUTCH

Re-assembly



Re-assembly sequence

1. Clutch cylinder 2. Soft pipe 3. Clutch main pump assembly 4. Clutch panel 5. Return spring 6. Pin 7. Shaft 8. Clutch switch or limit bolt 9. Clutch panel and bracket assembly 10. Oil-intake soft pipe of main pump 11. Clutch pipe and soft pipe



Re-assembly step

1. Clutch cylinder

Tightening torque of assembly bolts of clutch cylinder 1.6 kgf • m

Adjust handspike of clutch cylinder rightly before installing return spring of clutch cylinder.

Unscrew locking nuts of clutch handspike.

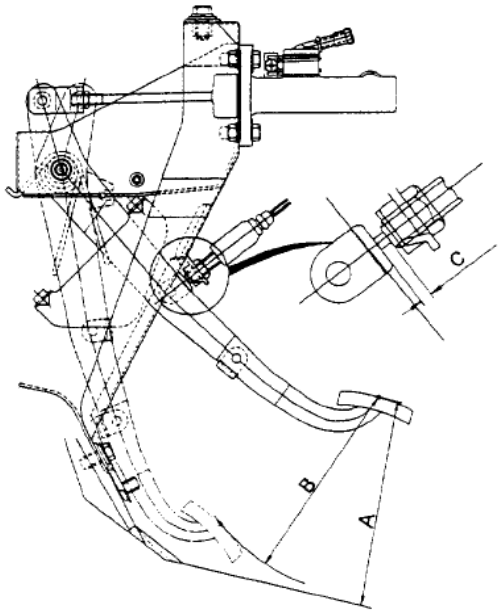
Turn handspike until supporting separator fork.

Turn back handspike for 1.5 circles. (Free travel of separator fork is about 2 mm)

Screw locking nuts.

Tightening torque of locking nut 1.9 kgf.m

CLUTCH



1. Clutch soft pipe
2. Clutch main cylinder
   Install clutch main cylinder on clutch panel and bracket. Tightening torque of assembly nut 1.3 kgf.m.
3. Clutch panel
4. Return spring
5. Pin and shaft
6. Clutch switch or limit bolt
7. Clutch panel and bracket assembly

Tightening torque of clutch panel and bracket assembly bolt 3.8 kgf.m

After those assemblies above, it is necessary to adjust clutch control equipment

Height and travel of clutch panel

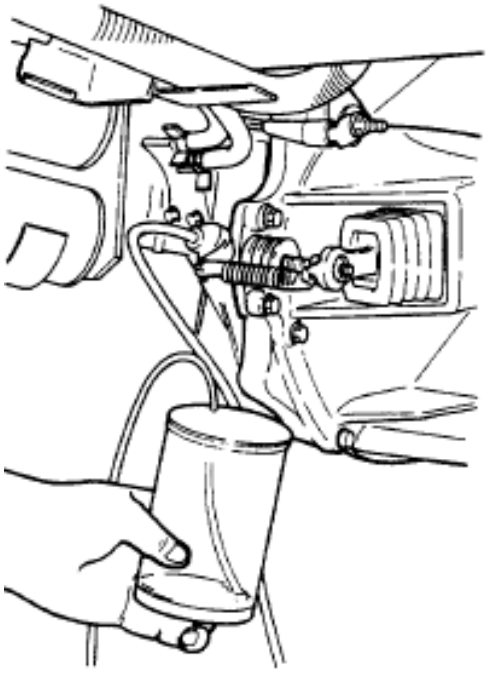
1) Unscrew locking nuts of clutch main pump handspike
2) Turn handspike to adjust panel.

Height of clutch panel A: 160-170mm

Travel of clutch panel B: 159-169mm

3) Tightening torque of locking nuts of clutch main pump handspike 1.3 kgfm

4) Re-install instrument to adjust free travel of clutch panel, unscrew clutch switch or panel limit bolt, Adjust clutch switch or panel limit bolt to make free travel of clutch panel is 3—5mm.



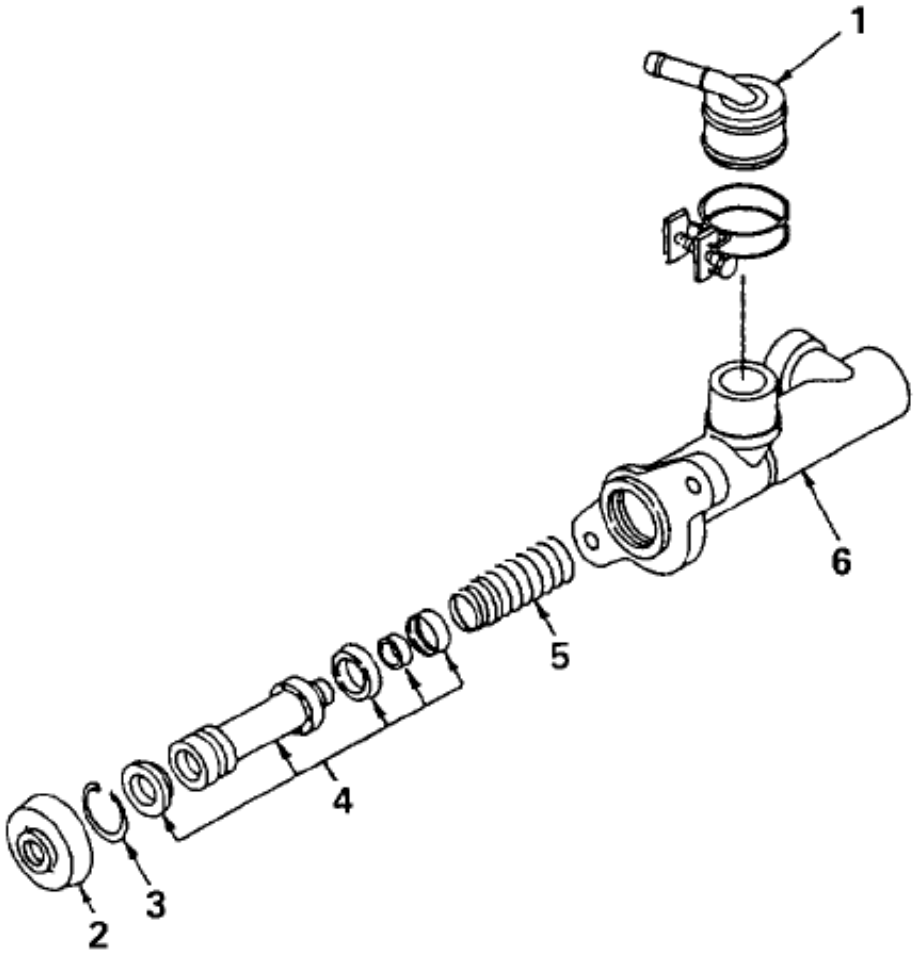
Deflation of clutch pipeline should be made by following steps:

1. Strain park arrester.
2. Put brake liquid in oil storage pot until reaching maximal liquid level. It is necessary to note whether there is any brake liquid in oil storage pot.
3. Dismantle bleed screw rubber cap on clutch cylinder, link plastic pipe on bleed screw, and insert the other end of plastic pipe into translucent vessel with brake liquid.
4. After stepping down clutch panel for several times continually, step on clutch panel.
5. When keeping on stepping on penal, unscrew bleed screw to discharge air, then screw bleed screw.
6. Repeat those operations above, until the air in pipeline has been drained out completely.

After deflation operation, intake brake liquid until " MAX " mark in oil storage pot.

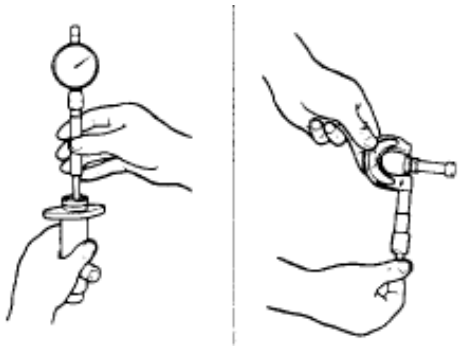
Clutch main cylinder

Disassembly



Disassembly sequence

1. Pipe tie-in 2. Handspike fork 3. Locking nut 4. Dustproof cover 5. Clamp ring
6. Limit block 7. Handspike 8. Piston assembly 9. Return spring 10.Pump body



Inspection and repair

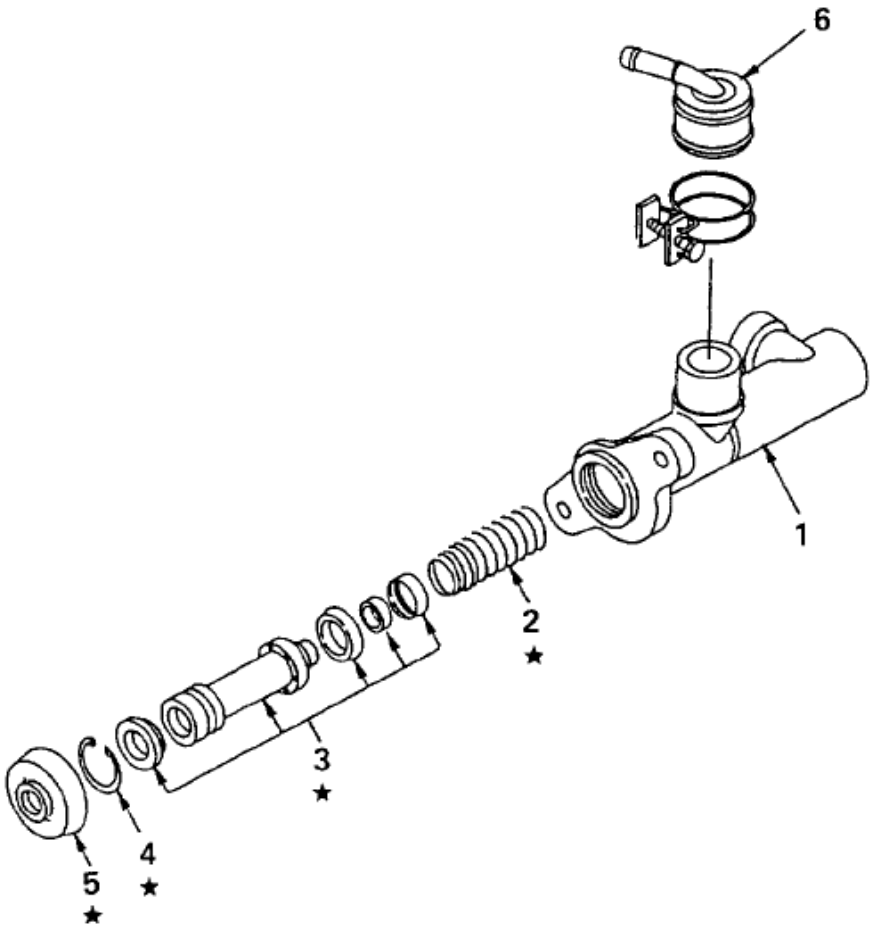
Measure the inner diameter of main pump body.

Inner diameter of main pump body ：19.050---19.102mm

Clearance between clutch main pump piston and inner diameter of main pump body: 0.12mm(limit)

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Re-assembly



Re-assembly sequence

1.Pump body 2. Return spring 3. Piston assembly 4. Handspike 5. Limit block 6. Clamp ring 7. Dustproof cover 8. Locking nut 9. Handspike fork 10. Pipe tie-in

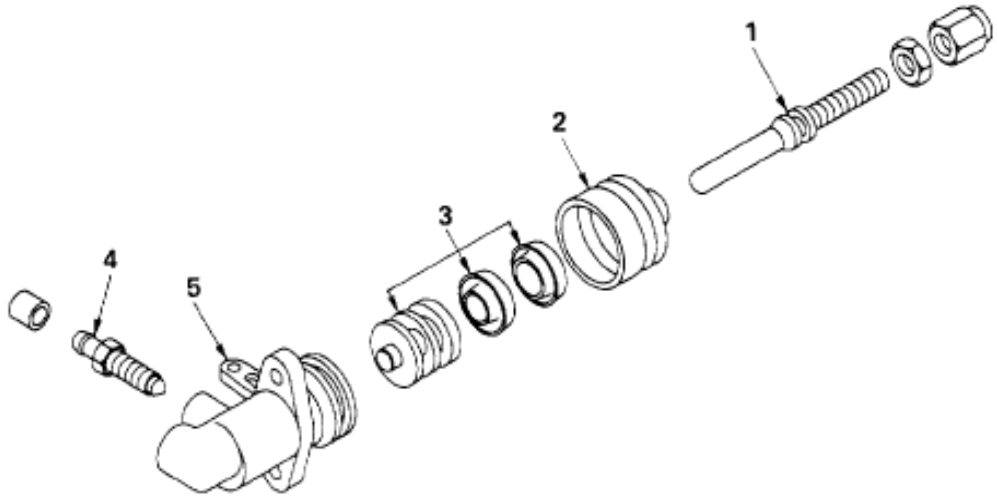
Re-assembly notes:

1. Dip the pump body and piston with clean brake liquid before re-assembly.
2. Spread a sheet of thin lubricating grease on skin bowl.
3. It is necessary to note to prevent the lip of skin bowl from being damaged in assembly process.

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Clutch cylinder

Disassembly

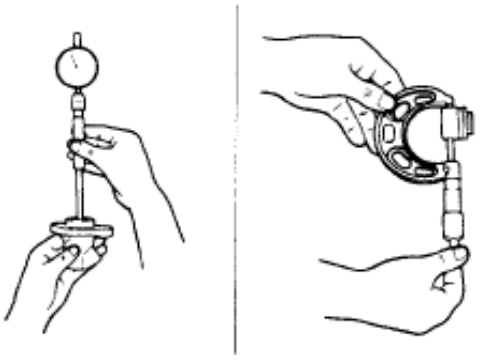


Disassembly sequence

1. Handspike 2. Dustproof cover 3. Piston assembly 4. Deflation screw 5. Cylinder body

Inspection and repair

If there is any excessive abrasion or damage about parts in checking process, it is necessary to adjust, repair or change those parts.



Clutch cylinder assembly

Wash clutch cylinder body with brake liquid.

Measure the inner diameter of cylinder body.

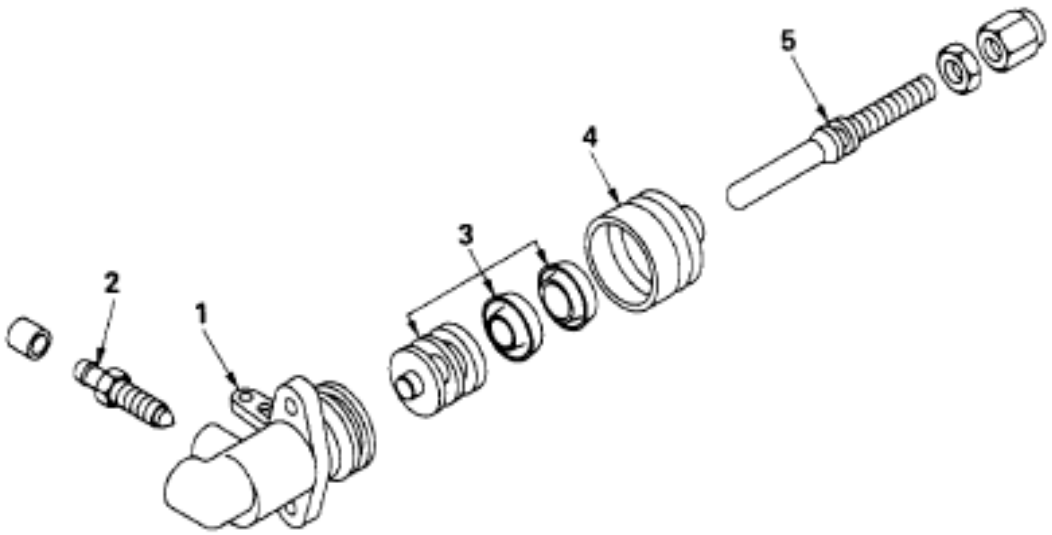
Inner diameter of cylinder body : 23.99---24.042mm

Clearance between clutch cylinder piston and inner diameter of cylinder body: 0.12mm(limit)

Warning: for disassembled clutch cylinder, it is necessary to change repair bag.

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Re-assembly



Re-assembly sequence

1. Cylinder body 2. Deflation screw 3. Piston assembly 4. Dustproof cover 5. Handspike

Re-assembly notes:

1. Dip the pump body and piston with clean brake liquid before re-assembly.
2. Spread a sheet of thin lubricating grease on skin bowl.
3. It is necessary to note prevent the lip of skin bowl from being damaged in assembly process.

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故障诊断（ Fault Diagnosis)---------- 7
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主要技术参数 （ Main Specification ）:

形式 (Type)	五档超速型(Overspeed with 5th gear position)
额定输入扭矩 (Input Torque)	300N·m
中心距(Center Distance)	88mm
总成质量(Assembly quality)	约 70Kg(about 70Kg)
润滑油型号(Lubricating Oil Type)	85W/90 GL-4 (85W/90 GL-4 Gear Oil)
润滑油量(Lubricating Oil Capacity)	约 2.7L(about 2.7L)

速比 (Gear Ratio)

一档 (1st)	4.717	四档(4th)	1.000
二档(2nd)	2.513	五档(5th)	0.784
三档(3rd)	1.679	倒档(Rev.)	4.497

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使用说明（Operation Structure Manual）

1．LC5T28(A2Q02),江淮代号：1701001E8Q28 变速器的各前进档均带有锁环式同步器，为了减轻齿轮和同步器的磨损，使同步器和齿轮顺利脱开，

防止打碎齿轮，换档动作要和缓。汽车只有在停稳后才能由前进档换入倒档或由倒档换入前进档。

2. 应特别注意：变速器的五档为超速档，为避免超速齿轮损坏，在整车不超载，路面状况较好，车速达到 50 公里/小时以上才能使用五档。在使用五档时，如遇某种情况致使整车速度降到50 公里/小时以下，此时应换入低档，如继续使用五档，极易使五档齿轮打碎。

3．变速器可使用 85W/90 GL-4 齿轮油，汽车通常行驶 6000 公里时换一次油。放完脏油后，变速器挂倒档，将后桥顶起，注入煤油，使变速器齿轮旋转 2～3 分钟，放出脏油，再加入纯净的齿轮油.

4．汽车在下坡滑行时，不允许将发动机熄火，更不允许发动机在熄火状态下，利用下坡滑行的惯性启动发动机，以免损坏齿轮。

Ⅰ. Since each forward gear position in LC5T28 T/M is with lock-ring synchronizer,in order to lessen the wear between gear and synchronizer,disengage the synchronizer from the gear,the gear-shifting should be gentle to avoid breaking the gear.Only after the truck parks completely, can be the forward gear position change into the reverse position or the reverse

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into the forward.

Ⅱ. Warn:Since the fifth gear position is overspeed,it should be engaged only under the condition of good road, being not overload and speeding more than 50km/h.Otherwise the gear will be broken.If the speed is less than 50km/h,the lower position should be engaged and the fifth position should not be used any more.

Ⅲ. 85W/90 GL-4 Gear Oil should be adopted.Change the oil at the completionof driving 6000km. After discharging the dirty oil,engage the reverse position,raise therear axle ,add kerosene,rotate the gear 2～3 minutes,discharge the dirty oil,and refill with purified gear oil.

Ⅳ. Do not stop the engine during descending from a steep hill.Do not start the engine in use of the inertia of descending from a hill under the resting state of the engine.so as not to break the gear.

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检查与维修（ Check and Maintenance ）

通过检查如发现零件磨损、损坏或其它故障时，应进行必要的修理或更换。肉眼检查：检查所有拆下零件的磨损、损坏或其它故障情况，具体要求如下：

Check the wear,break of the parts.Repair or change if necessary. The requirements are as following:

1.换档拨叉厚度（thickness of the shift fork）mm

标准（standard）	极限(limit)
10.0	9.0

2.倒档限位弹簧自由长度（the free length of reverse set spring）mm

标准（standard）	极限(limit)
39.8	38.5

3.同步器齿环和结合齿间的间隙 mm
（clearance between gear ring and engaging gear）

档位（gear position）	标准（standard）	极限(limit)
三、四档（3rd 4th）	1.0	0.5
一、二、五档（1st 2nd 5th）	1.5	

4. 同步器齿环和滑块间的间隙 mm
(clearance between gear ring and slide)

档位（gear position）	标准（standard）
二、三、四、五档（ 2nd 3rd 4th 5th ）	4.34～4.66
一档、倒档（ 1st Rev ）	4.84～5.16

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5.同步器齿毂与滑块间的间隙 mm
(clearance between hub and slide)

标准（standard）	0.09～0.31

6.变速器二轴径向跳动 mm
(radial jig of mainshaft)

极限(limit)	0.1

7.齿轮内孔与二轴间的间隙 mm
(clearance between inner hole and mainshaft)

档位（gear position）	标准（standard）	极限(limit)
三档 (3rd)	0.05～0.08	0.2
五档（5th）	0.05～0.09	

8.衬套与倒档轴间的间隙 mm
（clearance between sleeve and reverse gear shaft）

标准（standard）	极限(limit)
0.04～0.08	0.2

9.球轴承径向跳动 mm
（radial jig of ball bearing）

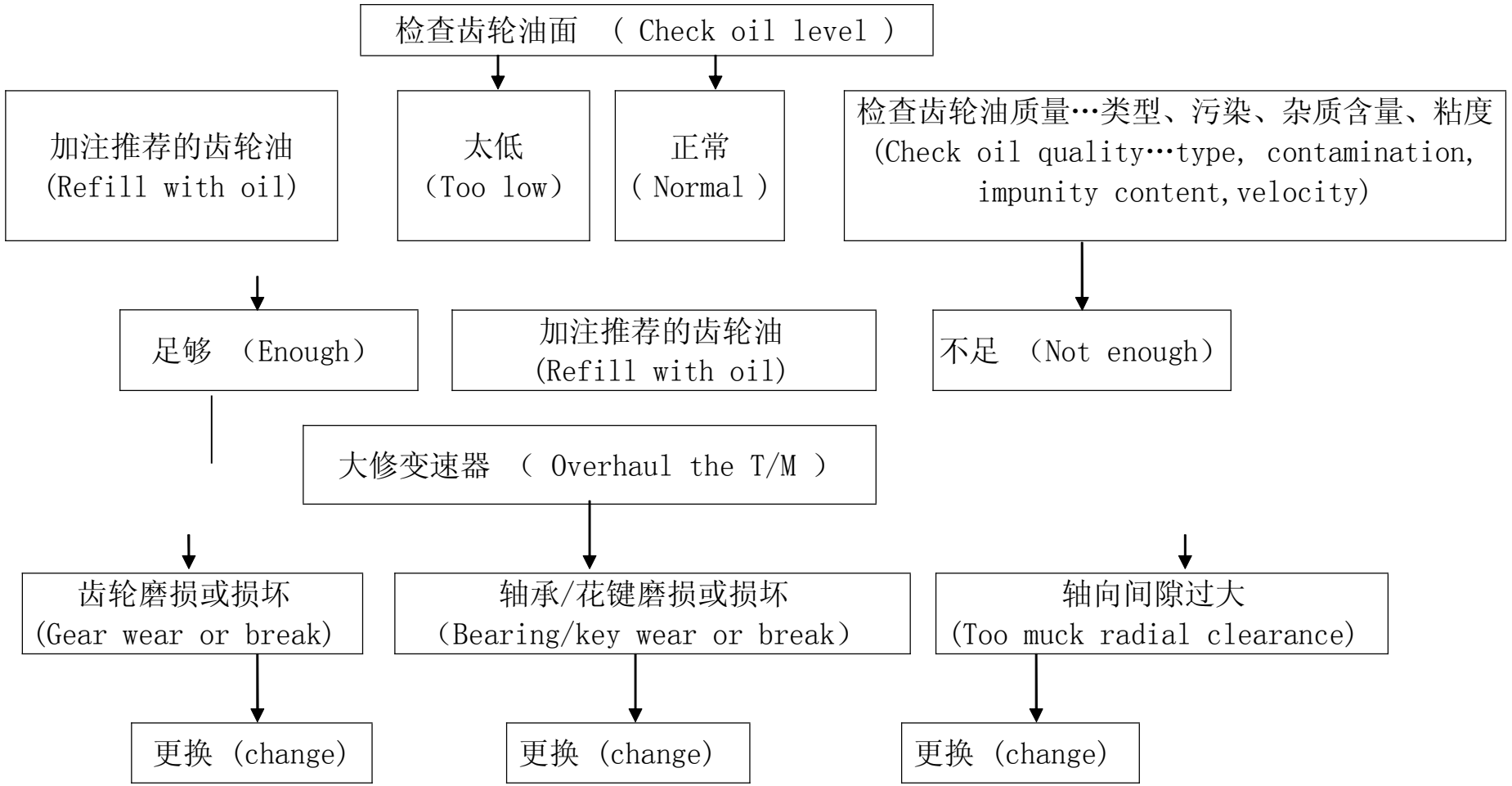
极限(limit)	0.2	

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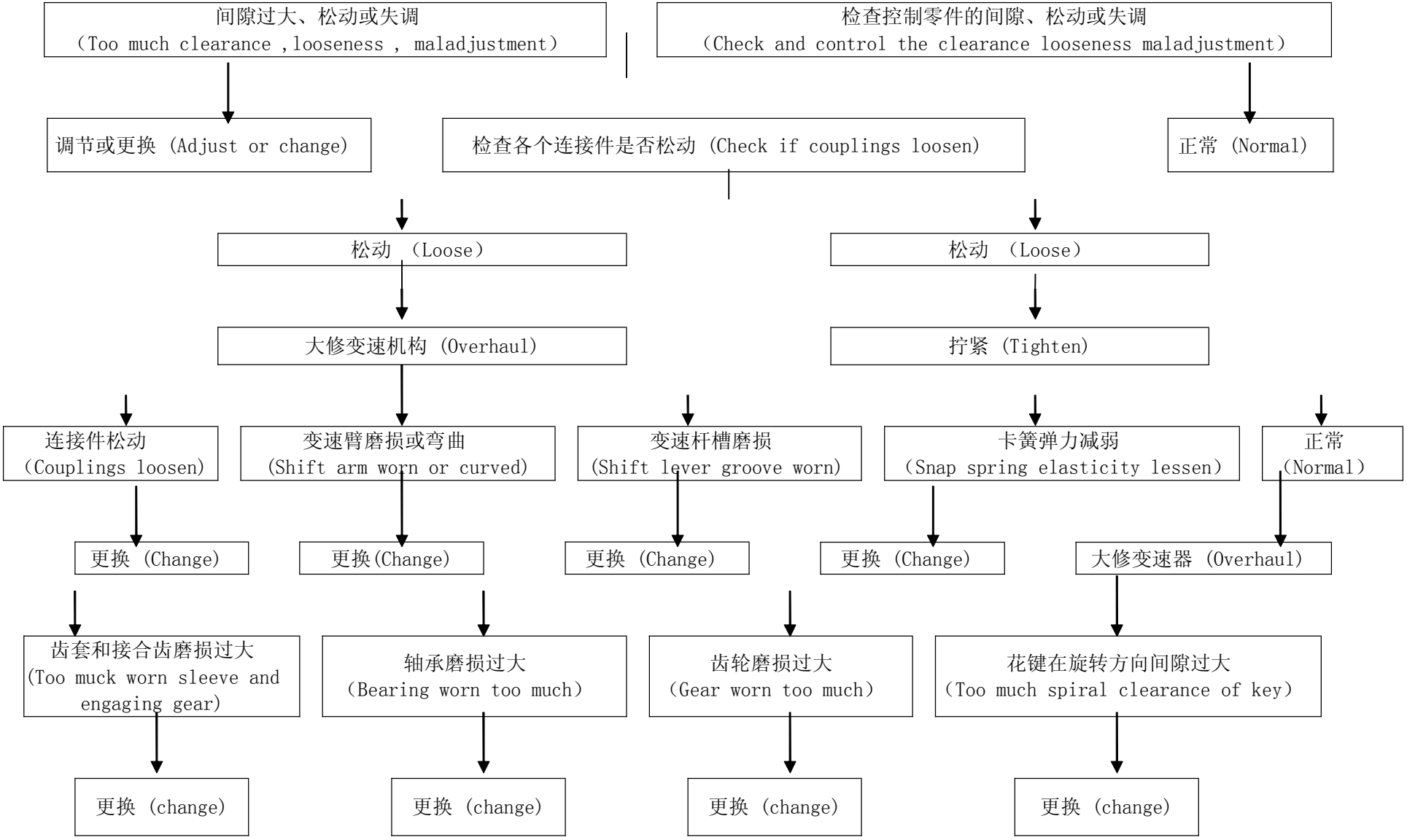
故障诊断（ Fault Diagnosis ）

一. 变速器噪音 （T/M Noise）

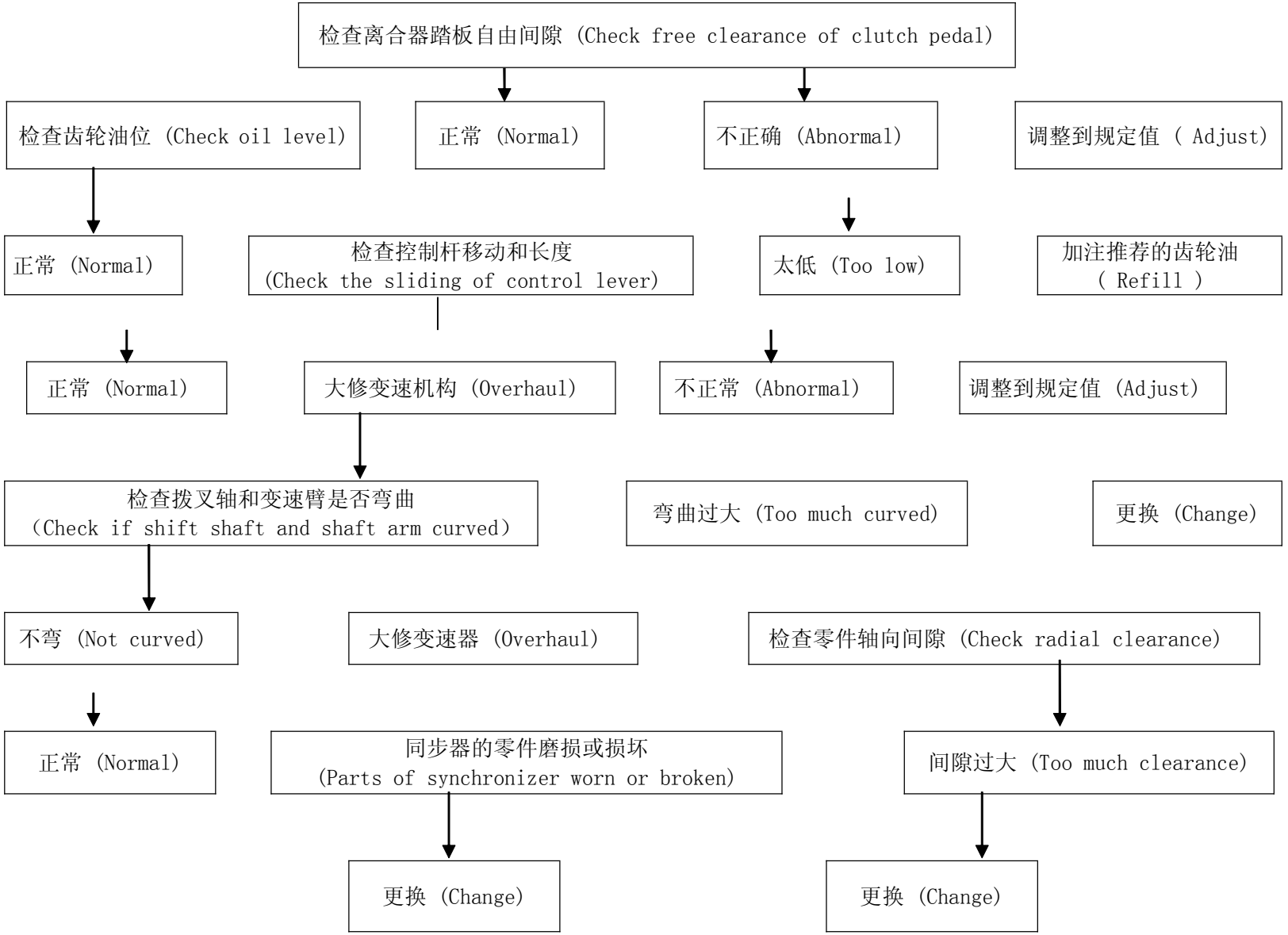
在怠速转动时，如果从变速器周围发出噪音，首先应检查离合器。若踩下离合器踏板后，噪音停止，则说明噪音发自变速器。
（If there is noise from the surroundings of the T/M during idle rotation,first check the clutch。 If the noise disappears when the pedal is engaged, the trouble derives from the T/M.）



二. 齿轮脱档(Gear Dislocation)

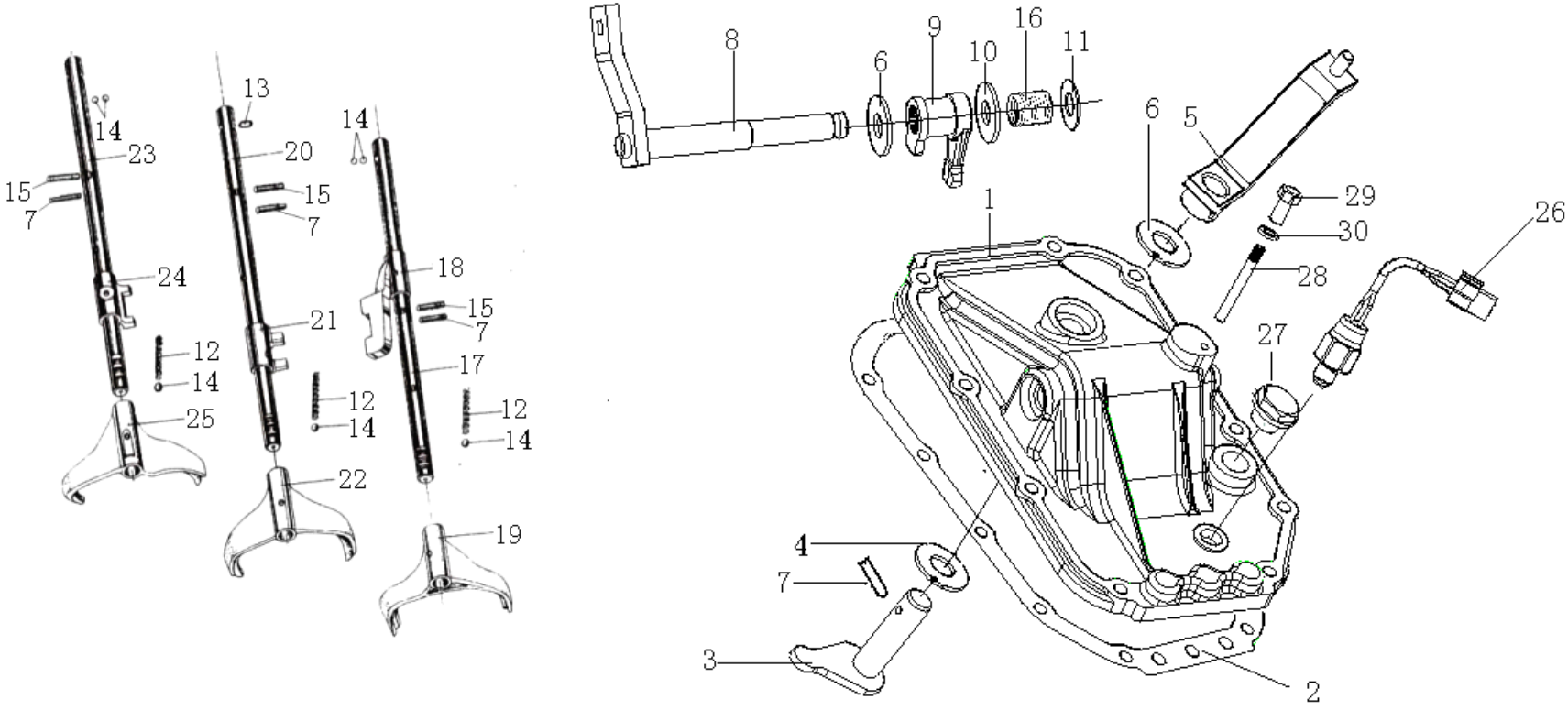


三．齿轮不能平滑的变速（变速时发出噪音）Shift not freely (shift with noise)



图一　LC5T28(A2Q02)变速器盖及换档机构

LC5T28(A2Q02) TRANSMISSION COVER AND GEAR---SHIFT MECHANISM



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图一　LC5T28(A2Q02)变速器盖及换档机构

LC5T28(A2Q02) TRANSMISSION COVER AND GEAR---SHIFT MECHANISM

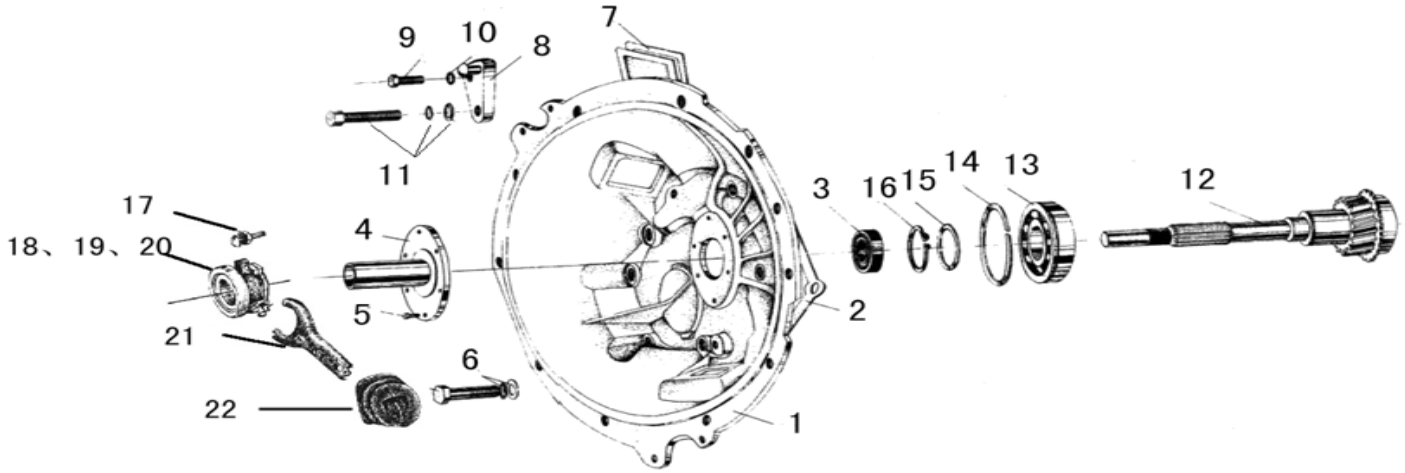
序号 (No.)	图号或代号 (Code)	产品名称 (Name)	数量 (Number)
1	N-1702111-24-01	变速器盖（Transmission Cover）	1
2	N-1702111-23-01	变速器盖衬垫（Gasket-Transmission Cover）	1
3	N-1702190-00Z	内选档摇臂（Gear-select Rocker Arm）	1
4	N-1702193-00	平垫圈（Plain Washer）	1
5	N-1702174-00-15	外选档摇臂合件 (Outer Select Rocker Arm Assy)	1
6	N-1702112-00	变速器盖油封（Oil Seal）	2
7	Q5280525	弹性圆柱销 (Column Pin)	7
8	N-1702174-00-15	外换档摇臂合件 (Shift Rocker Arm Assy)	1
9	J-1702180-00-00	内换档摇臂（Gear-shift Rocker Arm）	1
10	N-1702176-00Z	平垫圈（Plain Washer）	1
11	N-1702173-00	平垫圈 (Plain Washer)	1
12	J-1702254-00-00	锁球弹簧（Ball---Set Spring）	3
13	N-1702255-01	互锁顶销 (Pin)	1
14	8.731-GB308-84	钢球（Steel Ball）	7
15	Q5280325	弹性圆柱销 (Column Pin)	6
16	N-1702174-20	倒/5 档阻力弹簧（Spring）	1
17	N-1702233-20-01	1/2 档拨叉轴（1/2 Shaft Shift）	1

序号 (No)	图号或代号 (Code)	产品名称 (Name)	数量 (Number)
18	N-1702241-21	1/2 档拨块（Shift Block,1/2）	1
19	N-1702232-20	1/2 档拨叉（Shift Fork,1/2）	1
20	N-1702212-20-01	3/4 档拨叉轴（3/4 Shaft Shift）	1
21	N-1702241-20	3/4 档拨块（Shift Block,3/4）	1
22	N-1702230-20	3/4 档拨叉（Shift Fork,3/4）	1
23	N-1702243-20-01	R/5 档拨叉轴（R/5 Shaft Shift）	1
24	N-1702241-01	R/5 档拨块（Shift Block,R/5）	1
25	N-1702242-30-01	R/5 档拨叉（Shift Fork,R/5）	1
26	JK611CB	倒车灯开关 (Reverse Lamp Switch,Assy)	1
27	N-1701011-20-01	加油螺塞总成（Oil Filler Plug）	1
28	Q5240440	滚花圆柱销（Column Pin）	1
29	Q150B0612	六角螺栓（Bolt）	1
30	N-1702211-04	垫圈（Plain Washer）	1

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图二　LC5T28(A2Q02)变速器一轴及离合器壳

LC5T28(A2Q02) TRANSMISSION PRIMARY SHAFT AND CLUTCH HOUSING



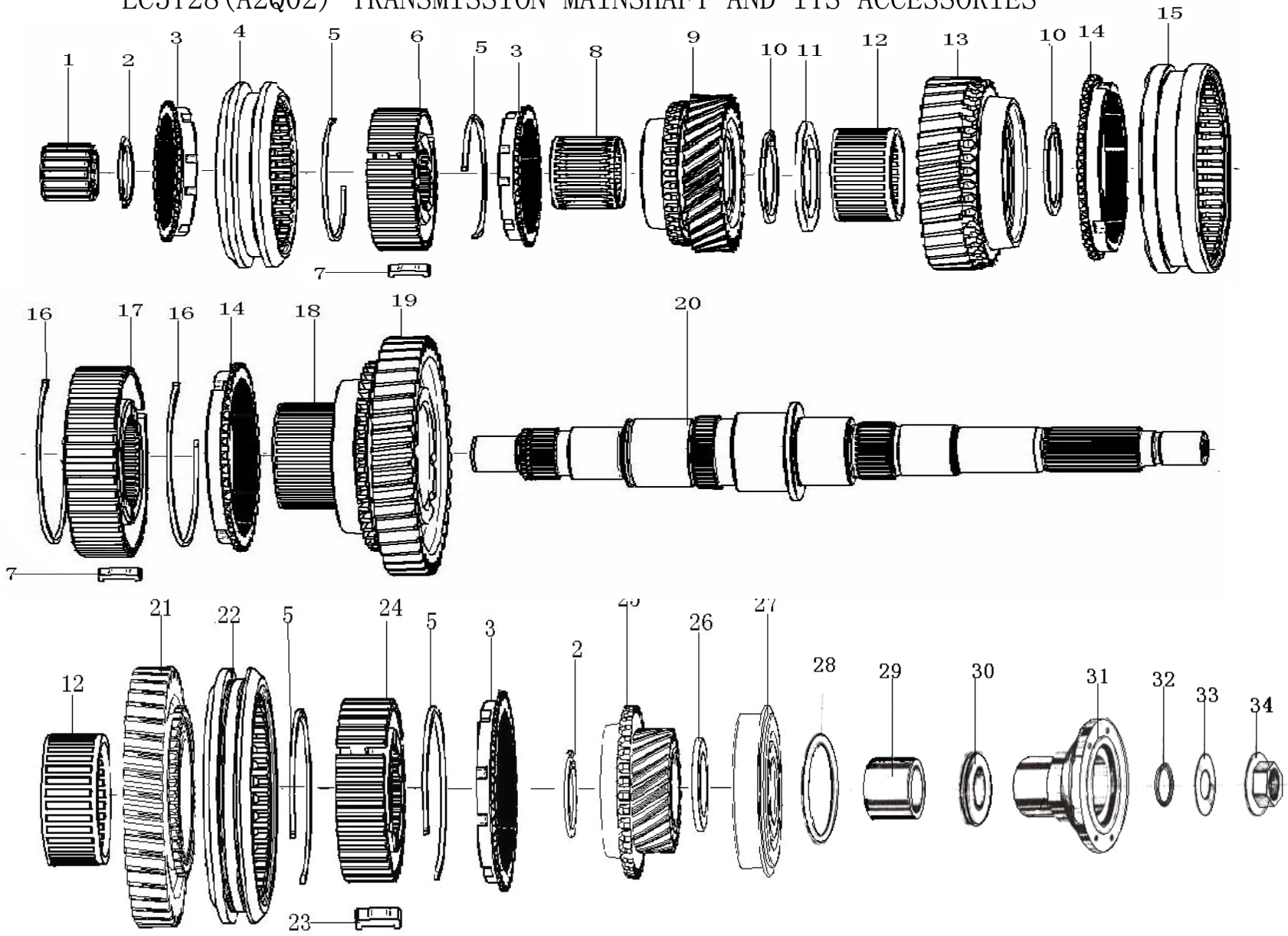
序号 (No.)	图号或代号（Code）	产品名称 (Name)	数量 (Number)
1	N-1601311-04	离合器壳 (Clutch Housing)	1
3	N-1601320-00	离合器壳油封 (Oil Seal)	1
4	N-1601310-21	一轴前盖(Bearing Cover)	1
5	Q218B0612	内六角圆柱头螺钉(Bolt)	6
6	Q1501240F3	螺栓（Bolt）	5
7	N-1601311-00	挡尘片(cleaning slice)	1
8	N-1601321-00	球头支架(stand for fork head)	1
9	Q2580820	螺栓（Bolt）	1
11	Q1501260F3	螺栓（Bolt）	1
12	J-1701110-00-02	一轴与接合齿环合件 (Primary Shaft,Assy)	1
13	TM6308YA1-RS1 N/P63	一轴前轴承(Bearing)	1

序号 (No.)	图号或代号（Code）	产品名称 (Name)	数量 (Number)
14	90/96.5 GB/T305	止动环（Bearing Thrust Ring）	1
15	N-1701132-00	一轴垫片(Washer)	1
16	N-1701133-00	卡环(Snap Ring)	1
18、19、20	1602050Z1	分离抽成套筒总成 (Bearing Cover of Separate)	1
21	1602040Z1	分离叉总成 (Yoke-Release Clutch,Assy)	1
22	1602049E4	分离叉护套（Dust-proof Piece,Housing）	1

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图三　LC5T28(A2Q02)变速器第二轴及其附件

LC5T28(A2Q02) TRANSMISSION MAINSHAFT AND ITS ACCESSORIES



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图三　LC5T28(A2Q02)变速器第二轴及其附件

LC5T28(A2Q02) TRANSMISSION MAINSHAFT AND ITS ACCESSORIES

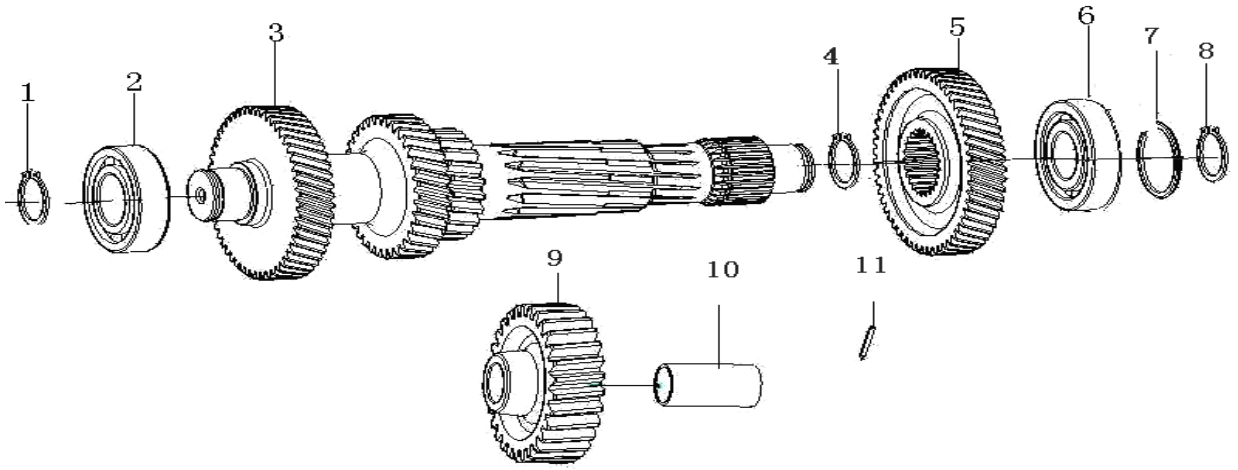
序号 (No)	图号或代号 (Code)	产品名称 (Name)	数量 (Number)
1	J-1701210-00-00	滚针轴承---二轴前、一轴内 (Needle Bearing)	1
2	N-1701222-01Z	卡环 (Snap Ring)	1
3	N-1701226-00	3/4、5 档同步器齿环 (Gear Ring,3/4,5)	3
4	J-1701225-00-00	3/4、R/5 档同步器弹簧 (Spring, 4/5,R/5)	4
5	N-1701221-20	3/4 档同步器齿毂 (Hub,3/4)	1
6	N-1701223-01	3/4 档同步器齿套 (Sleeve,3/4)	1
7	N-1701224-00	同步器滑块---1/2档、3/4档 (Slide,1/2,3/4)	3
8	N-1701244-20	滚针轴承-主三齿 (Needle Bearing)	1
9	J-1701240-00-00	二轴三档齿轮总成 (3rd gear ,Assy)	1
10	N-1701235-00Z	卡环 (Snap Ring)	2
11	N-1701236-00	二轴二档齿止推垫圈 (Thrust Washer,2nd Gear)	1
12	N-1701260-01	滚针轴承-二轴二档、倒档 (Needle Bearing)	2
13	J-1701250-00-00	二轴二档齿轮总成 (2nd gear ,Assy)	1
14	N-1701276-01	1/2 档同步器齿环 (Gear Ring,1/2)	2
15	N-1701274-00	1/2 档同步器弹簧 (Spring, 1/2)	2
16	N-1701271-01A	1/2 档同步器齿毂 (Hub,1/2)	1
17	N-1701272-30-01	1/2 档同步器齿套 (Sleeve,1/2)	1
18	N-1701260-02A	滚针轴承-主一齿 (Needle Bearing)	1

序号 (No)	图号或代号 (Code)	产品名称 (Name)	数量 (Number)
19	J-1701280-00-00	二轴一档齿总成 (1st Gear Assy)	1
20	N-1701201-00-12	二轴 (Main Shaft)	1
21	J-1701290-00-00	二轴倒档齿轮总成 (Reverse Gear Assy)	1
22	N-1701332-20	R/5 档齿套 (Sleeve,R/5)	1
23	N-1701331-20	R/5 档齿毂 (Hub,R/5)	1
24	N-1701333-01	R/5 档同步器滑块 (Slide,R/5)	3
25	J-1701230-00-00	二轴五档齿轮总成 (5th Gear Assy)	1
26	N-1701321-01	二轴五档齿轮止推垫圈 (Thrust Washer,5th Gear)	1
27	63/32NY1C3Z2	轴承 (Radial Ball Bearing)	1
28	75/81.6GB305	止动环(Bearing Thrust Ring)	1
29	N-1701361-00-12	里程表齿轮前隔套 (Distance Tube, Odometer Gear)	1
30	N-1701362-21	里程表主动齿轮 (Drive Gear, Odometer)	1
31	N-1701371-30-08	二轴法兰盘 (Flange)	1
32	N-1701372-01	O 型密封圈 (O Seal)	1
33	N-1701375-01	碟型垫圈 (Washer)	1
34	N-1701374-01-01	二轴螺母 (Nut, Mainshaft)	1
35	N-1701362-00-12	里程表齿轮后隔套 (Distance Tube, Odometer Gear)	1

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图四 LC5T28(A2Q02)变速器中间轴及倒档轴

LC5T28(A2Q02) TRANSMISSION COUNTERSHAFT AND REVERSE GEAR SHAFT

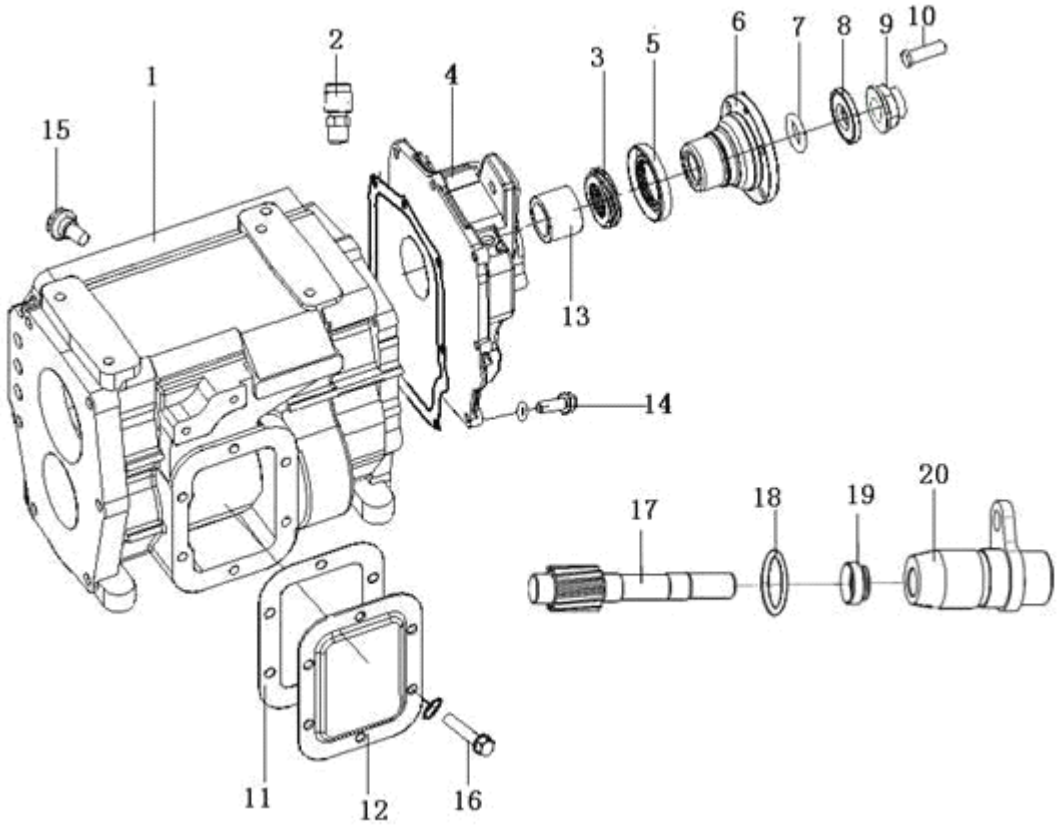


序号 (No.)	图号或代号（Code）	产品名称 (Name)	数量 (Number)
1	GB894.1-86-35	挡圈-中间轴前（Snap Ring）	1
2	6207NC3Z2	单列向心球轴承---中间轴前轴承(Bearing)	1
3	J-1701413-00-00	中间轴（Countershaft）	1
4	N-1701133-00	卡环（Snap Ring）	1
5	J-1701411-00-00	中间轴五档齿轮 (5th Gear)	1
6	63/32NC3Z2	轴承（Bearing）	1
7	75 81.6GB305	止动环(Bearing Thrust Ring)	1
8	N-1701133-03	卡环（Snap Ring）	1
9	J-1701480-00-00	倒档齿轮总成（Reverse Gear Assy）	1
10	N-1701483-00	倒档轴（Reverse Gear Shaft）	1
11	N-1701502-00	倒档轴销（Pin）	1

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图五 LC5T28(A2Q02)变速器壳体、第二轴轴承盖

LC5T28(A2Q02) TRANSMISSION HOUSING MAINSHAFT BEARING CAP



序号 (No)	图号或代号（Code）	产品名称 (Name)	数量 (Number)
1	N-1701001-22	变速器壳体 （ Housing ）	1
2	Q9001	通气塞总成(Breathing Plug,Assy)	1
3	N-1701362-21	里程表主动齿(Driven Gear,Odometer)	1
4	N-1701521-N1-02	后盖 （ Rear Cover ）	1
5	N-1701522-02	后 盖 油 封 (Oil Seal,Rear Cover)	1
6	J-1701295-00-00	二轴法兰盘 （ Flange ）	1
7	N-1701372-01	O 型密封圈 （ O Seal ）	1
8	N-1701375-01	碟型垫圈 （ Washer ）	1
9	N-1701374-01	二轴螺母 （ Nut，Mainshaft ）	1
10	2202208Z8	法兰盘螺母	4
11	N-1701512-01	侧 盖 衬 垫 (Gasket, Side Cover)	1
12	N-1701511-01	侧盖 （ Side Cover ）	1
13	N-1701361-00-12	里被齿主动齿轮前隔套(Distance Tube,Odometer Gear)	1
14	N-1701513-01	六角螺栓（Bolt）	17
15	N-1701007-20-01	放油螺塞总成（Bleeding Plug）	1
16	N-1701513-04	六角螺栓 （ Bolt ）	6
17	N-1700011-03	里被齿轮 (Driven Gear,Odometer)	1
18	GB1235-76 24X2.4	O 型密封圈 （ O Seal ）	1
19	N-1700021-00	轴套油封 (Oil Seal,Cable Sleeve)	1
20	N-1700023-03	里程表轴套 (Cable Sleeve,Odometer)	1

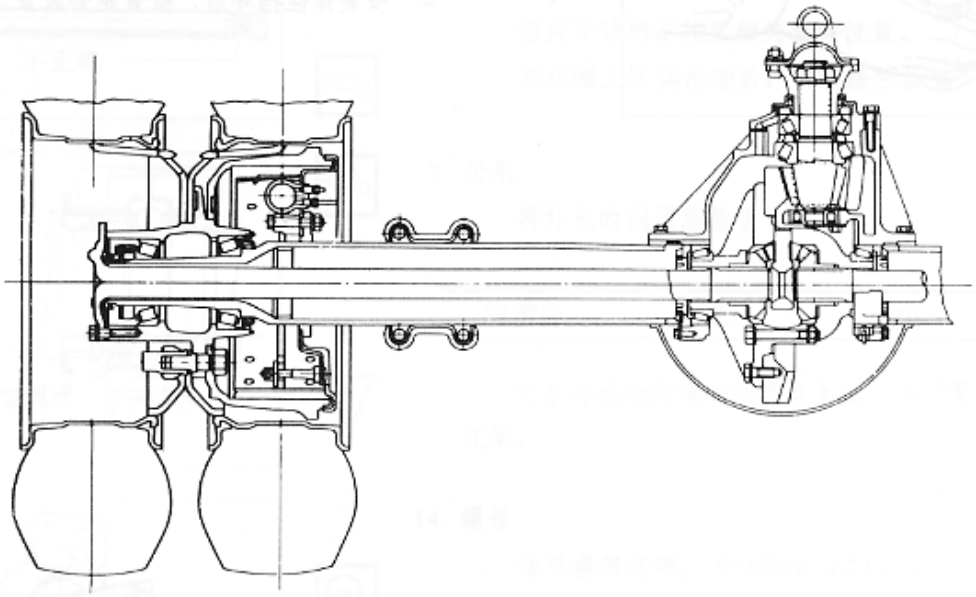
https://truckmanualshub.com/

易损件目录(Parts Wear Catalogue)

序号 (No.)	图号或代号(Code)	产品名称 (Name)	数量 (Number)	备注 (Memo)
1	N-1701512-01	侧盖衬垫（Gasket,Side Cover）	1	
2	N-1702111-23-01	变速器盖衬垫（Gasket,Upper Cover）	1	
3	N-1701522-02	后盖油封 (Oil Seal,Rear Cover）	1	
4	N-1601320-00	离合器壳油封 (Oil Seal）	1	

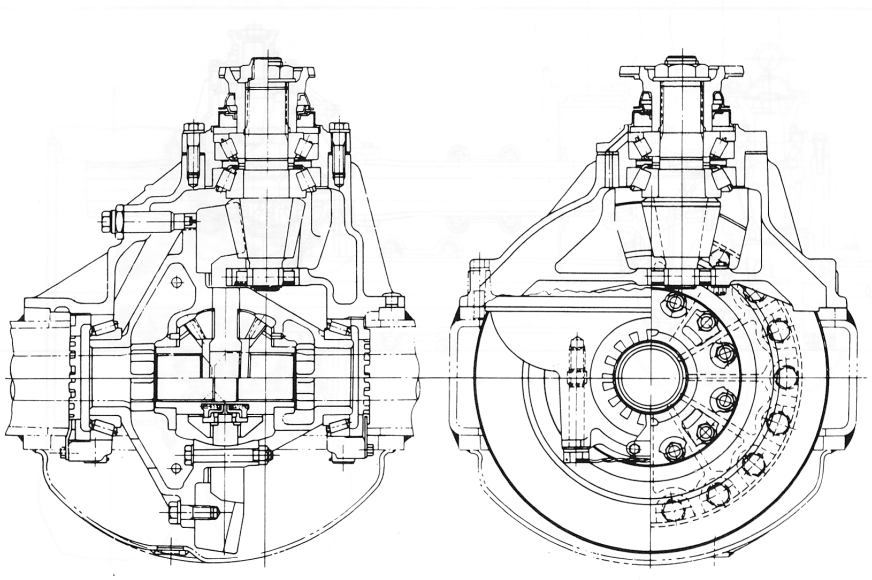
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REAR AXLE



https://truckmanualshub.com/

General

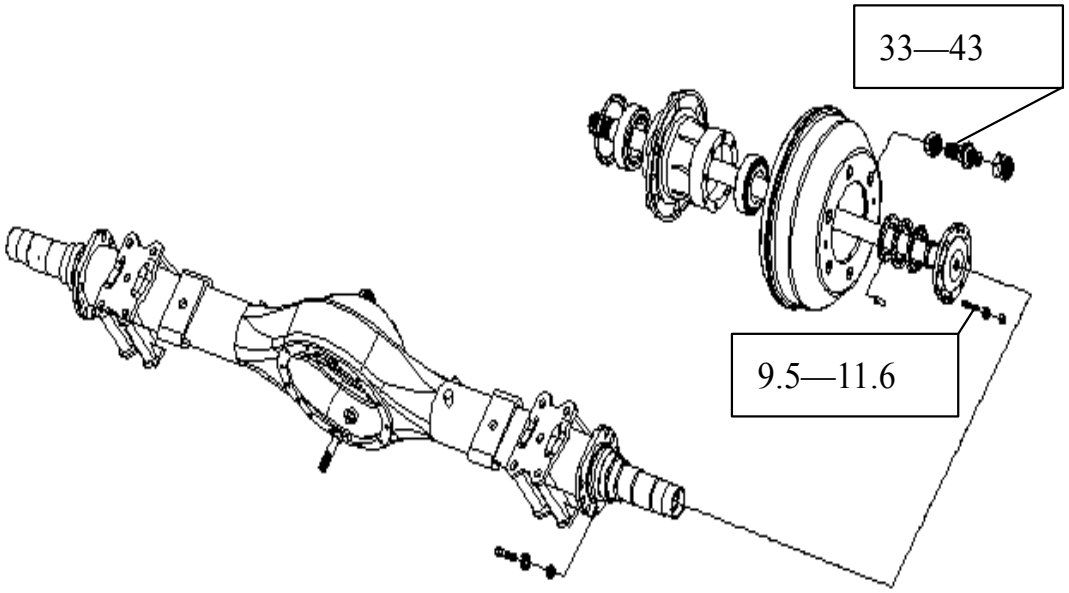


Main data and specifications of rear axle

Item		
Half-shaft bearing type		Full-float type
Driving and driven gear type		Hyperboloid gear
Driving and driven gear clearance	（mm）	0.18－0.25
Driving gear bearing preload （without oil seal）	（kg）	1.3－2.2
Differential bearing preload	（kg）	1.5－2.6
Lubricating grease number of single wheel hub	（gram）	280
Dosage of lubricating oil	（litre）	3

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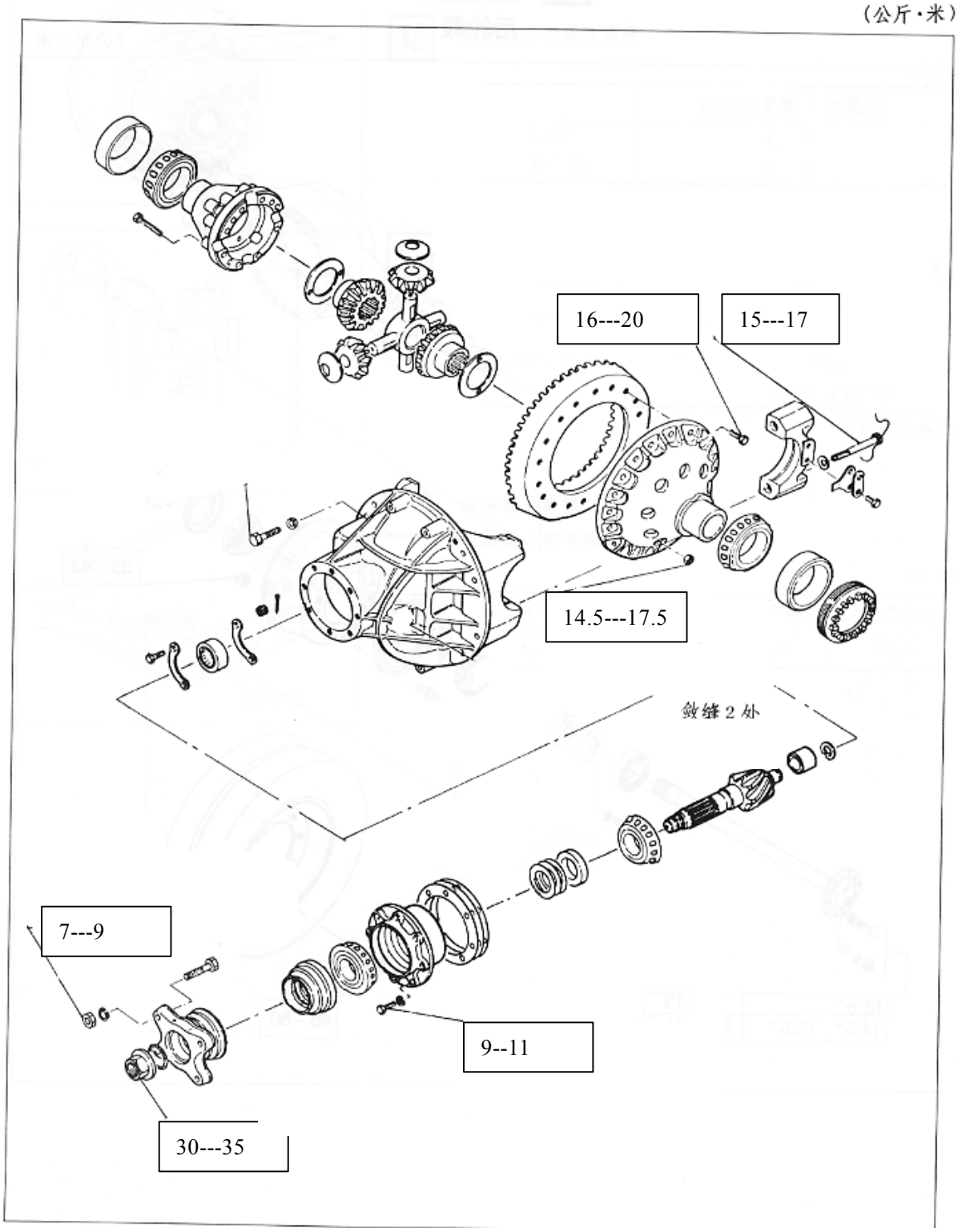
Tightening torque (kgf.m)



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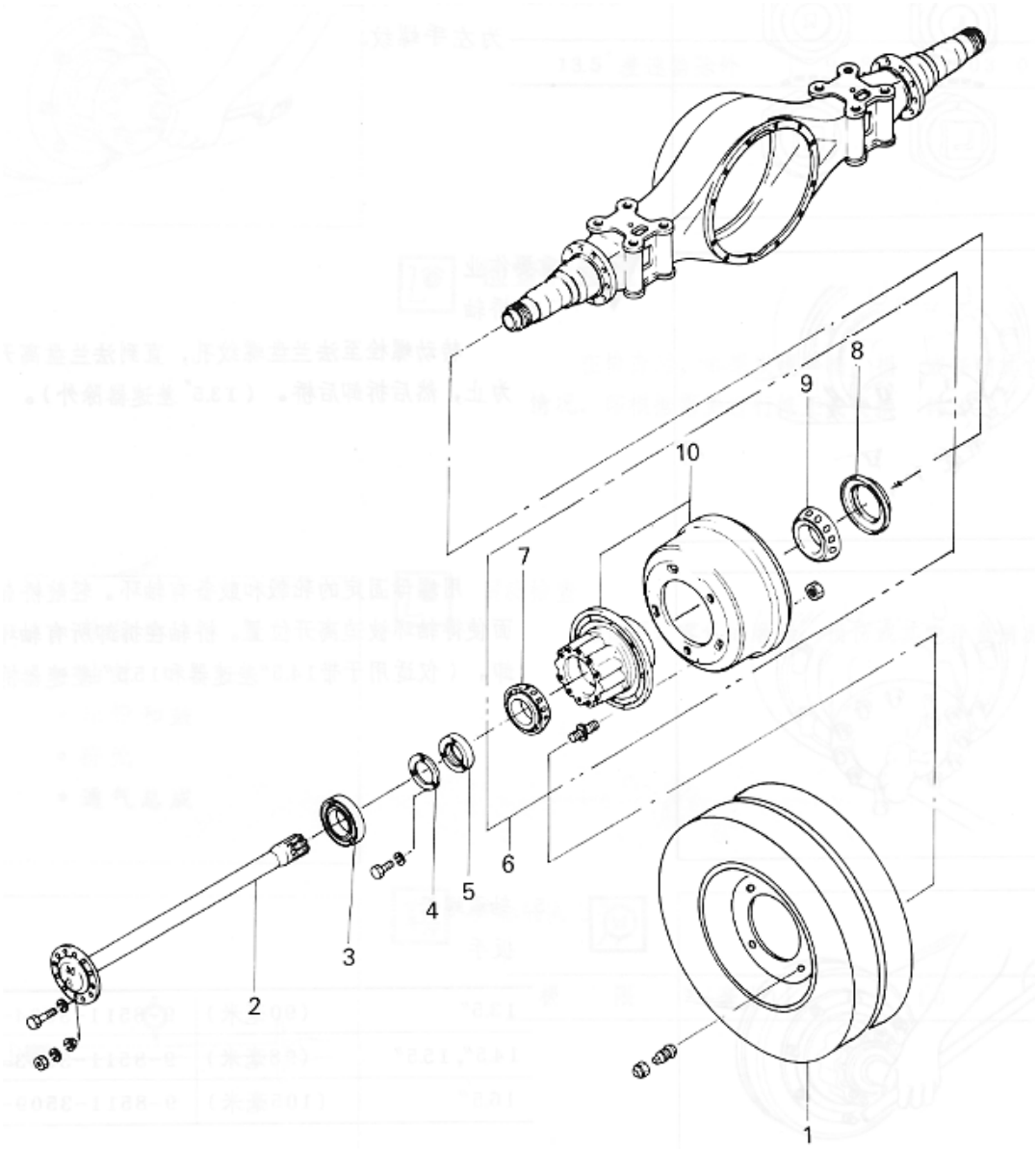
单级减速

（公斤·米）



REAR AXLE

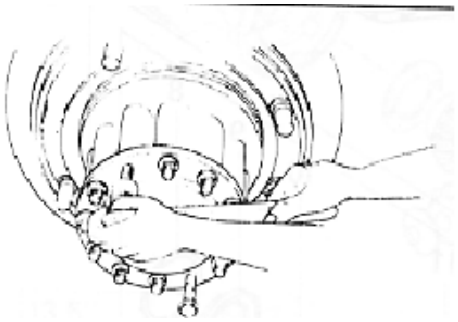
Disassembly



Disassembly sequence

1. Wheel assembly 2. Half shaft 3. Exterior oil seal 4. Locking washer
5. Bearing nut 6. Wheel hub and brake drum assembly 7. Exterior bearing
8. Inner oil seal 9. Inner bearing 10. Wheel hub, brake drum

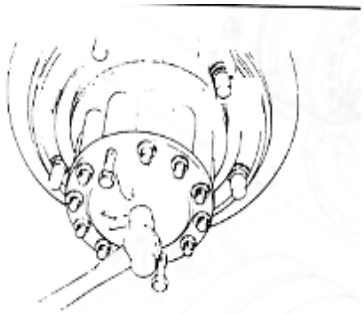
REAR AXLE



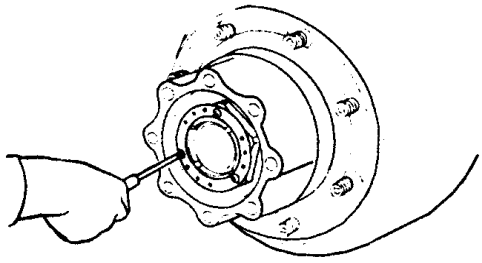
Important works

I. Dismantle rear axle half shaft

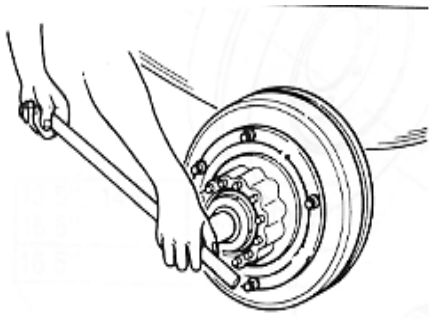
1. Dismantle bolts and nuts of half shaft



2. Knock half shaft flange end surface lightly with copper hammer until half shaft has been loosened.



3. Screw bolts to thread hole of flange plate until flange plate has left its position, then take out half shaft.

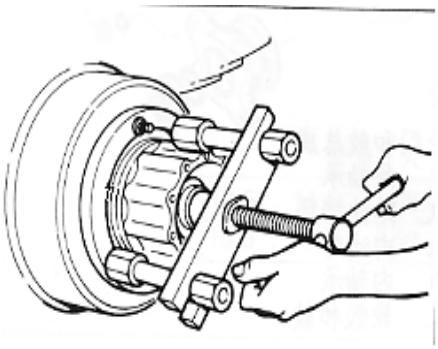


II. Dismantle wheel hub and brake drum assembly

1. Dismantle locking washer
2. Dismantle locking nuts of wheel hub bearing

Note:

Dismantle adjusting nuts with wheel hub bearing nut-adjusting wrench.

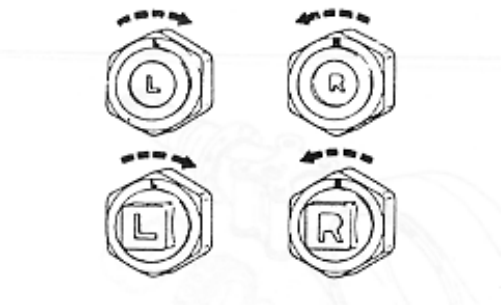


3. Dismantle wheel hub and brake drum assembly.

Note：

Use wheel hub puller to dismantle

REAR AXLE

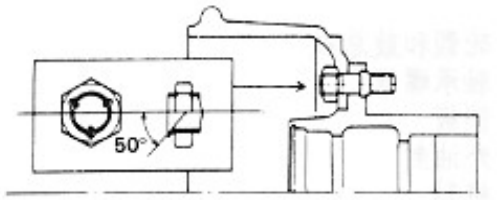


III. Dismantle and install the bolts and nuts of wheel

Thread turning direction of tyre bolts and nuts on right wheels is right.

Thread turning direction of tyre bolts and nuts on left wheels is left.

Note: distinguish the direction in disassembly and re-assembly process to avoid any mistake.



IV. Dismantle and install the nuts in bolts of wheel hub and brake drum assembly

Tightening torque of the nuts in bolts of wheel hub and brake drum assembly 30--36 kgf. m

Make three mark pegs on each nut after re-assembly screw to avoid any loose.

Inspection and repair

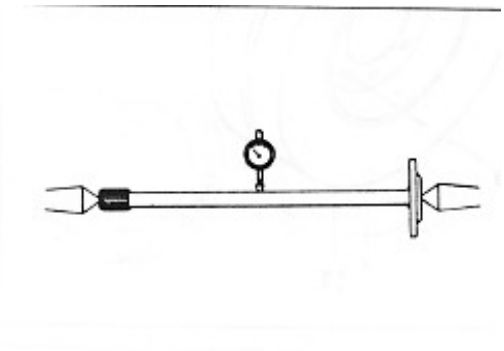
If there is any abrasion, damage or any other abnormal situation in checking process, it is necessary to repair or change parts according to requirement.

Visual inspection

Check whether there is any abrasion, damage or any other abnormal situation about parts on left side.

Wheel bearing, oil seal, wheel hub, brake drum,

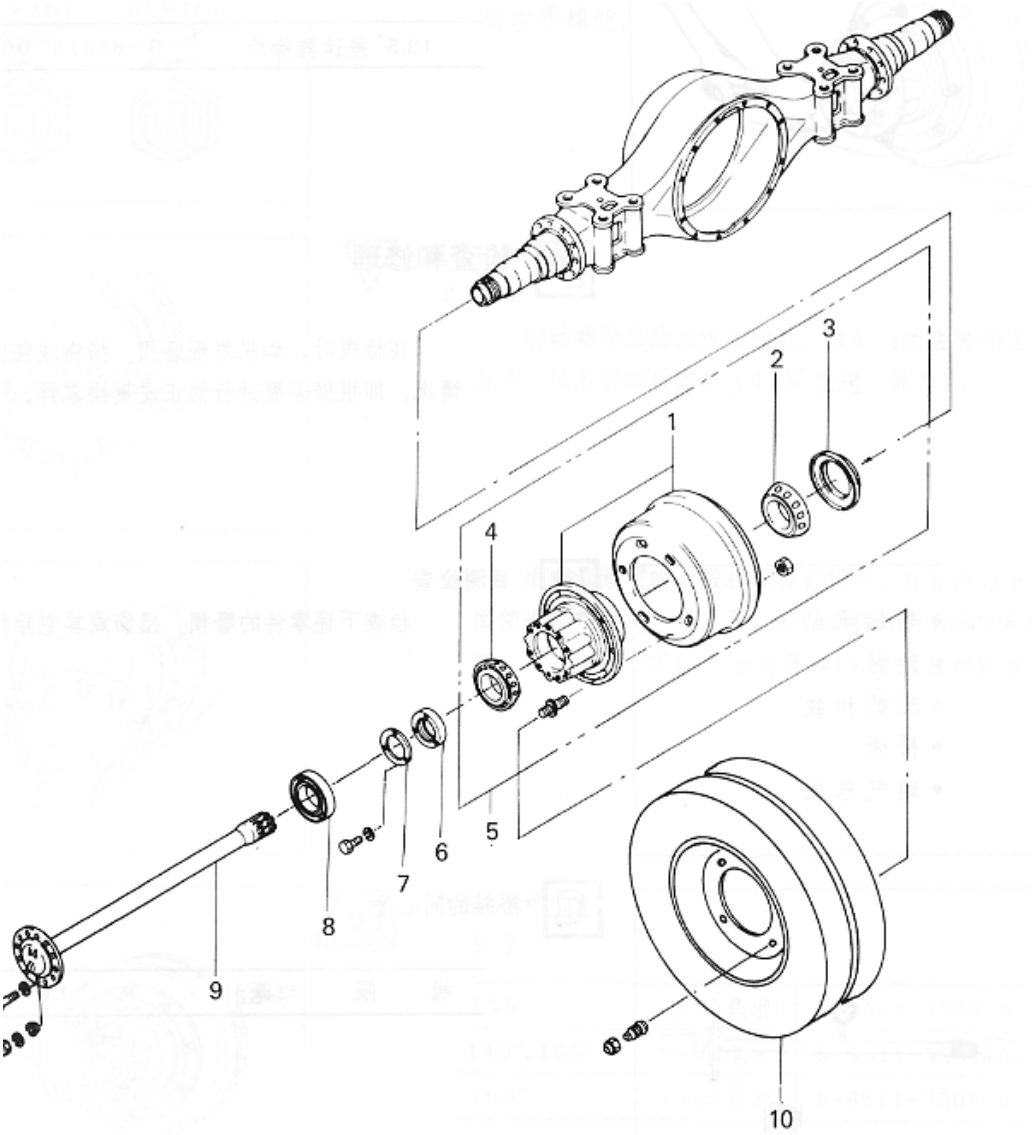
axle shell ventilation plug assembly



Concentric degree limit of half shaft 1．0mm

REAR AXLE

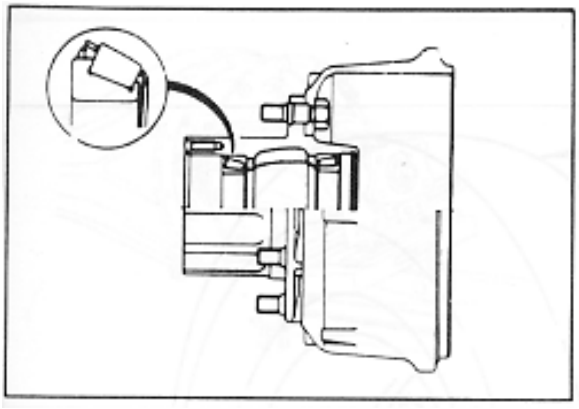
RE-assembly



Re-assembly sequence

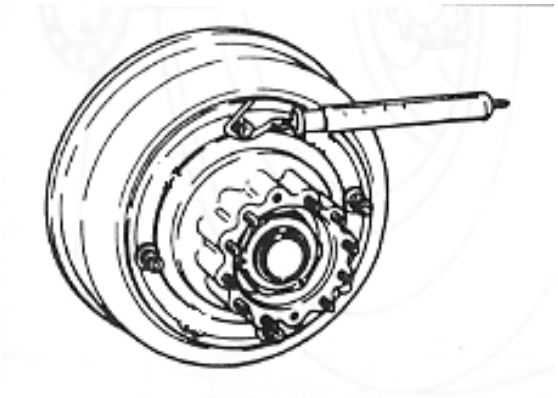
1. Wheel hub, brake drum 2. Inner bearing 3. Inner oil seal 4. Exterior bearing
5. Wheel hub and brake drum assembly 6. Bearing nut 7.Locking washer 8. Exterior oil seal
9. Half shaft 10. Wheel assembly

REAR AXLE



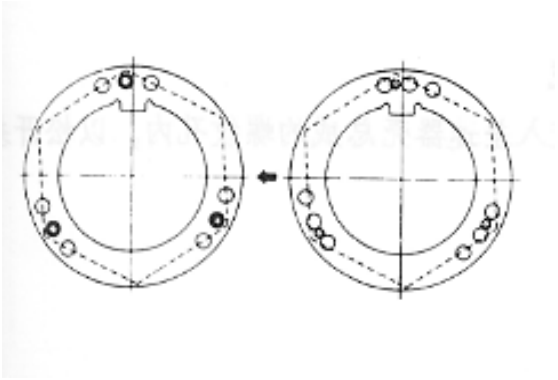
Important works

1. Dosage of lubricating grease on each side wheel hub is 280 gram, after spreading inner and exterior bearing, complete surplus lubricating grease should be spread on middle part of wheel hub evenly.



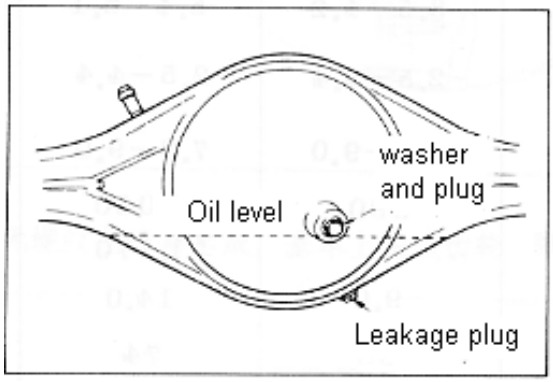
2. Adjustment of wheel hub bearing preload

Screw bearing nut until wheel hub is immovable or heavy, then unscrew bearing nut back for 1/6—1/8 rings, measured preload tangential pull on tyre bolts is 3—5. 5 kg.



3. Fix locking washer

If convex pin of locking washer could not head thread stop slot of positive half shaft sleeve, reverse locking washer; if it could not head after reversal all the time, it is necessary to turn bearing nut by requirement.



4．Wheel

Tightening torque of wheel nut 33—43kg．m

5. Dosage of changed rear axle gear oil （reference）3 litres

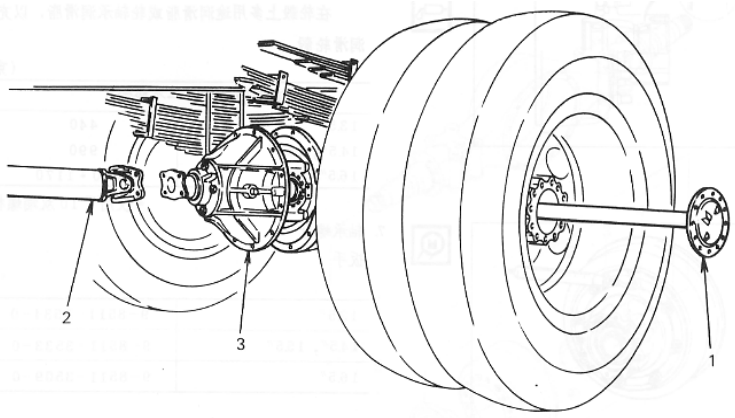
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REAR AXLE

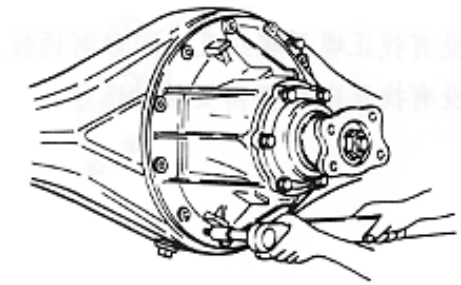
REAR AXLE

Main retarder

Disassembly and assembly



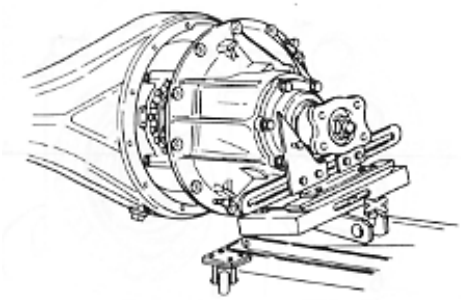
Disassembly sequence 1．Transmission shaft 2．Half shaft 3．Main retarder assembly
Assembly sequence 1．Main retarder assembly 2．Half shaft 3．Transmission shaft



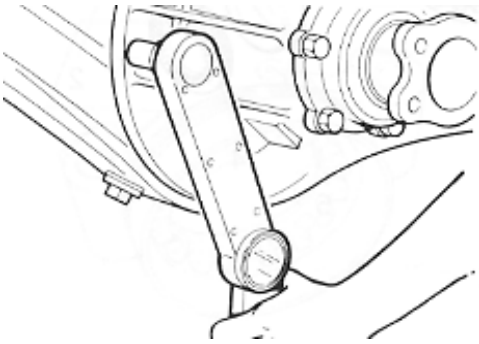
Important works

Dismantle main retarder assembly

1. Dismantle the nuts on main retarder shell
2. Screw the bolts into thread hole of main retarder shell, and turn the bolts to loosen main retarder assembly.



3. Use transmission jack to move main retarder assembly.



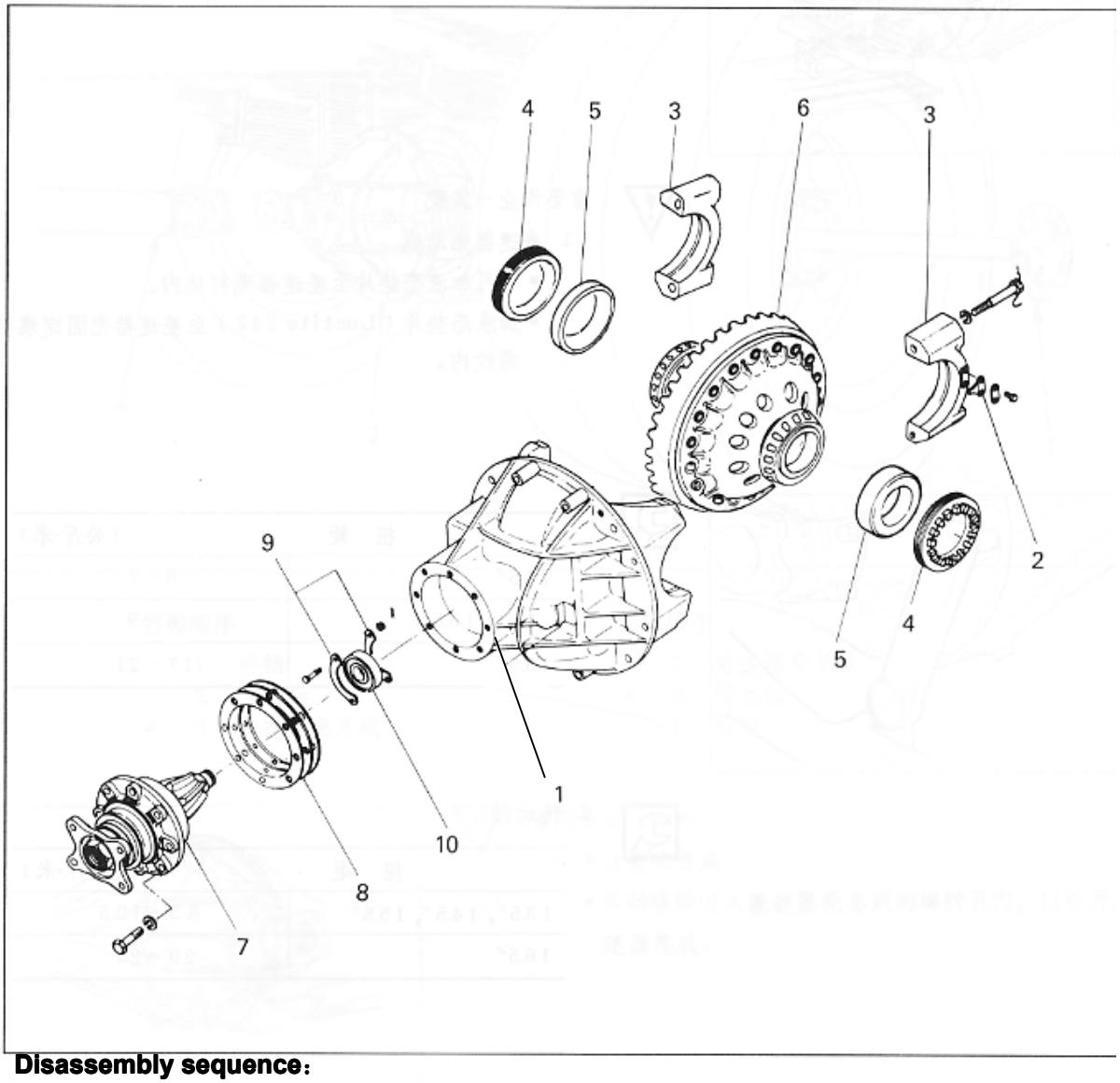
Assembly

Tightening torque of fixed nuts of main retarder shell 6－8 kgf.m

Tightening torque of transmission shaft assembly 7--9kgf.m

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分解
大元件



Disassembly sequence：

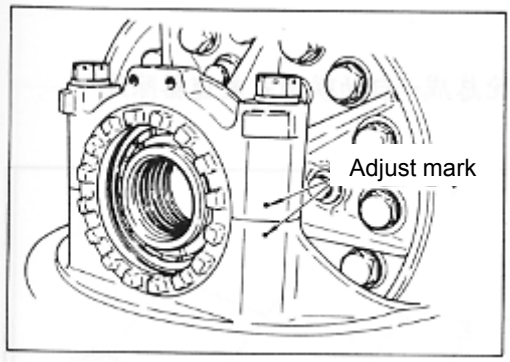
1. Main retarder shell assembly 2. Locking sheet 3. Bearing cap

4. Adjusting nut 5. Exterior loop of differential bearing 6. Differential assembly

7. Driving gear assembly 8. Adjusting washer of driving gear bearing saddle

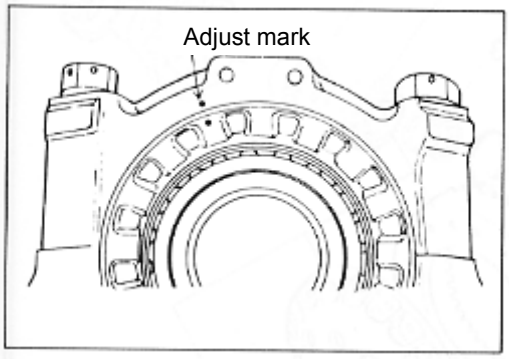
9. Retainer plate of guiding bearing 10. Exterior ring of guiding bearing

REAR AXLE



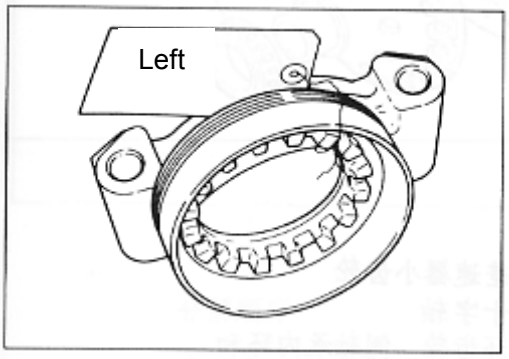
Important works

1. Before disassembly, make assembly marks on bearing cap and main retarder shell to avoid any mistake.

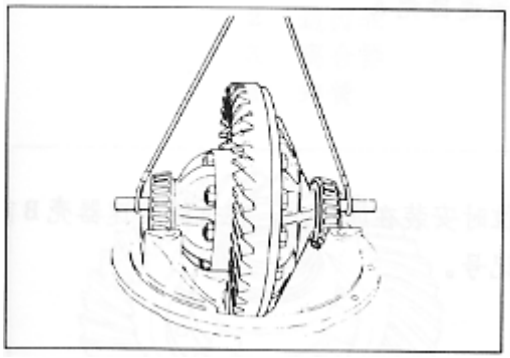


2. Before adjusting the nuts, make assembly marks on adjusting nut and bearing cap.

3. Before dismantling the adjusting nut, it is necessary to unscrew fixed bolts of bearing cap at first.



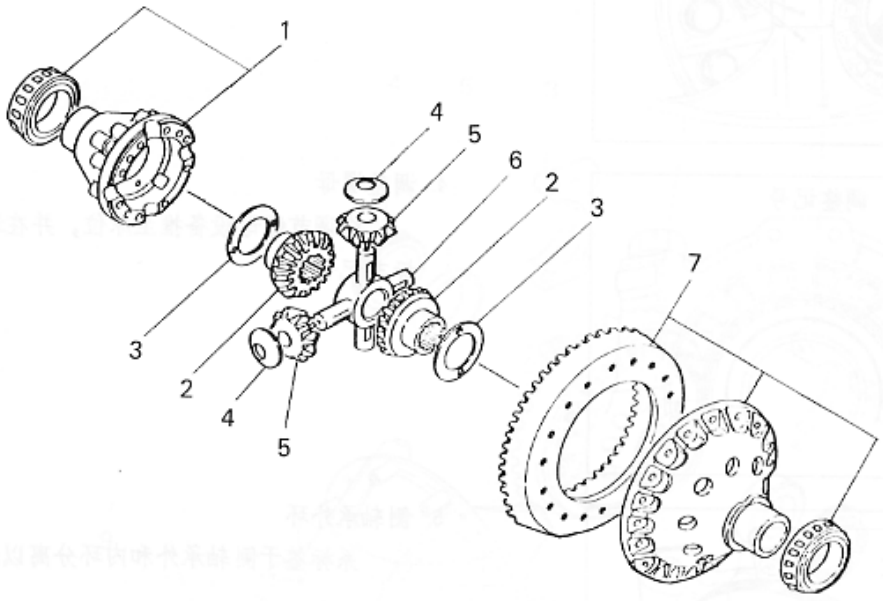
4. Left and right mark of bearing cap, adjusting nut and inner and exterior bearing ring should be placed independently to avoid mixed assembly.



5. Get through differential assembly with a proper stick, and lift differential assembly with hand or crane.

REAR AXLE

Disassembly of differential assembly

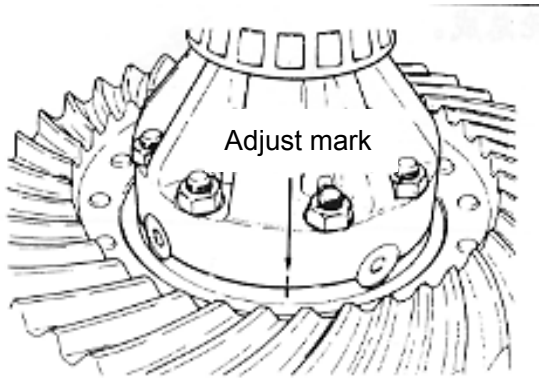


Disassembly sequence：

1. Differential right shell 2. Half shaft gear 3. Thrust washer of half shaft gear

4. Thrust washer of planetary gear 5. Planetary gear 6.Cross shaft

7. Driven gear, half shaft gear and differential left shell



Important works

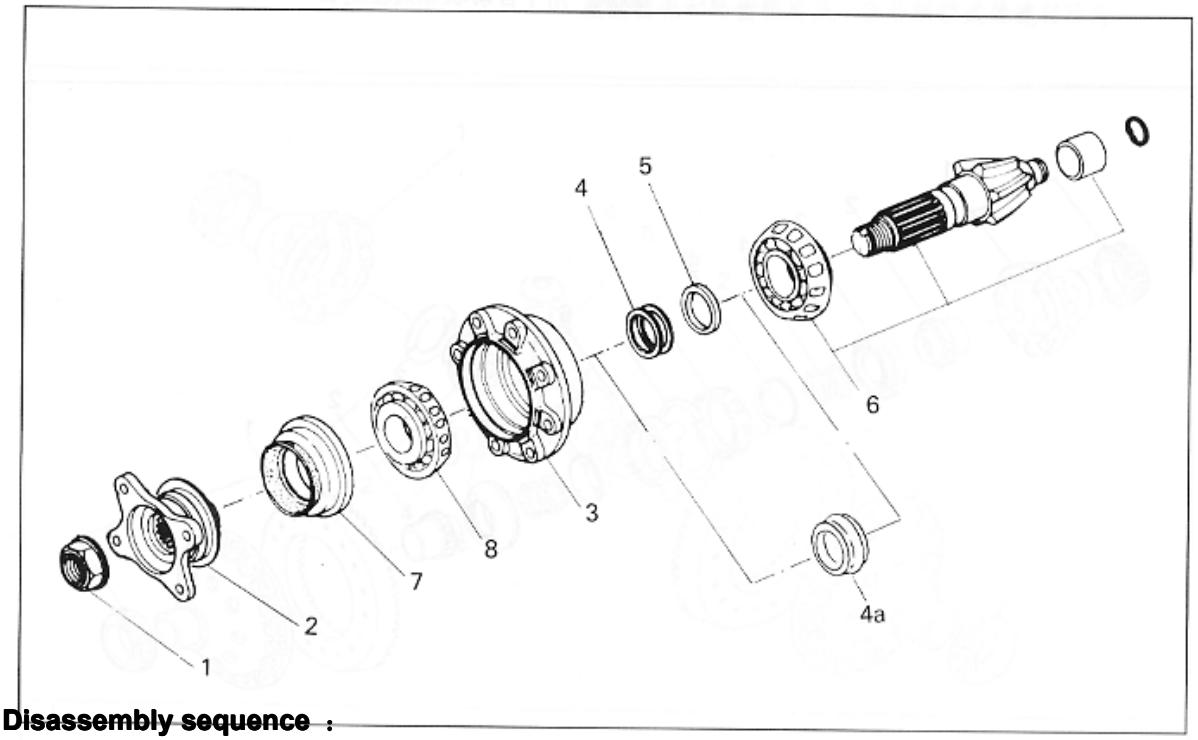
To install left and right shell of differential on original position in re-assembly process, make adjusting marks on left and right shell body before dismantling differential shell.

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REAR AXLE

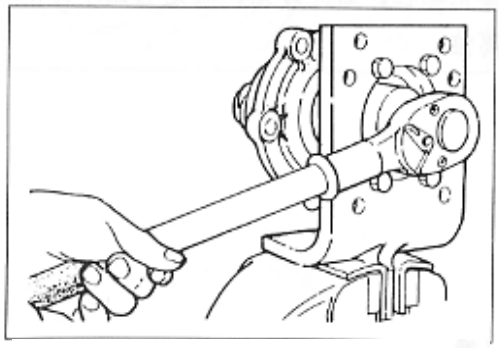
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传动小齿轮和壳总成



Disassembly sequence ：

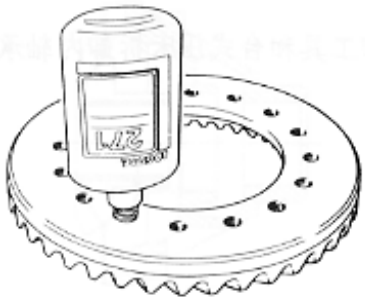
1. Flange nut 2. Flange plate 3. Drive gear bearing saddle 4. Bearing space cover and adjusting washer 5. Drive gear, inner bearing and guiding bearing 6. Oil seal of main gear 7. Inner loop of exterior bearing



Important works

1. Flange nut

Fix driving gear assembly on table vice, and dismantle flange nut with lengthened wrench.

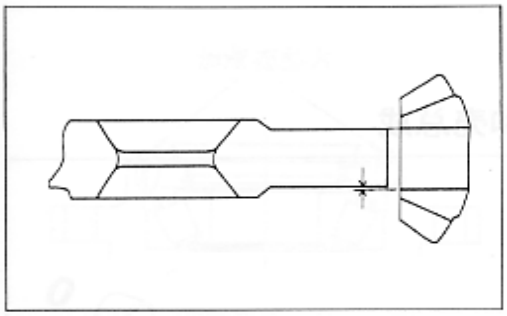


Change driven gear

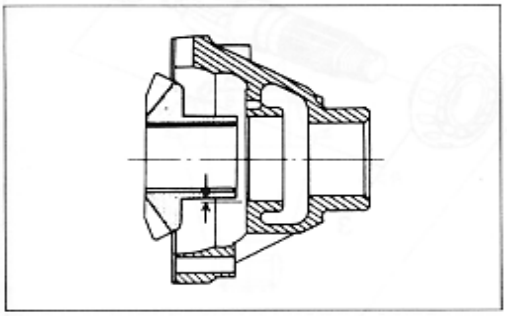
1. Place driving gear together with driven gear all the time.

2.Tightening torque16--20kg . m 。 When installing driven gear, add loose-proof glue on the thread of bolts and the thread hole of driven gear, then screw the bolts to regulated torque.

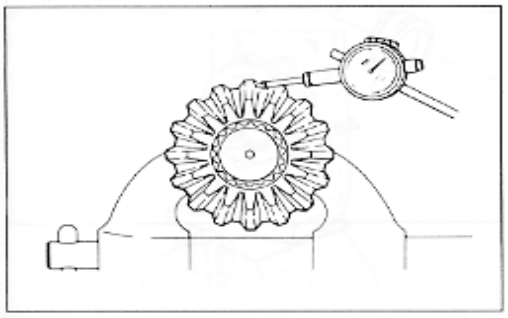
REAR AXLE



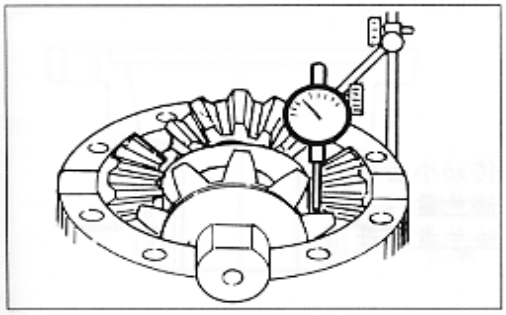
Clearance between cross shaft and planetary gear
Limit 0．2mm



Clearance between half shaft gear and differential shell
Limit 0．2mm



Clearance between half shaft gear and half shaft spline
Limit0．5

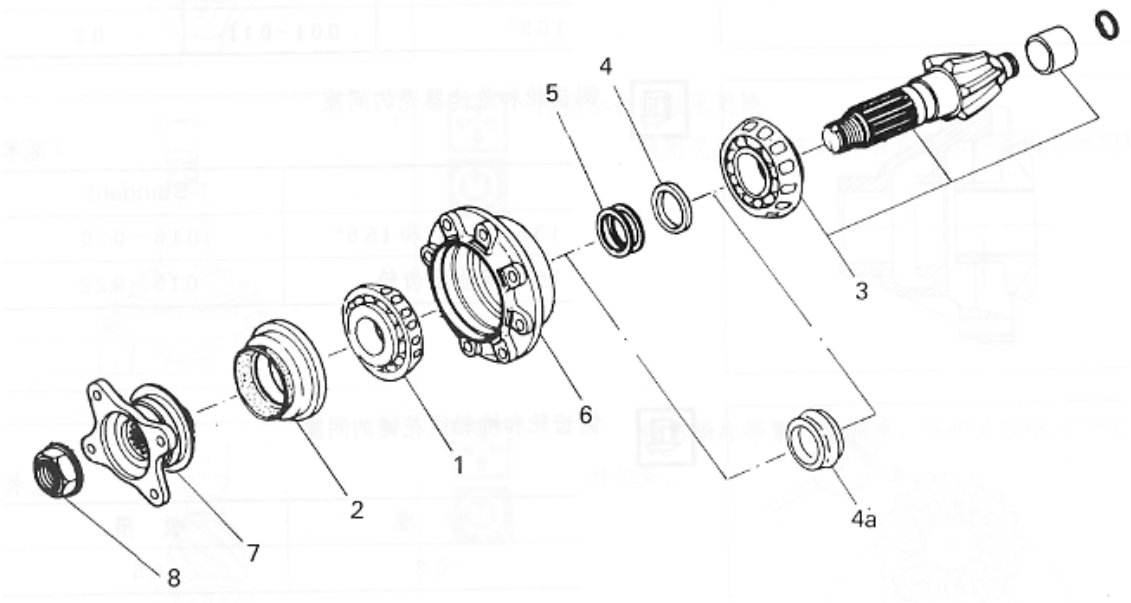


Clearance between half shaft gear and planetary gear
Limit 0．2mm

REAR AXLE

Drive gear assembly

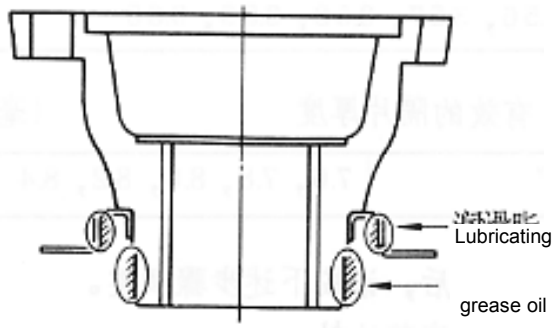
Re-assembly



Re-assembly sequence

1. Inner ring of exterior bearing 2. Oil seal of main gear 3 . Driving gear, inner bearing and guiding bearing 4. Bearing space cover and adjusting washer 5.Driving gear shaft bearing saddle 6. Flange 7.Flange nut

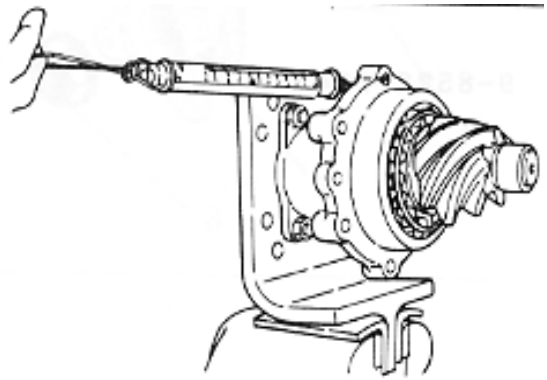
REAR AXLE



Important works

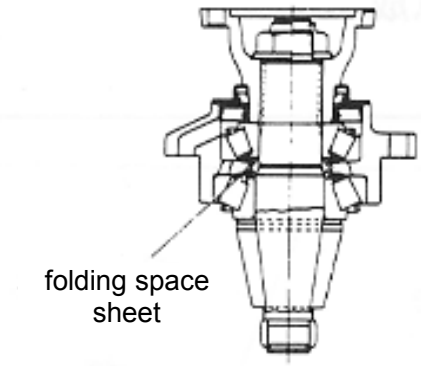
Clean inner part of dustproof cover, and spread a sheet of lubricating grease.

Spread a sheet of engine oil on sliding surface of main gear oil seal.



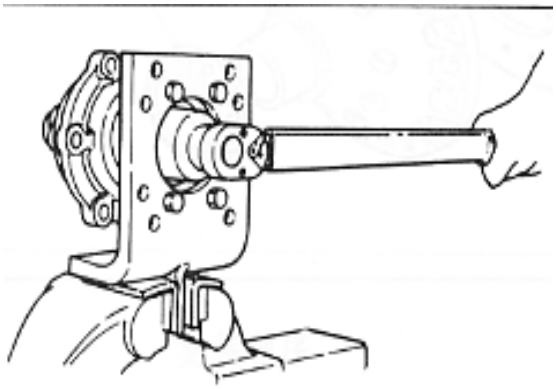
Adjustment of main gear bearing preload

1. Adjust main gear bearing preload by increasing/decreasing adjusting washers.
2. Without installing main gear oil seal, measured tangential force on bolt hole of bearing saddle is 1, 3-2.2 kg.



After adjusting main gear bearing preload, operate by following steps:

1. Dismantle flange and install oil seal.

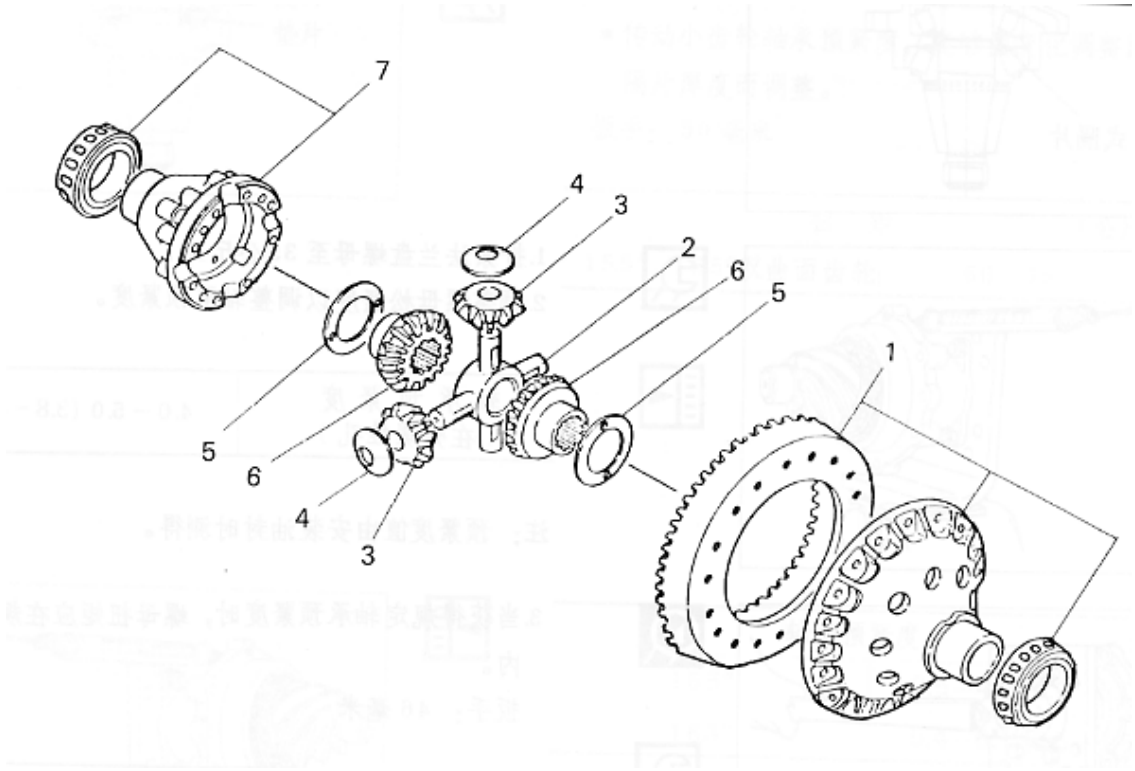


2． Install flange, then after screwing flange nut with 30—35 kg. m torque, make two mark pegs on the nut.

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Differential assembly

Re-assembly



Re-assembly sequence

1.Driven gear, half shaft gear and differential left shell 2.Cross shaft 3.Planetary gear 4.Thrust washer of planetary gear 5.Thrust washer of half shaft gear 6. Half shaft gear 7.Differential right shell

Important works

1. Find adjusting marks on the equipment.
2. Abandon original fixed bolts and nuts, and install new ones.

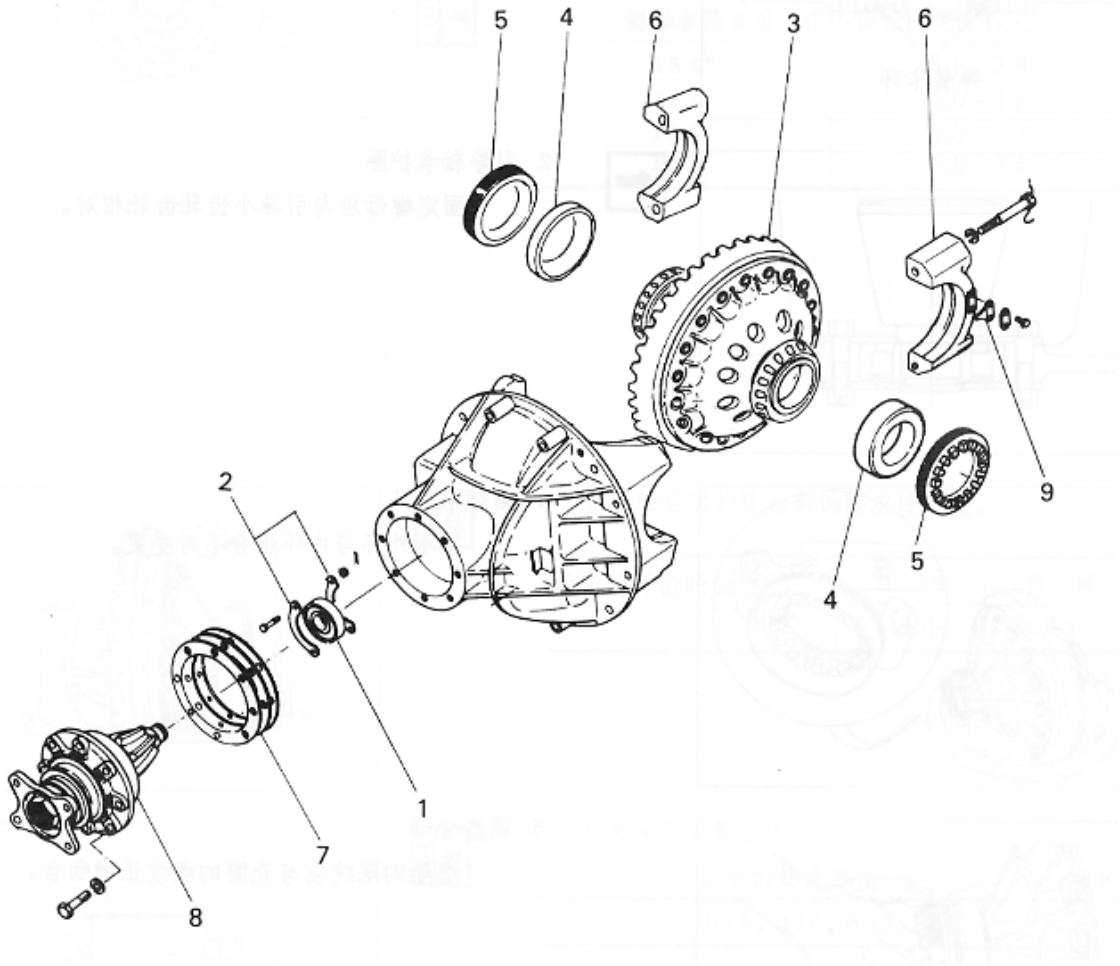
Make two mark pegs on each nut after screwing.

Torque 14．5—17．5kg .m

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Main retarder

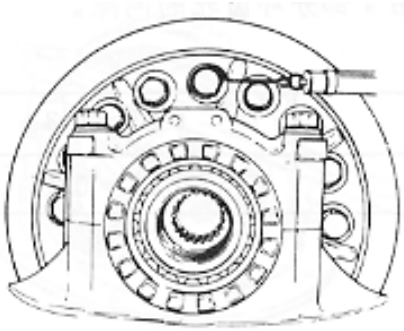
Re-assembly



Re-assembly sequence：

1. Exterior ring of guiding bearing　2. Retainer plate of guiding bearing
3. Differential assembly　4. Exterior ring of differential bearing
5. Adjusting nut　6. Bearing cap　7. Adjusting washer of driving gear bearing saddle
8.Driving gear assembly　9. Locking sheet

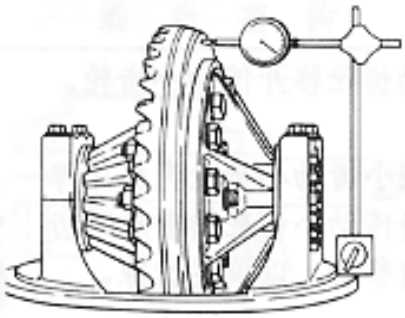
https://truckmanualshub.com/



Important works

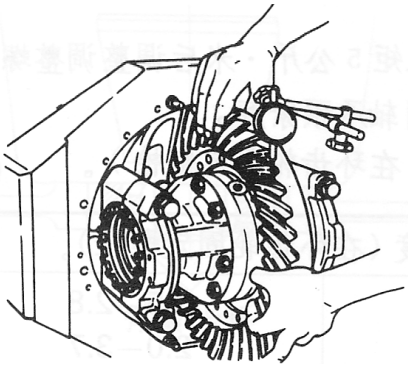
1. Adjustment of differential bearing preload

Screw fixed bolts on bearing cap to torque 5kg．m，and adjust left and right adjusting nut to adjust side bearing preload. Measured tangential pull on fixed bolts is 1.5－2.6 kg.



2．Inspection of driven gear deflection

Deflection limit measured on negative surface of driven gear is 0.2 mm.

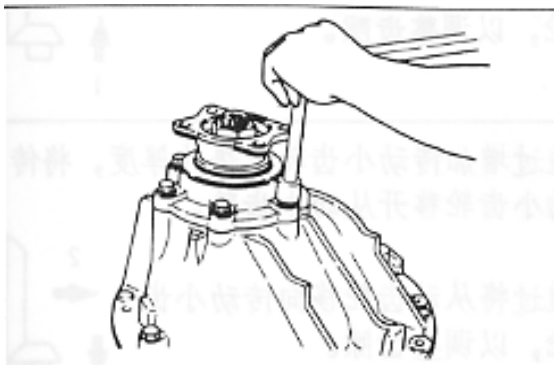


3．Adjustment of clearance between driving and driven gear side

Measure on four positions placing along round ring of driven gear, and measuring head of micrometer should be vertical with the surface of measured point.

Clearance between driving and driven gear side is 0．18—0．25 mm.

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4．Driving gear bearing saddle

Screwing moment of fixed bolts on driving gear seat: 9－11kg．m

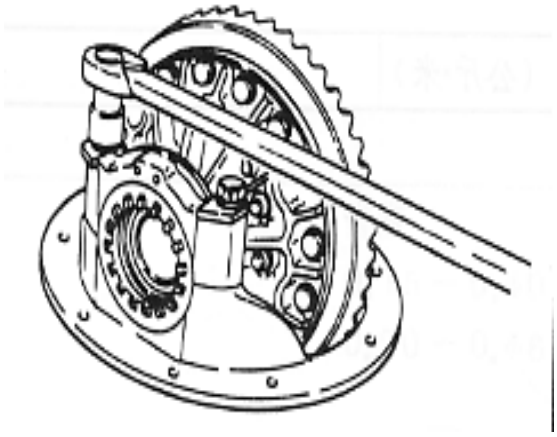


Correct gear contact

5．Adjustment of mesh mark of driving and driven gear

Correct mesh mark is shown in left figure, and the mark locates at small end of high and middle part of driven gear occupying over 60% of gear surface. Correct mesh mark is adjusted by increasing/decreasing adjusting washers of driving gear bearing saddle and adjusting washers of differential bearing, just liking that in following table.

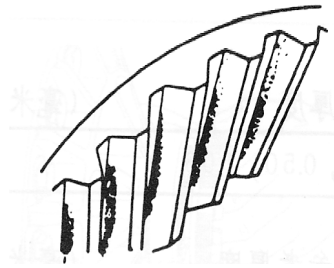
To guarantee adjusted differential bearing preload is unchangeable, screwed ring number of one end adjusting nut should be equal with that number on the other end adjusting nut. Finally, fix locking sheet.



6．Fix bearing saddle

After getting correct gear mesh mark, screw the bolts of bearing cap, its tightening torque is 17—20kg．m.

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Contacting mark of driven gear	Reason	Adjusting step
 Driven gear root	Driving gear is too close to driven gear	1. Adjust driven gear close to driving gear. 2. Adjust driving gear apart from driven gear (increase adjusting washers)
 Driven gear top	Driving gear is too apart from driven gear	1. Adjust driven gear apart from driving gear. 2. Adjust driving gear close to driven gear (decrease adjusting washers)
 Driven gear small end	Driven gear is too close to driving gear	1. Adjust driving gear apart from driven gear. (increase adjusting washers) 2. Adjust driven gear apart from driving gear.
 Driven gear big end	Driven gear is too apart from driving gear	1. Adjust driving gear close to driven gear (decrease adjusting washers). 2. Adjust driven gear close to driving gear.

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FRONT AXLE

Maintenance data

Adjusting of front wheel

Front axle

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Maintenance data

Main data and specifications

Tread		
Adjusting of front wheel（mm） Front wheel toe-in Front wheel camber King pin caster King pin inclination(KPI)	 4~6（diagonal tyre） 1~3（Radial ply tyre） 1° 1°30′ 7.5°	
Steering angle: Outer inner	 35° 42°	
Dosage of lubricating grease on one side of the front wheel hub bearing (g)		
Preload of the front wheel hub bearing New bearing (N) Old bearing (N)	 17~31 14~28	
Front suspension	standard	limit
external diameter of leaf spring pin	25	24.7
clearance between shackle pin and liner	0.1	0.5

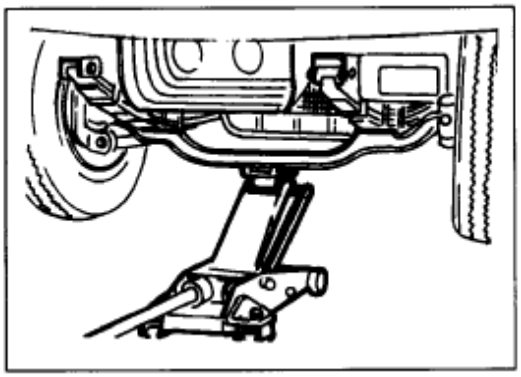
FRONT AXLE

Adjusting of front wheel

1. clearance of the front wheel hub bearing
2. clearance of the steering link connecting ball pin
3. tightening of the parts of the front suspension
4. clearance of the king pin bearing

Inspection:

Inspect whether the items listed in the left form are normal.

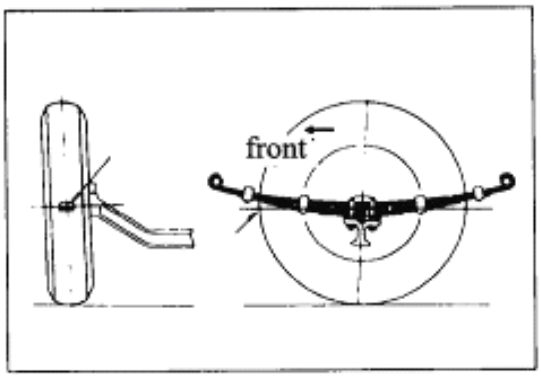


Measuring of the front wheel toe-in

(1) Stop the front wheel on even ground.

(2)Jack up the front axle.

(3) Make marks on central part of the tire tread with a chalk.



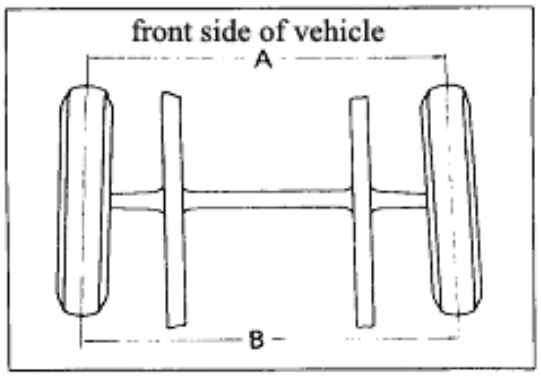
(4) Place toe-in measuring equipment on central position of the wheel.

(5) Score tyre central line by turning wheel.

(6) Let the vehicle fall on ground.

(7) Adjust height of the toe-in measuring equipment pointing at the mark on tyre.

(8) Measure the distance between tyre central lines (A).



(9) Jack up the front axle again.

(10) Turn each wheel by 180°.

(11) Make the toe-in measuring equipment point at the mark on tyre.

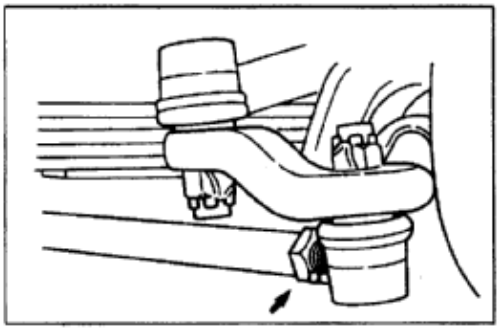
(12) Measure the distance between tyre central lines on rear side of the front wheel（B）.

The toe-in value equivalents: B－A

Toe-in value:

Diagonal tire	4~6
Radial tire	0~3

FRONT AXLE

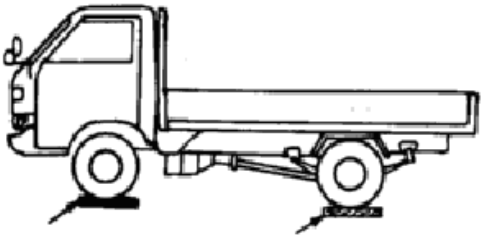


Toe-in adjustment:

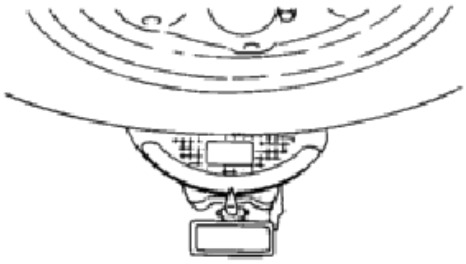
1. Loose the tie rod connecting lock nut
2. Rotate the tie rod to adjust the toe-in.
3. Tighten the lock nut to specified torque

Tightening torque of the lock nut:：

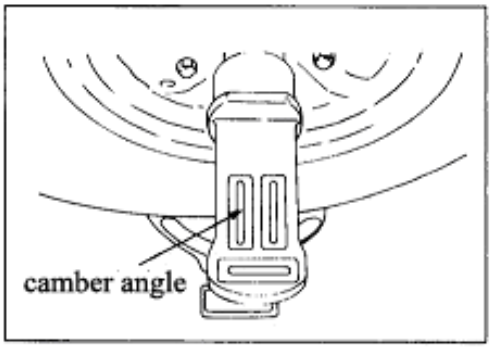
Tightening torque	113



(1)Put a cushion block of the same thickness with the steering angle measurer under each rear wheel.
(2)Jack up the front wheel
(3) Put each front wheel on a steering angle measurer.
Tire central line should align with the center of steering angle measurer.

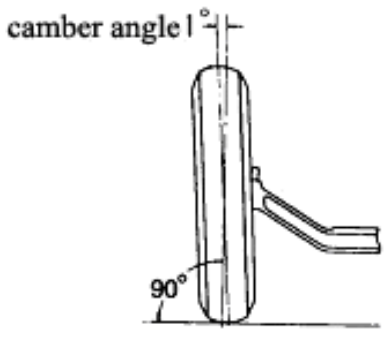


(4) Let the front wheel fall.
(5) Set the scale of the steering angler measurer to zero.
(6) Remove the front wheel hub cover.
(7) Wipe the steering knuckle ends and clean up all lubricating grease.
(8) Install upper front wheel--king pin camber measurer and turn the steering knuckle left and right horizontally.
(9) Read camber degree from the dial directly.
(11) Repeat step (8) and step (9) on another steering knuckle.



If measured camber degree deviates the specification: Adjust toe-in

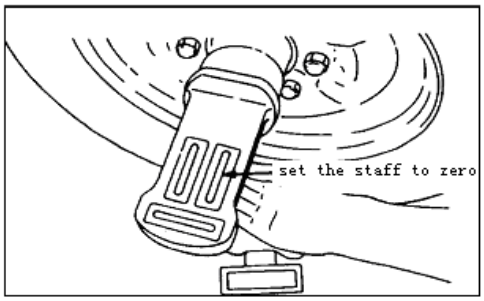
(a) Check whether the steering swivel pin, bearing and the liner bushing have been abraded too much.
(b) Check whether the front wheel hub bearing has loosed.
(c) Check the torsion and extroversion of the front axle.

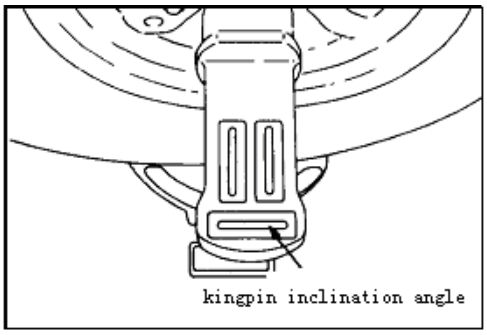


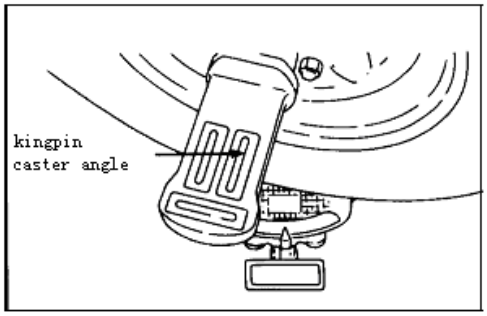
Camber degree of the front wheel：

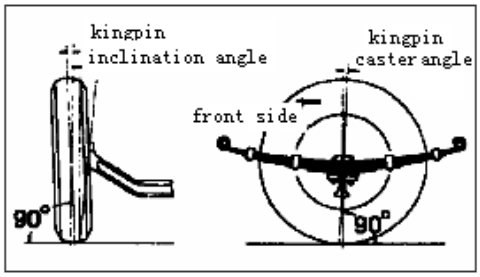
	1°

FRONT AXLE









Measurement of the castor of the steering king pin and K.P.I.

The castor of the steering king pin and the K.P.I of the king pin can be measured by the front wheel king pin camber measurer at the same time.

(1)Adjust the scale of the steering angle measurer to zero (after finishing the camber measuring).

(2) Turn the steering wheel right until the front wheel has turned by 20 ° (measured by the steering semi diameter measurer).

(3) Adjust the scale of the right king pin castor and K.P.I of the front wheel to zero.

(4) Turn the steering wheel in opposite direction until the front wheel has turned left by 20 ° (measured by the steering angle measurer).

(5) Read the degree of the right king pin castor and K.P.I from the right scale directly.

(6) With the wheel turning left by 20 °, adjust the scale of the left king pin castor and K.P.I of the front wheel king pin camber to zero.

(7) Turn steering plate in opposite direction until front wheel has turned left to 20 ° (measured by the steering angle measurer).

(8) Read the left king pin castor and K.P.I from the left scale directly.

Caster angle and Inward inclination angle：

Caster angle	1°30′
Inward inclination angle	7.5°

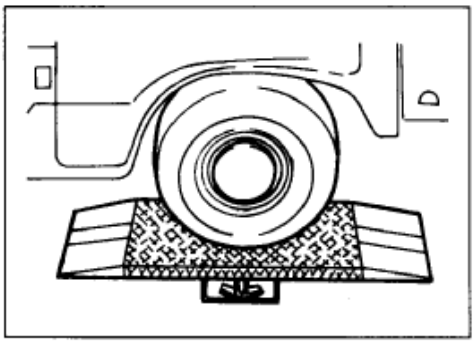
If the degree of the king pin camber is measured to deviate the specification：

（a） Check whether the steering knuckle, the bearing and the liner bush have been abraded too much.

（b） Check the abrading situation of the front steel plate spring.

（c） Check torsion and camber of the front axle.

FRONT AXLE



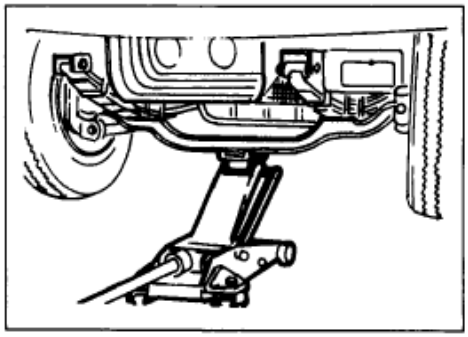
Measuring of sideslip

Measuring of sideslip should be made after the measuring and adjusting of the camber of toe-in and king pin

(1) Roll the wheel across the sideslip measurer as slowly as possible.

(2) Read out the reading indicating on the sideslip measurer.

If sideslip value exceeds 5 mm per meter, it is necessary to adjust the wheel alignment again.

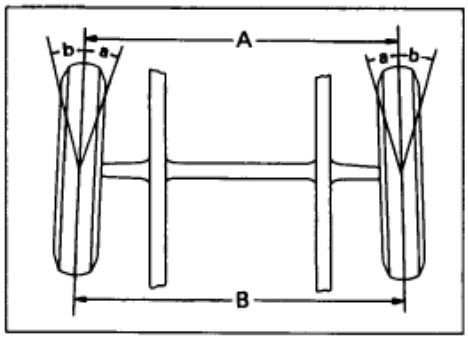


Measurement of the maximal steering angle

1. Stop the vehicle on even place.
2. Jack up the front wheel

(3) Put each front wheel on a steering angle measurer.

Tire central line should align with the center of steering angle measurer.



(4) Let the front wheel fall.

(5) Set the scale of the steering angle measurer to zero.

6. Turn the steering wheel right until it is blocked.
7. Measure the steering angle

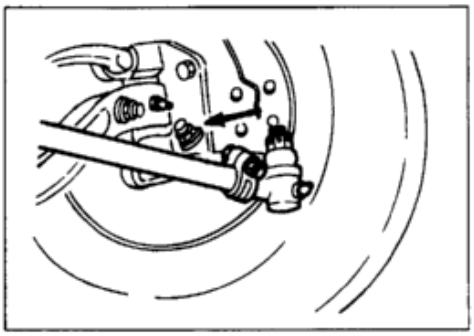
a--- Maximal steering angle of exterior wheel

b--- Maximal steering angle of interior wheel

8. Turn steering wheel left until it is blocked.
9. Measure the steering angle

a--- Maximal steering angle of exterior wheel

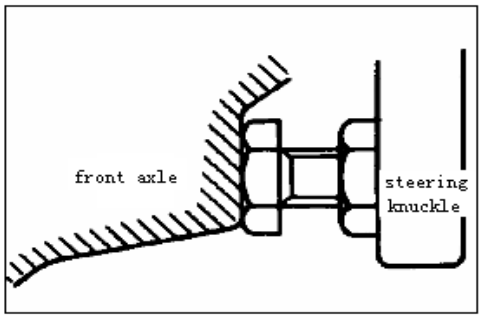
b--- Maximal steering angle of interior wheel



interior wheel and exterior wheel：

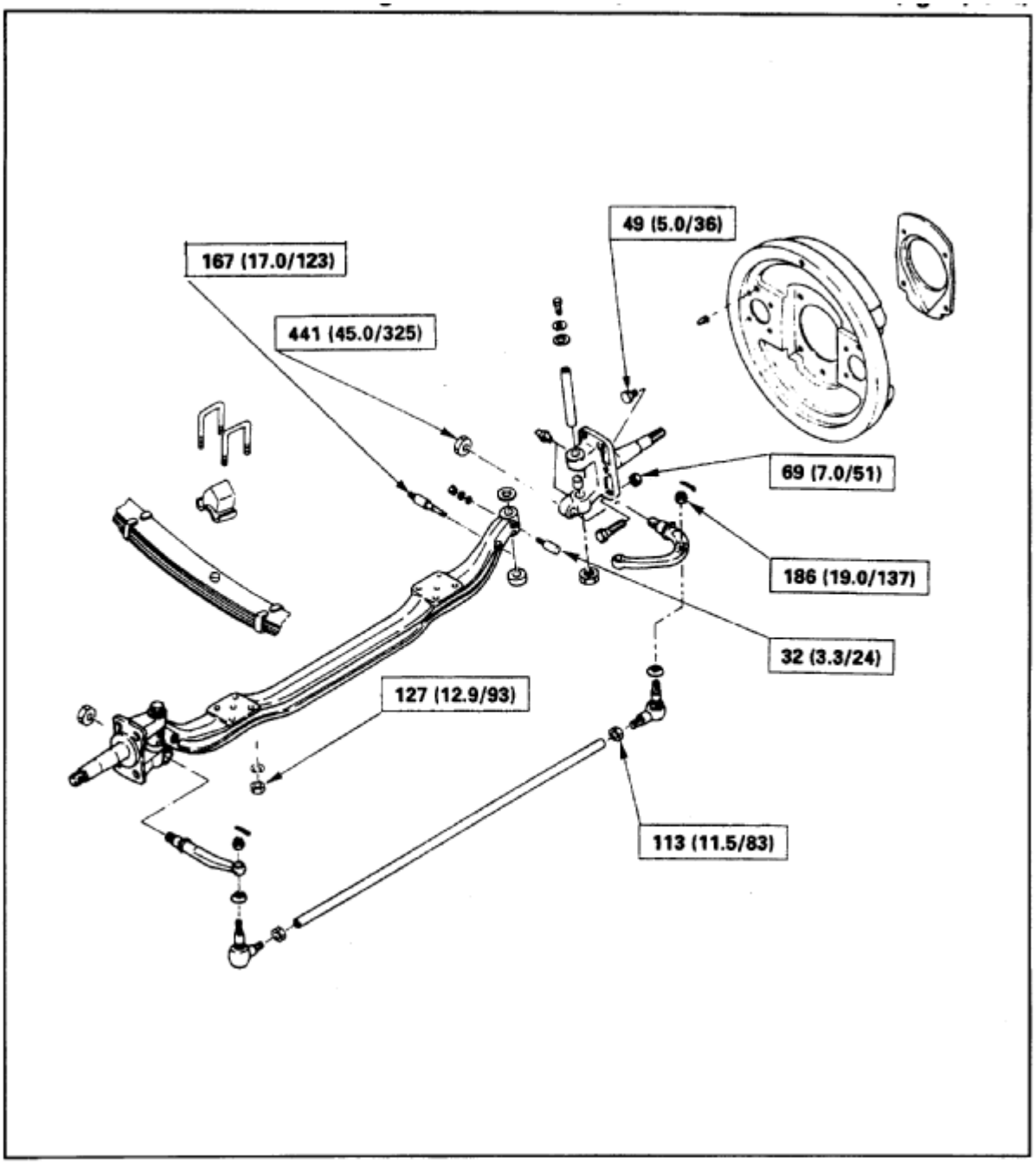
interior wheel	42°
exterior wheel	35°

If the steering angle is measured to deviate the specification, please adjust it with steering knuckle stop bolt.

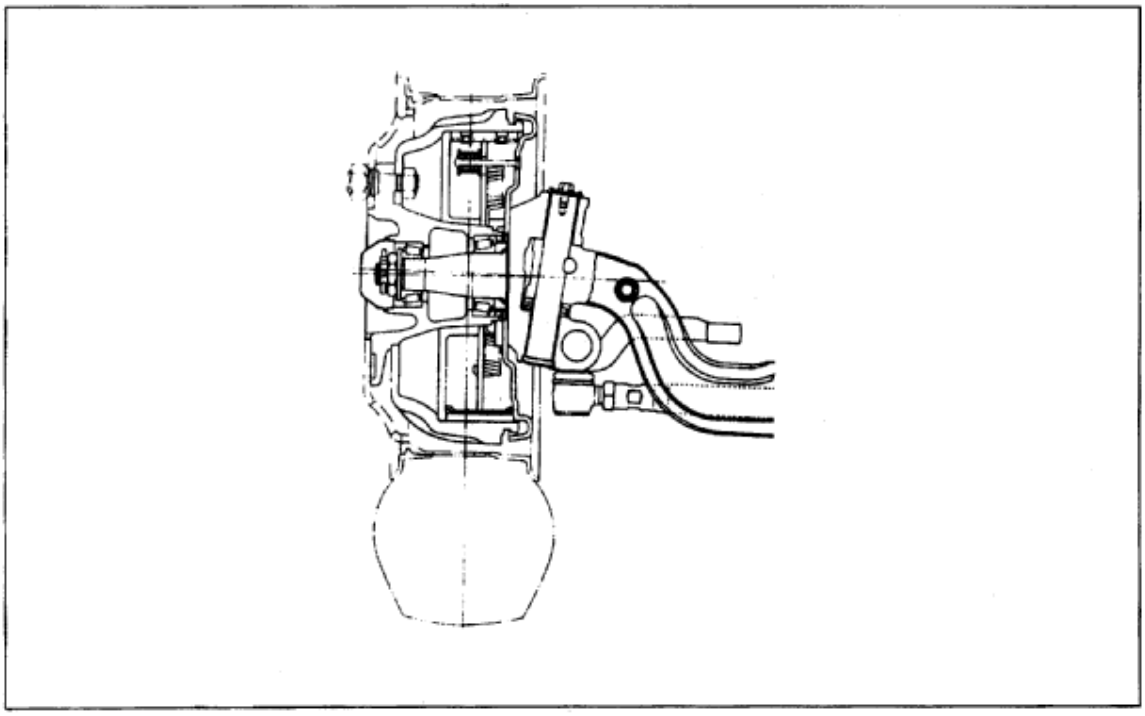


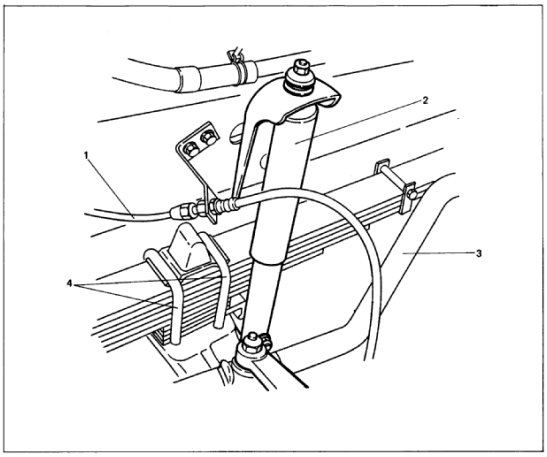
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Fixed torque



FRONT AXLE





Disassembly sequence：

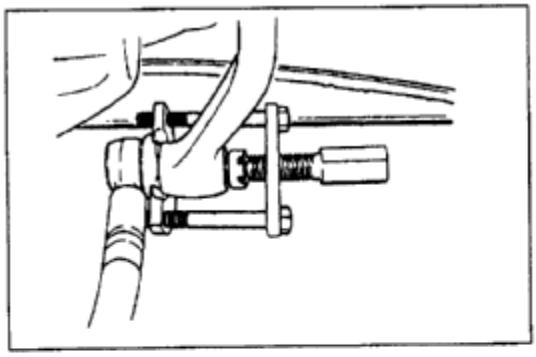
1. brake tube
2. shock absorber
3. drag link
4. steel spring U-bolt U-nut

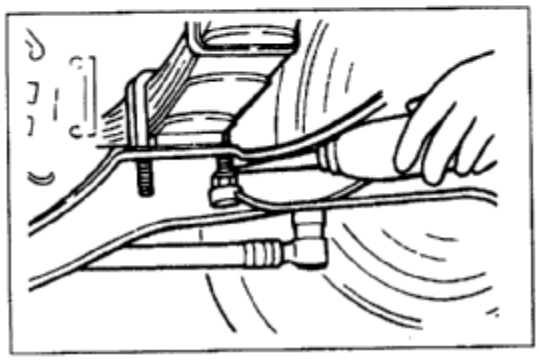
Assembly sequence：

Just the opposite of the disassembly sequence

FRONT AXLE

Disassembly



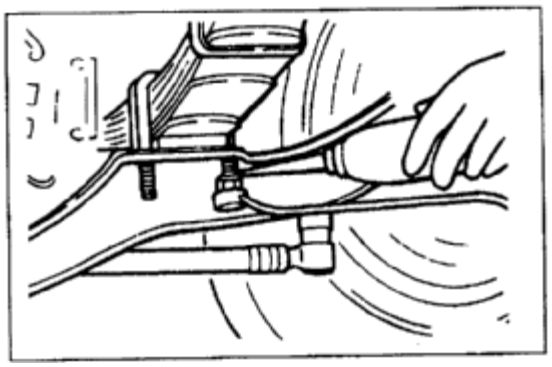


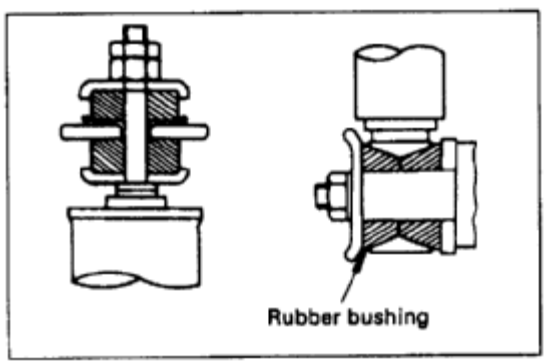
Re-assembly sequence：
As before mentioned

Removal of the drag link ：
Use special tools

Removal of the U-bolt：
If corrosion of the U bolt is serious, lubricate the thread with certain quantity of oil, and then loose the nut in case of thread damage.

Reinstallation





Reassembly sequence ：
As mentioned before

Assembly of U nut and U bolt ：
When tighten U bolt or U nut ， lubricate the thread with certain quantity of oil in case of thread damage.

Tightening torque of U-bolt：

tightening torque	127Nm

Assembly of drag link ：
Tighten the drag link nut to specified torque, if the nut opening does not align with the cotter hole, increase the torque slightly to adjust it.

Tightening torque of the drag link nut：

Tightening torque	167Nm

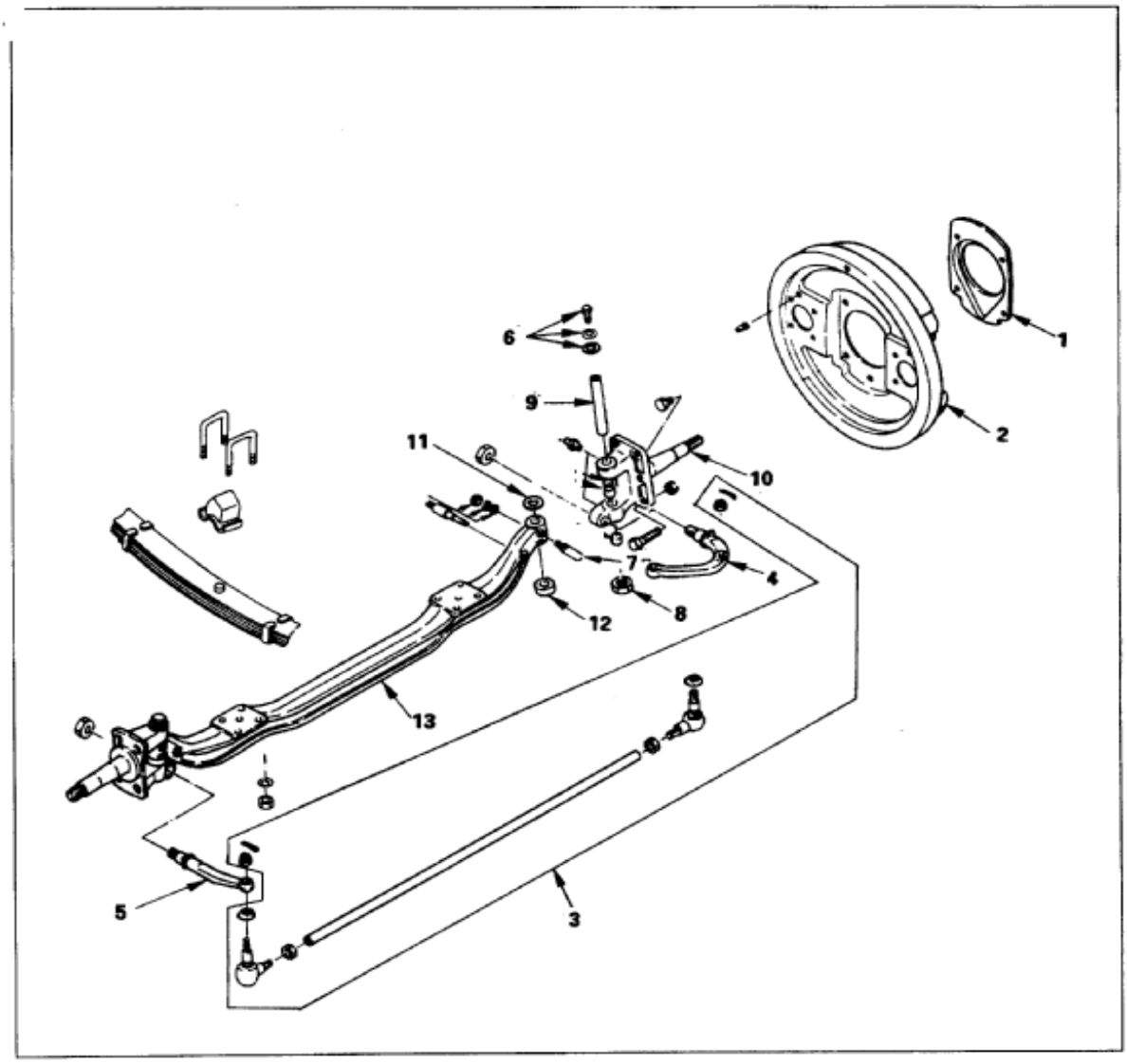
Assembly of rear shock absorber ：
Install shock absorber nut, gasket and rubber liner bush according to the diagram.

Tightening torque of absorb nut ：

Upper nut	
Lower nut	95Nm

FRONT AXLE

Knuckle and king pin



Disassembly sequence ：

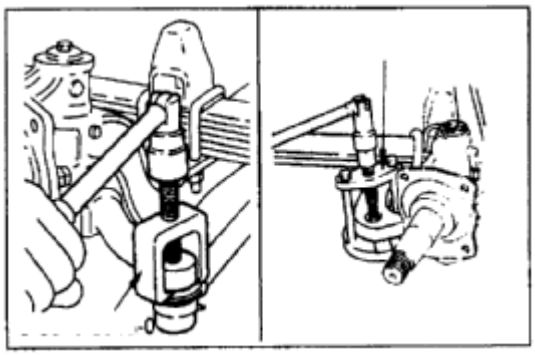
1. Oil retainer
2. Brake shield plate
3. Steering knuckle tie rod and tension bar attachment
4. Knuckle curved arm
5. Knuckle straight arm
6. King pin cap
7. Locking pin
8. Stops up the lid
9. Swivel pin
10. Knuckle
11. Adjusting shim
11. Thrust bearing
12. I-beam

Assembly step:

13. I-beam
10. Knuckle
12. Thrust bearing
11. Adjusting shim
9. Swivel pin
7. Locking pin
6. King pin cap
8. Stops up covers
5. Knuckle straight arm
4. Knuckle curved arm
3. Steering knuckle tie rod and tension bar attachment
2. Brake shield plate
1. Oil retainer

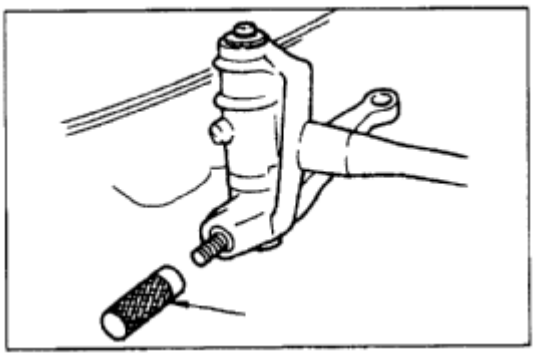
FRONT AXLE

Disassembly ：

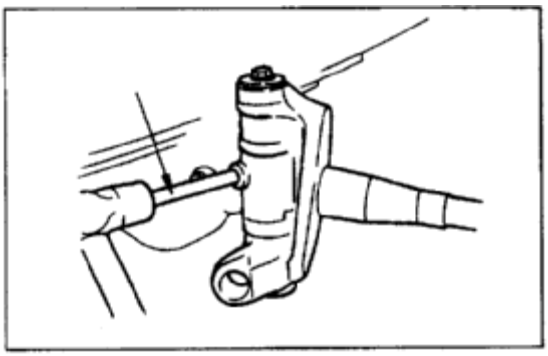


Preparation ：
Jack the vehicle up and support it on the chassis platform

Steps of removal:
Steps of removal are introduced at before.
Removal of steering knuckle tie rod ball:
Remove with the special-purpose tool and the hammer impact

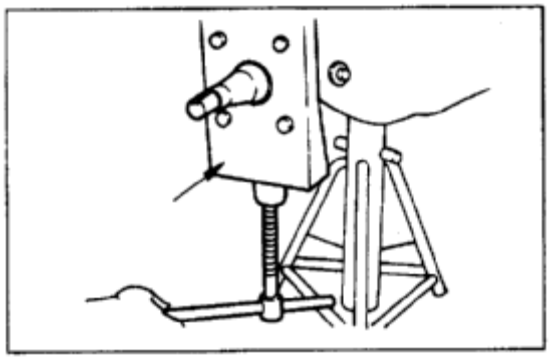


Removal of the knuckle drop arm and the curved arm:



Removal of lock pin:
Remove it with the special-purpose tool.

Removal of the swivel pin:
Remove it with the special-purpose tool.



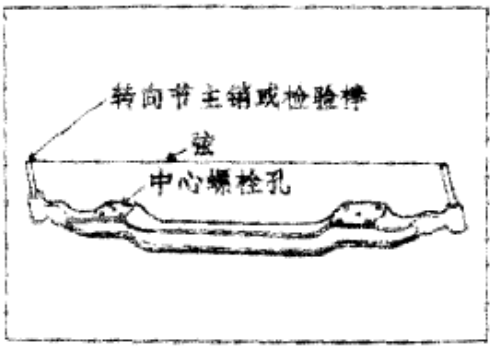
FRONT AXLE

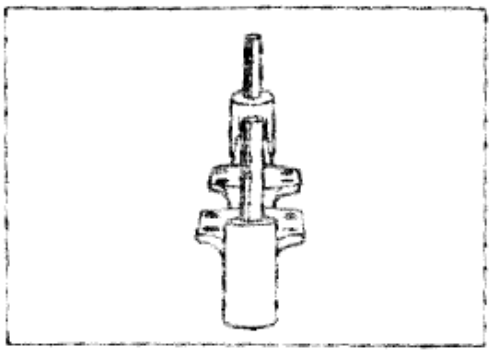
Inspection and repair ：

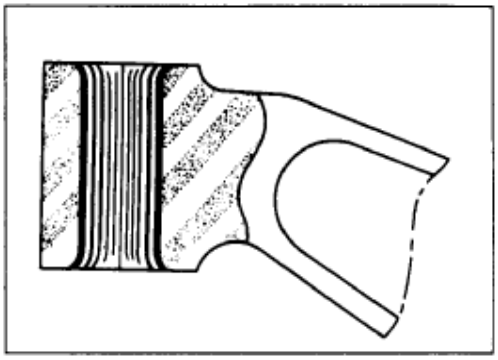
1. I-beam
2. Knuckle
3. Changes the drop arm and the curved arm
4. Steering knuckle tie rod and tension bar attachment
5. Swivel pin, bushing, thrust bearing and adjusting shim
6. Universal joint ball
7. Front wheel hub, bearing and oil seal
8. Brake drum
9. Brake facing

Inspection and repair:
When inspect, if find wearing, damage or any other abnormal situations, Repair or replace the parts if necessary.

Visual inspection：
Check the parts listed in left form for wearing, damage or any other abnormal situations

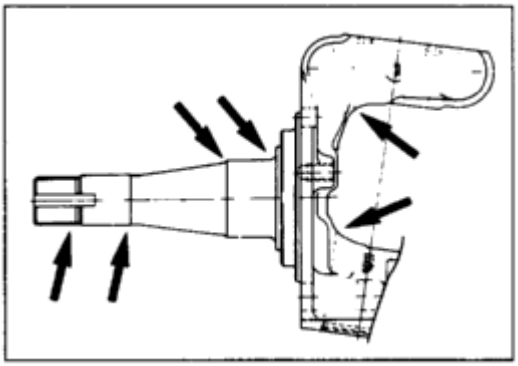


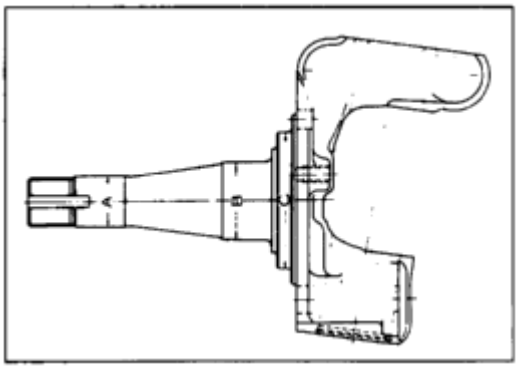




I-beam inspection:
1. Put the steering swivel pin (or inspection stick) into the steering swivel pin hole.
2. Tighten a string (or inspection stick) between the steering swivel pins.
3. The string should be consistent with the spring holder center bolt hole as you look down from it.
4 From the side looked the swivel pin (or examines stick), the swivel pin (or examines stick) to be supposed to be at good vertical to the uneven condition
5 Inserts a new swivel pin into the pin hole and inspect the cooperation situation of the steering swivel pins in the steering swivel pin hole. If cooperation of the swivel pins becomes less compact, the front axle must replaced; if the upper of lower flange of the king pin mounting hole is excessively worn, the front axle must also be replaced.

FRONT AXLE



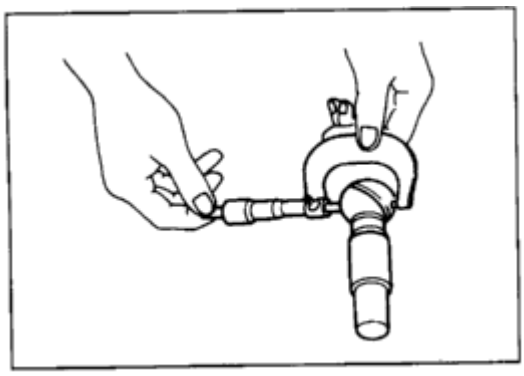


Inspection of the steering knuckle:

1. Check the knuckle for cracking or other damages with the magnetic flaw detector

2. Surveys diameter of the bearing and oil seal assembly surfaces A, B

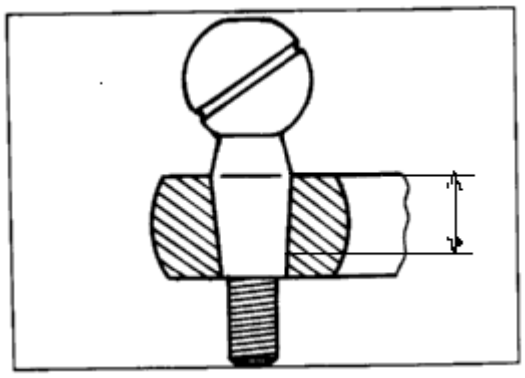
Model	A	B
	35mm	50mm



Inspection of the universal joint ball:

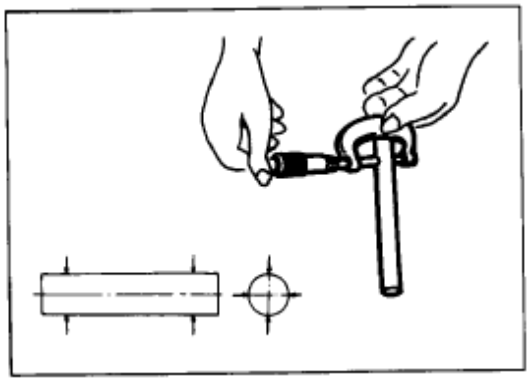
1. Outer diameter survey

Axle model	Standard	Limit
	39.0mm	38.5mm



1. Spreads light special mixture on the universal joint ball cone-shape spot (mixture of red lead and machine oil)
2. Installs the drop arm and the curved arm on the universal joint ball
3. Inspect whether the universal joint ball contacts well. The contacted area should not be shorter than 3/4 of the entire length.
4. If the universal joint ball does not contact well, it must be repaired or replaced.

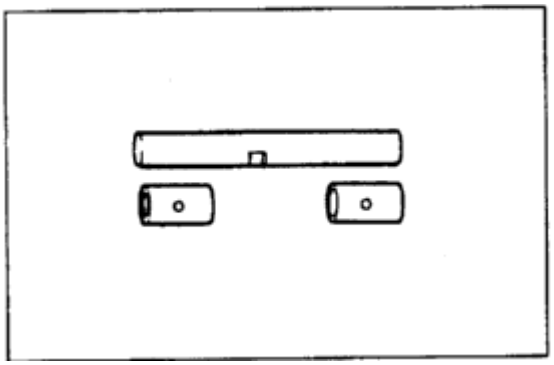
FRONT AXLE



Diameter of the steering swivel pin：

（mm）

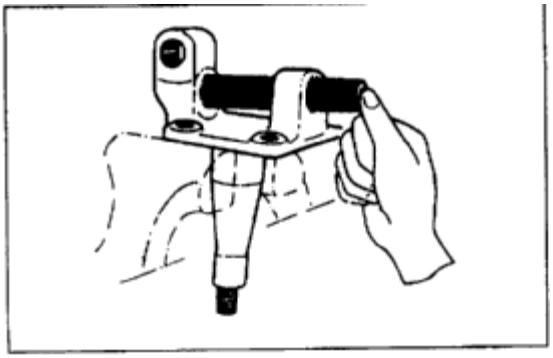
Model	Standard	Limit
	30.0	29.9



Clearance between swivel pin and bushing：

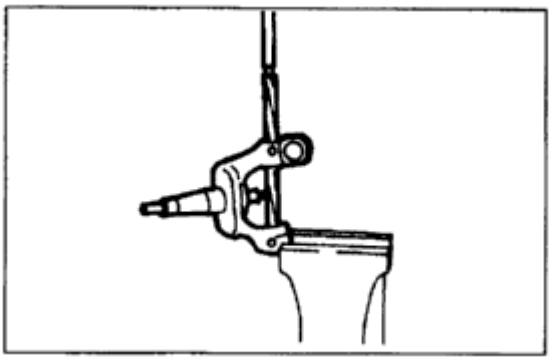
Model	Standard	Limit
	0.06mm	0.15mm

Notes: When install the bushing, its lubricant filler is supposed to align with the filler of the universal joint.



Inspection of cooperation of the steering swivel pin and king pin bushing:
Put the king pin into the king pin bushing, and inspect according to following method.

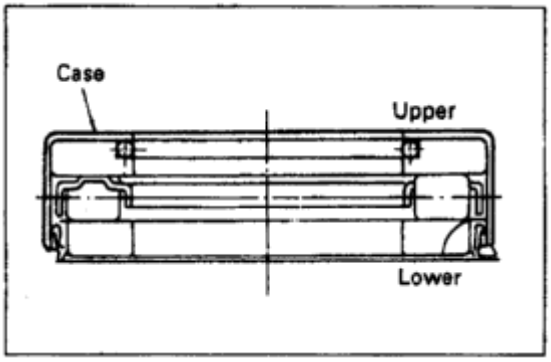
Along the king pin spool thread direction, bulldozes end of the king pin with fingers, and inspect whether the fingers can move smoothly.

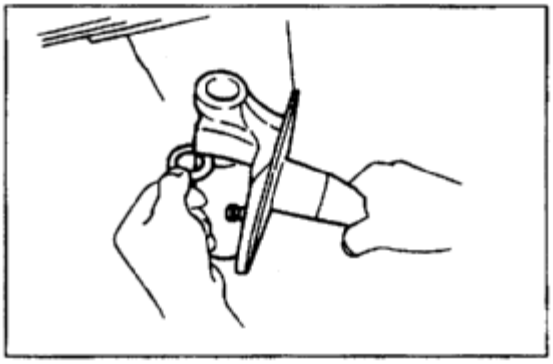


If the king pin bushing is excessively tight, ream the bushing with a reamer to ensure the concentricity of the upper cotter hole and lower cotter hole of the steering knuckle.

FRONT AXLE

Assembly





Steps of installation:

Steps of installation are introduced at before.

Installation of the thrust bearing:

4. Spreads lubricating grease on the thrust bearing
5. Keep the dust cover surface upward.
6. Install the thrust bearing

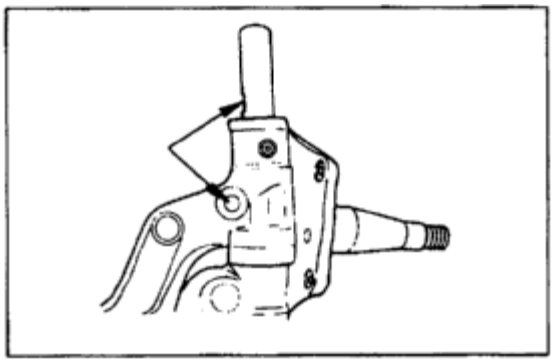
Installation of the adjusting shim:

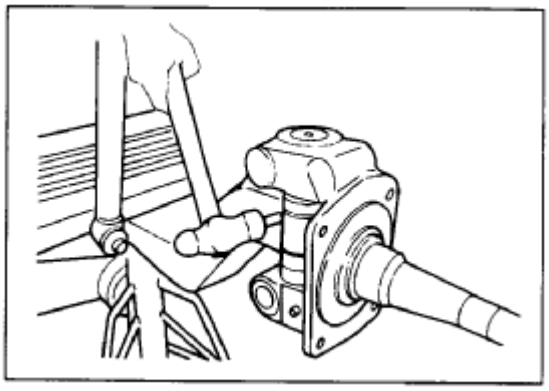
After installing the adjusting shim, inspect the clearance between the steering knuckle and the front axle.

Model	Standard	Limit
	0~0.10mm	0.20mm

：Adjust specification of the shim:（mm）

Thickness	0.50、0.55、0.60、0.65、0.70、0.80、0.90

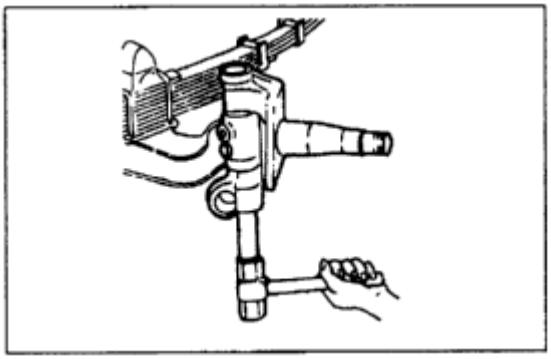




Installation of king pin:

1. Apply the lubricating grease on the king pin and the bushing
2. Align lock dowel slot of the king pin and lock dowel hole of the front axle
3. Install the steering swivel pin, and inspect whether the knuckle turns smoothly.

FRONT AXLE

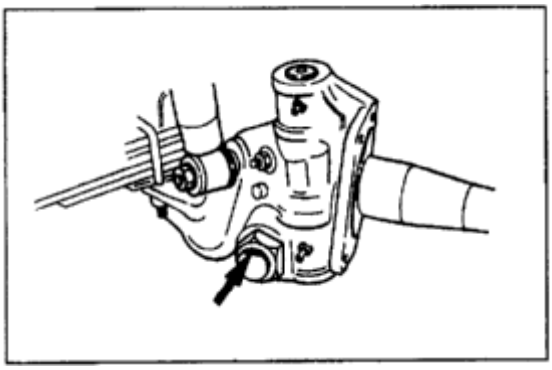


Tightening torque of the lock dowel:：

	32Nm

Specification of adjusting shim：

Thickness	0.50、0.55、0.60、0.65、0.70、0.80、0.90

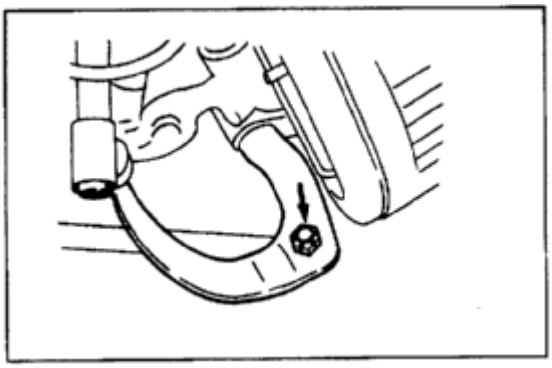


Installation of blocking cap:
Install the blocking cap upwardly with an appropriate stick.

Installation of the drop arm and the curved arm:
Tighten the nut to specified tightening torque, caulk the nut.

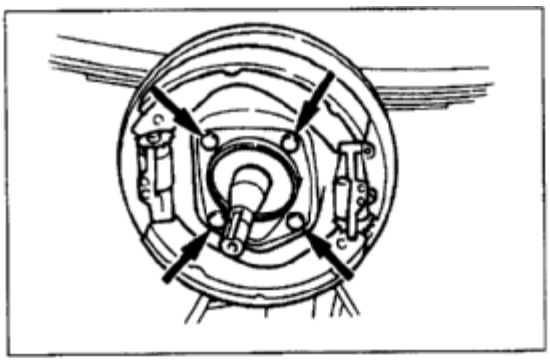
Tightening torque of the nut：

	441Nm



Tightening torque of the tie rod jointing nut：

	186Nm



Tightening torque of the brake shield plate bolt

	69Nm

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DRIVE SHAFT

General

Specifications

Maintenance

Disassembly sequences

Disassembly and assembly

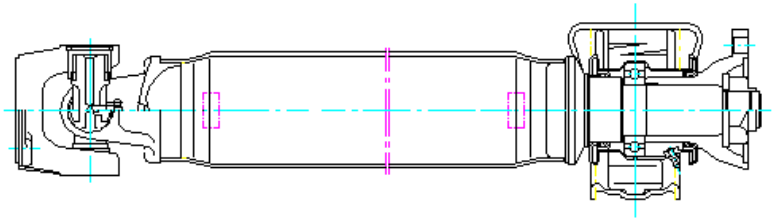
Disassembly

Check and repairs

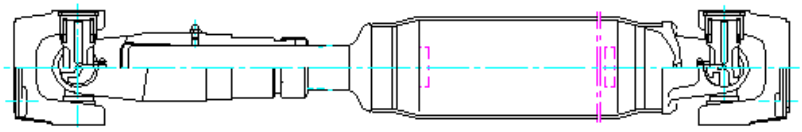
Re-installation

DRIVE SHAFT

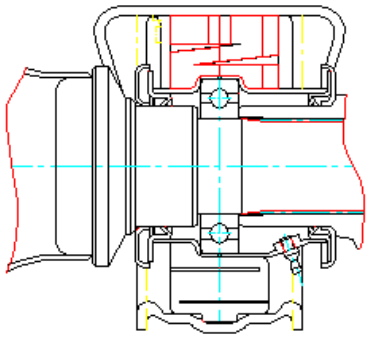
General



Intermediate drive shaft assembly



Rear drive shaft assembly



Intermediate supporting assembly

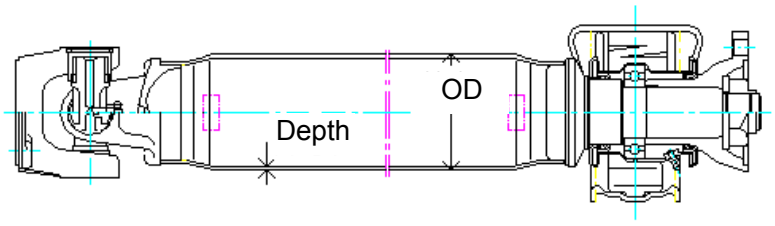
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DRIVE SHAFT

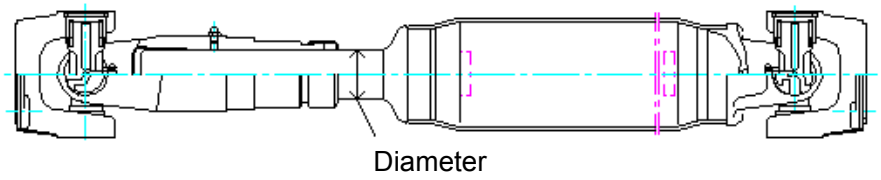
Specifications

Intermediate drive shaft assembly		Rear drive shaft assembly		Intermediate bearing
OD × Wall depth (mm)	Universal joint crossing shaft diameter (mm)	OD (mm)	Universal joint crossing shaft diameter (mm)	OD×ID×W
69×2.5	18.46	69	18.46	75×32×20

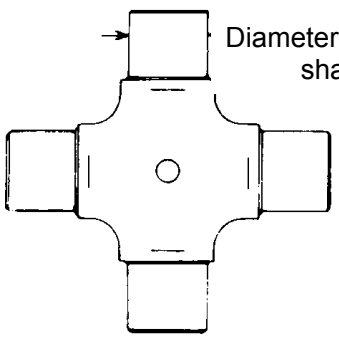
Intermediate drive shaft assembly



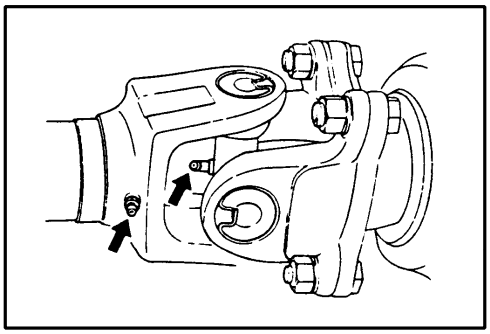
Rear drive shaft assembly



Crossing shaft

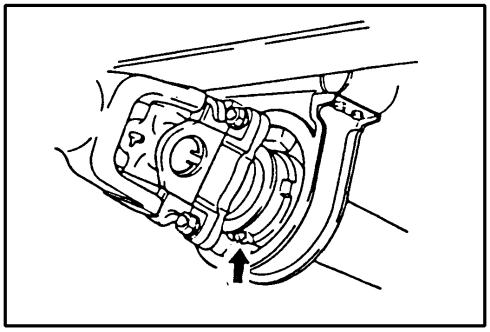


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Maintenance

Apply the oil
Drive shaft universal joint and sliding sleeve (GB49 2 calcium base grease)

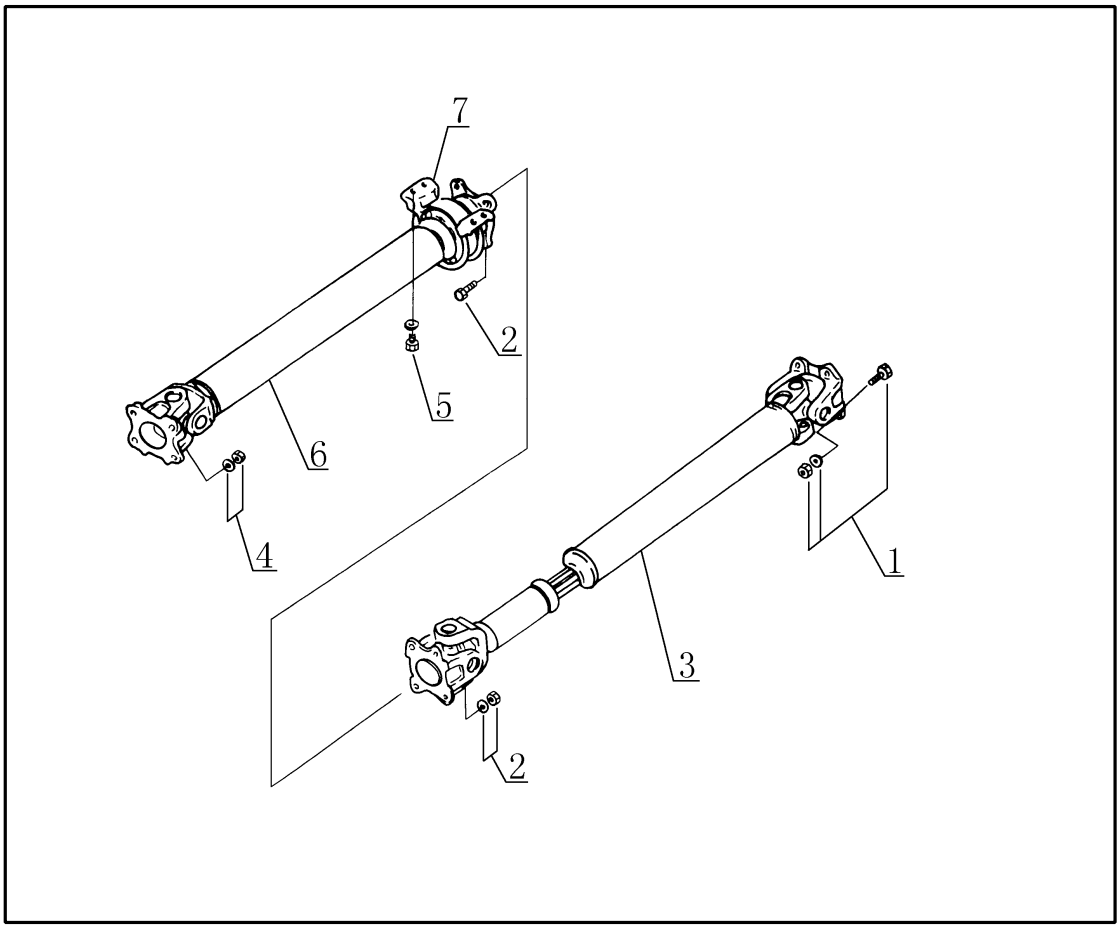


Drive shaft intermediate supporting bearing for lubricating grease
Remove the intermediate bearing, clean it, and then fill in No. GB49 2 calcium base grease. In case the vehicles are frequently used under harsh condition, fill in the lubricating grease frequently by grease nipple of the middle support.

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Disassembly and assembly

Before removing the drive shaft, support it with a crane or other metal lines for safety.



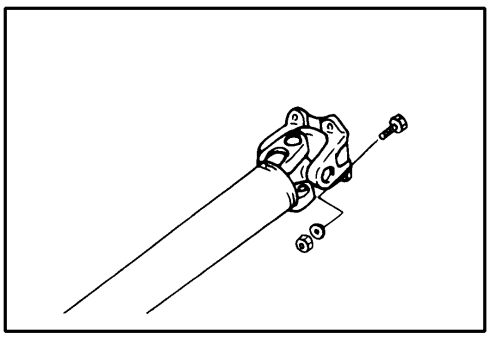
Disassembly sequences

1. Bolt, nut and spring washer, differential end
2. Bolt, nut and spring washer
3. Rear drive shaft assembly
4. Nut and spring washer, transmission end
5. Bolt, nut and washer
6. Intermediate drive shaft assembly
7. Intermediate bearing bracket

Assembly sequences

6. Intermediate drive shaft assembly
▲ 4. Nut and spring washer, transmission end
7. Intermediate bearing bracket
5. Bolt, nut and washer
3. Rear drive shaft assembly
▲ 1. Bolt, nut and spring washer, differential end
▲ 2. Bolt, nut and spring washer

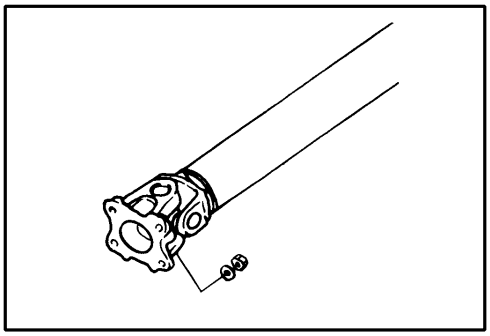
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Important – assembly

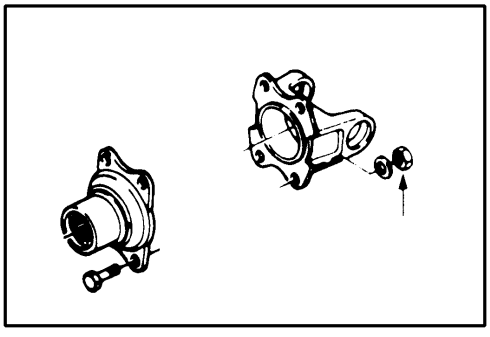
1. Nut and spring washer, transmission end

Torque (N • m)	46-62



2. Bolt, nut and spring washer, differential end

Torque (N • m)	46-62



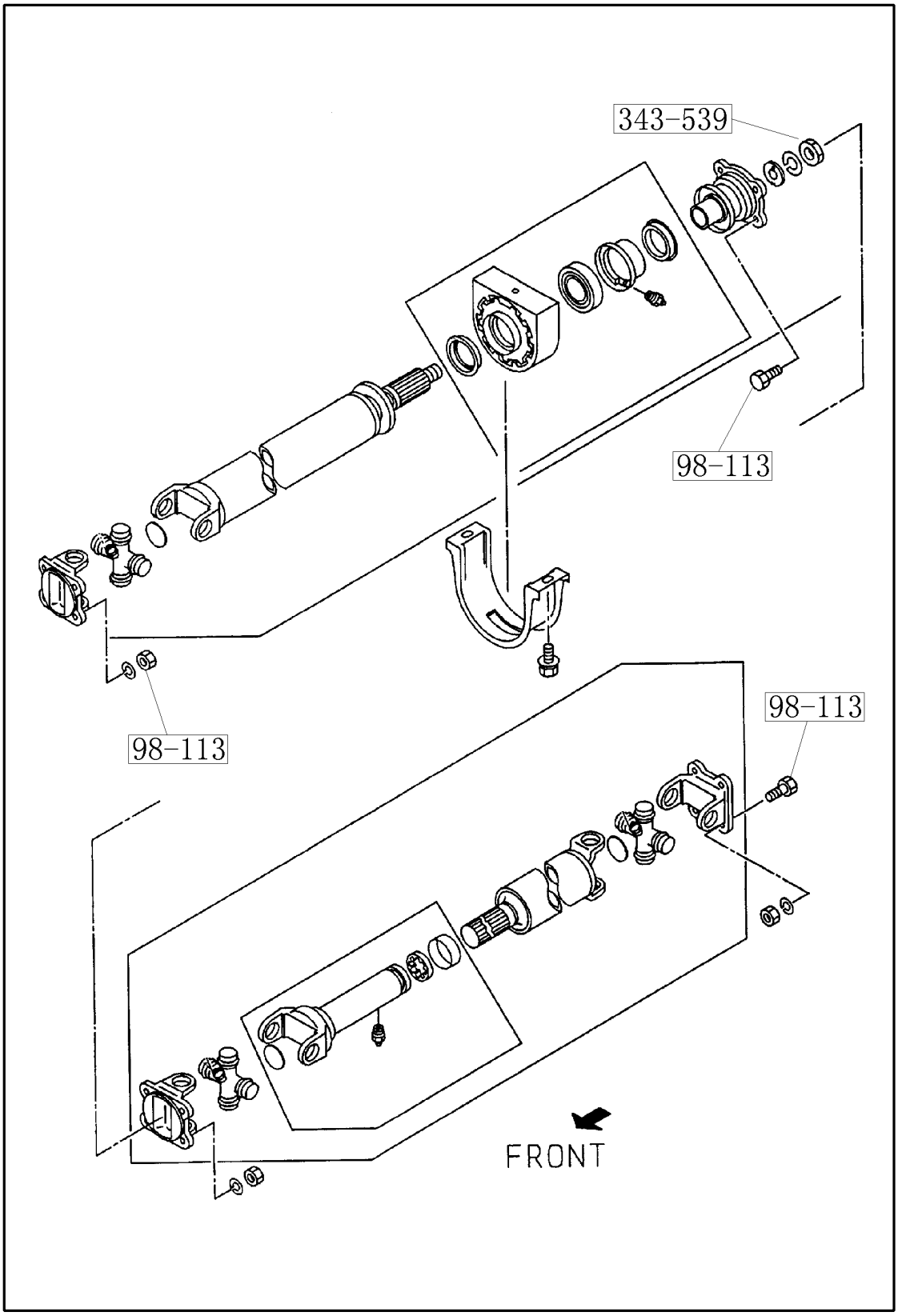
3. Bolt, nut and spring washer

Torque (N • m)	46-62

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Disassembly torques

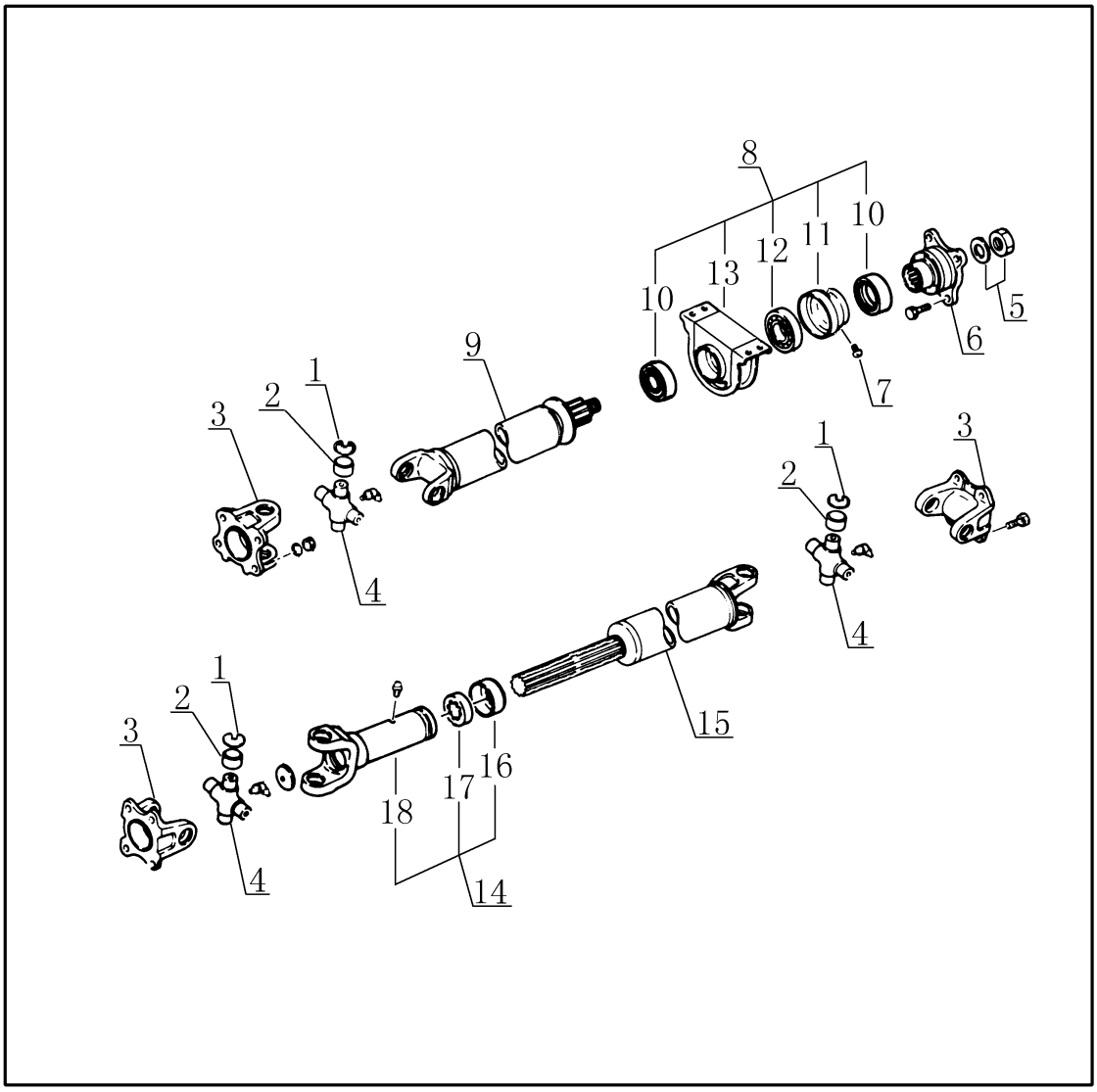
（N・m）



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DRIVE SHAFT

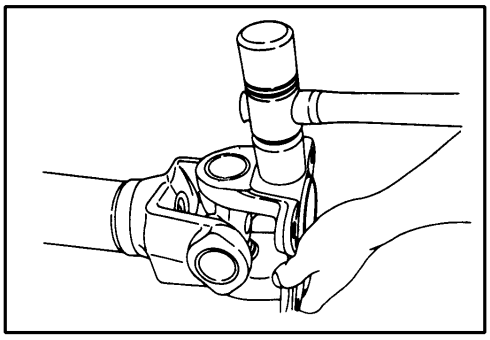
Disassembly



Disassembly Sequence

1. Universal joint end ring
▲ 2. Needle bearing
3. Flange yoke
4. Crossing shaft
▲ 5. Washer and nut
6. Intermediate drive shaft flange assembly
7. Grease nozzle
8. Middle supporting assembly
9. Intermediate drive shaft assembly
10. Dust cover
11. Retainer
12. Bearing
13. Buffer rubber
14. Sleeve spline pipe assembly
15.Rear axle drive shaft bearing assembly
16. Dust cover
17. Oil seal
18. Spline tube

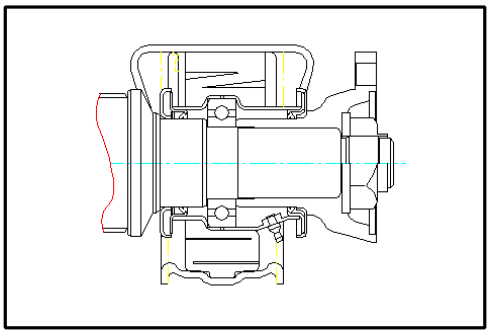
DRIVE SHAFT



Important --- disassembly

2. Needle bearing

Knock out the bearing by impacting the upper end of flange.



5. Washer and nut

Nut code: Q340B10

Wrench: 10mm

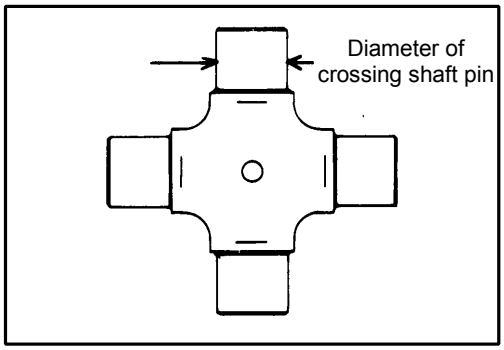
Check and repairs

In case of abrasion, damages or any other unusual conditions, make a necessary correction or replace parts.

Crossing shaft
Needle bearing
Buffer rubber
Spline tube assembly
Flange yoke
Bearing

Visual check

Check the following parts for abrasion, damages or other unusual conditions.



Diameter of crossing shaft pin

(mm)

Dimension	Limit
18.46	18.43

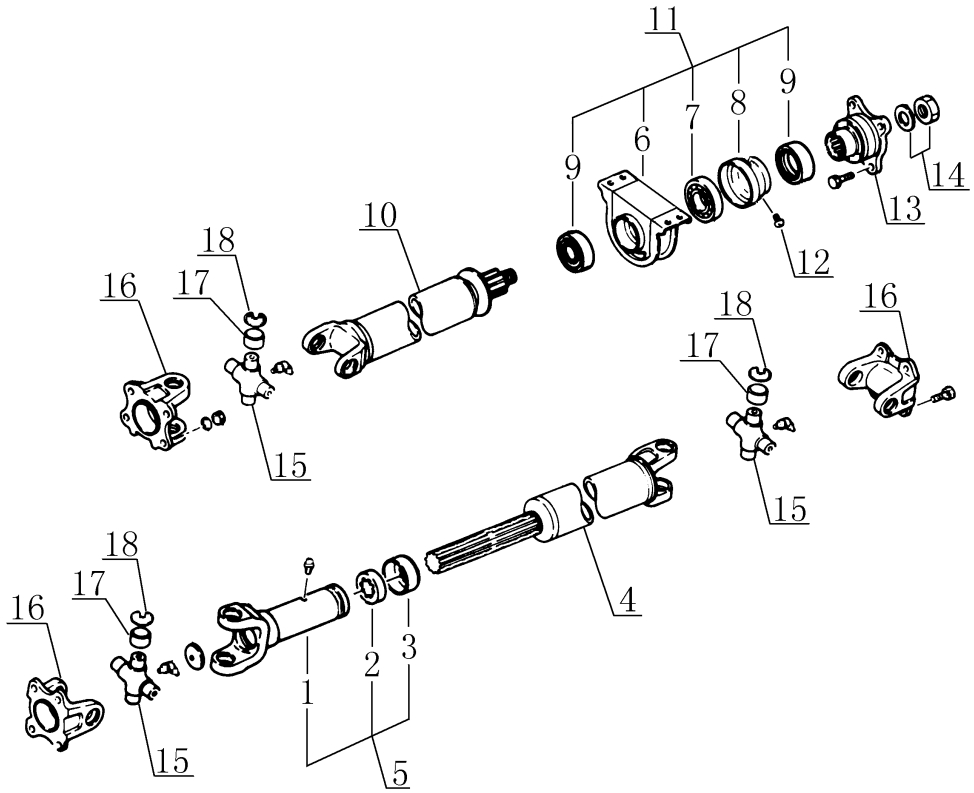
Check for maladjustment (only for reference)

Measure an unbalance value between crossing shaft end.

Dimension (mm)	Tube (mm)	Rate of turning (rpm)	unbalance value (g·cm)
706 (intermediate shaft)	69	3200	40

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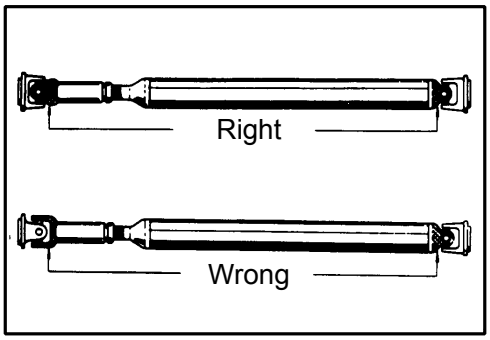
Re-installation



Disassembly sequences

1. Spline tube
▲ 2. Oil seal
3. Dust cover
4. Rear axle drive shaft bearing assembly
▲ 5. Sleeve spline pipe assembly
6. Buffer rubber
7. Bearing
8. Retainer
9. Dust cover
10. Intermediate drive shaft assembly
11. Middle supporting assembly
12. Grease nozzle
13 Intermediate drive shaft flange assembly
14. Washer and nut
15. Crossing shaft
16. Flange yoke
17. Needle bearing
18. Universal joint end ring

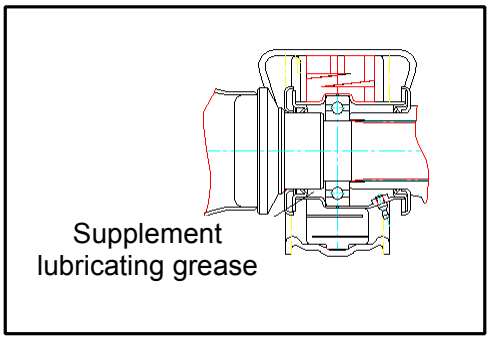
DRIVE SHAFT



Important

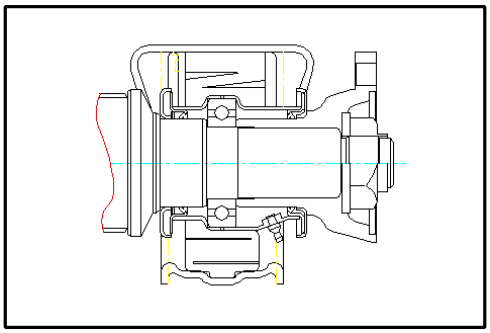
4. Rear axle drive shaft bearing assembly
13 Intermediate drive shaft flange assembly
16. Flange yoke

After applying the lubricating grease on the splilne, install the flange yoke。



7. Bearing
Supplement the lubricating grease.

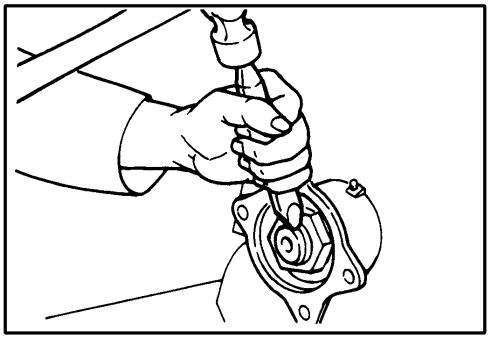
After tightening flanges at two sides of drive shaft, please tighten the intermediate bearing bracket.



5. Washer and nut
Nut code: 2202042N
Wrench: 30mm

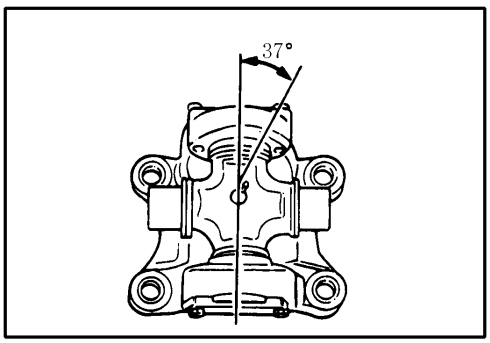
Torque (N • m)	343-539

Use a new nut. Do not use the old one.

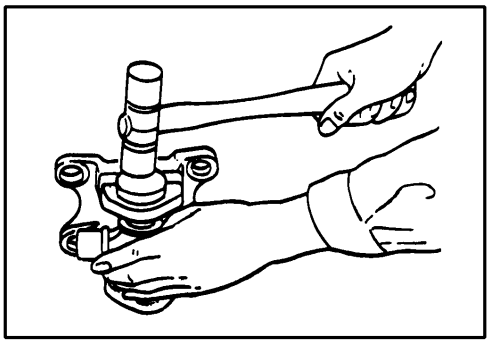


Make a marking stake on the nut.

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15. Crossing shaft
Install the lubricating grease nozzle according to the specified angle.



17. Needle bearing
Insert the crossing shaft into the flange yoke, and install the needle bearing to the yoke hole by using a wrench with soft surface.
1) Always use a new universal joint end ring
2) After installing end ring, check whether it is correctly placed.

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SUSPENSION

Front suspension

General

Disassembly

Re-installation

Tightening torque

Rear suspension

General

Disassembly

Check and repair

Re-installation

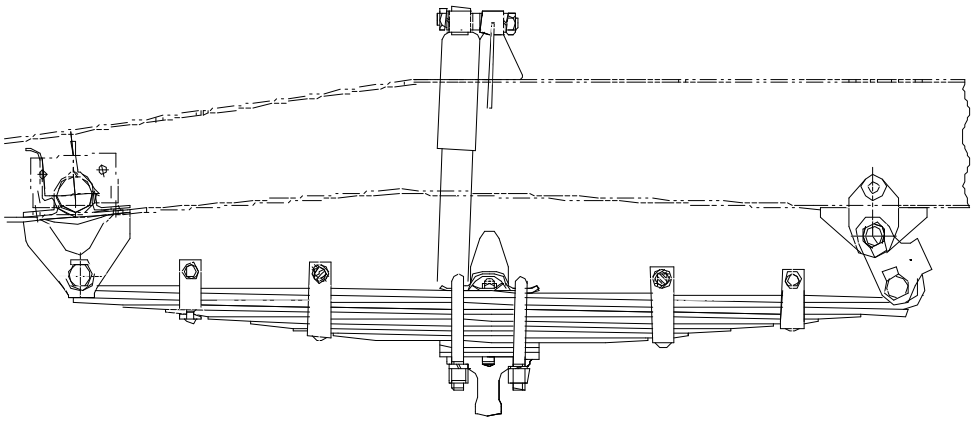
Tightening torque

Shock absorber assembly

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FRONT SUSPENSION

General



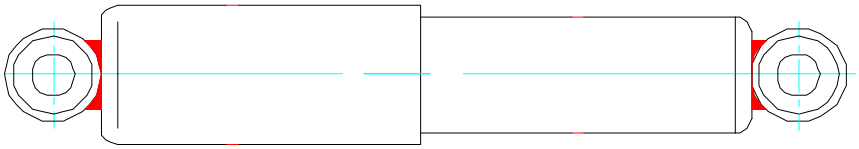
Specifications

Serial No.	Leaf spring		
	L (mm)	W (mm)	D (mm)
1	1140	70	8
2	1140	70	8
3	1150	70	8
4	1030	70	7
5	910	70	7
6	790	70	7
7	670	70	7
8	550	70	7
9	440	70	7
10	320	70	7
11	200	70	7

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SUSPENSION

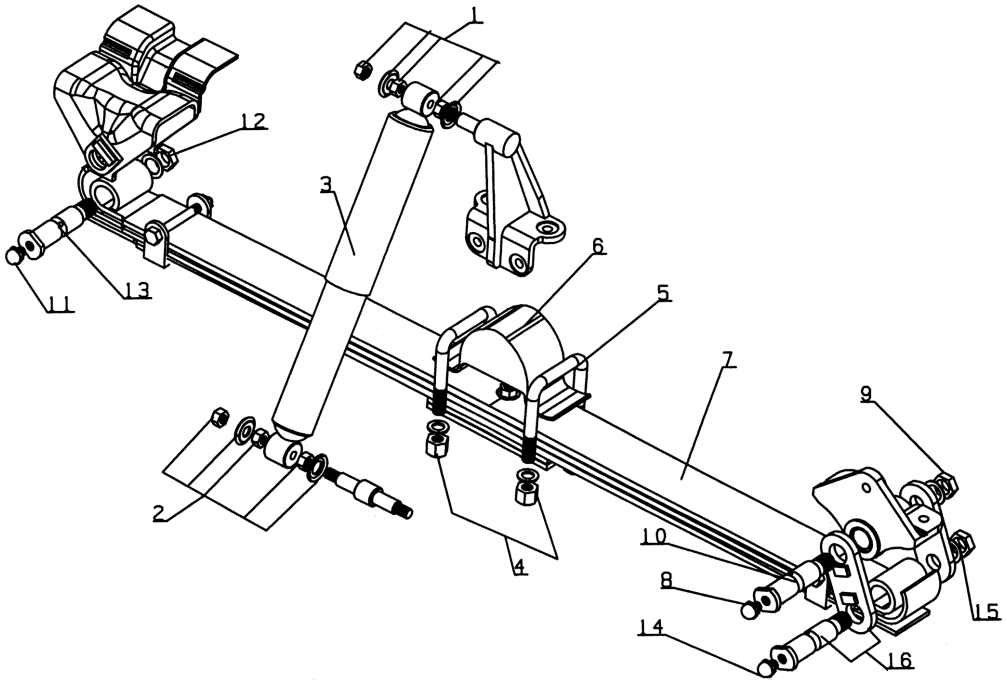
Shock absorber assembly



Shock absorber assembly	
Type	Hydraulic double telescopic
Max. OD of liquid tank (mm)	¢45
Max. OD of dust cover (mm)	¢53
Main stroke (mm)	220
Compression length (mm)	330
Extended length (mm)	550

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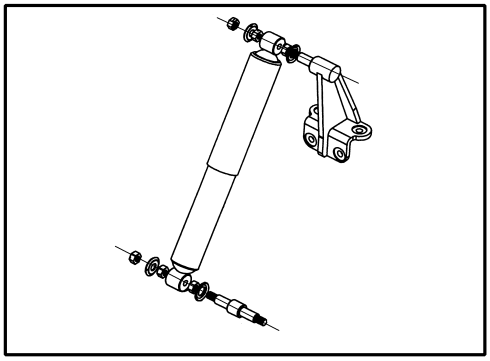
Disassembly



Disassembly sequences

1. Rubber mat, washer and nut
▲ 2. Nut, washer and rubber bearing shell
3. Shock absorber assembly
▲ 4. Nut
▲ 5. U-bolt
6. Front buffer block assembly
7. Leaf spring assembly
8. Grease nipple
9. Spring washer and nut
10. Leaf spring cotter
11. Grease nipple
12.Spring washer and nut
13. Leaf spring cotter
14. Grease nipple
15.Spring washer and nut
16. Front spring lug and lug cotter

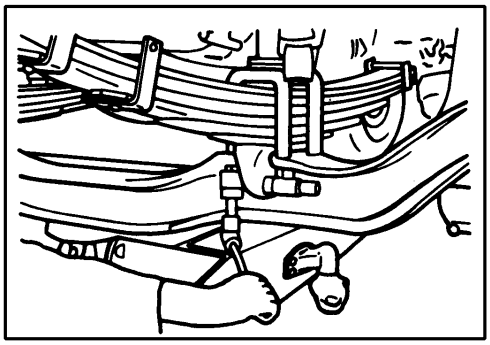
https://truckmanualshub.com/



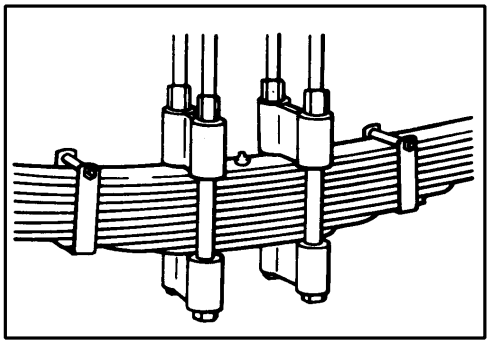
Important --- Disassembly

2. Nut, washer and rubber bearing shell

Disassemble the vibration absorber assembly, nut, washer and bearing shell as shown.



4. Nut
5. U-bolt
   (1) Release (do not remove) U-bolt and nut
   (2) Lift the vehicle and support it on the chassis bracket.
   (3) Remove the U-bolt and nut

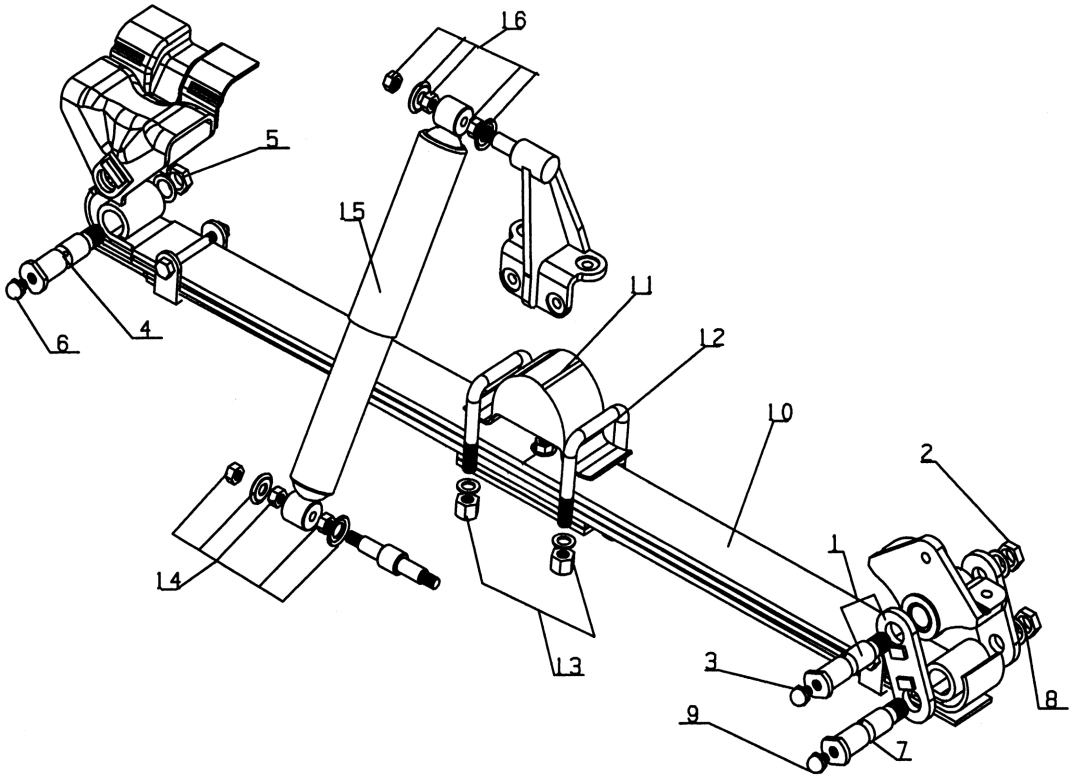


Check and repairs

In case of abrasion, damages or any other unusual conditions, make a necessary correction or replace parts.

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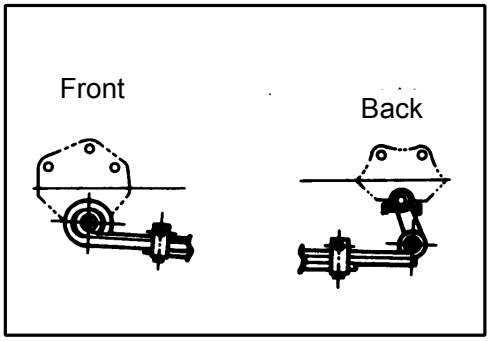
Re-installation



Re-installation sequences

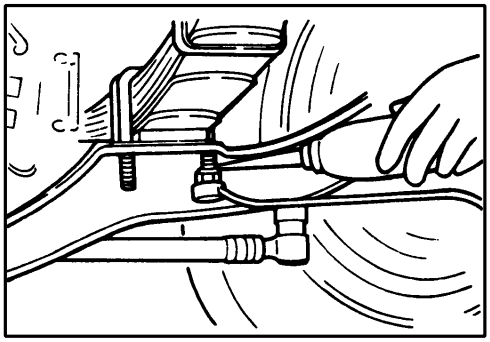
1. Front spring lug and lug cotter
2. Spring washer and nut
3. Grease nipple
4. Leaf spring cotter
5. Spring washer and nut
6. Grease nipple
7. Leaf spring cotter
8. Spring washer and nut
9. Grease nipple
- ▲ 10. Leaf spring assembly
11. Front buffer block assembly
- ▲ 12. U-bolt
- ▲ 13. Nut
- ▲ 14. Nut, washer and rubber bearing shell
- ▲ 15.Vibration absorber assembly
16. Rubber mat, washer and nut

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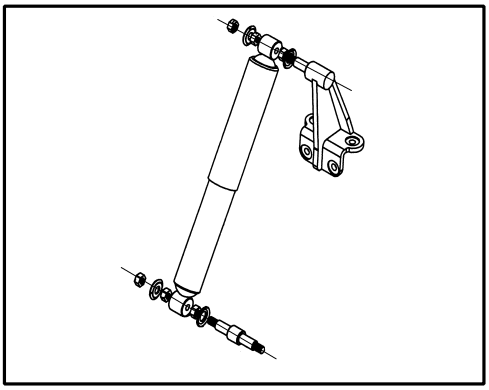


Important --- assembly

10. Leaf spring assembly
    Install the leaf spring assembly by double wrapping end of left steering side



12. U-bolt
13. Nut
    (1) Place the vehicle at a horizontal plane and install U-bolt to a corresponding position of the leaf spring.
    (2) Lift the vehicle.
    (3) Align with the front axle hole and U-bolt.
    (4) Apply the engine oil on the nut before tightening them to prevent damages of thread.
    (5) Tightening nuts.

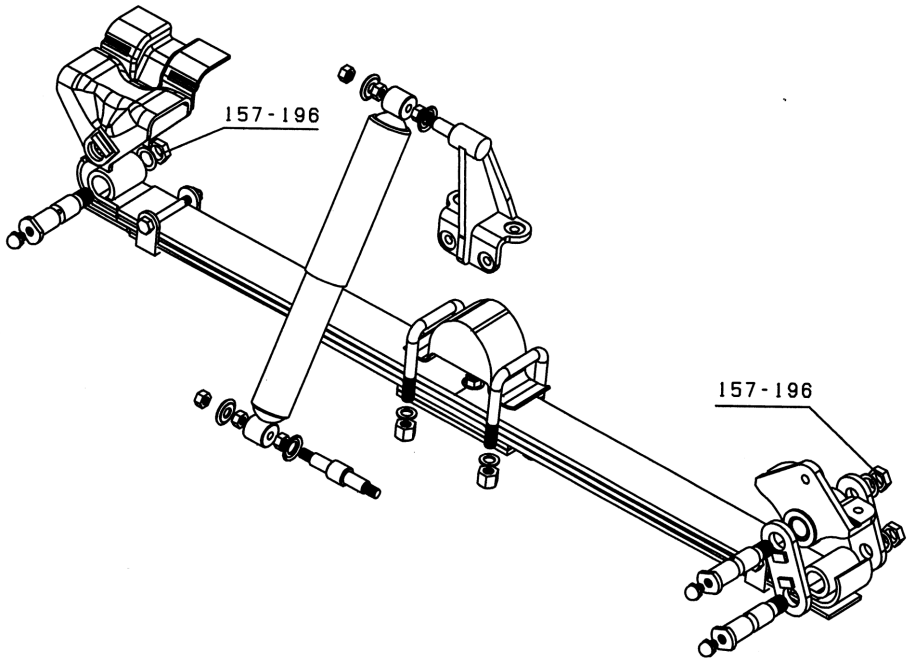


14. Nut, washer and rubber bearing shell
15. Front vibration absorber assembly
    Disassemble the vibration absorber assembly, nut, washer and bearing shell as shown.
    Tighten the nut till the washer contacts with fitting face of bearing end.

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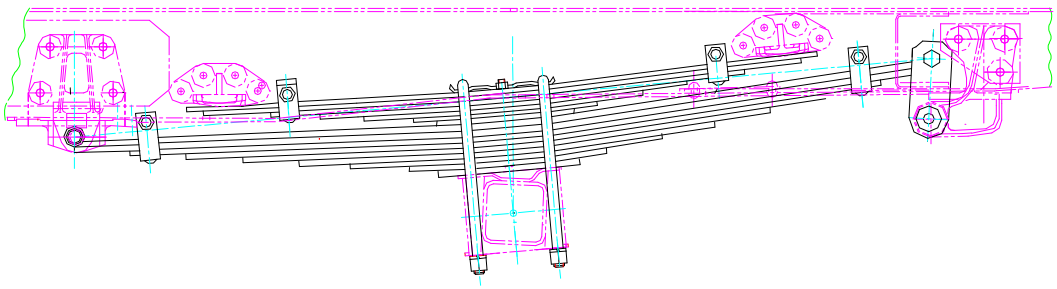
Tightening torque

(Unit: N•m)



REAR SUSPENSION

General



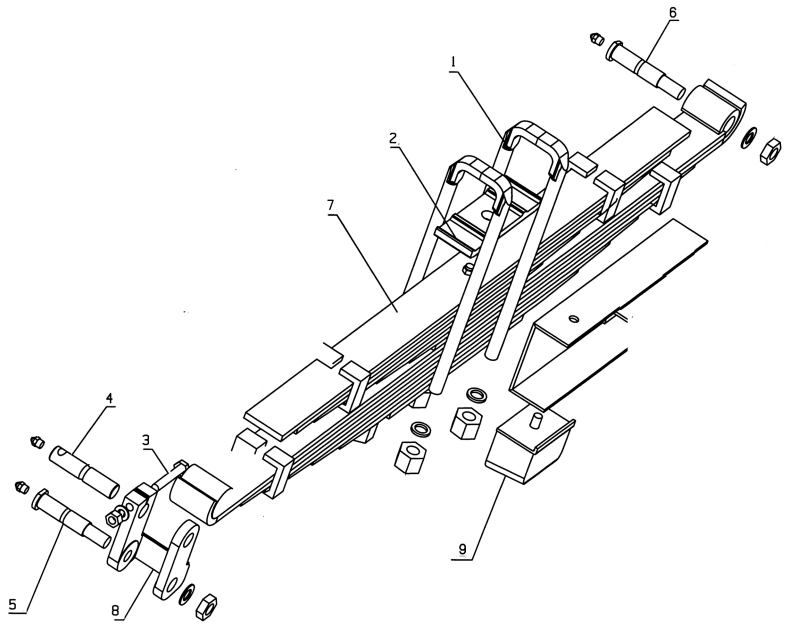
Specifications

Serial No.	Main spring		
	L (mm)	W (mm)	D (mm)
1	1300	70	10
2	1320	70	10
3	1140	70	8
4	970	70	8
5	800	70	8
6	630	70	8
7	300	70	8
8	300	70	8

Serial No.	Auxiliary spring		
	L (mm)	W (mm)	D (mm)
1	960	70	7
2	910	70	7
3	710	70	7
4	560	70	7
5	420	70	7
6	270	70	7
7	170	70	7

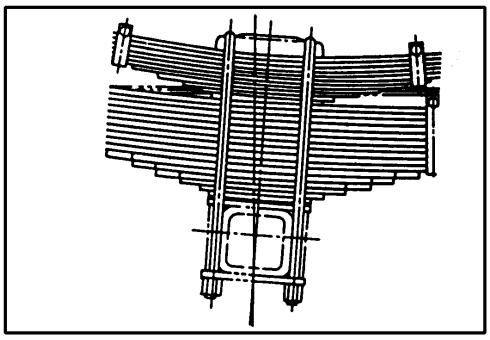
https://truckmanualshub.com/

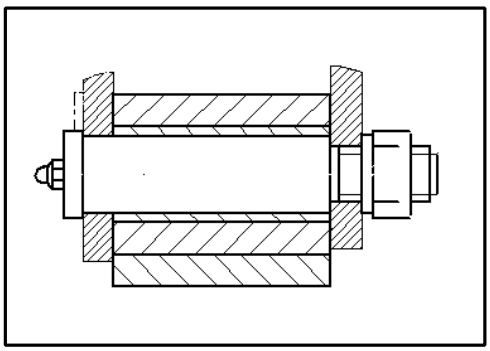
Disassembly



Disassembly sequences

▲ 1.U-bolt and nut
2. Rear spring plate
3.Leaf spring cotter, locking bolt and nut
4.Leaf spring cotter and grease nipple
5.Leaf spring cotter and grease nipple
▲ 6.Leaf spring cotter and grease nipple
7.Leaf spring
8. Rear leaf spring lug
9. Buffer block





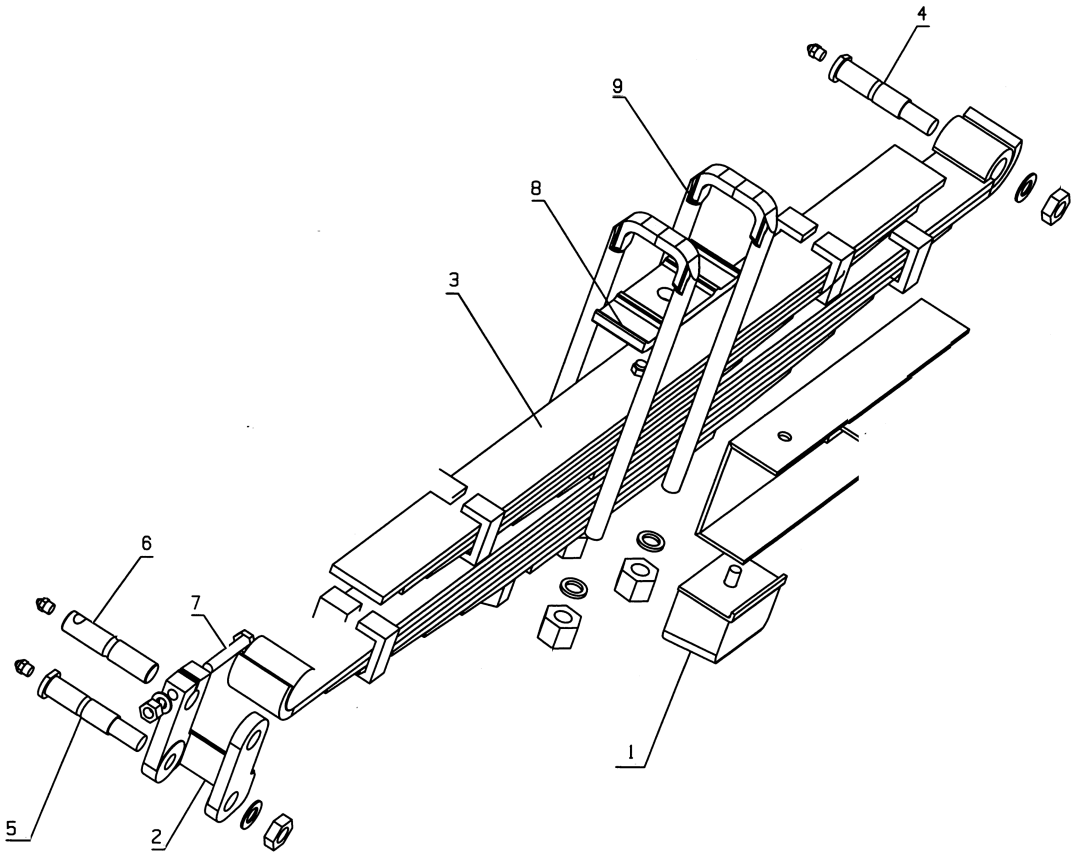
Important

1. U-bolt and nut
After loosening the nut, lift the vehicle, and support it by chassis platform. Remove U-bolt and move the front axle assembly.

4. Leaf spring pin
Lift the leaf spring assembly by a jack, remove the nut and eject the bolt outwards.

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Re-installation



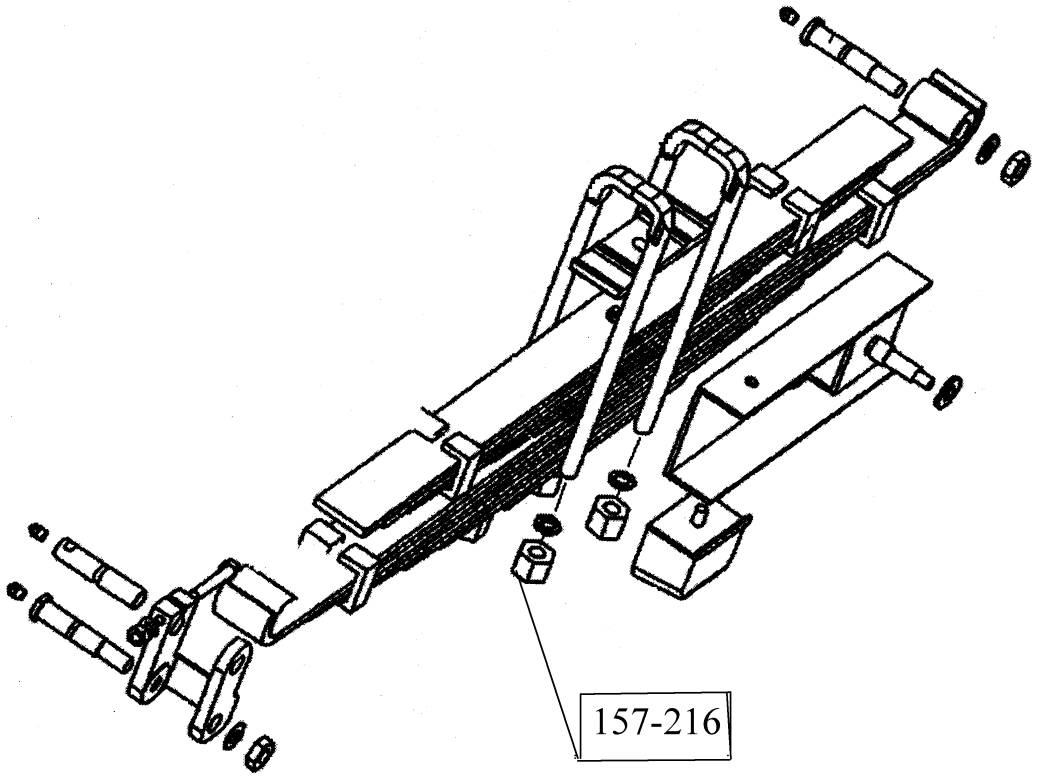
Disassembly sequences

1. Buffer block
2. Rear leaf spring lug
3. Rear leaf spring assembly
4. Leaf spring cotter
5. Leaf spring cotter
6. Leaf spring cotter
7. Leaf spring cotter, locking bolt and nut
8. Washer
9. Rear spring plate
10. U-bolt and nut

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Tightening torque

(Unit: N • m)



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Steering gear

General

Main data and specifications

Maintenance

Steering column and shaft

Disassembly and assembly

Check and repairs

Steering gear assembly

Disassembly and assembly

Power steering device

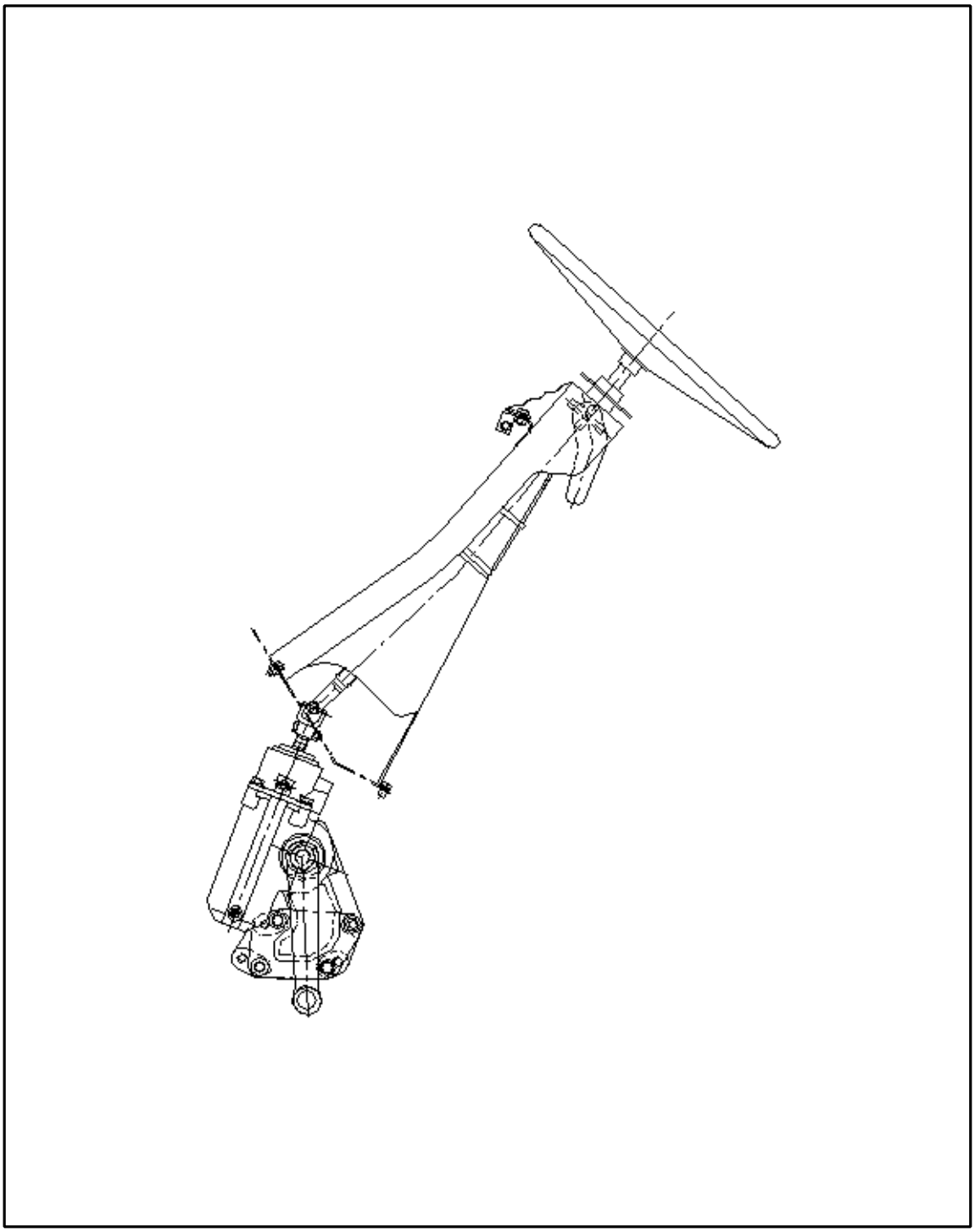
Disassembly

Re-installation

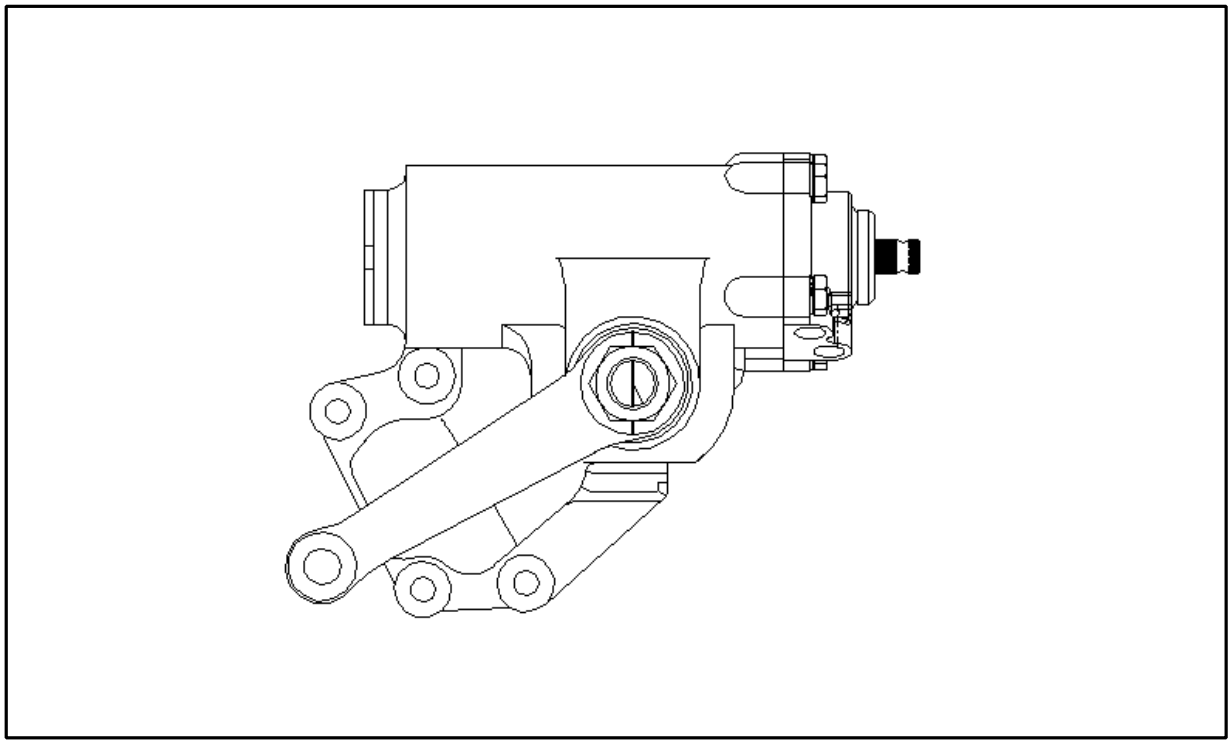
https://truckmanualshub.com/

General

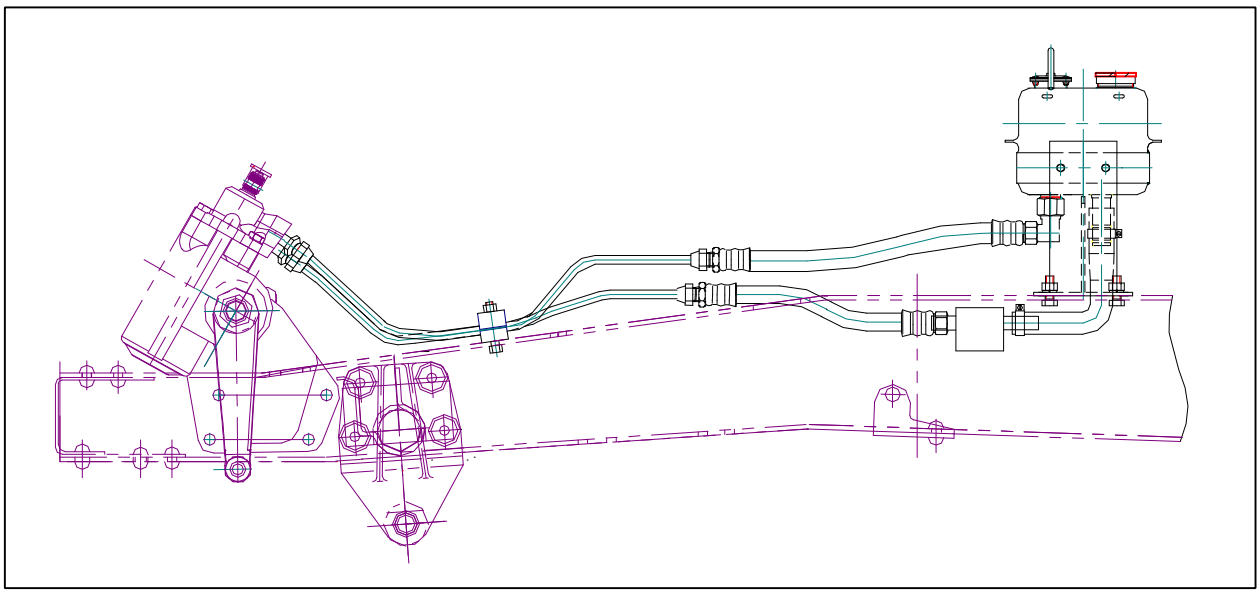
Steering mechanism



Power steering device



Power steering pipe



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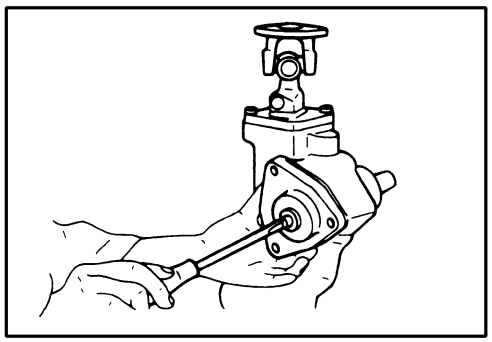
Main data and specifications

Steering column and shaft

Diameter of steering wheel	(mm)	410
Free stroke	(mm)	10----15
Type of steering shaft		Double shaft

Power steering device

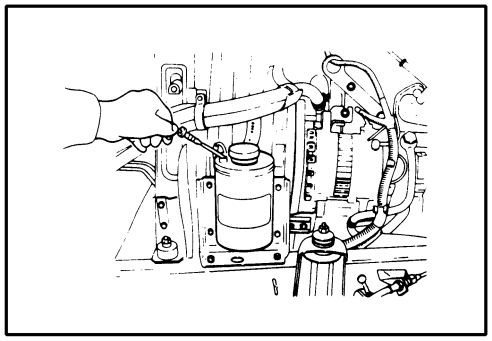
Type		Recirculating ball
Angle ratio		17：1
Max. working pressure	（Mpa）	10
Working flow	（l/min）	7
Theoretic max. output torque	(N・m)	1200
Direction of turning		Left
Output swing angle	(°)	±43



Maintenance

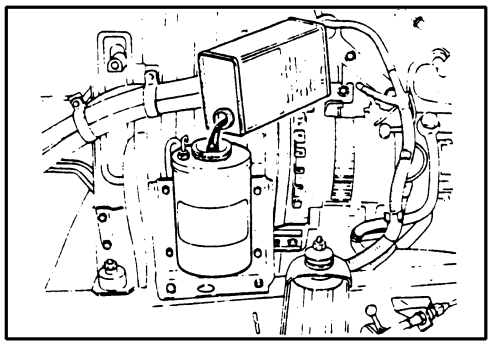
Adjustment of free stroke of steering wheel

In case of too large free stroke of steering wheel, check whether steering shaft, universal joint has clearance. If these parts are normal, then adjust it by an adjusting screw of device. Rotate the adjusting screw clockwise, the free stroke will reduce; rotate it anticlockwise, it will increase.



Oil level check (for power steering)

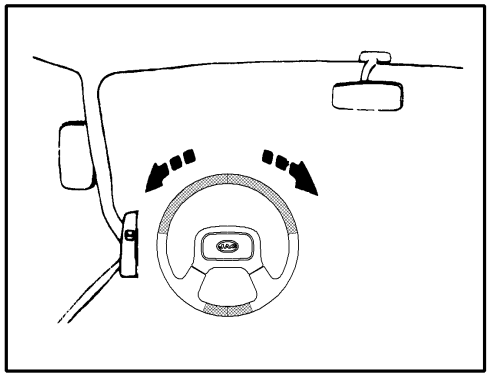
Remove a level meter rod from the oil tank and check the oil level of the meter rod.



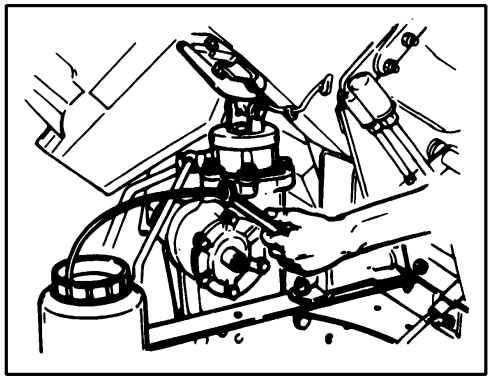
Exhaust of power steering pipe

(1) Fill steering oil into the power steering oil reservoir (use the specified one), separate the front wheel and the ground by lifting the front axle, and turn the steering wheel to the limit position by two sides several times.
Note: During exhaust, check the liquid level in the power steering oil reservoir frequently, and fill up in case of insufficiency

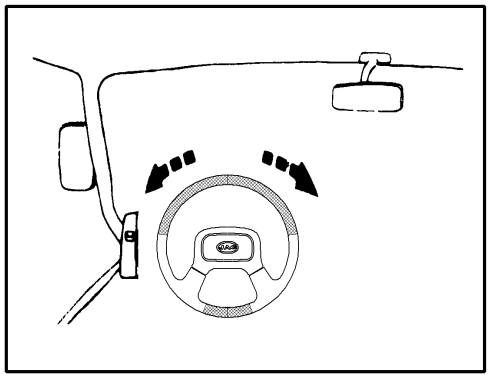
(2) Start up the engine, and turn the steering wheel to the limit position by two sides several times while it is idle running.

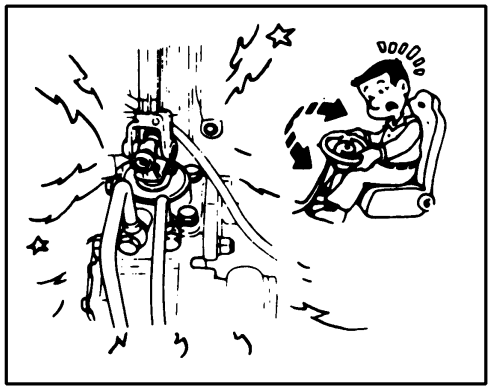


(3) During expelling of air, fill up the steering oil liquid continuously to the oil reservoir to ensure it not empty. In case of no air out, it indicates air in the steering system has been expelled.



(4) Lower the front wheel and rotate the steering wheel by double directions while the engine is running at medium speed. In case of no unusual noises for steering operation, it indicates air has been expelled.



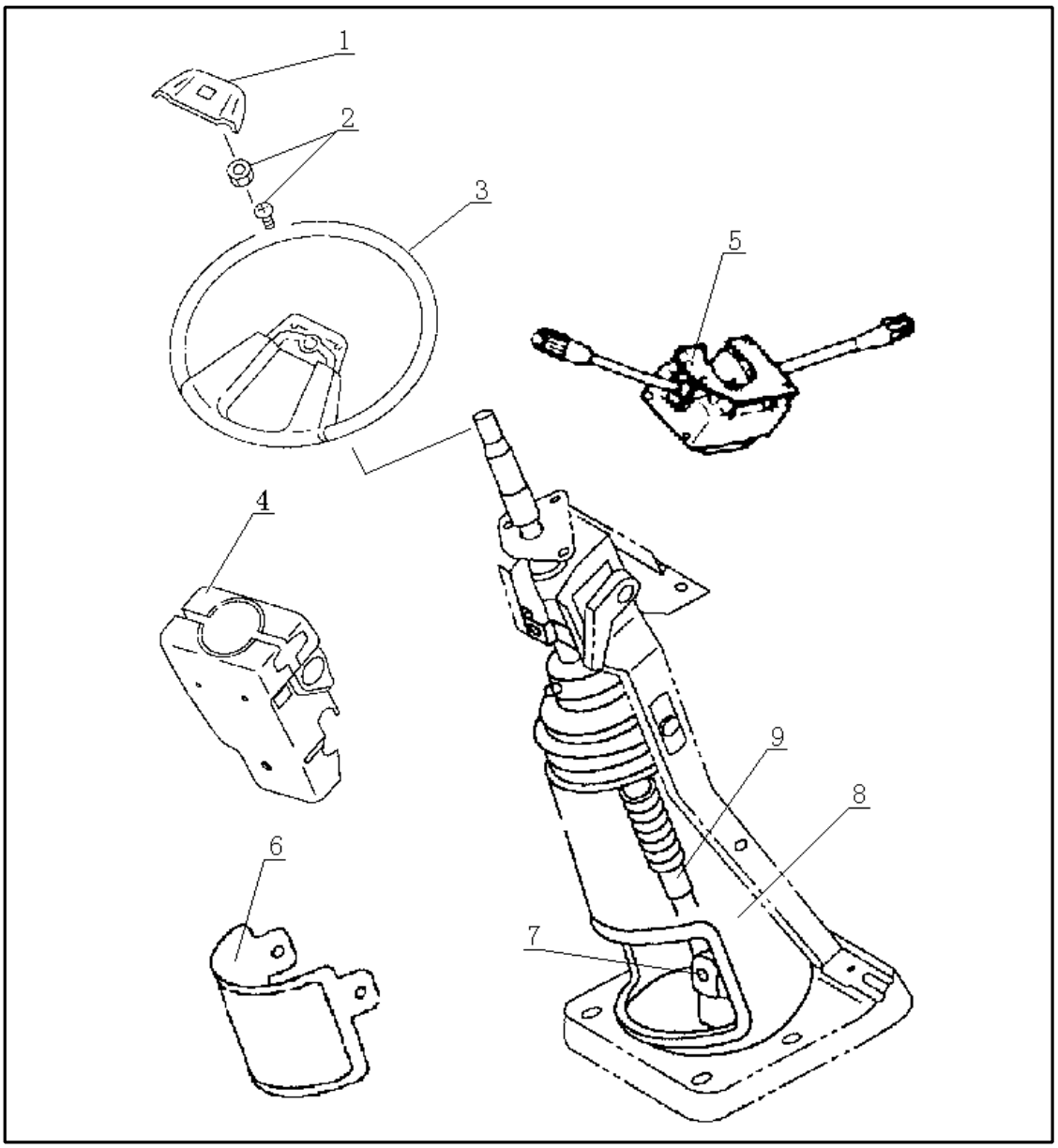


(5) In case of unusual noises, continue the above-mentioned exhaust operations.

(6) After exhaust operations, check whether steering device and pipes are oil leaking.

Steering column and shaft

Disassembly and assembly

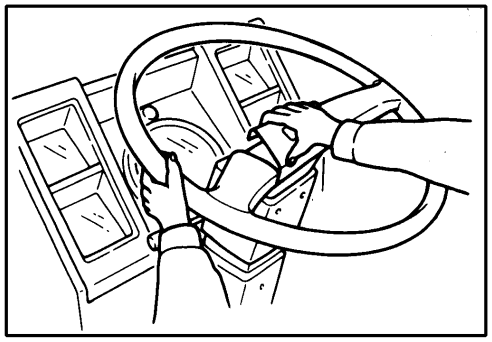


Disassembly sequences

▲1. Horn button
2. Nut and spring washer of steering wheel
▲3. Steering wheel
4. Steering shaft cover
5. Combination switch assembly
6. Steering shaft sleeve cover assembly
▲7. Bolt: fixing worm shaft and steering yoke
8. Steering column sleeve cover assembly
9. Steering column and shaft assembly

Assembly sequences

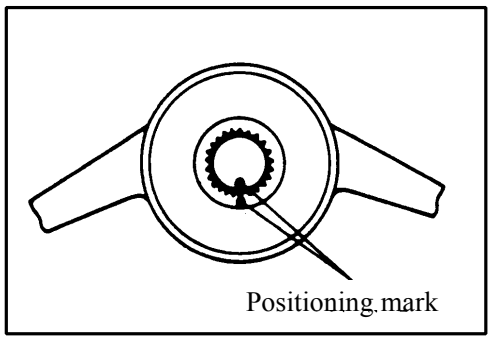
9. Steering column and shaft assembly
8. Steering column sleeve cover assembly
▲ 7. Bolt: fixing worm shaft and steering yoke
6. Steering shaft sleeve cover assembly
5. Combination switch assembly
4. Steering shaft cover
▲ 3. Steering wheel
2. Nut and spring washer of steering wheel
1. Horn button



Important – disassembly

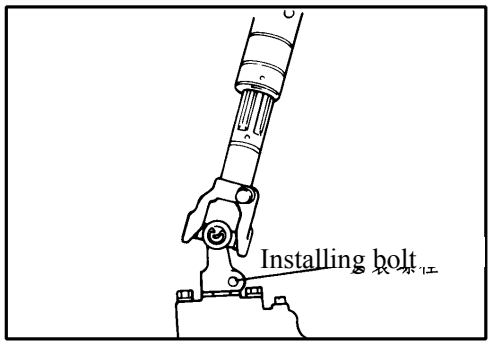
1. Horn button

Pull out the horn button by hands



3. Steering wheel

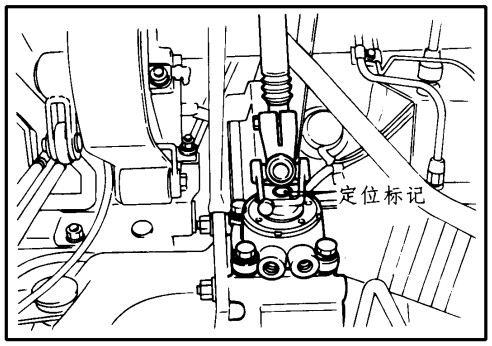
Make a mark by crossing the steering wheel and steering shaft to ensure the parts could be at the original position while assembling.



7. Bolt: fixing worm shaft and steering yoke

(1) Incline the cab upwards and support it by a supporting rod.

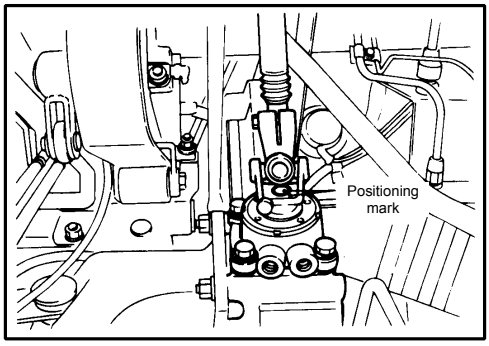
(2) Mark a positioning mark at the steering yoke and worm.



(3) Remove the installation bolt by pneumatic wrench or open-end wrench, and then pull the flange yoke out of the shaft.

(4) Put down the cab gradually.

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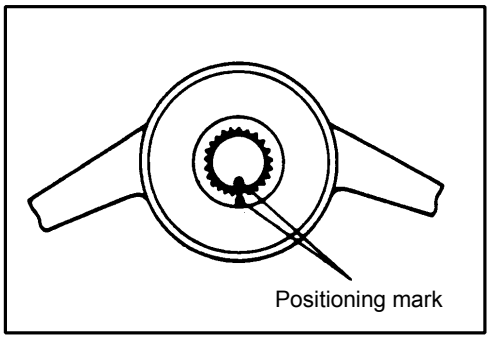


Important --- assembly

7. Bolt: fixing worm shaft and steering yoke
While installing, align with the positioning mark made for the disassembly.

Range of locking torque:

Torque (N • m)	37-75



3. Steering wheel
Make a mark by crossing the steering wheel and steering shaft to ensure the parts could be at the original position while assembling.

Range of locking torque:

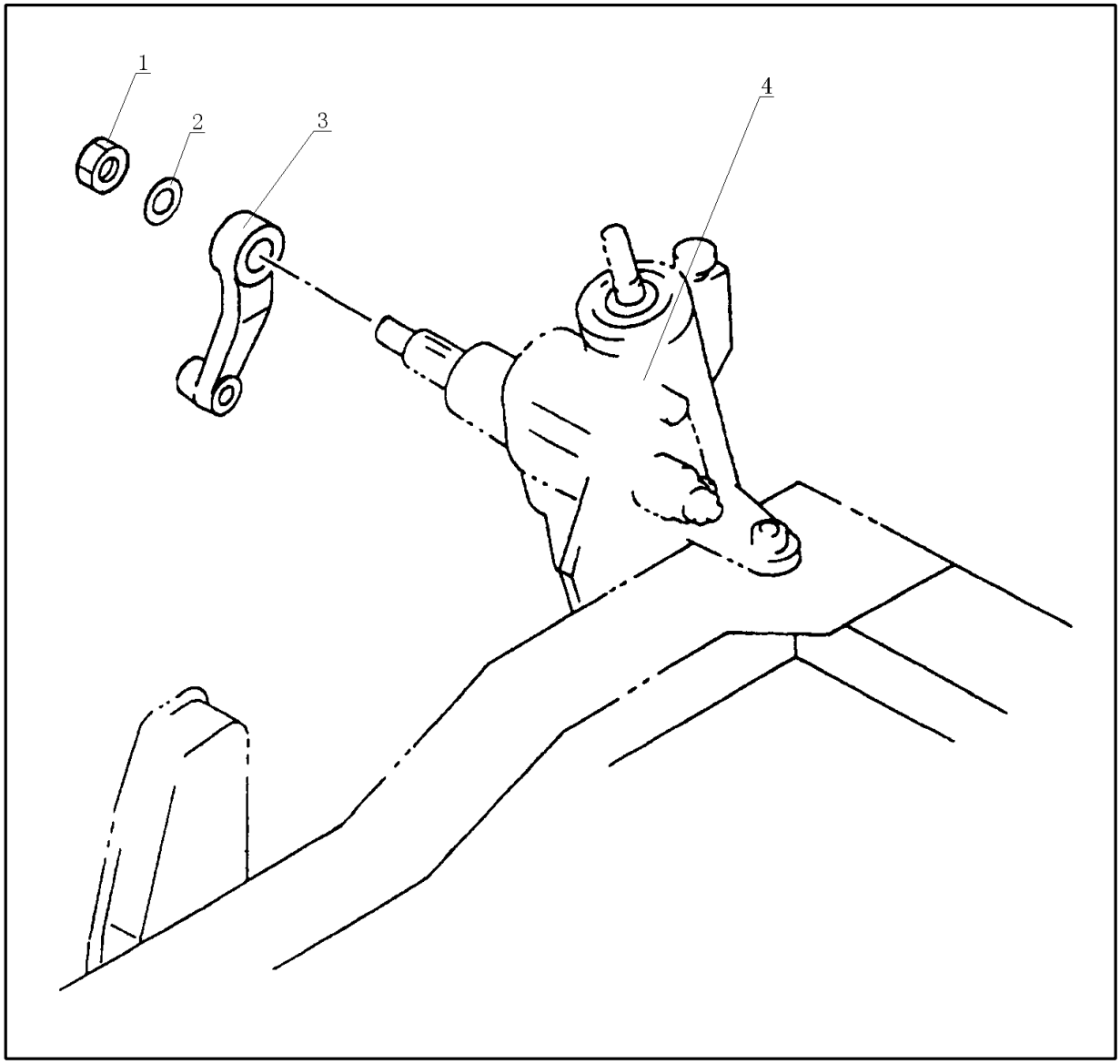
Torque (N • m)	54-68.6

Check and repairs

In case of abrasion, damages or any other unusual conditions, make a necessary correction or replace parts.

Steering gear assembly

Disassembly and assembly



Disassembly sequences

1. Locking nut
2. Spring washer
3. Steering vertical arm
4. Steering gear

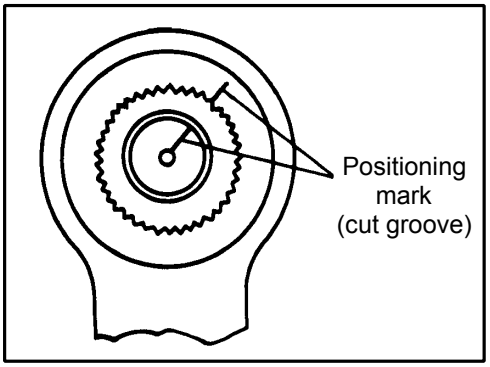
Assembly sequences

4. Steering gear
▲ 3. Steering vertical arm
2. Spring washer
1. Locking nut

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Important – disassembly

Note: Disassemble the input, output oil hoses of power steering pipe parts before removing the steering gear assembly. Pay special attention to those areas around the connection and plug, or seal the oil port after removing the oil pipe to prevent entry of dust or other foreign substances.



Important --- assembly

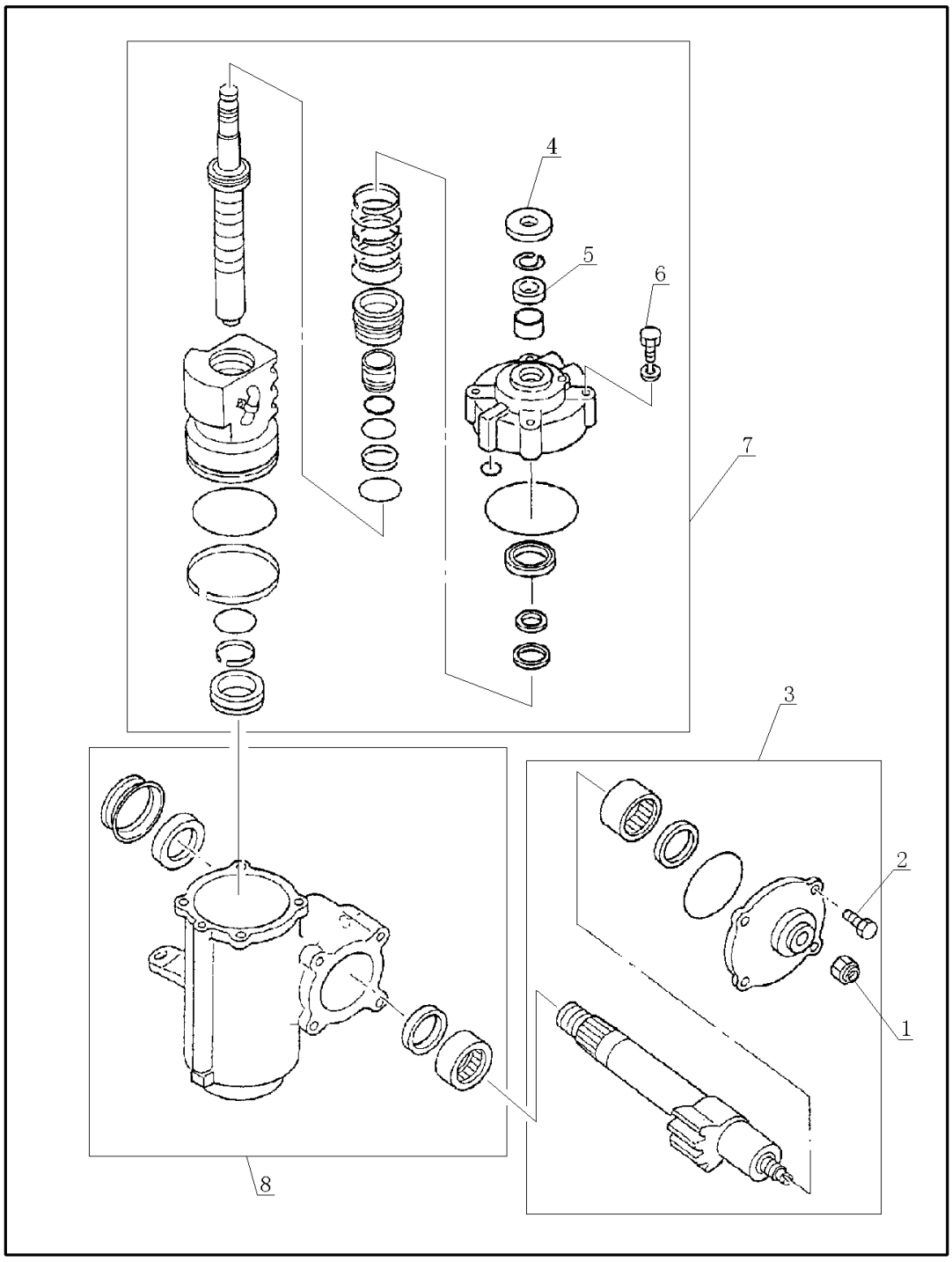
3. Steering vertical arm
Align with the positioning mark.

Range of locking torque:

Torque (N • m)	196-250

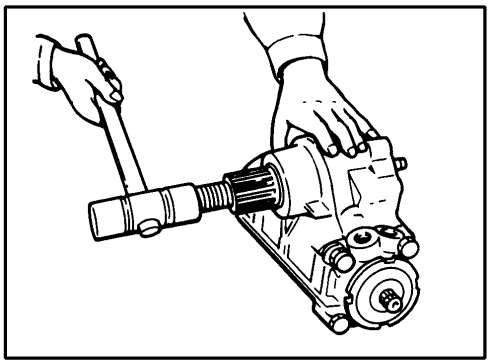
Power steering device

Disassembly



Sequences

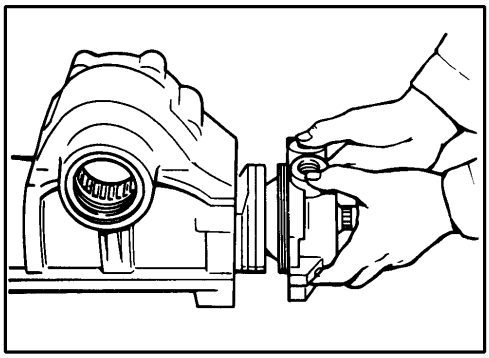
1. Locking nut
2. Bolt
3. ▲ Side cover assembly and steering arm shaft assembly
4. Dust cover
5. Sealing ring
6. Bolt
7. ▲ Valve body assembly
8. ▲ Shell assembly



Important

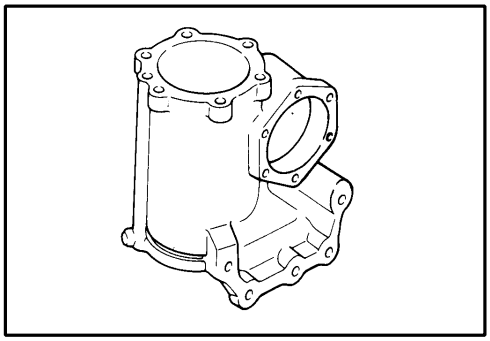
3. Side cover assembly and steering arm shaft assembly

Do not damage tooth face, thread and oil seal while disassembling.



7.Valve body assembly

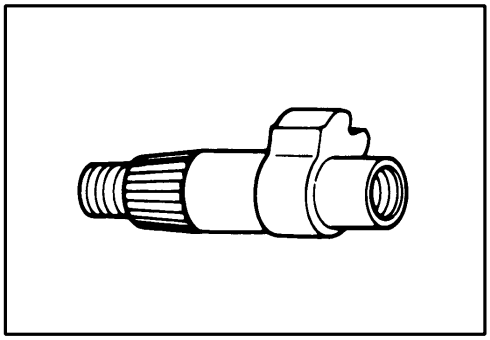
Disassemble valve body together with piston assembly.



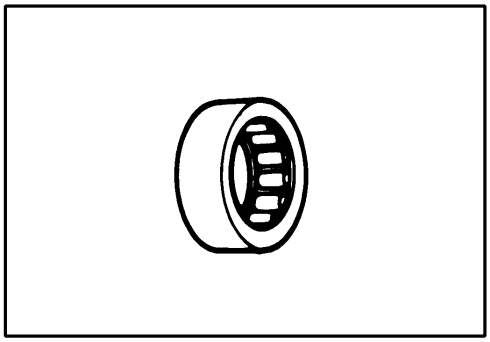
8.Shell assembly

(1) Check whether the shell has cracks, whether there are scratches on the surface in the shell and sliding surface of the piston.

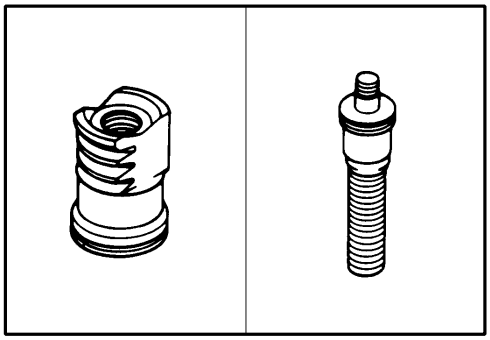
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(2) Check the steering arm shaft. In case of abrasion, bending, scratches, or partial abrasion, replace it for a new one.

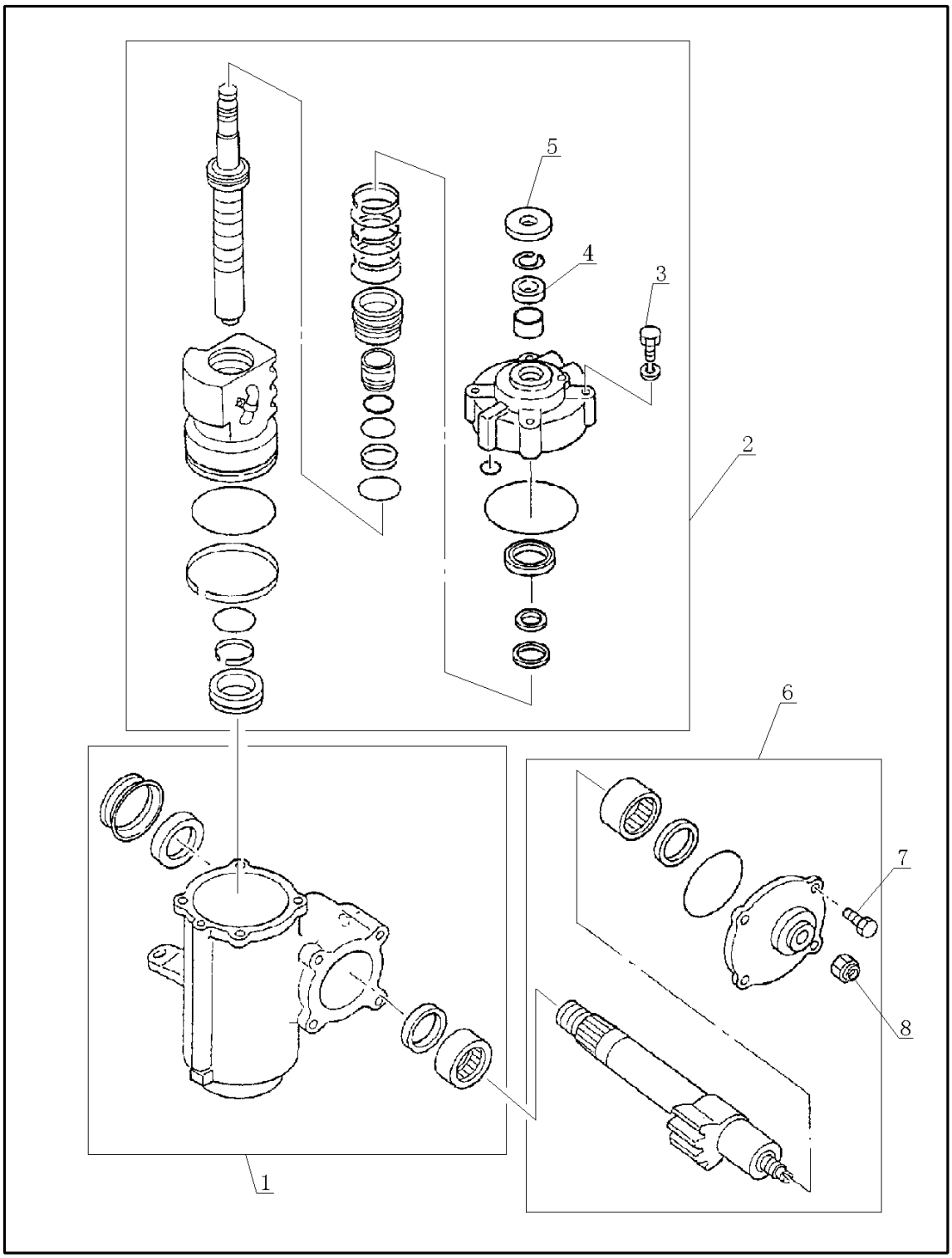


(3) Check the bearing. In case of abrasion, scratches of the surface or jamming, replace it for a new one.



(4) Check the piston and worm shaft. In case of abrasion or too large clearance, replace it.

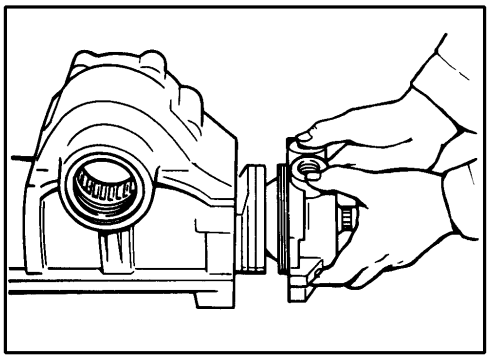
Re-installation



Sequences

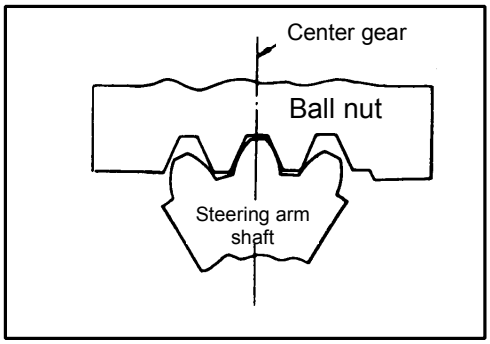
1.Shell assembly
▲2.Valve body assembly
3. Bolt
4. Sealing ring
5. Dust cover
▲6. Side cover assembly and steering arm shaft assembly
7. Bolt
▲8. Locking nut

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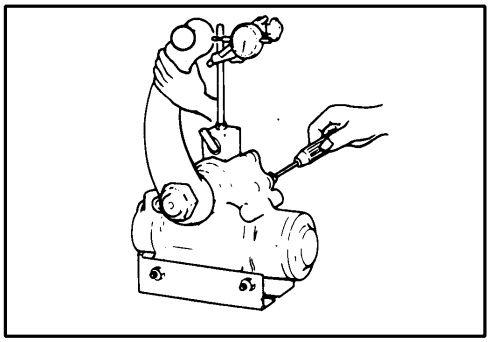


Important

2.Valve body assembly
For parts with valve body assembly, make the worm gear of the piston face the fanshaped gear. Apply the liquid on the contacting surface of the valve body.



6. Side cover assembly and steering arm shaft assembly
Align the center gear of the piston with that of steering arm shaft.



8. Locking nut
(1) Assemble the steering vertical arm.
(2) Keep the steering vertical arm upward and vertical.
(3) Tighten the nut after adjusting the clearance.

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BRAKE SYSTEM

General

Main data and specifications of brake

Screwing moment of main bolts and nuts of brake

Disassembly

Inspection and repair

Re-assembly

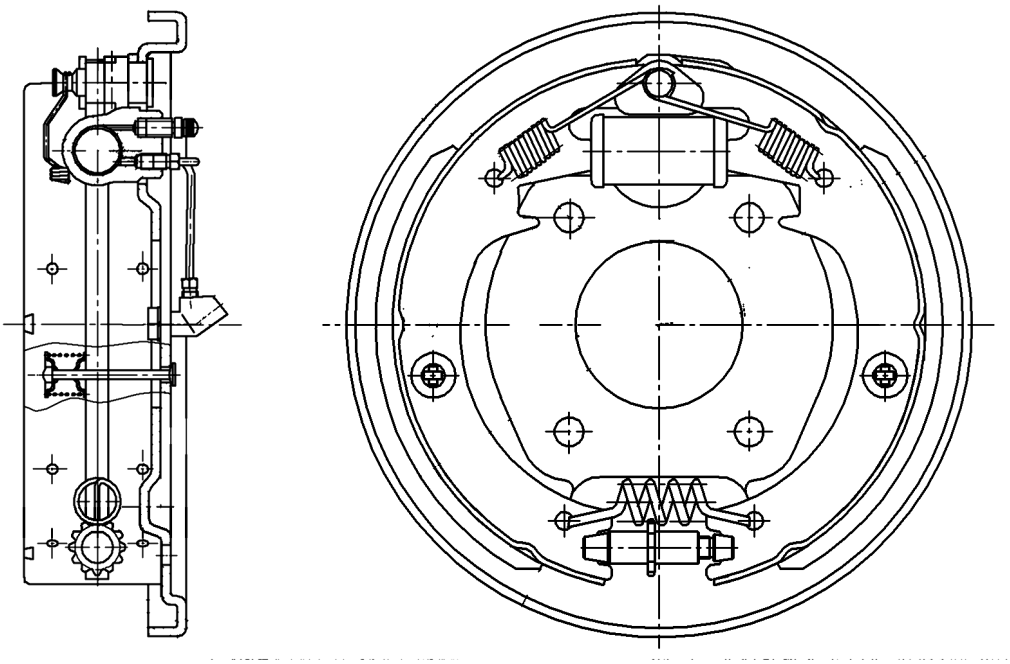
Brake main cylinder assembly

Parking brake

BRAKE

General

Brake



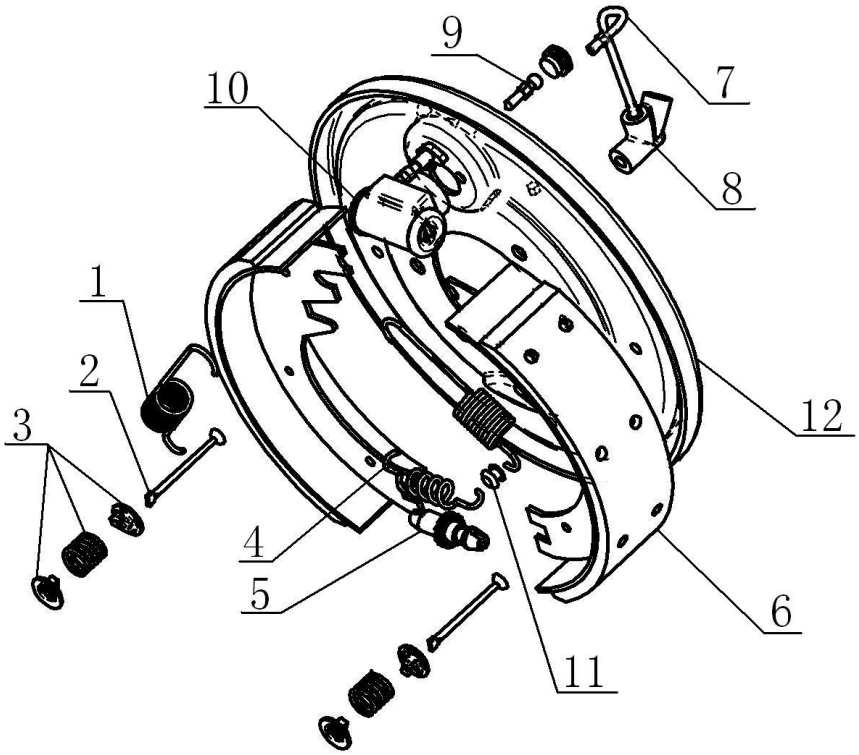
Main data and specifications

Item		
Type		Front brake: dual self-servo brake
Inner diameter of brake drum	(mm)	
：front		310
：rear		310
Brake main cylinder		
：inner diameter	(mm)	28.58
：travel	(mm)	⩾32
Wheel brake cylinder		
inner diameter ：front	(mm)	28.58
：rear	(mm)	28.58
Vacuum booster		
Diameter of film sheet	(mm)	230
Free travel	(mm)	34
Panel free travel	(mm)	5—8
Brake liquid		Synthetic brake liquid Accord with the JG3 requirement in GB10830 “Using technical conditions for vehicle brake liquid”.

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Front brake（dual self-servo type）

Disassembly



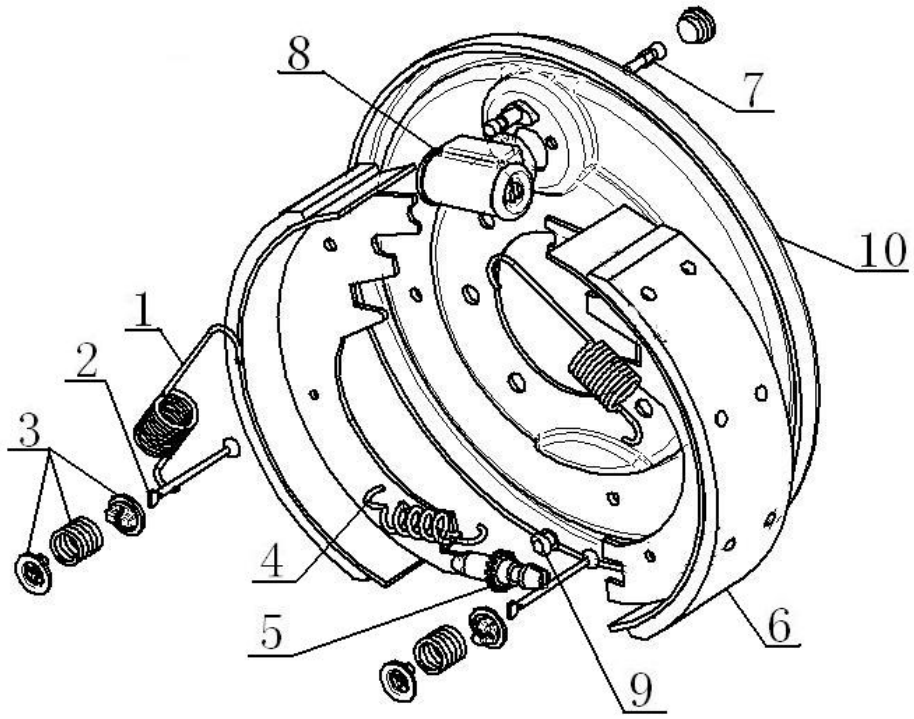
Disassembly sequence

1. Return spring of brake　2. Link lever of brake hoof　3. Pressure spring assemblies of brake hoof　4. Brake hoof spring　5. Adjusting bolt 6. Brake cylinder assembly of brake hoof　7 . Brake pipe　8 .Tie-in　9 . Deflation screw 10 .Brake cylinder 11 . Jam of adjusting hole　12 . Bottom plate of brake

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Rear brake（dual self-servo type）

Disassembly



Disassembly sequence

1．Return spring of brake　2．Link lever of brake hoof 3．Pressure spring assemblies of brake hoof　4．Brake hoof spring　5．Adjusting bolt　6．Brake hoof assembly　7 .Exhasut screw　8 .Tie-in　9 . 10.　Brake cylinder　11 . Jam of adjusting hole　12 . Bottom plate of brake

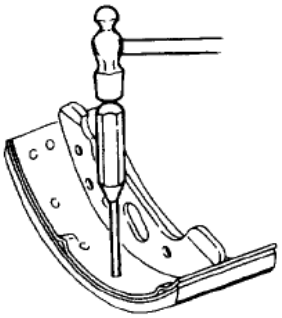
Inspection and repair

Brake friction sheet　Brake hoof sheet
Return spring　Brake drum
Brake soft pipe　Brake pipe
Brake cylinder

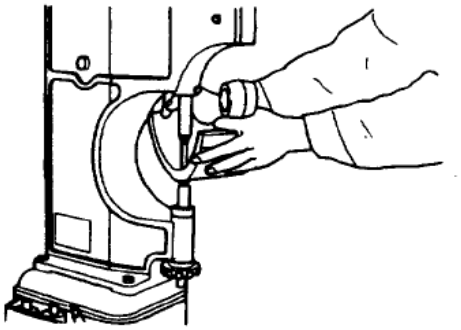
If there is any abrasion, damage or any other similar situation in checking process, it is necessary to repair or change the parts by requirement.

Visual inspection

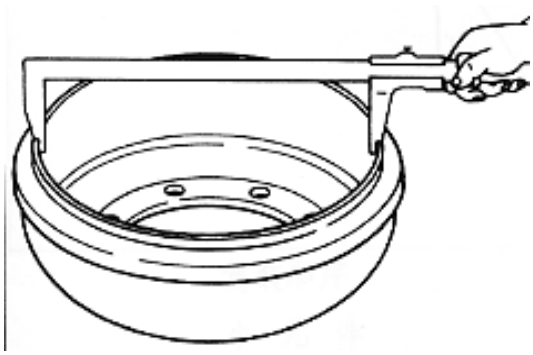
Check whether there is any abrasion, damage or any other abnormal situation about those parts in left part.



Dismantle old friction liner sheet.

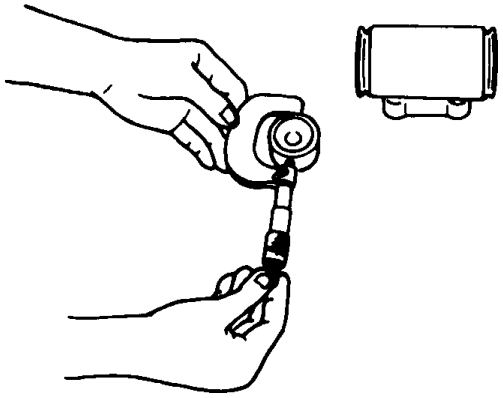


Rivet new friction liner sheet



Brake drum
（mm）

Note: if inner diameter of brake drum has been increased for the abrasion or milling, it is necessary to adopt size-added brake friction sheet.
Inner diameter using limit 311.5



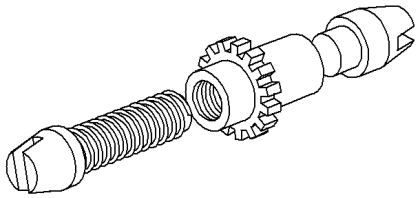
Brake cylinder
Clearance between brake cylinder piston and cylinder body
Clearance using limit 0.25

Re-assembly of brake

Assembly sequence is opposite with disassembly sequence

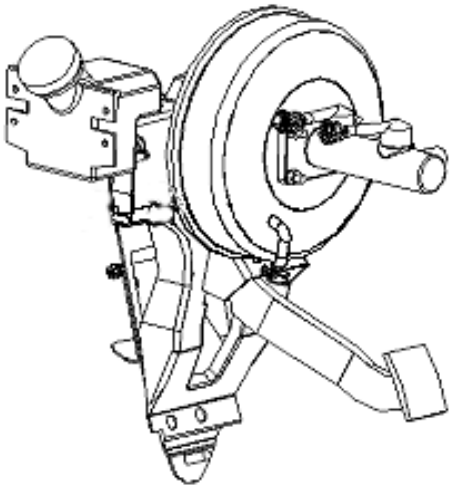
BRAKE

Important works



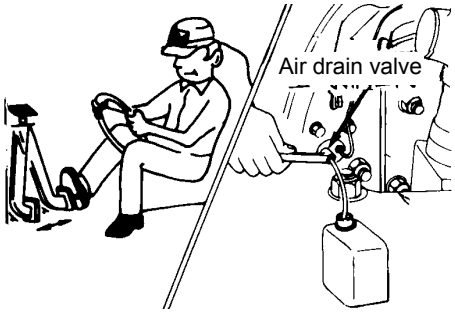
Adjusting screw

1. Spread lubricating grease on adjusting screw.
2. Brake cylinder assembly
3. Screw adjusting screw to end.



Adjustment of brake panel

Adjust the height of brake panel with adjusting bolt, then adjust free travel of panel to 5---8mm by turning vacuum booster handspike. Forbid dismantling return spring in adjusting process.



Deflation

Notes in deflation

Liquid level in oil storage pot should keep some quantity in deflation process.

Deflation step

2. After moving brake panel up and down several times, some resistance will be felt, at this time, step on panel and unscrew vent screw on brake to deflate, then screw the vent screw.

3. Repeat those operations above until no air bubble discharge from pipeline.

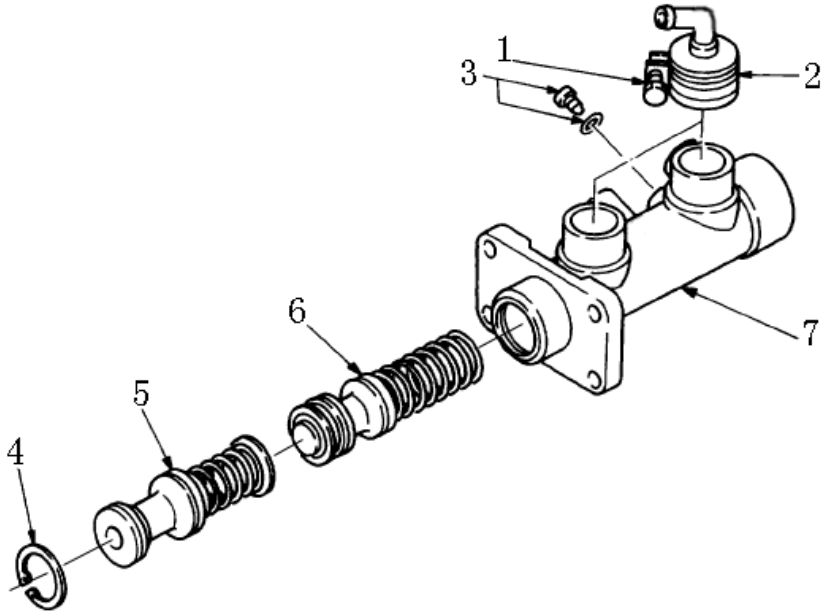
4. Intake brake liquid in oil storage pot to the mark ”MAX”.

Note: it is necessary to use brake liquid according with related requirements, and brake liquids with different types produced by different factories could not mix.

BRAKE

Brake main cylinder assembly

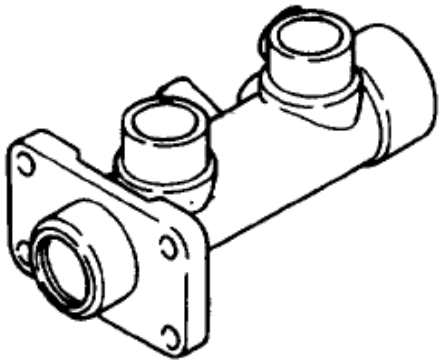
Disassembly



Disassembly sequence

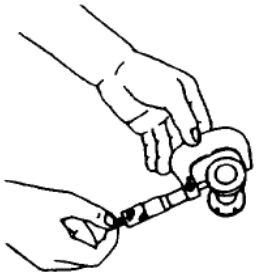
1.Clamp 2. Oil-intake tie-in 3. Limit screw 4.Clamp loop 5.Rear piston 6. Front piston

Inspection and repair



If there is any abrasion, damage or any other similar situation in checking process, it is necessary to repair or change the parts by requirement.

Check the diameter of brake main pump with eyes, if there is any screape, it is necessary to change.



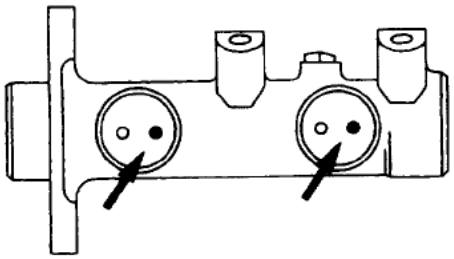
Use micro-meter and bore gauge to measure the diameter of piston and inner diameter of cylinder body independently, and gain the clearance of piston and cylinder body by calculation.

Clearance using limit 0.22

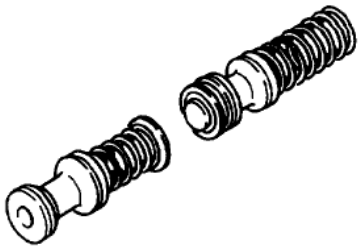
Re-assembly

Re-assembly sequecne is opposite with disassembly sequence

Important works



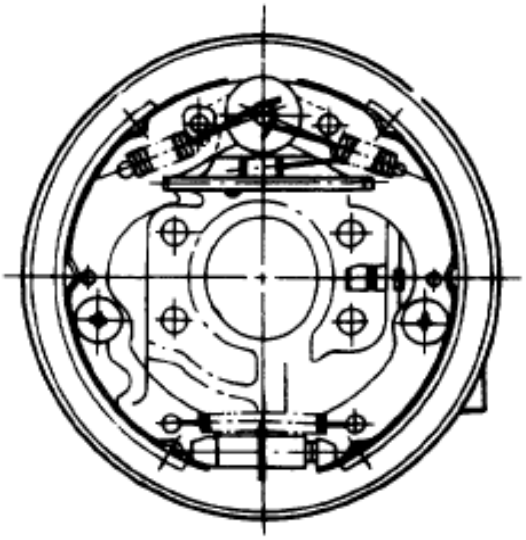
Clean cylinder body with compressed air before assembly, especially note cleaning the small oil-return hole on cylinder body.



Dip front and rear piston with clean brake liquid before installation, then install them in cylinder body.

BRAKE

Parking brake

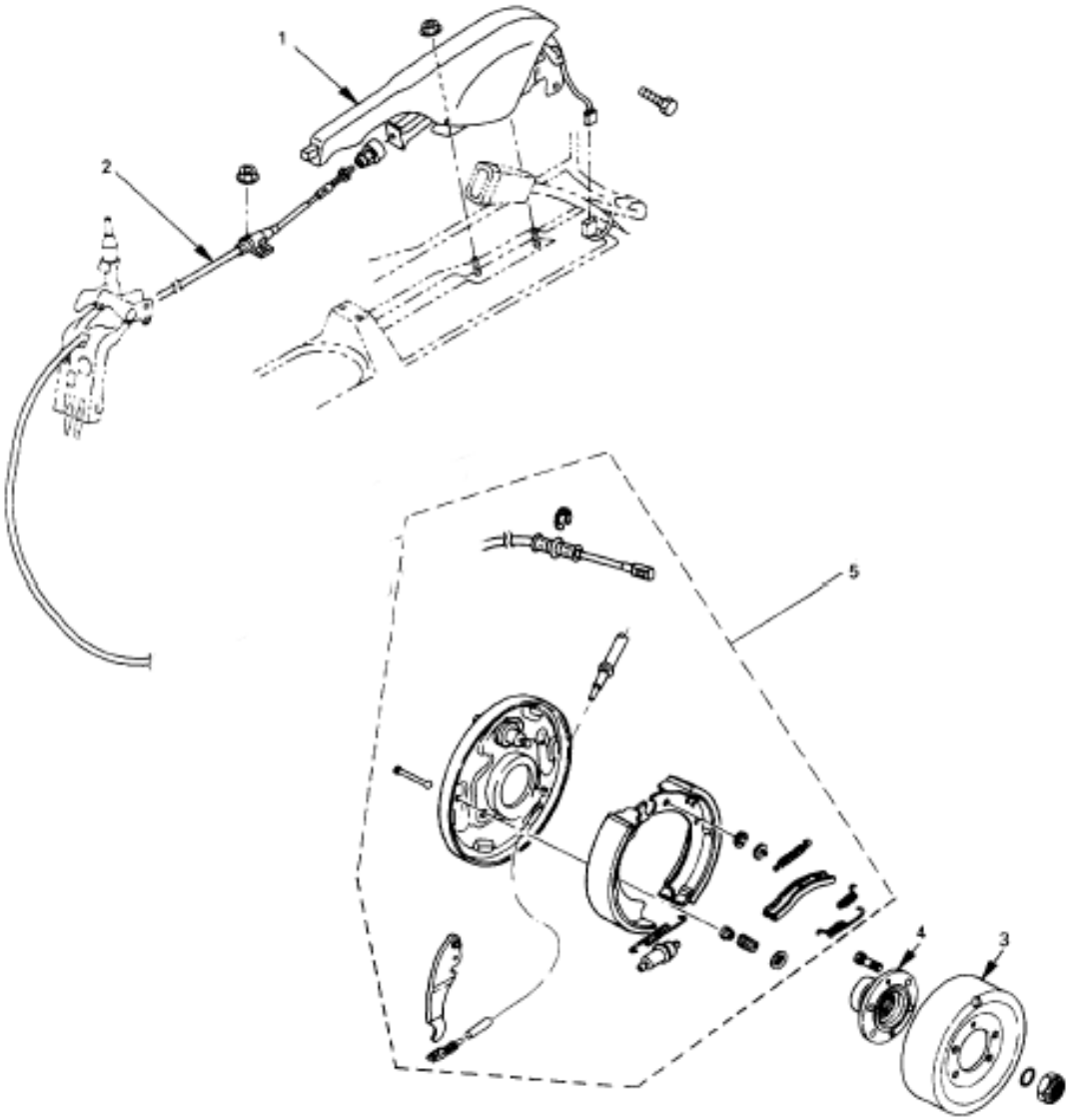


Parking brake is a kind of in-stretch type brake operated by machine, it is installed in rear part of gearbox shell body. Parking brake operation draw thread connects with parking brake operation handle in cab.

BRAKE

Disassembly

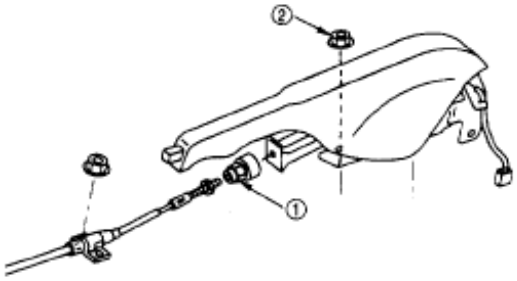
Disassembly of parking brake system



Disassembly sequence

1. Parking brake operation handle 2. Parking brake operation draw thread
3. Parking brake drum 4. Flange 5. Parking brake

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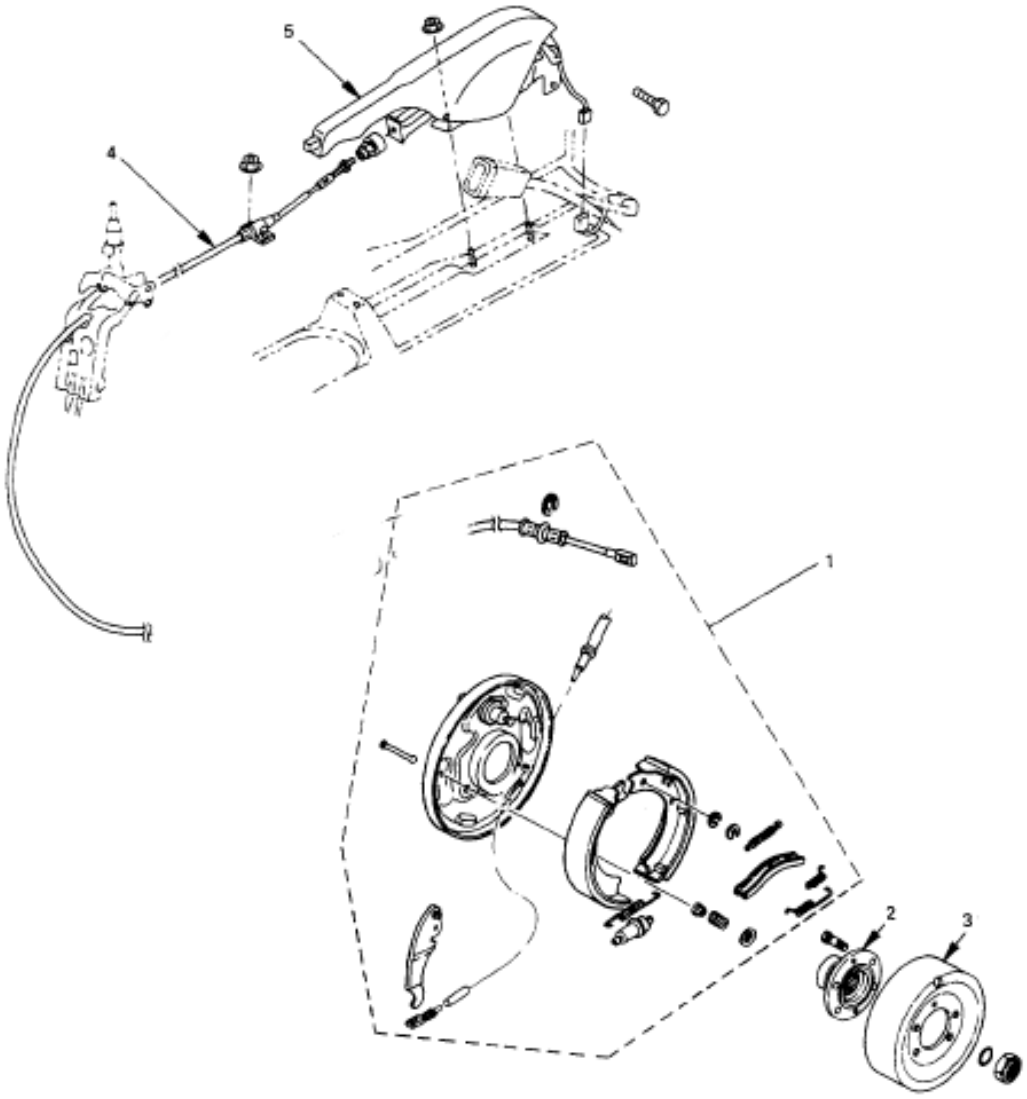
Disassembly step

Unscrew adjusting nut 1 to dismantle operation draw thread from handle.

Unscrew nut 2 dismantle handle.

BRAKE

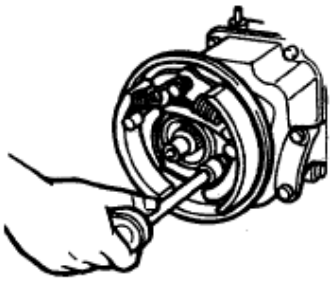
Re-assembly



Re-assembly sequence

1. Parking brake 2. Flange 3. Parking brake drum 4. Parking brake operation draw thread
5. Parking brake operation handle

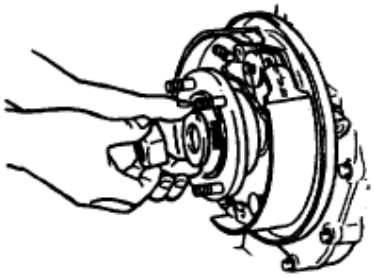
BRAKE



Re-assembly step

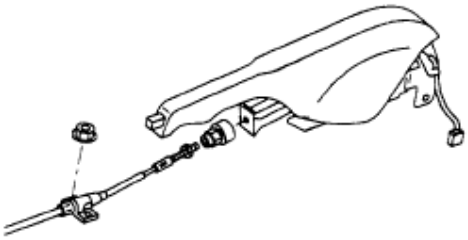
1. Parking brake assembly

Tightening torque of the nut on parking arrester is 8.5 kgf.m

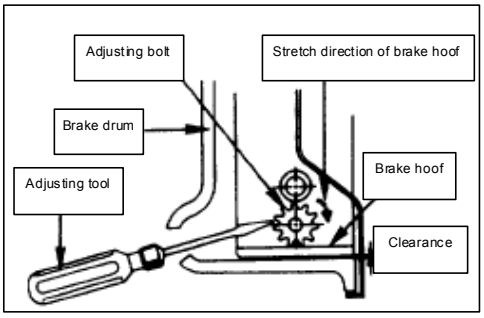


2. Flange

Tightening torque of flange nut is 23 kgf.m



3. Connect parking brake operation draw thread with handle.



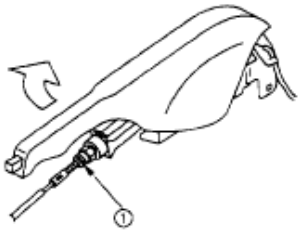
4. Adjustment of parking brake

Adjustment of the clearance of brake drum

Draw back and put down parking brake handle for 3 to 4 times continually.

Dial adjusting bolt with adjusting tool (screwdriver) until brake drum has been locked.

Dial it in opposite direction for 26 gears, at this time, the clearance of brake drum is about 0.6mm.



5. Adjustment of parking brake operation handle

Draw back and put down parking brake operation for several times completely.

2. Unscrew locking nut of draw thread.

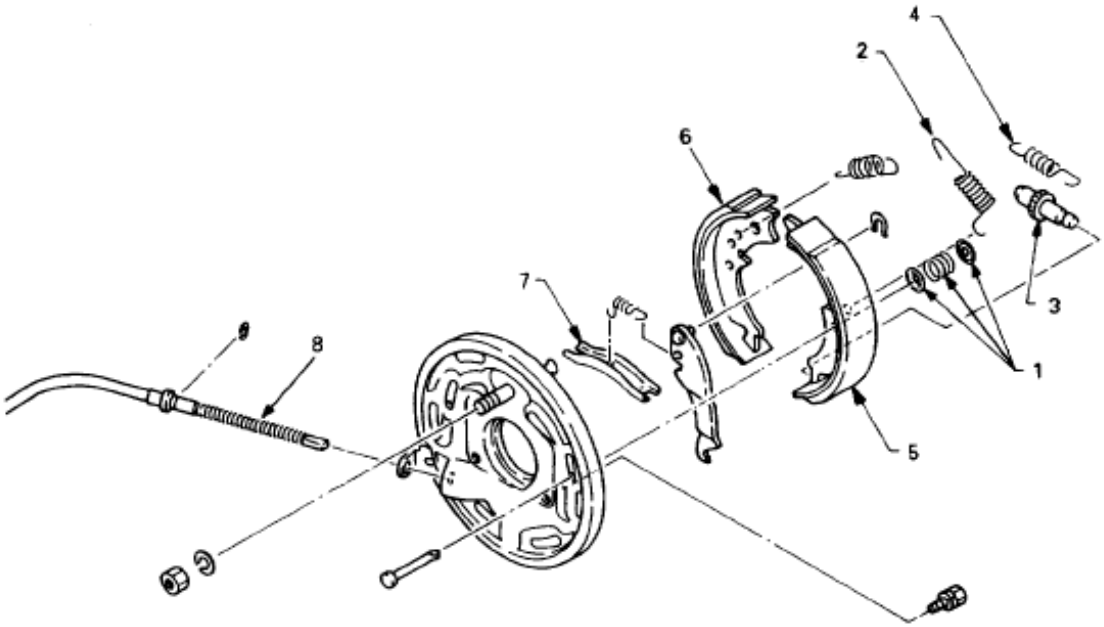
Adjust the adjusting nut to following requirement:

Draw back the handle with 15 kg strength, and move the handle for 5—8 gears.

BRAKE

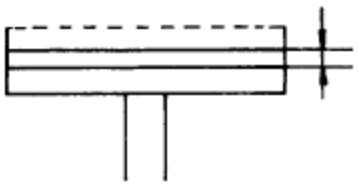
Parking brake

Disassembly



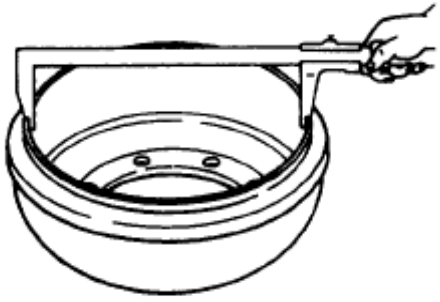
Disassembly sequence

1. Tension rod spring 2. Return spring 3. Adjusting equipment 4. Adjusting spring
5. Second brake hoof and lever assembly 6. Main brake shoe assembly 7. Strut bar
8. Operation draw thread assembly



Measure the thickness of brake liner sheet with vernier.

It the thickness is less than 1 mm, it is necessary to change brake liner sheet assembly.

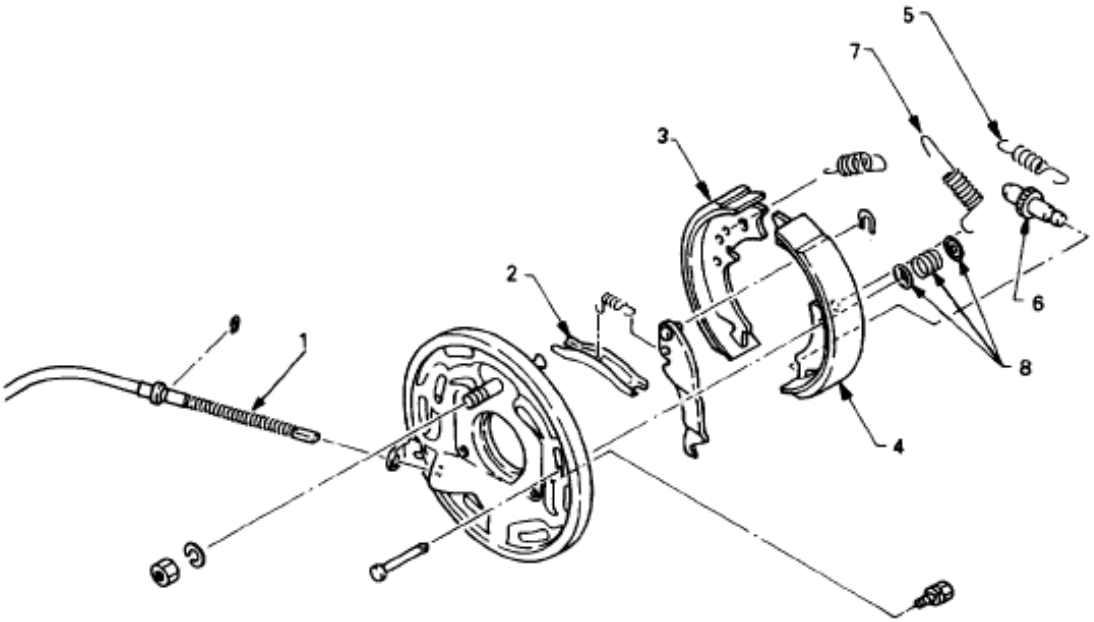


Measure inner diameter of brake drum with vernier.

If inner diameter exceeds 191 mm, it is necessary to change brake drum.

BRAKE

Re-assembly



Re-assembly sequence：

1. Operation draw thread assembly 2. Strut bar 3. Main brake hoof assembly 4. Second brake hoof and lever assembly 5. Adjusting spring 6. Adjusting equipment 7. Return spring 8. Drag rod spring

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Brake and Control System

General

Technical parameters

Tightening torque

Front brake assembly

Rear brake assembly

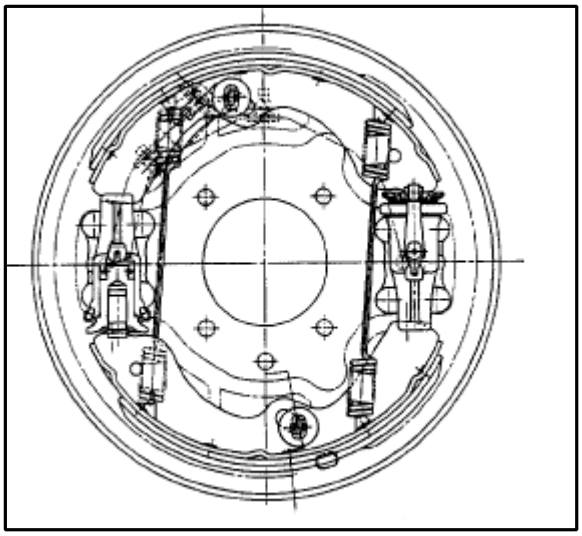
Parking brake assembly

Trouble shooting

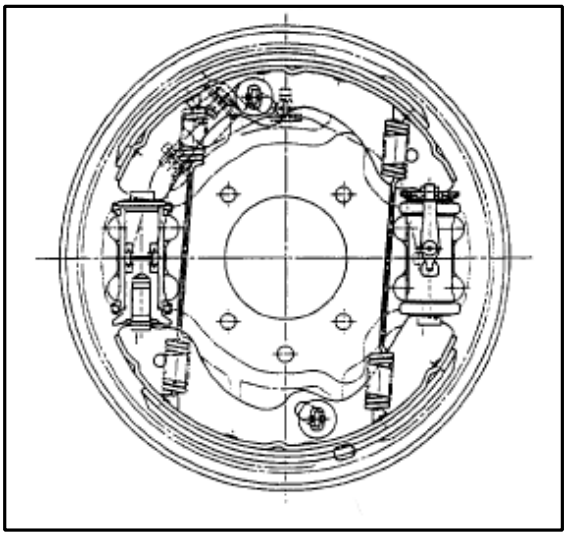
Brake

General

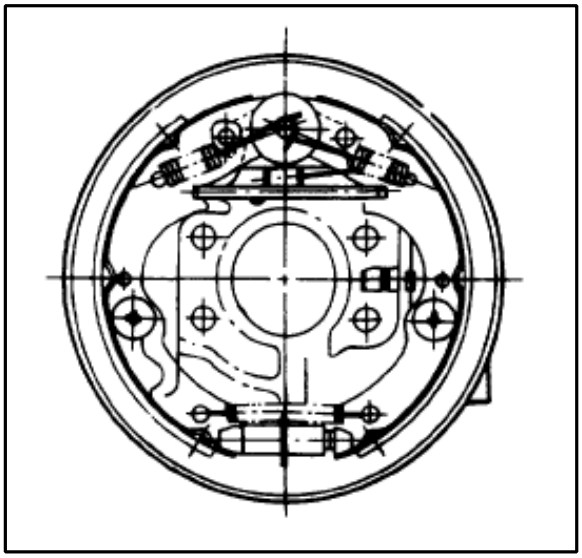
Front brake assembly



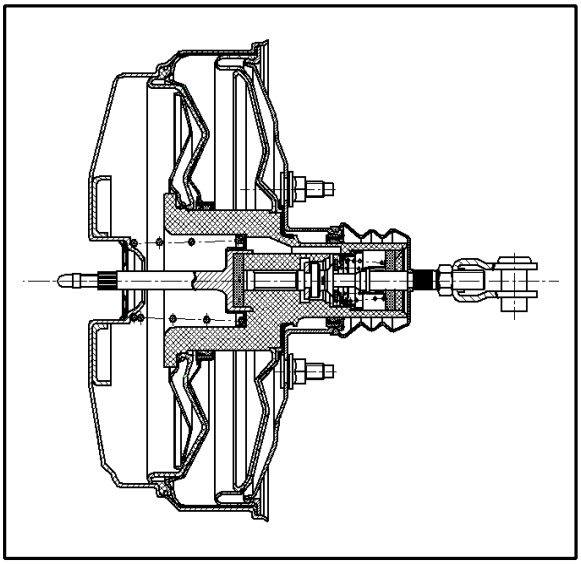
Rear brake assembly



Parking brake

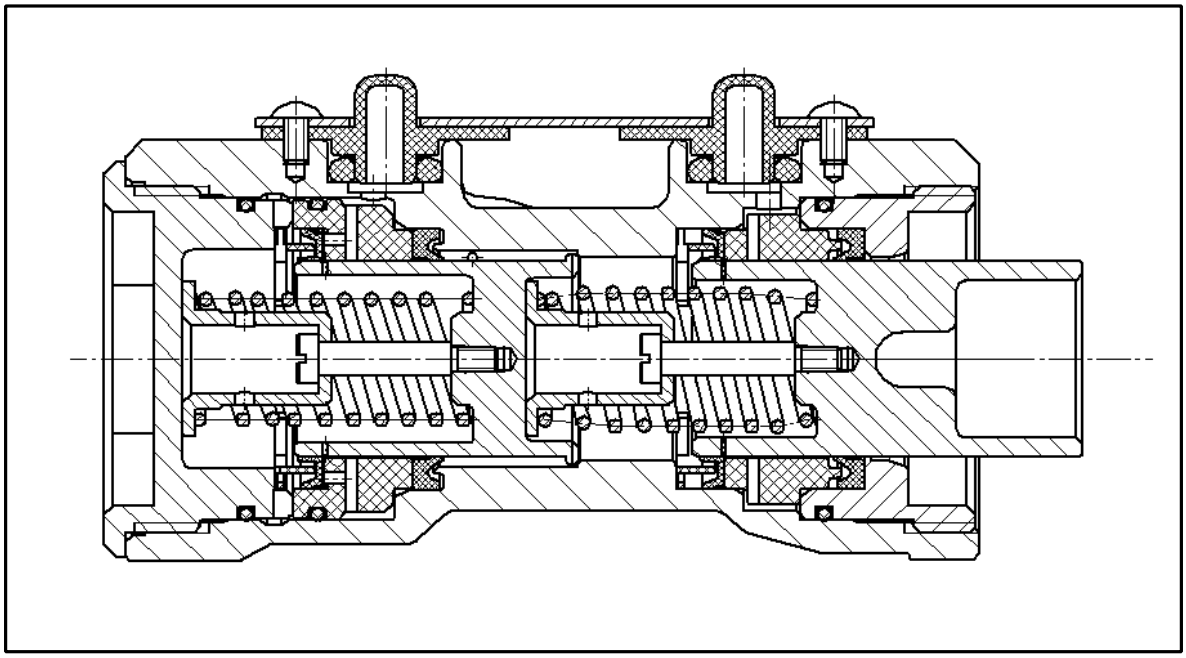


Vacuum booster

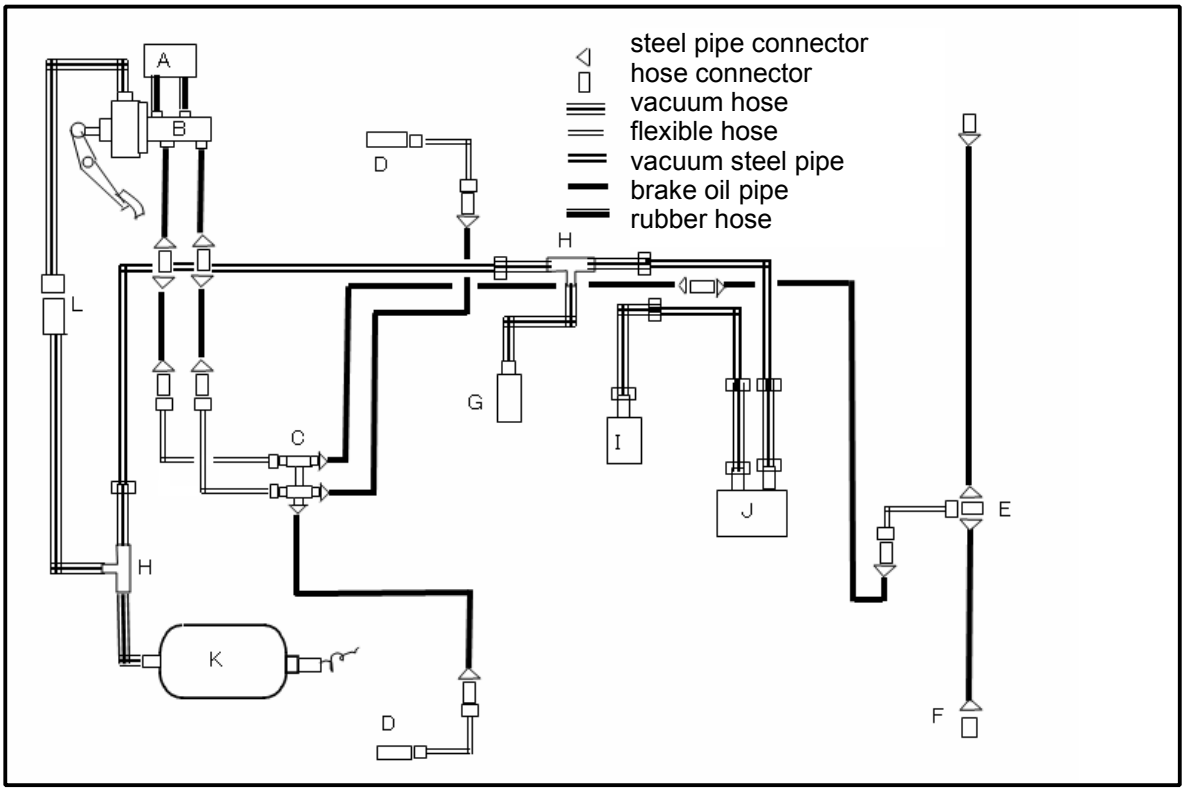


Brake

Brake master cylinder



Brake pipe drawing



A、oil pot；B、vacuum booster, with serial master brake cylinder assembly；C、5-way connector；D、front wheel cylinder；E、oil pipe tee；F、rear wheel cylinder；G. vacuum pump；H、vacuum pipe tee；I、venting aux. brake；J. venting aux. brake solenoid valve；K、vacuum barrel；L、vacuum pipe connecting plate.

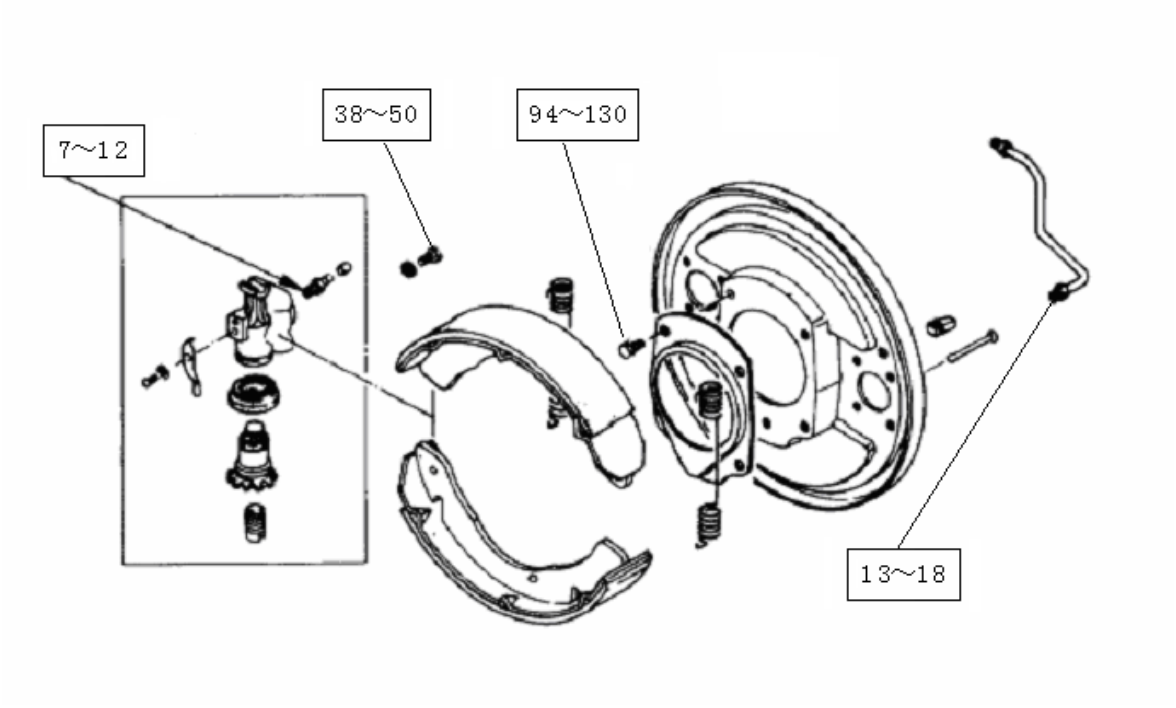
Brake

Brake Specifications

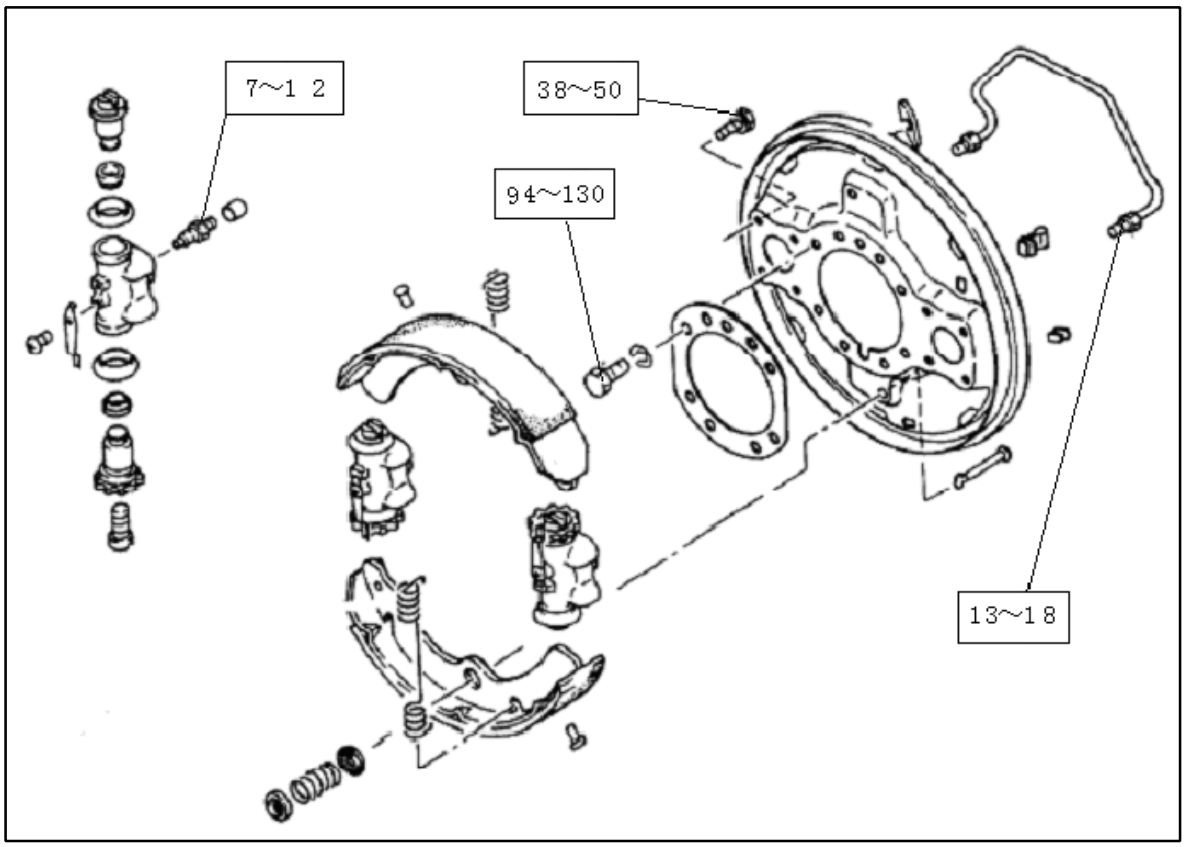
Service brake			
		Front	Rear
Type		Dual leading shoe	Duo duplex shoe
Brake drum ID (mm)		320	320
Friction plate size	Length (mm)	307	307
	Width (mm)	75	75
	Thickness (mm)	8.1	8.1
Brake shoe return spring	Free length (mm)	208.0	208.0
	Design length (mm)	224.0	224.0
	Design load (N)	225~275	225~275
Clearance between friction plate and brake shoe (mm)		Below 0.05 at rivet, below 0.2 at side, below 0.3 at end face	
Brake master cylinder			
ID (mm)		31.75	
Piston stroke（front + rear）(mm)		18+15.5	
Wheel cylinder			
		Front	Rear
ID (mm)		30.16	30.16
Parking brake			
Brake drum	ID (mm)	178	
Friction plate size	Length (mm)	193	
	Width (mm)	35	
	Thickness (mm)	5.0	
Brake shoe return spring	Spring serial No.	First	Second
	Free length (mm)	62	49
	Design length (mm)	70	57
	Design load (N)	108～132	90～110
Vacuum booster			
Diaphragm diameter (mm)		228+203	
Stroke (mm)		35	
Pedal			
Free stroke (mm)		5～8	

Fixed torque (N·m)

Front brake assembly (two leading shoe)



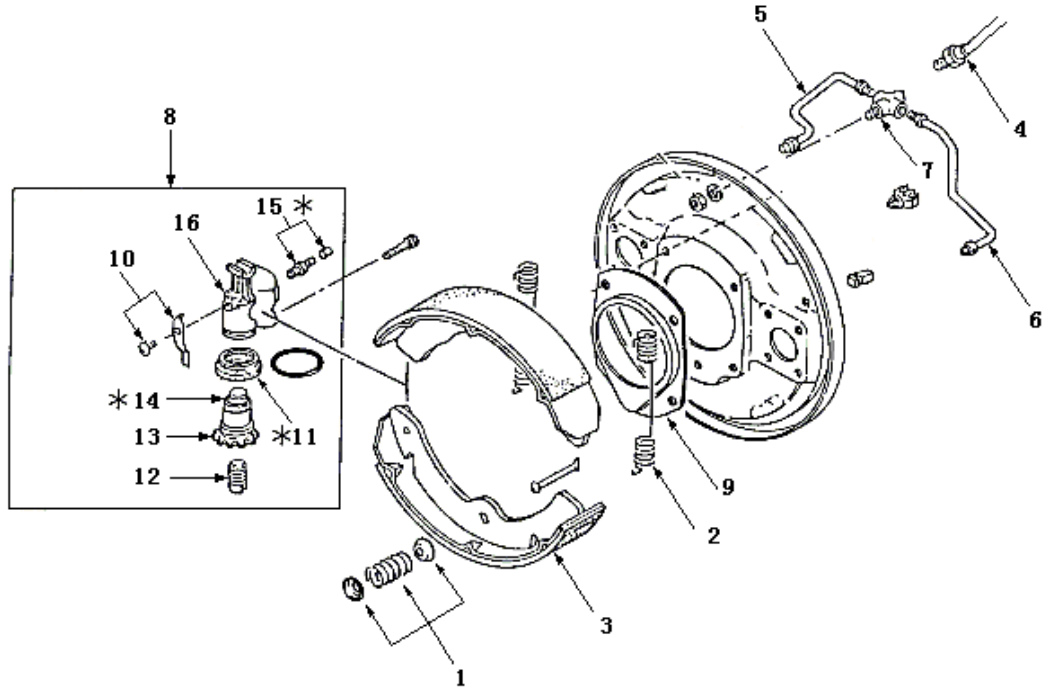
Rear brake assembly (two leading shoe)



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Front brake assembly (two leading shoe)

Disassembling

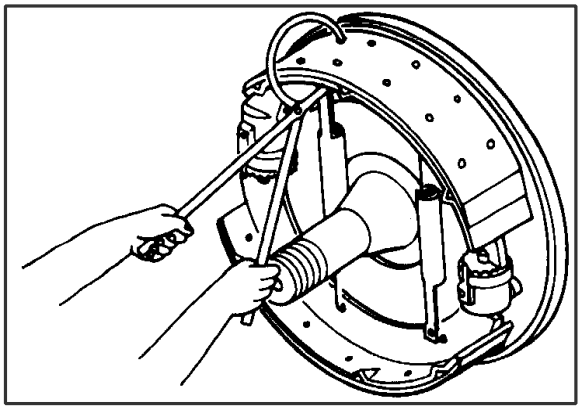


Parts repair: wheel cylinder

Disassembling sequence

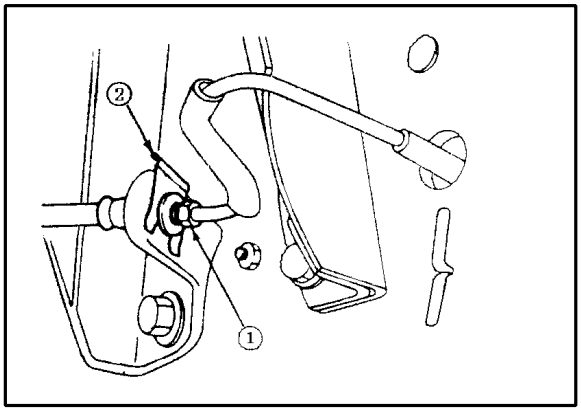
1. brake shoe spring rod, hold down spring and spring holder
2. brake shoe return spring
3. brake shoe assembly
4. brake hose
5. brake connecting pipe
6. brake connecting pipe
7. tee connector assembly
8. wheel cylinder assembly
9. oil cover
10. locking claw
11. shield
12. piston
13. adjusting screw
14. piston cup
15. venting screw and its cover
16. wheel cylinder body

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Important operation

2、Remove the return spring of the brake shoe.



4、Hose

Loosen the connecting nut ①, and take down the clip ② and the hose.

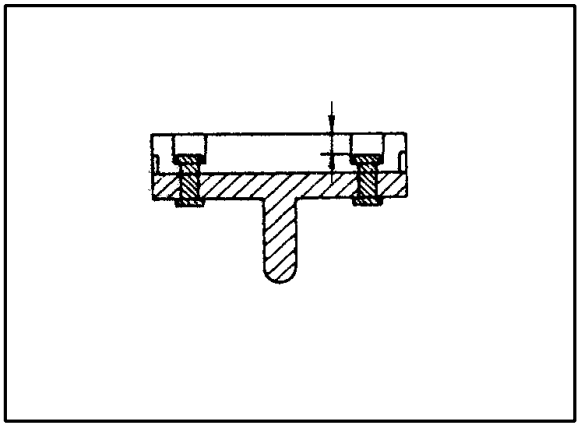
- brake drum
- brake friction plate
- wheel cylinder body
- piston
- piston cup
- return spring

Inspection and repair

Repair or replace the parts if they are found worn out, damaged or with other problems after inspection.

Visual inspection

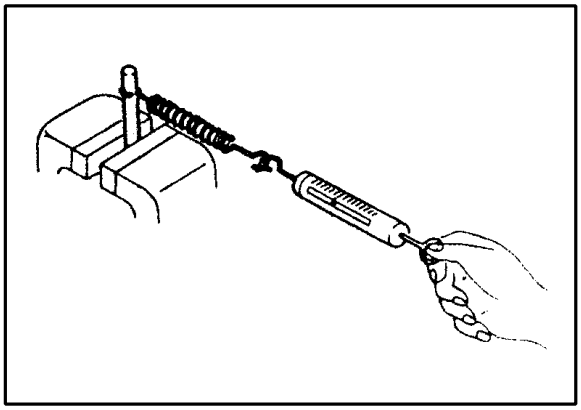
Check the following parts for any abrasion, corrosion, scratches or other problems.



Thickness of brake friction plates

Max. thickness: 1.0mm

Brake

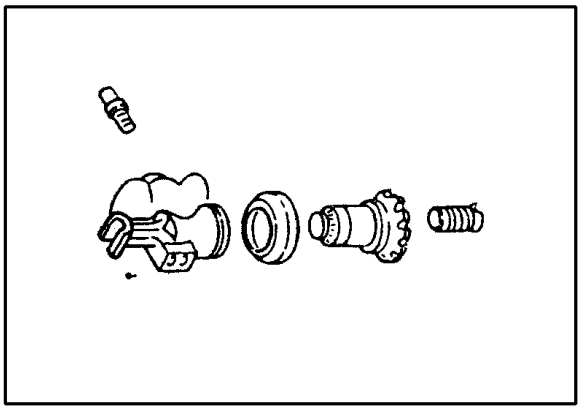


Return spring

Free length: 208.0mm

Design length: 224.0mm

Design load: 225～275N



Washing wheel cylinder parts

The wheel cylinder parts must be washed and with clean brake fluid.

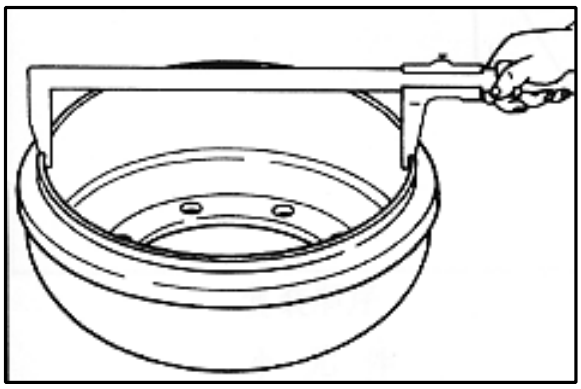
Do not use any mineral based cleaning solution like gasoline, kerosene, and acetone, paint thinner, CO_4, etc.

Piston cup

Check the piston cup for any abrasion, deformation, damage or other problems.

Clearance between wheel cylinder and piston

Max: 0.15mm.



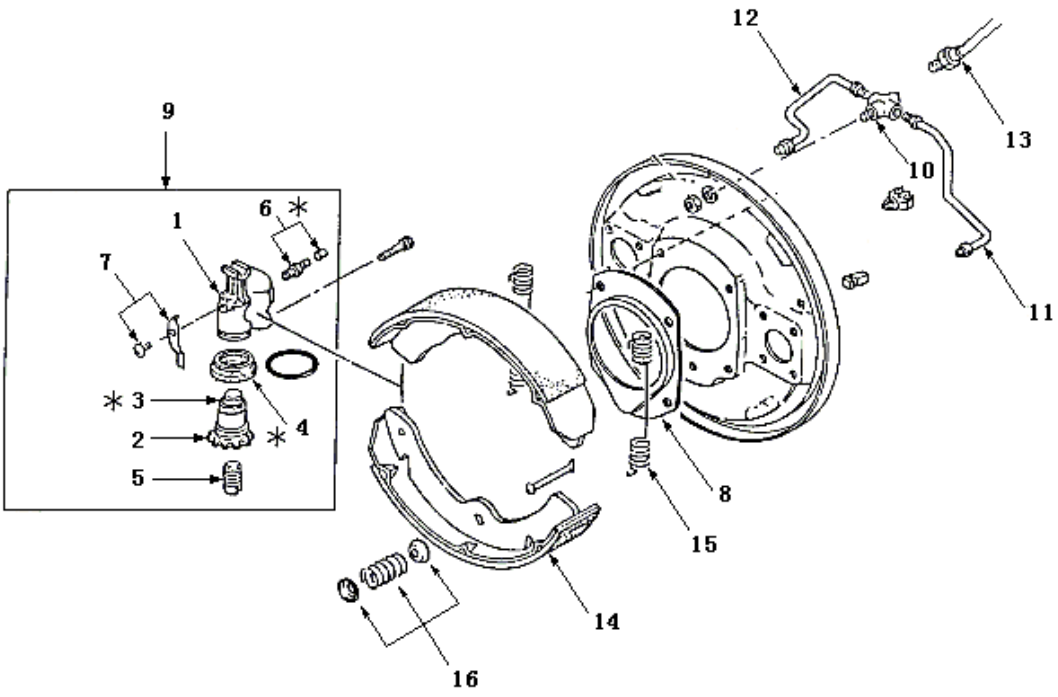
Brake drum

mm

	Standard	Maximum
ID	320	321.5
Out-of-roundness	≤0.13	

Brake

Reassembling

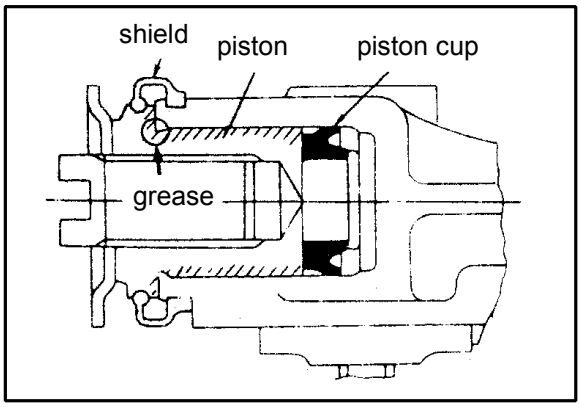


Parts repair: wheel cylinder

Reassembling sequence

1. wheel cylinder body
2. piston brake shoe
3. piston cup
4. shield
5. adjusting screw
6. venting screw and its cover
7. locking claw
8. oil cover
9. whell cylinder assembly
10. tee connector assembly
11. brake connecting pipe
12. brake connecting pipe
13. brake hose
14. brake shoe assembly
15. return spring
16. brake shoe spring rod, hold down spring and its holder

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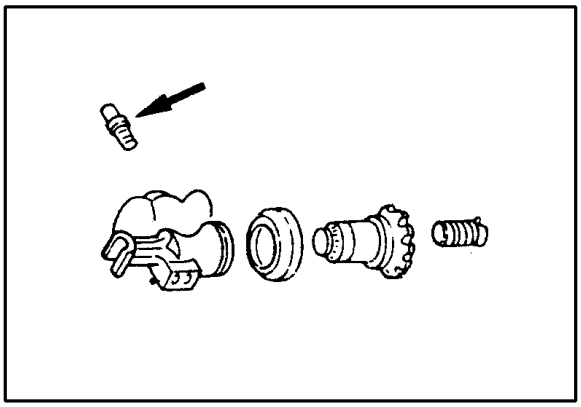
Important operation

3. Piston cup

When fixing the piston cup, have its butterfly side facing the cylinder. First, apply clean brake fluid to the piston cup, take care not to damage the cup lip. Apply rubber grease to the piston shoulder.

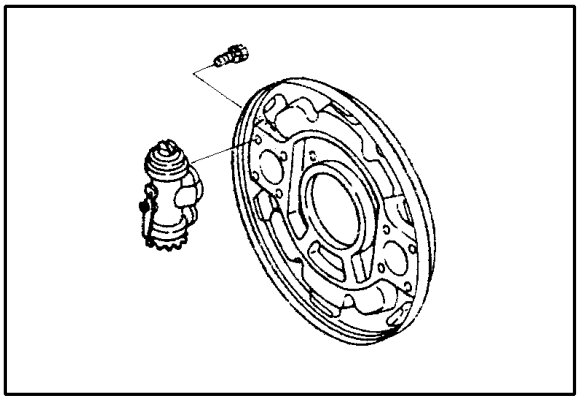
4. Shield

To prevent water entry, apply clean brake fluid to the shield inner surface.



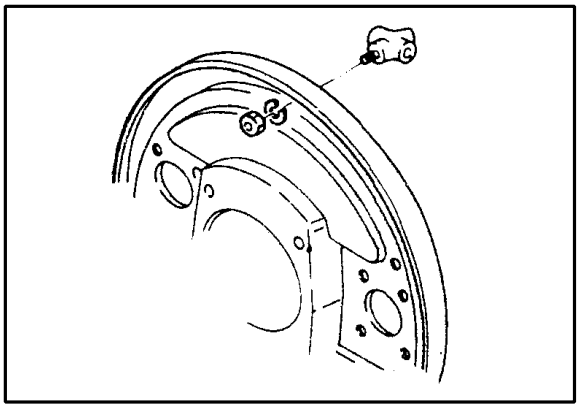
6. Venting screw

Tightening torque：7～12N·m



9. Wheel cylinder assembly

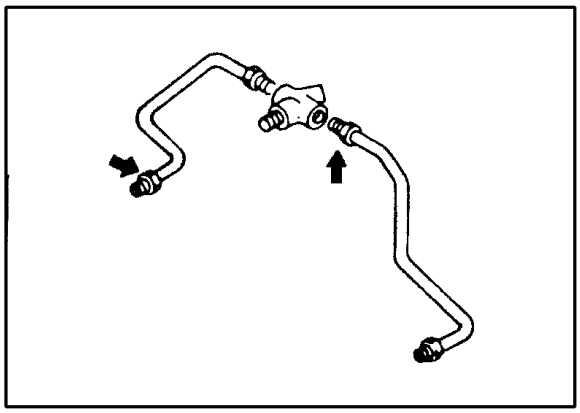
Tightening torque：38～50N·m



10. Tee connector assembly

Tightening torque：14～23N·m

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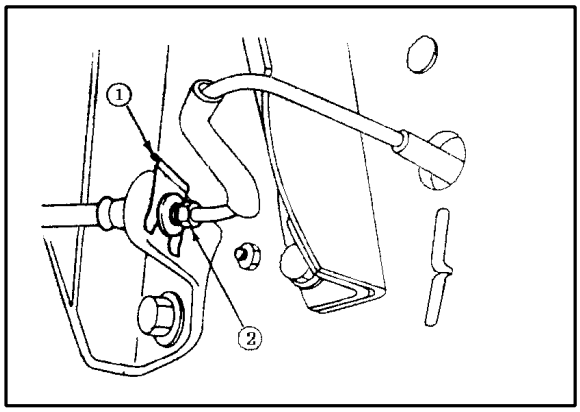


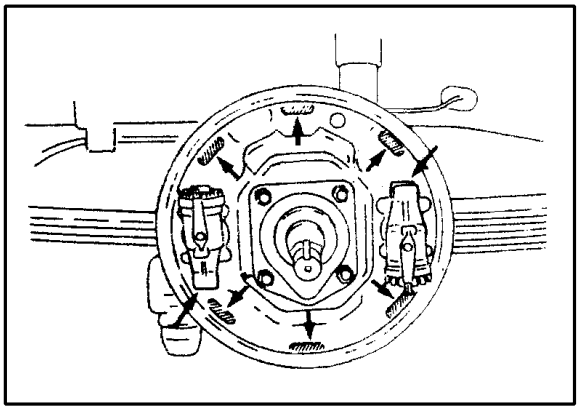
11,12. Tee connector assembly

Tightening torque：13～19N·m

13. Hose

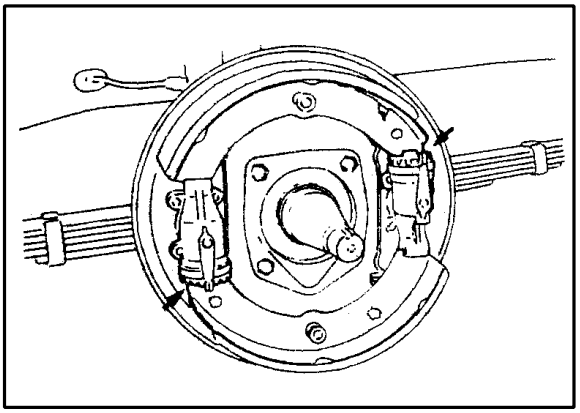
Fix the hose clip ① on the bracket, and tighten the connecting nut②.





14. Brake shoe

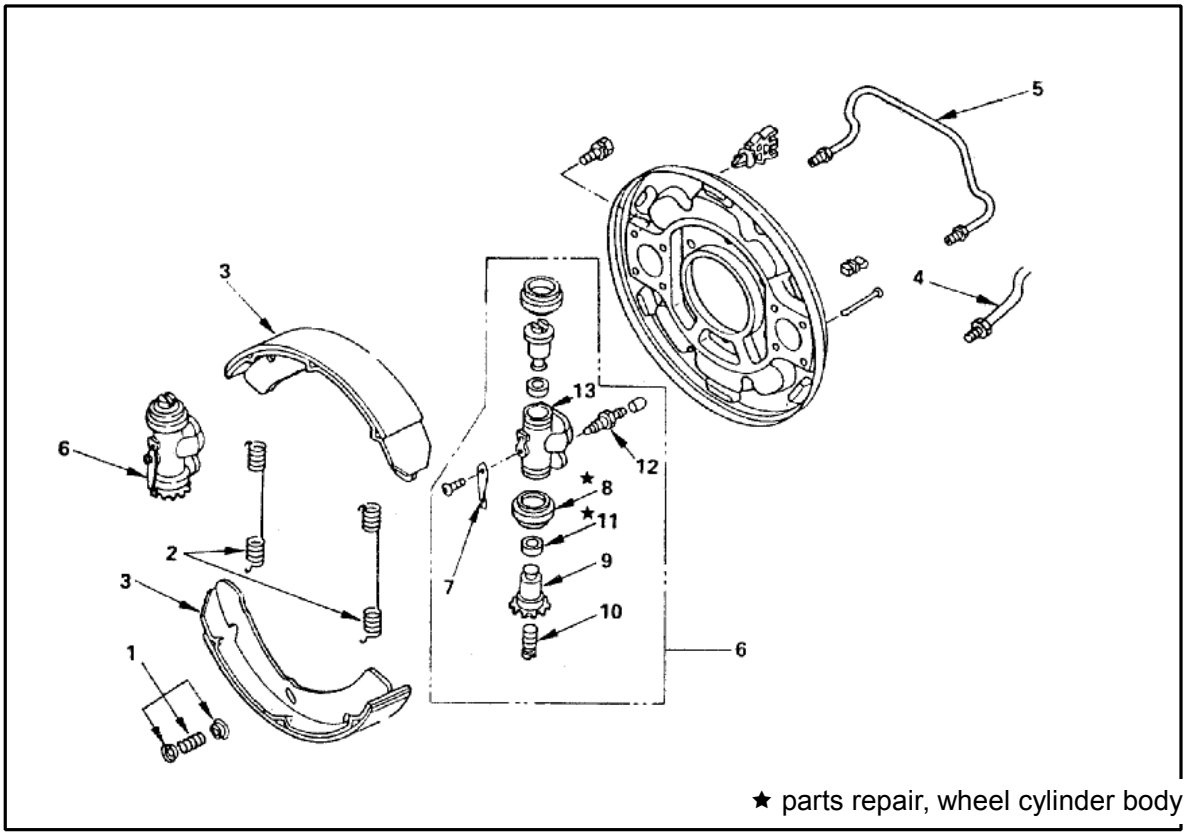
Apply a thin layer of heat resistance grease to the brake shoe, wheel cylinder and the inner surface of the back plate.



When fixing the brake shoes, have their tip sides facing the wheel cylinder and the adjuster.

Rear brake assembly (two leading show)

Disassembling



★ parts repair, wheel cylinder body

Disassembling sequence

1. brake shoe spring rod, hold down spring and spring holder
2. brake shoe return spring
3. brake shoe assembly
4. brake connecting pipe
5. brake connecting pipe
6. wheel cylinder assembly
7. locking claw
8. shield
9. piston
10. adjusting screw
11. piston cup
12. venting screw and its cover
13. wheel cylinder body

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Inspection and repair

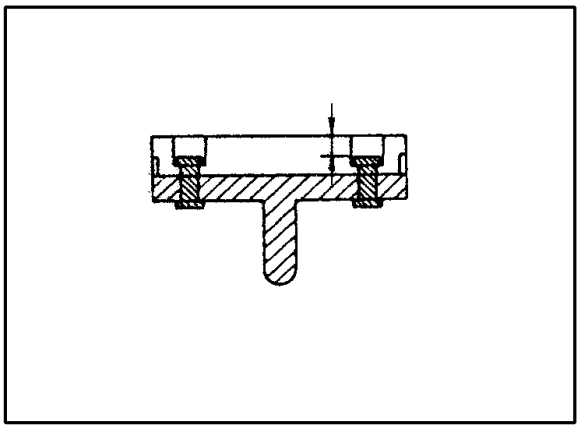
Repair or replace the parts if they are found worn out, damaged or with other problems after check.

- brake drum
- brake friction plate
- wheel cylinder body
- piston
- piston cup
- return spring

Visual inspection

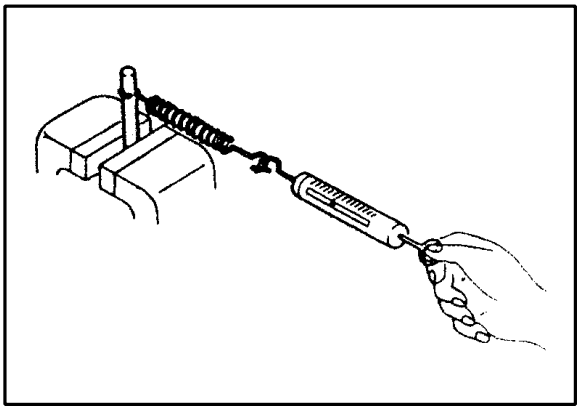
Check the following parts for any abrasion, corrosion, scratches or other problems.

,



Thickness of brake shoe friction plate

Max. thickness: 1.0mm



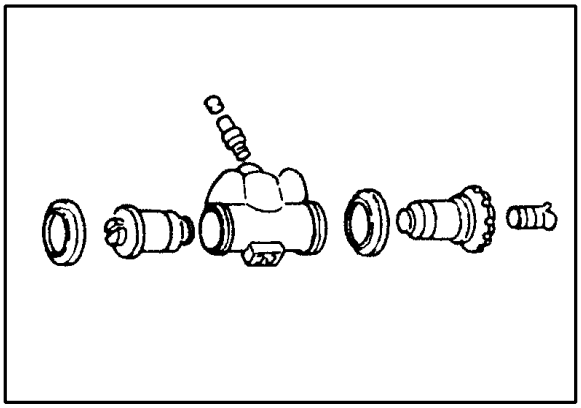
Return spring

Free length：208.0mm

Design length：224.0mm

Design load：225～275N

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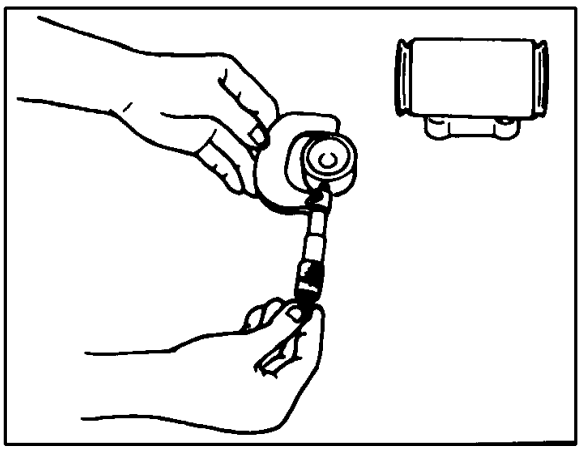
Washing wheel cylinder parts

The wheel cylinder parts must be washed and with clean brake fluid.

Do not use any mineral based cleaning solution like gasoline, kerosene, and acetone, paint thinner, CO_4, etc.

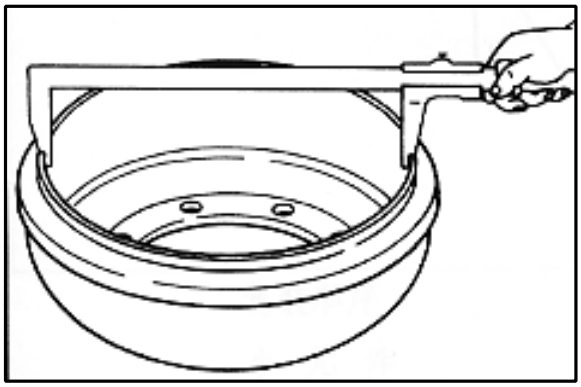
Piston cup

Check the piston cup for any abrasion, deformation, damage or other problems.



Clearance between wheel cylinder and piston

Max: 0.15mm.



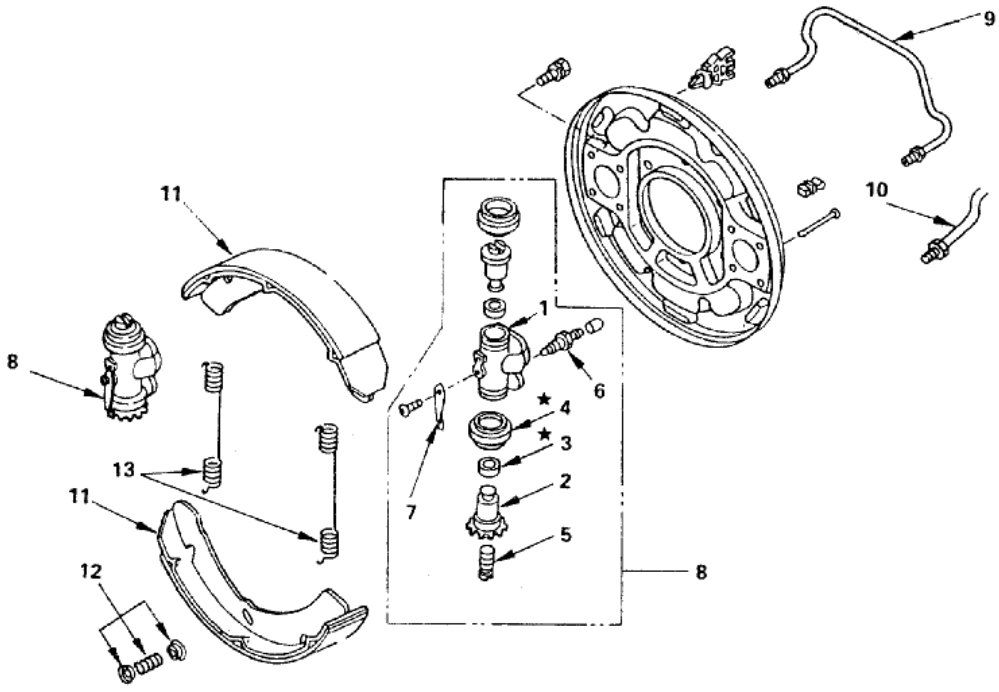
Brake drum

mm

	Standard	Limits
ID	320	321.5
Out-of-roundness	≤0.13	

Brake

Reassembling

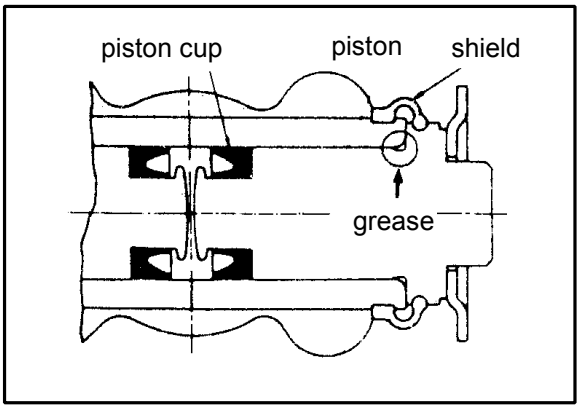


★ parts repair, wheel cylinder body

Reassembling sequence

1. wheel cylinder body
2. piston
3. .piston cup
4. shield
5. adjusting screw brake connecting pipe
6. venting screw and its cover
7. locking claw
8. wheel cylinder assembly
9. piston brake connecting pipe
10. brake connecting pipe
11 brake shoe assembly
12. brake shoe spring rod, hold down spring and spring holder
13. brake shoe return spring

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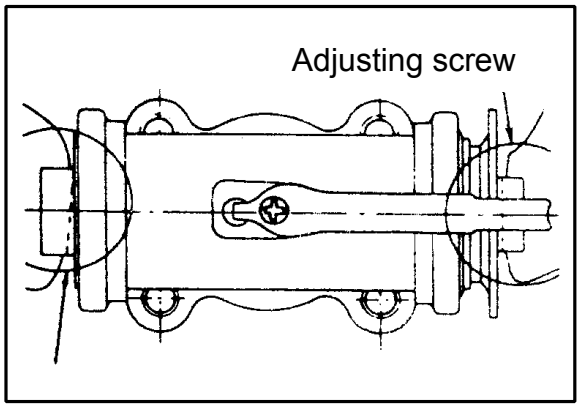
Important operation

3. Piston cup

When fixing the piston cup, have its butterfly side facing the cylinder. First, apply clean brake fluid to the piston cup, then insert the cup. Take care not to damage the cup lip. Apply rubber grease to the piston shoulder.

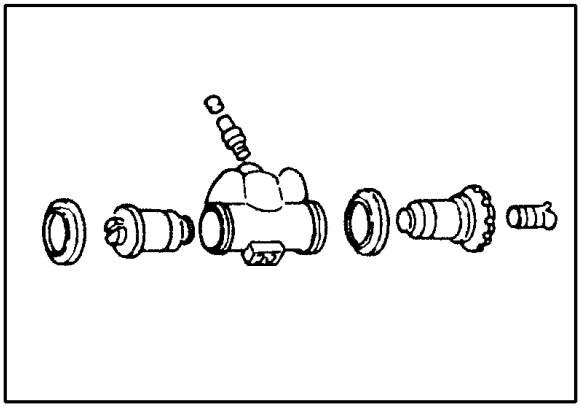
4. Shield

To prevent water entry, apply clean brake fluid to the shield inner surface.



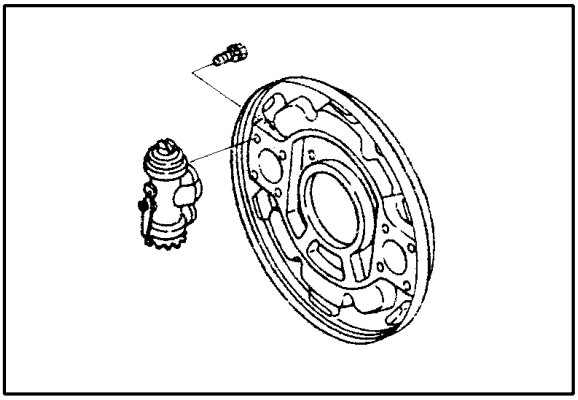
5.Adjusting screw

When fixing the wheel cylinder adjuster, have the shallow slot side face the outside.



6 Venting screw

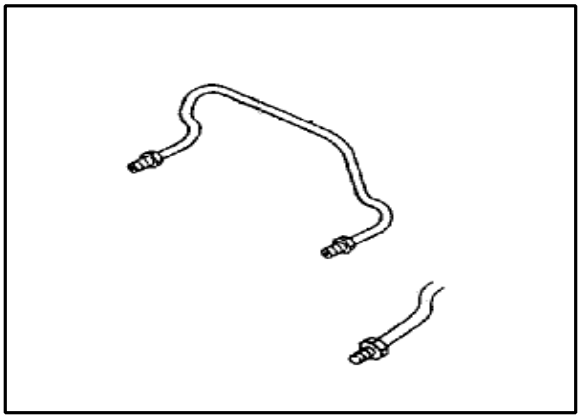
Tightening torque 7～12N·m



9. Wheel cylinder assembly

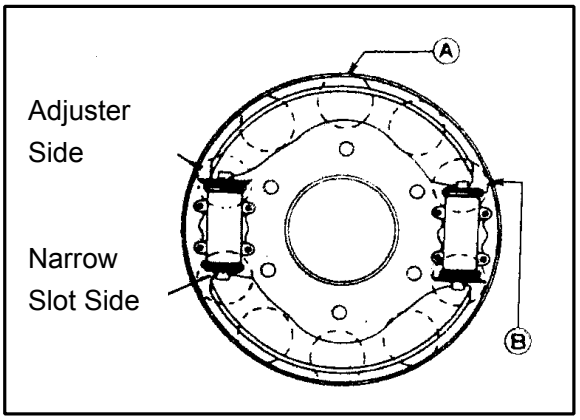
Tightening torque：38～50N·m

https://truckmanualshub.com/



9, 10. Brake connecting pipe

Tightening torque：13～19N·m



11. Brake shoe

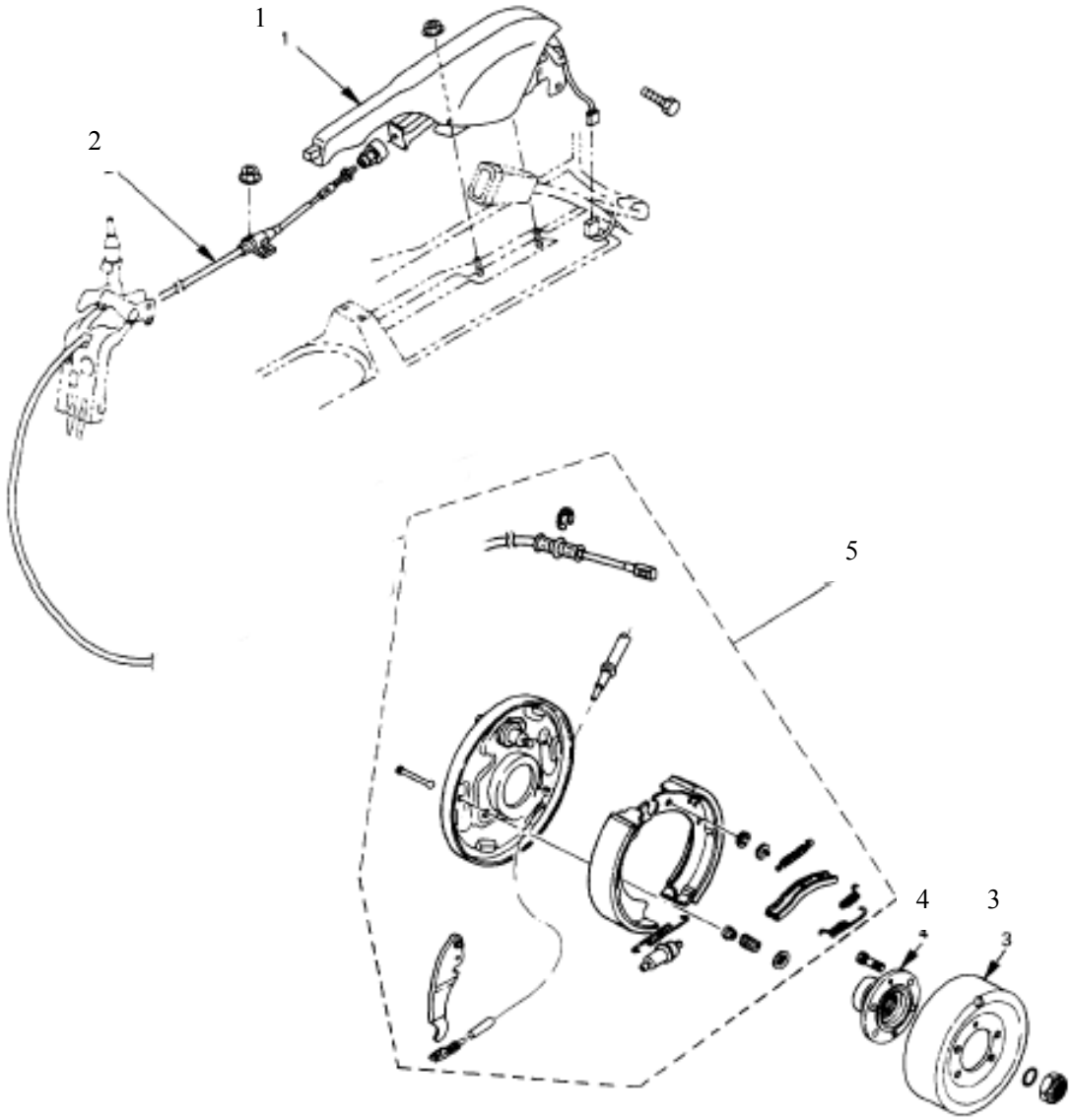
Apply a thin layer of heat resistant grease to the back plate A between the brake shoe and wheel cylinder as well as the inner part B.

When fixing the brake shoes, have the tips face the wheel cylinder and adjuster.

Brake

Parking brake

Disassembling

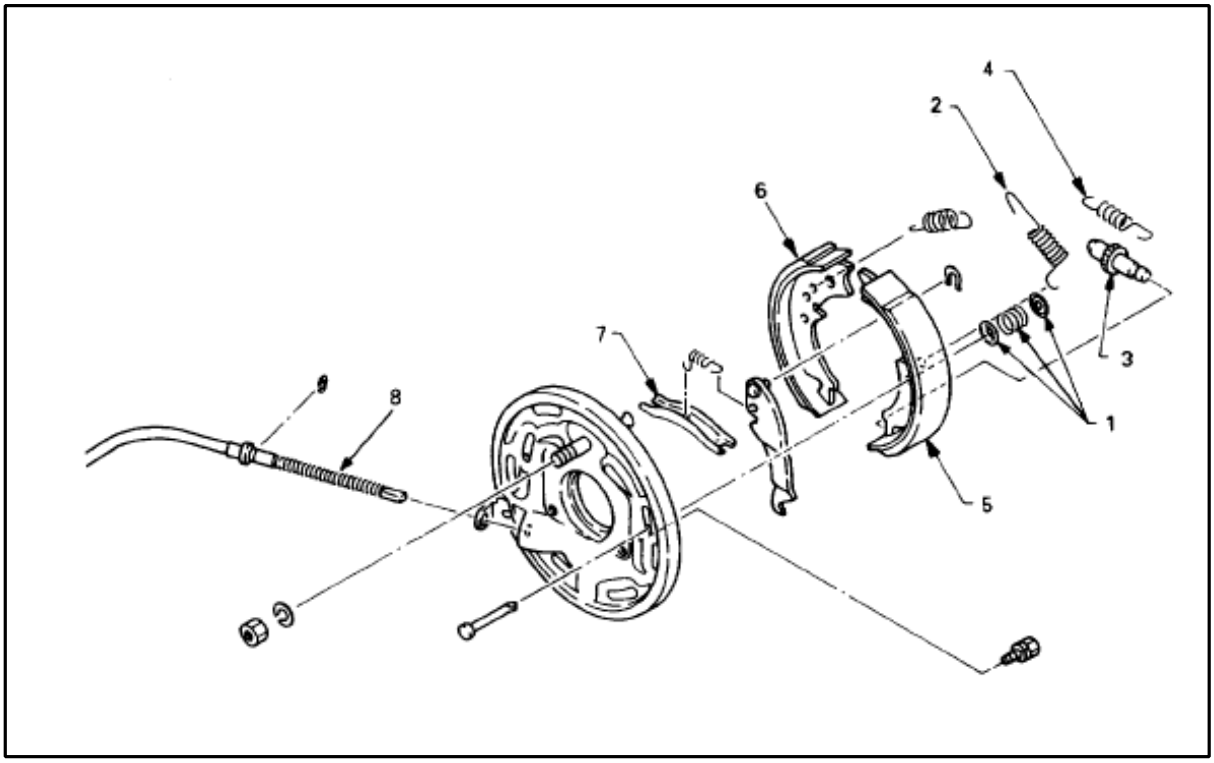


Disassembling sequence

1. Parking brake handle 2. Parking brake control cable 3. Parking brake drum
4. Flange 5. Parking brake

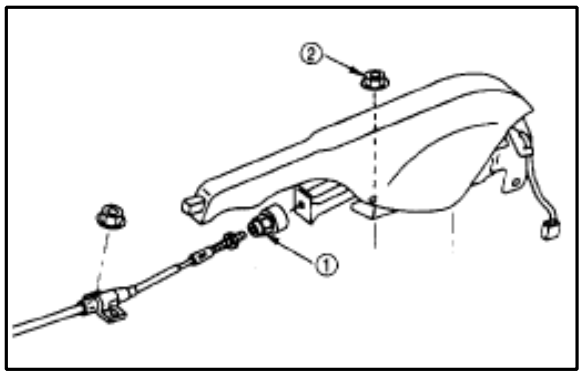
Parking brake

Disassembling



Disassembling sequence

1. pull-rod spring 2. return spring 3. adjuster 4 adjusting spring 5. 2nd brake shoe and lever assembly 6. 1st brake shoe assembly 7. hold down rod 8. control cable assembly



Disassembling steps

Loosen the adjusting nut①, and remove the control cable from the handle.

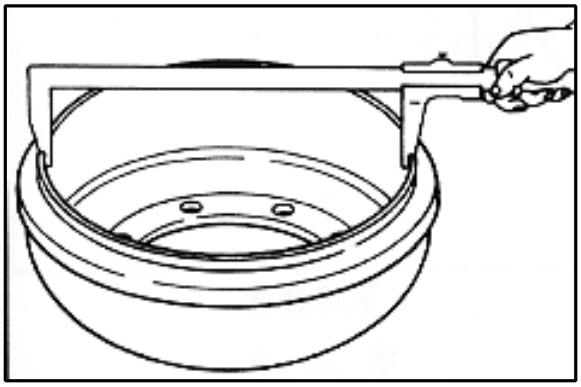
Loosen the nut② before removing the handle.

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Inspection and repair

Repair or replace the parts if they are found worn out, damaged or with other problems after check.

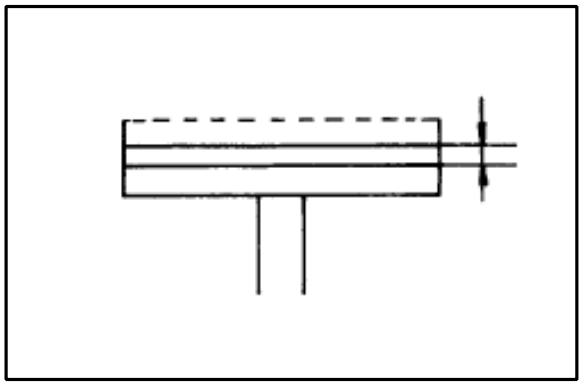
- brake drum
- brake friction plate
- return spring
- strut
- control cable
- control handle



Brake drum

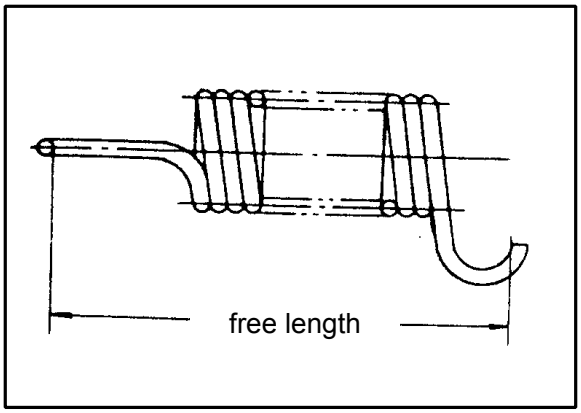
mm

	Standard	Limit
ID	178	179
Out-of-roundness	≤0.13	



Thickness of brake friction plates

Measure the thickness of brake lining by a vernier caliper. If it is less than 1mm thick, the brake shoe assembly should be changed.



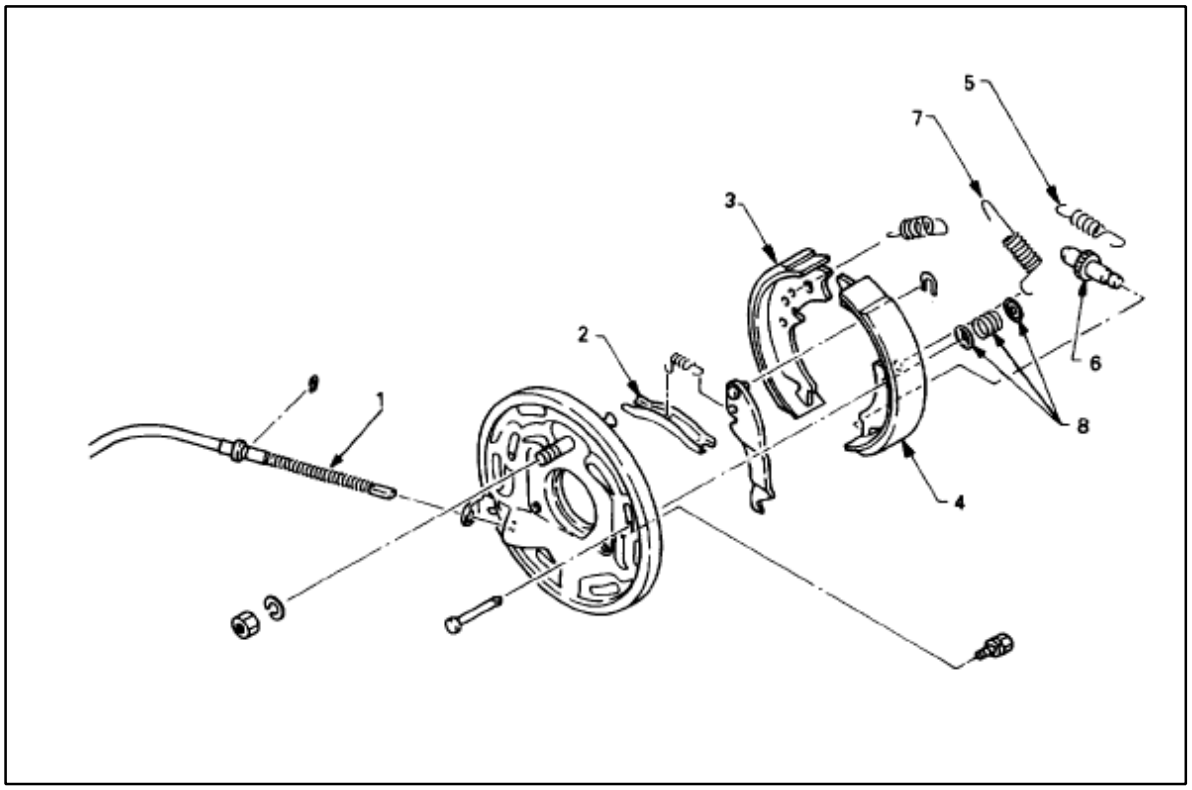
Return spring

Free length：62.1mm

Design length：66.9mm

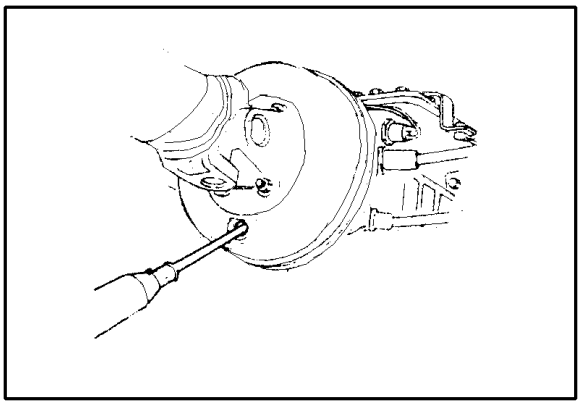
Design load：54～66N

Reassembling



Reassembling sequence

1. control cable assembly 2. push rod 3. 1st brake shoe assembly 4.2nd brake shoe and lever assembly 5. adjusting spring 6. adjuster 7. return spring 8. pull-rod spring



Adjustment of parking brake

Brake friction plate adjustment

Move the adjuster upward with a screw driver, until the brake drum is locked. And then move the adjuster back for about 25 notches. The clearance between the brake drum and friction plates is about 0.5mm by now.

Adjustment of the parking brake handle travel

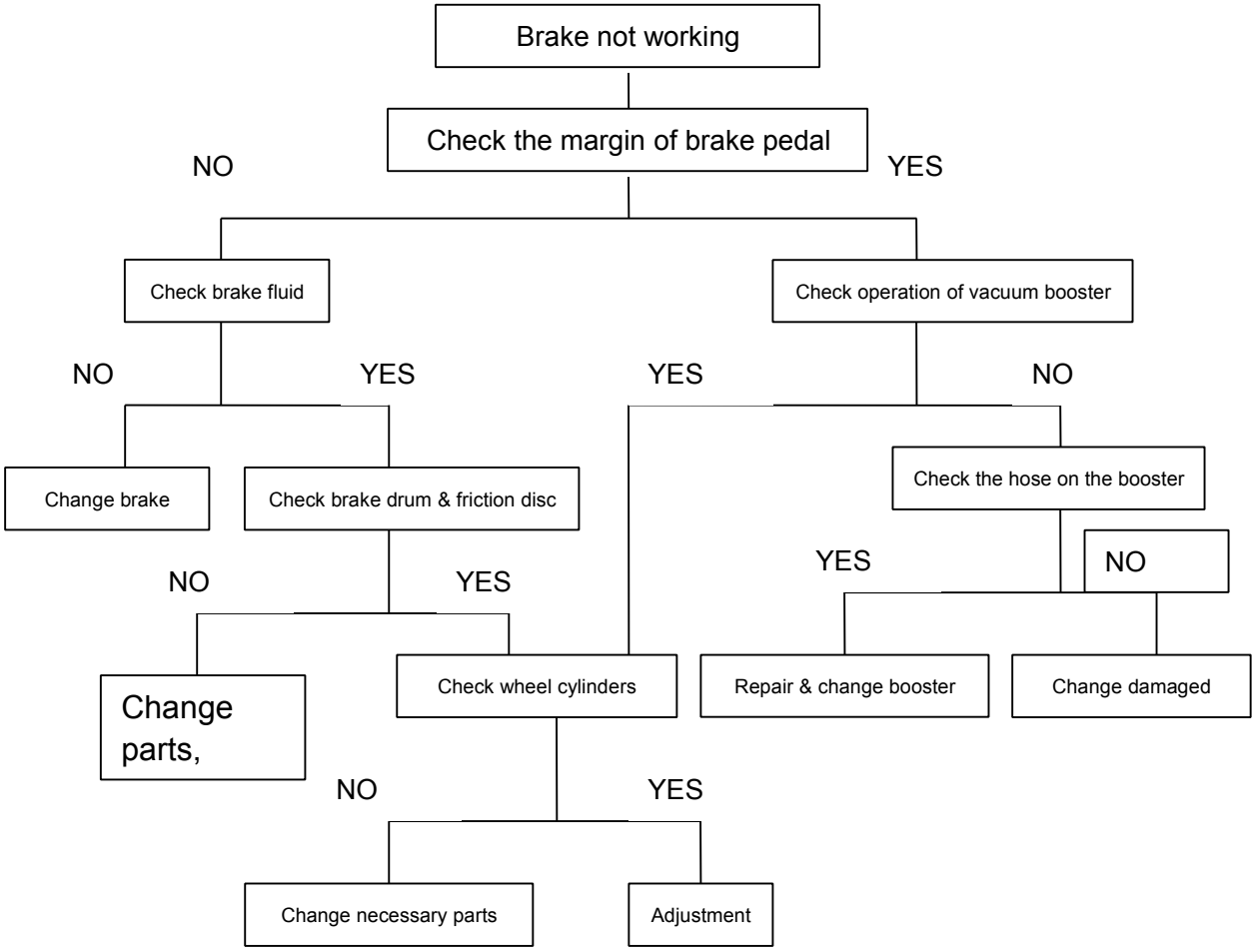
Pull up the parking brake handle to the end，count the number of the gears in the brake lever. If the parking brake handle is pulled with a force of 300N, its travel covers 9 to 14 notches. Adjust the parking brake if necessary.

Before adjustment of the parking brake, make sure that the clearance of the rear brake shoe is already adjusted.

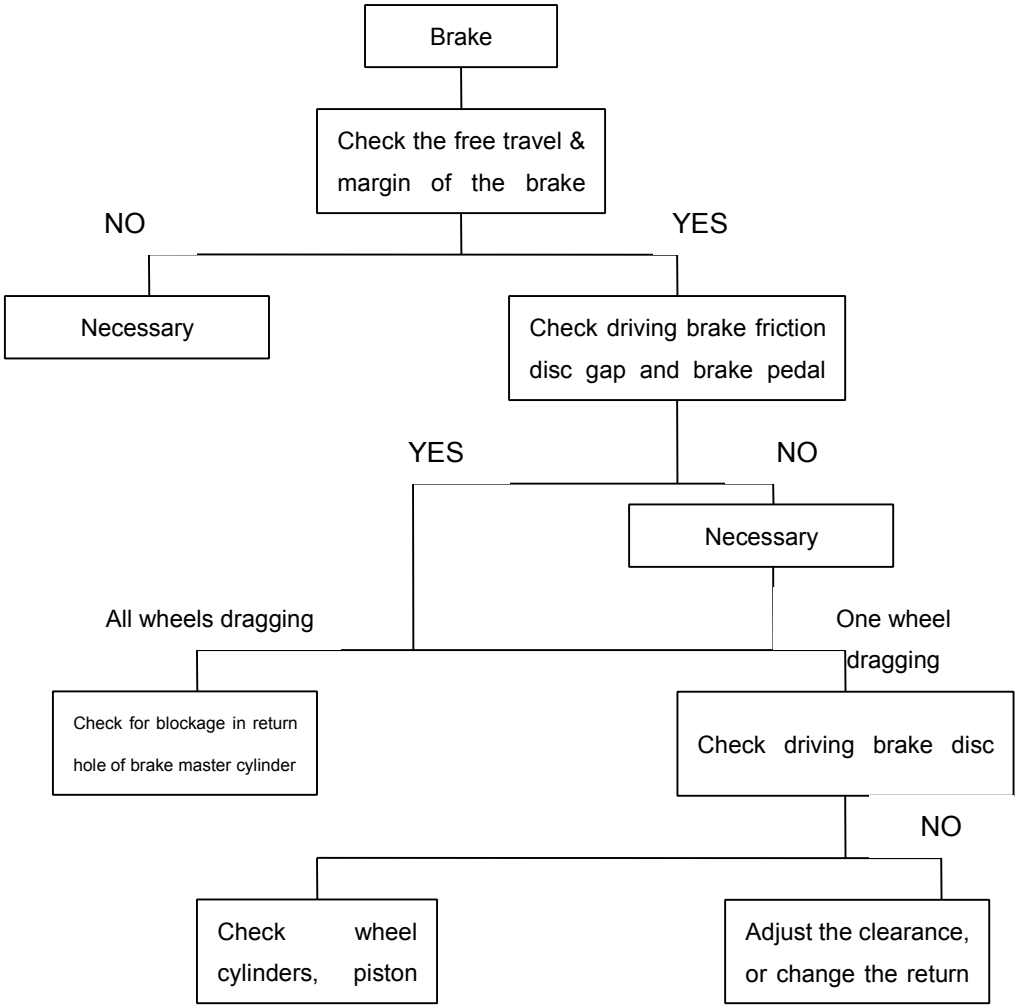
1. Loosen the locknut, rotate the adjuster to adjust the travel distance.

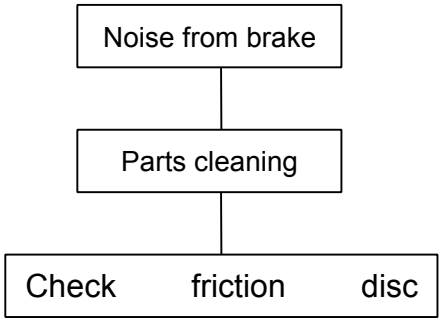
2. Tighten the locknut.

Trouble shooting

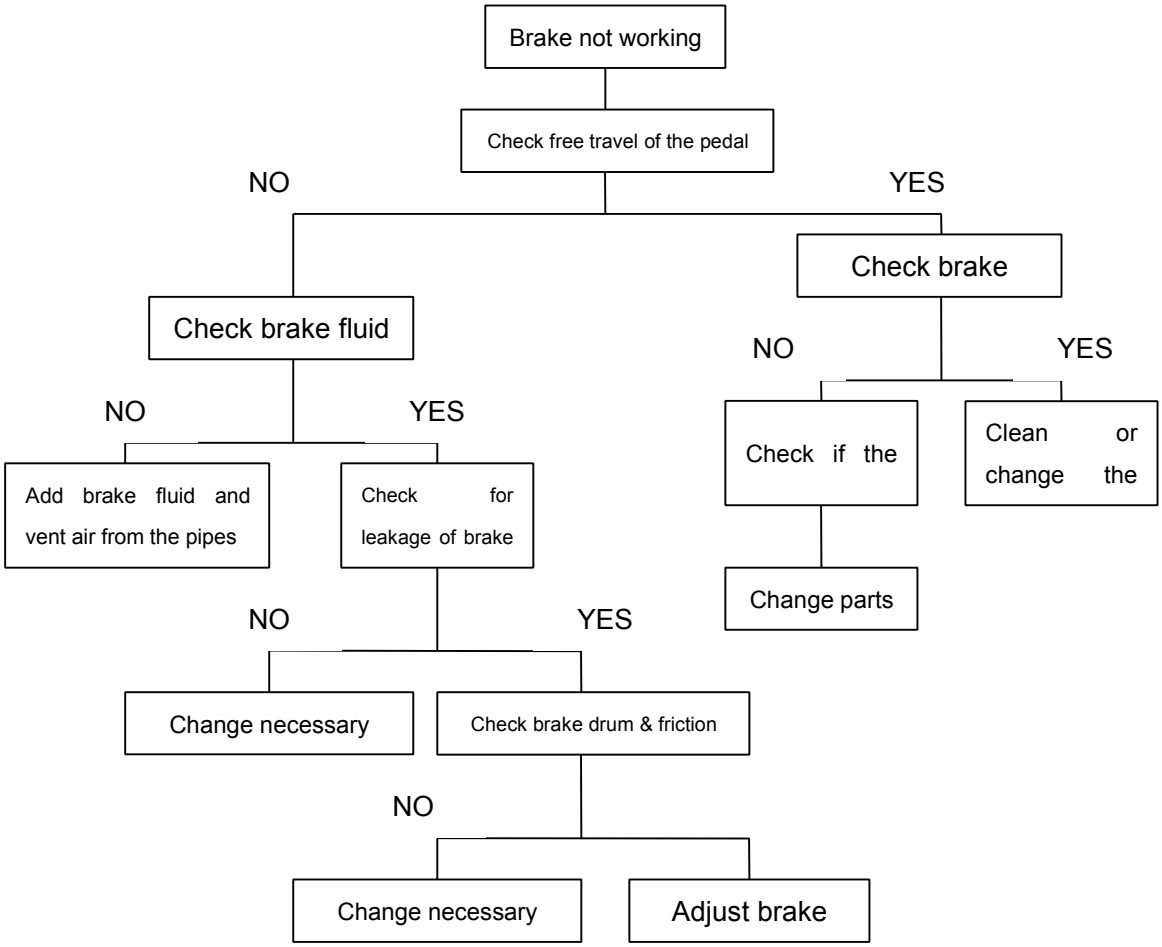


Brake

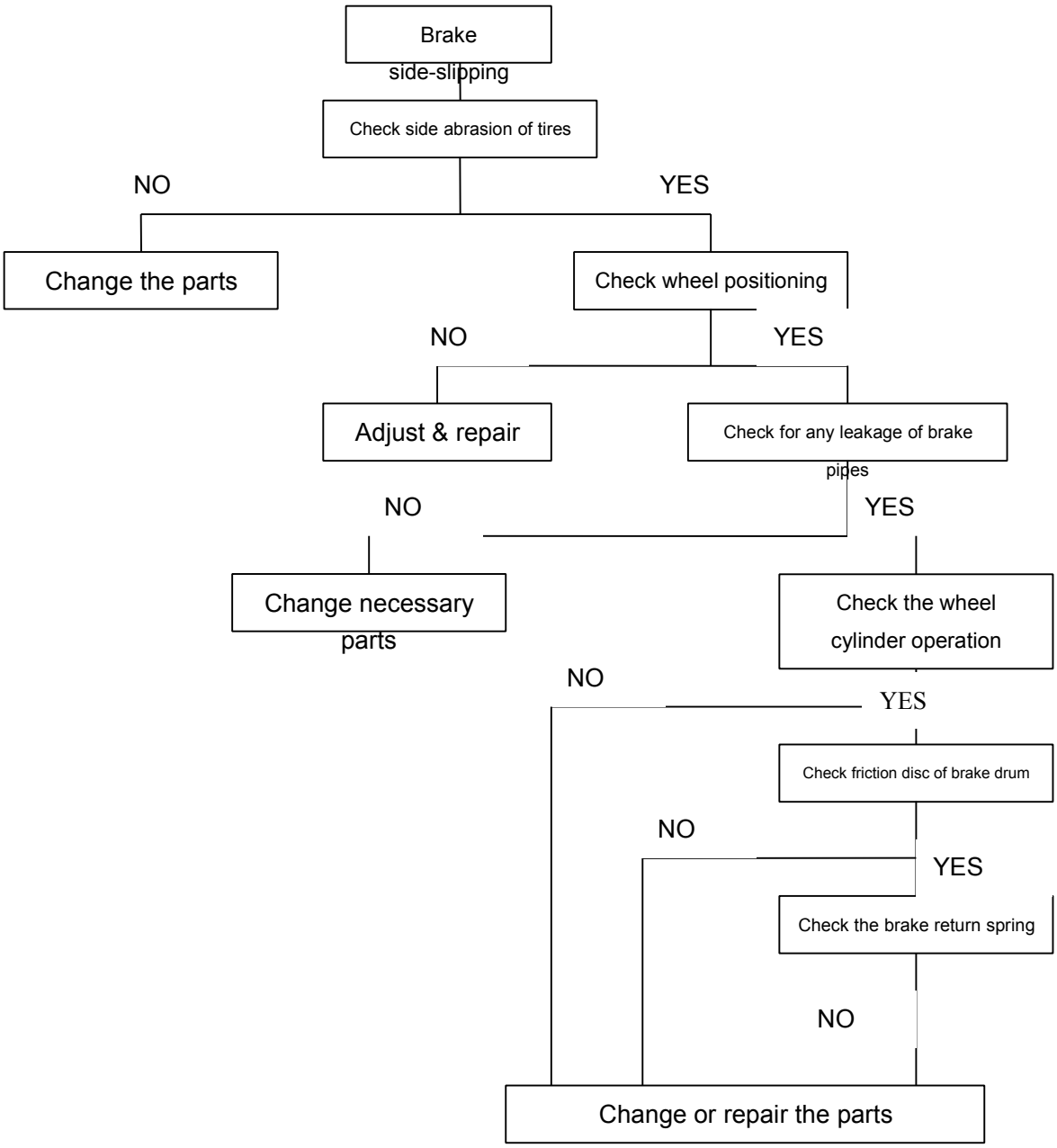

Brake
Check the free travel & margin of the brake
NO
YES
Necessary
Check driving brake friction disc gap and brake pedal
YES
NO
Necessary
All wheels dragging
One wheel dragging
Check for blockage in return hole of brake master cylinder
Check driving brake disc
NO
Check wheel cylinders, piston
Adjust the clearance, or change the return


Noise from brake
Parts cleaning
Check friction disc

Brake


Brake not working
Check free travel of the pedal
NO
YES
Check brake fluid
Check brake
NO
YES
NO
YES
Add brake fluid and vent air from the pipes
Check for leakage of brake
Check if the
Clean or change the
Change parts
NO
YES
Change necessary
Check brake drum & friction
NO
Change necessary
Adjust brake

Brake


Brake side-slipping
Check side abrasion of tires
NO
YES
Change the parts
Check wheel positioning
NO
YES
Adjust & repair
Check for any leakage of brake pipes
NO
YES
Change necessary parts
Check the wheel cylinder operation
NO
YES
Check friction disc of brake drum
NO
YES
Check the brake return spring
NO
Change or repair the parts

Electrical System

General

I . Operation table

II. Electric diagram identification

1. Wire code identification:

2 . Electrical component identification:

III .Electrical designations and usages of the complete vehicle

1. Battery

2. Starter

3. Generator

4. Speed sensor

5. Electric preheating

6. Fuel cutoff solenoid valve

7. Wiper

8 .Washer

9. Headlamp

10 .Front small lamp

11. License lamp

12. Direction signal lamp and hazard warning lamp

13. Rear combination lamp

14 .Reversing lamp and switch

15. Interior lamp and switch 150

16. Brake lamp and switch

17. Parking brake lamp and switch

18 Fog lamp and switch

19. Electric horn

20. Vacuum alarm

21 .Various relays

22 .Combined switches

23. Combined instrument

24 .CD player

25. Idle speed boost device

26. Exhaust brake controller

27. Electrical device

General

I . Operation table

		12 V
Battery		
Instrument	Speedometer	B
	Thermometer	B
	Fuel meter	B
Headlamp	Two abnormal shape crystal headlamps	B
Fog lamp		B
Illuminator	Speedometer	B
	Thermometer	B
	Fuel meter	B
	Meter board	B
Indicator and caution lamp	Direction indicator and hazard lamp	B
	Far beam indicator	B
	Parking brake indicator	B
	Brake liquid level indicator	B
	Heating plug indicator	B
	Oil pressure indicator	B
	Exhaust brake indicator	B
	Water separator indicator	B
Brake lamp and reversing lamp		B
Interior lamp	Three level lamp changes	B
	Intermittent wiper	B
Cigarette lighter		B
Horn		B
CD player and stereo radio cassette player		B
Buzzer	Vacuum warning buzzer	B
Warm air and air conditioner		B
Manually-operated door and window		B
Motor-driven door and window		O

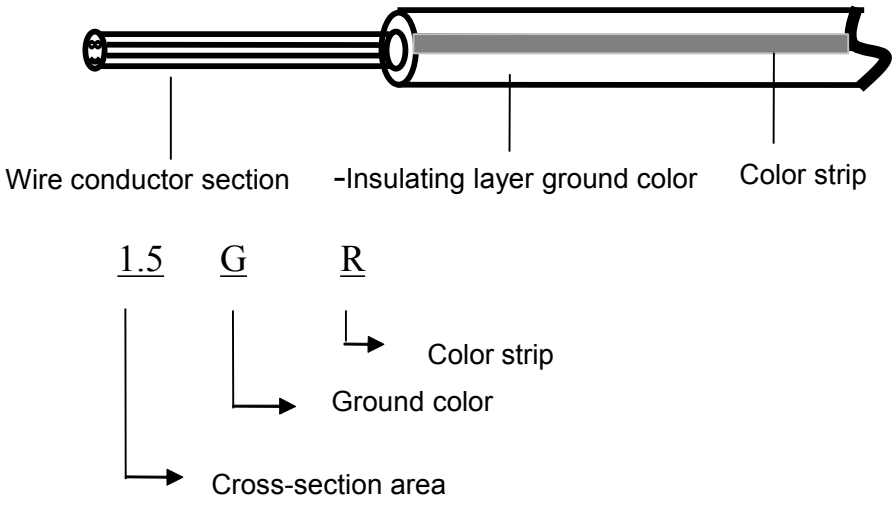
Note: B: Standard equipment O: Optional

II. Electric diagram identification

1. Wire code identification:

Specifications and colors of wires on the wiring diagram are distinguished by different codes. As different countries use different color codes for the wires, JAC product users and maintenance personnel should identify the wires according to Wire Color Code in Electric Maintenance Manual of JAC automobile.

E.g.: 1.5GR
1.5----------Section of wire conductor is 1.5 mm^2
G----------Color of insulating layer is green
R----------Color strip is red



Color codes of cables

Application circuit	Vinylon insulated wire					
Starter motor	Black (B)	Black - white (BW)	Black- yellow (BY)	Black- red (BR)		
Charging circuit	White (W)	White- red (WR)	White- black (WB)	White- blue (WL)	White- Green (WG)	
Lamp circuit	Red (R)	Red- white (RW)	Red- black (RB)	Red- yellow (RY)	Red- green (RG)	Red- blue (RL)
Signal circuit	Green (G)	Green- white (GW)	Green- red (GR)	Green- yellow (GY)	Green- black (GB)	Green- orange (GO)
Metering circuit	Yellow (Y)	Yellow- red (YR)	Yellow- black (YB)	Yellow- black (YB)		Blue - yellow (LY)
Wiper circuit	Blue (L)	Blue- white (LW)	Blue- red (LR)	Blue- black (LB)	Blue- orange (LO)	
Miscellaneous	Lamp green (Lg)	Lamp green - black (LgB)	Lamp green - red (LgR)			

	Brown (Br)	Brown- white (BrW)	Brown- red (BrR)	Brown- yellow (BrY)		

2 . Electrical component identification:

Electrical components in the JAC automobile electrical diagrams are indicated in common general signs. Refer to Common Automobile Electrical Signs for details.

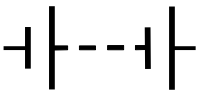
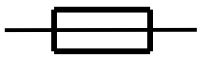
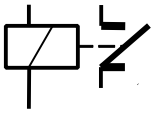
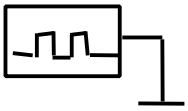
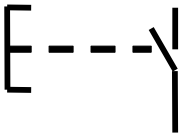
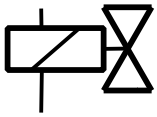
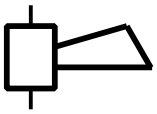
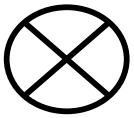
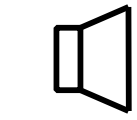
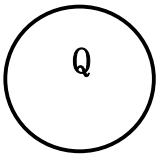
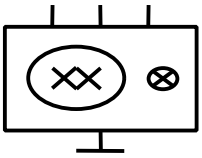
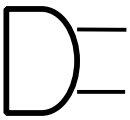
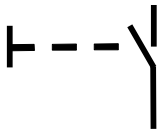
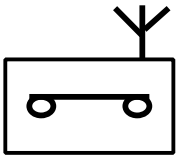
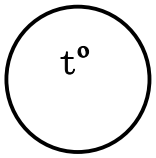
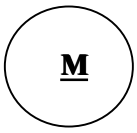
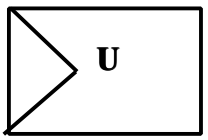
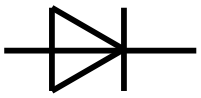
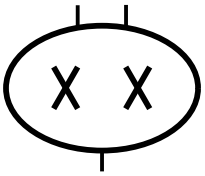
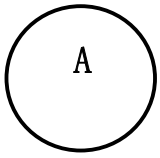
 Battery unit	 Fuse	 Relay	 Flasher	 Button switch
 Solenoid valve	 Electric horn	 Illuminator, indicator	 Speaker	 Fuel gauge
 Combination lamp	 Buzzer	 General hand switch sign	 Radio cassette player	 Thermometer
 Motor	 Voltage regulator	 Semiconductor diode	 Twin-filament lamp	 Amperemeter

Fig. 2 Common automobile electrical signs

III .Electrical designations and usages of the complete vehicle

1. Battery

(1) Battery is a kind of reversible low voltage direct current power supply that can convert chemical energy into electric energy and vice versa. Lead acid battery is supplied by JAC, which is dry-charged battery.

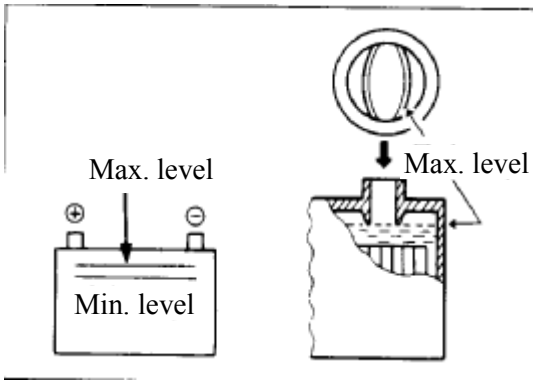
(2) Electrolyte in the battery is prepared by pure sulfuric acid and pure distilled water

in a certain proportion. Electrolyte purity is an important factor affecting the electrical performance and service life of the battery. As the industrial sulphuric acid and ordinary water contains foreign materials as copper and iron that accelerate the self discharge, it cannot be used in battery. The sulfuric acid and distilled water used must meet specialized standard.

(3) The battery is composed of six separate single cells that are connected in series with led rod. The voltage of a single cell is 2V, so the nominal voltage of one battery of six cells of series connection is 12V.

(4) The battery has charging hole that is sealed by plug screw. Charging hole plug screw has vent hole to release hydrogen and oxygen generated from chemical reaction. The vent hole must be kept clear in service. The shell may crack or explode if it is clogged.

(5) Battery inspection: a If the electrolyte level is too low, please add distilled water to the max. liquid level; b If the measured specific weight is under 1.23 (at 20℃), add or replace the electrolyte.; c Keep the terminals reliably connect, remove any corrosive marks and keep the battery terminal, power line and earth wire connection clean.



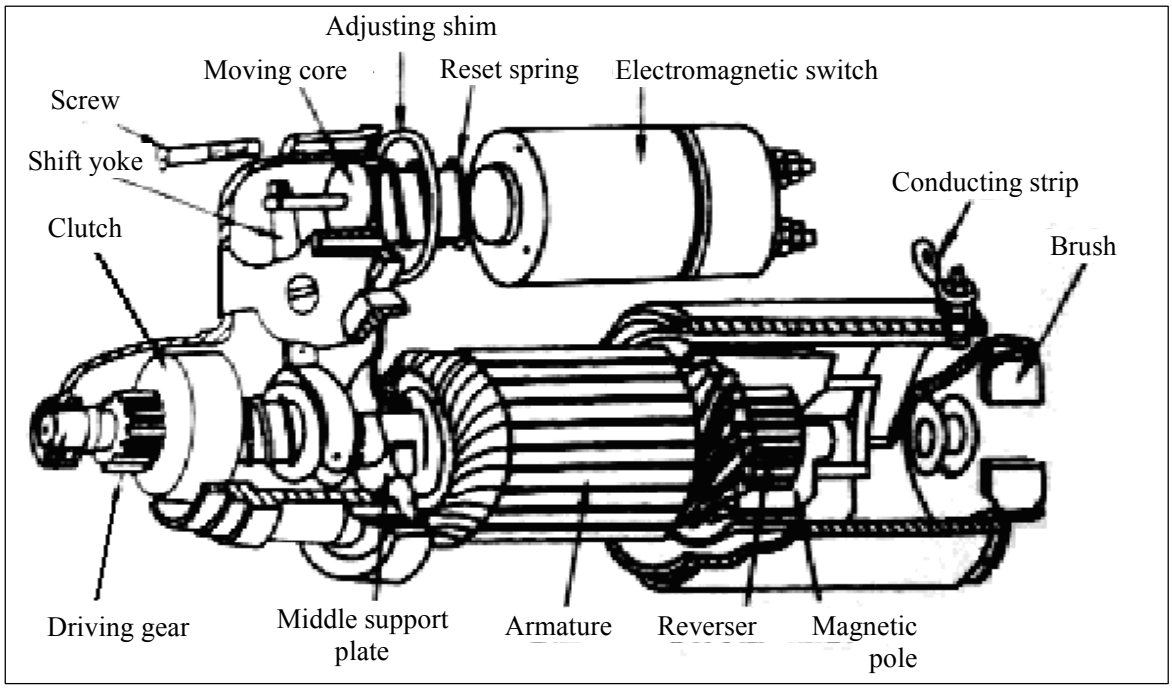
Battery inspection:
1. Check the terminal post for looseness and corrosion
Keep the connection reliable. Remove any corrosive mark and keep the connection clean.
2. Check the electrolyte level of the battery
If the electrolyte level is too low，please add distilled water to the max. liquid level

2. Starter

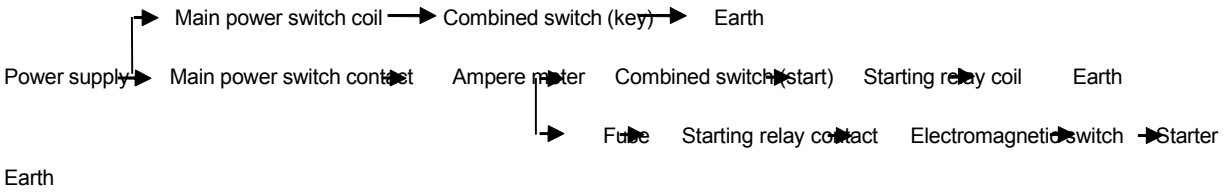
The function of starter is to convert the electric energy of battery into mechanical energy to drive the engine.

The starter used in this vehicle is 12V DC series excitation motor. It is composed of three parts: (1) DC series excitation motor: to convert the electric energy of battery into mechanical energy to generate torque; (2) Drive mechanism, also called engaging mechanism: To engage the driving gear of the starter into the engine flywheel toothed ring when the engine is started, so that the torque of starter is transmitted to the engine crankshaft, and to disengage the driving gear of starter and the engine flywheel toothed ring after the engine is started; (3) Control device: To connect and disconnect the starter and battery.

Starter structure:



Starter operating circuit:



The maintenance personnel should carry out inspection and repair for the lines indicated by the starter operating circuit diagram.

3. Generator

AC generator is the main power for the automobile. It is actually a self-exciting three-phase synchronous generator. There are three windings at an interval of 120º on the stator core of the generator. The ends of the three windings are connected, which are usually called star connection. The rotor has field winding on it. Magnetic field is generated when direct current passes the rotor winding. When the rotor is turned by the engine, relative cutting movement is generated between magnetic line of the rotor and three-phase winding of the fixed stator. Three phase alternating electromotive force, i.e., AC power, is generated in the three-phase winding. DC power is used in automobile circuit. So the AC power generated by the AC generator must be rectified before using. The rectifying is made mainly by the silicon rectifier in the generator. The three phase bridge full wave circuit composed of several silicon diodes commutates alternating current into direct current.

Silicon rectifying shunt excitation AC generator is adopted in this vehicle, which is composed of three phase AC motor and silicon diode rectifier. Minus earth is adopted. Do not connect otherwise, or the generator may be damaged.

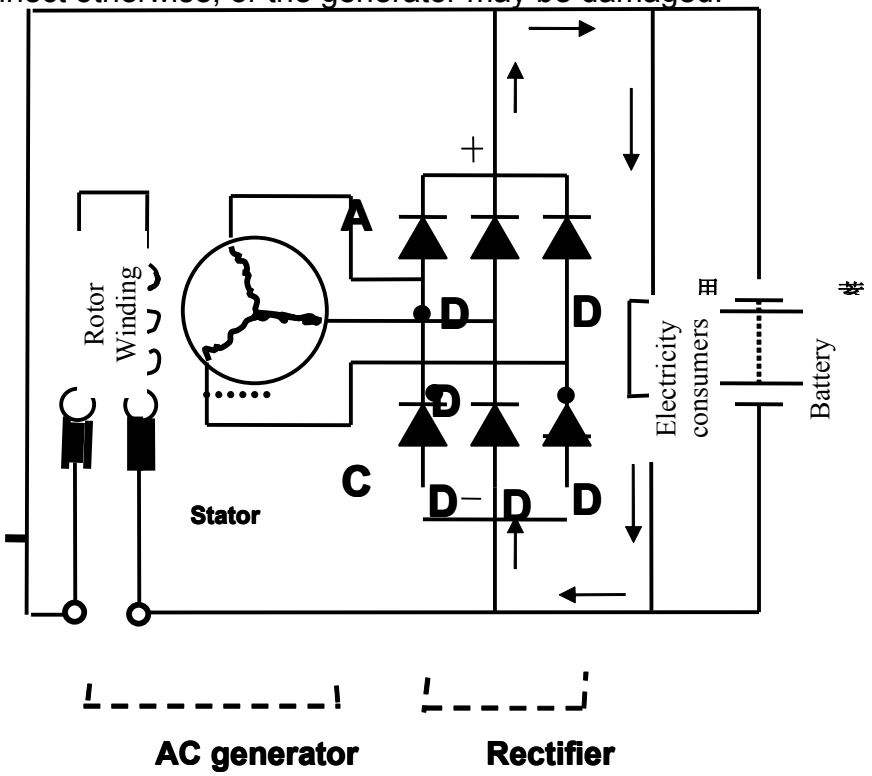


Fig. 1 AC generator wiring diagram

4. Speed sensor

Speed sensor is fit on the generator end. The signal is taken from generator speed signal terminal P. The number of pole pairs is 6. The generator and engine transmitting ratio is 82: 145. The sensor output waveform is regular square wave.

5. Electric preheating

Electric preheating for the engine is adopted in cold season for this vehicle. The heating wires should not be electrified for more than 30 sec., or they may be damaged.

If the preheating effect is not good, check if the circuit is switched on first. If the circuit is OK, use universal meter to check the heating wire and replace the burned-out electric heater.

6. Fuel cutoff solenoid valve

There is one electronic component on the rear end of the engine injection pump. Its function and wiring is as follows:

The electrical component is fuel cutoff solenoid valve. Its function is the same with that of electric engine shut down device. The fuel cutoff solenoid valve is powered on when the engine is started. The electric magnet lifts up the seal iron, so the injection pump of the engine starts to supply oil and the engine starts normal operation. When the engine needs to be shut down, turn the key to shutdown position, so the fuel cutoff solenoid valve is power off and the seal iron cut the fuel path by the spring operation.

Power supply → Fuse→ Ignition lock→ LOCK (shutdown)

7. Wiper

The electric wiper of this vehicle is automatic reset type. For installation, the motor should be in reset state. Then connect the link rod and wiper blade (wiper blade position should be in reset state).

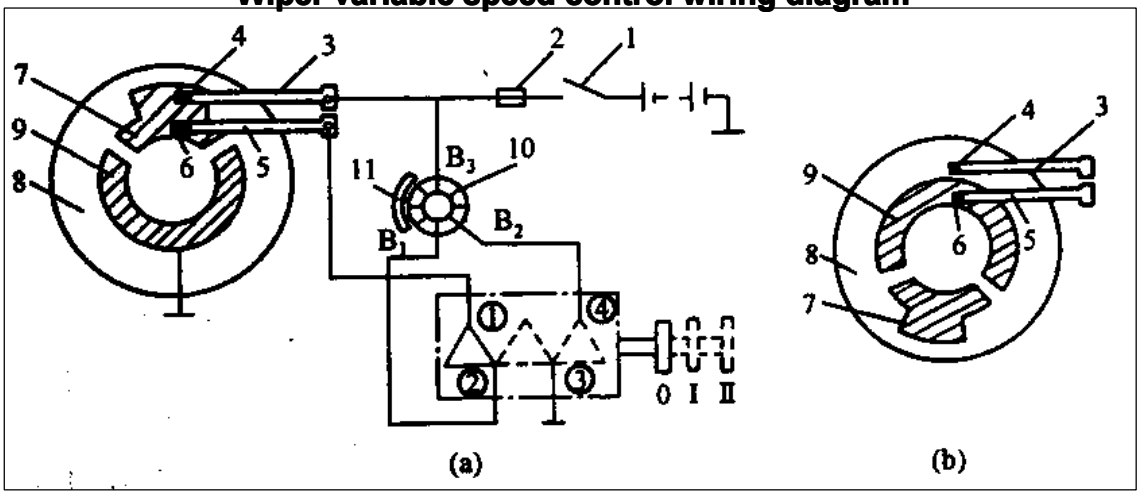
The variable speed switch controls the motor circuit to implement variable speed wiping. The variable speed control circuit is as shown in the figure. The control process is as follows:

a) Low speed wiping。 When the power switch is ON and the variable speed switch is in I position, the current flow is as follows: battery positive pole→power switch→fusing element→brush B3→armature→brush B1→variable speed switch I position earth→battery negative terminal. As the brush B2 has an offset angle, the wiper blade swings fast when the motor is running at high speed.

b) When the power switch is ON and the variable speed switch is in II position, the current flow is as follows: battery positive pole→power switch→fusing element→brush B3→armature→brush B2→variable speed switch II position earth→battery negative terminal. As the brush B2 has an offset angle, the wiper blade swings fast when the motor is running at high speed.

c) Shutdown and reset. The automatic reset mechanism of motor wiper is as shown in Fig. 1－21 (b). The nylon impeller is embedded with copper ring 7 and 9. The copper ring has two parts. The larger copper ring 9 is connected to the casing to earth. Contact piece 3 and 5 is made of phosphorus copper or other elastic material.

Wiper variable speed control wiring diagram



1-Power switch; 2-Fusing element; 3、5-Auto reset contactor; 4, 6-Contact;

7, 9-Auto reset slide ring (copper ring); 8-Worm wheel; 10-Armature; 11 - Permanent magnet

Contact 4 and 6 is riveted on one end. As contact 3 and 5 is elastic, when impeller 8 turns, contact 4 and 6 maintains contact with the end surface of impeller 8 (including copper ring 7 and 9).

When wiper variable speed switch is in "0" position, if the rubber brush does not stop at bottom edge of the windshield glass, the impeller turning will make contact 6 and copper ring 9 connect, so the current keeps flowing into the armature. Here the current forms a circuit from battery positive pole→power switch→fusing element→brush B1→variable speed switch→contact piece 5→contact 6→copper ring 9→earth→battery negative terminal. The motor runs at low speed until the impeller turns to the position shown in Fig. 1－21 (a) and contact 4 and 6 connects with copper ring 7.

When contact 4 and 6 is connected with copper ring 7, the motor cannot stop immediately owing to the inertia force of armature turning. Instead, electricity is generated with engine operation. As the direction of electromotive force generated by armature winding is opposite to that of external supply voltage, the current flows in the circuit of brush B3→contact piece 3→contact 4→copper ring 7→contact 6→contact piece 5→variable speed switch→brush B1. Torque is also generated (called brake torque) to make the motor stop immediately. Here the rubber brush is just reset to the bottom edge of the windshield.

The maintenance personnel can look for the fault of wiper circuit according to the wiper working principle and variable speed control wiring diagram.

a. Main components

Designation	Quantity	Mounting position
Connecting rod assembly	1	Bottom edge of front windshield
Wipe rod and brush assembly (left)	1	Front windshield
Wipe rod and brush assembly (right)	1	Front windshield
Rain wiper motor assembly	1	Inside the cab
Washer jug assembly	1	Inside the cab
Water pipe assembly	1	Inside the cab
Nozzle assembly	2	Cab front panel
Control switch (combined switch)	1	On steering column

Wiper relay	2	Inside the cab fuse box

b. Functional requirements

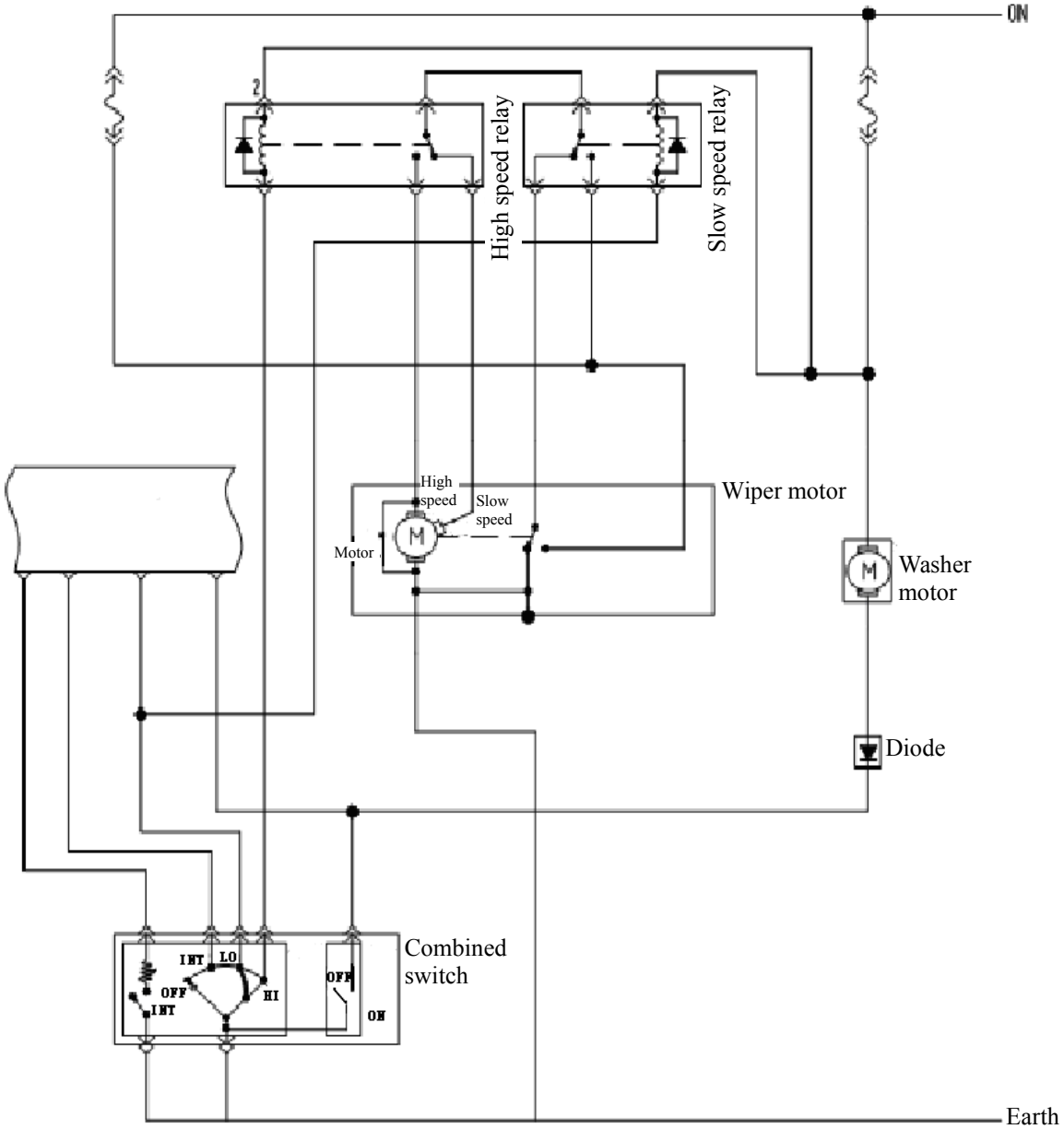
I. Three operation modes of high speed, low speed and intermittent

II. Automatic reset function of wiper rod

III. Interval of intermittent operation can be adjusted

IV. Linked control of washer and wiper

c. Circuit design



8 .Washer

Dust or dirt may get onto the windshield glass during the driving. To ensure good sight of the driver, most vehicles have windshield glass washer.

When the washing engine armature is powered on, it turns in the permanent magnetic field. When the armature shaft turns, it drives the pump shaft via coupling, so the pump rotor also rotates. The pump rotor pumps the washing liquid from the pot to the wind shield via the outlet hose and the nozzle. In the meantime, the wiper blade swings to remove the dirt on the wind shield glass.

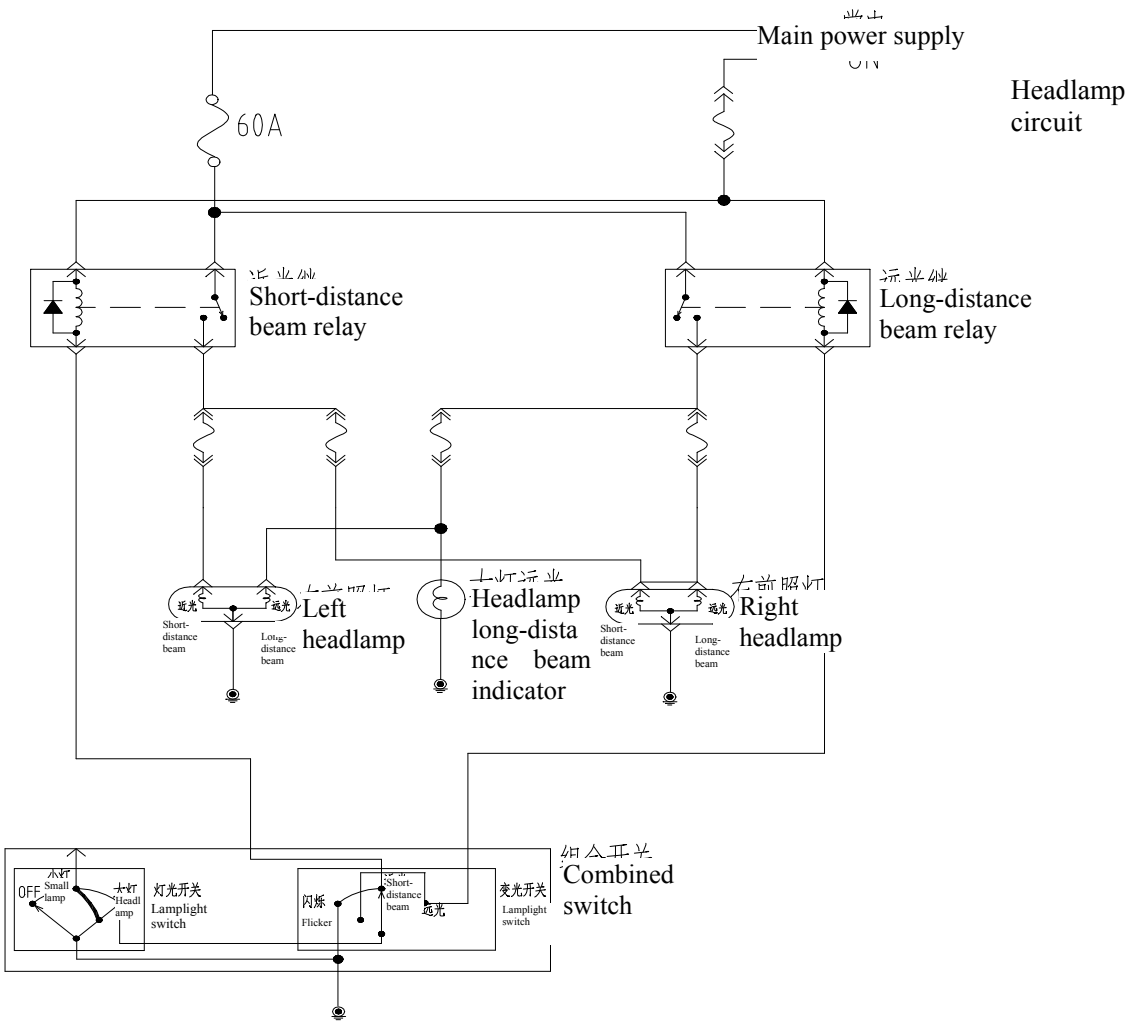
To use the washer, switch on the washing pump before the wiper. The continuous work time of washing pump should not exceed 5s, interval not be less than 10s. When there is no washing liquid in the pot, do not switch on the washing pump. Otherwise, the motor may be damaged.

9. Headlamp

The headlamp of this vehicle is anti-glare combination lamp. The bulb is twin filament type (long-distance beam/short-distance beam). When long-distance beam is switched on, the long-distance beam indicator on the dashboard illuminates at the same time. Lamp switch and change is operated from the group switch.

If the lamp is not ON, please check in the following sequence.

Step	Inspection content	Method
1	Check if the fuse is blown	If the fuse is blown, replace it after the cause is found. If not, check the next item.
2	Check if the lamp relay operates normally	Turn on the lamp switch to see if the headlamp relay operates. Or use a universal meter to check if the relay terminal is OK.
3	Check the headlamp bulb	If the result of the above checks is acceptable, please check if the bulb is damaged. If not, check the next step.
4	Check if the wiring connectors are reliable	Check if all the terminals are reliably connected according to the wiring diagram.
5	Check the combined switch (lamp switch)	Check if the lamp switch on the group switch can be normally turned on



10 .Front small lamp

The front small lamp of this vehicle (width lamp) is combined lamp, i.e., front small lamp on the lower part and direction lamp on the upper part. Check for fault according to the small lamp operating circuit:

Power supply→ Fuse → Relay coil→Combined switch→Earth

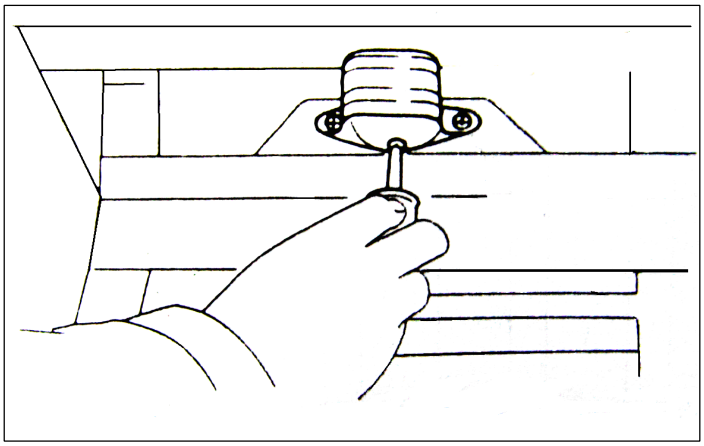
→Relay contact →Front small lamp→Earth

The trouble shooting method is the same with that of front lamp. The difference is that you need to check the small lamp relay when you check the relay.

11. License lamp

The license lamp is on the plate support on the rear of the vehicle. The license lamp is ON when the lamplight switch is in any position.

The trouble shooting method is the same with that of small lamp.



License lamp
To replace the bulb, remove one screw fixing the lens.

Check for fault according to the license lamp operating circuit:

Power supply→ Fuse → Relay coil→Combined switch→Earth
→Relay contact→License lamp→Earth

12. Direction signal lamp and hazard warning lamp

The direction lamp and front small lamp is combined. It is on the top of the combined lamp. The light color is yellow. The operating circuit of the direction lamp is shown below:

Power supply → Fuse → Flasher ---→Combined switch -----→Left and right direction lamp→Earth
---→Left and right direction lamp→Earth
---→Warning switch

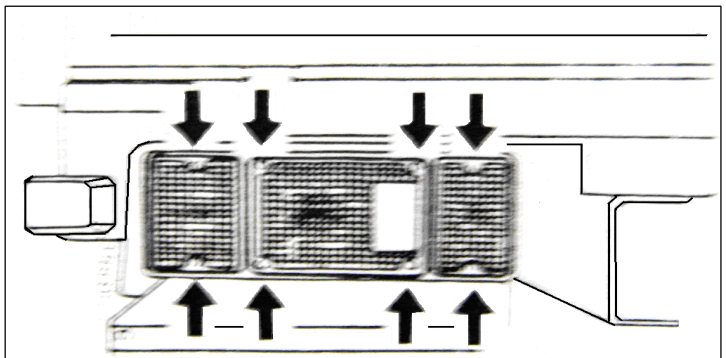
The direction lamp circuit should be checked according to the circuit diagram. When the vehicle is at fault or there is other danger, turn on the warning switch. The bulbs of the direction lamp flicker at the same time to give a warning. The trouble shooting method is the same as above.

13. Rear combination lamp

Rear lamp is a combined lamp with brake lamp, reversing lamp and direction lamp at the bottom of the rear of the vehicle on both left and right. The color is red. The rear lamp control switch is on the lamp switch of the combined switch. Its circuit is:

Power supply → Fuse → Relay coil→Combined switch→Earth
→ Relay contact→Rear lamp→Earth

Note: The rear lamp use the same relay with front small lamp. It also share the same fuse with front small lamp, license lamp, fog lamp and instrument lamp. The maintenance personnel should pay attention to this in maintenance. The trouble shooting method of rear lamp is the same with that of front small lamp.



Rear combination lamp
To replace the bulb, unscrew the four bolts fixing the lens.

14 .Reversing lamp and switch

Reversing lamp position is the same with that of rear lamp. The reversing lamp light is white in color. The reversing lamp works together with the reverse gear switch mounted on the gearbox. Its operating circuit is:

Power supply→Fuse→Reverse gear switch→Reversing lamp→Earth

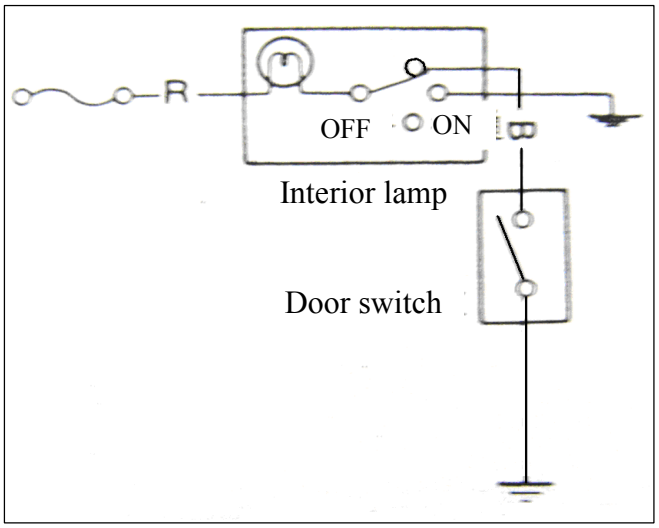
Note: the reversing lamp shares the same fuse with brake lamp and roof lamp. Please pay attention to this in maintenance and repair.

15. Interior lamp and switch 150

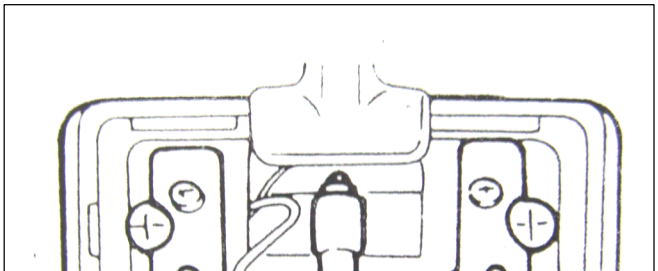
The interior lamp is at the middle of the upper edge of the front windshield of the cab. It has two switches, one is the roof lamp composite switch and the other is the door post switch installed on the left door post of the cab. Its operating circuit is:

Power supply → Fuse → Interior lamp → Interior lamp switch → Earth

→ Door post switch → Earth



Interior lamp switch circuit diagram



Interior lamp switch position

ON ←OFF→ Door

16. Brake lamp and switch

Brake lamp position is the same with that of rear lamp. The brake lamp light is red and the brightness is higher than that of rear lamp. The brake lamp works together with the brake lamp switch mounted on the brake pedal. Its operating circuit is:

Power supply→ Fuse→Brake switch→Brake lamp→Earth

Note: the brake lamp shares the same fuse with reversing lamp and roof lamp. Please pay attention to this in maintenance and repair.

17. Parking brake lamp and switch

Parking brake switch is integrated with parking brake control lever. When the manual control lever is lifted, the parking brake switch is ON. Here the parking brake indicator on the dashboard turns ON. Let down the manual control lever, and the parking brake switch is OFF and the parking brake indicator is OFF. Its operating circuit is:

Power supply→Fuse →Parking brake indicator→Parking brake switch →Earth

Parking brake indicator sign on the dashboard:



18 Fog lamp and switch

The fog lamp is combined with the headlamp and its light color is yellow. The working principle of fog lamp is: when you drive on a foggy day, first switch on any lamp on the combined switch and then press the fog lamp switch to turn it on. Turn off the lamp switch on the combined switch or the fog lamp switch to turn off the fog lamp.

Fog lamp operating circuit:

Power supply → Fuse → Relay coil→ Combined switch→Earth

→ Relay contact →Fog lamp switch →Fog lamp→ Earth

Note: The fog lamp shares the same fuse with the front small lamp, rear lamp, license lamp and instrument lamp. The maintenance personnel should pay attention to it in

repair.

19. Electric horn

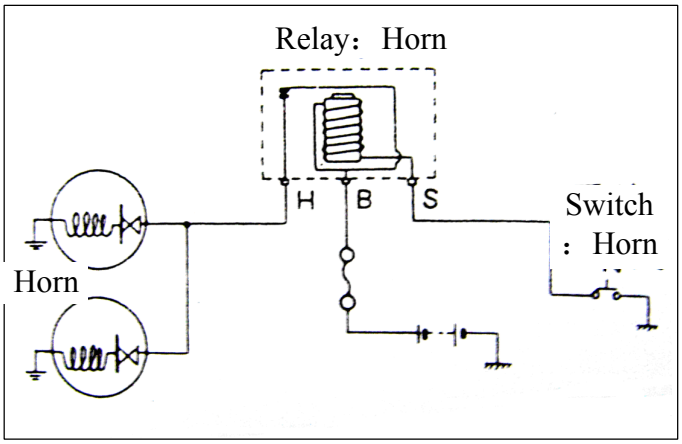
The electric horn of this vehicle is dual tone (high and low tone) electric horn. It is fitted on No. 1 girder on the chassis in the middle of the front bumper. Its operating circuit is:

Power supply → Fuse → Horn relay coil →Horn button→Earth

→ Relay contact →Horn →Earth

Note: The contact of horn button is an elastic joint on the combined switch that keeps effective connection with the button contact iron ring on the steering wheel. Pay attention to the connection state of the contact in maintenance.

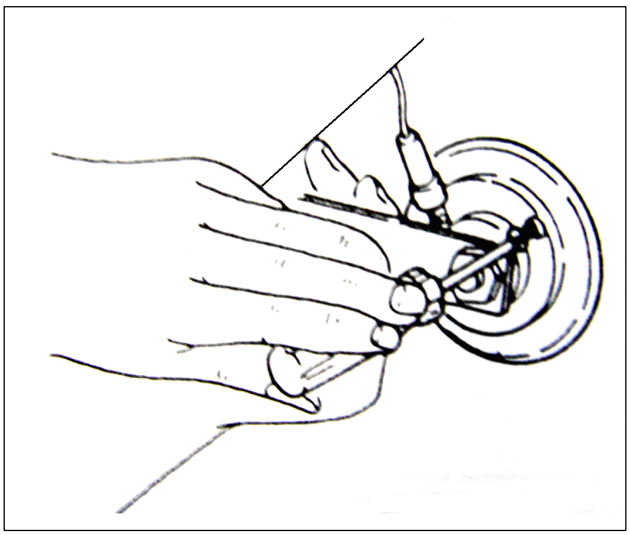
Electric horn:



Wiring diagram

Horn specifications:

Structural shape	Diaphragm diameter mm	Sound level dB (A)	Base frequency range Hz	Volume range fitting (dual tone)
Disc type	>115	105~125	250~650	4: 5



If the horn does not sound or sounds abnormally when you press the horn button, check the line and battery voltage before the following items:

1. Check if the fuse is blown. At the same time, check if the wire connection is tight.
2. If both the fuse and connector can operate in normal sequence, remove the horn from the steering wheel and short-circuit the horn switch guide line terminal and the steering shaft thread.

a. No sound --- Poor contact between horn contact of the combined switch and the steering wheel bottom.

b. Sound --- The horn switch is at fault.

3. If the horn sounds without stop, the source of trouble may be the horn switch or bad reset contact ring.

20. Vacuum alarm

When the vacuum pressure in the vacuum cylinder exceeds certain value, the pressure contact on the vacuum horn closes to complete the circuit. The vacuum alarm buzzer and alarm lamp on the dashboard is switched on to warn the driver to find out the cause.

The vacuum abstraction is carried out by the vacuum pump on the generator. The maintenance personnel should pay attention to this in repair.

Alarm lamp identification: 

21 .Various relays

The relays for this vehicle include lamp relay, horn relay, warm air relay, starting relay and preheating relay. As the lamp, horn and warm air does not consume high current, relay of the same specification is used for these current consumers. The solenoid switch of the starter and heating plug consumes high current, so they use special purpose relays that are installed in the chassis electric box. From left to right, starting, preheating, horn, air conditioner and braking relay.

22 .Combined switches

The combined switch is a switch integrating power, start, lamp, wiper, washer and direction lamp. There are many lines together, so faults are likely to occur here. It will help the maintenance personnel a lot to know about the structure of the combined switch in electric trouble shooting.

Combined switch structural diagram

1. Ignition switch working position conduction diagram

Contact code / and power / Working gear	B	ACC 220W	ON 240W	R 60W	ST 220W	P1 40W	P2 40W	B1	R1 60W	R2	Remarks
Wire color	B	L	BY	BR	BW	LY	LW	L	R	Y	
Specification mm²	5.0	3.0	3.0	3.0	3.0	1.0	1.0	1.0	0.75	0.75	

LOCK											
ACC											
ON											
START											Automatic reset
Power switch	Key in										
	Key out										

2 Lamp switch beam selection and overtaking signal conduction diagram

Contact code			BT	E	J	B	BH	HU	
Rated power			80W		120W	10W	150W	150W	
Gear	OFF								
									Overtaking
	Small lamp								
									Overtaking
	Headlamp	Short-distance beam							
									Overtaking
		Long-distance beam							

3 Direction switch, warning switch, exhaust brake switch and horn conduction diagram

Contact code		TL	TB	TR	B1	F	B2	EX	ER	HO
Rated power		72W	144W	72W	120W		120W			120W
Warning switch	Direction switch									
OFF	L	O—O			O—O					
	OFF				O—O					
	R		O—O		O—O					
ON	L OFF R	O—O—O				O—O				
Exhaust brake switch	OFF									
	ON							O—O		
Horn										O

4 Wiper switch and water spraying switch

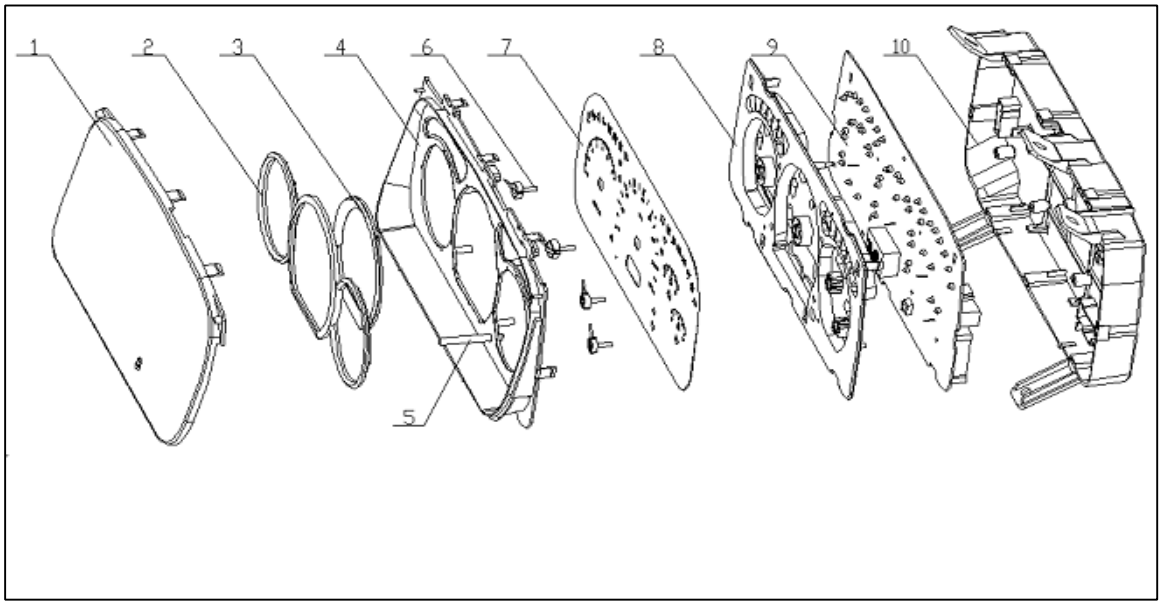
Water spraying	Wiping	11	E1	12	AS	L	H	E2	W	E3
OFF	OFF				O—O					
	INT	O—O		O—O						
	LO					O—O				
	HI						O—O			
ON	OFF INT LO HI								O—O	

EZ

23. Combined instrument

Instrument

Disassembling and reassembling



Disassembling sequence:

1.	Transparent top cover	6.	Pointer component
2.	Instrument decorative ring A	7.	Gauge plate
3.	Instrument decorative ring B	8.	Middle cover
4.	Black frame	9.	Circuit board parts
5.	Reset rod	10.	Bottom cover

Disassembling sequence:

Follow the reverse order of disassembling to reassemble.

1 Instrument indicator:

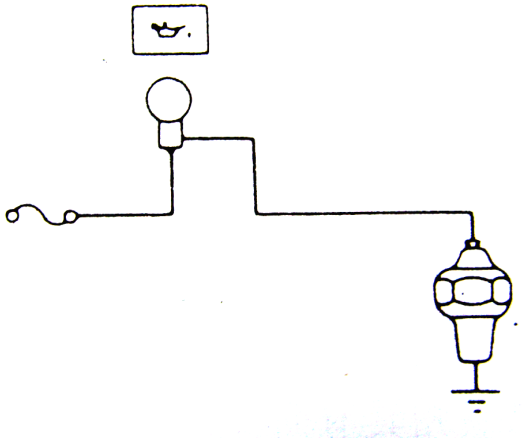
No.	Designation	Function	Color
1	Engine oil pressure alarm lamp	ON when the engine oil pressure is too low	Red
2	Charging indicator	ON when the battery discharges	Red
3	Parking brake alarm lamp	ON when the parking brake is switched on	Red
4	Preheat indicator	ON during the preheating	Yellow
5	Exhaust brake indicator	ON when the exhaust brake is switched on	Yellow
6	Left/right direction indicator	ON when the direction lamp is switched on	Green
7	Beam indicator lamp	ON when the headlamp is switched on	Blue
8	Fog lamp indicator	ON when the fog lamp is switched on	Yellow
9	Hazard alarm lamp indicator	ON when the hazard alarm is switched on	Red
10	Fuel oil level alarm lamp	ON when the fuel oil level is low	Yellow
11	Small lamp indicator	ON when the small lamp is switched on	Yellow
12	Door open alarm lamp	ON when the door is open	Red
13	ABS alarm lamp	ON when the ABS system is at fault	Yellow
14	Brake fault alarm lamp	ON when the brake is at fault or the brake fluid is low	Red

1) Main component installation

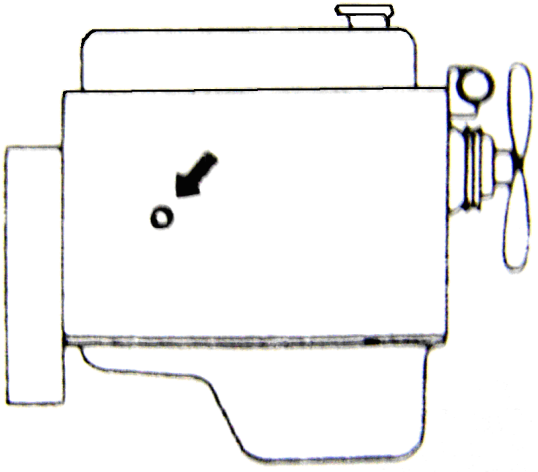
Main component	Model	Mounting position
Combined instrument	Stepping motor type	Under dashboard
Speed meter/odometer	Electronic	Middle of combined instrument
Odometer sensor		On gearbox output shaft
Engine oil pressure sensor	Varistor type	On engine oil pipe
Water temperature	Thermister	On engine water inlet pipe

sensor		
Fuel oil sensor	Varistor type	Inside oil tank

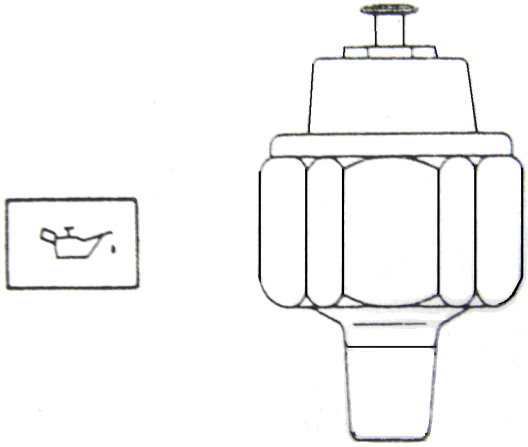
2) Indicator and warning switch:



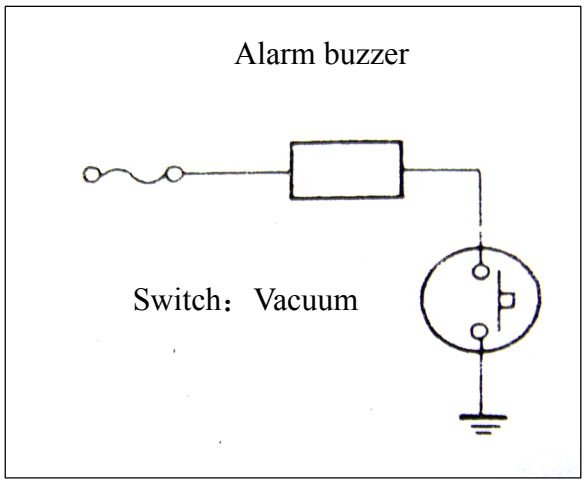
Engine oil pressure indicator switch
Wiring diagram



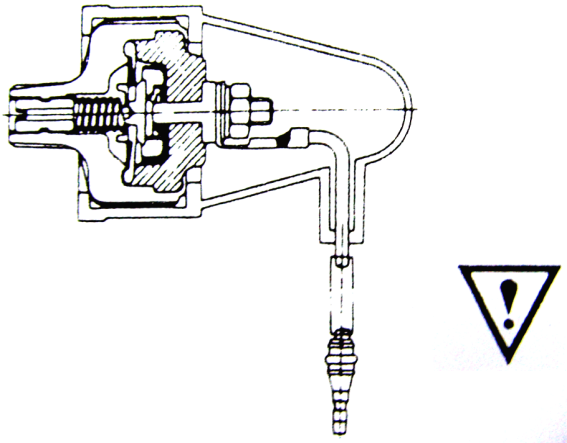
Indicator switch position



Switch specification
Working pressure: 0.3- 0.5 KSC.
When the oil pressure is as low as the switch action pressure, the indicator is ON.

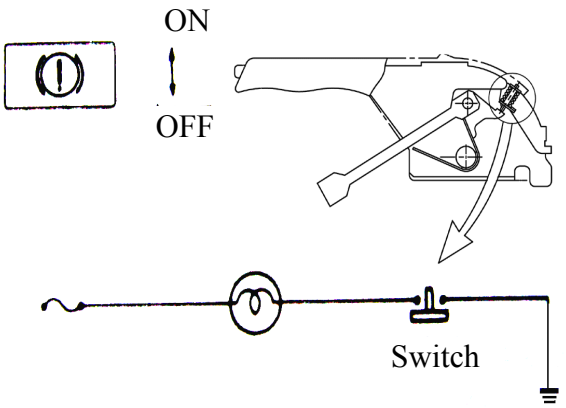


Vacuum alarm switch
Wiring diagram
Its position is the inner side of the left pedal in the cab.



Switch specification
Stamping sign: 350
Negative pressure (mm hg): 320- 380

Note: The switch has working negative pressure mark. Make sure that you replace it with switch of the same negative pressure when necessary.



Parking brake switch
Wiring diagram

2 Technical requirements:

Technical requirements of combined instrument

3801910D800 Combined instrument assembly

The basic deviation requirements are as follows:

<table>
<tr><td colspan="10">Basic deviation</td></tr>
<tr><td rowspan="3">Speedometer (stepping motor type)</td><td>Indicated speed Km/h</td><td>20</td><td>40</td><td>60</td><td>80</td><td>100</td><td>120</td><td>140</td><td>160</td></tr>
<tr><td>Allowable deviation Km/h</td><td>±3</td><td>+5
0</td><td>+5
0</td><td>+5
0</td><td>+5
0</td><td>+6
0</td><td>+7
0</td><td></td></tr>
<tr><td>Transmitting ratio</td><td colspan="2">1:637</td><td colspan="2">Interface mode</td><td colspan="3">Sensor type</td></tr>
<tr><td rowspan="4">Fuel gauge (stepping motor type)</td><td>Indicated mark</td><td colspan="2">E</td><td colspan="2">1/2</td><td colspan="3">F</td></tr>
<tr><td>Basic resistance (Ω)</td><td colspan="2">97</td><td colspan="2">32.5</td><td colspan="3">6</td></tr>
<tr><td>Allowable deviation (Ω)</td><td colspan="2">±16</td><td colspan="2">±6.5</td><td colspan="3">±3</td></tr>
<tr><td>Sensor</td><td>Designation</td><td colspan="2">Fuel oil sensor</td><td>Model</td><td colspan="3">RG1164B1</td></tr>
<tr><td rowspan="4">Water temperature gauge (stepping motor type)</td><td>Indicated mark (℃)</td><td colspan="2">C (50)</td><td colspan="2">100</td><td colspan="3">H (115)</td></tr>
<tr><td>Basic resistance (Ω)</td><td colspan="2">230</td><td colspan="2">40.4</td><td colspan="3">26.4</td></tr>
<tr><td>Allowable deviation (Ω)</td><td colspan="2">±30</td><td colspan="2">±5</td><td colspan="3">±1.5</td></tr>
<tr><td>Sensor</td><td>Designation</td><td colspan="2">Water temperature sensor</td><td>Model</td><td colspan="3">WG1371</td></tr>
</table>

All alarm indication systems of 3801910D800 instruments conform to GB4094 - 1999 Signs of automobile controls, indicators and signal devices.

DJY7121-1.6-20;DJY7141-1.6-20;DJY7121A-1.6-20 combined socket is adopted for the instruments.

24 .CD player

A single disk dual track CD player is mounted on this vehicle. The L channel speaker is mounted in the left door and the R channel speaker is mounted in the right door.

If you find that some functions do not work, please read carefully the operation instructions in the manual first before you send it for repair. You can check the player

according to the following table. It will help you fix the trouble.

Please send the player to the maintenance service station if the fault cannot be fixed. Do not disassemble the player to repair it by yourself.

General situation

The player does not work and there is no display.

·Check the fuse connection of the player and vehicle

·Check the voltage.

The player works but there is no sound or the sound is very low

·Raise the volume.

·Check the front and rear, left and right balance setting of the horn.

·Check the antenna and connection.

Horn volume lowers by itself

·The internal safety circuit can prevent the internal temperature from exceeding certain value.

·Raise the volume after the temperature is lowered.

Reception

Cannot get the channel:

·Check if the antenna is fully drawn and if the connection is right.

·Check if the negative terminal (brown line) is grounded (chassis).

·Please use manual tuning if the signal is too weak.

Poor reception:

·Some vehicle (such as Volkswagon and SEAT) needs a 12 V antenna on the top. Please consult your dealer if there is 12 V power supply to this antenna.

CD

CD ERROR is displayed:

·Check if the CD is correctly inserted, and make sure that the CD is not broken or dirty.

Distortion of sound

·CD cannot be read, damaged or dirty.

CD player out of operation:

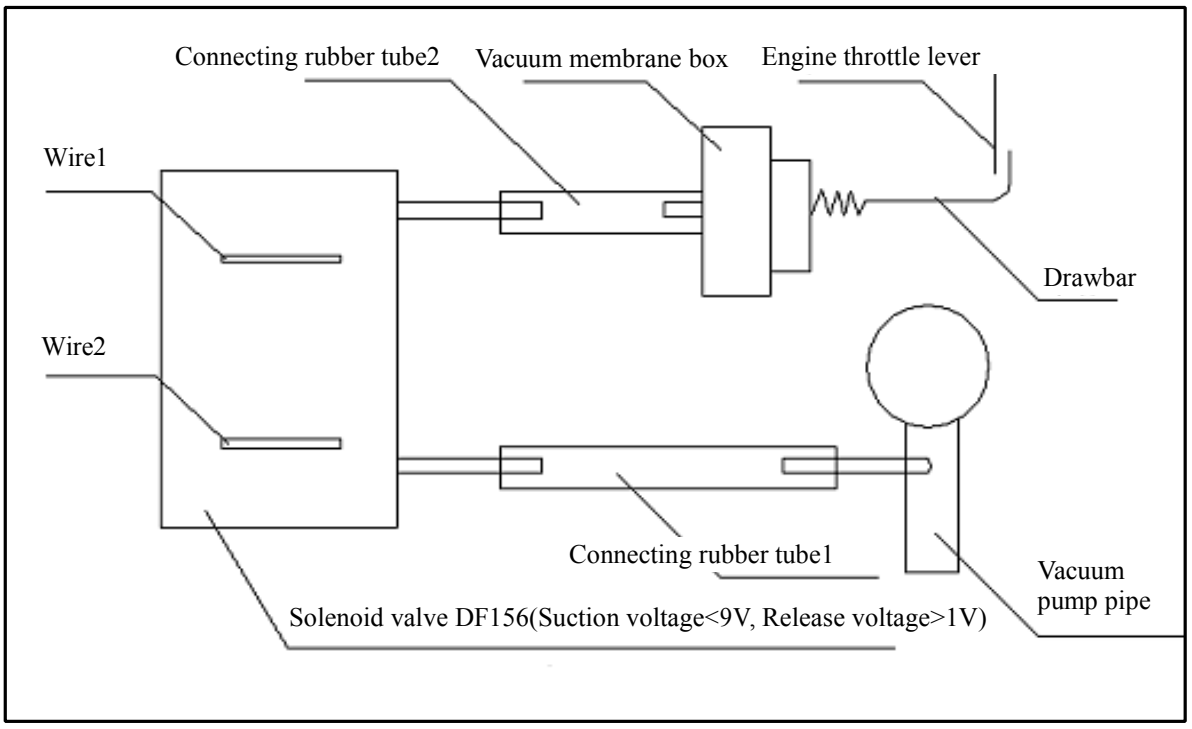
·Moisture may condensate on the laser magnetic head when it is very cold. Turn it to radio reception for about 5 minutes to let the moisture evaporate.

NO CD or NO DISC is displayed.

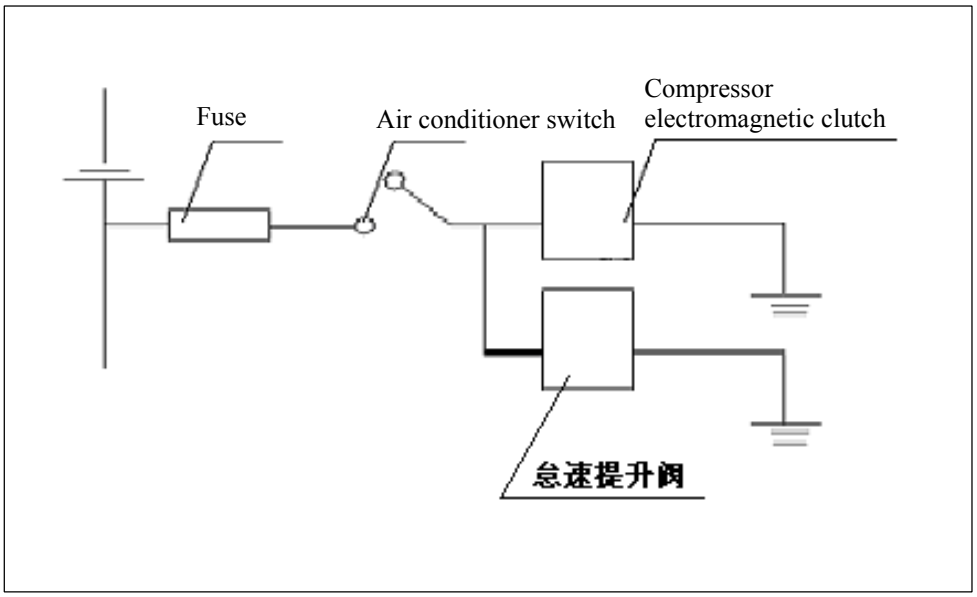
·Check if there is CD in the CD player.

25. Idle speed boost device

A solenoid valve called idle speed boost device is fitted on the rear end (left side of the chassis) of the vacuum pump on the engine. When the engine is at idle speed and the air conditioner is switched on, it boosts the idle speed of 700r/min to 850±50r /min, so that the power generation meets the requirements of the air-conditioner. Its functional diagram is as follows:

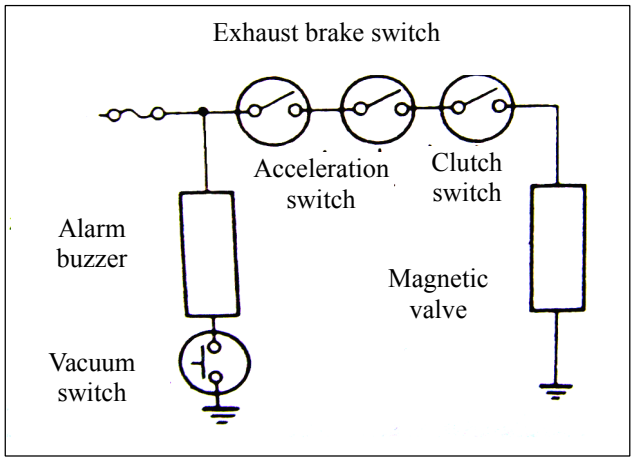


When the air conditioner is switched on, the solenoid valve of the idle speed boost device operates so that rubber tube 1 and rubber tube 2 is connected. With the vacuum membrane, the fuel up lever is pushed by the push rod to the fuel up direction, so that the engine idle is raised to 850±50r /min. The wiring diagram is as follows:

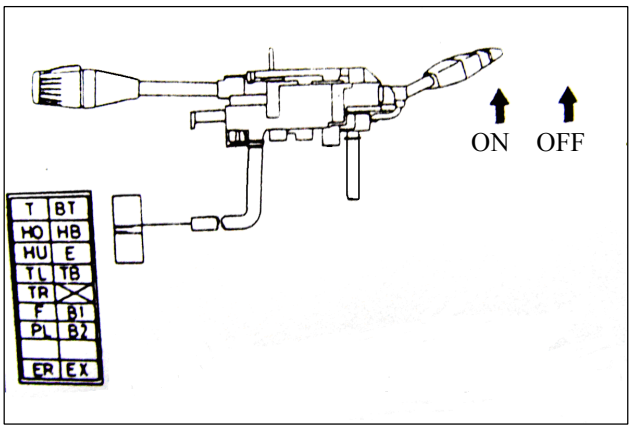


Idle speed boost valve

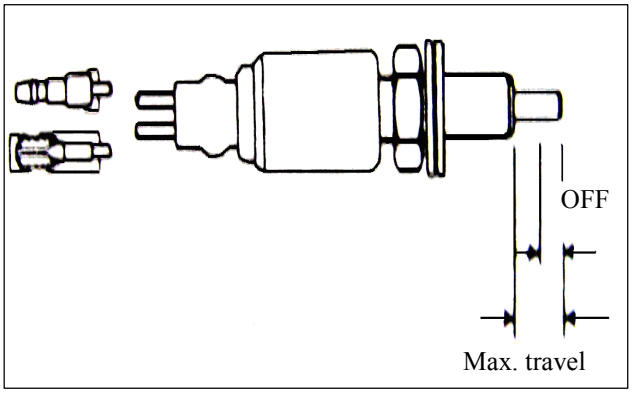
26. Exhaust brake controller



1. Wiring diagram



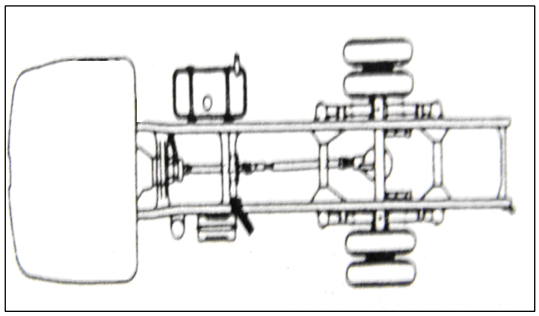
2. Switching diagram



3. Accelerator and clutch switch:

Maximum stroke: 4mm;

Working stroke: 2.0-2.8mm.

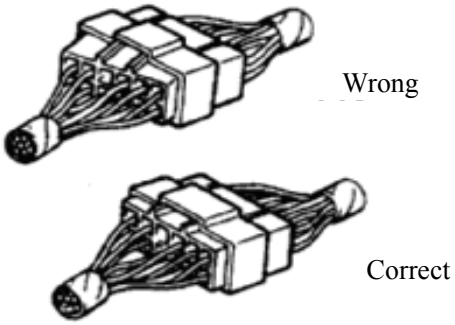


4.Position of exhaust brake solenoid valve (left arrow)

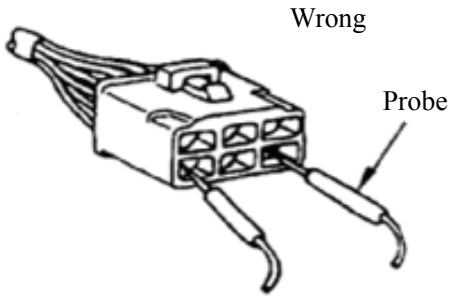
27. Electrical device



Disassembly of line bundle connector:
Please always both hands to cut the connector. Drawing the connector with single hand will result in rupture of the wire terminal.
Note: press the lock plates on both sides before drawing out the connector to cut.

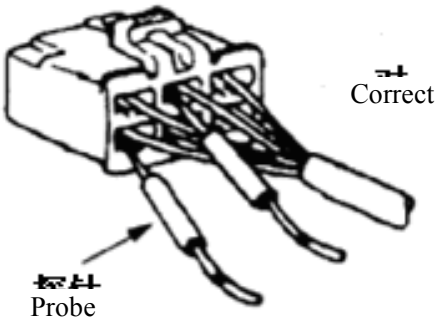


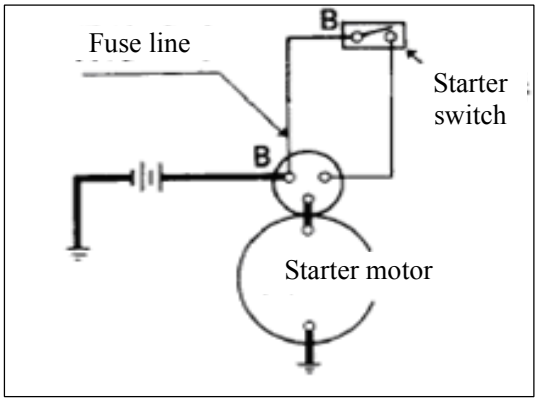
Connection of line bundle connector:
Clench both sides (male and female) of the connector and make sure that the connector terminal pins match and align with the holes. Press both sides of the connector carefully until you hear a clear click.



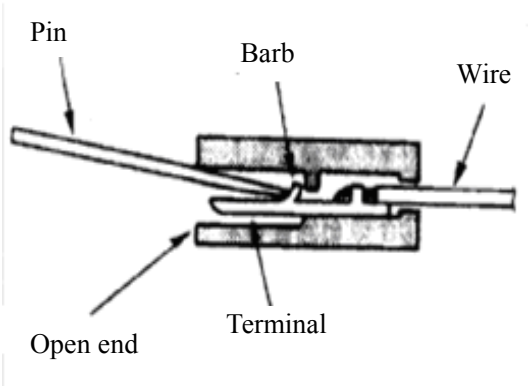
Inspection of line bundle connector:
Use circuit tester to check the connector continuity. Insert test probe from side of the connector wire

Do not insert the test probe in connector open end

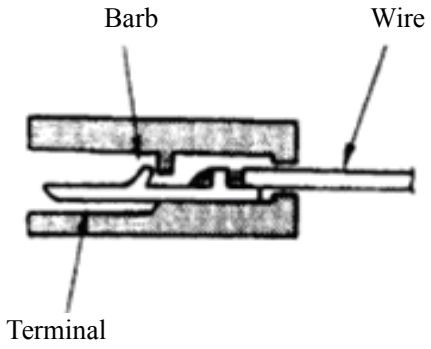

Correct
Probe



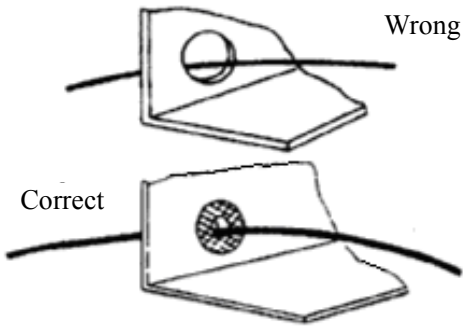
Inspection of fuse line:
The fuse line is fitted on battery positive terminal and starter switch B terminal
If there is over current, the fuse is blown to protect the main power supply from being overloaded. Please use universal meter to check the continuity of the circuit.



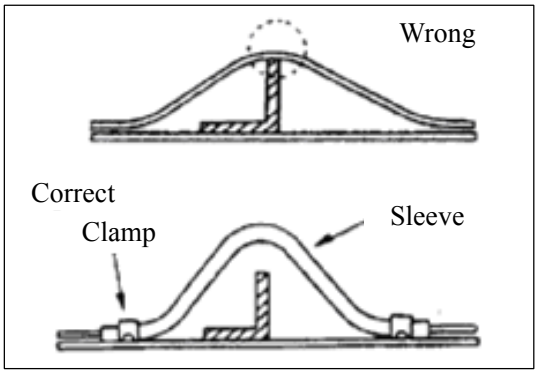
Disassembly of wire terminal
1. Insert a pin into the open end of the connector shell
2. Press the barb (facing the connector wire side) and pull the wire on the connector wire side.



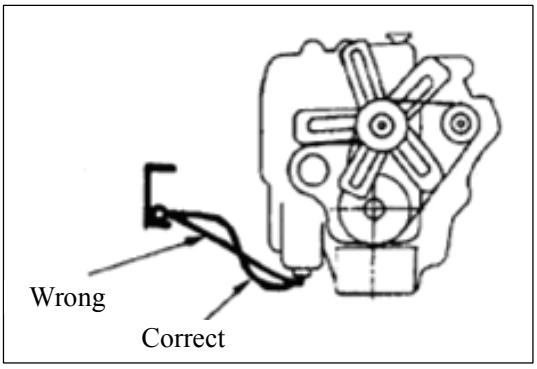
Insertion of wire terminal:
1. Check if the barb is completely open.
2. Insert the terminal from connector wire side and press it until the barb fixes it firmly.
3. Pull the wire gently to reset the terminal.



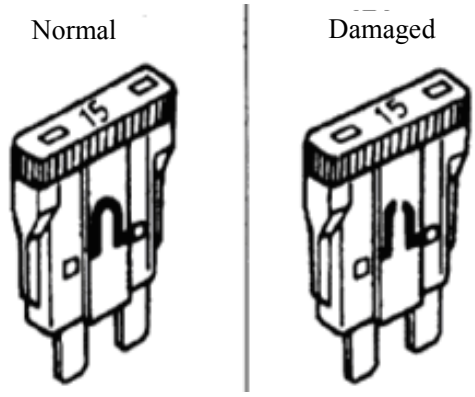
Precautions of line bundle arrangement:
Use jacket or sleeve to protect the line bundle and avoid direct contact with sharp edge or surface.



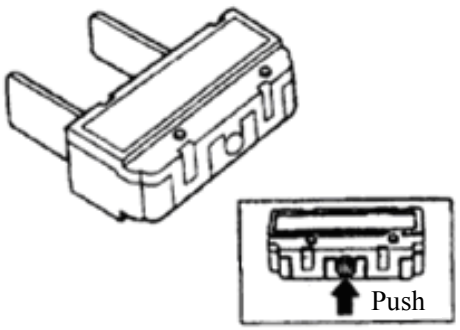
There should be sufficient clearance between the line bundle and bracket. Use ethylene sleeve and clip to protect the line bundle and avoid direct contact.



The line bundle between the engine and chassis should be long enough to avoid abrasion or damage owing to vibration.



Fuse:
Fuse is the most used circuit protection of vehicle circuit. When there is over current in the circuit，the fuse is blown to prevent the high current from damaging other parts in the circuit. Find out the cause of overload current and solve the problem before you replace the fuse.
Use new fuse of the same ampere to replace the original one. Otherwise, there will be line burning or other serious damage to the circuit.



Circuit breaker:
Breaker is a protective device to open the circuit when the load current exceeds the rated breaker capacity.
If there is short circuit or other form of overload, the over current will open the circuit on both sides of the breaker. When the circuit is open, the breaker button pops up.

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Air heating & air conditioning equipment

Generator

Technical parameters

Disassembling and reassembling

Troubleshooting

General

1. Air conditioner refrigeration cycle

1.1 main parts of refrigeration system

Refrigeration cycle system of integrated air conditioner (warming and cooling) of JAC vehicle mainly consists of compressor, compressor exhaust hose, condenser assembly, reservoir, HP hose, F type expansion valve, evaporator assembly, and LP hose. The reservoir assembly includes internal drier and filter etc., as well as HP/LP pressure switches, sight mirror and fusible plug installed on casing.

1.2 Refrigerating principle

The compressor sucks in and compresses low temperature, low pressure refrigerant gas to generate high temperature, high pressure refrigerant gas, which will be sent to condenser via HP hose for condensing, releasing heat to air passing condenser and being condensed to high pressure medium temperature liquid. This liquid flows to the reservoir where impurities in refrigerant are filtered and water content is removed, and then flows to expansion valve via HP hose, where it is changed to low pressure, low temperature liquid-gas mixture by throttling and depressurizing effect of the valve, and then enters the evaporator. This mixed refrigerant will evaporate in the evaporator and absorb heat from air inside vehicle and flowing pass the evaporator to become superheated gas, which will enter compressor for next refrigeration cycle. Air inside vehicle passing the evaporator will discharge heat to the evaporator and become cold air. In addition, since temperature of evaporator surface is lower than air dew point, water vapor in air will condense to become dew that will be drained outside the vehicle, hence reducing temperature and humidity of air inside vehicle. Fig.1 shows air conditioning refrigeration schematic diagram.

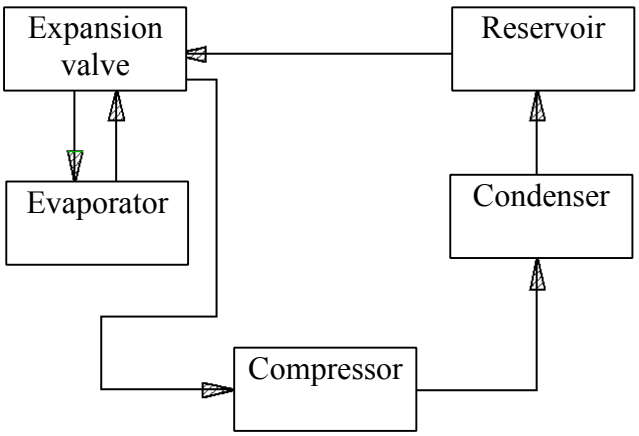


Fig.1 Air conditioning refrigeration schematic diagram

2. Air conditioning warming cycle

2.1 Main parts of warming system

Warming cycle system of integrated air conditioner (warming and cooling) of JAC vehicle mainly consists of warm air blower, engine, water pump, water valve, water tank and pipelines etc.

2.2 Warming principle

By means of a water pump, hot coolant of engine is pumped into warm air blower core, where heat exchange occurs to release heat to air inside vehicle. Later, this coolant returns to the water tank and enters next warming cycle.

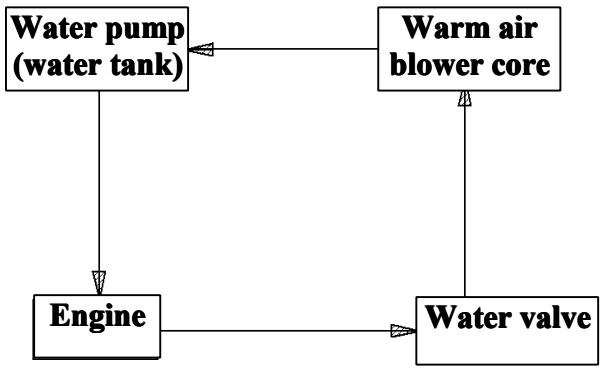


Fig.2 Air conditioning warming schematic diagram

3. Electric control

3.1 Main parts of electric control

The electric control mainly consists of power supply switch, electromagnetic clutch, controller, defrosting thermistor, defrosting temperature controller, HP/LP pressure switches, electric control box, governing resistor, and connection harness etc.

3.2 Electric control principle

The controller is the control center of air conditioning (refrigerating and warming parts). Electronic elements in the electric control box are used to control On/Off of refrigerating and warming, and adjustment of AC fan rotation speed and temperature.

The power supply switch is used to control driving power of the air conditioning. This switch is a mina part of the controller and functions to turn AC on or off (also referred to as A/C switch). At gears 1, 2, 3 and 4, refrigeration will be executed.

3.2.1 Temperature control

The defrosting thermistor is a control element that senses temperature of discharged air from evaporator. It directly converts temperature to electric signal and transmits

this signal to the defrosting temperature controller inside electric control box. The defrosting temperature controller receives electric signal from defrosting thermistor and control On/Off of compressor EM clutch according to set parameters (i.e. On/Off of air conditioning refrigeration cycle), so as to control temperature inside the vehicle.

The electric control box is the execution center of air conditioning control. It receives commands from controller and feedback electric information from defrosting thermistor, and uses internal relays to control On/Off of compressor clutch.

3.2.2 Pressure protection control

The HP/LP pressure switch is a safety part used to ensure safe operation of refrigeration system. When the high pressure is ≥3.14MPa or low pressure is ≤0.2MPa, this switch will be turned off, disengaging compressor clutch and stopping the refrigeration system. When system high pressure falls to 2.5MPa or system low pressure rises to 0.23MPa, this switch will be turned on, engaging compressor clutch and starting the refrigeration system.

Technical parameters

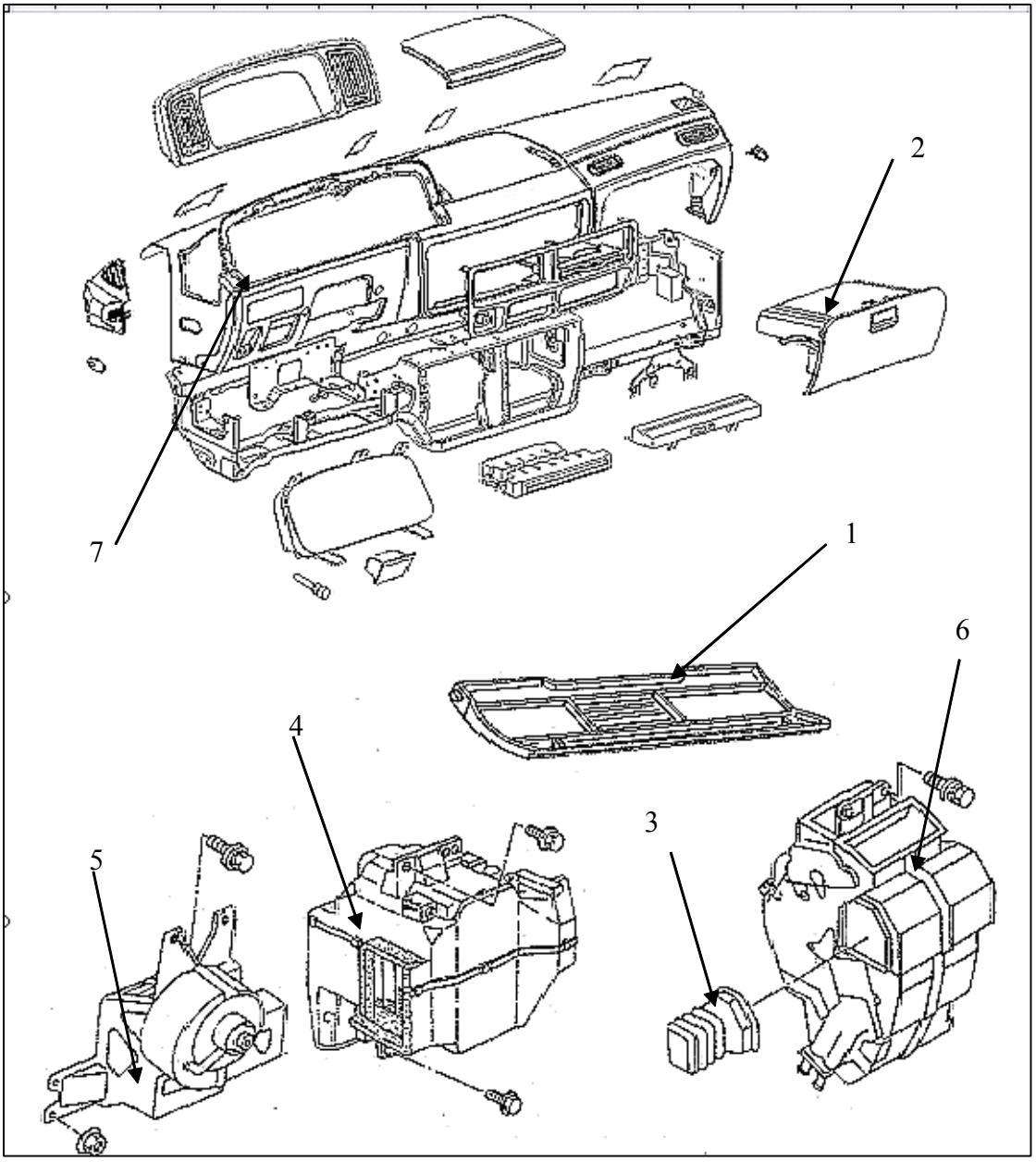
1. Technical parameters

S/N	General item	Sub-item	Parameter
1	Cooling medium	Code	R134a
		Amount of filling	0.85kg
2	Refrigerating oil	Code	PAG56
		Amount of filling	150g
3	Compressor	Model	5H14
		Voltage	12V
		Displacement	138cm^3/r
4	Condenser with reservoir assembly	Condenser heat sinking capacity	9000W
		Voltage	12V
		Maximum current	15A
		Air flow	1800m^3/h
5	Front evaporator/ heater assembly	Refrigerating capacity	3900W
		Heating capacity	4000W
		Voltage	12V
		Maximum current	18A
		Air flow	350m^3/h
7	2-state pressure switch	High pressure protection characteristics	Disconnected at ≥3.14Mpa Connected at ≤2.5Mpa
		Low pressure protection	Disconnected at

		characteristics	≤0.2Mpa Connected at ≥0.23Mpa

2. Structure of main parts of air conditioning

2.1 Heating equipment, blower equipment and evaporator

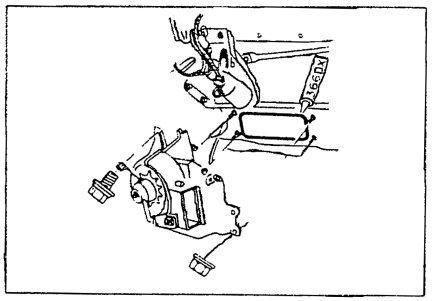


1. Lower cover; 2. Fuse and relay box; 3. Ventilating air duct; 4. Evaporator; 5. Blower; 6. Heating equipment; 7. Instrument stand

For removal of heating equipment, blower and evaporator from instrument stand, follow this sequence: 1. lower cover 2. fuse and relay box 3. →ventilating air duct→ 4. evaporator →5. blower → 6. heating equipment.

Sequence of assembling is the reverse of this sequence. For tightening torques, refer to the table below:

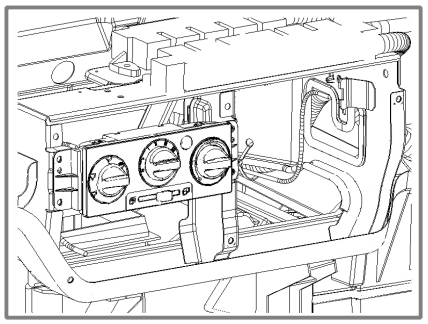
Diameter of thread (mm)	Pitch (mm)	Tightening torque (N·m) Standard value	Maximum	Minimum
6	1	9	12	6
8	1.25	23	26	16
8	1	25	28	17
10	1.5	59	75	37
10	1.25	63	79	45
10	1	64	80	46
12	1.75	95	111	73
12	1.5	97	113	75
12	1.25	99	115	78



Important operation-assembling

● To assembly blower, prevent water leakage.

Sealant	Butyl rubber (none-dry type)

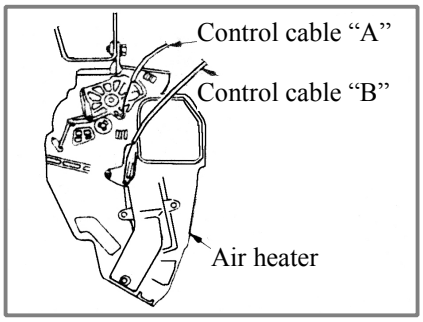


Air conditioning panel

● Turn mode handle to left most (FACE direction);

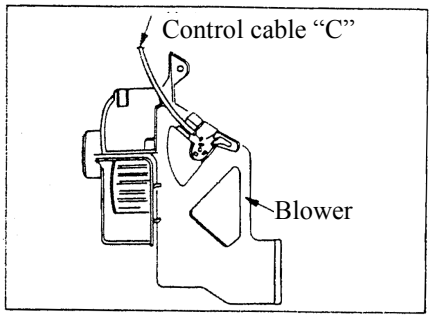
● Turn temperature lever to left most (COLD direction);

● Turn inner/outer air control lever to left most (INSIDE direction)



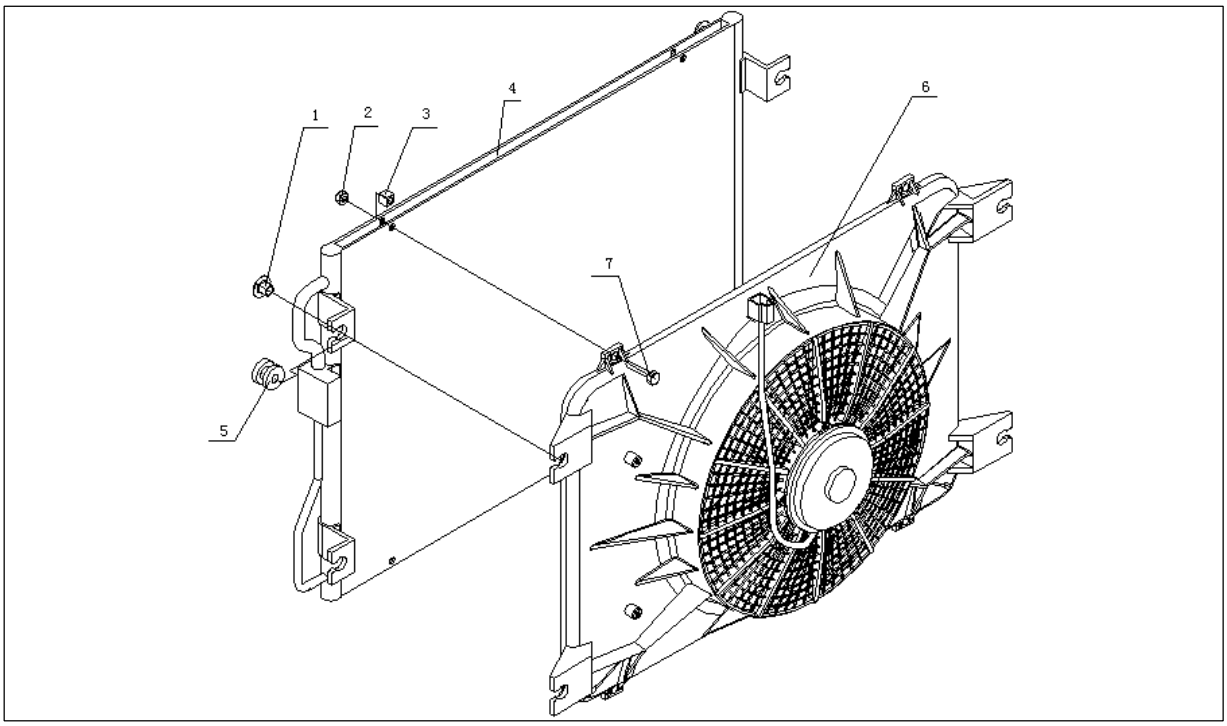
● Hang control cable “C” on blower clip, press butterfly nut to bottom and fix cable on clip;

● Hang control cable “B” on heater clip, press butterfly nut to bottom and fix cable on clip.



Hang control cable “C” on blower clip, press butterfly nut to bottom and fix cable on clip

2.2 Structure of condenser assembly

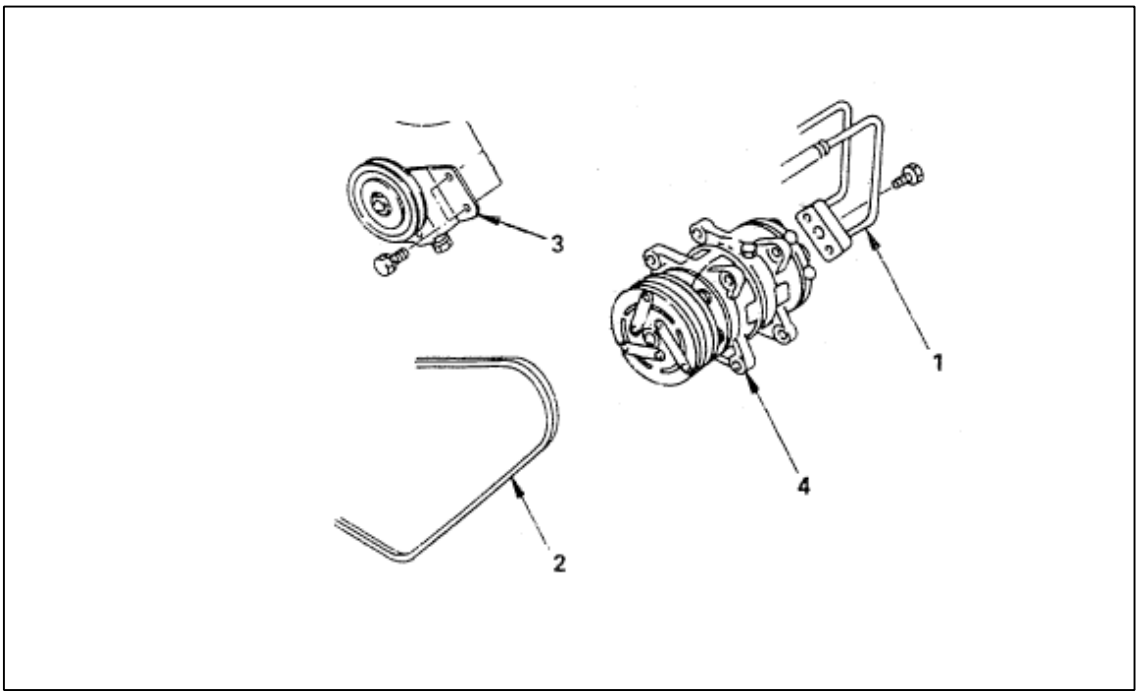


1. Condenser damping pad sleeve;
2. Hex flanged face nut;
3. Pad;
4. Condenser core;
5. Condenser damping pad;
6. Condensing fan assembly;
7. Bolt combination

Important operations

1. When removing pipe from each device, avoid damaging connecting nut or the pipe.
2. Cover pipe port with plastic cloth to avoid ingress of dust in pipe.

2.3 Disassembling and assembling of compressor



Disassembling sequence:	Assembling sequence:
1. Pipe	4. Compressor
2. Belt	3. Idler
3. Idler	2. Belt
4. Compressor	1. Pipe

Important operations

1. To remove pipe from each device, avoid damaging connecting nut or the pipe.

2. Cover pipe port with plastic cloth to avoid ingress of dust in pipe.

Operation prompts

1.1 To avoid accidents and ensure safety of relevant personnel, non-discipline personnel must not perform disassembling or repair.

1.2 Use of open flame or smoking is prohibited.

1.3 Always wear working clothes during working. Ensure intact protective devices.

1.4 Perform operation in a weld ventilated environment.

1.5 Before starting the engine, confirm that there is no tool, measuring instrument or other part on moving and rotating parts, and parts through which electric current flows.

1.6 Before start of engine, blow horns to warn operating workers and confirm safety.

1.7 To check electric lines, take care not to touch terminals or other parts through which electric current flows; otherwise short circuit may occur due to human body or

other part.

1.8 Use fuses of rated capacity. Avoid burning of electric devices such as relay and fire.

1.9 When using hose and hard pipeline, take care to avoid leakage of gas.

1.10 Thoroughly clean dust at hose or hard pipeline connecting part and inside pipelines; prevent gas leakage and abnormal operation.

1.11 Avoid water or oil etc. on fan, fan motor or V belt, so as to prevent damage and fire.

1.12 Before shutdown of air conditioner is confirmed, do not touch belt or fan to avoid injury.

1.13 Do not place refrigerant cans on engine or radiator, so as to prevent serious accident.

1.14 Do not subject refrigerant cans to direct sunshine, moisture, or temperatures exceeding 40℃, so as to prevent serious accident. Store these cans at a cool and dry place.

1.15 Store refrigerant cans where no fierce collision with other hard matter or iron ware etc. will occur, so as to avoid serious accident.

1.16 When handling refrigerant gas, wear protective goggles to avoid injury of eyes. In case such gas enters the eye, timely wash with large amount of clear water to prevent frostbite; if serious, go to hospital at once.

Items that must be inspected before AC system maintenance or diagnosis

2.1 Visually check hoses for damage and friction.

2.2 Ensure that condenser fins are not blocked by insects, impurities and dirt etc.,

2.3 And that fins have no apparent falling.

2.4 Correct operating direction of condenser fan.

2.5 No overheating of engine water tank.

2.6 Check tension of driving belt and for damage.

2.7 Operation of compressor.

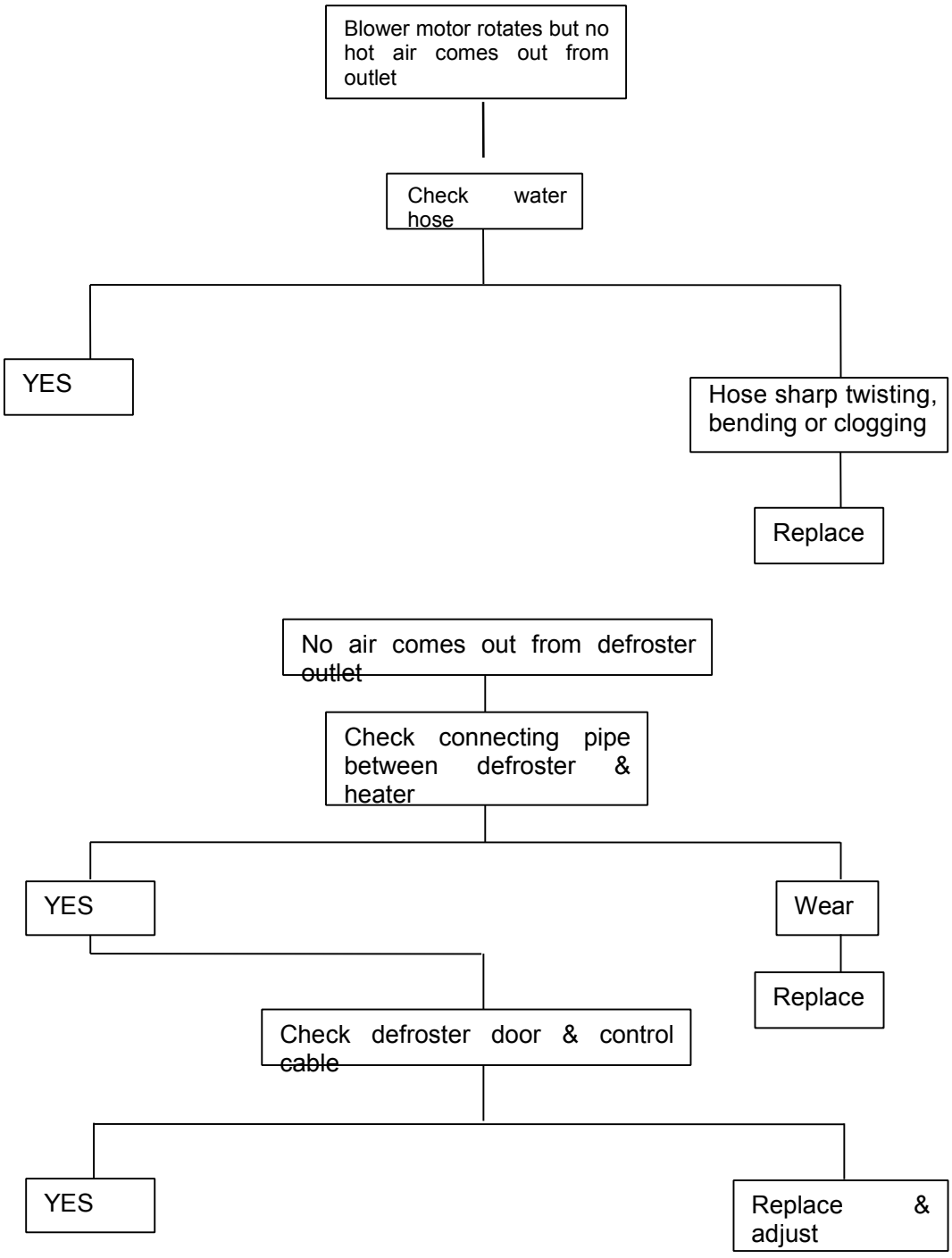
2.8 Check for clogging of evaporator drain hose.

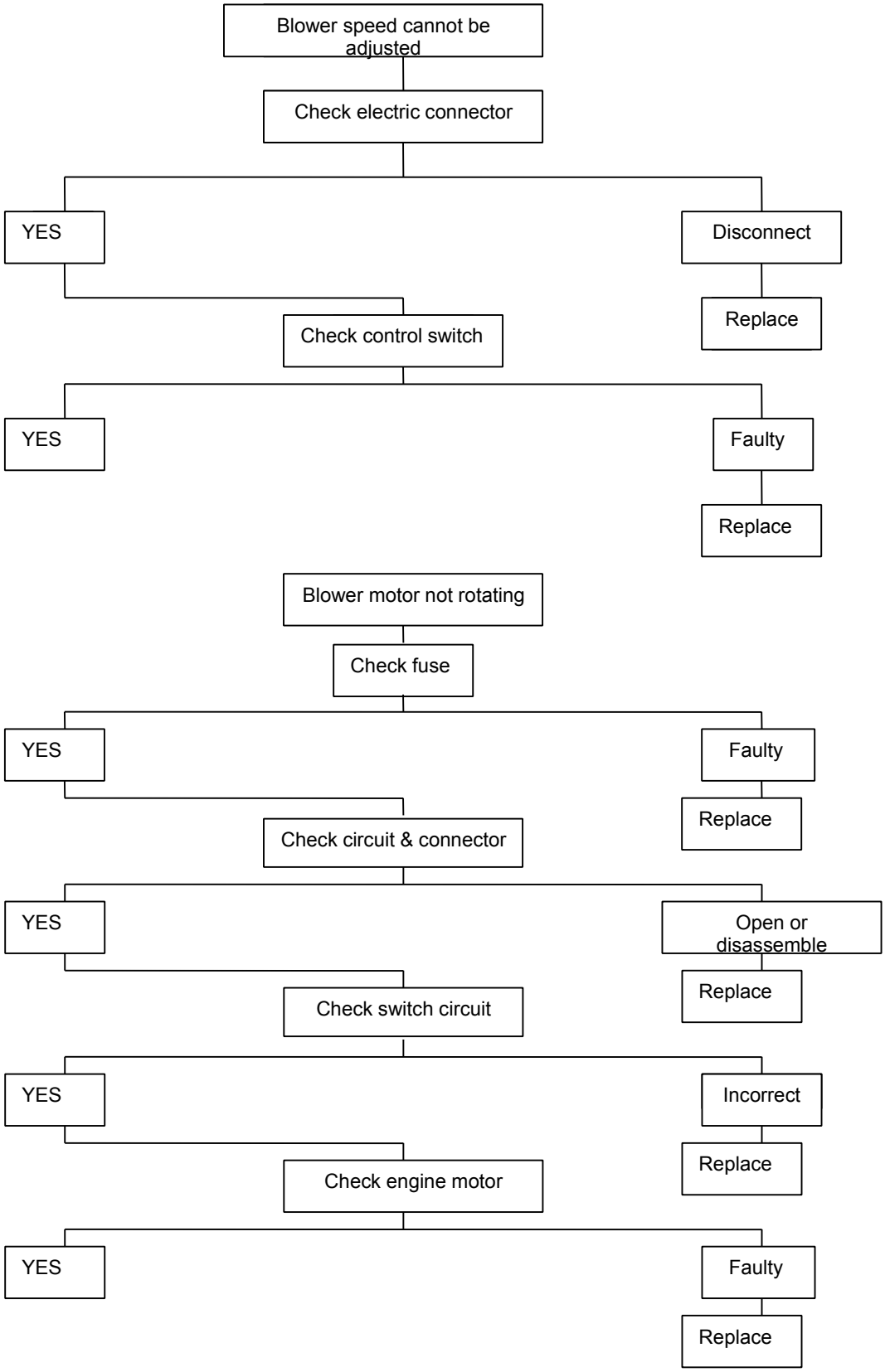
2.9 Check free action of switch at each air outlet.

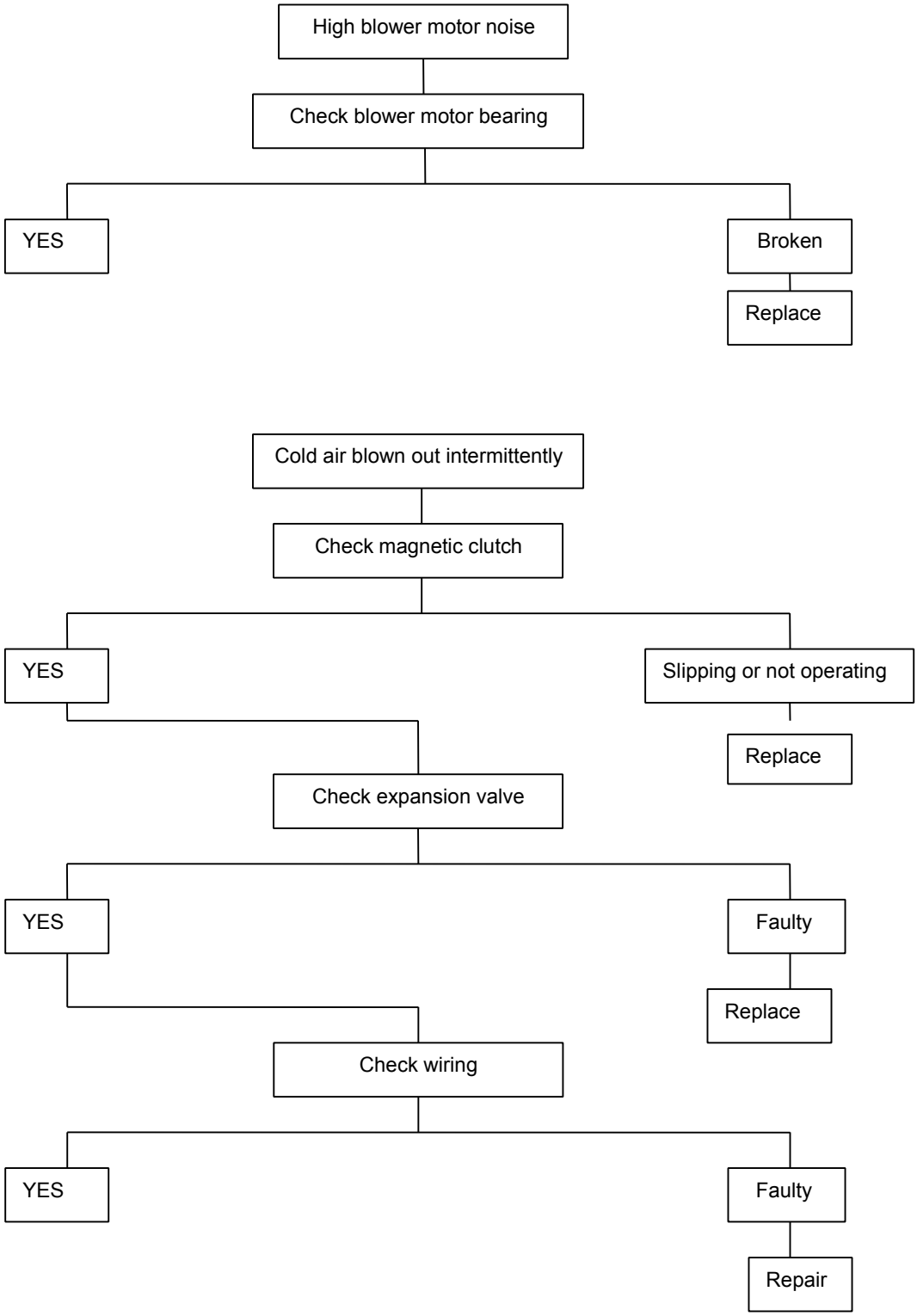
2.10 Check if blower and evaporator fan can operate at specified fan speed.

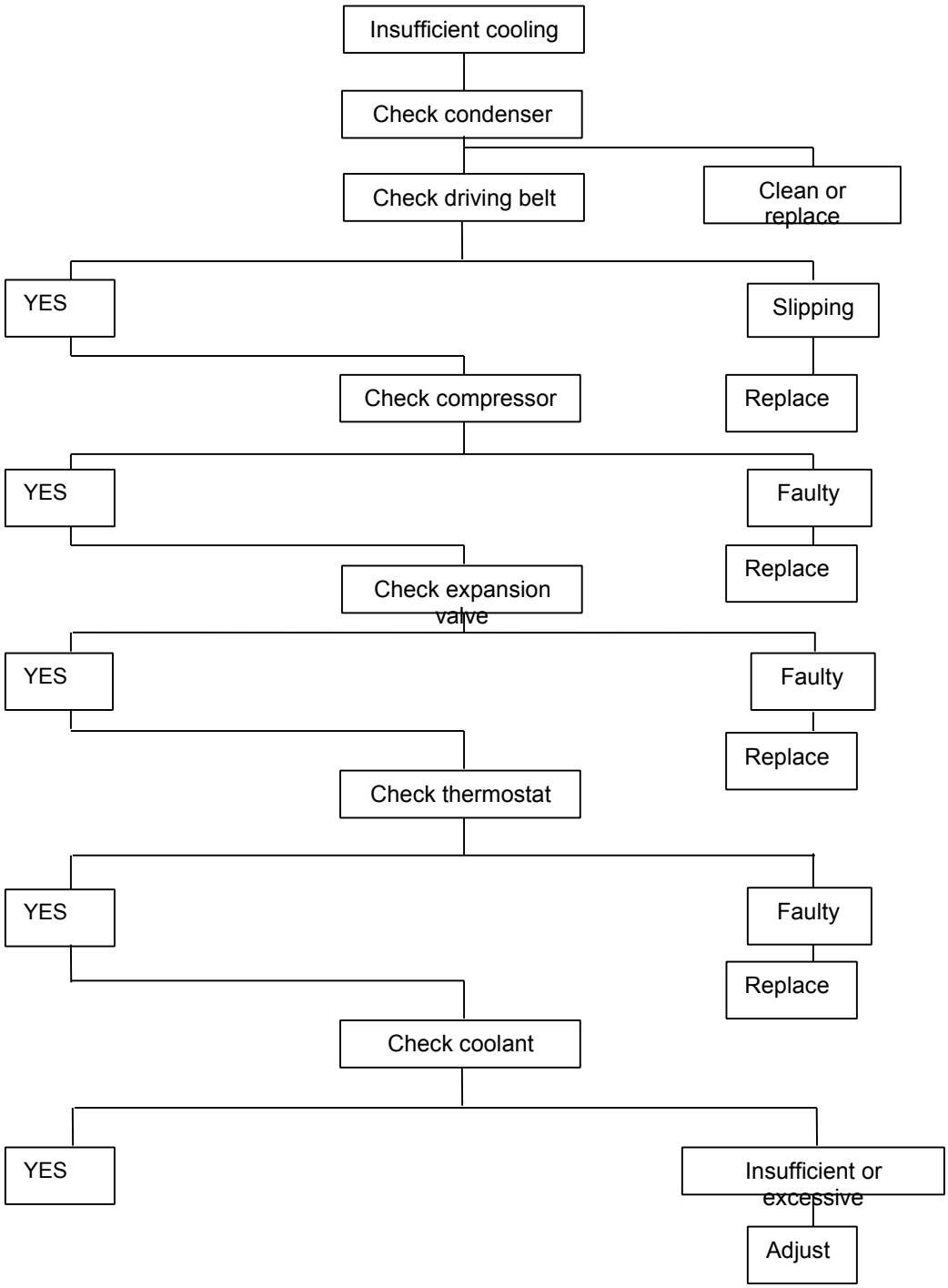
2.11 Check that there is no apparent refrigerant leakage or oily dirt on device or pipeline connector.

Troubleshooting




Blower speed cannot be adjusted
Check electric connector
YES
Disconnect
Check control switch
Replace
YES
Faulty
Replace
Blower motor not rotating
Check fuse
YES
Faulty
Replace
Check circuit & connector
YES
Open or disassemble
Replace
Check switch circuit
YES
Incorrect
Replace
Check engine motor
YES
Faulty
Replace


High blower motor noise
Check blower motor bearing
YES
Broken
Replace
Cold air blown out intermittently
Check magnetic clutch
YES
Slipping or not operating
Replace
Check expansion valve
YES
Faulty
Replace
Check wiring
YES
Faulty
Repair


Insufficient cooling
Check condenser
Check driving belt
Clean or replace
YES
Slipping
Check compressor
Replace
YES
Faulty
Replace
Check expansion valve
YES
Faulty
Replace
Check thermostat
YES
Faulty
Replace
Check coolant
YES
Insufficient or excessive
Adjust

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CABIN

Front wall

Front windshield glass

Rear windshield glass

Instrument desk

Ceiling inner trim

Ceiling ventilation

Door

Seat

Seat safety belt

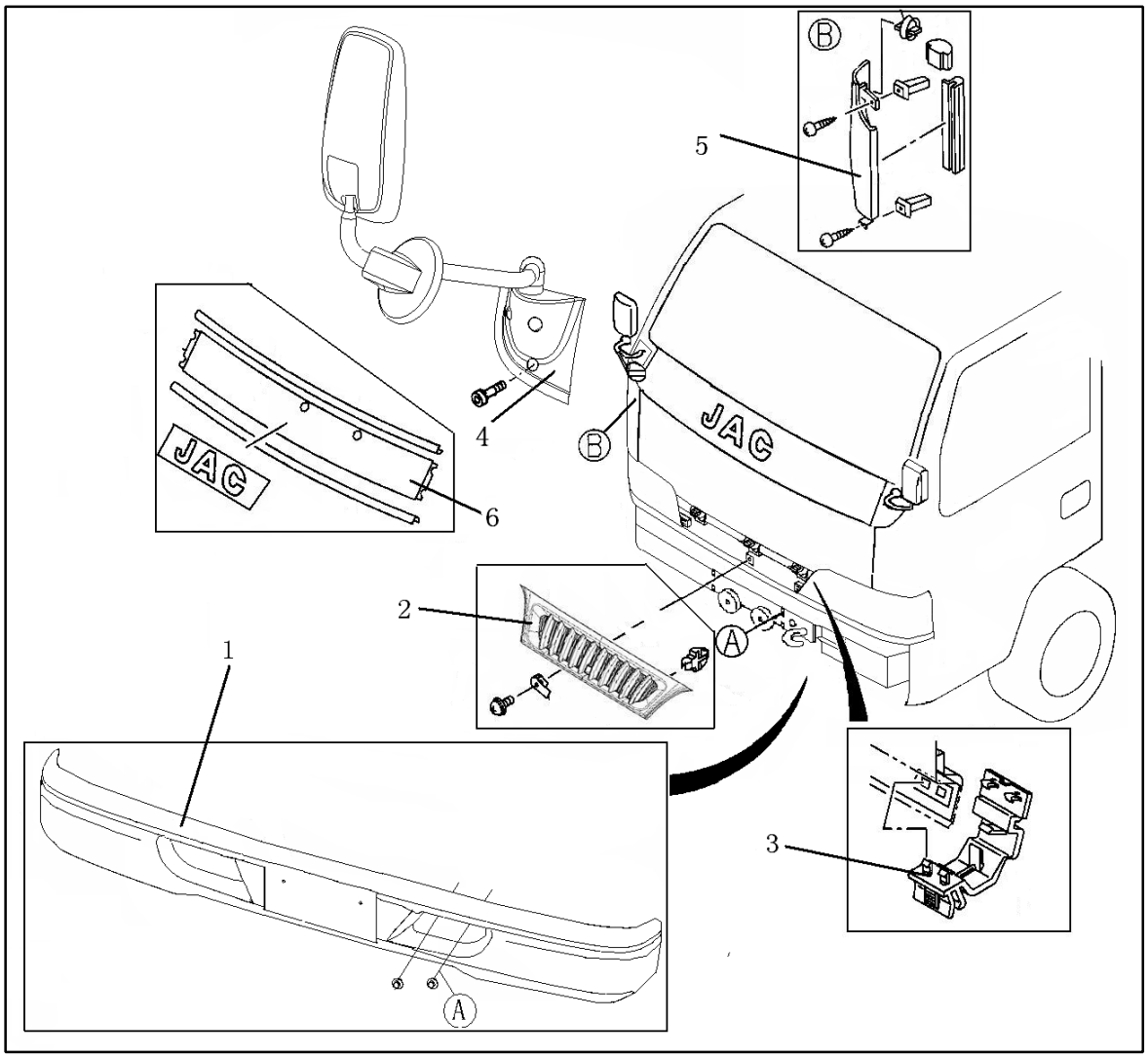
Disassembling and assembling of tilting mechanism

Disassembling and assembling of lock mechanism

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Front wall parts

Disassembling and assembling



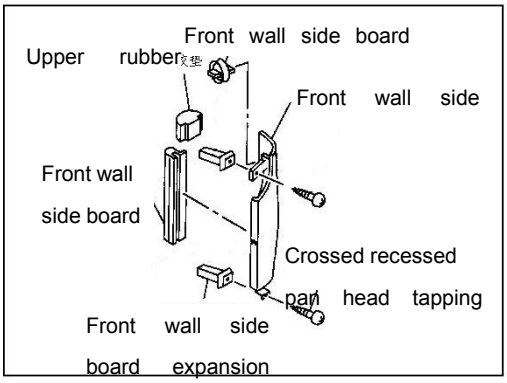
Disassembling sequence

1. Front bumper assembly
2. Veil
3. Clip on veil
4. External rear view mirror assembly
5. Front wall side board assembly
6. Front wall trim board

Assembling sequence

▲5. Front wall side board assembly
6. Front wall trim board
4. External rear view mirror assembly
3. Clip on veil
1. Bumper assembly
2. Veil

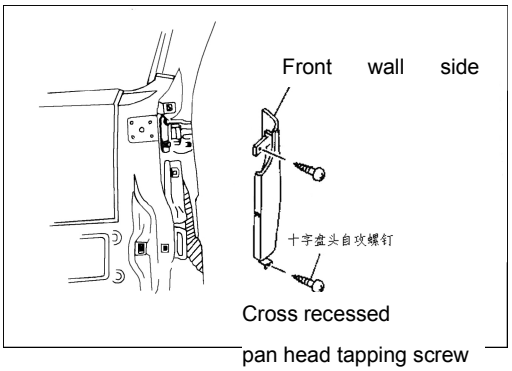
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Important operation--assembling

5. Front side board

- Use 507 glue to stick upper/lower rubber pads on front wall side board
- Use 507 glue to stick front wall side board rubber strip on front wall side board side
- Install front wall side board clip on door column.



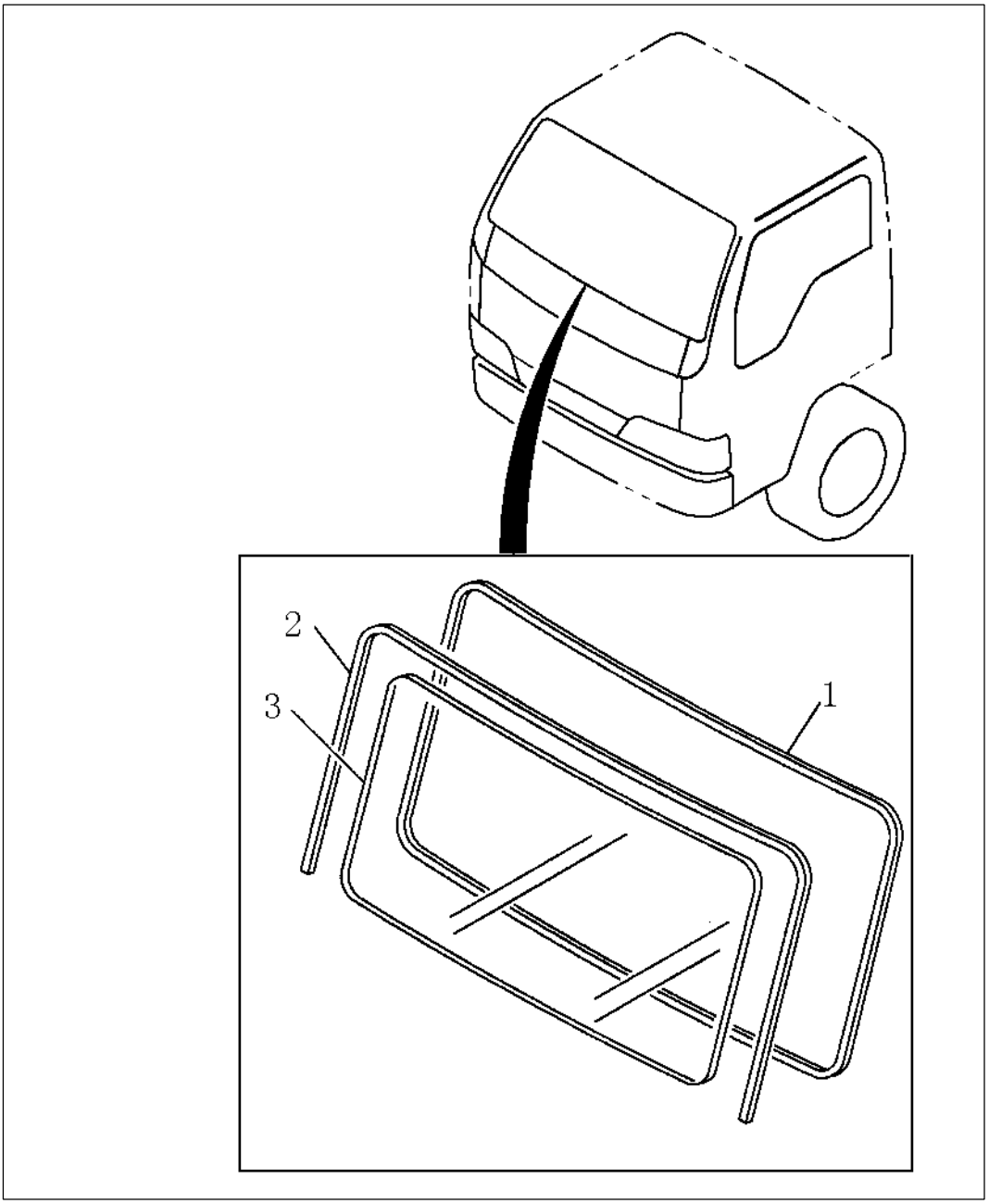
5. Install front wall side board assembly on door column.

Install front wall side board sleeve on front wall side board clip (use cross recessed pan head screw for fixing)

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Front windshield glass

Disassembling and assembling



Disassembling sequence

▲ 3. Front windshield glass

2. Front windshield front rubber strip

1. Front windshield inner rubber strip

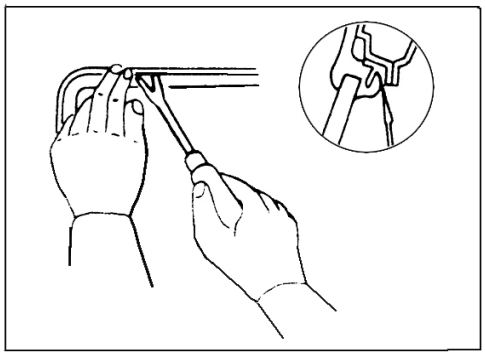
Assembling sequence

1. Front windshield inner rubber strip

2. Front windshield front rubber strip

▲ 3. Front windshield glass

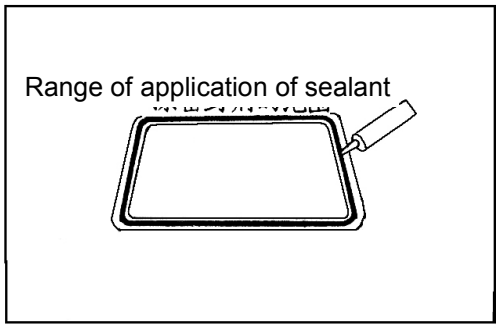
https://truckmanualshub.com/



Important operation---disassembling

1. Front windshield glass

- Tear out sealing strips from upper flange and each corner of vehicle body flange, and then slowly push out and remove the glass. Do not touch glass surface.
- Use gasoline to wash sealant on vehicle body.

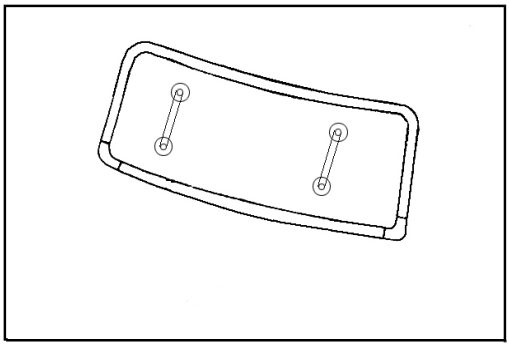


Important operation---assembling

3. Front windshield glass

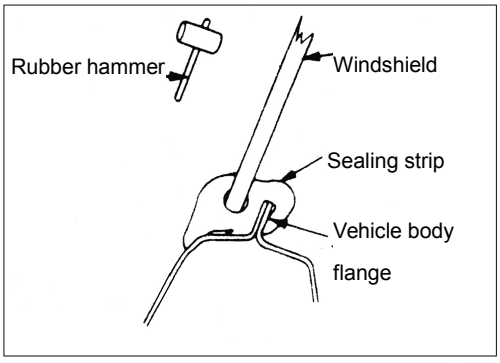
- As shown in left figure, apply enough sealant on flange (about 10mm dia.). If not enough, water leakage may occur.

Sealant	Single component polyurethane glass glue



3. Windshield assembly

- Stick windshield glass on cab proper front windshield flange.

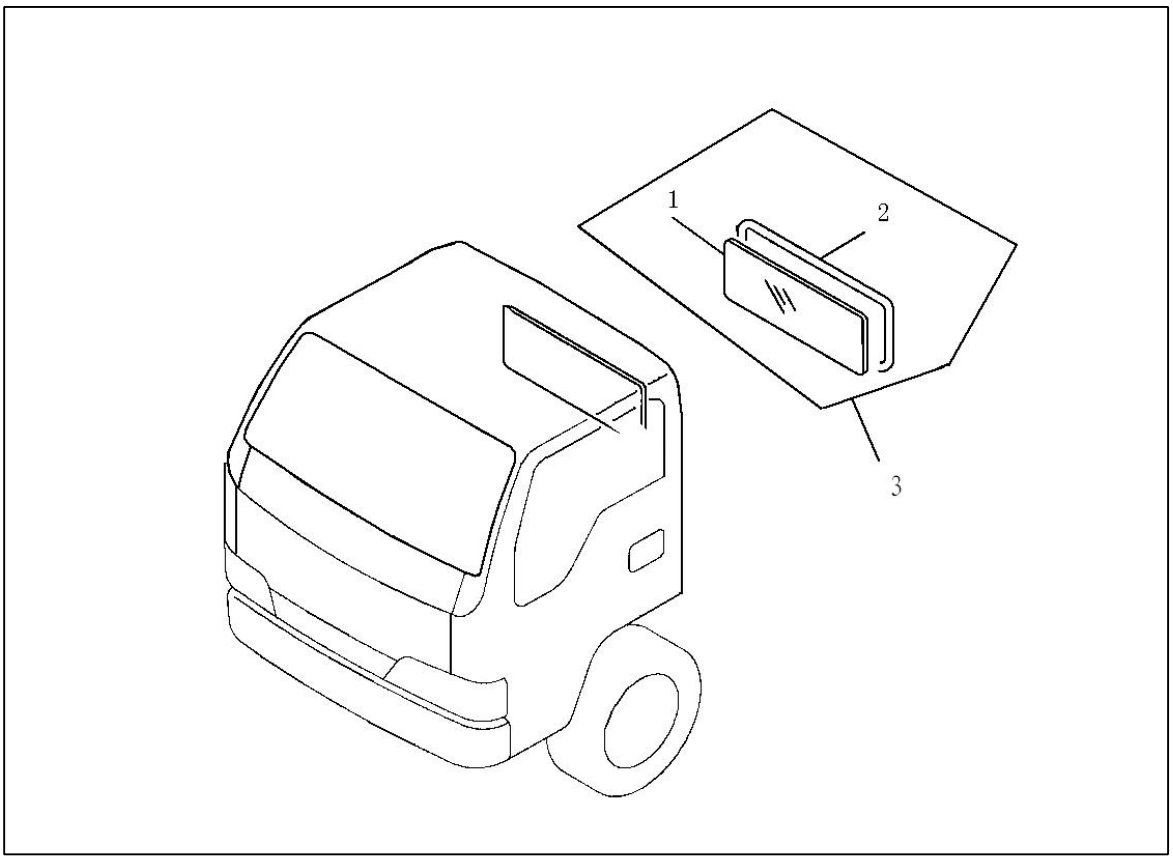


- Lightly tap glass with rubber hammer so that vehicle body flange is in full contact with sealing strips.

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Rear windshield glass

Disassembling and assembling



Disassembling sequence

▲ 3. Rear windshield assembly

2. Rear windshield rubber strip

1. Rear windshield glass

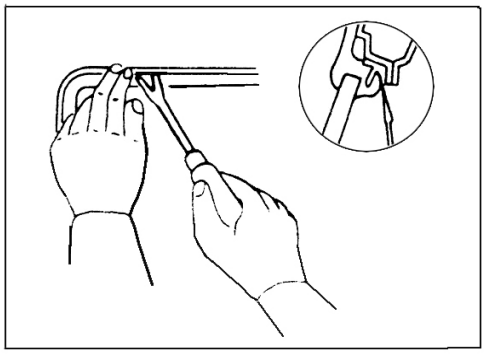
Assembling sequence

1. Rear windshield glass

▲2. Rear windshield rubber strip

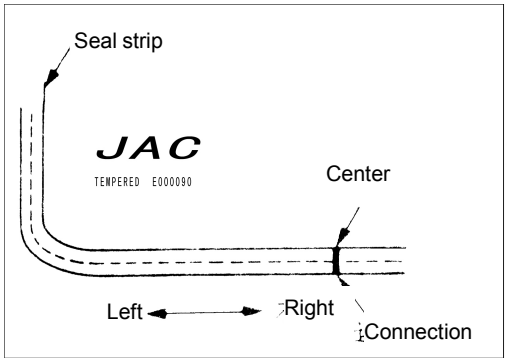
▲ 3. Rear windshield assembly

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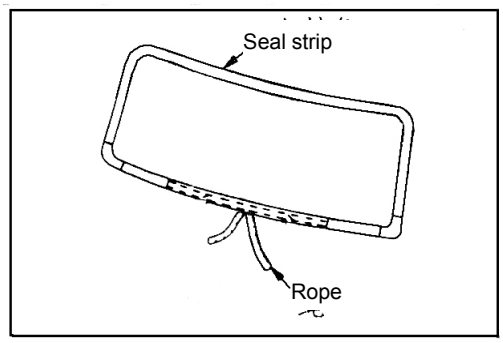
Important operation --disassembling

1. Rear windshield assembly
   - Remove sealing strips from upper flange and each corner of flange, then slowly push out and remove the glass. Do not touch coated surface or glass.

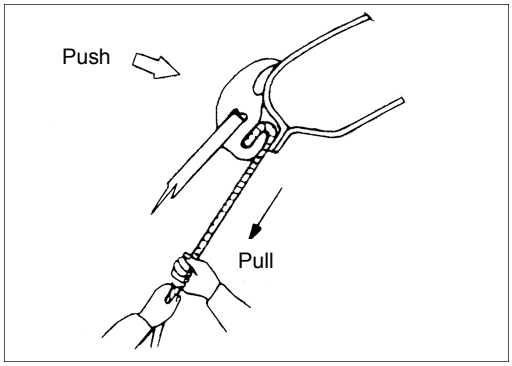


Important operation ---assembling

2. Sealing strip
   - Place glass brand position at left lower corner. Adjust glass center to align with seal strip lower connector.



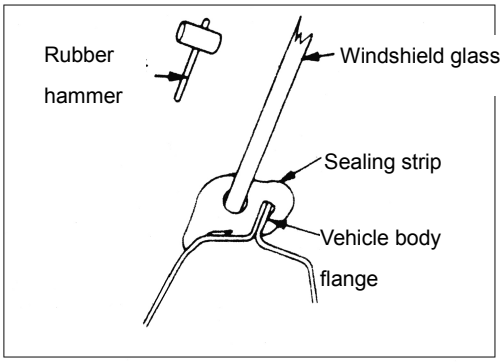
- Thread Φ5-6mm rope in the flange. Wind rope for one round for coinciding at lower center of glass.



1. Rear windshield assembly

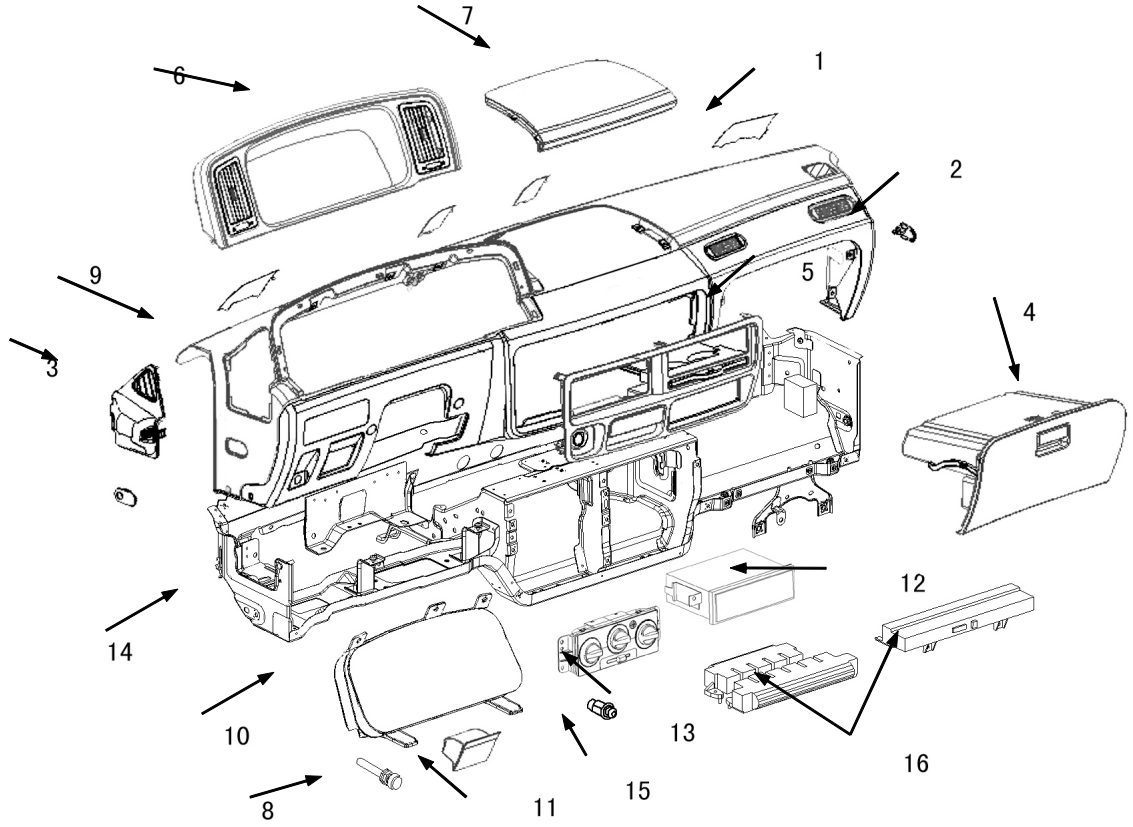
- Adjust glass so that it is at center of windshield. Press glass from outside, then pull rope toward glass center from inside. Stick rear windshield rubber strip on vehicle body flange.

Avoid twisting of strip and mismatching with rear windshield; otherwise water leakage may occur.



- Lightly tap glass with rubber hammer so that vehicle body flange is in full contact with sealing strips.

Instrument desk



Disassembling

Disassembling sequence

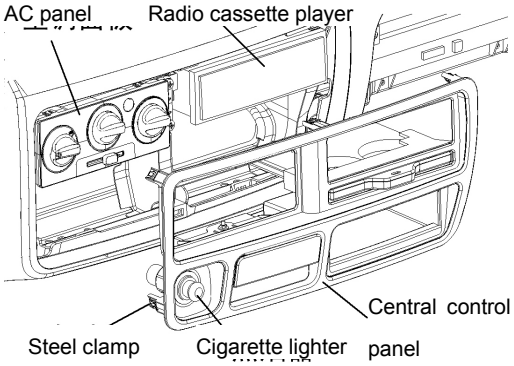
1. Instrument desk front cover plate
2. Instrument desk side end cover
3. Brake oil pot cover
4. Glove box
5. Central control panel
6. Instrument hood
7. Relay box cover
8. Idling button
9. Instrument desk cover
10. Combination instrument
11. Left ash tray
12. Radio cassette (or CD) player
13. Air conditioning panel
14. Instrument desk frame
15. Cigarette lighter
16. Fuse box and relay box

Reassembling

Assembling sequence

16. Fuse box and relay box
15. Cigarette lighter
14. Instrument desk frame
13. Air conditioning panel
12. Radio cassette (or CD) player
11. Left ash tray
10. Combination instrument
9. Instrument desk cover
8. Idling button
7. Relay box cover
6. Instrument hood
5. Central control panel
4. Glove box
3. Brake oil pot cover
2. Instrument desk side end cover
1. Instrument desk front cover plate

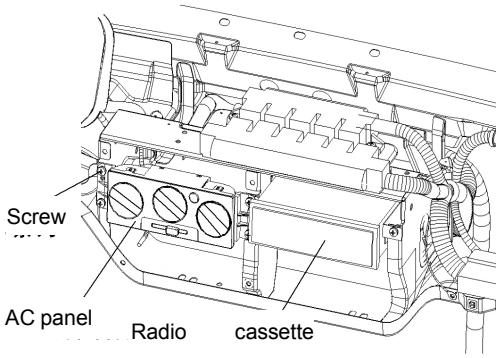
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Important operation-- disassembling

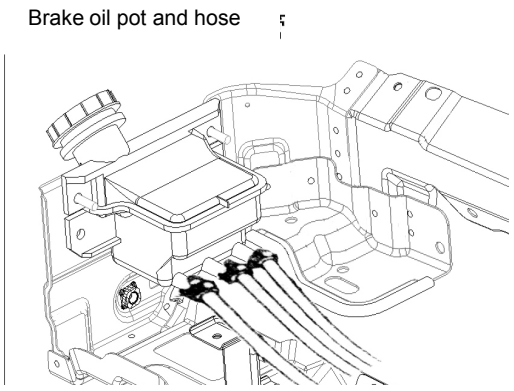
5. Central control panel

- Remove central control panel (do not touch the panel)
- Remove connector between cigarette lighter and vehicle body harness.



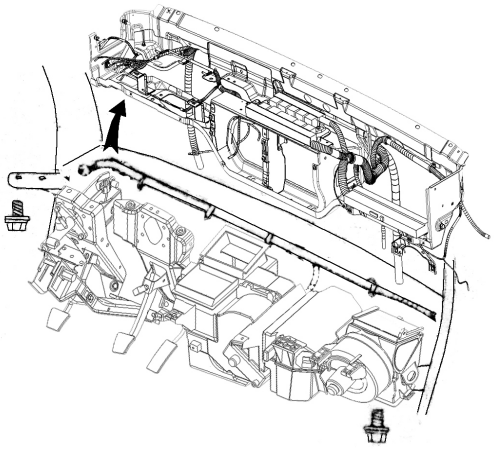
12 & 13. AC panel and radio cassette (or CD) player

- Disconnect each connector of radio cassette (or CD) player and AC control wire
- Remove radio cassette (or CD) player and AC panel



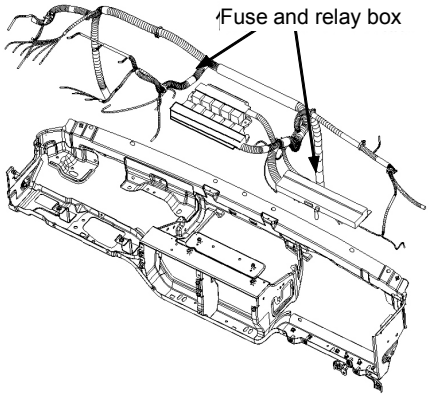
14. Instrument desk frame

- Remove brake oil pot mountings from instrument desk frame. You must first loosen hose and drain oil in the pot; otherwise brake oil may leak.



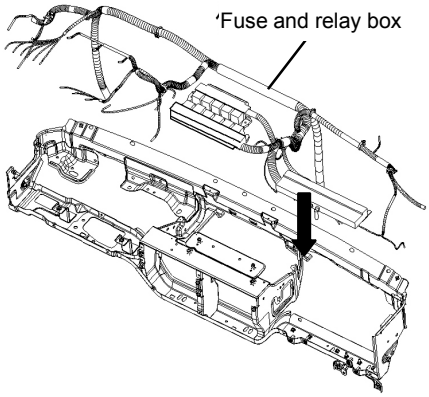
- Disconnect all plugs connected to vehicle body harness
- Remove bolts; do not touch and damage surfaces of other parts

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16. Fuse and relay box

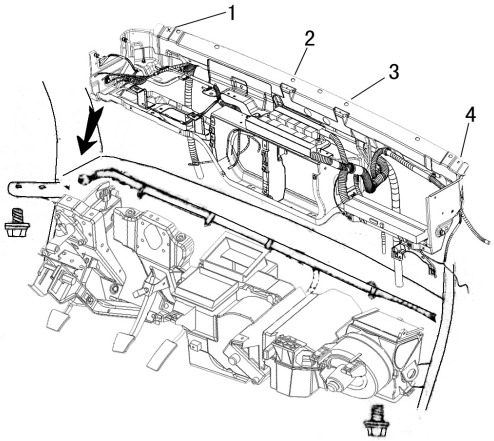
- After removal of instrument desk frame, remove the fuse and relay box installed on this frame, then the vehicle body harness.



Important operation ---assembling

16. Fuse and relay box

- Fit vehicle body harness on instrument desk frame, fix fuse and relay box at its position, and use wire clip to fix harness. Check harness or wire clip, and then connect vehicle body harness with chassis harness.

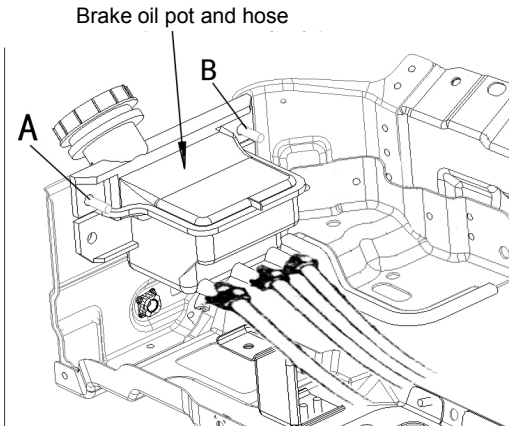


14. Instrument desk frame

- Fit and tighten bolts in holes 1-4 (as shown)
- Fit frame on steering column support, fit and tighten bolts

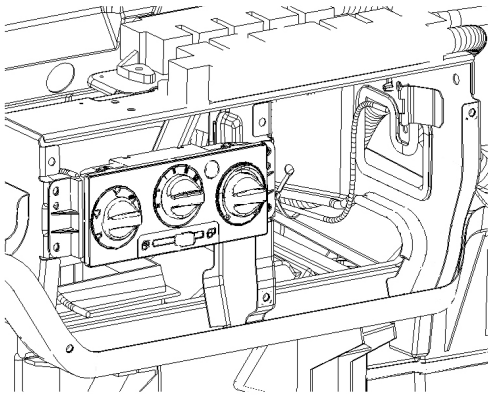
Torque: N·m	8－10

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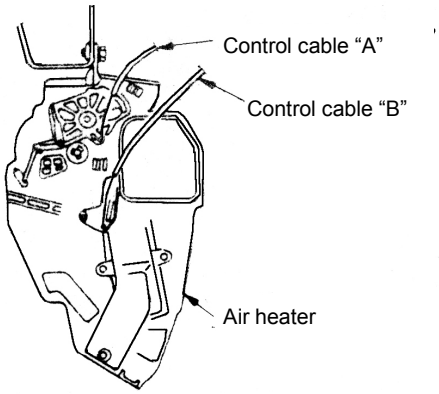
- Fit brake oil pot on instrument desk frame
- Tighten nuts at A and B
- Connect the pot to hose and tighten

Torque: N·m	5—11

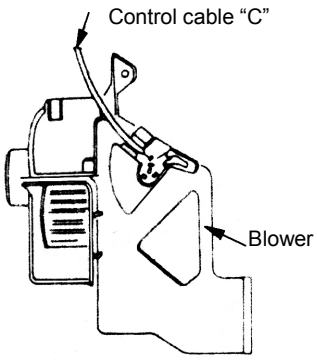


13. Air conditioning panel

- Thread control wire into instrument panel, and then firmly fit AC panel.
- Turn mode switchover knob to left most position (toward FACE direction)
- Turn temperature control knob to left most position (toward COLD direction)
- Turn inner/outer circulation lever to left



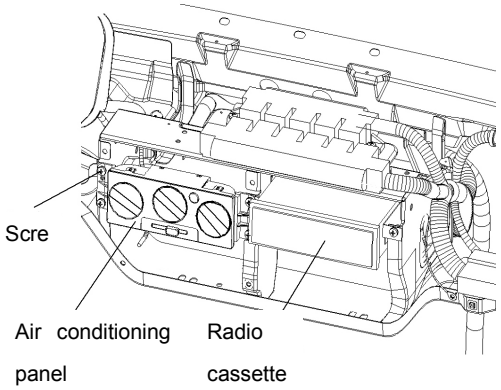
- Hang control cable “A” on blower pawl hook, push butterfly valve to the end, fix electric cable on clip.
- Hang control cable “B” on air heater pawl hook, move butterfly valve to lowest position, fix electric cable on clip.

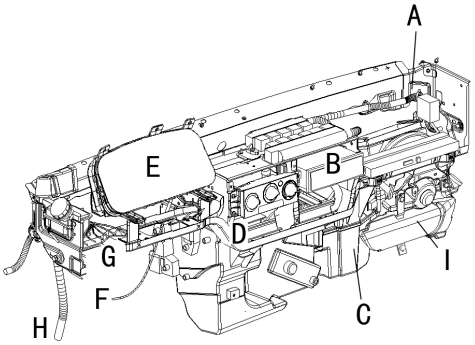


Control cable “C”;

- Hang control cable “C” on blower pawl hook, push butterfly valve to the end, and then fix electric cable on clip.

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12. Radio cassette (or CD) player

- Fit this player inside instrument panel, and then connected harness connector and antenna to rear of the radio
  Make sure to fit firmly to prevent vibration

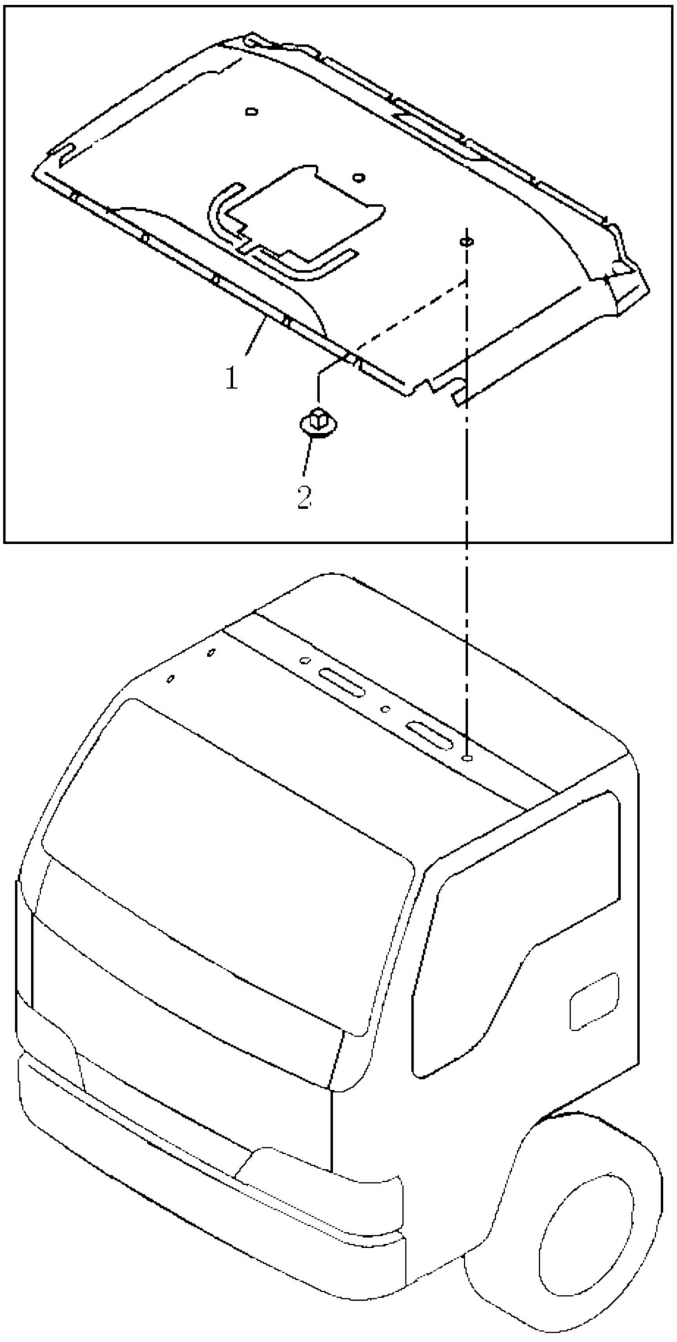
Connect harness at each point below:

A. Antenna cable
B. Radio
C. Blower switch
D. Cigarette lighter
E. Instrument
F. Clutch switch, brake switch, throttle switch
G. Fog light switch, warning switch, warming up switch
H. Combination switch
I. Washer pot

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Ceiling inner trim

Disassembling and assembling



Disassembling sequence

2. Ceiling inner trim buckle
1. Ceiling inner trim

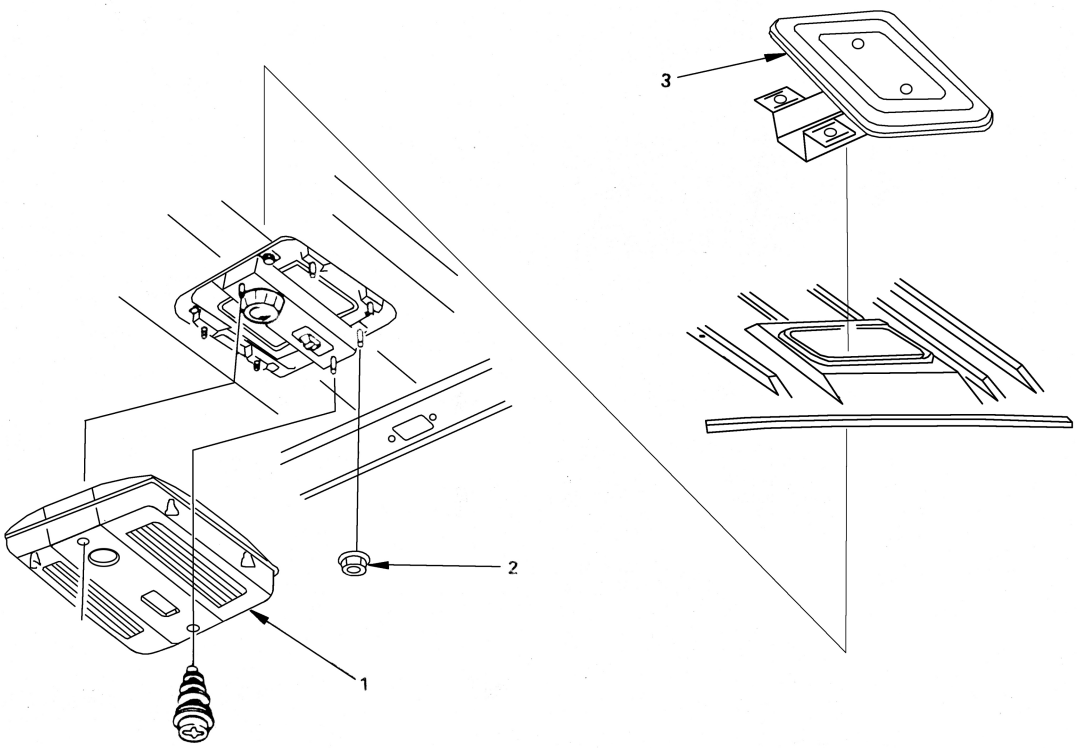
Assembling sequence

1. Ceiling inner trim
2. Ceiling inner trim buckle

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Ceiling ventilation

Disassembling and assembling



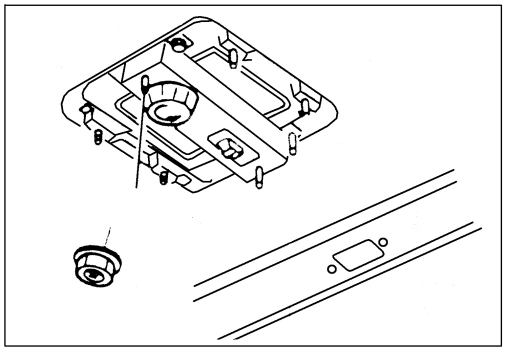
Disassembling sequence

1. Inner cover assembly
▲2. Hex nut
▲3. Outer cover & control assembly

Assembling sequence

▲3. Outer cover & control assembly
▲2. Hex nut
1. Inner cover assembly

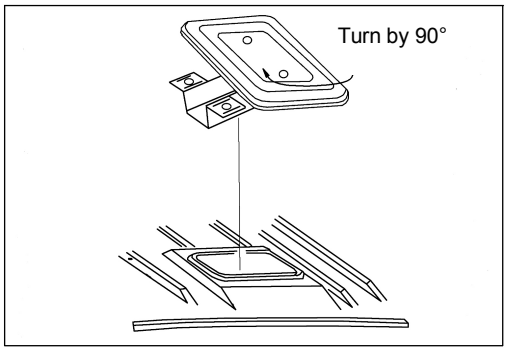
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Important operation --disassembling

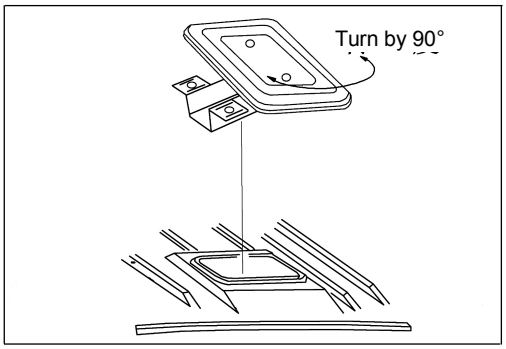
2. Nut

- After removal of nut, place outer cover and control assembly at air inlet



3. Outer cover & control assembly

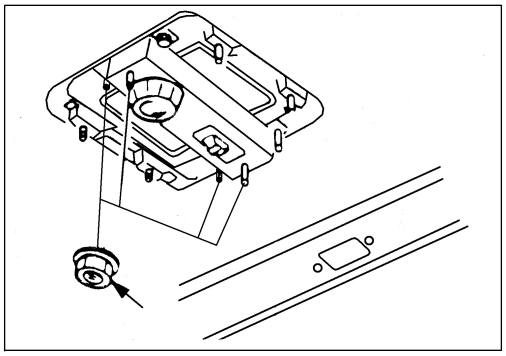
- Move outer cover assembly upward and turn it by 90°, then pull the control assembly out.



Important operation ---assembling

3. Outer cover & control assembly

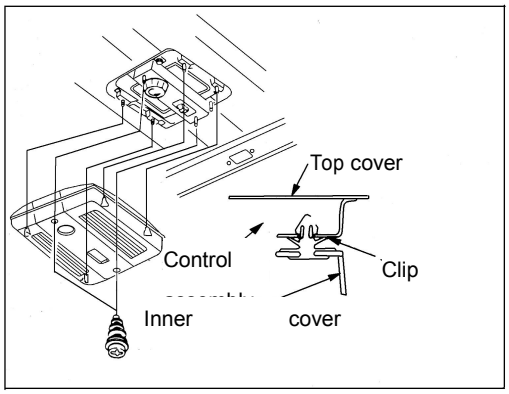
- Place this assembly at air inlet position
- Move outer cover assembly upward and turn it by 90°; install control assembly



2. Hex nut

- At fully open position, tighten the hex nut

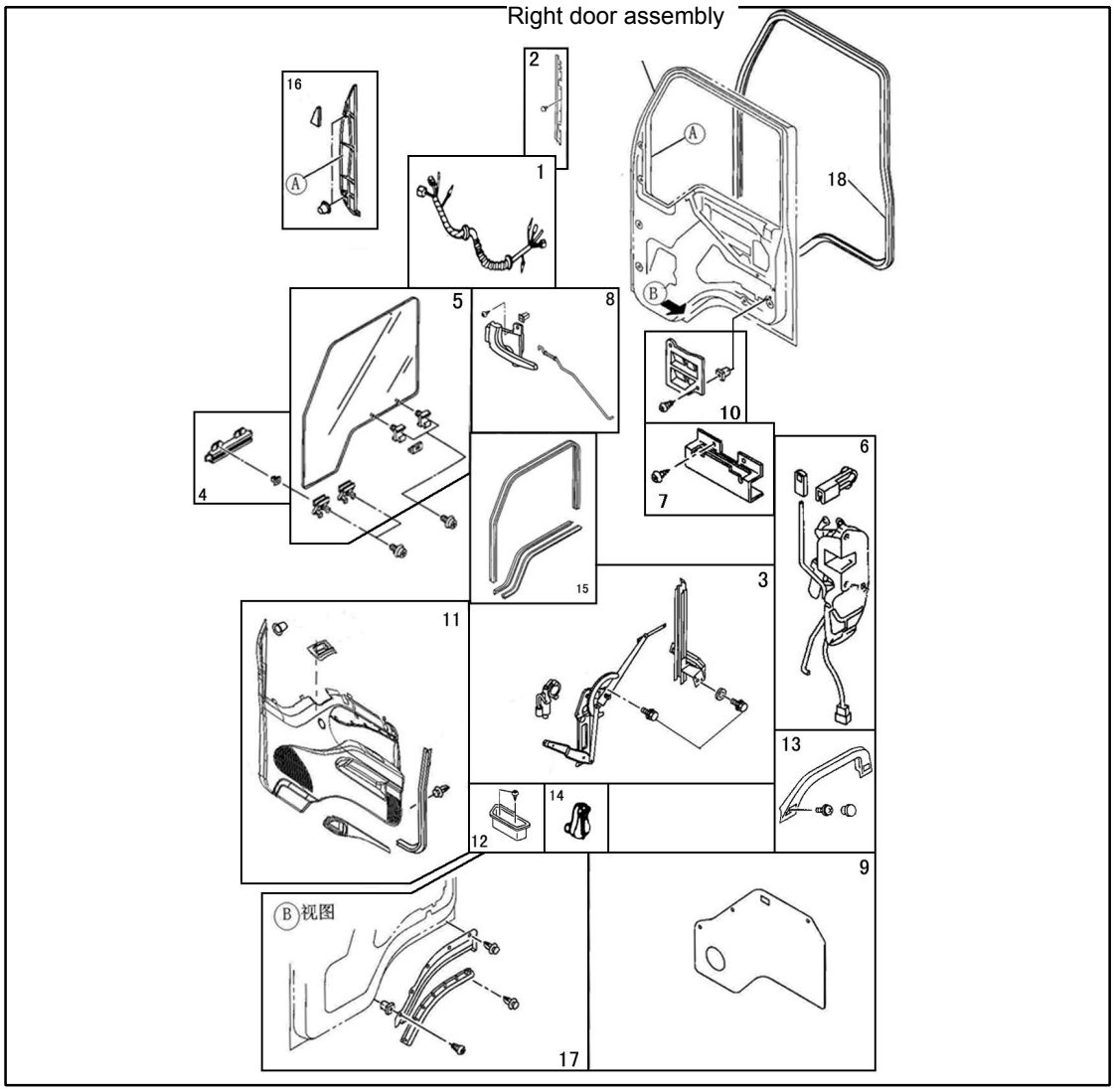
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1. Inner cover assembly

CABIN

Door Disassembling



16. Door outer upper decorating strip
17. Door lower embedded strip, lower rubber strip

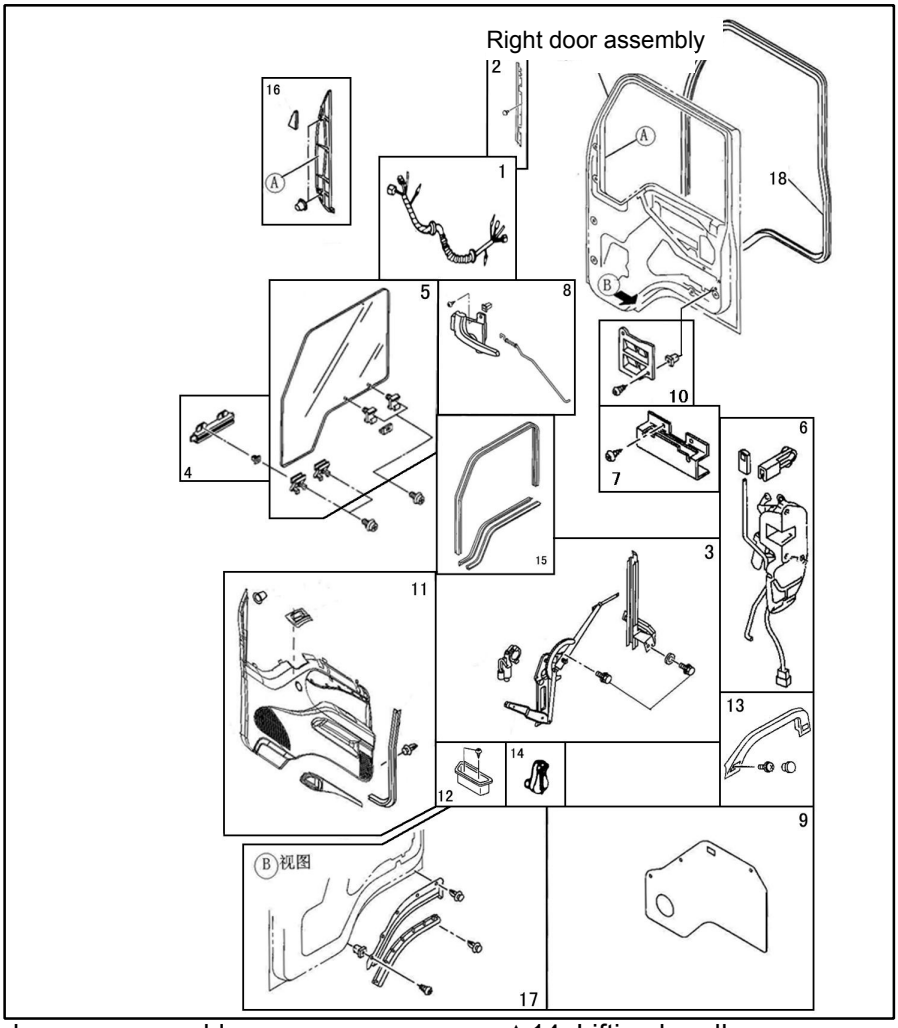
2. Door rubber pad
15. Door glass inner/outer water seal
13. Door large arm rest
12. Door hand catch
14. Lifting handle
18. Door seal strip
11. Door inner trim board
7. Door seal cover plate assembly
9. Door seal membrane
8. Door inner handle
10. Door hand catch bracket
3, 4. Door window lift assembly, front bracket assembly
5. Door window assembly
15. Door glass seal strip
6. Door lock core assembly
1. Door harness assembly

Additional note:

(15. Door glass seal strip, water seal)

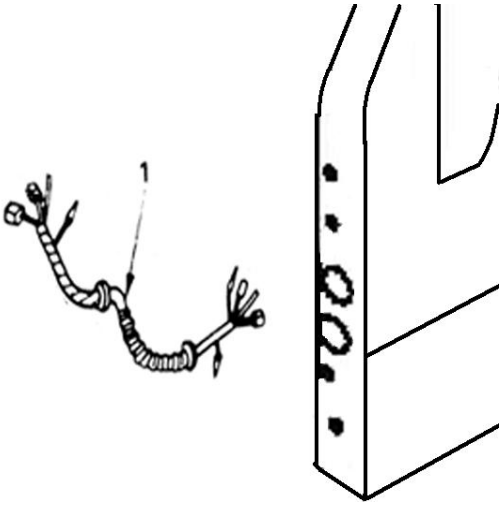
https://truckmanualshub.com/

Reassembling



▲1. Door harness assembly
2. Door rubber pad
▲3. Door window lift assembly
4. Door glass front bracket
▲5. Door glass assembly
15. Door glass seal strip
▲6. Door lock core assembly
7. Door hand catch bracket
▲8. Door inner handle assembly
▲9. Door seal membrane
10. Door cover plate assembly
▲11. Door inner trim board assembly
12. Door hand catch
13. Door large arm reset
▲14. Lifting handle
15. Door glass water seal
16. Door outer upper decorating strip
17. Door lower embedded strip/rubber strip
18. Door seal strip
Additional note:
(15. Door glass seal strip, door glass water seal)

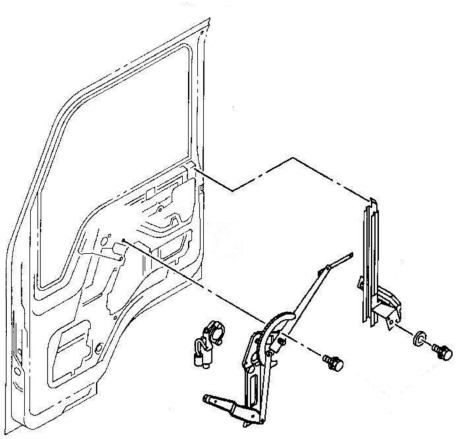
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Important operation ---assembling

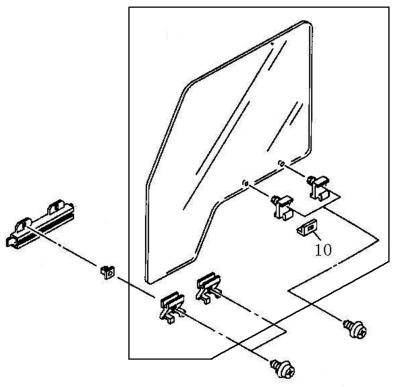
1. Door harness assembly

- Thread harness assembly through the hole on door inner panel and fit a suitable rubber washer according to shape of the hole.
- Fit door harness clip on support bracket and door inner panel reinforcing part.



3. Door window lift assembly

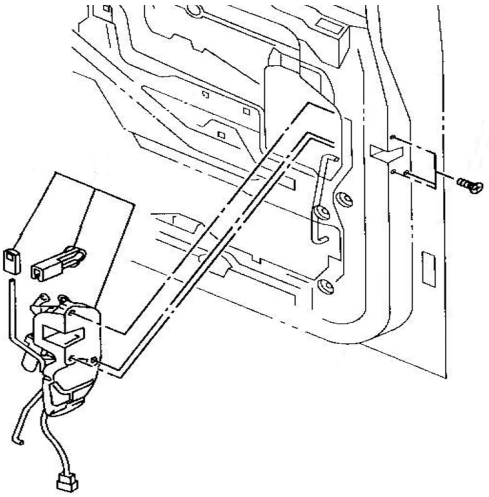
- First fit the window lift assembly on the door, then fit glass on lift front bracket and glass front/rear bracket
- Next, install door window groove and adjust the glass so that lifting is smooth.



5. Door window glass assembly

- Fit window lift front bracket and front/rear glass brackets on door glass.
- Use a plastic or wood hammer to tap the groove lightly; when doing so, cover the glass with cloth or similar

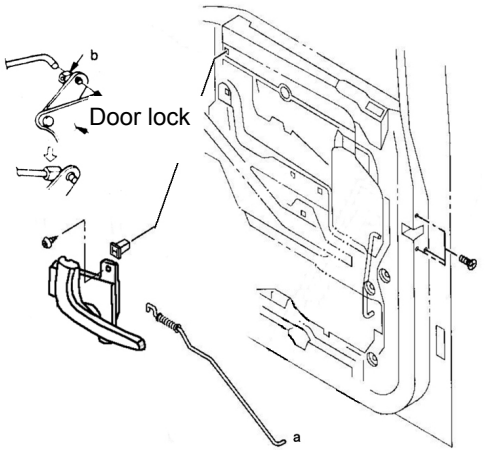
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6. Door lock core assembly

- When door lock outer handle is connected to the connector, rotate this connector so that handle end gap is about 5mm.

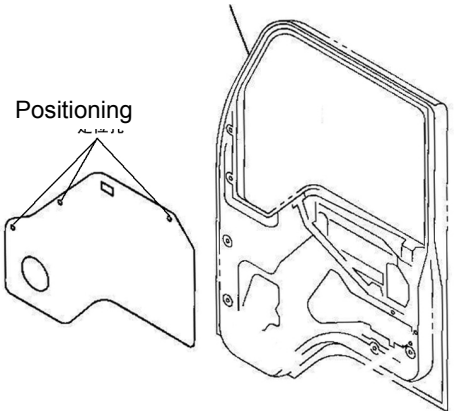
Torque: N·m	4－8



8. Inner handle assembly

- Firmly insert inner handle assembly “a” in door lock “b” position and rotate the sheath tight.
- Allow certain free gap of inner handle assembly at door inner trim board

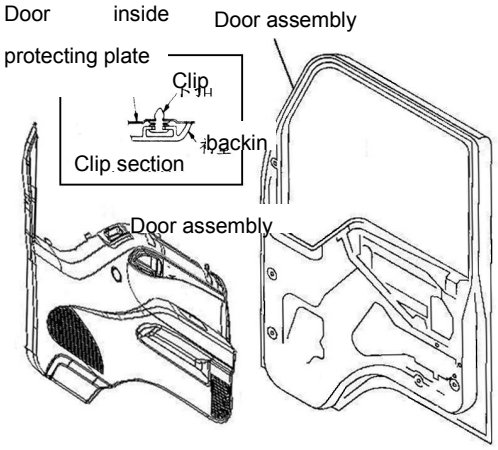
Right door assembly



9. Door sealing membrane

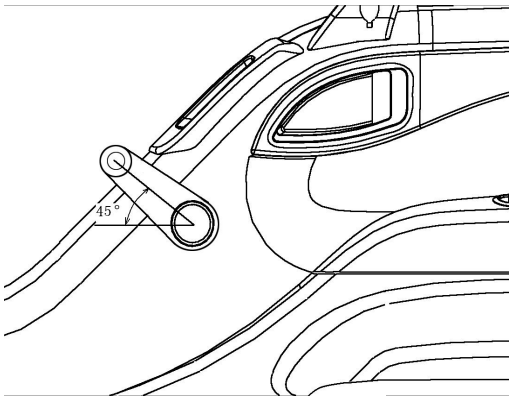
- Stick butyl rubber tape (Φ5mm) along door inside protecting plate
- Adjust door sealing membrane positioning holes to corresponding positions on door inside protecting plate, and stick well. Avoid crimple of tape; otherwise water leakage may occur.

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11. Door inner trim board assembly

- Insert 7 inner trim board clips into holes on door inside protecting plate. When firmly inserted, a sound of “kata” will be heard; if not, water leakage may occur.



14. Lifting handle

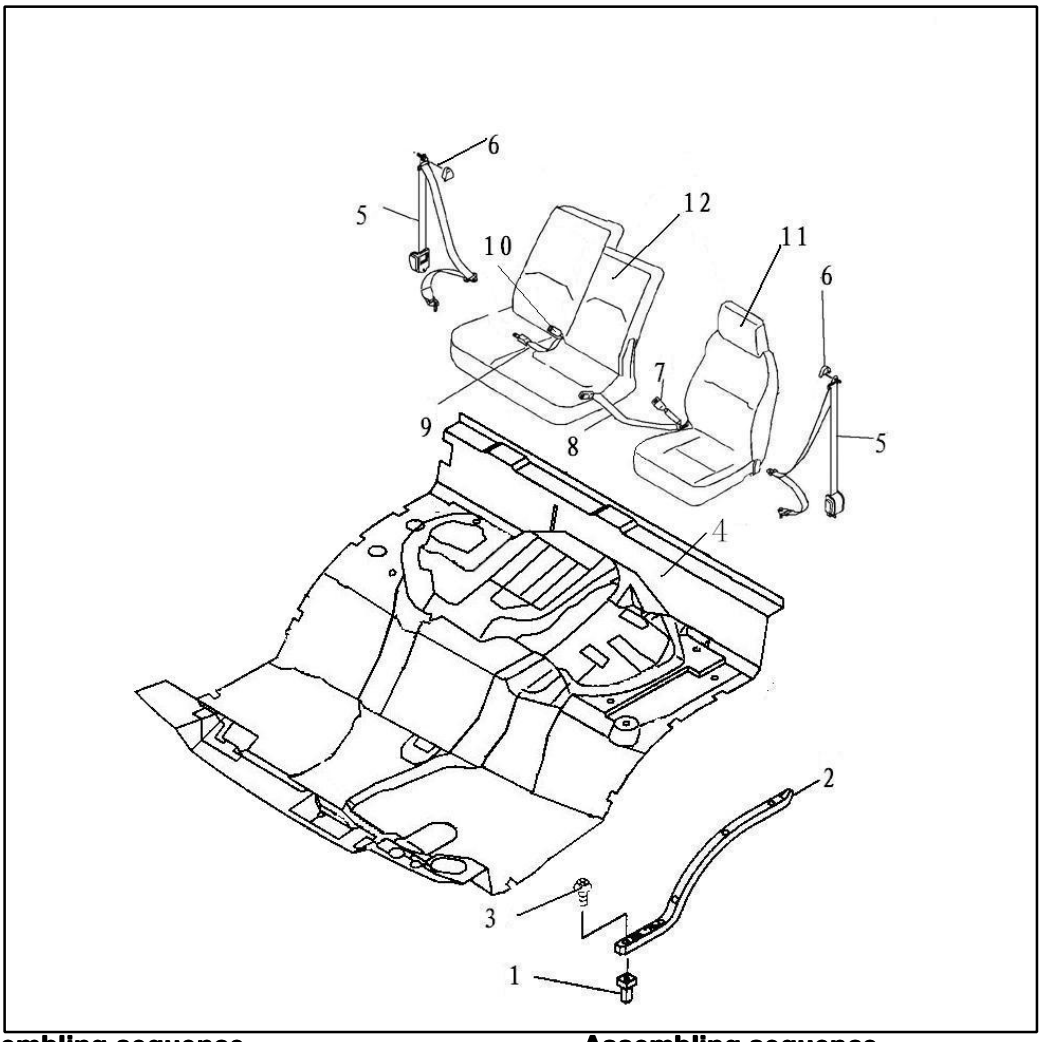


- Adjust this handle to the position shown in left figure and at 45° with horizontal line Lift all door window glasses.

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Seat

Disassembling and assembling



Disassembling sequence

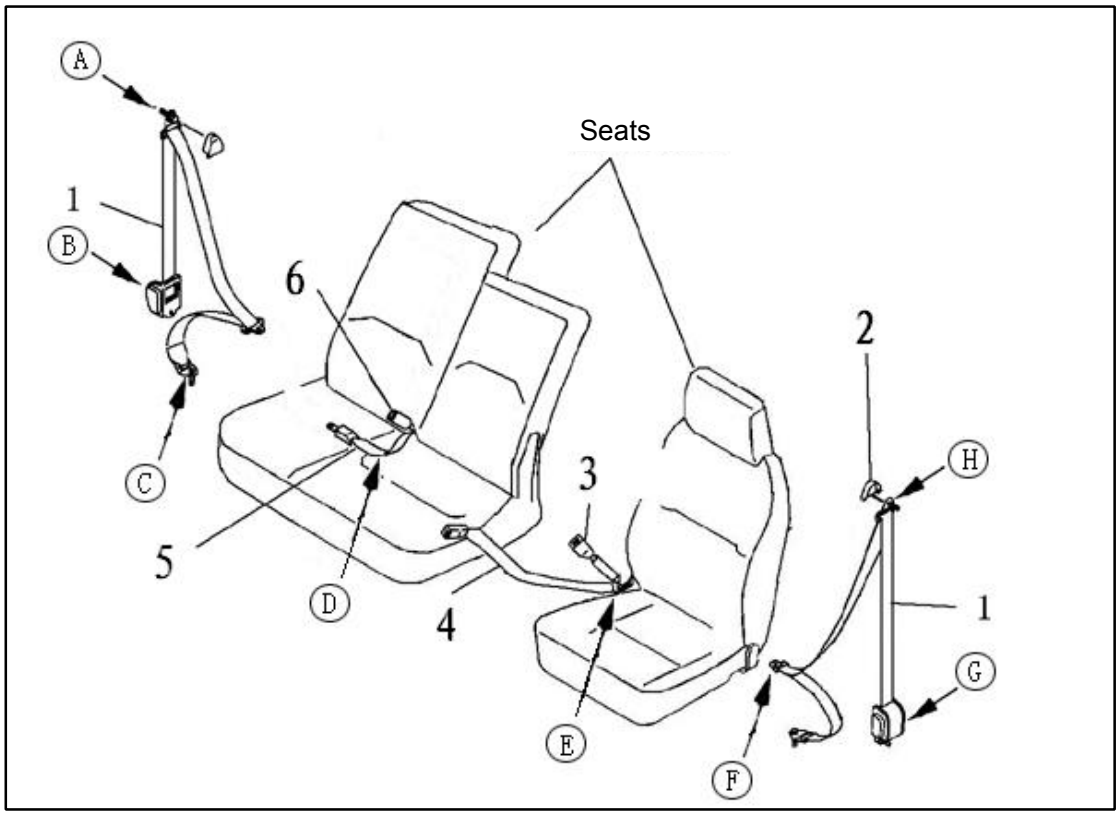
3. Cross recessed pan head tapping screw
2. Map batten
1. Floor batten expansion buckle
4. Integral carpet
12. Seat for 2 persons
11. Driver seat
10. Passenger safety belt buckle assembly
9. Middle (additional) seat safety belt assembly
8. Middle (additional) seat safety belt buckle ASSY
7. Driver safety belt buckle assembly
6. Hex head bolt
5. 3-point safety belt assembly

Assembling sequence

1. Floor batten expansion buckle
2. Map batten
3. Cross recessed pan head tapping screw
4. Integral carpet
5. 3-point safety belt
6. Hex head bolt, flat washer, spring washer
7. Driver safety belt buckle assembly
8. Middle (additional) seat safety belt buckle ASSY
9. Middle (additional) seat safety belt assembly
10. Passenger safety belt buckle assembly
11. Driver seat
12. Seat for 2 persons

Seat safety belt

Disassembling and assembling



Disassembling sequence

6. Passenger safety belt buckle assembly
5. Middle (additional) seat safety belt assembly
4. Middle (additional) seat safety belt buckle assembly
3. Driver safety belt buckle assembly
2. Hex head bolt, flat washer, spring washer
1. 3-point safety belt assembly

Assembling sequence

▲ 1. 3-point safety belt assembly

2. Hex head bolt, flat washer, spring washer

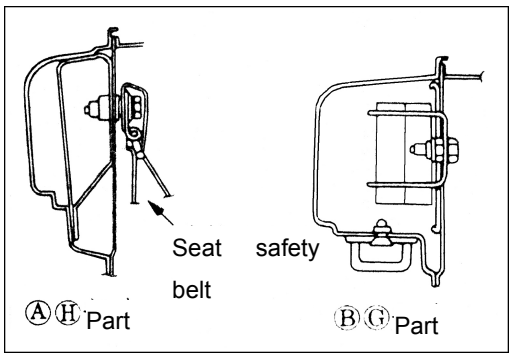
3. Driver safety belt buckles assembly

4. Middle (additional) seat safety belt buckles ASSY

5. Middle (additional) seat safety belt assembly

6. Passenger safety belt with buckle assembly

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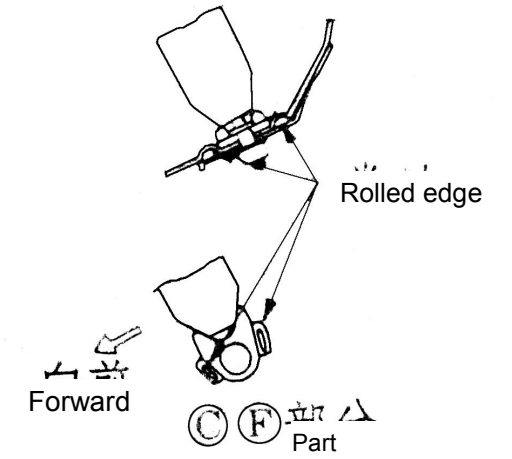
Important operation--- assembling

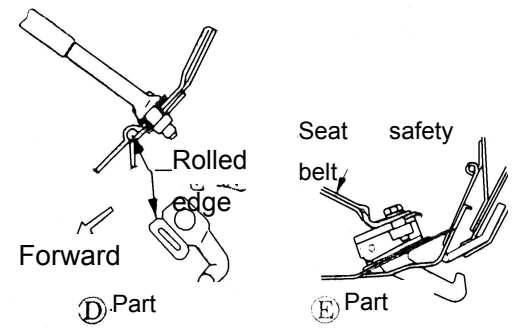
1. 3-point safety belt assembly

Install seat safety belt mountings on floor.

Note installation direction of seat safety belt mountings.

Torque: N·m	30－50



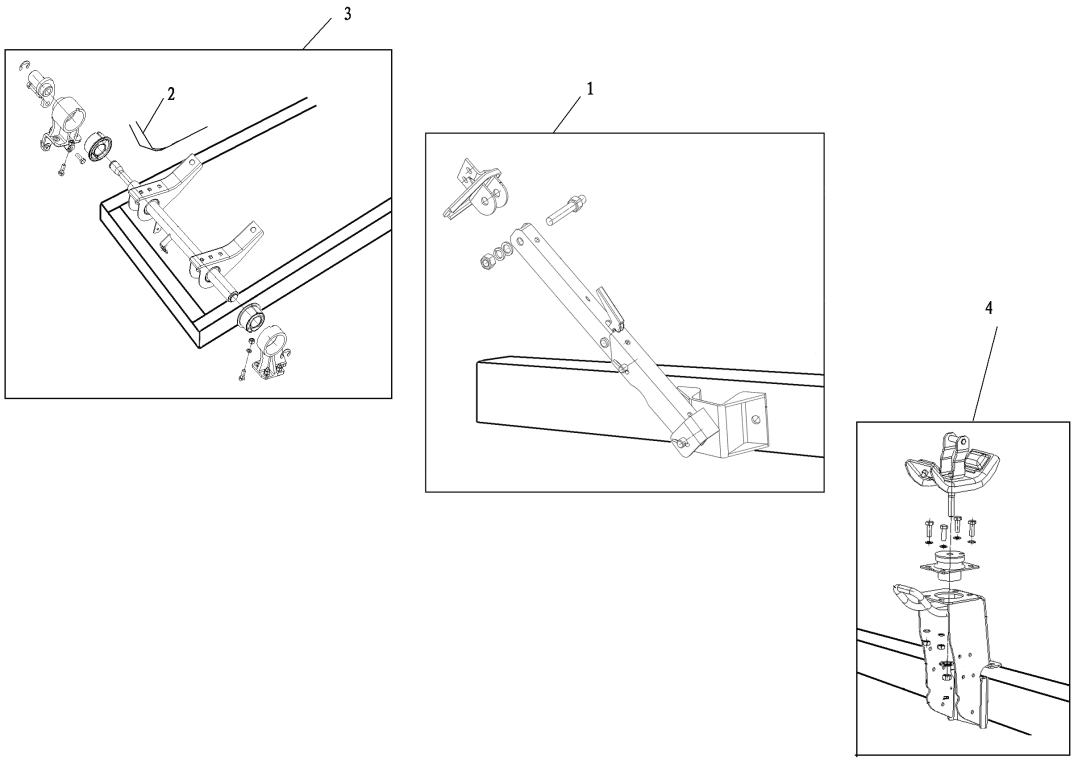


Cab tilting and locking mechanism

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Tilting mechanism

Disassembling and assembling sequences

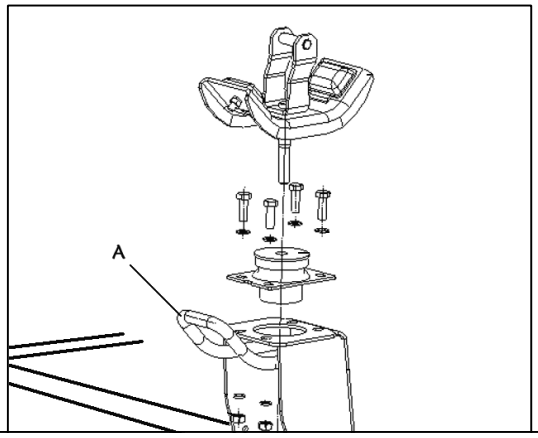


Disassembling sequence

1. Cab rear support and bracket assembly
2. Can
3. Can front support tilting mechanism
4. Can rear bracket

Assembling sequence

4. Can rear bracket
3. Can front support tilting mechanism
2. Cab
1. Cab rear support and bracket assembly

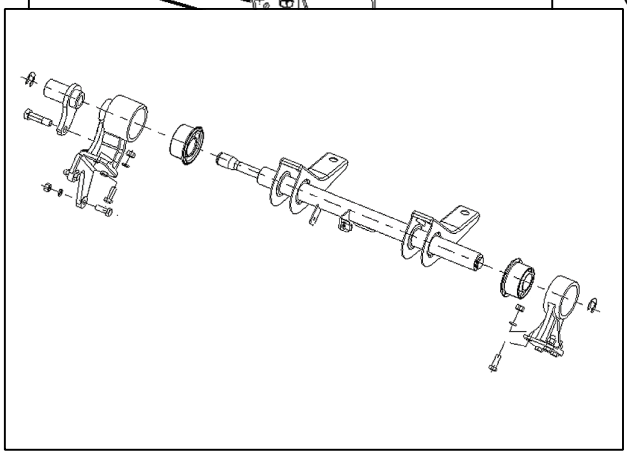


4. Cab left rear bracket

(Right rear support is symmetric to left rear support except absence of structure A)

T

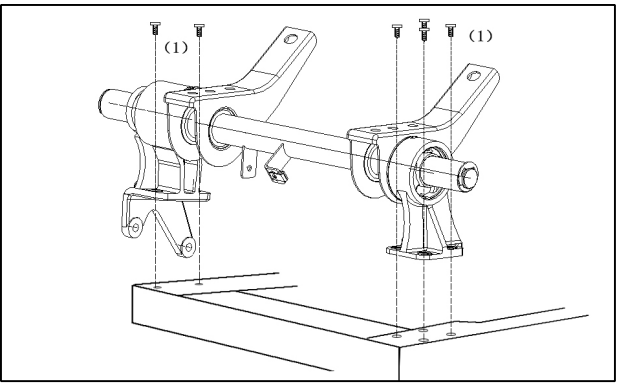
orque (N·m): 78



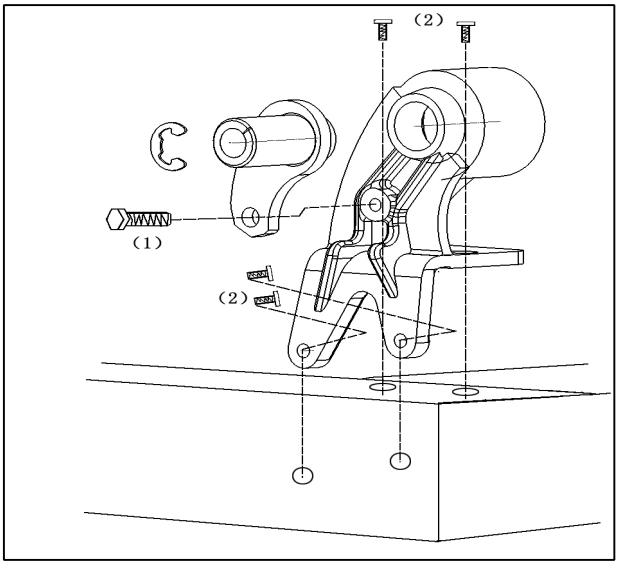
3. Cab front support tilting mechanism

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For installation, align marking I on axle tube assembly to marking I on torsion bar.



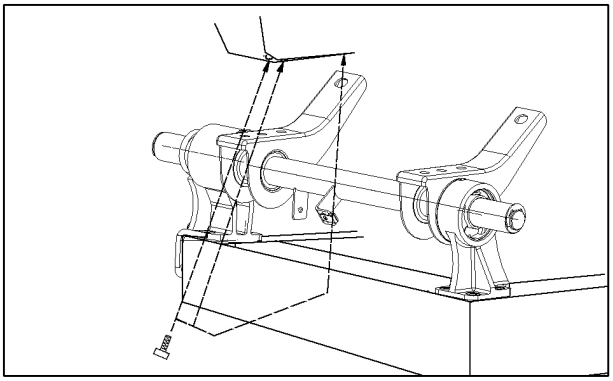
Torque (N·m): 116——153



Torque (N·m): (1) 105——133

(2) 76——92

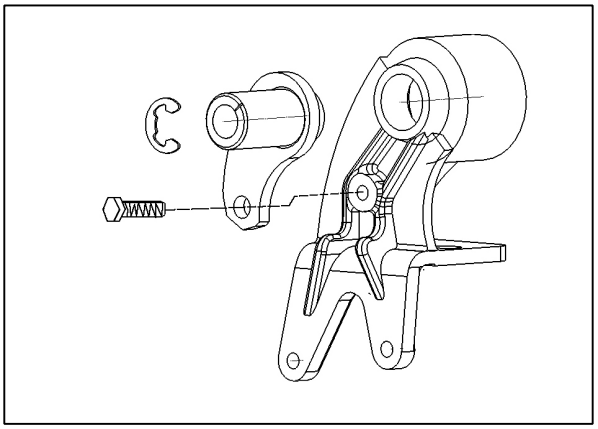
https://truckmanualshub.com/



2. Cab

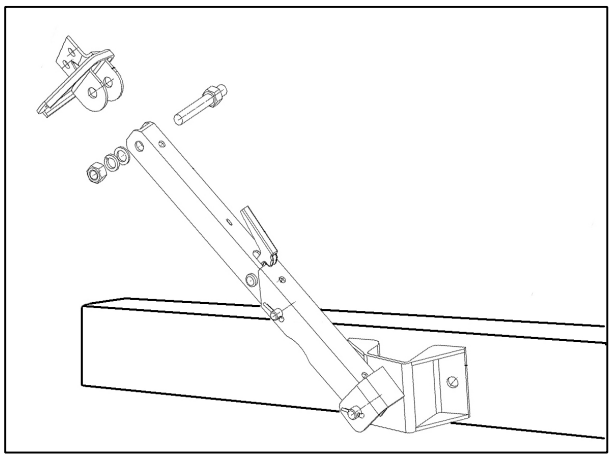
Fit guide pin into support arm guide hole and then fit cab.

Torque (N·m): 76——92



Tilt cab and tighten bolts so that bolts lean against groove rear end.

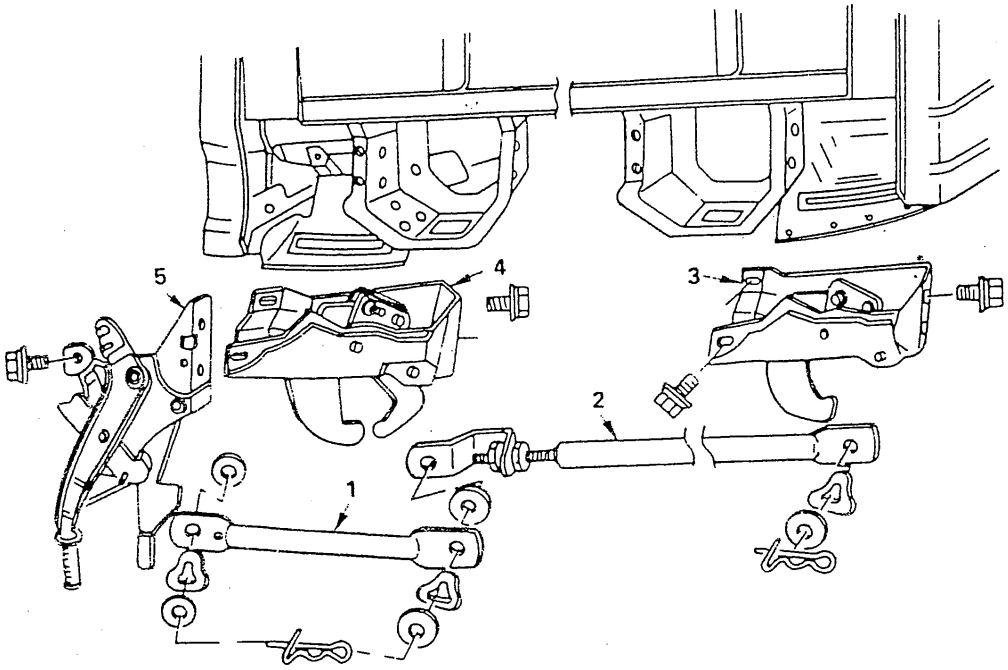
Torque (N·m): 105——133



1. Cab middle rear support and bracket assembly

Torque (N·m): 29——41

Disassembling and assembling of cab locking mechanism



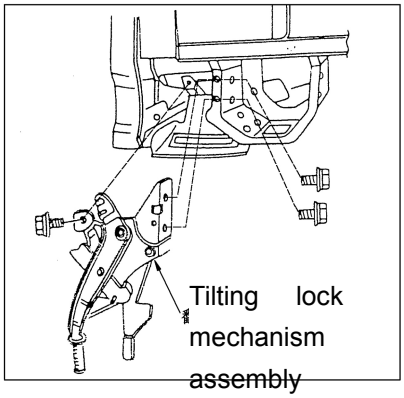
Disassembling sequence

1. Short slide rod assembly
2. Long slide rod assembly
3. Lock mechanism right assembly
4. Lock mechanism left assembly
5. Tilting lock mechanism assembly

Assembling sequence

5. Tilting lock mechanism assembly
4. Lock mechanism left assembly
3. Lock mechanism right assembly
2. Long slide rod assembly
1. Short slide rod assembly

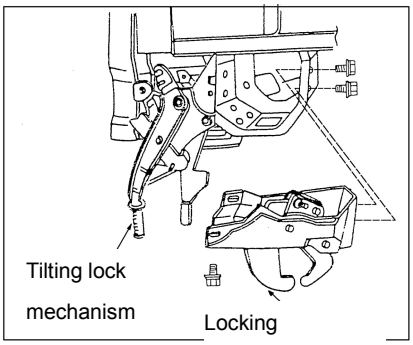
CABIN



Important operation--- assembling

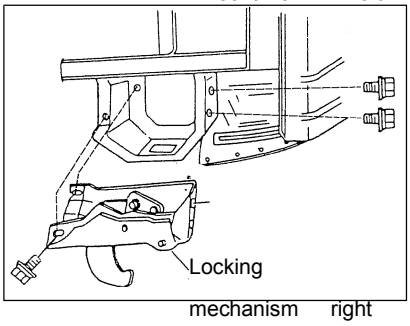
5. Tilting lock mechanism assembly

Fit tilting lock mechanism assembly on cab rear bracket. Torque: (N·m): 14——24



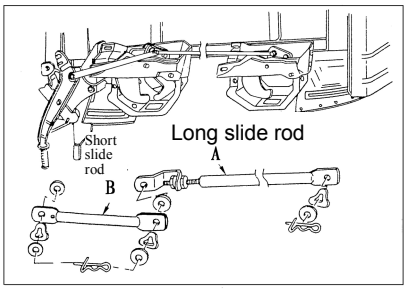
4. Locking mechanism left assembly

Torque (N·m): 14——24



3. Locking mechanism right assembly

Torque (N·m): 14——24



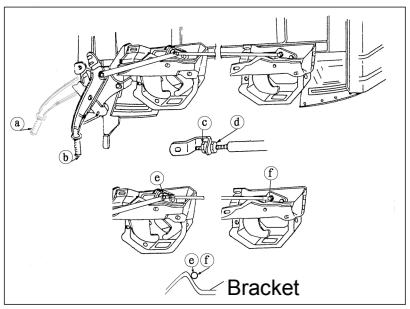
2. Long slide rod assembly

1. Long slide rod

Apply grease at position A on rod contact face, and then fit long slide rod assembly.

Apply grease at position B on rod contact face, and then fit short slide rod assembly.

Fit the part with stamp at handle side.



Move handle of cab lock mechanism from position a to position b (locked position).

Adjust pins e and f of left and right locking mechanism assemblies, use lock nuts to fit them on bracket, and then fix them with clips