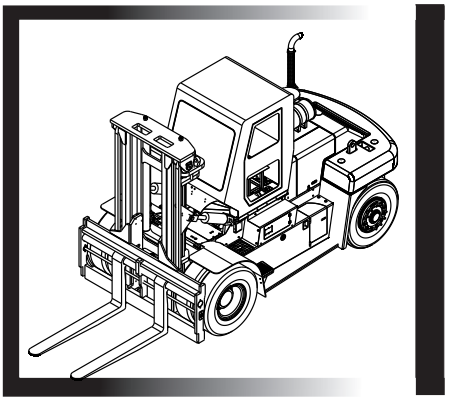
OPERATION & SERVICE MANUAL



Balanceweight Type
Forklift Truck With Engine

HELI

安徽合力股份有限公司

ANHUI HELI CO., LTD.

FOREWORD

This manual mainly describes the performance, structure, operation and maintenance of the CPCD15-CPCD16 forklift (load center: 600mm) so as to help the operator to use and maintain the truck properly.

Operators and equipment supervisors should read the manual carefully and operate and maintain according to the relative requirements and regulations during the usage in order to keep the truck in good working condition.

This manual might not correspond with the actual condition because of the improving of our products. Our products are subject to improvements and changes without notice.

CONTENTS

Ⅰ. SAFETY REGULATIONS ON TRUCK DRIVING AND OPERATION

Drivers and superiors of the truck should always keep “SAFTY FIRST” in mind. Operate according to the OPERATION & SERVICE MANUAL and OPERATOR’S MANUAL.

1. The delivery of the truck

Pay attention to the following items when delivering the forklift truck:

(1) Pull up the hand brake;

(2) Fix the mast and the counter weight with rope and wedge the four wheels well;

(3) Sling points should be the positions specified in sling plate when hoisting up the forklift truck.

2. The storage of the truck

(1) Let out the fuel completely (if the cooling liquid is rust prevention anti frozen fluid, it is not necessary to let it out.)

(2) Apply anti-rust to the surface of the unpainted surface and lubrication oil to the lifting chains;

(3) Lower the mast to the lowest point;

(4) Pull up the parking brake;

(5) Wedge the four wheels well.

3. Preparations before use

(1) Don’t check fuel leakage and lever or instruments where there is open flame. Never fill the fuel tank with the engine running;

(2) Check the tyre pressure;

(3) Put the forward and backward lever in the neutral position;

(4) Do not smoke when the fuel system is working or the battery is checked;

(5) Check the condition of the knobs and the pedals;

(6) Complete the preparation work before starting;

(7) Loose the parking brake;

(8) Carry out the operation of mast lifting and lowering, forward and backward tilting, steering and braking;

4. Safety operation regulation

(1) Only trained and authorized operator shall be permitted to operate the truck.

(2) Wear safety guards such as shoes, helmet, clothing and gloves while operating the truck.

(3) Inspect the control devices and alarming devices and operate after repairing if there is damage or fault.

(4) Overloading is strictly prohibited. The fork should insert completely under the cargo and make the cargo placed on it evenly. Do not raise an object with one fork end.

(5) The starting, turning, driving, braking and stopping operation of the truck should be done smoothly. When steering on the humid or low friction road, the truck should be decelerated.

(6) Lower the goods as possible and tilt the mast when travelling with load.

(7) Be careful when travelling on a slope. If the gradient is more than 10%, drive forward when going up the slope and backward when down the slope. Never steer on a slope in preventing of overturning. Do not load or off-load goods when descending.

(8) Take care of the pedestrian, obstacle, bumpy road and clearance above the forklift truck.

(9) Persons are prohibited to stand on the forks or be driven by the truck.

(10)Never walk or stand under the raised fork.

(11) Never operate the truck or accessories out of the driver’s seat.

(12) Be care with the goods falling if the lifting height is over 3m. Take protective measures if necessary.

(13) Tilt the mast backward as possible if the lifting height is high. Load or unload with mast slightly forward or backward tilt.

(14) Slow down and be more careful when travelling on dock or bridge plate.

(15) Shut down the engine and get off the truck when filling fuel. Do not ignite the engine when inspecting the battery or hydraulic oil tank.

(16) Truck with accessories without load should be operated as truck with load.

(17) Do not handle the unfixed or loose stacked goods. Be care with the goods with big size.

(18) Lower the fork to the ground, and put the knob in the neutral gear and shut off the engine or disconnect the battery when leaving the truck. Pull up the parking brake and wedge the four wheels if the truck stops on a slope.

(19) Do not open the cover of the radiator when the engine is hot.

(20) The pressures of the control valve, safety valve are regulated and can not be adjusted by users at will in preventing of damaging the hydraulic system or unit.

(21) Inflate the tyre according to the tyre pressure plate.

Front and rear tyre model:12.00-20-20PR front and rear regulated pressure:900kPa

(22) The Max. noise outside the truck should be lower than 89dB(A). Measure the noise according to the JB/T3300.

(23) Pay attention to and be familiar with the plates on the truck.

(24) tyre fixing nut tighten torque: front tyre:480-500Nm; rear tyre: 480-560Nm; check their pressure every 50h.

Note: do as the following to tighten the tyre fixing nut when changing tyre:

1) When changing the tyre, mark the fixing nut. The tighten torque is followed: ront tyre:480-500Nm; rear tyre: 480-560Nm.

2) Travel with first gear or second gear for 20 min, it is prohibited to brake suddenly. Then retighten the nut.

3) Travel with second gear or third gear for 30 min, it is prohibited to brake suddenly. Then retighten the nut.

4) Remark the fixing nut. Check every 50h.

5. Daily maintenance of the truck

(1) Starting

a) The hydraulic oil lever should stays between the max. lever and min. lever.

b) Check if the pipeline, joints, pump and valve leak or damaged.

c) Check the service brake. The idle stroke of the braking pedal should be about 40mm. The clearance between the front floor board and pedal should be more than 20mm.

d) Check the parking brake. The unloaded truck can be braked on a 25% gradient slope when the hand brake is applied.

e) Check if the meter, lamps, links, switches and other electric parts are normal.

(2) Oil for the truck

Name	Type	Recommended brand
fuel（diesel ）	Summer 0＃， winter -10＃	
Lubrication oil for the gears of the driving axle	GL-5（85W90）	ELF
Transmission oil	CF-4（15W40）	ELF
Lubrication oil for the engine	CF-4（15W40）	ELF
Hydraulic oil	L－HM46	ELF
Brake liquid	DOT3	CHANGCHENG
Lubrication grease	3＃lithic grease dropping point:170	CHANGCHENG
Anti-frozen liquid	FD-2type -35℃	LONGPAN JIANGSHU

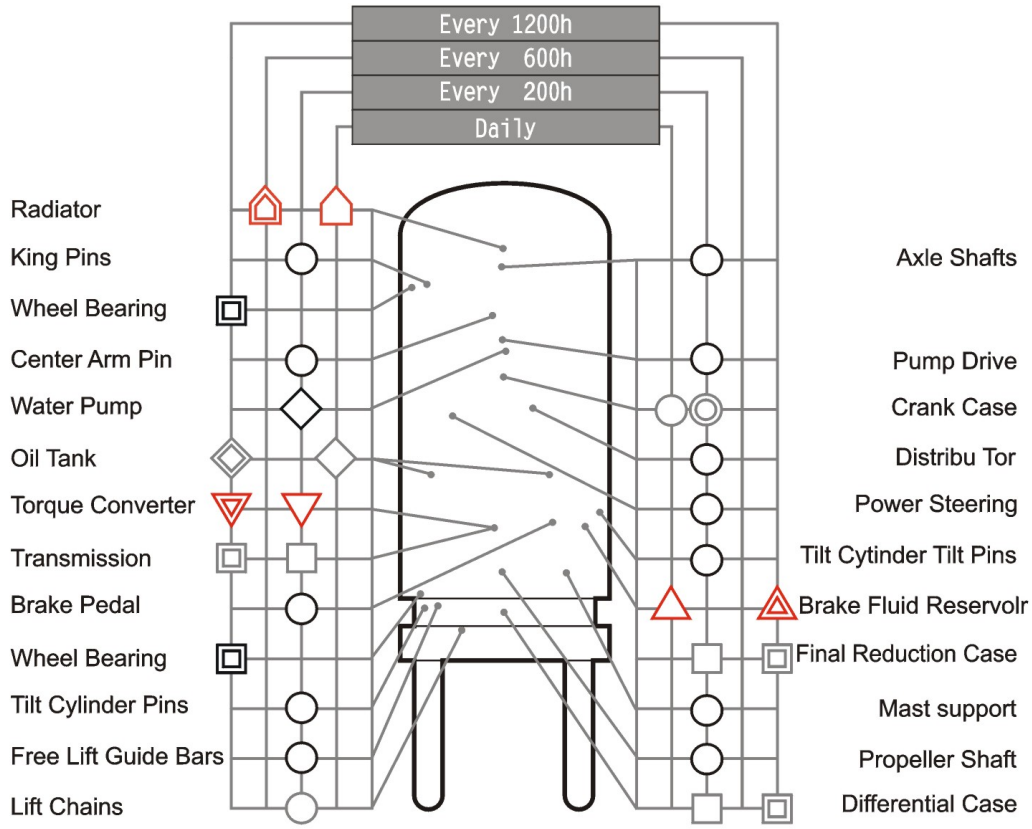
(3) Usage notes on the cooling system

a) During operation, if the radiator of forklift “boils” or the temperature of cooling liquid is too high, do not open the cover of radiator immediately. If the cover needs to be removed to find out the cause for it, reduce the rotation speed of engine to the moderate, slowly rotate the cover and not remove it very soon so as to prevent operators from being scalded by the splashing liquid. When recovering the radiator, it must be screwed tightly, otherwise, the system may not be well enclosed and the system pressure stipulated cannot be formed.

b) Based on different working conditions, regularly clean the outer surface of the radiator with detergent, compressed air or high-pressure water (no less than 4kg/cm^2).

(4) Lubrication chart

LUBRICATION CHART



NOTE:Some Models Have Unnecessary Places

Chassis Grease
Wheel Bearing Grease
Water Pump Grease
Engine Oil
Gear Oil
Hydraulic Oil
Brake Fluid
Torque Converter Oil
Clean Soft Water

Supply

Replace

Ⅱ. Primary Parameters of Forklift Truck

Model			Unit	CPCD150-160-Wx-06II	CPCD150-160-Wx-06III	CPCD150-160-Cu-06III
Lifting capacity			kg	15000/16000		
Load center			mm	600		
Lifting height（standard）			mm	3000		
Mast tilt angle forward/backward			°	6/12		
Max. traction force （loaded）			KN	170		180
Gradeability (loaded/unloaded)			°	25/20		
Lifting speed(loaded/unloaded			mm/s	330/350		
Travelling speed (loaded/unloaded)			km/h	23/28		
Wheelbase			mm	3100		
Tread front/rear			mm	1904/2050		
Overhang front/rear			mm	815/820		
Min. under clearance			mm	265		
Weight			kg	18200/18700		
Min. turning radius			mm	4800		
Outline dimension	Overall length （with fork）		mm	6105		
	Overall width		mm	2590		
	Overall height	Driver’s cab	mm	3105		
		Mast	mm	3220		
Engine	Engine manufactory/model			XICHAICA6110 /125ZT	Wuxi CA6DF3-16GAG3U-HL10	Cummins QSB6.7
	type			6-110/125	6/7.127	6-107/124
	Rated power/rotation speed		kW/rpm	117 /2200	118/2200	119 /2200
	Max. torque/ rotation speed		Nm/rpm	580/1500	640/1300-1700	732/1500
Transmission box				HELI specialized transmission box		
Tyre	Front wheel			12.00-20		
	Rear wheel			12.00-20		
Fork	Adjusting range （the outer side of the fork）		mm	490-2400		
	Length *width *thickness		mm	1370*200*85		

Ⅲ. Primary Assembly of Forklift Truck

No.	Name	Contents
1	dynamic system	Includes engine mounting, fuel, exhausting system and cooling system(torque converter cooling included)
2	Transmission system	Includes transmission, tor-con, transmission shaft, gears shifting operation etc.
3	Drive axle	Includes axle house, half shafts, differential, hub reduction, brake, front wheels
4	Steering system	Includes steering hand wheel, wholly hydraulic steering unit
5	Steering axle	Includes steering axle, steering cylinder, rear wheels
6	Lifting system	Includes mast, fork, lift bracket, backrest, tilt cylinder, lifting cylinder, cylinder positioner, lift chain, chain, roller etc.
7	Body	Includes frame, hood, fuel tank, hydraulic oil tank, upper counterweight, lower counterweight, driver's cab assembly, seat etc.
8	Operating system	Includes: (1)service brake and inching operation (2) Parking brake (3) throttle operation
9	Hydraulic system	Includes pump, valve, high pressure oil pipe, low pressure oil pipe, joints
10	Electric system	Includes relay, lamps, battery, meter, harness
11	Driver's cab	Includes driver's cab, fun, air conditioner(optional)

Ⅵ. The Structure, Principle, Adjustment and Maintenance of Forklift Truck

1. Dynamic System

1.1 Brief description

The dynamic system mainly includes engine mounting, fuel system, cooling system and exhausting system. The engine is mounted on the frame through rubber cushion to reduce the vibration. Engine, torque converter, transmission box, transmission shaft and driving axle are to form a unit. Refer to the fig. 1.1.

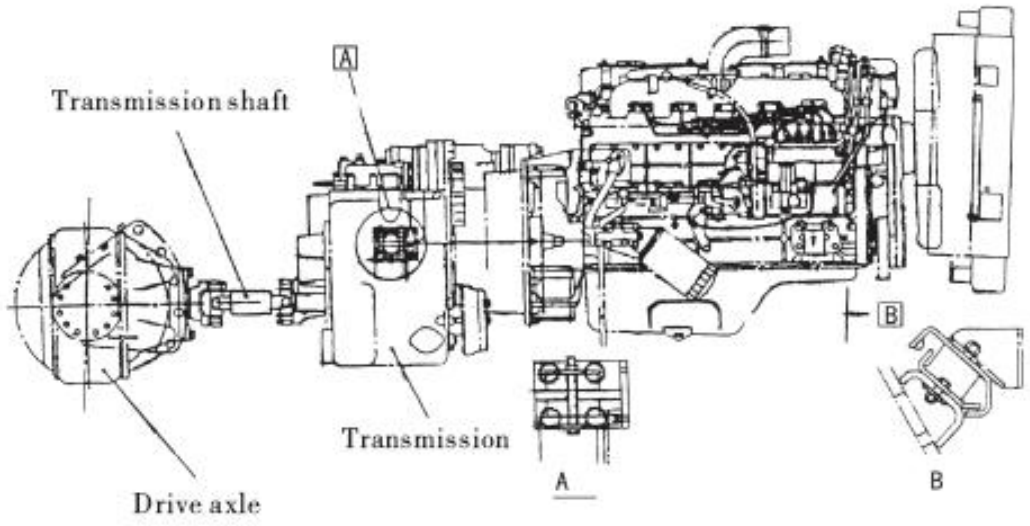


Fig. 1.1 engine mounting

1.2 Engine

1.2.1 Brief description

(1) XICHAI CA6110-125ZT diesel engine is mounted on this truck. The engine has turbocharging performance except for the characteristics of the XICHAI engine 6110-125B to boost the engine power. China emission standard stage II is satisfied.

NOTE: refer to the DIESEL ENGINE OPERATION MANUAL FOR CA6110.6110/125 • 613 for detail information.

(2) American Cummins6QSB6.7 diesel engine is mounted on this truck. Engine accessories such as air cleaner, muffler are provided by the service provider of Cummins. Refer to the OPERATION AND SERVICE MANUAL of the engine for

detail information.

(3) The truck with XICHAI CA6DF3-16GAG3U-HL10 diesel engine meets GB20891 China non road emission standard stage III. CA6DF3-*G3U diesel engine adopts electric control system, supercharged inter-cooling technology and it is new model through optimized performance and improved reliability.

Note: for details, please refer to “CA6DF3 engine operation manual”

1.2.2 Inspection and adjustment of engine

(1) Air cleaner

a) Remove element.

b) Check the element. If it is dirty, it should be blown with low pressure from inner to outer. If it is damaged, it should be replaced with a new one.

c) Clean up the cover of dust-collector.

d) Replace it every 1200 hours or six months.

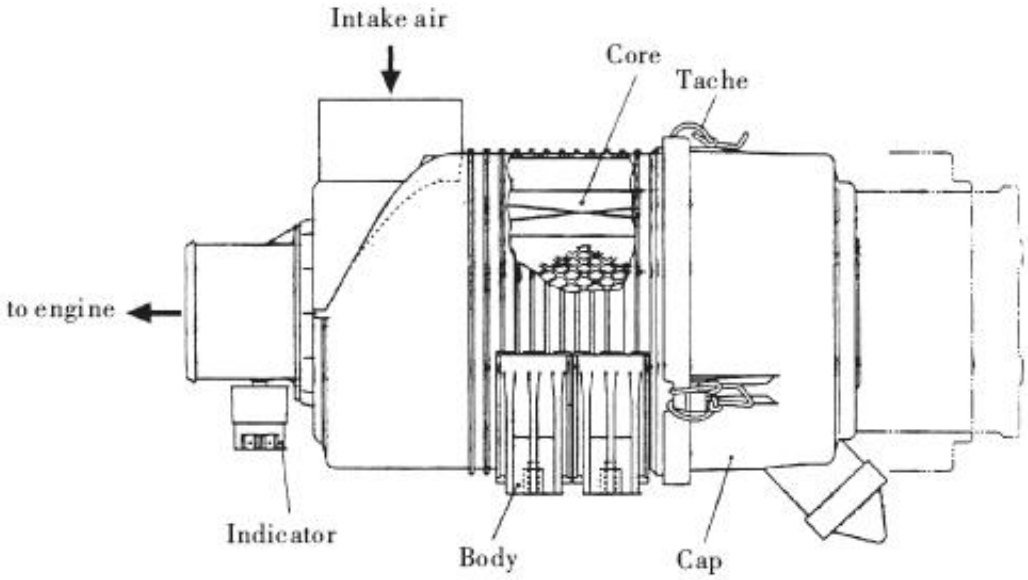


Fig. 1.2 air cleaner

(2) Fuel filter

a) Remove the filter with the special spanner. If damaged or blocked, replace it.

b) Apply several drops of fuel to the around of the new filter’s seal before installation and it should be screwed 2/3 circles again when the filter’s seal touches

the body of filter.

Fig. 1.3 fuel filter

(3) Oil filter

a) Remove the oil filter with the spanner and replace it with a new one.

b) Apply several drops of engine oil to the around of the new filter's seal before installation and it should be screwed 2/3 circles again when the filter's seal touches the body of engine.

c) Replace it every 600 hours or three months.

(4) Pump oil

Fill the injection pump chamber with diesel fuel by moving the hand pump up and down. Press 5-10 times again when the feeling of pressing is heavy.

1.3 Fuel System

The fuel system is composed a tank, fuel filter, fuel sensor.

1.3.1 Fuel tank

The fuel tank is a welded construction integrated with the truck frame. It is located on the left side of the truck frame. The tank cover with a fuel sensor is located on the top surface of the tank.

1.3.2 Fuel sensor

The fuel sensor is designed to convert the remaining amount of fuel into electric

current. The rheostat made of alloy steel wire is linked with a float. As the float moves up and down, the electric current is changed by the resistance's changes.

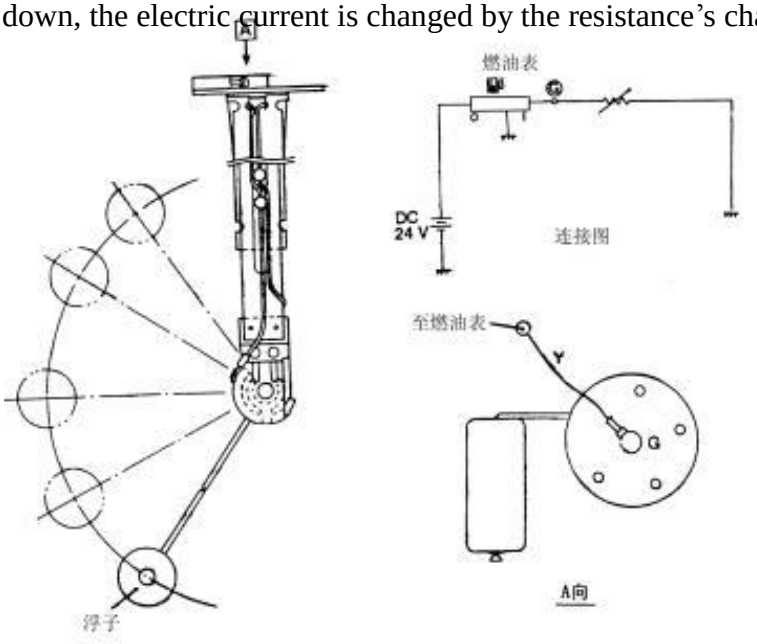


Fig. 1.4 fuel sensor

1.3.3 Fuel filter

The fuel filter is used to clean the fuel applying to the engine. It is installed on the intake manifold of the engine. There is also bypass valve installed in the filter. If the element is blocked, it can also apply the fuel to the engine.

1.4 Cooling System

The cooling system is composed a water pump, fan, radiator and tank. The water pump is installed on the engine. The crank shaft drives the water pump through the V-belt.

1.4.1 Inspection and adjustment of cooling system

(1) Check the cooling water level of the tank

(2) Replace the cooling water

a) Wait 30 minutes after shutting off the engine. Remove the cap and loosen the draining switch of the radiator.

b) Loosen the draining switch of the engine and drain all the cooling water.

c) Tighten the above two draining switches.

d) Add the correct cooling water to the radiator. Let the engine running in idle speed for a while after topping up and assure the water level of tank stays it's correct position.

(3) Adjust the fan belt tension

If the fan belt loosen, tension it.

(3) Radiator of transmission oil

Check the seal and clean status of the radiator.

2. Drive Unit

The drive unit includes a torque converter and a transmission.

2.1 Hydraulic powered torque converter and oil pipeline

2.1.1 Structure and function

Hydraulic powered torque converter is mainly made up of impeller, guide pulley, turbine and pump case. Three types of working pulley are assembled in the pump case which is full of oil. The impeller is connected to the pump case with bolt. The spring plate through which the power of the engine is transmitted to torque converter on the pump wheel is connected to the engine flywheel connecting ring with bolt. The turbine is splined to the turbine shaft. The guide pulley is connected with the guide pulley seat which is fixed to the transmission box with bolt.

Refer to the fig. 2.1 for torque converter's structure.

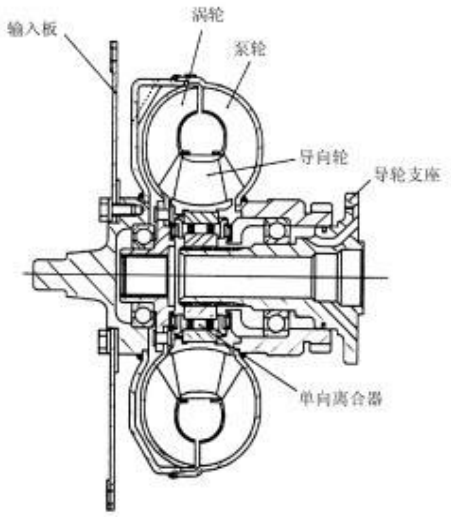


Fig. 2.1 torque converter

A closed oil circuit is formed by the vanes of the three types of working wheels of the hydraulic powered torque converter when working. The power from the engine is transmitted to the impeller through connecting ring, spring plate and pump case. The oil flows out along the vane of the impeller to change the mechanical energy to the hydraulic energy under the centrifugal force caused by the rotation of the impeller. The high speed fluid flows to the turbine from the outer exit of the impeller to make the turbine rotate. Thus the shaft of the impeller will rotate and the power is transmitted. Then the oil flows to the guide pulley and a counter torque is given to the working fluid because the guide pulley is fixed. The torque together with the torque given by the impeller to the oil fluid is transmitted to the turbine. So that the torque received by the turbine is larger than the engine inputting torque and the torque is boosted, that is torque converting. The travelling speed and traction force can be changed according to the road condition and load by the torque converter to meet different conditions. When the resistance increases, the travelling speed slows down while the traction force increases; on the other hand, when the resistance decreases, the travelling speed increases while the traction force decreases. Meanwhile, the travelling speed and traction force can be controlled by the throttle through stepless speed adjusting to a certain range in order to start the truck stably.

Hydraulic powered torque converter acts the role of the main clutch in the

mechanical transmission type truck to protect the engine and transmission from shock and flaming out. So the lifetime of the engine can be prolonged. The popular stamping structure is adopted by HELI torque converter. The vanes of the impeller and the turbine are stamping parts which have characters of high intensity, light weight and low cost when mass produce.

2.1.2 Oil circuit

The oil flows in circuits and strikes in the working wheels constantly. In that case, the temperature will increase and at the same time the working wheel itself has loss. So compensation must be made by inputting working oil with certain pressure.

The torque converter and transmission box form a circulating oil circuit (refer to fig. 3-1). The working oil is drawn from the oil tank by oil pump and then flows to main control valve which will control the oil pressure of the clutch gears and the oil pressure of torque converter. The oil finishing the circulating work flows to the radiator through the outlet valve of the torque converter. Then the oil flows to the cooling friction piece of the torque converter after cooling and then flows back to oil tank.

2.1.3 Maintenance

(1) Often check the oil lever of the transmission oil and make sure the oil lever is above the lowest lever. Replenish or change the oil with regulated type.

(2) Keep the oil clean and clean the element of the filter regularly. Change the oil according to the regulation in 500 hours to keep the oil circuit clean.

(3) Pay attention to the oil temperature indicated by the meter and keep the engine in idle speed or stop the engine for a while when the temperature exceeds 110℃.

(4) Make sure the inner cavity pressure of the working wheel stay between 0.5-0.7MPa. If the pressure is low, the working wheel will arise cavitations; if the pressure is high, the oil will leak much. Both unmoral pressures will affect the normal working the torque converter. The pressure which is controlled by the outlet valve of

the torque converter is regulated well before going out the factory. Users shall not change it at will.

2.2 Transmission box

2.2.1 The character, structure and working principle of the transmission box

The transmission box is of hydraulic gear shifting type with parallel shaft always engaged. The gears service life will be prolonged because of the often engagement of the transmission gears. The hydraulic gear shifting makes the box structure more compact and gears shifting easier.

The transmission box is mainly made up of forward and backward gear shaft, first and third gear shaft, second and forth gear shaft, output shaft, main control valve and box case.

When shifting gear, hydraulic powered torque converter and lubrication pump on the transmission box oil circuit supply oil with 1.8-2.2MPa pressure. The oil goes to the different gears' clutch through main control valve to make the clutch connect. Thus the gear shifting is realized.

The route of the transmission oil:

- Oil tank→prefilter→lubrication pump→finer filter→main control valve→gear clutch→oil tank
- Oil tank→prefilter→lubrication pump→finer filter→overflow valve→torque converter→oil cooler→gear clutch and bearing lubrication→oil tank
- Oil tank→prefilter→lubrication pump→gear clutch and bearing lubrication→oil tank

2.2.2 Power of the transmission box transmit process

The transmission box has four forward speeds and four backward speeds. Refer to the fig. 2.2 for the power transmit route.

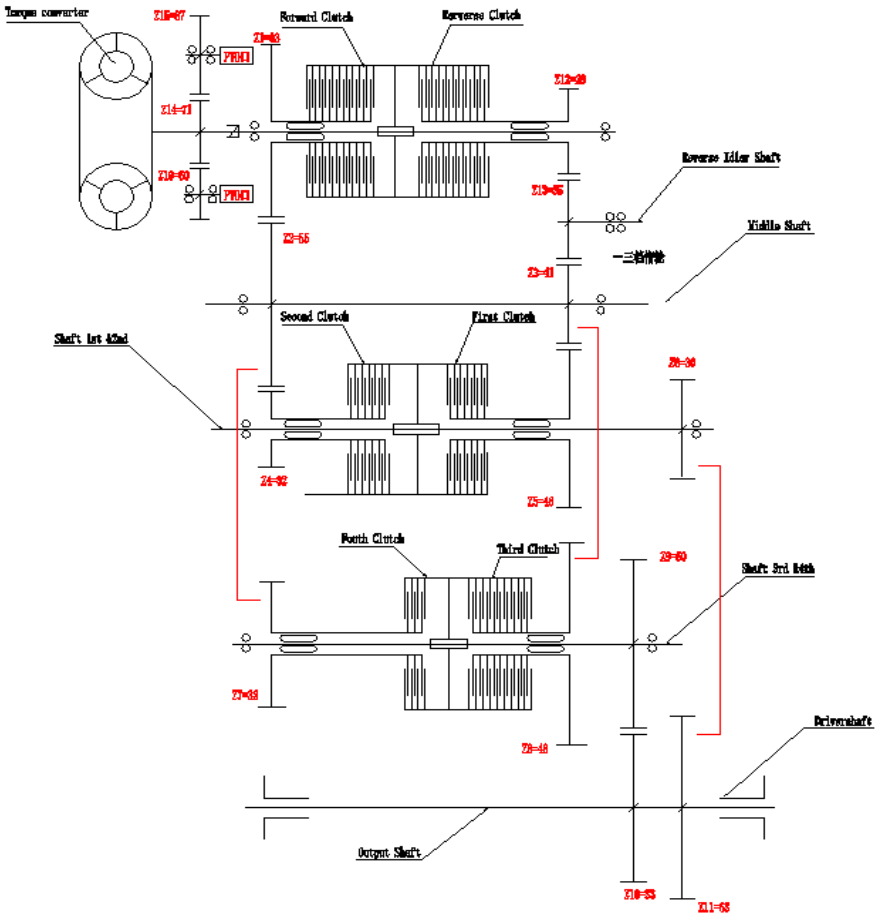


Fig. 2.2 power transmit route

Forward:

First gear: the forward clutch F of the transmission box input shaft connects→Z1→Z2→I gear clutch connects→Z3→Z5→Z6→Z11

Second gear: the forward clutch F of the transmission box input shaft connects→Z1→Z2→II gear clutch connects→Z4→Z6→Z11

Third gear: the forward clutch F of the transmission box input shaft connects→Z1→Z2→III gear clutch connects→Z3→Z8→Z9→Z10

Fourth gear: the forward clutch F of the transmission box input shaft connects→Z1→Z2→IV gear clutch connects→Z7→Z9→Z10

Backward:

First gear: the backward clutch R of the transmission box input shaft connects→Z12→Z13→Z3→I gear clutch connects→Z5→Z6→Z11

Second gear: the backward clutch R of the transmission box input shaft connects →Z12→Z13→Z3→Z2→II gear clutch connects→Z4→Z6→Z11

Third gear：the backward clutch R of the transmission box input shaft connects →Z12→Z13→Z3→III gear clutch connects→Z3→Z8→Z9→Z10

Fourth gear：the backward clutch R of the transmission box input shaft connects →Z12→Z13→Z3→Z2→IV gear clutch connects→Z7→Z9→Z10

2.2.3 Gears table of the transmission box

Logic table of the control valve (● means the solenoid has electricity)				
Gear	Forward solenoid	Backward solenoid	H-L chose solenoid	Range chose solenoid
Forward 1 gear	●		●	●
Forward 2 gear	●		●	
Forward 3 gear	●			
Forward 4 gear	●			●
Neutral gear				
Backward 1 gear		●	●	●
Backward 2 gear		●	●	
Backward 3 gear		●		
Backward 4 gear		●		●

2.3 Structure and principle of the hydraulic powered clutch

Six hydraulic gear shifting clutch with the same structure are installed in the transmission box.

The forward and backward gear should be mounted on the forward and backward shaft; the first gear and second gear should be mounted on the first and second gear shaft; the third and fourth gear on the third and forth gear shaft.

The clutch is made up of shaft, cylinder body, piston, driving piece, driven piece and waveform spring.

The connection and disconnection of the clutch: the pressure oil flows to the cylinder body of the clutch from the main control valve and pushes the piston overcoming the spring force to make the driving piece of the clutch connect with the driven piece when operating the gear shifting valve lever. So the power is transmitted and the power is output through gear. When the pressure oil circuit is cut, the piston returns to its original position by the action of the waveform spring. The driving piece and driven piece disconnect and the power is cut.

The forward and backward clutches have 9 driving pieces and 8 driven pieces separately. First gear clutch has 11 driving pieces and 10 driven pieces; second gear clutch has 7 driving pieces and 6 driven pieces; third gear clutch has 11 driving pieces and 10 driven pieces; fourth gear clutch has 7 driving pieces and 6 driven pieces. Oil from the radiator flows through the oil pipeline on the bearing seat, shaft and gears to the friction pieces acting the role of lubrication and cooling.

2.4 The principle diagram of the transmission box’s hydraulic system (refer to the fig. 2.3)

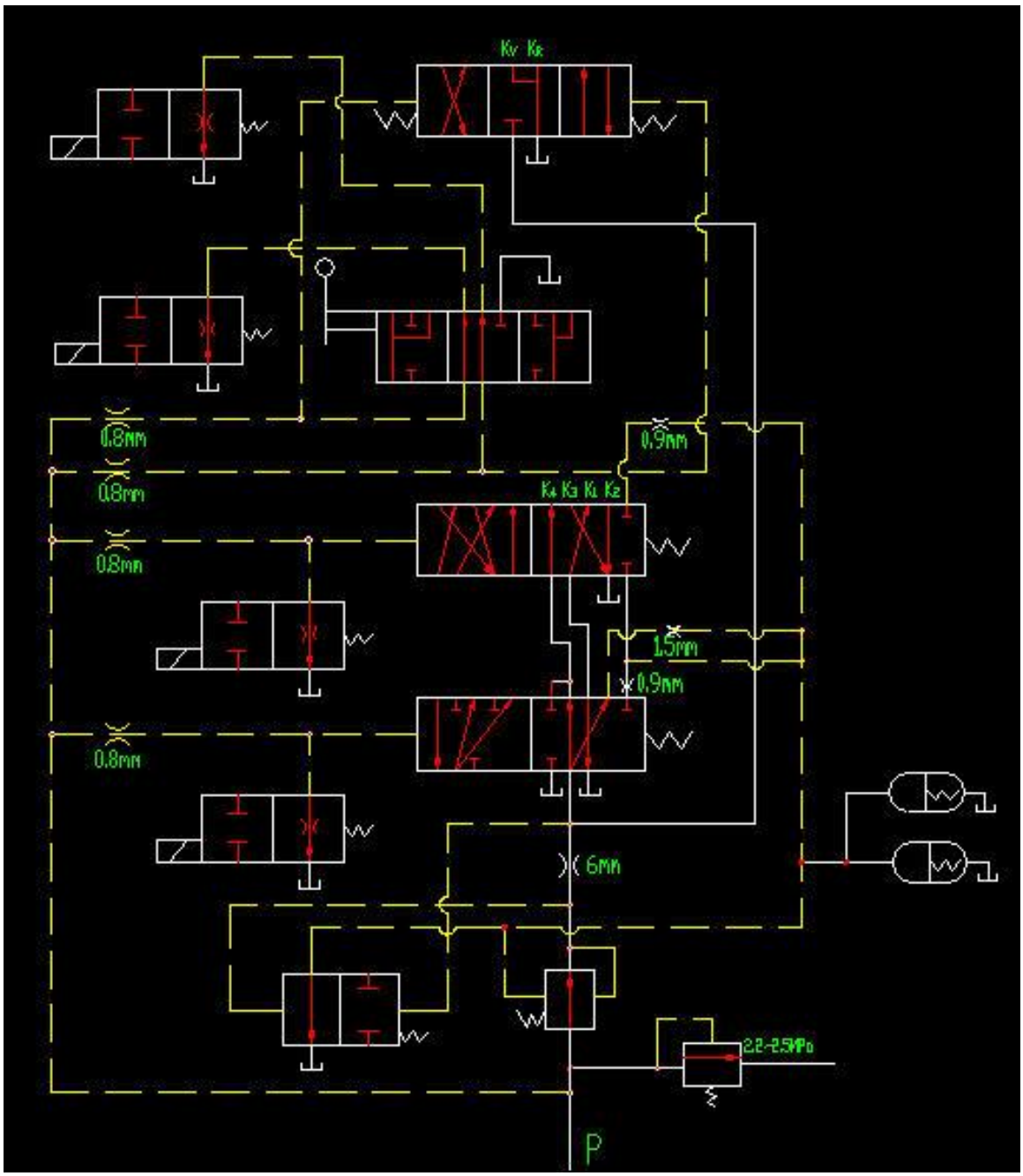


Fig. 2.3 The principle diagram of the transmission box's hydraulic system

2.5 Main control valve

(1) Both the direction control valve and gear control valve adopt the series connection, so the solenoid is few.

(2) The control mode: the pilot oil circuit is controlled by the electric system and main oil pressure of the clutch is controlled by the pilot oil circuit. Especially when the gear pressure curve of the K-D gear is proper, the gear pressure drops quickly first and

then increase smoothly and stably under working of adjusting valve, fast returning valve and accumulator. The whole process will be no more than 2S. The driving torque of the clutch increases under the working of the high pressure hydraulic oil and the clutch connects smoothly.

(3) The two accumulators are connected in parallel on the clutches of different gears. The accumulator can reduce the oil pressure of the positive engaged clutch to avoid the rotation torque loss when shifting gears and lessen the shock to the transmission box. The accumulator can store the oil pressure of the clutch temperately to ensure the stable gear shifting without delay and stable pressure.

2.6 The operation and maintenance of the transmission box

2.6.1 Preparation and maintenance before travelling

The oil in the transmission box acts the role of working medium of the hydraulic powered torque converter and transmission box's hydraulic system on one hand; on the other hand, it cools and lubricates the parts in the torque converter and transmission box. Add the transmission oil according to the regulation. Before the working of the transmission box, apply proper lubrication oil. Take radiator, filter and oil pipelines into consideration when adding transmission oil in the first time.

The lubrication oil will goes to every place of the whole system after adding oil. The amount of first time adding will be more than later adding.

After the oil cooler of the torque converter is mounted on the truck, the oil flows back to oil tank through the oil pipeline. So when the engine stays in idle speed, the transmission box remains the heat balanced temperature. So take care of the oil lever.

NOTE: Take care when check the oil lever. Apply the parking brake avoiding truck moving.

Keep the gear in the neutral gear when carrying out the following controlling.

When check the oil lever, if the oil temperature is 80℃, the transmission oil lever should stays in the highest mark; if the temperature is 40℃,the oil lever should

stays in the lowest mark. When draining out the oil, the oil in the transmission and torque converter may be let out.

When cleaning the oil filter, be care not to let dirt or oil pollution fall into the oil circuit. And also, place a plate avoiding the oil going into the parking brake.

Mount the oil filter gently.

2.6.2 Travelling and gears

Before starting the engine, keep the gear in the neutral gear. Or the engine can not start.

When the engine is started, connect the emergency button and parking brake and chose proper travelling direction and corresponding gear. Step on the acceleration pedal and the truck can move.

If the truck is stopped while the engine is working, engage a gear and the engine will not die out. The truck will creep slowly on a flat and straight road because of the small traction force produced by the torque converter when the engine is in idle speed.

Be sure to apply the parking brake and emergency brake when stopping the truck.

Put the direction gear on the neutral when stopping for a long time.

Before starting the truck, release the emergency brake and parking brake.

The engine rotation speed will increase when shifting gears from high speed to low speed because of the effect of torque converter especially skipping a gear. So when shifting gears from high speed to low speed, slow down the travelling speed with foot brake first and then shifting gears if condition permits.

Slow down first when changing travelling direction with high travelling speed.

Carry out the direction changing operation with a speed no more than 10km/h.

2.6.3 Stooping for a wile and stopping for a long time

There is no rigid connection among torque converter, engine and transmission

box. So apply the parking brake and wedge the block to the four wheels when parking on slop.

2.6.4 Towing the truck

The towing speed should be no more than 10km/h and the towing distance should be no more than 10km or the transmission box will be damaged because of insufficient oil supply. If the distance is long, transport the disable truck with other vehicle.

2.6.5 Check

2.6.5.1 Oil temperature check

Check the transmission oil with oil temperature sensor.

The torque converter outlet oil temperature will be no more than 120℃ if the working condition and systems are normal. If the temperature is higher than 120℃, stop the truck to check if there is oil leakage of the circuit. Keep the diesel engine run with certain speed and check if the transmission box leaks. Keep the engine run with a speed of 1200-1500r/min and the transmission box on the neutral gear, the oil should fall to the normal value about two minutes. If not, the system has fault. Use the truck until the fault is solved.

2.6.5.2 Oil pressure check

Oil pressure gauge is installed on the truck to monitoring the oil pressure. The normal range is 18-22MPa.

2.6.6 Maintenance

2.6.6.1 Lubrication oil types

Use the regulated lubrication oil type. No substitution.

2.6.6.2 Lubrication oil amount

The total oil amount is about 30L of the torque converter and transmission system. Control the actual oil amount with oil dipstick.

2.6.6.3 Oil changing

The first oil changing should be carried out after 100h running of the truck. Change the oil every 1000h or one year.

2.6.6.4 Oil filter replace

Replace the oil filter each time changing the oil.

2.6.7 The procedure of oil changing

Check and adjust the transmission oil lever regularly so as to keep the normal working of the transmission box. If the oil lever is low, the transmission box may be damaged; if the oil lever is low, the power loss of the transmission box and the oil temperature will increase.

The points of oil lever checking:

(1) Park the truck on a flat and straight road;

(2) Engage the direction gear on the neutral gear;

(3) Run the engine 100r/min.

Follow the three steps to check the oil lever:

2.6.7.1 Oil adding

Open the transmission oil adding cover and add oil before starting. The theoretical value of oil adding is 30L. Fill the transmission oil radiator with oil also. Take care with the oil cleanness and not to let the dirt on the oil container fall into the transmission system.

2.6.7.2 Oil lever check in COLD ZONE

Check the oil lever when the oil temperature is no more than 40℃ and the engine speed is 1000r/min. The oil lever should be in the COLD ZONE on the oil dipstick at that time. If it is insufficient, add oil to the COLD ZONE; if it is above the lever, do not drain out the oil.

The lever check in COLD ZONE only guarantees the oil is enough to carry out the lever check in HOT ZONE while the check in HOT ZONE is the last check deciding the oil lever.

2.6.7.3 Oil lever check in HOT ZONE

Keep the engine speed at 1000r/min when the transmission oil increases to 80-90℃ and check if the oil lever is in the HOT ZONE. If it is insufficient, resupply the oil; if it exceeds the lever, drain out the oil.

Concrete ways are following:

Carry out the oil lever checking according to the following two procedures:

(1) Oil lever check in COLD ZONE

Engage the gear on the neutral. Check if the oil lever is in the ODE ZONE of the dipstick after starting the engine for 2 minutes. If it is not enough, add the oil to the regulated lever.

(2) Lever check in HOT ZONE (carry out when the check in COLD ZONE is standard)

Engage the gear on the neutral (park the truck on a flat road. Make sure there is enough space which is about a length of a truck before and after the truck. Make sure there is no person in front of and after the truck.) carry out the check under the following order:

a) Press the emergency brake and release the parking brake;

b) Step on the foot brake to the floor;

C) Engage the gear on the forward Ⅳ and then the torque converter oil temperature increase fast.

When the oil temperature reaches 80℃， put the gear on the neutral. Then check if the oil lever is in the HOT ZONE. If it is not enough, resupply the oil; if it exceeds the lever, drain out the oil.

The oil lever stands for the result when the oil temperature is among 80-90℃。Carry out the weekly check under the working oil temperature that is the temperature of heat balance.

2.7 Notes when the truck has fault

When the truck is disabled and it is necessary to tow the truck. Pay attention to the following notes:

(1) Dismount the transmission shaft between the transmission box and differential.

(2) Put the gear shifting lever on the neutral.

If the oil supply pump does not work, the lubrication will be abnormal. If the rotation of the driving wheel is transmitted to the gears of the transmission box and clutch, sticking may occur. (So it is necessary to dismount the transmission shaft.)

2.8 Troubleshooting

(1) The oil temperature increases high. Refer to table 2.1.

(2) Insufficient power. Refer to table 2.2.

(3) The noise of the transmission box is high. Refer to table 2.3.

(4) The transmission efficiency is low. Refer to table 2.4.

(5) Oil leakage. Refer to table 2.5.

Table 2.1

Parts	Reasons	Checking method	Remedy
Torque converter	(1)low oil lever	Check the oil lever	Add oil
	(2)The oil filter blocks	Dismount it and check	Clean or replace
	(3) The flywheel collides with the other parts	Drain out the oil in the oil filter and in the oil tank and check if there are foreign matters in the oil	Replace
	(4) The air is taken in	Check the joints and oil pipeline on the air taken in side	Tighten the joints or change the shim
	(5)Water is mixed into the oil	Drain out the oil and check	Change oil
	(6) Low oil flow	Check if the pipeline is damaged or bent	Repair or replace
	(7)The bearing wear or get stuck	Dismount it and check	Repair or replace
Transmission box	(1)The clutch skips	Put the gear on the neutral and check if the truck runs	Replace the friction piece of the clutch

	(2) The bearing wear or get stuck.	Dismount it and check	replace

Table 2.2

Parts	Reasons	Checking method	Remedy
Torque converter	Low oil pressure		
	(1) low oil lever	Check the oil lever	Add oil
	(2)The air is taken in on the oil taken in side	Check the joints and pipeline	Retighten the joints and replace the sealing
	(3) The oil filter is blocked	Dismantle it and check	Clean and replace
	(4)The displacement of fuel feeding pump is insufficient	Dismantle it and check	Replace
	(5)The spring of the main relief valve is deformed	Check the spring tension	
	(6)The sealing ring or O ring is damaged	Dismantle it and check	Replace
	The flywheel collides with the other parts	Drain out little oil and check if there is foreign matter	Replace
Transmission box	Improper of oil or form bubble	Check	
	(1) The air is taken in on the oil taken in side	Check the joints and pipeline	Retighten the joints and replace the sealing
	(2)The torque converter oil pressure is low or form bubble	Measure the pressure	Adjust the pressure
	The clutch skips		
	(1) Low oil pressure	Measure the pressure	Adjust the pressure
	(2)The sealing is broken	Dismantle, check and measure	Replace
	(3) The piston ring of the clutch is worn out	Dismantle and check	
	(4)The friction piece wear and the steel piece is deformed.	Dismantle and check the engine. Put the gear on the forward, backward and neutral gear respectively. When	Replace

		on the neutral gear, the truck will not work if the truck goes forward or backward	
	The incorrect position of the inching link and gear shifting valve.	Check and measure	regulation
Engine	Low engine efficiency	Check the rotation speed when the engine goes to a stall. Check the sound when the engine works. Check the max. rotation speed of the engine when the gear is on the neutral.	Adjust or repair the engine

Table 2.3

Parts	Reasons	Checking method	Remedy
Torque converter	(1)The spring plate is broken	Check the rotation noise in low speed	Replace the spring plate
	(2)The bearing is damaged	Dismantle and check	Replace
	(3)The gear is broken	Dismantle and check	Replace
	(4)The spline is worn out	Dismantle and check	Replace
	(5) loud noise of the oil feeding pump	Dismantle and check	Repair or replace
	(6)The bolt is loose	Dismantle and check	Tighten or replace
Transmission box	(1) The bearing is worn or stuck	Dismantle and check	Replace
	(2) The gear is broken	Dismantle and check	Replace
	(3) The spline is worn	Dismantle and check	Replace
	(4)The bolt is loose	Dismantle and check	Tighten or replace

Table 2.4

Parts	Reasons	Checking method	Remedy
Torque converter	(1)The spring plate is broken	Check the rotation noise in low speed and check if the front cap rotates	Replace

	(2)Insufficient oil amount	Check the oil lever	Add oil
	(3)The driving system of the oil feeding pump is out of work	Dismantle and check	Replace
	(4)The shaft is broken	Dismantle and check	Replace
	(5)Low oil pressure	Check if there is sucking pressure on the oil inlet side of the oil feeding pump	Replace
Transmission box	(1)Low oil lever	Check the oil lever	Add oil
	(2)The sealing is broken	Dismantle and check	Replace
	(3)The clutch piece skips	Check the clutch oil pressure	Replace
	(4)The bearing is broken	Dismantle and check	Replace
	(5)The clutch cap is broken	Dismantle and check	Replace
	(6)The snap ring of the clutch is broken	Dismantle and check	Replace
	(7)The are foreign matters in the clutch oil tank	Dismantle and check	Clean or replace
	(8)The spline part of the shaft is worn	Dismantle and check	Replace

Table 2.5

Parts	Reasons	Checking method	Remedy
Torque converter and transmission box	(1)The sealing is broken	Dismantle and check if lip or other matching parts are worn.	Replace the oil sealing
	(2)Incorrect connection of the case	Check	Tighten or change the piece
	(3)Loose joint and pipeline	Check	Replace or replace the pipe
	(4)Loose oil outlet plug	Check	Tighten or replace
	(5)Oil blows off from the air vent hole	Drain out oil and check if water is mixed in; check if air is taken in the sucking joints; checking air venting system	Change oil Tighten or change the sealing Repair
	(6)Too much oil	Check the oil lever	Drain out the excess oil

3. Drive Axle

3.1 General Description

The drive axle that consists of a main reduction, differential, hub reduction and brakes is bolted to the front support of the frame. The masts are installed on the front support of the frame.

3.2 Main reduction and Differential

The main reduction and differential consists primarily of a cross case, ring gear and drive pinions, which are all assembled on the differential carrier, and is fitted to the axle housing through packings.

The cross case is of the split type. The cross case, assembled with bolts, contains side gears and pinions fitted to the spider, being in mesh with each another. The drive pinions supported by two taper roller bearings are installed in the bearing cage fitted to the differential carrier through shims and packings. The ring gear is of the spiral bevel gear type. It is bolted to the cross case. Power from the transmission is reduced by the combination of the ring gear and drive pinions.

3.3 Hub Reduction

The hub reduction is of the planet gear type consisting of a sun gear, planetary gears and an internal gear. Two hub reduction are installed on each end of the axle housing. The sun gear is splined to the axle shaft and locked with snap ring. The planetary gears are installed onto the shafts in the planet carrier which is fixed to the wheel hub. The internal gear is splined to the axle spindle through hub.

The principle of power transmission is as follows: When the sun gear turns, the rotation is transmitted to the pinion gears and ring gear. However, since the ring gear is fixed to the spindle, the pinion gears revolve around the sun gear while spining themselves. The pinion gears are installed to the carrier which is fixed to the wheel hub, therefore, power of the drive shaft causes the wheel to turn.

3.4 Troubleshooting Guide (See Table3.1)

Table3.1

Cause	Trouble	Correction
Oil leaks from main reduction case	Loose bolt or broken gasket of main reduction case.	Replace or retighten.
	Breather is clogged.	Clean or replace.
	Oil seal is worn or damage.	Replace.
Noisy differential	Gear is worn, damaged or broken.	Replace.
	Bearing is worn, damaged or broken.	Replace.
	Improper backlash.	Adjust.
	Loose spline fitness of side gear to propeller shaft.	Replace parts.
	Insufficient gear oil.	Add as necessary.

4. Electric System

WARNING

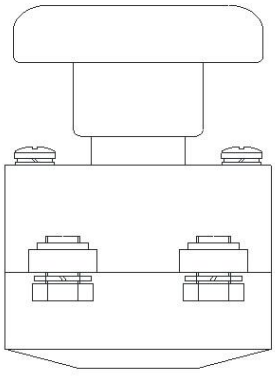
1) Cut off the main power source after work is finished and before leaving the cab.

2) When maintaining the truck, cut off the main power source.

3) Cut off the main power source and disconnect the electric controller sockets before using welding equipment.

Note：

1） See the figure below for truck main power source. The main power source is near the electric cabin.



2) Special notes on electric control elements (including engine control unit (ECU), transmission control unit (TCU))

Precautionary measures when installing control unit

We suggest to take the following measures to prevent electric control unit damage caused by improper operation/

(1) Disconnect the electric control unit when carrying out welding work on chassis. If welding work has to be done besides electric control unit, remove the electric control unit first.

(2) When reconnecting the battery after relative work that needs disconnecting battery is finished, make sure the battery end and clamp is firmly connected.

(3) Battery charger can not be used to start engine.

(4) When charging, disconnect the battery.

(5) When engine is running or electric control unit has electricity, do not connect or disconnect electric control unit.

(6) When engine is running, do not disconnect battery.

(7) When the temperature is higher than 80℃， remove the electric control unit.

3) The electric units of CPCD160-WX(CU/)-06III are distributed in cab, electric cabin and truck body.**

4.1 Electric system

The electric system mainly includes battery, generator, starter, starting switch and so on. It is used for truck start and stop and truck equipments that need electricity. Voltage: DC 24V.

4.1.1 Battery

Model: D01-6-150 (2 12V, 150Ah maintenance free batteries)

The battery is on the right side of the truck body.

Every 200 hours:

◆ Clean carefully battery cell, wires and battery cell box. Remove oxides and corrosiveness that may cause electric leakage.

◆ Check if the connections between the battery cable and column head..

◆ Observe the color of electric eye of the battery which is green normally. It needs charging if it is black; it needs changing or repair if it is light yellow.

Special notes:

◆ The polarity pole of the battery can not be exposed outside or places with flame. It can not approach to the smoke or frog. The hydrogen produced during charging will mix with the air to produce a kind of gas with flammability and high explosive. When starting the engine, do not change the connection and do not make the battery tilt towards any direction.

◆ Make sure both the positive pole and negative pole cables are connected to the column. If it is poor connected, the electric devices may badly damaged. Refer to the wire connection principle of the engine systems. Be careful with the connecting order of the positive pole and negative pole. The negative pole must fixed after dismantle.

◆ Wear glasses when dealing with battery. The electrolyte of the battery has sulfuric acid with high corrosiveness. Once it is splashed onto your skin, wash with lots of soapsuds first and then seek medical help. If it is splashed into eyes, wash with lots of clean water and then seek medical help.

4.1.2 Generator

(Please refer to the engine manual.)

Daily maintenance: Check if the connection is all right.

Every 1600 hours: clean the convergence coil; check the wear condition and connection condition of the carbon brush. Change the carbon brush with the same type if necessary.

4.1.3 Starter

(Please refer to the engine manual.)

Daily maintenance: Check if the connection is all right.

Every 1600h: check the wear condition and connection condition of the carbon brush. Change the carbon brush with the same type if necessary.

(1) Starter operation note:

◆ The starter is designed based on the working system of high current and short time working shift. There is no cooling device inside. When starting the engine, the working time of the starter can not exceed 5 seconds every time. If a start fails, the next start should be two minutes later or the engine may burn caused by overheating.

◆ When starting the engine in low temperature, start the engine after preheating.

◆ When the battery power is insufficient, overlong starting time may burn engine. In order to reduce starting time, keep the battery full.

◆ Loose the key as soon as the engine starts. Never put the key switch on the IGNITION lever when the engine in working normally.

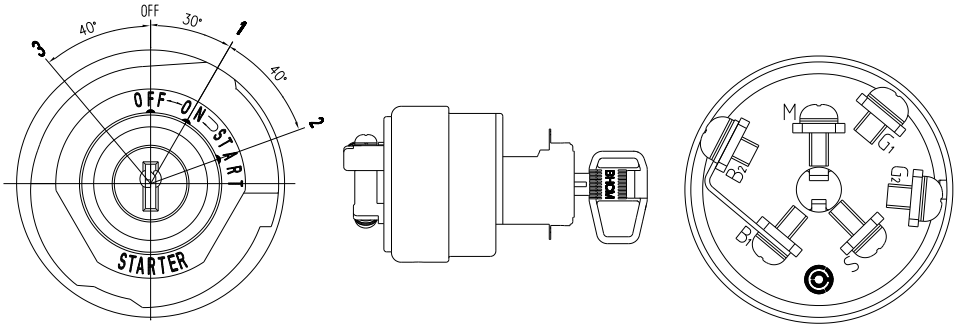
◆ It is strictly forbidden to exhaust for the engine or trail the whole truck with the starter.

(2) Trouble shooting for the starter

Phenomenon	Possible reasons	Remedy
The motor can not move.	Poor connection of the wires	Check the wire circuit
	The electromagnet switch is burn.	Change the electromagnet switch
	The connection between the electric brush and redirection is not firm	Change the electric brush.
	Rotator element is damaged	Change the rotator assembly
	The redirection is damaged	Change the rotator assembly
	The insulation element on the electric brush cap is damaged	Change the electric brush cap assembly
	The electromagnetic switch has no electricity	Check the other parts in the wire circuit
The motor can not generate the engine.	The battery electric quantity is not enough	Recharge the battery or change the battery
	Poor connection of the wires	Tighten the wire connectors

	The isolator slips or is damaged	Change the isolator
	The electric brush wears out and powdered carbon has piled up	Clean the powdered carbon or change the electric brush
	The armature, the stator and the ground forms short circuit	Repair or change
	The bushing with oil is worn out	Change the bushing with oil
The move of the motor can not stop.	When starting, the start relay sticks	Change the starting relay
	The electromagnetic switch of the starter sticks	Change the electromagnetic switch

4.1.4 Starting switch



通断逻辑表

接头代码 / 档位	B_1	B_2	M	S	G_1	G_2
OFF	○	○				
1-ON	○	○	○			
2-ST	○	○	○	○		○
3	○	○			○	

B1、B2---starting switch power M---Switch gets electricity position
S----Switch starting position G1----independent preheating position
G2----Starting preheating position

Note: Before starting, check if the gear shifting knob is on neutral position.

✧ Insert the key into the switch and turn to 1”ON” position in clockwise direction. At this time, warning light and indicator light can be tested.

✧ Turn the key switch to 2”starting” position and loose at once after the engine is

started. Do not press the accelerator pedal. After the engine is started, check if the engine oil pressure stays in the setting range.

✧ Turn the key switch to OFF position and the engine is flame out.

Note: If engine can not start, the time turning the key switch can not exceed 5s or engine may be damaged or battery leakage may be caused.

4.1.5 Engine instruction

4.1.5.1 Xichai CA6DF3-GAG3U

CA6D3-*G3U diesel engine which adopts electric control system and supercharged and mid-cooling technology meets China emission standard III with optimized performance and reliability. Take care of the following items when using:

4.1.5.1.1 Low temperature starting

When starting in low temperature, if the inlet air heater is controlled by electric control unit, please start the engine according to the following procedures:

1) Turn the key switch to ON position;
2) If the cooling temperature is lower than -10℃, the preheating indicator on meter turns on and turns off after preheating is finished.
3) After the preheating indicator is off, turn the key switch to “START” position and start the engine.
4) When the engine is started successfully, turn the key switch to “ON” position.

Note:

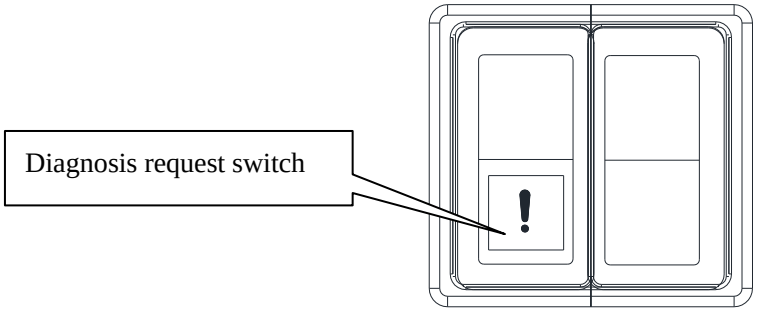
1) Because preheating will consume much electric energy, so avoid repeated operation or a bad effect on battery may be caused.
2) Start then engine within 5s after the preheating indicator is turned off. Avoid working conditions such as running with high speed or repeat idling after the engine is started shortly.

4.1.5.1.2 Engine self-diagnosis system

The electric control system has two fault check methods: flash code and fault code. fault code can be read through meter.

✧ Check procedure when there is flash code

1) Turn the key switch from OFF to ON position when the diagnosis request switch is off. Do not start engine. At this time, system fault indicator on the meter turns on. The electric control system carries out self-diagnosis. If there is no current fault (fault unsolved), engine system fault light flashes and then turns off. At this time, engine can be started normally.
2) If there is fault, engine fault indicator is on all the time. At this time, diagnosis request switch is connected and system fault light shows fault through flash code in circulation until the first flash code is shown. That means all fault is shown. When there is fault, starting is forbidden.
3) Solve the problem through changing the relative parts or fault parts according to corresponding fault reasons of flash code.
4) After the fault is solved, disconnect the diagnosis switch and turn the key switch to ON position from OFF position. If the fault lights turns off after 3 seconds and make sure there is no fault, then the truck can be used.



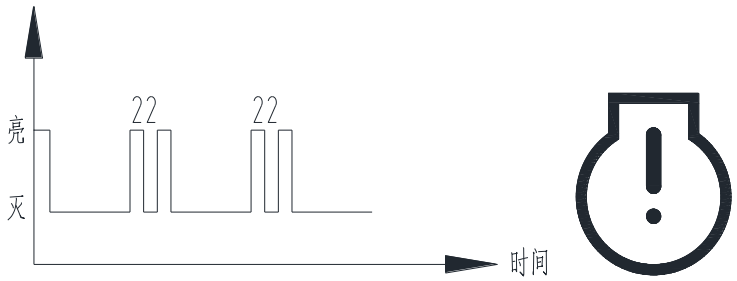
Note:

1) When engine control system detects serious fault, even though the fault is solved, the system will store these fault information is ECU memory, during normal using, although these faults are solved and the system fault is off, the flash code will display when the diagnosis switch is connected. The flash

code will disappear only when the fault code in memory is cleared through fault diagnosis tester. Recheck to make sure there is no fault after the fault is solved and then the truck can be reuse again.

2) When engine control system detects serious fault, even though the fault is solved, the system will store these fault information is ECU memory, during normal using, although these faults are solved and the system fault is off, the flash code will display when the diagnosis switch is connected. The flash code will disappear only when the fault code in memory is cleared through fault diagnosis tester. This situation does not affect normal operation.

✧ Fault flash code reading



Fault light indicating Fault flash code diagram fault light

Fault flash code is shown through the flashing of fault light. The consecutive flashing times stands for a figure. When is showing one figure, the interval between each flashing is 0.5s. when it is showing different figure, the interval between two flashing is 1.5s.

For example, for fault code 22, the flashing method is: the fault light flashes twice consecutively (the interval between two flashing is 0.5), it stands for figure 2; after 1.5s, the light flashes twice consecutively (the interval between two flashing is 0.5s), it stands for another figure 2. If there is more than one fault, press the fault diagnosis switch to show next fault until the first fault is shown again.

✧ Fault code table

Fault position	Flash code	P-code	DTC	SPN	FMI	Fault description	Fault causes	Check item	Possible effect
Bent axle sensor	1-1	P0335	0x000C00BE	190	12	No bent axle sensor signal	1. Open circuit of bent axle connection 2. Bent axle sensor fault	1. Check if bent axle sensor harness meets requirements . 2. Check the assembling time of bent axle sensor and the clearance between fly	1. Engine is hard to start or can not be started 2. Engine performance is limited.
	1-2	P0336	0x000B00BE		11	Incorrect bent axle sensor signal	1. Incorrect connection of bent axle sensor harness 2. Bent axle sensor fault		

								wheel disc teeth 3. Check if fly wheel disc teeth meets requirements	
Camshaft Sensor	1-3	P0340	0x000C027C	636	12	No camshaft sensor signal	1. Camshaft sensor fault 2. Camshaft sensor open circuit	1. Check if canshaft sensor harness meets requirements . 2. Check installing position of	1. Engine is hard to start 2. Engine can not be started
	1-4	P0341	0x000B027C		11	Incorrect camshaft sensor signal	1. Camshaft signal is disturbed. 2. Incorrect harness		

							connection	camshaft	
Camshaft cylinder detection signal	1-5	P0348	0x000700BE	190	7	Large offset of bent axle cylinder detection signal	The timing offset between camshaft and bent axle signal. It may be caused by incorrect timing assembling of sensor or engine.	sensor and the clearance between camshaft teeth. 3. Check if the signal disc meets requirements	
Atmosphere pressure sensor	1-9	P2229	0x0003006C	108	3	high atmosphere pressure sensor APS	Environment pressure sensor fault	1. Check ECU 2. Change ECU	1. Environment pressure takes default value, the supercharger Protection
	2-1	P2228	0x0004006C		4	Low atmosphere pressure sensor APS			

									function based on environment can not be realized. 2. Environment pressure takes default value ad engine torque is limited.
Supercharge Pressure sensor	2-2	P0238	0x00030066	102	3	High supercharge pressure sensor BPS	1. Open circuit of supercharge pressure sensor signal 2. Short circuit	1. Check supercharge pressure sensor and harness	1. Air amount based on supercharge pressure can not be calculated. If

							between sensor and power		the system has no air flow meter, the engine air intaking amount will use default value. 2. Engine performance may be limited. 3. There may be dark smoke.
	2-3	P0237	0x00040066		4	Low supercharge pressure sensor BPS	1. Short circuit between supercharge pressure sensor signal and earth		
	2-4	P0236	0x00020066		2	Supercharge pressure sensor reasonable fault	1. Aging of supercharge pressure sensor 2. Aging of environment pressure	1. Check supercharge pressure sensor 2. Check environment pressure	

							sensor	sensor	
	2-5	P0238	0x000F0066		15	High supercharge pressure sensor phasic value	Aging of supercharge pressure sensor	1. Check supercharge pressure sensor and harness	
	2-6	P0237	0x00110066		17	Low supercharge pressure sensor phasic value	Aging of supercharge pressure sensor		
Supercharge temperature sensor	2-7	P0113	0x00030069	105	3	High supercharge temperature sensor IATS	1. open circuit of air intaking temperature sensor signal 2. short circuit between air	1. check air intaking temperature sensor and harness	

							intaking temperature sensor signal wire and power		
	2-8	P0112	0x00040069		4	Low supercharge temperature sensor IATS	Short circuit between air intaking signal and earth		
	2-9	P0113	0x000F0069		15	high air intaking temperature sensor physic value	Aging of air intaking temperature sensor		
	3-1	P0112	0x00110069		17	Low air intaking temperature sensor physic	Aging of air intaking temperature		

						value	sensor		
	3-2	P0096	0x000C0069		12	Unreasonable Air intaking temperature sensor signal static value	Aging of air intaking temperature sensor		
Cooling water temperature sensor	3-3	P0118	0x0003006E	110	3	High cooling water temperature sensor CTS	1. short circuit between water temperature sensor circuit and high level 2. open circuit of water temperature	1. check water temperature sensor 2. check relative harness	1. Engine performance may be limited. 2. Water temperature takes default value.

							ground wire		
	3-4	P0117	0x0004006E		4	Low cooling water temperature sensor CTS	1. short circuit between water temperature sensor circuit and earth 2. short circuit between water temperature sensor circuit and low level		
	3-5	P0116	0x0002006E		2	Unreasonable of cooling water temperature	1. abnormal of water temperature	1. check if water temperature	Engine performance is limited

						sensor CTS	2. sensor work abnormal of cooling system work	2. sensor works normally 2. check if engine cooling system works normally	
	3-6	P0118	0x000F006E		15	High cooling water temperature sensor phasic value			
	3-7	P0117	0x0011006E		17	Low cooling water temperature sensor phasic value			
	1-1-9	P0116	0x000F006E		15	High cooling water temperature			
Cooling water temperature	3-8	P0116	0x00E2F006	520198	2	Dynamic test of cooling water			

sensor test						temperature sensor			
	3-9	P0217	0x00E2F006		2	Absolute test of cooling water temperature sensor			
Fuel temperature sensor	4-1	P0183	0x000300AE	174	3	High fuel temperature sensor FTS	1. open circuit of fuel temperature sensor signal wire 2. short circuit between fuel temperature signal wire and power	1. check fuel temperature sensor and harness	Engine performance is limited

	4-2	P0182	0x000400AE		4	Low fuel temperature sensor FTS	Short circuit between fuel temperature sensor signal wire and earth		
	4-3	P0183	0x000F00AE		15	High fuel temperature sensor phasic value	Abnormal working of cooling system	Abnormal working of cooling system	Engine performance is limited
	4-4	P0182	0x001100AE		17	Low fuel temperature sensor phasic value			
Oil throttle 1 signal	4-5	P0123	0x0003005B	91	3	High Oil throttle 1 signal ACCPED	Fault of oil throttle pedal and harness	Check oil throttle pedal and harness	1. oil throttle pedal can not work normally

							connection		2. engine has no respond to oil throttle 3. engine speed is limited
	4-6	P0122	0x0004005B		4	Low Oil throttle 1 signal ACCPED	APP1 and APP2 signal exceed normal range caused by oil throttle pedal aging and so on.		
	4-7	P2135	0x0002005B		2	Unreasonable oil throttle signal			
Oil throttle 2 signal	4-8	P0223	0x0003010D	29	3	High Oil throttle 2 signal ACCPED	Fault of oil throttle pedal and harness connection		
	4-9	P0222	0x0004001D		4	Low Oil throttle 2 signal ACCPED			
Over high of engine speed	5-1	P0219	0x000f0215	533	15	Over high of engine speed	1. engine fuel injector fault 2. improper	1. check oil injector 2. check truck	1. engine is damaged by over speed

							driving posture	driving way	2. ECU stops injection under over speed state.
Environment Temperature sensor	5-2	P0073	0x000300AB	171	3	High environment temperature sensor	Short circuit between sensor and power	Change ECU	1. Environment temperature is replaced by default value
	5-3	P0072	0x000400AB		4	Low environment temperature sensor	Short circuit between sensor and ground		
Engine oil pressure sensor	5-4	P250D	0x00030064	100	3	High engine oil pressure sensor	1. broken circuit of engine oil pressure	1. Check engine oil pressure sensor and	1. Engine oil pressure can not monitor normally

							sensor signal wire 2. short circuit between engine oil pressure sensor signal and power positive pole 3. short circuit of engine oil pressure sensor signal wire high level	harness 2. Check engine oil level	2. Engine oil temperature can not monitor normally 3. engine performance is limited
	5-5	P250C	0x00040064		4	Low engine oil	Short circuit		

						pressure sensor	between engine oil pressure sensor signal wire to ground		
	5-6	P0524	0x00110064		17	Engine oil pressure reasonability low fault	Low engine oil pressure		
	5-7	P250B	0x00020064		2	Engine oil pressure reasonability high fault	High engine oil pressure		
Engine oil temperature sensor	5-8	P0198	0x000300AF	175	3	high engine oil temperature sensor	1. open circuit of engine oil temperature sensor signal	Check engine temperature sensor and harness	

							wire 2. short circuit between engine oil temperature sensor signal wire and high level		
	5-9	P0197	0x000400AF		4	Low engine oil temperature sensor	Short circuit between engine oil temperature sensor signal wire and ground		
	6-1	P0196	0x000200AF		2	Engine oil temperature reasonability	Over high of engine oil temperature	1. check engine oil temperature	

						fault		sensor	
	6-2	P0196	0x000F00AF		15	Engine oil temperature exceeding max. value is unreasonable.		2. Check engine oil level	
Air flow sensor	6-8	P0103	0x00030084	132	3	High air flow sensor	1. abnormal of air flow meter signal 2. signal is disturbed 3. HFM is polluted or damaged	1. Check HFM sensor 2. Check HFM harness 3. Check if HFM is polluted	1. HFM can not work normally 2. EGR system is closed 3. Engine torque is limited 4. Intaking amount use replacing value
	6-9	P0103	0x00040084		4	Low air flow sensor			
	7-1	P0103	0x000F0084		15	Over high of air flow physic value			
	7-2	P0102	0x00110084		17	Over low of air flow physic value			

Air flow sensor	8-1	P0113	0x000300AC	172	3	Over high of air flow sensor			
	8-2	P0112	0x000400AC		4	Over low of air flow sensor			
Air flow sensor temperature	8-3	P0113	0x00E3F001	520193	3	High air flow sensor temperature period			
	8-4	P0112	0x00E4F001		4	low f air flow sensor temperature period			
Air flow sensor	8-5	P0113	0x00F00AC	172	15	High air flow sensor temperature physic value			

	8-6	P0112	0x001100AC		17	Low air flow sensor temperature physic value			
Clutch switch reasonable fault	8-7	P0704	0x00020256	598	2	Clutch switch reasonability fault	1. Open circuit of clutch signal circuit 2. Short circuit of clutch signal circuit	Check clutch switch and harness	1. Cruise function can not be activated 2. Truck driving is affected.
Speed sensor signal	8-8	P0500	0x000C0054	84	12	Speed sensor signal reasonability fault	1. Speed sensor fault 2. Harness fault	Check speed sensor and harness	1. Functions related with speed can not work. 2. Truck driving performance
	8-9	P0501	0x00000054		0	Speed exceeds limit value	1. Over fast of speed		

	9-1	P1511	0x00030054		3	High speed sensor signal period	1. Speed sensor fault 2. Harness fault		is badly affected.
	9-2	P1512	0x00040054		4	Low speed sensor signal period			
EGR position	9-9	P0404	0x000D0AE7	2791	13	Over large offset between ERG and last value	1. ERG is aging 2. Connect caused by too much accumulated carbon in EGR.	Check EGR	1. EGR system can not work 2. Engine torque is limited
	1-1-1	P0404	0x00140AE7		20	Large positive offset of EGR position control			
	1-1-2	P0404	0x00150AE7		21	Small negative offset of EGR position control			
	1-1-3	P0400	0x00140AE7		20	EGR is blocked			

						in open state.			
	1-1-4	P0400	0x00150AE7		21	EGR is blocked in off state.			
	1-1-5	P0406	0x00030AE7		3	High ERG position sensor	Short circuit of EGR valve position sensor signal wire and sensor power positive pole	Check EGR position sensor signal harness	
	1-1-6	P0405	0x00040AE7		4	Low ERG position sensor	Short circuit of EGR valve position sensor signal wire and ground		
	1-1-7	P0406	0x000F0AE7		15	High position sensor physic	1. EGR valve is aging	1. Check EGR	

						value	2. Connect is caused by too much accumulated carbon in EGR		
	1-1-8	P0405	0x00110AE7		17	Low position sensor physic value			
Start motor drive	1-2-1	P1600	0x000502A5	677	5	Open circuit of start motor drive	1. Starter control relay is damaged 2. Open circuit of drive circuit	1. Check engine relay and harness	1. Starter can not work normally
	1-2-2	P1601	0x000302A5		3	Short circuit of start motor drive	1. Short circuit between starter control relay		

							drive circuit and ground		
Brake pedal signal reasonability judge failure	1-2-3	P2299	0x000C0255	597	12	Brake pedal signal reasonability Judge failure	1. brake signal relay fault 2. brake signal relay circuit fault	1. check brake main and auxiliary switch harness 2. check if two switch signals are synchronal.	1. Enter cruise function can not be achieved; 2. 2. The reasonability of brake and oil throttle signal can not be judged; 3. Brake priority judge function failure
acceleration pedal and brake pedal signal reasonability judge failure	1-2-4	P2299	0x000C005B	91	12	Acceleration pedal and brake pedal signal reasonability judge failure			
Water in oil	1-2-5	P1001	0x00E5F000	520192	5	Open circuit of	Open circuit of	Check water in	Water in oil

indicator						water in oil indicator	water in oil indicator drive circuit	oil indicator and harness	indicator cannot work normally
	1-2-6	P1002	0x00E3F000		3	Short circuit of water in oil indicator	Short circuit of water in oil indicator drive circuit		
+ key of multifunction switch is stuck	1-6	P1530	0x00EBF02D	520237	11	+ key of multifunction switch is stuck	1. more than one cruise buttons are activated at the same time; 2. button has been triggered for	1. check cruise button switch and harness	1. cruise or PTO or idling function can not be activated
-key of multifunction switch is stuck	1-7	P1531	0x00EBF02E	520238	11	-key of multifunction switch is stuck			
RES key of multifunction switch is stuck	1-8	P1532	0x00EBF02F	520239	11	RES key of multifunction switch is stuck			

OFF key of multifunction switch is stuck	1-6-5	P1533	0x00EBF030	520240	11	OFF key of multifunction switch is stuck	a long time 3. button switch circuit fault		
Long distance oil throttle 1 signal	1-6-6	P1520	0x00E3F033	520243	3	High long distance oil throttle 1 signal	1. long distance oil throttle pedal and harness connection fault	1. check long distance oil throttle pedal and harness	1. engine power output function and so on based on long distance oil throttle pedal can not be activated.
	1-6-7	P1521	0x00E4F033		4	Low long distance oil throttle 1 signal			
	1-6-8	P1522	0x00E2F033		2	long distance oil throttle signal is unreasonable.	APP1 and APP2 signal exceeds normal range caused by long distance oil throttle pedal aging.		

Long distance oil throttle 2 signal	1-6-9	P1523	0x00E3F034	520244	3	High long distance oil throttle 2 signal	long distance oil throttle pedal and harness connection fault		
	1-7-1	P1524	0x00E4F034		4	Low long distance oil throttle 2 signal			
first cylinder injection drive	1-3-2	P0262	0x00030288	651	3	Short circuit of first cylinder injection drive	Corresponding injector short circuit	1.check relative injector harness	1. relative injector does not work 2.Engine performance may be affected 3. engine may stop working
	1-3-3	P0201	0x0005028B		5	Open circuit of first cylinder injection drive	Corresponding injector open circuit		
second cylinder injection drive	1-3-5	P0265	0x0003028C	652	3	Short circuit of second cylinder injection drive	Corresponding injector short circuit		
	1-3-6	P0202	0x0005028C		5	Open circuit of	Corresponding		

						second cylinder injection drive	injector open circuit		
third cylinder injection drive	1-3-8	P0268	0x0003028D	653	3	Short circuit of third cylinder injection drive	Corresponding injector short circuit		
	1-3-9	P0203	0x0005028D		5	Open circuit of third cylinder injection drive	Corresponding injector open circuit		
fourth cylinder injection drive	1-4-2	P0271	0x0003028E	654	3	Short circuit of fourth cylinder injection drive	Corresponding injector short circuit		
	1-4-3	P0204	0x0005028E		5	Open circuit of fourth cylinder injection drive	Corresponding injector open circuit		
fifth cylinder injection drive	1-4-5	P0274	0x0003028F	655	3	Short circuit of fifth cylinder	Corresponding injector short		

						injection drive	circuit		
fifth cylinder injection drive	1-4-6	P0205	0x0005028F		5	Open circuit of fifth cylinder injection drive	Corresponding injector open circuit		
sixth cylinder injection drive	1-4-8	P0277	0x00030290	656	3	Short circuit of sixth cylinder injection drive	Corresponding injector short circuit		
	1-4-9	P0207	0x00050290		5	Open circuit of sixth cylinder injection drive	Corresponding injector open circuit		
Injecting time is limited	1-7-2	P1210	0x00F0F021	520225	16	Injecting times is limited by power system ability	1. too many injecting times, which exceeds system limit	Check if relative demarcated parameters are matched.	1. Injecting times is limited 2. Engine performance is affected
	1-7-3	P1211	0x00EFF021		15	Injecting times is limited by			

						high pressure pump ability			
	1-7-4	P1212	0x00EBF021		11	Injecting times is limited by system ability			
Engine oil quantity is limited.	1-7-6	P1215	0x00EEF022	520226	14	Engine oil quantity is limited.	Relative fault activate oil quantity limit	Check relative devices	Engine performance is affected
OBD fault oil quantity limit 1	1-7-7	P1216	0x00EEF023	520227	14	OBD fault oil quantity limit 1	OBD relative faults occur	Check relative exhausting devices	Engine performance may be limited
OBD fault oil quantity limit 2	1-7-8	P1217	0x00EEF024	520228	14	OBD fault oil quantity limit 2			
OBD fault oil quantity limit 3	1-7-9	P1218	0x00EEF025	520229	14	OBD fault oil quantity limit 3			
OBD fault oil quantity limit 4	1-8-1	P1219	0x00EEF026	520230	14	OBD fault oil quantity limit 4			

Main relay	1-8-3	P0686	0x00030A4A	2634	3	Short circuit of main relay	ECU main relay working is abnormal	1. Check main relay and harness 2. change main relay	1. injector does not work 2. engine performance may be affected 3. engine may stop working
	1-8-4	P0685	0x00050A4A		5	Open circuit of main relay			
	1-8-5	P1685	0x000C0A4A		12	Connect of main relay			
	1-8-6	P1686	0x000C0A4A		12	Early disconnect of main relay			
Air conditioner relay	1-8-7	P1647	0x00030547	1351	3	Short circuit of air condition relay	1. short circuit between air condition relay drive circuit and ground	Check air condition relay and harness	Air condition can not work normally
	1-8-8	P1645	0x00050547		5	Open circuit of air condition	1. air condition relay is		

						relay	damaged 2. open circuit of drive circuit		
Air exhausting brake valve	1-8-9	P0478	0x00030432	1074	3	Short circuit of air exhausting valve	1. short circuit between air exhausting brake valve relay drive circuit and ground	Check air exhausting brake valve relay and harness	Air exhausting brake valve can not work normally
	1-9-1	P0477	0x00050432		5	Open circuit of air exhausting valve	1. air exhausting brake valve relay is damaged		

							2. open circuit of drive circuit		
Air exhausting brake indicator	1-9-2	P1650	0x00E3EFFE	520190	3	Short circuit of air exhausting brake indicator	1. short circuit between air exhausting brake indicator drive circuit and ground	Check air exhausting brake indicator and harness	air exhausting brake indicator can not work normally
	1-9-3	P1651	0x00E5EFFE		5	Open circuit of air exhausting of brake indicator	1. air exhausting indicator is damaged 2. open circuit of drive		

							circuit		
Air intaking heating relay	1-9-4	P0542	0x000302D9	729	3	Short circuit of air intaking heating relay	1. Short circuit between air intaking heating relay drive circuit and ground	Check air intaking heating relay and harness	air intaking heating relay can not work normally
	1-9-5	P0540	0x000502D9		5	Open circuit of air intaking hearing relay	1. air intaking heating relay is damaged 2. open circuit of drive circuit		
Air intaking hearing indicator	1-9-6	P1635	0x00E3EFFF	520191	3	Short circuit of air intaking heating relay	1.Short circuit between air intaking heating	Check air intaking heating indicator and	air intaking heating indicator can not work

							indicator drive circuit and ground	harness	normally
	1-9-7	P1637	0x00E5EFFF		5	Open circuit of air intaking hearing relay	1. air intaking heating indicator is damaged 2.open circuit of drive circuit		
OBD fault light	1-9-8	P1652	0x00E3F002	520194	3	Short circuit of OBD fault light	short circuit between OBD fault indicator driver circuit and ground	check OBD fault light and harness	OBD fault light can not work normally
	1-9-9	P1653	0x00E5F002		5	Open circuit of OBD fault light	1.OBD fault light is damaged 2. Open circuit		

							of drive circuit		
Svs light	2-1-1	P1654	0x00030270	624	3	Short circuit of svs light	1. short circuit between svs drive circuit and ground	Check svs light and harness	svs light can not work normally
	2-1-2	P0650	0x00050270		5	Open circuit svs light	1. svs light is damaged 2. open circuit of drive circuit		
EGR motor	2-1-3	P0404	0x00ECF003	520195	12	EGR motor power supply fault	EGR valve fault	Check EGR valve and harness	1. EGR system can not work normally 2. Engine torque is limited
	2-1-4	P0490	0x00E3F003		3	Short circuit between EGR motor and			

						power			
	2-1-5	P0489	0x00E4F003		4	Short circuit between EGR motor and ground			
	2-1-6	P0403	0x00E5F003		5	Open circuit of EGR motor			
	2-1-7	P0488	0x00E2F003		2	EGR motor too heat			
EGR flow	2-1-9	P0402	0x00EFF005	520197	15	Too large of EGR flow	EGR valve fault	Check EGR valve and harness	1.EGR system can not work normally 2.Engine torque is limited
	2-2-1	P0401	0x00F1F005		17	Too small of EGR flow			
EGR valve NOx limit value	2-2-2	P1410	0x00EFF007	520199	15	EGR valve NOx limit value 1 out of limit			

	2-2-3	P1411	0x00F0F007		16	EGR valve NOx limit value 2 out of limit			
Pneumatic EGR fault	2-1-8	P0400	0x00ECF004	520196	12	Pneumatic EGR fault	EGR valve fault	Check EGR valve and harness	1.EGR system can not work normally 2.Engine torque is limited
Fan speed high	2-4-9	P0526	0x00030667	1639	3	Fan speed high	1. Fan circuit is abnormal. 2. Engine temperature is over high	1. Check fan drive circuit harness 2. Check fan relay	1. Fan can not work normally 2. Engine water temperature is over high
Fan speed low	2-5-1	P0527	0x00040667		4	Fan speed low			
Engine temperature over high	2-5-2	P1540	0x00F0F008	520200	16	Engine temperature over high			
Fan drive	2-5-3	P0691	0x0005042F	1071	5	Fan drive open circuit			

	2-5-4	P0483	0x0004042F		4	Short circuit between fan drive and ground			
	2-5-5	P0692	0x000C042F		12	Fan drive overload			
	2-5-6	P0692	0x0002042F		2	Fan drive overheat			
	2-5-7	P0480	0x0003042F		3	Short circuit of fan drive			
	2-5-8	P1690	0x0003042F		3	Short circuit of high speed fan drive			
	2-5-9	P1691	0x0004042F		4	Open circuit of high speed fan drive			

	2-6-1	P1692	0x0003042F		3	Short circuit of low speed fan drive			
	2-6-2	P1693	0x0004042F		4	Open circuit of low speed fan drive			
Water in oil	2-6-5	P102A	0x000C0061	97	12	Water in oil sensor self check failure	Sensor self check failure	Check sensor and harness	1. Too much water in oil 2. Fuel system service life may be affected 3. Engine performance is limited
	2-6-6	P102B	0x000B0061		11	Water in oil is detected	Too much water in oil-water separator	1. Check fuel quality 2. Drain the water in oil-water separator	
Fuel heating	2-6-7	P1009	0x00E5F027	520231	5	Open circuit of	1. Fuel heating	Check fuel	Fuel heating relay

drive fault						fuel heating drive	replay is damaged 2. Open circuit of drive circuit	heating relay and harness	can not work normally
	2-6-8	P1008	0x00E3F027		3	Short circuit of fuel heating drive	Short circuit between fuel heating relay drive circuit and ground		
EEPROM	2-7-5	P062F	0x00020276	630	2	Sector unable to use in EEPROM is much	EEPROM memory are is damaged	1. Clear and confirm the fault again 2. Change ECU	1. Operation parameter become invalid or can not be recorded.
	2-7-6	P062F	0x000C0276		12	EEPROM clear fault			
	2-7-7	P062F	0x00040276		4	EEPROM			

						program fault			
CANO_BusOff	28-2	U0029	0x00ECF00B	520203	12	CANO_BusOff	CAN0 bus is disconnected or disturbed	1. check CAN0 harness 2. checkCAN0 other point connections and baud rate	1.Demarcating system, diagnosis system can not connect 2. impossible connection with other parts
CANO_BusOff	2-8-3	U0038	0x00ECF00C	520204	12	CANO_BusOff	CAN1 bus is disconnected or disturbed	1.check CAN1 harness 2.checkCAN1 other point connections and baud rate	impossible connection with other parts
Overtime of receiving	2-8-4	U1000	0x00ECF00D	520205		Overtime of receiving	Message 1 is not received in set	Check message sending point	No respond to receiving message

message 1						message 1	time.		1’s relative event
Overtime of receiving message 2	2-8-5	U1001	0x00ECF00E	520206	12	Overtime of receiving message 2	Message TCO1 is not received in set time.	Check message sending point	Information such as external speed can not be received
Overtime of receiving message 3	2-8-6	U1002	0x00ECF00F	520207	12	Overtime of receiving message 3	Message TSC1AE is not received in set time.	Check message sending point	The point’s request can not be received.
Overtime of receiving message 4	2-8-7	U1003	0x00ECF010	520208	12	Overtime of receiving message 4	Message TSC1DE is not received in set time.	Check message sending point	The point’s request can not be received.
Overtime of receiving message 5	2-8-8	U1004	0x00ECF011	520209	12	Overtime of receiving message 5	Message TSC1PE is not received in set	Check message sending point	The point’s request can not be received.

							time.		
Overtime of receiving message 6	2-8-9	U1005	0x00ECF012	520210	12	Overtime of receiving message 6	Message DSC1TE is not received in set time.	Check message sending point	The point's request can not be received.
Overtime of receiving message 7	2-9-1	U1006	0x00ECF013	520211	12	Overtime of receiving message 7	Message TSC1VE is not received in set time.	Check message sending point	The point's request can not be received.
Overtime of receiving message 8	2-9-2	U1007	0x00ECF014	520212	12	Overtime of receiving message 8	Message 8 is not received in set time.	Check message sending point	No respond to receiving message 8's relative event
Overtime of receiving message 9	2-9-3	U1008	0x00ECF015	520213	12	Overtime of receiving message 9	Message 9 is not received in set time.	Check message sending point	No respond to receiving message 9's relative event
Overtime of	2-9-4	U1009	0x00ECF016	520214	12	Overtime of	Message 10 is	Check message	No respond to

receiving message 10						receiving message 10	not received in set time.	sending point	receiving message 10’s relative event
Overtime of receiving message 11	2-9-5	U100A	0x00ECF017	520215	12	Overtime of receiving message 11	Message 11 is not received in set time.	Check message sending point	No respond to receiving message 11’s relative event
SVLDO#1 power supply module fault	3-1-2	P1639	0x00ECF01D	520221	12	SVLDO#1 power supply module fault	1. fault of sensor power supply 1 , corresponding sensor and harness	1. check the sensors and harness whose power is supplied by the power module	1. engine performance is limited; 2. the sensors and harness whose power is supplied by the power module can not work normally

									3. oil throttle pedal has no respond 4. supercharging pressure sensor can not work normally.
5VLDO#2power supply module fault	3-1-3	P163A	0x00ECF01E	520222	12	5VLDO#2power supply module fault	Fault of sensor power supply module 2 and sensor and harness connected with it		
Battery voltage	3-1-6	P0653	0x000300A8	168	3	High battery voltage	1. battery fault 2. harness	1. check battery	1. engine performance

							connection fault	voltage 2. check harness connection	is limited. 2. All sensors powered by the module can not work. 3. Oil throttle has no responds 4. Camshaft sensor can not work
	3-1-7	P0652	0x000400A8		4	Low battery voltage	1. battery short of electricity 2. harness connection fault	1. check battery voltage 2. check harness	1. electric elements service life is badly affected or damaged

								connection	
DCDC	3-1-8	P1640	0x00E3F028	520232	3	DCDC short circuit	1. interior DCDC electric circuit fault	Read DCDC voltage through diagnosis machine	1. injector start is abnormal 2. engine can not start
	3-1-9	P1641	0x00E5F028		5	DCDC open circuit			1. injector can not start 2. engine can not start
Reset caused by clock fault	3-2-2	P1671	0x00ECF02A	520234	12	Reset caused by clock fault	Core fault	1. Clear and affirm the fault again 2. Change ECU	1. Controller reset 2. Engine operation has fault
Reset caused by watch dog	3-2-3	P1672	0x00ECF02B	520235	12	Reset caused by watch dog	Core fault		
Illegal address visit	3-2-4	P1673	0x00ECF02C	520236	12	Illegal address visit	Core fault		

4.1.5.2 Electric system for the Cummins QSB6.7

(Refer to the instruction of the engine manufactory provided with the truck.)

Cummins QSB6.7 is high performance electric fuel injection engine with ECU controller meeting Europe Ⅲ emission standard. The engine has self diagnosis function and adopts electric throttle to control the rotation speed. The engine is energy-saving and environment friendly.

4.1.5.2.1 Engine preheating

Automatic preheating system assembled in this engine facilitates starting in low temperature. Turn the key switch to the 1 position, the ECU will supply electricity to the intaking air heater when the environment temperature is low. The intaking air is heated and the preheating indicator on the meter lights on. Start the engine until the indicator turns off.

Step the acceleration pedal and the truck will speed up. 6-wire type electric throttle replaces the mechanical throttle. The throttle operation is more sensitive because of no mechanical connection between the throttle operation and engine.

4.1.5.2.2 Protection function of the electric controller system

The protection function includes: reduce the torque converter automatically under the condition of high water temperature, high intaking air temperature, high engine oil temperature, low engine oil pressure, low water lever, high fuel temperature, much lower exhausting and little engine oil. Lower the rotation speed automatically when the engine oil pressure is low. Protect the engine from speeding. Restrict the engine rotation speed and torque converter based on the engine oil pressure when the engine is started to protect the key parts of the engine such as supercharger.

4.1.5.2.3 Self diagnosis function of the electric controller system

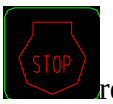
Cummins QSB6.7 engine has self diagnosis function which automatically diagnoses the engine working condition and each sensor. If there is something wrong, it alarms and stores the fault code. The serviceman can find out the fault according to

the fault code.

The whole truck has trouble if both yellow alarming light and red alarming light on the meter flicker. Read the fault code through the flickering frequency of the red alarming light.

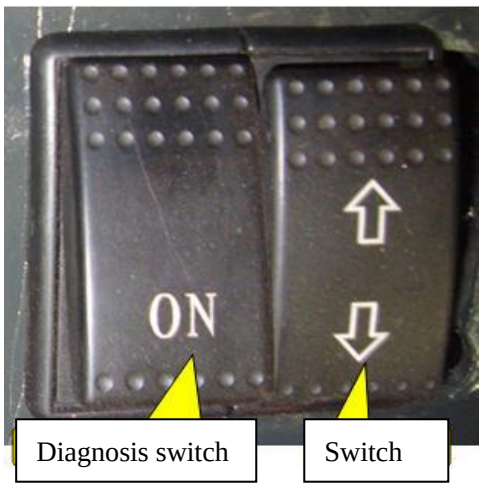
Two different colors are used to indicate the fault according to the severity degree.


yellow warning light: the yellow warning light is on indicating that it needs to troubleshoot as soon as possible.



red stop signal: the red light is on indicating that it needs to stop the engine and troubleshoot as soon as possible. Do not start the engine before troubleshooting.

Check whether the current fault code exists or not .turn the key switch to "OFF" off position, and the diagnostic switch to the “ON" position, then the key switch to the "ON" position.



If there is no record of the current fault code, the yellow warning light and red stop signal will be on at the same time, and will be always on.

If there is current fault code record, the yellow warning light and red stop lights will turn on instantly, and then start flashing recorded fault code.

Fault codes will flash in the following order:

The yellow warning light lights up. After 1 to 2 seconds' pause, the red signal begins to flash the fault code with 1 to 2 seconds between each number. For example:*halt*halt*halt*******

The yellow light lights up again after the red signal finishes its flashing. And then red signal repeats flashing the fault code.

When the whole machine is more than one fault, use the fault diagnosis switch for page turning.

Flip the "idling adjustment switch" to the (+) position to check the next fault code; Flip the "idling adjustment switch" to the (-) position to check the fault code before. If there is only one fault code, the fault signal will display the one constantly in either (+) position or (-) position.

Disconnect the diagnosis switch when the diagnostic system is not in use. If the diagnosis switch is not turned off, ECM will not record some of the fault code.

If the diagnosis switch is not turned off after the starting of the engine, when adjusting "idling adjustment switch", the idling of the engine will be adjusted. The idling will be increased or decreased by 25r/min in each page up or page down.

4.1.5.2.4 Fault code of the Cummins engine

Read the fault code according to the above procedure when the engine has fault. Remove the fault based on the recommended remedies.

Fault code	Lamp color	JI939		Fault reasons	Engine effect
		SPN	FMI		
111	Red	0629	12	Engine control module critical internal failure-bad intelligent device or component. Error internal to the ECM related to memory hardware failures or internal ECM voltage supply circuits.	Possible no noticeable performance effects, engine dying, or hard stating.
115	Red	0612	02	Engine magnetic crankshaft speed/ position lost both of two signals-data erratic intermittent, or incorrect. The ECM has detected that the primary engine speed sensor and the backup engine speed sensor signals are reversed.	Fueling to injection is disabled and the engine can not be started.
122	Yellow	0102	03	Intake manifold 1 pressure sensor circuit-voltage above normal, or shorted to high source. High signal voltage or open circuit detected at the intake manifold pressure circuit.	Engine power derate.

123	Yellow	0102	04	Intake manifold 1 pressure sensor circuit-voltage below normal, or shorted to low source. Low signal voltage or open circuit detected at the intake manifold pressure circuit.	Engine power derate.
124	Yellow	0102	16	Intake manifold 1 pressure-data valid but above normal operation range-moderately severe lever. Intake manifold pressure has exceeded the maximum limit for the given engine rating.	Engine power derate.
131	Red	0091	03	Accelerator pedal or lever position sensor 1 circuit-voltage above normal or shorted to high source. High voltage detected at accelerator pedal position circuit.	Severe derate in power output of the engine. Limp home power only.
132	Red	0091	04	Accelerator pedal or lever position sensor 1 circuit-voltage below normal or shorted to low source. low voltage detected at accelerator pedal position signal circuit.	Severe derate in power output of the engine. Limp home power only.
133	Red	0974	03	Remote accelerator pedal or lever position sensor 1	Remote accelerator will not operate. Remote

				circuit-voltage above normal, or shorted to high source. High voltage detected at remote accumulator pedal position circuit.	accelerator position will be set to zero percent.
134	Red	0974	04	Remote accelerator pedal or lever position sensor 1 circuit-voltage below normal, or shorted to low source. Low voltage detected at remote accumulator pedal position signal circuit.	Remote accelerator will not operate. Remote accelerator position will be set to zero percent.
135	Yellow	0100	03	Engine oil rifle pressure 1 sensor circuit-voltage above normal, or shorted to high source. High signal voltage detected at the engine oil pressure circuit.	None on performance. No engine protection for oil pressure.
141	Yellow	0100	04	Engine oil rifle pressure 1 sensor circuit-voltage below normal, or shorted to low source. low signal voltage detected at the engine oil pressure circuit.	None on performance. No engine protection for oil pressure.
143	Yellow	0100	18	Engine oil rifle pressure-data valid but below normal operation range-moderately severe lever.	None on performance.
144	Yellow	0110	03	Engine coolant temperature 1 sensor circuit-voltage above normal, or shorted to high source. High signal	Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for

				voltage or open circuit detected at engine coolant temperature circuit.	engine coolant temperature.
145	Yellow	0110	04	Engine coolant temperature 1 sensor circuit-voltage below normal, or shorted to low source. low signal voltage or open circuit detected at engine coolant temperature circuit.	Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for engine coolant temperature.
146	Yellow	01110	16	Engine coolant temperature-data valid but above normal operation range-moderately severe lever. Engine coolant temperature signal indicates engine coolant temperature is above engine protection warning limit.	Progressive power derate increasing in severity from time of alert.
147	Red	0091	01	Accelerator pedal lever position 1 sensor circuit frequency-data valid but below normal operational range-most severe lever. A frequency of less than 100Hz has been detected at the frequency throttle input to the ECM.	Severe derate in power output of the engine. Limp home power only.
148	Red	0091	00	Accelerator pedal or lever position sensor 1-data valid	Severe derate in power output of the engine.

				but above normal operational range-most severe level. A frequency of more than 1500Hz has been detected at the frequency throttle input to the ECM.	Limp home power only.
151	Red	0110	00	Accelerator pedal or lever position sensor 1-data valid but above normal operational range-most severe level. Engine coolant temperature signal indicates engine coolant temperature above engine protection critical limit.	Progressive power derate increasing in severity from time of alert. If engine protection shutdown feature is enable. Engine will shut down 30 seconds after red stop lamp starts flashing.
153	Yellow	0105	03	Intake manifold 1 temperature sensor circuit-voltage above normal, or shorted to high source. High signal voltage detected at intake manifold air temperature circuit.	Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for intake manifold air temperature.
154	Yellow	0105	04	Intake manifold 1 temperature sensor circuit-voltage below normal, or shorted to low source. low signal voltage detected at intake manifold air temperature circuit.	Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for intake manifold air temperature.
155	Red	0105	00	Intake manifold 1 temperature –date valid but above	Progressive power derate increasing in severity

				normal operational range-most severe level. Intake manifold air temperature signal indicated intake manifold air temperature above engine protection circuit limit.	from time of alert. If engine protection shutdown feature is enabled, engine will shut down 30 second after red stop lamp starts flashing.
187	Yellow	1080	04	Sensor supply 2 circuit-voltage below normal or shorted to low source. Low voltage detected at the sensor supply number 2 circuit.	Engine power derate.
195	Yellow	0111	03	Coolant level sensor 1 circuit-voltage above normal or shorted to high source. High signal voltage detected at engine coolant level circuit.	None on performance.
196	Yellow	0111	04	Coolant level sensor 1 circuit-voltage below normal or shorted to low source. low signal voltage detected at engine coolant level circuit.	None on performance.
197	Yellow	0111	18	Coolant level-data valid but below normal operational range-moderately severe level. Low coolant level has been detected.	None on performance.
221	Yellow	0108	03	Barometric pressure sensor circuit-voltage above	Engine power derate.

				normal or shorted to high source. High signal voltage detected at barometric pressure circuit.	
222	Yellow	0108	04	Barometric pressure sensor circuit-voltage below normal or shorted to low source. Low signal voltage detected at barometric pressure circuit.	Engine power derate.
227	Yellow	1080	03	Sensor supply 2 circuit-voltage above normal, or shorted to high source. High voltage detected at sensor supply number 2 circuit.	Engine power derate.
234	Red	0190	00	Engine crankshaft speed/ position-data valid but above normal operational range-most severe level. English speed signal indicates engine speed above engine protection limit.	Fuel injection disabled until engine speed falls below the overspend limit.
235	Red	0111	01	Coolant lever-data valid but below normal operational range-most severe level. Low engine coolant level detected.	Progressive power derate increasing in severity from time of alert. If engine protection shutdown feature is enabled, engine will shutdown 30 seconds after red stop lamp starts flashing.
237	Yellow	0644	02	External speed command input (multiple unit	Primary or secondary engines may be shutdown.

				synchronization)-data erratic, intermittent, or incorrect. The throttle input signal to the primary or secondary engine for multiple unit synchronization is less than three percent or more than 97 percent.	
238	Yellow	0611	04	Sensor supply circuit-voltage below normal, or shorted to low source. Low voltage detected on the +5 VDC sensor supply circuit to the engine speed sensor.	Possible hard starting and rough running.
241	Yellow	0084	02	Wheel-based vehicle speed-data erratic, intermittent, or incorrect. The ECM lost the vehicle speed signal.	Engine speed limit to maximum engine speed without VSS parameter value. Cruise control, gear down protection, and road speed governor will not work.
242	Yellow	0084	10	Wheel base vehicle speed sensor circuit tampering has been detected-abnormal rate of change. Signal indicates an intermittent connection of VSS tampering.	Engine speed limited to maximum engine speed without VSS parameter value. Cruise control, gear down protection, and road speed governor will not work.
245	Yellow	0647	04	Fan control circuit-voltage below normal, or shorted to low source. Low signal voltage detected at the fan	The fan may stay on continuously or not run at all.

				control circuit when commanded on.	
253	Red	0098	01	Engine oil level-value valid but below the normal range-most severe level. The engine level sensor detected very low level.	Engine power is reduced; engine oil pressure is low; engine will be damaged.
268	Yellow	0094	02	Fuel delivery pressure-data erratic, intermittent, or incorrect. The ECM has detected that the fuel pressure signal is not changing.	The ECM will estimate fuel pressure and power is reduced.
269	Red	1195	02	Theft proof code indicator-the value is not stable, or incorrect. Try to start the engine without prove through the engine lock theft proof equipment.	Engine can not start.
271	Yellow	1347	04	Fuel pump pressurizing assembly 1 circuit-voltage below normal, or shorted to low source. Low signal voltage detected at the fuel pump actuator circuit.	Engine will run poorly at idle. Engine will have low power. Fuel pressure will be higher than commanded.
272	Yellow	1347	03	Fuel pump pressurizing assembly 1 circuit-voltage above normal, or shorted to high source. High signal voltage detected at the fuel pump actuator circuit.	Engine will not run or engine will run poorly.
275		1347	7	Pump oil element 1 (front)-mechanical system not	Engine will not run or possible low power.

	Yellow			responding properly or out adjustment.	
281	Yellow	1347	07	Fuel pump pressurizing assembly 1-mechanical system not responding properly or out of adjustment. A pumping imbalance between the front and rear pumping plungers has been detected.	Engine will not run or possible low power.
284	Yellow	1043	04	Engine speed/position sensor (shaft) power voltage circuit-voltage lower than the normal value or shorted to low voltage. Low voltage detected on the ECM voltage supply line to the engine speed sensor.	Possible hard to run or run rudely.
285	Yellow	0639	09	SAE J1939 multiplexing PGN timeout error-abnormal update rate. The ECM expected information from a multiplexed device but did not receive it soon enough or did not receive it at all.	At least one multiplexed device will not operate properly.
286	Yellow	0639	13	SAE J1939 multiplexing configuration error-out of calibration. The ECM expected information form a multiplexed device but only received a portion of the necessary information.	At least one multiplexed device will not operate properly.

287	Red	0091	19	SAE J1939 multiplexed accelerator pedal or lever sensor system-received network data in error. The OEM vehicle electronic control unit detected a fault with its accelerator pedal.	Engine may only idle or engine will not accelerate to full speed.
288	Red	0974	19	SAE J1939 multiplexed remote accelerator pedal or lever position sensor system-received network data in error. The OEM vehicle electronic control unit detected a fault with the remote accelerator.	The engine will not respond to the remote throttle engine may only idle. The primary or cab accelerator may be able to be used.
291	Red	0625	09	Special data communication connecting port fault (OEM/ data communication connecting port)-updating rate abnormal, ECM can not communicate with the engine lock thief proof system.	Abnormal working of the engine lock thief proof system. Engine can not start.
292	Red	0441	14	Auxiliary temperature sensor input 1-special instructions.	Possible engine power derate.
293	Yellow	0441	03	Auxiliary temperature sensor input 1 circuit-voltage above normal, or shorted to high source. High signal voltage or open circuit detected at the OEM auxiliary	None on performance.

				temperature circuit.	
294	Yellow	0441	04	Auxiliary temperature sensor input 1 circuit-voltage below normal, or shorted to low source. Low signal voltage or open circuit detected at the OEM auxiliary temperature circuit.	None on performance.
295	Yellow	0108	02	Atmospheric pressure-value is not stable, interrupted, or incorrect. The atmospheric pressure sensor can not read stable value at the very beginning of turning on the key switch.	Engine power derate.
296	Red	1388	14	Auxiliary pressure sensor input 1-special instructions.	Possible engine power derate.
297	yellow	1388	03	Auxiliary pressure sensor input 1 circuit-voltage above normal, or shorted to high source. High signal voltage detected at the OEM pressure circuit.	None on performance.
298	yellow	1388	04	Auxiliary pressure sensor input 1 circuit-voltage below normal, or shorted to low source. Low signal voltage detected at the OEM pressure circuit.	None on performance.
319	yellow	0251	02	Real time clock power interrupt-data erratic,	None on performance. Data in the ECM will not

				intermittent, or incorrect. Real time clock lost power.	have accurate time and data information.
322	yellow	0651	05	Injector solenoid valve driver cylinder 1 circuit-current below normal or open circuit. High resistance detected on injector number 1 circuit or no current detected at number 1 injector driver or return pin when the voltage supply at the harness is on.	Engine can possibly misfire or run rough.
323	yellow	0655	05	Injector solenoid valve driver cylinder 5 circuit-current below normal or open circuit. High resistance detected on injector number 5 circuit or no current detected at number 5 injector driver or return pin when the voltage supply at the harness is on.	Engine can possibly misfire or run rough.
324	yellow	0653	05	Injector solenoid valve driver cylinder 3 circuit-current below normal or open circuit. High resistance detected on injector number 3 circuit or no current detected at number 3 injector driver or return pin when the voltage supply at the harness is on.	Engine can possibly misfire or run rough.
325	yellow	0656	05	Injector solenoid valve driver cylinder 6 circuit-current	Engine can possibly misfire or run rough.

				below normal or open circuit. High resistance detected on injector number 6 circuit or no current detected at number 6 injector driver or return pin when the voltage supply at the harness is on.	
331	yellow	0652	05	Injector solenoid valve driver cylinder 2 circuit-current below normal or open circuit. High resistance detected on injector number 2 circuit or no current detected at number 2 injector driver or return pin when the voltage supply at the harness is on.	Engine can possibly misfire or run rough.
332	yellow	0654	05	Injector solenoid valve driver cylinder 4 circuit-current below normal or open circuit. High resistance detected on injector number 4 circuit or no current detected at number 4 injector driver or return pin when the voltage supply at the harness is on.	Engine can possibly misfire or run rough.
334	yellow	0110	02	Engine coolant temperature- data erratic, intermittent or incorrect. The engine coolant temperature reading is not changing with engine operation conditions.	The ECM will estimate engine coolant temperature.

341	yellow	0630	02	Engine control module data is lost- data erratic, intermittent or incorrect. Data from ECM is lost.	Possible none on performance. Engine misfire or hard to start. Travelling information and maintenance information are not accurate.
342	red	0630	13	Electronic calibration code incompatibility-out of calibration. An incompatible calibration between the primary and secondary OEM installed ECM's has been detected.	None on performance.
343	yellow	0629	12	Engine control module warning internal hardware failure-bad intelligent device or component. Internal ECM failure.	No performance effects or possible severe power derate.
351	yellow	0627	12	Injector power supply-bad intelligent device or component. The ECM measured injector boost voltage is low.	Possible smoke, lower power, engine misfire, and/or engine will not start.
352	yellow	1079	04	Sensor supply 1 circuit-voltage below normal, or shorted to low source, low voltage detected at sensor supply number 1 circuit.	Engine power derate.
386	yellow	1079	03	Sensor supply 1 circuit-voltage above normal, or	Engine power derate.

				shorted to high source, high voltage detected at sensor supply number 1 circuit.	
387	yellow	1043	03	Power voltage circuit of the acceleration pedal or operation lever sensor-voltage higher than normal value or shorted to high power. The acceleration pedal or operation lever position sensor voltage is detected high on the sensor power circuit.	Engine may only idle.
412	no	0608	02	SAE J1587/J1922 data communication port-can not be transmitted. The communication of the J1587/J1922 data communication port is cut	None on performance. Possible no working of the device on the J1587/J1922 data communication port.
415	red	0100	01	Engine oil riffle pressure-data valid but below normal operational range-most severe level. Oil pressure signal indicates oil	Progressive power derate increasing in severity from time of alert. If engine protection shutdown feature is enabled, engine will shutdown 30 seconds after red stop lamp starts flashing.
418	yellow	0097	15	Water in fuel indicator-data valid but above normal operational range-least severe level. Water has been detected in the fuel filter.	Possible white smoke, loss of power, or hard starting.

426	no	0639	02	SAE J1939 data communication port-no transmission. Communication on the SAE J1939 data communication port is cut.	None on performance. Possible no working of the J1939 equipment.
427	no	0639	09	SAE J1939 datalink-abnormal update rate. Communication between the electronic control module (ECM) and another device on the SAE J1939 datalink has been lost.	Engine speed will ramp down and remain at idle.
428	yellow	0097	03	Water in fuel indicator sensor circuit-voltage above normal, or shorted to high source. High voltage detected at the water in fuel circuit.	None on performance. No water in fuel warning available.
429	yellow	0097	04	Water in fuel indicator sensor circuit-voltage below normal, or shorted to low source. low voltage detected at the water in fuel circuit.	None on performance. No water in fuel warning available.
431	yellow	0558	02	Accelerator pedal or lever idle validation switch-data erratic, intermittent, or incorrect. Voltage detected simultaneously on both idle validation and off-idle validation switch.	Engine will only idle.

432	red	0558	13	Accelerator pedal or lever idle validation circuit-out of calibration. Voltage at idle validation on idle and off-idle circuit down not match accelerator pedal position.	Engine will only idle.
433	yellow	0102	02	Air inletting pipe pressure sensor circuit-incorrect date. Pressure sensor signal is detected incorrect by ECM on the air inletting.	Engine output power derate.
434	yellow	0627	02	Power supply lost without ignition off-data erratic, intermittent, or incorrect. Supply voltage to the ECM fell below 6.2 volts momentarily, or the ECM was not allowed to power down correctly.	Possible no noticeable performance effects, engine dying, or hard starting. Fault information, trip information and maintenance monitor may be inaccurate.
435	yellow	0100	02	Engine oil rifle pressure-data erratic, intermittent or incorrect. An error in the engine oil pressure switch signal was detected by the ECM.	None on performance. No engine protection for oil pressure.
436	yellow	0105	02	Temperature of air inletting pipe 1- data erratic, intermittent or incorrect. Instable data is read by the air inletting temperature sensor at the beginning of turning	ECM will estimate engine air inletting pipe temperature.

				on the key switch.	
441	yellow	0168	18	Battery 1voltage-data valid but below normal operational range-moderately severe lever. ECM supply voltage is below the minimum system voltage level.	Engine may stop running or be difficult to start.
442	yellow	0168	16	Battery 1voltage-data valid but above normal operational range-moderately severe lever. ECM supply voltage is above the minimum system voltage level.	Possible electrical damage to all electrical components.
443	yellow	1043	04	Accelerator pedal or operational lever position sensor power voltage circuit-voltage is lower than the normal value or shorted to the low power circuit. Sensor power circuit voltage is detected low of the accelerator pedal or operational lever.	Engine will only idle.
449	yellow	0157	00	Injector metering rail 1 pressure-data valid but above normal operational range-most severe level.	None or possible engine noise associated with higher injection pressures (especially at idle or light load0. engine power is reduced.

451	yellow	0157	03	Injector metering rail 1 pressure sensor circuit-voltage above normal, or shorted to high source. High signal voltage detected at the rail fuel pressure sensor circuit.	Power or speed derate.
452	yellow	0157	04	Injector metering rail 1 pressure sensor circuit-voltage below normal, or shorted to low source. Low signal voltage detected at the rail fuel pressure sensor circuit.	Power or speed derate.
471	no	0098	17	Engine oil level-data valid but lower than the normal working range-most lower sever. Engine oil is detected low by the oil level sensor.	Possible engine power is derated. Possible low pressure of the engine oil. Possible badly damage the engine.
488	yellow	0105	16	Intake manifold 1 temperature-data valid but above normal operational range-moderately severe lever. Intake manifold air temperature signal indicates intake manifold air temperature is above engine protection warning limit.	Progressive power derate increasing in severity from time of alert.
497	yellow	1137	02	Multiple unit synchronization switch-data erratic, intermittent, or incorrect. Multi-unit synchronous ON/OFF switch and multi-unit synchronous	Multi-unit synchronization feature is disabled.

				complimentary ON/OFF switch have different values in the ECM.	
498	yellow	0098	03	Engine oil level sensor circuit-voltage higher than the normal value or shorted to high voltage. Sensor of the engine oil level internal fault is detected.	Stop using the engine oil level sensor.
499	yellow	0098	04	Engine oil level sensor circuit-voltage lower than the normal value or shorted to low voltage. Sensor of the engine oil level internal fault is detected.	Stop using the engine oil level sensor.
523	yellow	0611	02	Auxiliary intermediate (PTO) speed switch validation-data erratic, intermittent, or incorrect. The position of the intermediate speed control switch 1 does not match the position of the intermediate speed control validation switch.	Intermediate speed control switch may not operate correctly.
527	yellow	0702	03	Auxiliary input/output 2 circuit- voltage above normal, or shorted to high source. High signal voltage or open circuit has been detected at the auxiliary input/output 2 circuit.	None on performance.

528	yellow	0093	02	Auxiliary alternate torque validation switch-data erratic, intermittent, or incorrect. An error has been detected in the alternate torque switch circuit.	Torque curve setting defaults to the default torque curve.
529	yellow	0703	03	Auxiliary input/ output 3 circuit-voltage above normal or shorted to high source. High signal voltage or open circuit has been detected at the auxiliary input/output 3 circuit.	None on performance.
545	yellow	1188	07	Waste gas bypass valve control of the turbocharger 1-mechanical system respond abnormal or exceed the adjustment. The pressure of the air inletting pipe exceeds the regulated max. value.	Engine power derate.
551	yellow	0558	04	Accelerator pedal or lever idle validation 1 circuit voltage below normal, or shorted to low source. No voltage detected simultaneously on both the idle validation off-idle and on-idle circuit.	Engine will only idle.
553	yellow	0157	16	Injector metering rail 1 pressure-data valid but above normal operational range-moderately severe level. The	None or possible engine noise associated with higher injection pressures (especially at idle or

				ECM has detected that fuel pressure is higher than commanded pressure.	light load). Engine power is reduced.
554	yellow	0157	02	Injector metering fail 1 pressure-data erratic, intermittent, or in correct. The ECM has detected that the fuel pressure signal is not changing.	The ECM will estimate fuel pressure and power is reduced.
559	yellow	0157	18	Injector metering rail 1 pressure-data valid but below normal operational range-moderately severe level. The ECM detected that fuel pressure is lower than commanded pressure.	Possible hard to start, lower power, or engine smoke.
584	yellow	0677	03	Starter relay driver circuit-voltage above normal, or shorted to high source. Open circuit or high voltage detected at starter lockout circuit.	Either the engine will not start or the engine will not have starter lockout protection.
585	yellow	0677	04	Starter relay driver circuit-voltage below normal, or shorted to low source. Open circuit or low voltage detected at starter lockout circuit.	The engine will not have starter lockout protection.
595	yellow	0103	00	High speed of turbocharger 1-warning level. The speed is detected high of the turbocharger.	Engine power derate. ECM use estimated turbocharger speed.

596	yellow	0167	16	Electrical charging system voltage-data valid but above normal operational range-moderately severe level. High battery voltage detected by the battery voltage monitor feature.	Amber lamp will light until battery voltage condition is corrected.
597	yellow	0167	18	Electrical charging system voltage-data valid but below operational range-moderately severe level. Low battery voltage detected by the battery voltage monitor feature.	Amber lamp will light until battery voltage condition is corrected.
598	red	0167	01	Electrical charging system voltage data valid but below normal operational range-most severe level. Very low battery voltage detected by the battery voltage detected by the battery voltage monitor feature.	Engine will shutdown.
599	red	0640	14	Auxiliary sending out of the double output stop indication-special note. Double output exceed the engine protection limit.	Engine will shutdown.
649	no	1378	31	Engine oil change interval-condition exists. Change engine oil and filter.	None on performance, maintenance reminder only.
687	yellow	0103	18	Low speed of the turbocharger 1-warning level.	Engine power derate. ECM use exterminated

				Turbocharger speed is detected low by ECM.	turbocharger speed.
688	red	0098	00	Engine oil level-data valid but above the normal working range-most severe. High oil level is detected by the sensor.	Possible engine power derate, much exhausting smoke, dilute engine oil, pollution or engine damaged. Engine power may derate.
689	yellow	0190	02	Engine crankshaft speed/position-data erratic, intermittent, or incorrect. Loss of signal from crankshaft sensor.	Engine can run rough. Possible poor stating capability. Engine runs using backup speed sensor. Engine power is reduced.
691	yellow	1172	03	Turbocharger 1 compressor inlet temperature circuit-voltage above normal or shorted to high source. High signal voltage detected at turbocharger compressor inlet air temperature circuit.	Engine power derate.
692	yellow	1172	04	Turbocharger 1 compressor inlet temperature circuit-voltage below normal or shorted to low source. Low signal voltage detected at turbocharger compressor inlet air temperature circuit.	Engine power derate.
731	yellow	0723	07	Engine speed /position crankshaft and crankshaft misalignment-mechanical system not responding	Engine will run derated. Excessive black smoke, hard start, and rough idle possible.

				properly or out of adjustment. Mechanical misalignment between the crankshaft and crankshaft engine speed sensor.	
757	yellow	0611	31	Electronic control module data lost-condition exists. Severe loss data from the ECM.	Possible no noticeable performance effects, engine dying, or hard starting.
778	yellow	0723	02	Engine camshaft speed/position sensor-data erratic, intermittent, or incorrect. The ECM has detected an error in the camshaft position sensor signal.	Possible poor starting. Engine power derate.
779	yellow	0703	11	Auxiliary equipment sensor input 3-rrot cause not known.	Possible engine power derate.
784	yellow	1590	02	Communication with the satisfying cruise control system is cut. The fault occurs when the ECM does not receive the signal from data bus.	Possible abnormal working of the cruise control.
951	no	0166	02	Imbalance of the power among the cylinder. ECM detects the imbalance.	Possible low power, instable idle or short of fire.
957	yellow	0027	02	EGR valve position-data instable, erratic or incorrect. ECM receives interrupted EGR position information.	Possible power is reduced. EGR valve is reduced.

958	yellow	2795	02	VGT position sensor-data instable, erratic or incorrect. ECM receives interrupted VGT position information.	Possible power derate. Electric supply to the operation element of the turbocharger is restricted.
1117	yellow	0627	02	Power supply lost with ignition on-data erratic, intermittent, or incorrect. Supply voltage to the ECM fell below 6.2 VDC momentarily or ECM was not allowed to power down correctly (retain battery voltage for 30 second after key OFF).	Possible no noticeable performance effects or engine dying or hard starting. Fault information, trio information, and maintenance monitor data may be inaccurate.
1139	yellow	0651	07	Injector solenoid driver cylinder 1-mechanical system not responding properly or out of adjustment. unintended fueling detected in cylinder number 1.	Engine will shut down.
1141	yellow	0652	07	Injector solenoid driver cylinder 2-mechanical system not responding properly or out of adjustment. unintended fueling detected in cylinder number 2.	Engine will shutdown.
1142	yellow	0653	07	Injector solenoid driver cylinder 3-mechanical system not responding properly or out of adjustment. unintended fueling detected in cylinder number 3.	Engine will shutdown.

1143	yellow	0654	07	Injector solenoid driver cylinder 4-mechanical system not responding properly or out of adjustment. unintended fueling detected in cylinder number 4.	Engine will shutdown.
1144	yellow	0655	07	Injector solenoid driver cylinder 5-mechanical system not responding properly or out of adjustment. unintended fueling detected in cylinder number 5.	Engine will shutdown.
1145	yellow	0656	07	Injector solenoid driver cylinder 6-mechanical system not responding properly or out of adjustment. unintended fueling detected in cylinder number 6.	Engine will shutdown.
1228	yellow	0027	02	EGR valve position-data instable, erratic or incorrect. ECM receive interrupted EGR position information.	Possible engine power derate. EGR valve will shut off.
1229	yellow	2795	02	VGT position sensor-data instable, erratic or incorrect. ECM receive interrupted changeable VGT position information.	Possible power is reduced. VGR valve is shut off.
1239	yellow	2623	03	Accelerator pedal or operational lever position sensor 2 circuit-voltage higher than normal value or shored to high voltage. Voltage on the accelerator pedal position	Output power of the engine is reduced sharply. Only has cruise returning power.

				sensor 2 signal circuit is detected high.	
1241	yellow	2623	04	Accelerator pedal or operational lever position sensor 2 circuit-voltage lower than normal value or shored to low voltage. Voltage on the accelerator pedal position sensor 2 signal circuit is detected low.	Output power of the engine is reduced sharply. Only has cruise returning power.
1242	red	0091	02	Accelerator pedal or operational lever 1 and 2-data erratic, intermittent, or incorrect. Value on the accelerator pedal sensor 1 and 2 different.	Engine will only idle.
1633	yellow	0625	02	Komnet data communication port can not transmit-data erratic, intermittent, or incorrect. Communication on the OEM data communication port net is interrupted.	None on performance.
1639	no	0703	11	Auxiliary equipment sensor input (OEM switch)-unknown root reason.	Engine power will derate.
1654	yellow	1323	31	Engine 1 cylinder short of fire-something occur. Short of fire is detected on the cylinder 1.	Possible low power, instable idle or short of fire.
1655	yellow	1324	31	Engine 2 cylinder short of fire-something occur. Short of fire is detected on the cylinder 2.	Possible low power, instable idle or short of fire.

1656	yellow	1325	31	Engine 3 cylinder short of fire-something occur. Short of fire is detected on the cylinder 3.	Possible low power, instable idle or short of fire.
1657	yellow	1326	31	Engine 4 cylinder short of fire-something occur. Short of fire is detected on the cylinder 4.	Possible low power, instable idle or short of fire.
1658	yellow	1327	31	Engine 5 cylinder short of fire-something occur. Short of fire is detected on the cylinder 5.	Possible low power, instable idle or short of fire.
1659	yellow	1328	31	Engine 6 cylinder short of fire-something occur. Short of fire is detected on the cylinder 6.	Possible low power, instable idle or short of fire.
1663	yellow	3241	31	Catalyzer input port and the exit temperature sensor is inversed-state exist. The connectors of the catalyzer input port and exit temperature sensor are inversed.	Stop using the injecting catalyzer in the backward dealing system.
1664	yellow	3050	31	No catalyzer-state exist. No backward dealing catalyzer in the exhausting system.	Stop using the injecting catalyzer in the backward dealing system.
1665	yellow	3241	04	Exhausting air temperature 1 circuit-voltage below normal or shorted to lower power. Low signal voltage is detected on the catalyzer input port temperature sensor circuit.	To be used as the implied temperature of the catalyzer input pot.

1666	yellow	3241	03	Exhausting air temperature 1 circuit-voltage high than normal or shorted to high power. High signal voltage is detected on the catalyzer input port temperature sensor circuit.	To be used as the implied temperature of the catalyzer input pot.
1667	yellow	3241	02	Exhausting temperature 1-erratic, intermittent or incorrect data. Exhausting temperature sensor 1 will not change with the engine state.	Stop using the injecting catalyzer in the backward dealing system.
1668	yellow	1761	04	Catalyzer level sensor circuit-voltage lower than the normal or shorted to low voltage. Low signal voltage is detected on the level sensor circuit.	Stop using the injecting catalyzer in the backward dealing system.
1669	yellow	1761	03	Catalyzer level sensor circuit-voltage higher than the normal or shorted to high voltage. High signal voltage is detected on the level sensor circuit.	Stop using the injecting catalyzer in the backward dealing system.
1671	no	1761	18	Catalyzer level-data valid but lower than the normal range-moderate severe level. Low level is detected.	None on performance.
1673	yellow	1761	01	Catalyzer level-data valid but lower than the normal range-most severe level. No catalyzer is detected.	Stop using the injecting catalyzer in the backward dealing system.

1674	yellow	3249	04	Exhausting air temperature 2 circuit-voltage below normal or shorted to lower power. Low signal voltage is detected on the catalyzer input port temperature sensor circuit.	To be used as the implied exhausting temperature of the catalyzer.
1675	yellow	3249	03	Exhausting air temperature2 circuit-voltage high than normal or shorted to high power. High signal voltage is detected on the catalyzer input port temperature sensor circuit.	To be used as the implied temperature of the catalyzer exit port.
1676	yellow	3249	02	Exhausting temperature 2-erratic, intermittent or incorrect data. Exhausting temperature sensor 1 will not change with the engine state.	To be used as the implied temperature of the exhausting temperature 2.
1677	yellow	3031	04	Catalyzer tank temperature-voltage lower than the normal or shorted to low voltage. Low signal voltage is detected on the level sensor circuit.	To be used as the implied temperature of the catalyzer temperature.
1678	yellow	3031	03	Catalyzer tank temperature-voltage higher than the normal or shorted to high voltage. High signal voltage or open circuit is detected on the level sensor circuit.	To be used as the implied temperature of the catalyzer temperature.

1679	yellow	3031	02	Catalyzer tank temperature-erratic, intermittent or incorrect value. The catalyzer temperature sensor will not change with the engine state.	To be used as the implied temperature of the catalyzer temperature.
1681	yellow	3361	12	Catalyzer lever control unit-intelligent unit or parts out of effect. An internal fault is detected on the catalyzer level control unit.	Stop using the injecting catalyzer in the backward dealing system.
1682	yellow	3362	31	Catalyzer level unit input Circuit-condition exist. A fault is detected on the catalyzer level control unit.	Catalyzer injected to the backward dealing system is stopped.
1683	yellow	3449	03	Catalyzer tank heater circuit-voltage higher than normal or shorted to high voltage power. High voltage signal is detected in the catalyzer tank heater relay sensor.	Stop use catalyzer tank heater.
1684	yellow	3363	04	Catalyzer tank heater circuit-voltage lower than normal or shorted to low voltage power. Low voltage signal is detected in the catalyzer tank heater relay sensor.	Stop use catalyzer tank heater.
1687	yellow	3050	00	High temperature of catalyzer-data valid but above the normal range-most severe level. Very high temperature	Stop using the injecting catalyzer in the backward dealing system.

				is detected in the backward dealing system.	
1689	yellow	0251	02	Real time clock power is cut-data erratic, intermittent or incorrect. The real time clock power is cut.	None on performance. Information in the ECM possible has no accurate time and date.
1692	yellow	3234	04	Backward dealing exit nitrogen sensor-voltage lower than normal or shorted to low voltage power circuit. battery voltage is detected exceeding the range by the backward dealing exit nitrogen sensor.	Backward dealing exit nitrogen sensor can not work. Engine power will be reduced after 50h under the fault condition.
1694	yellow	3234	02	Backward dealing exit nitrogen sensor-data erratic, intermittent or incorrect. Data on the nitrogen sensor is detected incorrect by the sensor.	Backward dealing exit nitrogen sensor can not work. Engine power will be reduced after 50h under the fault condition.
1697	yellow	3489	03	Backward dealing 1 air starting executive unit-voltage high than normal or shored to high voltage power. High signal voltage is detected on the catalyzer air solenoid valve.	Stop using the injecting catalyzer in the backward dealing system.
1698	yellow	3489	04	Backward dealing 1 air starting executive unit-voltage lower than normal or shored to low voltage power. Low signal voltage is detected on the catalyzer air solenoid	Stop using the injecting catalyzer in the backward dealing system.

				valve.	
1699	yellow	1761	02	Catalyzer tank level sensor-data erratic, intermittent, or incorrect. Catalyzer level will not change with the engine state.	Stop using the injecting catalyzer in the backward dealing system.
1711	yellow	3361	09	Level control unit data communication port-abnormal update rate. The communication between the ECM and the level control unit is cut.	Stop using the injecting catalyzer in the backward dealing system.
1712	yellow	3363	18	Catalyzer tank heater circuit-data valid but below the normal range-moderate severe lever. The catalyzer temperature is not increased even the heater is connected.	None on performance. If the catalyzer is frozen. Possible no use of the injecting catalyzer to the backward dealing system.
1713	yellow	3363	16	Catalyzer tank heater circuit-data valid but below the normal range-moderate severe lever. The tank heater is connected all the time.	None on the performance.
1716	no	0411	11	Auxiliary temperature sensor input 1 circuit-unknown root reason. High temperature is detected on the OEM temperature sensor or engine cooling liquid	Engine power will be reduced.

				temperature sensor.	
1717	yellow	3241	15	Exhausting air temperature 1-data valid but higher than the normal range-lightest severe level. The input pot of the catalyzer temperature is detected high.	Engine power will be reduced.
1718	yellow	1322	31	More than one cylinder of the engine is short of dire-condition exist. Being short of fire is detected in more than one cylinder.	Possible low power, instable idling or short of fire.
1848	yellow	0105	10	Air inletting pipe 1-abnormal change speed. Inletting pipe temperature sensor does not respond to the engine state.	ECM will estimate engine inletting pipe temperature.
1849	yellow	3241	10	Exhausting temperature 1- abnormal change speed. Inletting pipe temperature sensor does not respond to the engine state.	Be used as the implied temperature of the catalyzer inletting port temperature.
1851	yellow	3249	10	Exhausting temperature 2- abnormal change speed. Inletting pipe temperature sensor does not respond to the engine state.	Be used as the implied temperature of the catalyzer inletting port temperature.
1892	yellow	0084	18	Based on the truck speed-data valid but above the	Engine speed is restricted to the max. engine

				normal range(moderate sever level). Speed signal on the ECM disappear.	speed without VSS referring value. Cruise control, gear reducing protection and road speed adjuster can not work.
1911	yellow	0157	00	Oil injecting measuring oil rail 1 pressure-data valid but above normal-most severe lever. Fuel pressure indicated by the pressure signal exceeds the max. value.	No or possible engine noise connecting with the high injecting oil pressure. Engine power derate.
1992	yellow	0190	16	Engine crankshaft speed/position-data valid but above normal-moderate severe level. Engine speed indicated by the engine crankshaft speed/position signal exceeds the protection range.	Engine stop.
2183	yellow	1072	04	Engine braking executive unit driving 1 circuit-voltage lower than normal or shorted to low voltage power circuit. low voltage is detected in the engine brake solenoid 1 signal circuit.	The engine brake on the 1, 2, 3 cylinders can not be activated or the exhausting brake can not work.
2185	yellow	0232	03	Sensor supply 4 circuit-voltage below normal. Or shorted to low source. Low voltage detected at +5 VDC	Engine will only idle.

				volt sensor supply circuit to the accelerator pedal position sensor.	
2186	yellow	0232	04	Sensor supply 4 circuit-voltage above normal. Or shorted to high source. High voltage detected at +5 VDC volt sensor supply circuit to the accelerator pedal position sensor.	Engine will only idle.
2195	red	0703	14	Auxiliary equipment sensor input engine protection is critical-special note. OEM switch signal indicates the engine protection state on the OEM harness.	Speed is reduced. And the engine may stop if the engine stop protection starts.
2215	yellow	0094	01	Fuel pump delivery pressure-data valid but below normal operational range-moderately severe level. The ECM has detected that fuel pressure is lower than commanded pressure.	Possibly hard to start , low power, or engine smoke.
2216	yellow	0094	00	Fuel pump delivery pressure-data valid but above normal operational range-moderately severe level. The ECM has detected that fuel pressure is higher than commanded pressure.	Possibly hard to start, low power, or engine smoke.

2217	yellow	0630	31	Engine control module calibration program memory (RAM) corruption-condition exists. Severe loss of data from ECM.	Possible no noticeable performance effects, engine dying or bad starting. Fault information, trip information, and maintenance monitor data may be inaccurate.
2249	yellow	0157	01	Injector metering rail 1 pressure-data valid but below normal operational range-most severe level. The ECM has detected that fuel pressure is lower than commanded pressure.	Possible hard to start, low power, or engine smoke.
2265	yellow	1075	03	Electric lift pump for engine fuel supply circuit-voltage above normal or shorted to high source. High voltage or open detected at the fuel lift pump signal circuit.	Engine may be difficult to start.
2266	yellow	1075	04	Electric lift pump for engine fuel supply circuit-voltage below normal or shorted to low source. Low voltage or open detected at the fuel lift pump signal circuit.	Engine may be difficult to start.
2271	yellow	0027	03	Exhausting air recycle valve position sensor circuit-voltage higher than the normal value or shorted to high voltage power. EGR valve position sensor	Possible power is reduced. EGR valve motor will lose electricity.

				circuit signal voltage is detected high.	
2272	yellow	0027	04	Exhausting air recycle valve position sensor circuit-voltage lower than the normal value or shorted to low voltage power. EGR valve position sensor circuit signal voltage is detected low.	Possible power is reduced. EGR valve motor will lose electricity.
2273	yellow	0411	03	EGR valve pressure difference sensor circuit-shorted to high voltage. High voltage on the EGR pressure difference sensor circuit is detected.	EGR valve will shut off.
2274	yellow	0411	04	EGR valve pressure difference sensor circuit-shorted to low voltage. Low voltage on the EGR pressure difference sensor circuit is detected.	EGR valve will shut off.
2292	yellow	–	–	Fuel inletting metering device-data valid but above the normal (moderate severe lever) flow request amount exceeds the expecting value.	Possible bard to start, low power, engine smoke. Engine power is reduced.
2293	yellow	–	–	Fuel inletting metering device-data valid but below the normal (moderate severe lever) flow request amount below the expecting value.	No or possible noise connected with oil injecting

2311	yellow	0633	31	Electronic fuel injection control valve circuit-condition exist. Fuel pump actuator circuit resistance too high or too low.	Possible low power.
2321	yellow	0190	02	Engine crankshaft speed/ position sensor-data erratic, intermittent, or incorrect. Crankshaft engine speed sensor intermittent synchronization.	Engine may exhibit misfire as control switches from the primary to the backup speed sensor. Engine power is reduced while the engine operates on the backup speed sensor.
2322	yellow	0723	02	Engine crankshaft speed/position sensor-data erratic, intermittent, or incorrect. Crankshaft engine speed sensor intermittent synchronization.	Engine low power.
2345	yellow	0103	10	Invalid rate changing of the turbocharger is detected. Fault rotation speed is detected by the turbocharger speed sensor.	Use the estimated speed under low power.
2346	yellow	2789	15	Turbocharger turbine inlet temperature (calculated)-least severe level. Turbocharger turbine inlet temperature has exceed the engine protection limit.	Engine power derate.

2347	yellow	0611	15	Turbocharger compressor exit temperature-data higher than normal. High turbocharger compressor exit temperature calculated by ECM.	Restrict fuel to lower the turbocharger compressor exit temperature calculated by ECM.
2348	yellow	0027	13	ERG can not automatically demarcate-exceeding the demarcating.	Possible power derate. EGR valve motor will lose electricity.
2349	yellow	2791	05	EGR valve control circuit-current lower than normal or open circuit. high voltage or open circuit is detected on the EGR valve motor circuit.	Possible power derate. EGR valve motor will lose electricity.
2351	yellow	2791	04	EGR valve control circuit-voltage lower than normal or shorted to low circuit. Low voltage is detected on the EGR valve motor circuit.	Possible power derate. EGR valve motor will lose electricity.
2352	yellow	2791	03	EGR valve control circuit-voltage higher than normal or shorted to high circuit. High voltage is detected on the EGR valve motor circuit.	Possible power derate. EGR valve motor will lose electricity.
2353	yellow	2791	06	EGR valve control circuit-current higher than normal or connected to the earth. Over current is detected on the EGR valve motor output circuit.	Possible power derate. EGR valve motor will lose electricity.

2357	yellow	2791	07	EGR valve control-mechanical system responding incorrect or out of balance. Valve motor can not respond or respond slowly.	Possible power derate. EGR valve motor will lose electricity.
2359	yellow	0411	16	EGR pressure difference sensor-data valid but exceed the normal (moderate severe level). EGR pressure difference sensor can not automatically demarcate or invalid data of the EGR pressure difference under the working of engine.	EGR valve will shut off.
2362	yellow	1072	04	Engine brake actuator circuit number 1-voltage below normal or shorted to low source. Low voltage detected at the engine brake solenoid number 1 signal circuit.	Engine brake on cylinder 1,2 and 3 can not be activated or exhaust brake will not operate.
2363	yellow	1073	04	Engine brake actuator circuit number 2-voltage below normal or shorted to low source. Low voltage detected at the engine brake solenoid number 2 signal circuit.	Engine brake on cylinder 4,5 and 6 can not be activated or exhaust brake will not operate.
2366	yellow	1072	03	Engine brake actuator circuit number 1-voltage above normal or shorted to high source. High voltage detected at the engine brake solenoid number 1 signal circuit.	Engine brake on cylinder 1,2 and 3 can not be activated or exhaust brake will not operate.

2367	yellow	1073	03	Engine brake actuator circuit number 1-voltage above normal or shorted to high source. High voltage detected at the engine brake solenoid number 1 signal circuit.	Engine brake on cylinder 1,2 and 3 can not be activated or exhaust brake will not operate.
2373	yellow	1209	03	Exhausting air pressure sensor circuit-short to high voltage. Check high voltage on the exhausting air sensor circuit.	Engine power will be reduced.
2374	yellow	1209	04	Exhausting air pressure sensor circuit-short to low voltage. Check low voltage on the exhausting air sensor circuit.	Engine power will be reduced.
2375	yellow	0412	03	EGR temperature sensor circuit-voltage higher than normal or shorted to high power source. High voltage signal on the EGR temperature sensor is detected.	EGR valve will shut off.
2376	yellow	0412	04	EGR temperature sensor circuit-voltage lower than normal or shorted to low power source. Low voltage signal on the EGR temperature sensor is detected.	EGR valve will shut off.
2377	yellow	0647	03	Fan control circuit-voltage above normal, or shorted to high source. Open circuit or high voltage detected at	The fan may stay on continuously or not run at all.

				the fan control circuit.	
2381	yellow	2795	04	Turbocharger position sensor circuit-high voltage short circuit. high signal voltage detected on the turbocharger position sensor.	Possible power derate. Turbocharger executive motor will lose electricity. Turbocharger will restart.
2382	yellow	2795	04	Turbocharger position sensor circuit-low voltage short circuit. low signal voltage detected on the turbocharger position sensor.	Possible power derate. Turbocharger executive motor will lose electricity. Turbocharger will restart.
2383	yellow	0641	05	Changeable section type turbocharger executive motor current lower than normal or open circuit.	Possible power derate. Turbocharger executive motor will lose electricity.
2384	yellow	0641	04	VGT executive driving circuit-voltage lower than normal or shorted to low voltage power.	Possible power derate. Turbocharger executive motor will lose electricity.
2385	yellow	0641	03	VGT executive driving circuit-voltage higher than normal or shorted to high voltage power.	Possible power derate. Turbocharger executive motor will lose electricity.
2386	yellow	2975	06	Turbocharger executive motor circuit-current higher than normal. High current consumption detected on the turbocharger executive motor circuit	Possible power derate. Turbocharger executive motor will lose electricity.
2387	yellow	2975	07	Turbocharger executive motor circuit-mechanical	Possible power derate. Turbocharger executive motor

				system can not respond correctly or out of balance. Turbocharger executive motor circuit can not respond or respond slowly.	will lose electricity.
2388	yellow	2795	13	Changeable section type turbocharger executive position can not automatically demarcate-exceed demarcating range.	Changeable section type turbocharger power is low. Changeable section type executive remain open or closed.
2554	yellow	1209	02	Exhausting pressure sensor circuit-data erratic, cut or incorrect. Exhausting pressure sensor signal fault detected.	Engine power derate. EGR valve will shut off.
2555	yellow	0729	03	Intake air heater 1 circuit-voltage above normal, or shorted to high source. High voltage detected at the intake air heater signal circuit.	The heater may stay on continuously or not run at all.
2556	yellow	0729	04	Intake air heater 1 circuit-voltage below normal, or shorted to low source. Low voltage detected at the intake air heater signal circuit.	The heater may stay on continuously or not run at all.
2557	yellow	0697	03	Auxiliary pulse width modulation driver 1 circuit-voltage above normal, or shorted to high source.	Can not control transmission.

				High signal voltage detected at the analog torque circuit.	
2558	yellow	0697	04	Auxiliary pulse width modulation driver 1 circuit-voltage below normal, or shorted to low source. Low signal voltage detected at the analog torque circuit.	Can not control transmission.
2659	no	0110	–	Engine coolant temperature-data valid but above normal or shorted to low source. Low signal voltage detected at the analog torque circuit.	Can not control transmission.
2771	yellow	3234	09	Backward dealing exit nitrogen sensor-abnormal update rate. No data communication or valid data transmit does not detected on the J1939 data communication port between EGR and backward dealing exit nitrogen sensor.	No working of the backward dealing exit nitrogen sensor
2772	yellow	3226	15	Backward dealing exit nitrogen sensor-data valid but higher than normal-lightest severe level. The nitrogen exhausting amount higher than suggestion level.	The backward dealing exit nitrogen sensor can not work.

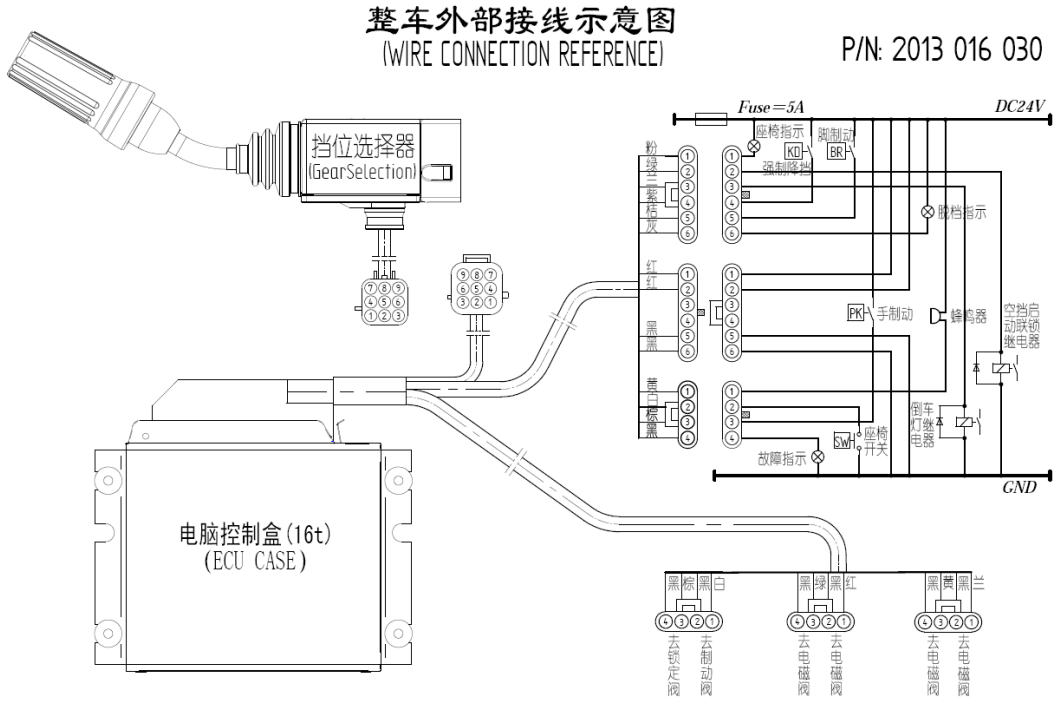
2773	yellow	3226	00	Backward dealing exit nitrogen sensor-data valid but higher than normal-most severe level. The nitrogen exhausting amount higher than suggestion level.	The backward dealing exit nitrogen sensor can not work. Engine will automatically slow down when noticing the truck speed is zero.
2961	no	0412	15	EGR temperature-data valid but higher than normal (lightest severe level).	Engine power derate until ERG temperature lower than the max. value.
2962	yellow	0412	16	EGR temperature-data valid but higher than normal (moderate severe level).	Reduce the oil supplying amount sharply until the EGR temperature reduce to the max. limit value.
2963	no	0110	15	Engine cooling liquid temperature high-data valid but higher than normal(lightest severe level). The cooling liquid temperature indicated by the temperature signal exceeds the engine protection alarming limit.	Power derating speed increase shapely after alarm.
2964	no	0105	15	Intake manifold 1 temperature-data valid but above normal operational range-least severe level. Intake manifold air temperature signal indicates intake manifold air temperature is above the engine protection warning limit.	Progressive power derate increasing in severity from time of alert.
2973	yellow	0102	02	Intake manifold 1 pressure-data erratic, intermittent, or	Engine power derate.

				incorrect, the ECM detected an intake manifold pressure signal that is too high or low for current engine operating conditions.	
2976	yellow	3361	02	Amount control unit temperature-data erratic, intermittent or incorrect. An internal fault is detected in the catalyzer amount controlling unit.	Stop using the injecting catalyzer to the backward dealing system.
9121	no	2791	15	EGR valve executive temperature is high-data exceed the normal range-lightest severe level.	EGR valve shut off.
9122	no	0641	15	Changeable section type turbocharger executive temperature high-data higher than normal-lightest severe level.	Possible power derate. Turbocharger executive power will be restricted.

4.2 transmission electric system

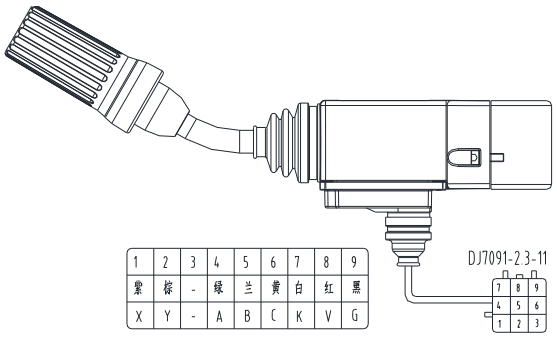
Transmission electric system includes: HELI self made transmission box, computer control box, gear shifting knob and special harness. The transmission system has protection function when starting on neutral gear and gear disengage function when braking.

4.2.1 Wire connection reference



4.2.2 Gear selector

■ Gear selector is also called “operation lever” which is the part realizing man-computer interaction in the transmission ox controlling system. The part changes the driver’s tension to code transmitted to the computer controller through harness.



挡位选择器逻辑输出表

状态 / 挡位	SA 绿	SB 蓝	SC 黄	SX 紫	SY 棕	SK 白
FP	●		●	●		●
F1	●	●	●	●		●
F2	●	●		●		●
F3	●			●		●
F4				●		●
NP	●		●			●
N1	●	●	●			●
N2	●	●				●
N3	●					●
N4						●
RP	●		●		●	●
R1	●	●	●		●	●
R2	●	●			●	●
R3	●				●	●
R4					●	●

说明：●--代表信号输出（电平信号）

■ Operation mode: Travelling direction can be controlled by pushing or pulling the lever horizontally. Gear shifting is achieved through turning the lever in the clockwise or anticlockwise direction. There are four travelling gears and one parking gear.

4.2.3 Computer control box

■ Computer control box is ECU assembly which is the heart of the whole transmission box controlling system. The micro processor receives the input signals from the operation lever and other devices and then drives the corresponding solenoid wire ring according to the preset gear shifting rule after processing the signals. Also it can output other signals to the truck’s electric circuit according to the needs.

■ The functions accomplished by the computer control box

◆ The computer control box will start the interlocking relay output to the neutral gear and allows the engine starting only if the gear selector on the neutral gear.

◆ Reversing light/back buzzer relay: When the gear selector is on the reverse gear, the relay will get electricity and the reversing light lights up and the back buzzer sounds up when the truck travels backward. Then the alarming function achieves when travelling backward.

◆ The computer control box will carry out the over current protection when the outer electric circuit forms short circuit because of abnormal loading.

◆ If the voltage is over high (more than 32V) or over low (lower than 16V), the computer control box will send out alarming signal and cut off all output solenoid.

■ Gear shifting rule

◆ Gear shifting in the same direction

A. Shift directly between the low speed gears and there is no relay transition.

B. Shift directly between the high speed gears and there is no relay transition.

C. Shift directly to the target gear between the high low gear or low high gear and there is no relay transition.

◆ Neutral gear and shifting from neutral gear

A. The corresponding gear solenoids respectively work with the gear selector when positioned in N1, N2 or N3. The corresponding solenoid will work with the direction gear which is shifted to.

B. Shifting the gear from neutral gear to the forward gear 1, 2 or 3 or backward gear 1, 2 or 3 has no relay transition. Just shift directly to the target gear.

C. When shift to the forward gear 4 or backward gear 4 from the neutral gear N4, first disconnect the solenoid gear 30s after getting electricity. And at the same time, gear 4 solenoid works.

D. When shifting from any gear to the neutral gear, shift to the corresponding neutral gear. There is no relay transition.

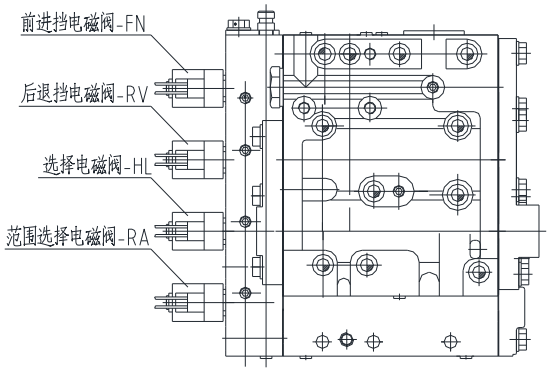
◆ Gear shifting from different direction gear

A. When shifting among gear 1, 2, or 3. Shift directly to the target gear and there is no relay transition.

B. Shifting between the gear 4: First disconnect the gear 4 solenoid with the same direction and then the gear 3 solenoid with the opposite direction works for 30s. Then disconnect the gear 3 solenoid and gear 4 solenoid works.

■ The solenoid output logic table under each gear

Gear	The condition of the solenoid				The connecting condition of the clutch		The condition of the relay	
	FN	RV	HL	RA			J1	J2
F1	○		●	●	KV	K1		
F2	○		●		KV	K2		
F3	●				KV	K3		
F4	●			●	K4	K3		
N						K1	●	
R1		○	●	●	KR	K1		●
R2		○	●		KR	K2		●
R3		●			KR	K3		●
R4		●		●	K4	K4		●
●-The solenoid gets electricity ; ○-The solenoid get electricity but disconnect when the brake is effective.								



■ Service break signal and parking brake signal are received at the same time. The computer control box allows electric out of gear and not out of gear.

4.2.4 Special harness

The harness is the special harness for the electric control system of the construction machinery transmission box. It is made up of several cables with different length. One end of the harness is special plug for 55 core with sealing connected with computer control box while the other end is connected to the connector with wire to control the hand lever, electric hydraulic gear shifting valve, the electric circuit and other control signal input connecting points.

4.2.5 Hydraulic brake control

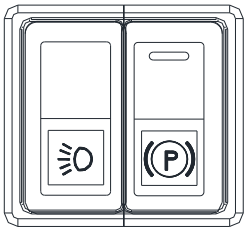
(1) Service brake

Double brake pedals are assembled in the driver's cab. Out of gear switch is fixed under the left foot brake pedal. The out of gear switch send signal to the transmission box control unit and then the transmission box get out of gear and the truck slows down.

Brake light switch is assembled on the right foot brake valve. The brake light switch connects and the brake light turns on when pressing the brake pedal. If the brake system pressure is low, the low pressure alarming switch fixed on the gas tank connects and alarming light on the meter lights up to remind driver to stop and check the truck.

(2) Parking brake

The parking brake is controlled by the rocker switch on the steering case. Press the parking brake switch to cut the dynamic output of the transmission box and the hand brake indicator turns up.



4.3 Meter system

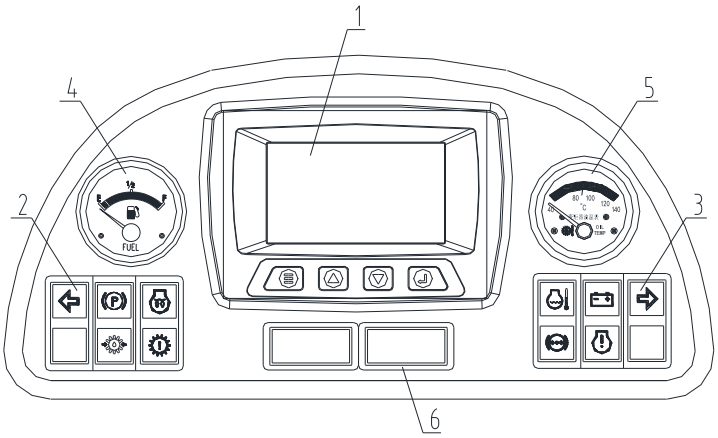
4.3.1 Brief introduction

Meter system can show the truck information comprehensively with CAN bus meter as core informative exchange part and functional single meter and warning indicator. With streamline plastic shell, the meter is beautiful and reliable. What is more, the distribution of functions is reasonable and it is easy for reading. It is easy to operate and it meets ergonomic design principle.

4.3.2 Meter function instruction

4.3.2.1 Meter instruction of truck with Xichai CA6DF3-GG3U

Dashboard assembly (max. outline dimension (380X185X68, unit:mm)



✧ Indicator instruction

Indicators group 2 includes: left turning indicator, parking brake indicator, engine preheating indicator, low transmission pressure alarm and transmission fault indicator.

Indicators group 5 includes: right turning indicator, charging indicator, high engine water temperature, low brake pressure and engine fault indicator.

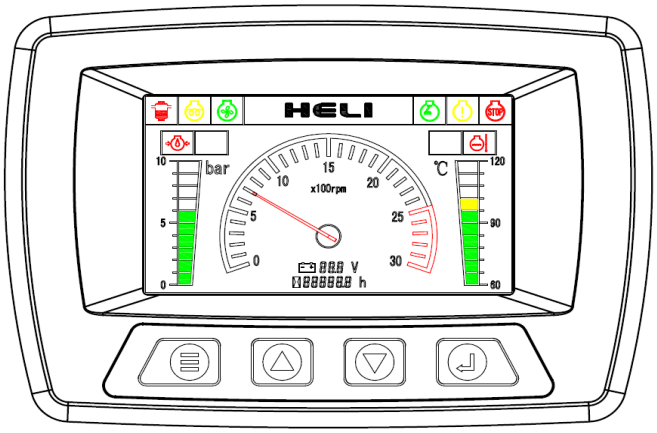
Warning: When alarm light turns on, it reminds drivers to stop and check the truck.

✧ Meter instruction

Meter includes:

1-CAN bus meter 4. Fuel gauge 5. Transmission oil temperature gauge

CAN bus meter introduction



Meter overall diagram

The meter will show the home page as shown in figure 1 in default conditions after the meter gets electricity.

Figure 1 Home page ----normal condition

Figure 2 Home page----alarm condition

1) Indicating symbols

The area at the upward two sides of the home page is symbols displaying area. When the corresponding signal of indicating symbol is invalid, the symbol is in gray state; when the corresponding signal of indicating symbol is valid, the symbol turns to color state. Refer to figure 2.

2) Fault display area

The area in the middle of homepage upward is fault display area. When the CAN is normal and no engine fault code and transmission box fault code are displayed, manufacturer logo is displayed. Refer to figure 1, HELI is shown. When the meter does not receive data from CAN bus in 10s, the meter will show “no contact of CAN bus” ; when the CAN bus connection is normal and the engine fault code or transmission fault code is detected, the area will show all fault code one by one. See figure 2.

3) Speedometer

The center of the home page is engine speedometer to show real time engine speed. See the example in figure 1. It suggest the current speed is 2000r/min.

4) Engine oil

The left side of the home page is engine oil pressure gauge, columnar or figure is used to display relative information. See figure 1. Columnar is more intuitional but figure can show the oil pressure value precisely. When low oil pressure fault is not detected from CAN bus, the oil pressure symbol is in grey state. See figure 1. When the fault is detected from CAN bus , the symbol is in red alarm state. See figure 2.

5) Cooling water temperature gauge

The right side of home page is cooling water temperature gauge, columnar or figure is used to display relative information. See figure 1. Columnar is more intuitional but figure can show the cooling water temperature precisely. When high cooling water temperature fault is not detected from CAN bus, the oil pressure symbol is in grey state. See figure 1. When the fault is detected from CAN bus , the symbol is in red alarm state. See figure 2.

6) Voltmeter

Digital voltmeter is under the speedometer in the homepage showing real time battery voltage. See figure 1.

7) Timer

Timer is under the voltmeter in the homepage showing engine working hours. See figure 1.

✧ Meter main menu

Enter meter main menu through pressing menu key under homepage. See figure 3.

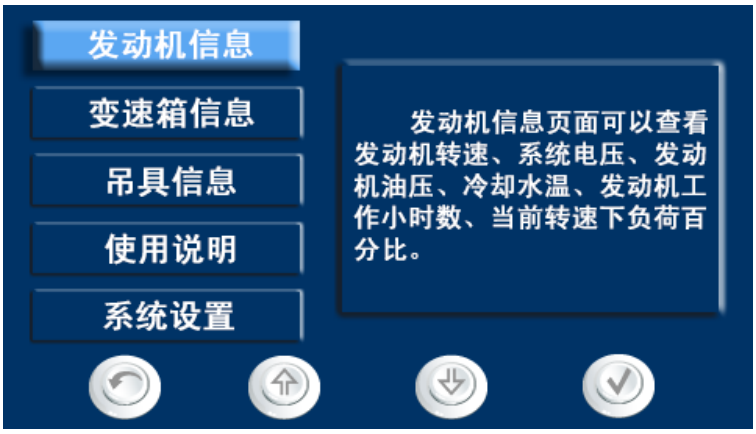
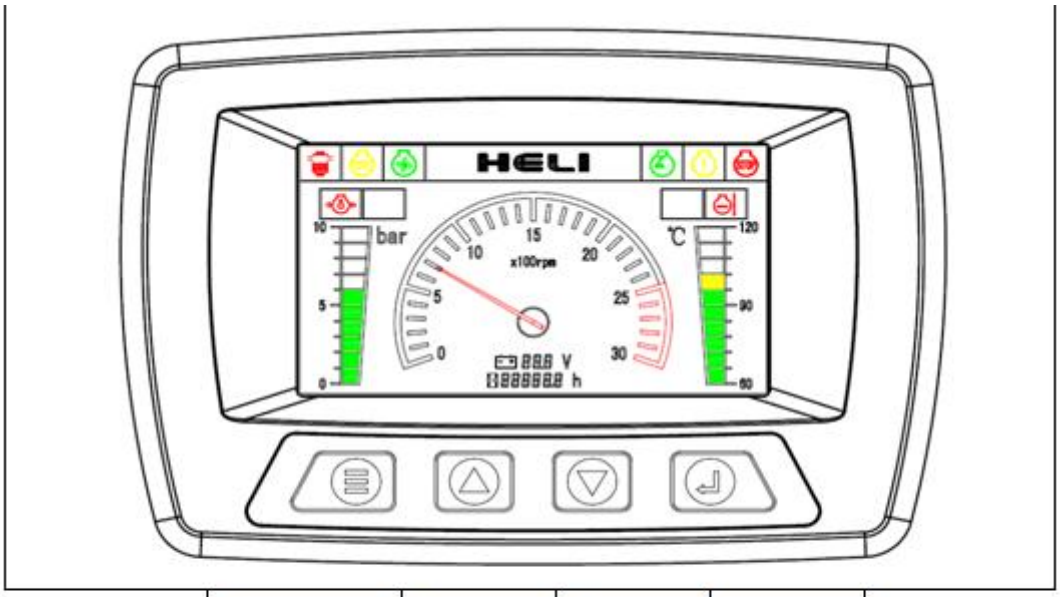


Figure 3 main menu page

There are five items in main menu page as shown in figure 3. They are: engine information, transmission information, sling information, operation information and system setting.



Back	Up	Down	Enter

Table 1 key function

Choose the menu through “up” key and “down” key and enter the menu through pressing the menu key or pressure “back” key to return back to homepage. Detail description of the four keys in different page is followed.

Engine information page (only the engine information of this mode)

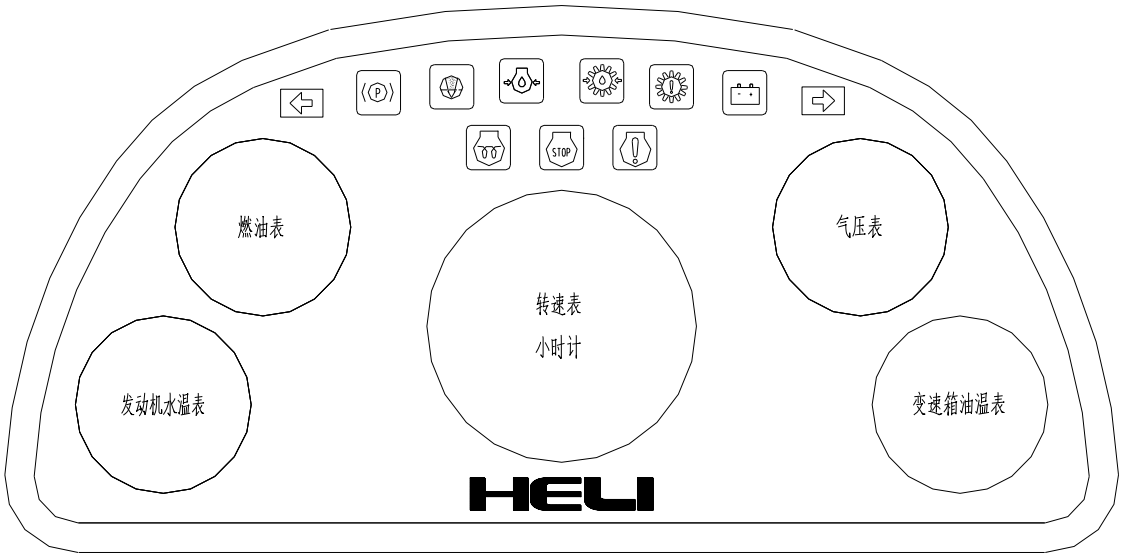
Choose “engine information” menu and press the enter key. See figure 4.

Figure 4 engine information page

Engine information gives main parameters during engine working, including rotate speed, voltage, engine oil pressure, cooling liquid temperature, working hours and load percentage.

When it stays in engine information page, press “back” key to main menu page. The other three keys are invalid.

4.3.2.2 Meter instruction of truck with Cummins QSB6.7



The upper indicators instruction (from left to right)

(1) Left turning indicator

(2) Parking brake

(3) Air cleaner blocking indicator: it alarms when the air cleaner is blocked;

(4) Engine oil pressure indicator: it alarms when the engine oil pressure is low;

(5) Transmission oil pressure indicator: it alarms when the transmission oil pressure is low;

(6) Transmission box fault alarm: it alarms when the transmission box has fault;

(7) Charging indicator: before start the engine, turn the starting switch clockwise to the position 1 and then the charging indication light turns on. The light turns off when the engine is started. If the light still be on with the engine working, it suggests the charging circuit has fault. Stop the truck and check.

(8) Right turning indicator

The lower indicators instruction (from left to right)

(1) Engine preheating indicator

(2) Engine stopping light: it indicates the engine has fault;

(3) Engine fault light: it indicates the engine has fault;

Meter instruction:

(1) Fuel meter: it suggests the remaining fuel lever in the tank.

(2) Water temperature meter: it suggests the engine cooling fluid temperature.

(3) Speedometer/hour meter: it suggests the engine rotation speed/ engine working hour.

(4) Barometer: it suggests the barometric pressure of the braking system's gas tank.

(5) Transmission oil temperature: it suggests the working temperature of the transmission oil.

4.4 Electric system for the lighting and signals

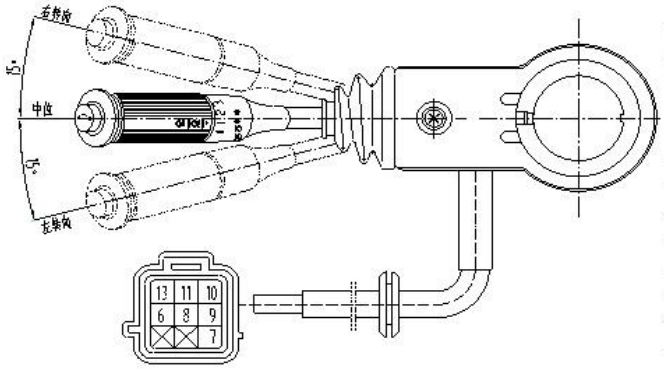
The lightings and signal devices are well appointed including front and rear head lamps, front and rear combined light (width light, steering light, reversing light and brake light), back buzzer and rotation type alarming light to ensure the daytime and night operation and travelling safety.

NOTE: Make sure the whole lighting system is normal before using the

truck. Clean the lights often.

Warning: keep the lights and mirrors clean.

4.4.1 lights switch



组合开关电路原理图

端子 / 导线颜色 / 功能定义 / 手柄位置	7 紫黄 左转向	8 黄绿 转向电源	9 蓝黄 右转向	6 红 示宽	11 绿 大灯远光	13 灰 大灯近光	10 棕黄和黄 电源
左转向	○—○						
右转向		○—○	○—○				
中 位							
0							
1				○			○
2				○	○		○
3				○		○	○

Operation： 0 gear: turn off width light and headlamp

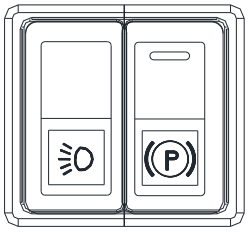
1 gear: turn on the width light

2 gear: turn on lower beam

3 gear: turn on the high beam

Push forward from neutral position and the right steering light is on; pull backward from neutral position and the left steering light is on.

4.4.2 Working light switch



Installing position: steering wheel
Operation: press the key and control the working light

4.4.3 lights

✧ Front combined light

Name	Parameters	Note
Front headlamp	12.5w	4 lights, LED
Steering signal light	3w/unit	6 lights，LED
Width signal light	3w/unit	6 lights，LED

✧ Rear combined light

Name	Parameters	Note
Width light	3w/unit	8 lights, LED
Brake light	3w/unit	8 lights, LED
Steering light	3w/unit	8 lights, LED
Reverse light	3w/unit	8 lights, LED

✧ Other lights

Name	Parameters	Note
Working light	3w/unit	4 light, LED
Operation alarming light	3w/unit	Light Stroboflash
Illuminating light	5w	Column type light

4.5 Electric system of driver's cab

The electric system of driver's cab includes inner top light, fan, front windshield wiper, rear windshield wiper. It can offer driver safety and comfort operation environment.

4.6 Air condition system (optional)

The air condition can only be used after the engine is started. Choose HOT and COOL mode and set temperature through air condition panel.

4.6.1 Control

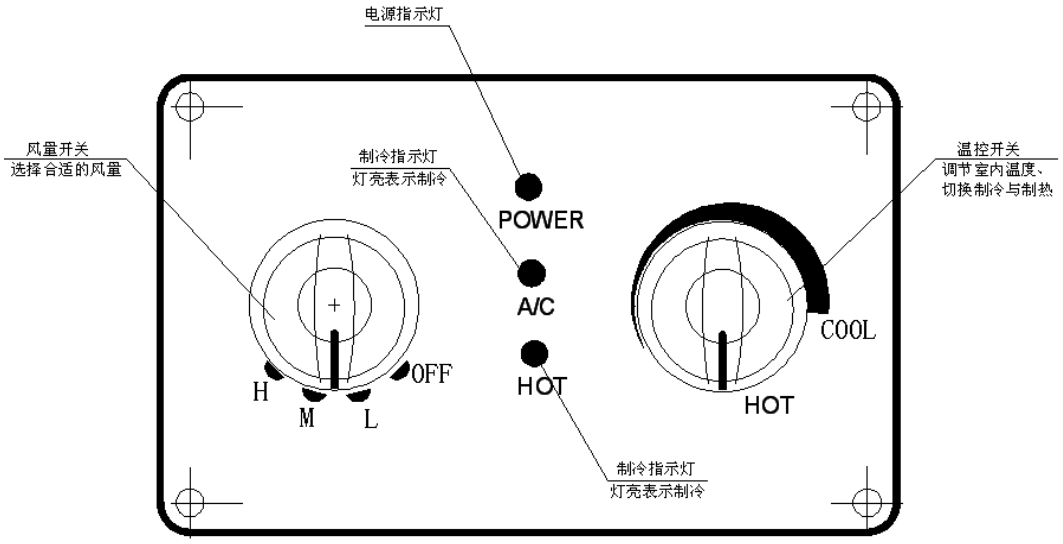
Air capacity switch: it is used to control fan speed to choose proper air capacity.

OFF—OFF L—ON—Low speed M—ON---medium speed

H---ON---high speed

4.6.2 Temperature seeing button

Temperature control switch: it is used to adjust the temperature in the driver's cab. It is used to shifting between HOT and COOL.



4.6.3Usage notice

(1) COOL: turn the air flow switch to the Ⅲlever for 5 minutes after starting the engine when using the refrigeration system for the first time. And then turn the temperature controlling switch to the refrigeration position. At that time, the temperature in the driver's cab begins to drop. Turn the temperature controlling switch anticlockwise direction until the indicator turns off and the compressor stops working when the temperature inside falls to the target temperature. when the temperature inside exceeds the target temperature, the indicator turns on and the compressor starts working. The refrigeration system begins to work. When the temperature inside is lower than the target temperature, the indicator turns off and the system stops work. Adjust the air outlet angle to change the cooling air flow angle; adjust the air flow switch to get proper air flow volume.

(2) HOT: turn off the temperature controlling switch and then turn the mode switching to heating when heating in winter. At that time, the hot water valve is turned on. Then turn on the air flow switch and the warm air flows out. When the temperature increases to the target temperature, turn off the air flow switch; when the temperature inside falls, turn on the air flow switch again.

NOTE: Add anti frozen fluid to the radiator when the environment temperature

bellows 0℃ because the heating system is connected with the radiator. The anti frozen fluid should not get frozen at -30℃ or the heat exchanger of the heating system will get broken.

If engine water temperature is low, the air temperature blowing into the cab will not change even the temperature is set at the highest value.

If the fog on glass needs to be cleaned quickly, choose the high air blowing and make the air blowing directly towards at the glass.

----make sure all blowhole and windows are closed.

----if the truck to be operated has been kept under the sunshine for a long time, turn the air speed switch to position III and open the window for a few minutes to quicken the cooling of the driver's cab.

----Do not make the air blowing towards to person directly.

Warning:

----Too cold air is bad for health and it is proper to set the temperature inside of the driver's cab to be 5-6℃ lower than the outside temperature .

----There is a thermostat inside of the cab to keep the temperature inside to be the set temperature.

----The water leakage caused by normal condensation is caused by system drying.

Suggestion: even in cold winter, make sure the air condition work for at least 5 minutes every week to make the well lubrication inside of the compressor and keep the air condition in good state.

4.6.4 Notices

(1) Never dismantle the whole air conditioning system at will in case of cold-producing medium leakage.

(2) Check the soft pipelines of the air conditioner regularly.

(3) Check if the compressor is loose or damaged regularly.

(4) Check if the belt is loose or worn regularly avoiding over loose or over tight.

(5) Clean the dirt on the condenser to ensure the refrigeration effect.

(6) When changing parts or filling cold-producing medium, take care not to pollute the joints and cavity. Apply refrigeration oil to the joints to ensure the assembly and sealing effect.

4.6.5 Repair and maintenance

(1) Disconnect the power when maintain the air conditioner.

(2) Check the fixing condition of the air conditioner monthly.

(3) Check if the air inletting hole, air outletting hole and the inletting and outletting hole of the condenser are blocked before starting the truck.

(4) Check the joints, linking cables and wire to the earth every season before using.

(5) Cover the outside of the air conditioner with canvas to prevent the dust.

(6) Clean the heat changer: the surface of the heat exchanger and the fins will be full of dust and dirt after a long-time use which will affect the heat changing effect and reduce the cold-producing amount. When clean the inside heat changer, first remove the top cover and then brush the fins vertically and nip the dirt that can not be brushed out with tweezers; when clean the outside heat changer, dismantle the support of the condenser and then brush the dirt. Be care with the fins which are made up of aluminum foil and is easy to deform.

(7) Whether the transmission mechanism of the driving condenser is normal is important to the whole air conditioning system. Check if the transmission mechanism is wear and its tension every week. The common faults of the belt are followed:

a) The side wall is shinning or smooth----the belt is loose or the pulley groove has oil;

b) Cleft----the deflection is over high or the diameter of the transmission wheel is over small;

c) a whole piece fall off----the cleft become more serious;

d) The layers are separated—the transmission parts leaks;

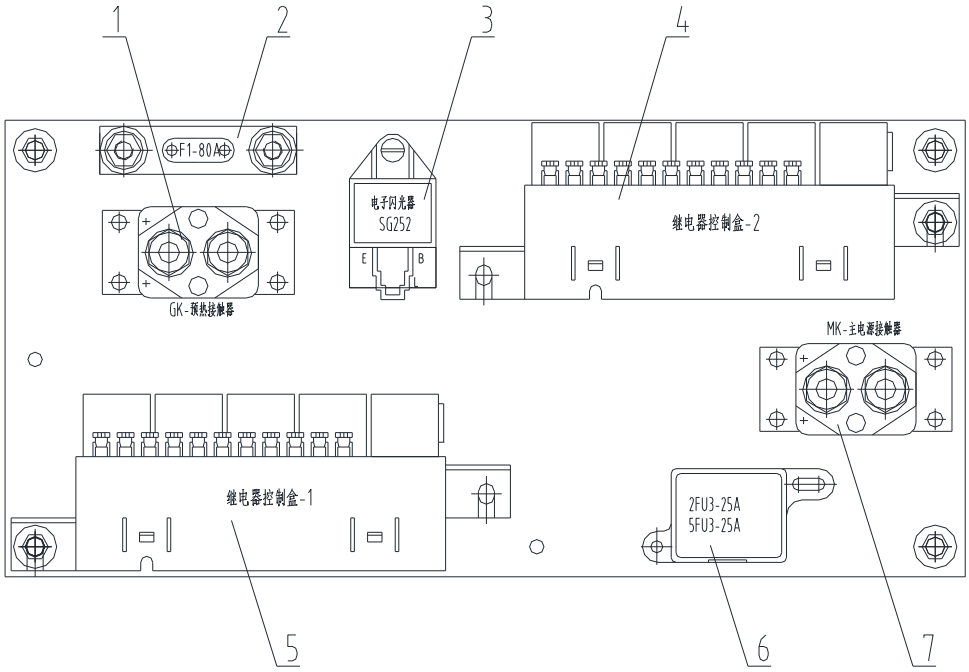
e) The tension line is broken----large foreign matters fall into the transmission wheel;

f) The side wall of the transmission belt is broken----the side wall of the pulley grove is rough or foreign matters are lodged into the side wall;

g) Edge angle belt is ineffective----the transmission wheel is small or the tension is high.

4.7 Electric cabinet

4.7.1 Electric board layout of truck with Xichai CA6DF3-GG3U



1. Preheating contactor 2. 80A fuse 3. Flasher 4. Relay control box

6. two circuit fuse box 7. Main power contactor

Main parts introduction

Note: relays protecting the electric elements are in the relay box in the left side of the electric cab. If the fuse is burn, find out the reason and replace with new one.

✧ Relay control box 1

Fuse capacity and function instruction

No.	Current （A）	Function
4FU1	5	Brake light---width

		light---meter light power supply
4FU2	5	Lights combined switch power supply
4FU3	5	Flasher power supply
4FU4	10	Front lamp power supply
4FU5	10	Horn power supply
4FU6	5	Backward signal power supply
4FU7	5	Brake light power supply
1F1	10	Key switch power supply
1F5	5	ECU power supply
6FU1	5	Spare power supply
6FU2	10	Spare power supply

Relay protection function instruction

No.	Model	Protection function
4K1	D07JD2914	Width/meter power relay
4K2	D07JD2914	Lower beam relay
4K3	D07JD2914	High beam relay
4K4	D07JD2914	Horn relay
4K5	D07JD2914	Backward relay
4K5	D07JD2914	brake light relay

✧ Relay control box 2

Fuse capacity and function instruction

No.	Current （A）	Function
1F2	7.5	Starting power
1F3	5	Starting relay----diagnosis end power
1F4	15	ECM power
2FU1	10	Transmission system----parking brake power
3FU1	5	Cooling fun relay power
3FU2	5	Meter system power
4FU8	5	Working light switch power
4FU9	15	Front/rear working light power
5FU1	5	Cab power
5FU2	10	Front brush power
5FU4	7.5	Rear brush power

Relay protection function instruction

No.	Model	Protection function
1K1	D07JD1914	Starting relay

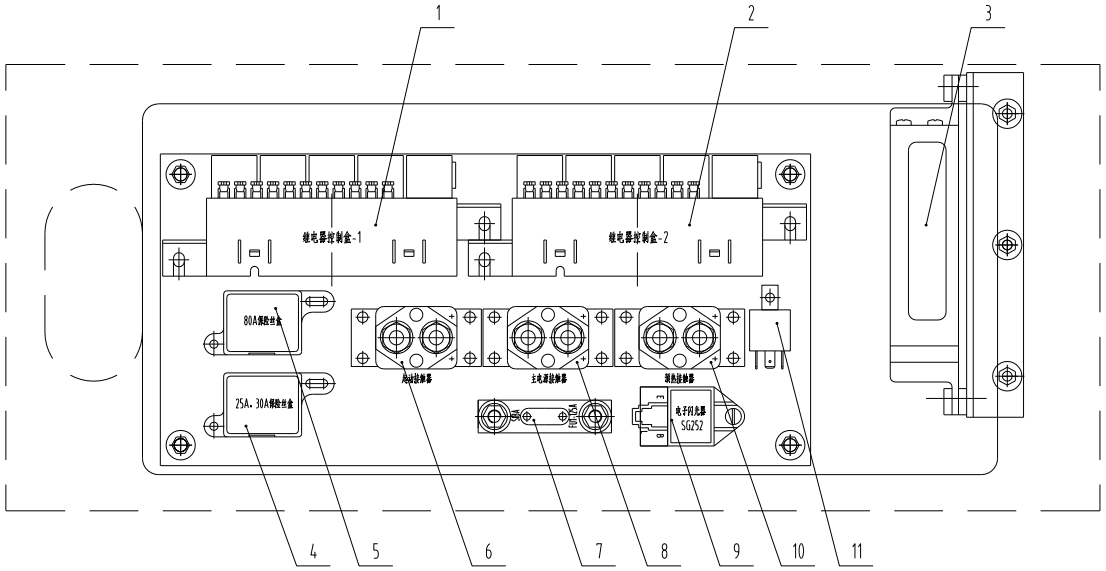
1K2	D07JD1914	Preheating relay
2K1	D07JD2914	Parking brake relay
3K1	D07JD2914	Hydraulic cooling fun relay
4K7	D07JD2914	Front working light
4K8	D07JD2914	Rear working light

✧ Other parts

No.	Model /current（A）	Protection function
MK	SW80-4	Power contactor
GK	SW80-4	Preheating contactor
2FU3	25A	Cooling fun power
5FU3	25A	Air condition power（for truck with air condition ）

4.7.2 Electric board layout of truck with Cummins QSB6.7

The inside layout of the cabinet:



(1) relay control box 1 (2) relay control box 2 (3) TCU (4) fuse box 25A, 30A

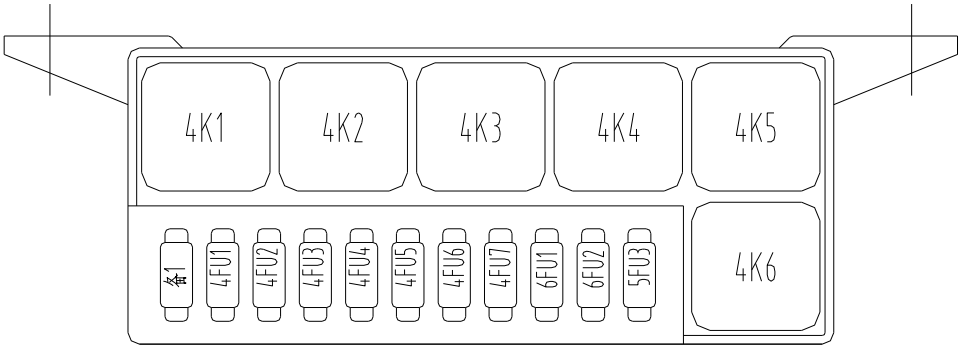
(5) fuse box 80A (6) starting contactor (7) fuse link 125A

(8) main power contactor (9) flasher (10)preheating contactor

(11) relay12V/50A

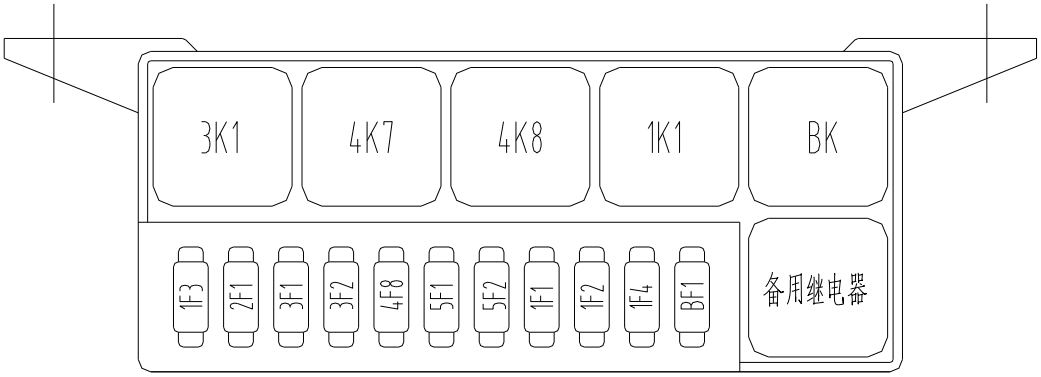
Function description of the parts:

(1) Relay control box 1



Fuse box 1			
Relay functions			
4K1	Light relay: control the width light	4K4	Born relay: control the horn
4K2	Light relay: control the dipped beam	4K5	Light/ horn relay: control the reversing light and reversing horn
4K3	Light relay: control the high beam	4K6	Light relay: control the brake light
Fuse functions			
4FU1	Fuse for the width light/meter light	4FU6	Fuse for the reversing light and back buzzer
4FU2	Fuse for the combined light switch power	4FU7	Fuse for the brake light
4FU3	Fuse for the flasher (steering light)	6FU1	For the spare use
4FU4	Fuse for the front combined light(high beam)	6FU2	For the spare use
4FU5	Fuse for the horn	Spare 1	For the spare use
5FU3	Fuse for air conditioner power		

(2) Relay control box 2



Relay box 2			
Relay functions			
3K1	Relay for the transmission oil cooling fan	1K1	Neutral relay: start protection control

4K7	Relay for the front working light: control the front working light	BK	For the spare use
4K8	Relay for the rear working light: control the rear working light	Spare use	For the spare use
Fuse functions			
1F3	Fuse for the ECU key rear power	5F2	Fuse for the windshield brush power in the driver’s cab.
2F1	Fuse for the transmission system power	1F1	Fuse for the diagnosis port power
3F1	Fuse for the transmission cooling fan relay	1F2	Fuse for the key switch power
3F2	Fuse for the combined meter power	1F4	Fuse for the ECU key front power
4F8	Fuse for the working light power	BF1	Fuse for the spare use relay power
5F1	Fuse for the driver’s cab power		

(3)Transmission box control unit: refer to the electric system for the transmission box for detail;

(4) Fuse box 25A, 30A: fuse for the cooling fan and air conditioner power;

(5) Fuse box 80A: fuse for the starter;

(6) Starter contactor: it is controlled by the ignition key. Turn the ignition key to the starting position and the contactor is connected and the engine starts;

(7) Fuse link 125A: fuse for the preheating contactor;

(8) Power contactor: it is controlled by the ignition key. Turn the key to the 1 position and the contactor is connected to the control return circuit;

(9) Flasher: steering light flashing control unit;

(10) Preheating contactor: supply power to the engine preheating unit;

(11) 12V/50A relay: charging indicator relay.

4.8 Troubleshooting of electric system

Fault point	Fault	Fault reason	Remedy
Engine	Engine can not be started	The flameout switch is on OFF state.	Reset flameout switch
		Gear knob is not on neutral position.	Place the gear knob on neutral position

		Starting switch is poor connected.	Replace
		Battery discharge or fault	Charge the battery or replace
		ECM power failure	Check EMC fuse
		Starting relay fault	Replace
Transmission box	The truck can not travel when the	Controller power fuse burn	Replace fuse
		Gear knob fault	Replace
		Left foot out of gear pressure switch fault	Replace
		Parking brake pressure switch fault	Replace
		Parking brake rocker switch fault	Replace
Light signal	Light control confusion	Light switch fault	Repair or replace
		Poor connection	Repair
	Poor horn sound quality	Poor horn switch connection	Replace
		Horn fault	Replace
	Horn does not sound up	Horn power fuse burn	Replace
		Horn wire is broken or is poor connected.	Repair or replace
		Horn switch is poor connected.	Repair or replace
		Horn control relay fault	Replace
		Horn fault	Replace
	Lights do not light on	Light switch power fuse burn	Replace
		Light switch fault	Repair or replace
		Light power fuse burn	Replace
		Fuse control relay fault	Repair or replace
		Light fault	Repair or replace
		Poor connection to earth	Repair
		open circuit	Repair

Battery	Insufficient charging	Poor insulation	Repair or replace
		AC generator belt loose	Adjust
		AC generator, poor adjuster	Repair or replace
Driver’s cab	Front wind brush does not work	Front windshield power fuse burn	Replace fuse
		Front windshield switch fault	Replace
		Front windshield motor fault	Replace
		Poor connection to earth of front windshield motor	Repair
	Rear wind brush does not work	Rear windshield power fuse burn	Replace fuse
		Rear windshield switch fault	Replace
		Rear windshield motor fault	Replace
		Poor connection to earth of rear windshield motor	Repair
	Driver’s cab top light and fan does not work	Top light, fan power fuse burn	Replace fuse
		Switch fault	Replace
		Top light, fan fault	Replace

5. Brake system

5.1 dry-type brake system

5.1.1 Brief description

The role of the braking system is to make the forklift reduce speed or stop when it is traveling with no load or full load. CPCD150-160-Wx uses air-over fuel brake system. Its working principle is that the air compressor draws air directly from the atmosphere through air filter and increases its pressure. The pressurized air shall be sent to oil-water separator combination valve to be stabilized, fine-filtered and drained of water. It is then sent to the storage tank for storage and for further water separation. The water can be drained manually by the discharge valve at the bottom of tank. When pressing down the braking valve, the air shall go to the air-over-hydraulic pump through the air-brake valve and push the braking liquid to the brake caliper of the front drive axle to produce braking force.

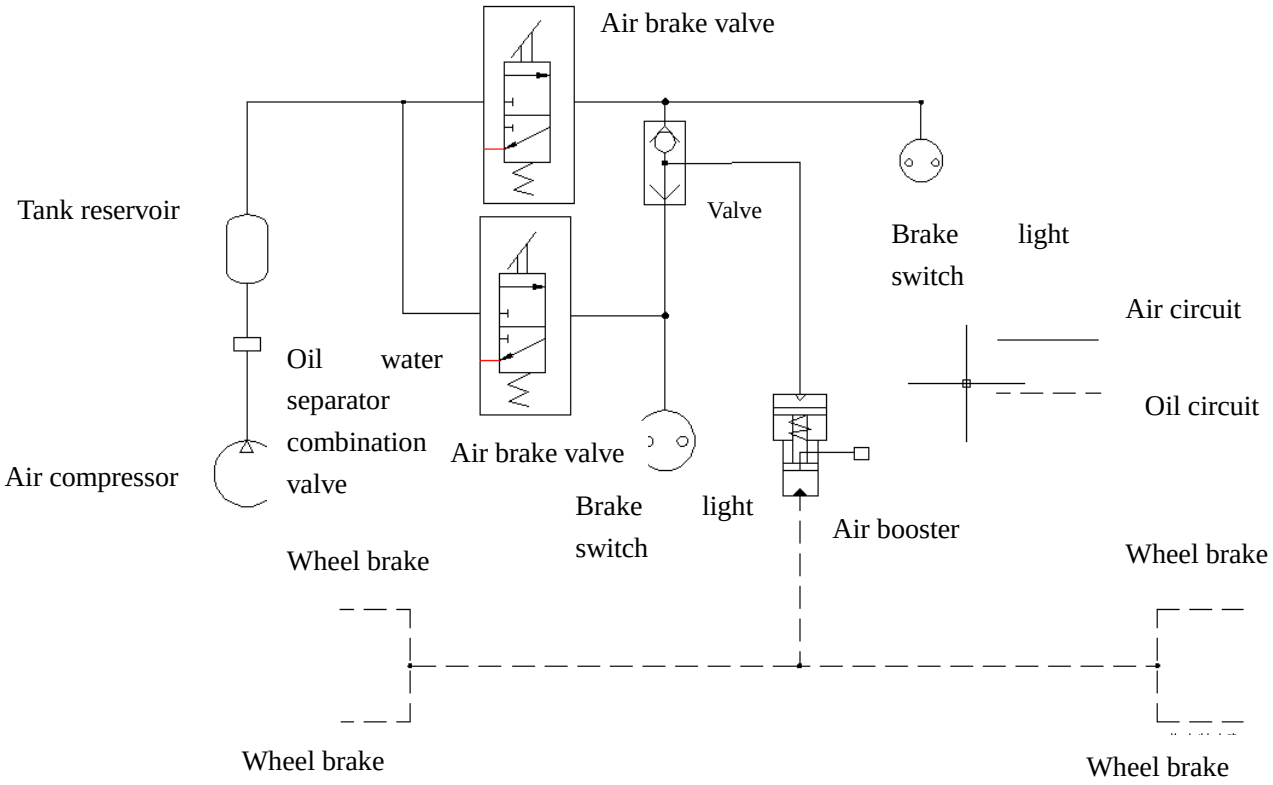


Fig. 5.1 Diagram of Working Principle

The brake system contains two parts: one is air brake valve brake and the other

one is inching pedal on the left side. Control the inching valve on the transmission box through soft shaft cable to achieve inching function. Brake and inching is linked through link mechanism.

5.1.2 Brief Introduction of Air-brake System Parts

(1) Air compressor

Type: Air-cooled single-cylinder piston, gear drive

Displacement: 380L/min (rated speed)

Rated working pressure: 0.78MPa

Air intake means: get air directly from air filter.

Fig.5.2 Air Compressor

(2) XM60C air brake valve

In the air-pressure brake pipeline system, the braking valve is located between air-storage tank and braking air chamber close to braking pedal. It is used to control the flow and pressure of the compressed air to the braking chamber of the wheel brake and play the servo role, that is, to ensure the air-pressure in the braking chamber having a certain proportional relation to braking pedal force and pedal displacement. Working pressure: 0.78MPa; working temperature: -30℃～80℃.

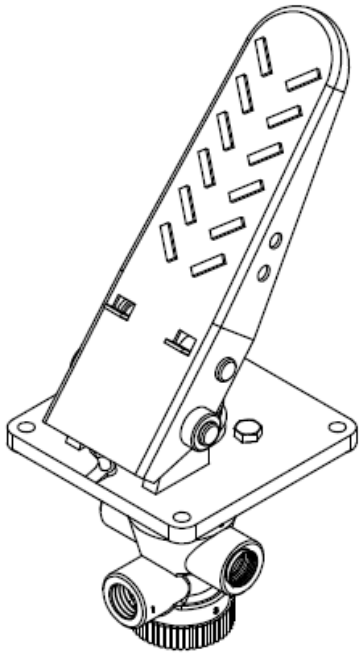


Fig. 5.3 Air brake valve

(3)Air booster

Air booster is used to increase brake liquid pressure through reducing cylinder so as to transmit energy to brake caliper disc to make the front axle brake quickly. Refer to the following figure for its appearance:

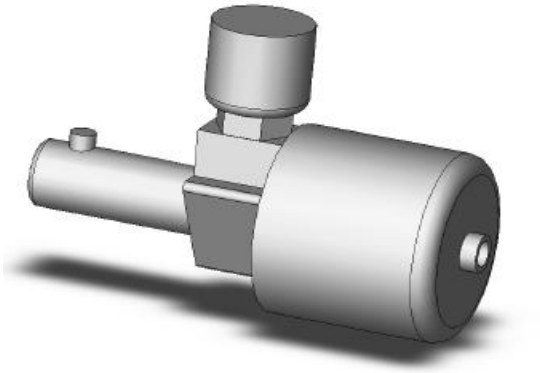


Fig. 5.4 air booster

(4) Oil-water separator combination valve

The role of oil-water separator in the air-over-hydraulic braking system is to separate the water in the high-pressure air and lube oil in the air-compressor. When

the pressure surpasses the pressure of the safety valve, the separator automatically exhausts air to ensure the pressure in the regulated range. So the air exhausting noise during the travelling process is normal. The rated pressure of the safety is 0.78Mpa.

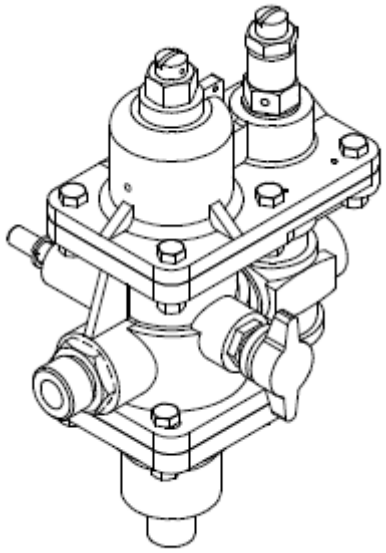


Fig. 5.5 Oil-water separator combination valve

5.1.3 Maintenance

The main tasks of the routine maintenance of air-over-fuel brake system are the discharge of the condensed water and the check of the braking fluid and air-compressor system. The condensed water discharge involves whole air-brake system, including oil-water separator combination valve, air-storage tank and pipeline system, etc. Fill the oil tank of air-booster pump with DOT3 standard synthetic brake fluid. The fluid level is a little lower than the oil cup filter. If stains are found on the filter screen during regular check, clean them with kerosene and put it back to ensure the cleanness of the brake fluid in the braking steel pipe. If the brake fluid level is low, add the synthetic brake fluid timely.

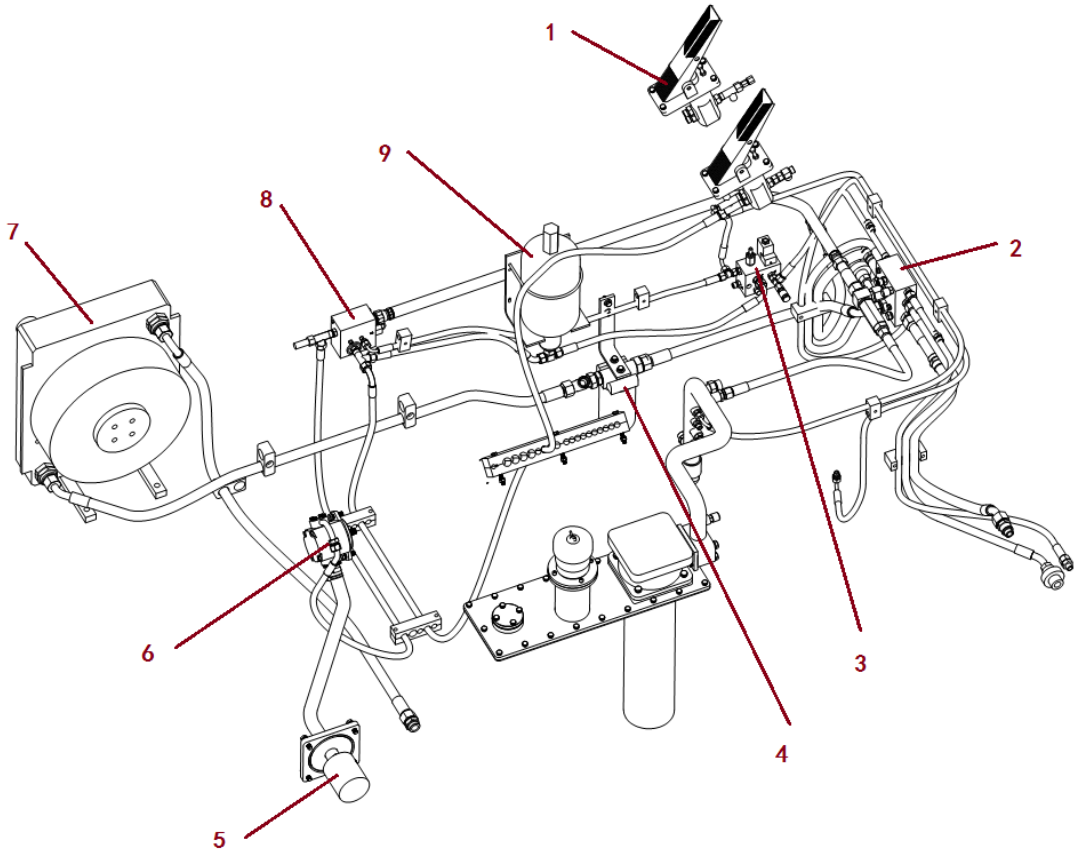
5.2 Wet type brake system

5.2.1 brake system working process

Pressurized oil from pump flows into service brake and energy accumulator in parking brake return circuit through prefill valve. Press the brake pedal, the

pressurized oil stored in accumulator flows into wheel brake through service brake. And thus brake is realized. Release brake pedal, the hydraulic oil in wheel brake flows back to oil tank through wheel brake. The oil pressure output from the service brake has a positive proportion to the force acted on brake pedal. A little force can realize complete brake.

5.2.2 Main elements layout



Main elements layout

1.Brake valve 2. Brake nine-way 3. Integrated valve
4. Brake return oil filter 5. Brake pump oil sunction filter
6. Brake pump 7. Oil cooling device 8. Oil charging valve
9. accumulator

5.2.3 Main parts

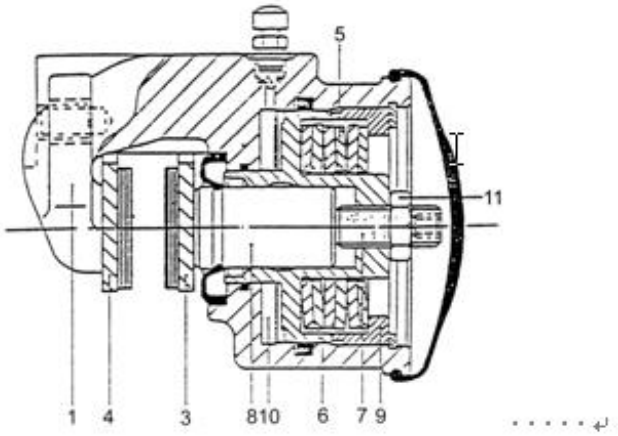
1) parking brake and serive brake, accumulator

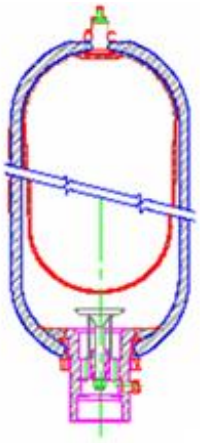
Parking brake is made up of brake round disc and brake cylinder installed on front axle input shaft. The spring in the cylinder applies brake to rund disc.

Parking brake can be used as emergency brake. When it is used as emergency

brake, the brake disc will be worn badly. The brake disc needs to be changed after it is used as emergency brake for twice. when travelling, the high pressure oil in the cylinder offsets spring force to make parking brake to be released.

The hydraulic oil is controlled by parking brake valve. When the parkingbrake valve is released, the valve is open; when the parking brake valve is applied, the cylinder can not flow to cylinder and the hydraulic oil in the cylinder flows to oil tank. And at this time, the oil cylinder will make the round disc brake.



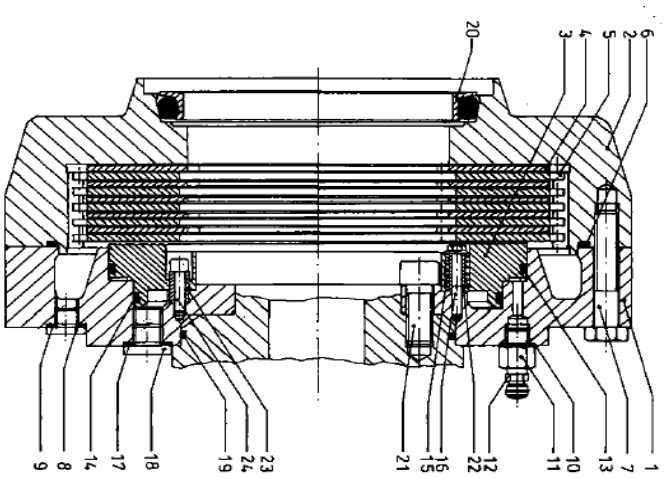


1. Oil cylinder and brake caliper assembly
2. Piston 3. Friction disc 4. Spring
5. Push rod 6. Washer 7. Adjusting bolt
8. lock nut 9. Oil chamber
10. oil seal 11. O ring 12. Dust-proof ring

Parking brake structure

Accumulator sturcture

The service brake is oil immersed type wet type multi disc brake. The advantage of this brake is that it does not need any adjustment and the brake force will be reduced. what is more, the wear is little. Besides, because the device is installed in sealed oil pool, so water and foreighn matters will not enter into brake. So the brake force torque is big, service life is long, anti-recession ability and anti-pollution ability is strong and is free from maintenance.

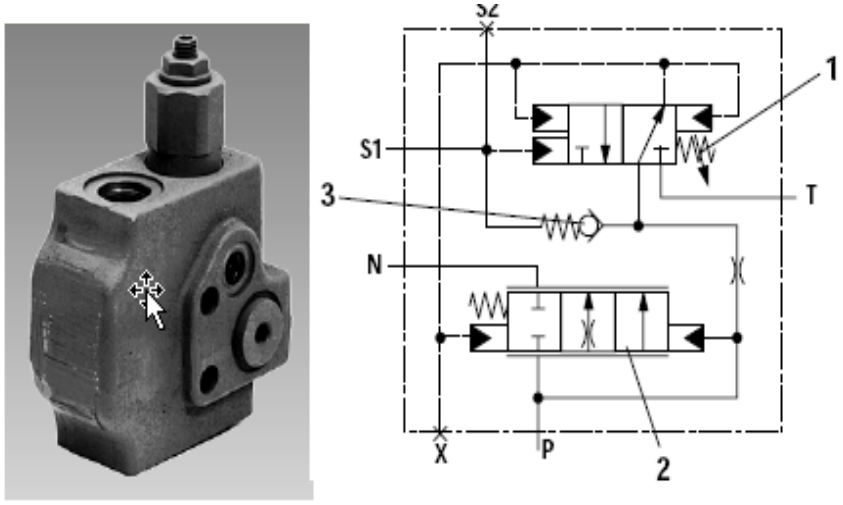


Service brake

The accumulators in service brake and parking brake are bag type. Only nitorgen can be charged into the accumulator and other gas such as oxygen, comrepssed gas and other flamable gas can not be charged into it. Charge the accumulator with special tool. The tool can also be used as exhasuting, measuring and adjusting tool. The charging pressure of the accumulator is 6Mpa. Check the accumulator pressure regularlly to ensure truck safety.

2)Liquid charging valve

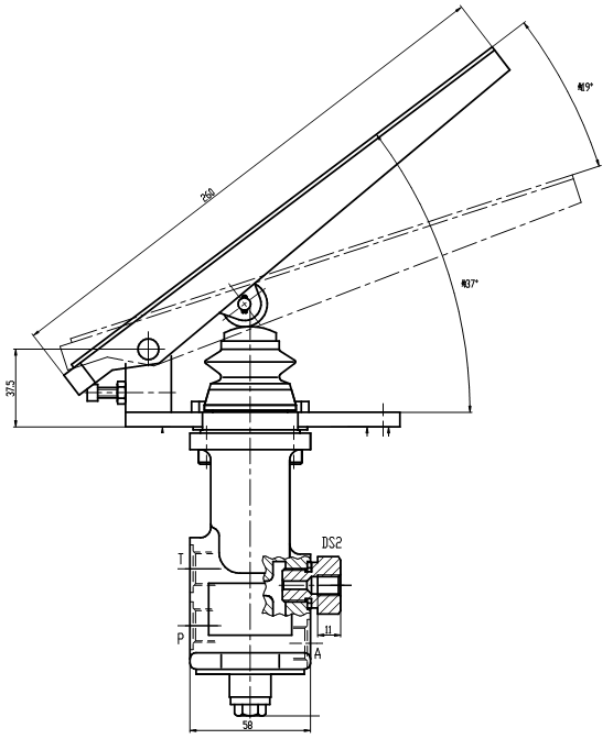
The main fucntion of liquid charging is to keep the accumaltor return circuit pressure within a certain limit value(cut-off pressure, connect pressure).



Liquid charging model and priciple diagram

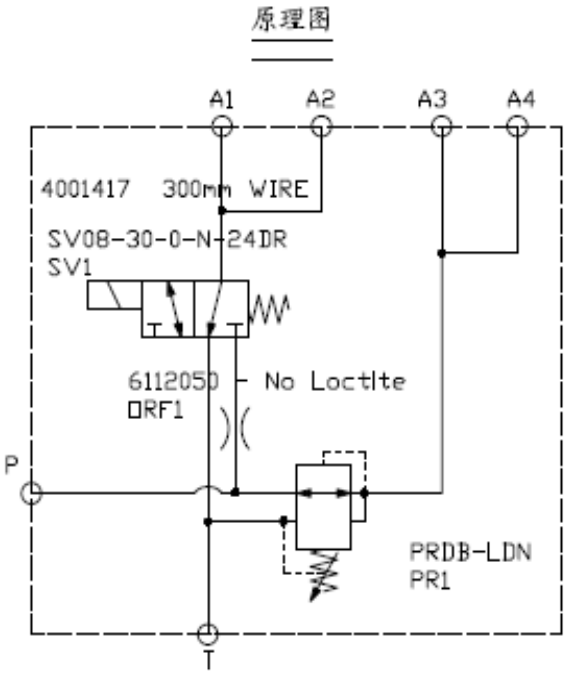
3)Brake valve

Dual hydraulic pedal ensure brake system safety.



4)Integrated valve block

The functions of integrated valve block: 1) conrol the oil supply of parking brake; 2) pressure reduction of pilot oil ; 3) low brake pressure alarm.



Integrated valve block priciple diagram

5.2.4 Brake system parameters

Brake system pressure: 10Mpa

Parking brake release pressure: 10Mpa

Accumulator nitorgen charging pressure: 6Mpa

5.2.5 Note

Parking brake can be used as emergency brake. When it is used as emergency brake, the brake disc will be worn badly. The brake disc needs to be changed after it is used as emergency brake for twice.

6. Steering system

6.1 Brief description

The steering system principally consists of a powered steering unit and a steering cylinder. The handwheel can be tilted properly forward or backward to meet driver's demand.

The powered steering unit has a favorable capacity which can compensate pressure variety for the variety of the steering load. It is fairly no infection between the working circuit of steering system and the others. The main flow preferential provide to the working circuit of steering system. So the truck is steering reliably and system economically.

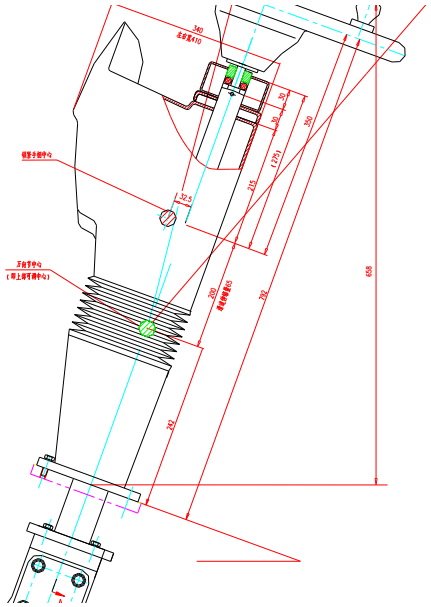


Fig. 6.1 Steering operation device

6.2 Full Hydraulic Steering Unit

6.2.1 Working principle

The valve core, valve sleeve and valve body of the steering unit constitute the follow-up rotary valve to control oil flow direction. The rotor and stator constitute cycloid gearing pair and play the role of measuring element to ensure that the oil flowing into the cylinder is directly proportional to the steering angle. It also plays the role of manual oil pump during manual steering. The driving shaft has the function of torque transmission.

When the steering wheel is not moving (in middle position), the valve core shall, under the function of centering spring, make the sleeve to be in the middle position. The oil from oil pump shall pass valve sleeve hole and valve core hole and return to the oil tank through oil sump. Then the two chambers of the steering oil cylinder and hydraulic motor shall be closed and the steering wheel shall remain at the original deflection angle (as shown in Diagram b in fig. 6.2).

When the steering wheel turns (power steering) to the right/left, the oil pipeline of the pump connecting directly to the tank shall be cut off, the oil pipeline to the steering oil cylinder shall be open and the piston rod shall push the wheel to turn. The rotor and stator constitute cycloid gearing pair and play the role of measuring element to ensure that the oil flowing into the cylinder is directly proportional to the steering angle (as shown in Diagram a in fig. 6.2).

When the engine stops, it can be used as manual steering system. The hydraulic motor shall be used as oil pump for manual driving operation. The steering wheel shall drive valve core, valve sleeve, cylindrical pin, driving shaft and rotor to push the oil out and make the steering cylinder to move and realize the deflection of the steering wheel (as shown in Diagram c in fig.6.2).

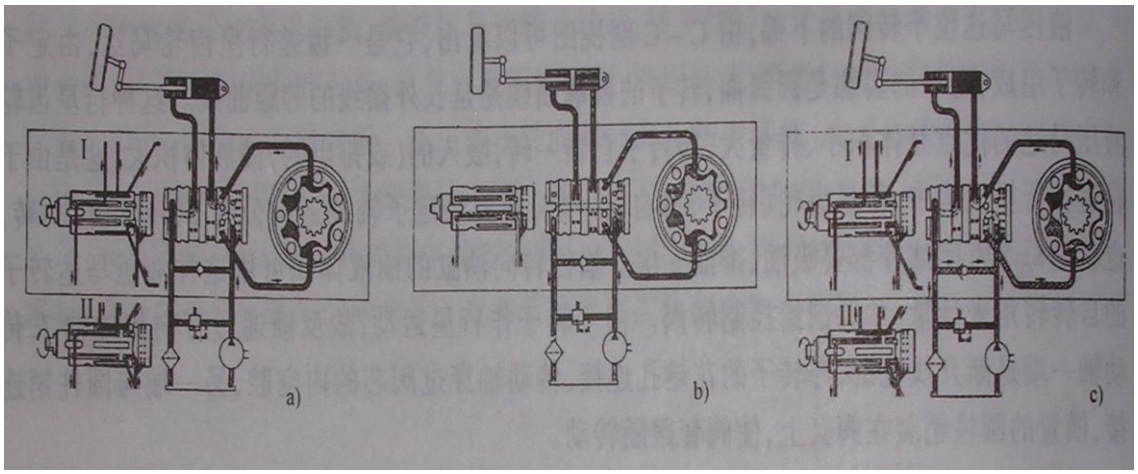


Fig.6.2 Working Principle

a) normal steering (Ⅰ-right steering Ⅱ-left steering) b) middle position

c) manual steering (Ⅰ-right steering Ⅱ-left steering)

6.2.2 Application requirements of the all hydraulic steering unit

(1)Installation

Ensure the steering gear is concentric with steering column and there is clearance in axial direction to prevent the jamming of valve element. Check if the steering wheel can turn freely after installation.

In pipe line installation, the "In" marked on the connector of the steering gear will connect with the pipe of oil pump, the connection marked "Return" will connect with oil reservoir. The connections marked "Left" and "Right" will be connected with the left and right chambers of the cylinder respectively.

The flow rate allowable in the suction pipe is 1—1.5m/s, pressure oil pipe and return oil pipe 4—5m/s. The test pressure of the high pressure host should not be 3 times lower than the maximum operating pressure.

The position of oil tank is normally higher than the location of the steering unit. The oil suction pipe shall plug into the oil so that it can feed oil during manual steering and avoid air mixing in the oil.

(2). Oil temperature

Oil temperature range: -20^0C--$+80^0$C

Normal oil temperatures: $+30^0$C--$+60^0$C

(3) Oil selection

Oil viscosity is 17—23 cSt. It is suggested that low freezing hydraulic oil be used.

(4) Filtering

The filtering fineness for the oil to the steering gear is 30μm. A back pressure of 0.2—0.3Mpa will be ensured for the return oil of the steering gear to prevent the oil returning to the reservoir during manual steering.

(5) Trial operation

Before operation, clean oil reservoir and fill oil up to the highest level. Loosen the crew plug on the reservoir and operate the oil pump at low speed to relief the air until there is no foam in the oil coming out.

Tighten all screw connections. Check if the steering system works normally under all working conditions. If the steering is heavy or out of order, do not turn the steering wheel forcefully or dismantle the steering gear to prevent damages of the steering gear parts.

Check if the piston of the steering cylinder has reached its limit positions and if the system pressure is in conformity with the specified values.

(6) Operation maintenance

Check leakages, oil level in the reservoir and working conditions every day. Chang filter elements and oil regularly according to requirements. Hydraulic oil condition can be checked by putting one drop of oil on absorbent paper. If there is a black spot in the center of oil stain, it will be changed.

If something abnormal happen during operation, try to find the reasons. Never turn the steering wheel by two people simultaneously.

To keep the steering system in a good working condition and prevent accidents, water content, mechanical impurities and acid value of the working oil will be checked periodically. If they are not in conformity with the requirements, the oil should be changed. It is forbidden to use unfiltered waste oil.

Do not dismantle steering gear rashly during system check. When the steering gear is confirmed to have problems, proceed according to the relevant procedures.
All the dismantling tools must be clean.

The working site will also be clean. It is better to do the dismantling inside a room.

6.3 Troubleshooting

Problem	Analyses of Trouble	Remedies
Fail to turn handwheel	Pump damaged or breaking down.	Replace
	Flow-divider blocked or damaged.	Clean or replace
	Hose or joint damaged or pipeline blocked.	Clean or replace
Hard to turn handwheel	Too low oil pressure from flow-divider.	Adjust pressure
	Air in oil circuit of steering system.	Exhaust air
	Steering unit fail to reposition due to spring plate damaged or elasticity-insufficient.	Replace spring plate
	Excessive inner-leakage in steering cylinder.	Check piston seals
	Excessive low level in oil tank.	Refill oil
Track snacking or moving with oscillation	Excessive flow as steering.	Adjust the flow of flow-divider
Excessive noise	Excessively low level of oil in tank.	Refill oil
	Suction pipeline or oil filter blocked.	Clean or replace

6.4 Steering Axle

6.4.1 General description

The steering axle is of welding structure type of trunk type cross section (refer to diagrams below). It consists of steering axle body, steering oil cylinder, connecting rod and steering wheel. The steering trapezium uses crank slide mechanism. The piston rod of the oil cylinder pushes steering knuckle to turn through the connecting rod. It results in the deflection of deflection wheel and steering is thus realized. The steering axle is connected on the tail frame of the vehicle by integral pins so that the axle can sway around the pins. There is a left and right steering knuckle on the left and right of the steering axle respectively. The wheels are pried on the hubs through wheel rims. There are oil seals inside the bearings to make lube grease stay in the wheel hubs and steering knuckles.

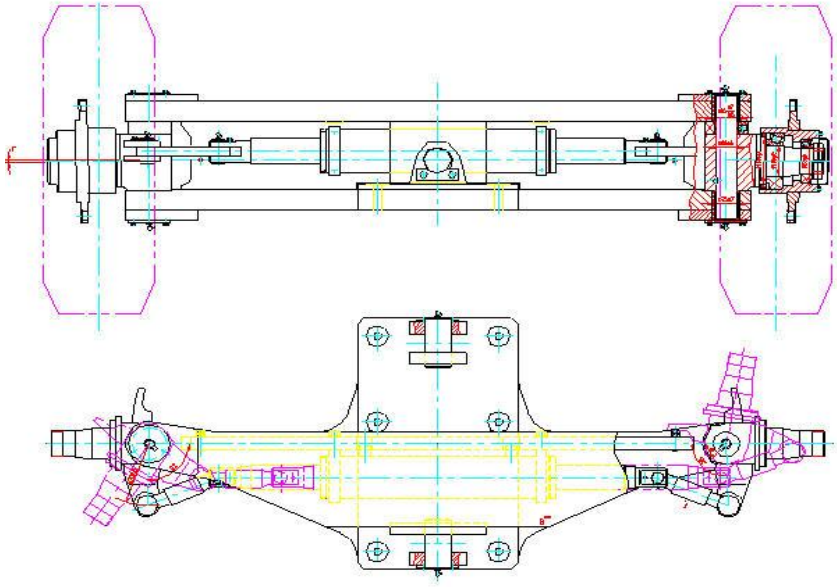


Fig. 6.3 Steering axle

6.4.2 Steering knuckles and king pin

The steering knuckle is fixed between upper and lower shaft sleeves at the two ends of steering axle with king pins, thrust bearings and adjusting gaskets. The center of the swivel pin is fixed on the steering knuckle with clamp pins. The two ends of the swivel pin are supported by needle bearing. There are oil seals at the two ends of the bearing. There is grease nipple on the upper end of the swivel pin.

6.4.3 Steering wheel bearing pre-load adjustment

(1) With lubricating grease, fill up the chamber formed by wheel hubs, wheel hub bearings, wheel hub covers and coat of the lips of the oil seals.

(2) Press the hub bearings into the hub and fit the hub on the knuckle shaft.

(3) Fit a flat washer and tighten a castle nut to a torque of 206-235Nm and loosen it and then tighten it again to a torque of 9.8Nm.

(4) To As shown in follows ,with lubricating grease ,fill up the chamber formed by wheel hubs, wheel hub bearings , wheel hub covers and coat of the lips ensure the installation of the nut is firmed, slightly knock at it with wooden hammer and in the meantime, rotate the nut for 3～4 turns.

(5) Tighten the castle nut and align one of its notches with a cotter pin hole drilled in

the steering knuckle.

(6) Again slightly knock at the hub with a wooden hammer and in this time, rotate manually the hub for 3～4 turns to ensure its smooth rotation with a specified torque of 2.94～7.8Nm.

(7) When the torque value measured is up to the specified one, lock the castle nut with a cotter pin.

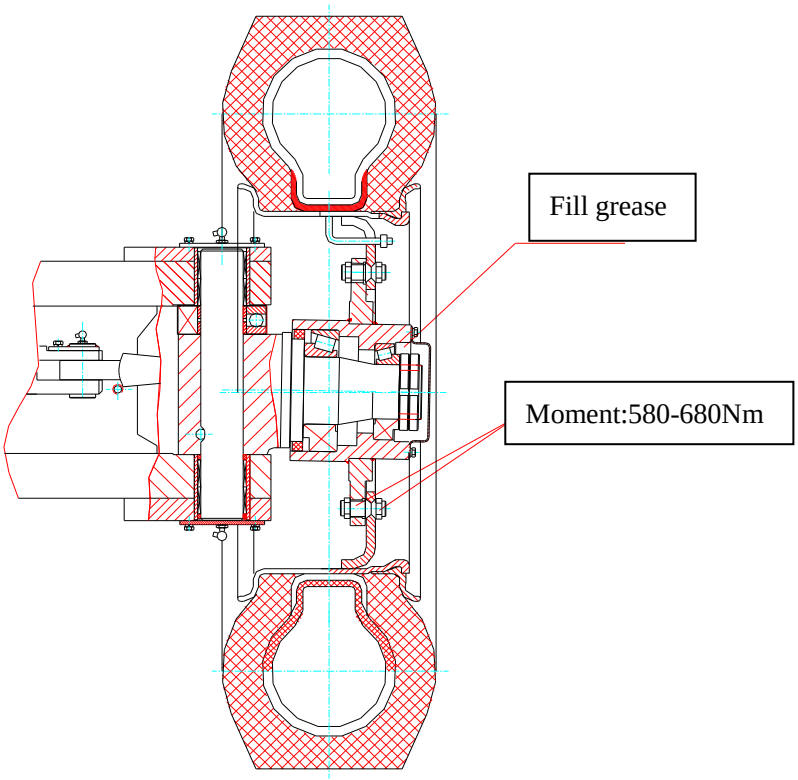


Fig. 6.4 Assembling diagram of the steering wheel hub

7. Hydraulic system

7.1 brief description

The hydraulic system of light type 15-16t truck (load center:600mm) adopts the Italy WALVOIL pilot controlling system. The load sensing steering system mainly including gear pump, control valve, balance valve, pilot control knob, steering unit, priority valve, steering unit, 1L accumulator, hydraulic integrated unit, flow regulator, hydraulic oil tank, return oil filter and other pipeline accessories is applied in this truck.

7.1.1 Principle diagram of the hydraulic system

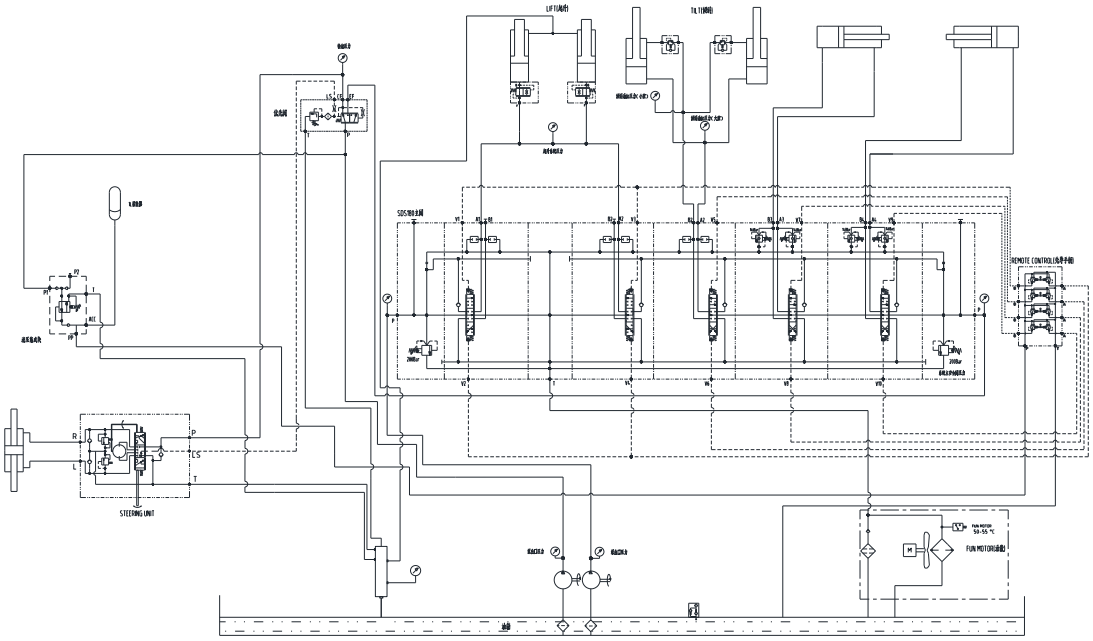


Fig. 7.1 principle diagram of the hydraulic system

7.1.2 Main specifications of the hydraulic system

Systematic pressure	22.5Mpa
Pilot pressure	3.5Mpa
The charging pressure of the 1l accumulator	2Mpa
Max. lifting speed (loaded/unloaded)	300/270mm/s
Max. lowering speed (loaded/unloaded)	350mm/s

7.1.3 Working principle of the hydraulic system

The hydraulic oil sucked by the double gear pump passing through oil filter is divided into two circuits: one is for control valve to carry out the lifting, tilting, side shifting and space adjusting; the other one is for priority valve which is supplied to steering unit first. When the steering does not act, the high pressure oil supplied to the priority valve flows to the P port on the control valve through the EF port on the priority valve to work together with the oil supplied to control valve. If the control valve does not act, the two oil circuits return to the T port and the high pressure oil flows back to oil tank directly. The pressured oil of the pilot knob is from hydraulic

integrated unit. The high pressure oil from the P port of the priority valve is supplied to the pilot knob after pressure reducing by the integrated unit to 3.5Mpa. the integrated unit A is connected to the 1l accumulator to ensure that the pilot knob can realize the direction changing in regulated times after the truck is stopped. The T port of the control valve is connected to condenser and return oil filter to ensure the stable working of the hydraulic system.

7.2 Main parts description

7.2.1 Gear pump

HCHC double gear pump is adopted. Displacement:（50+50）ml/r.

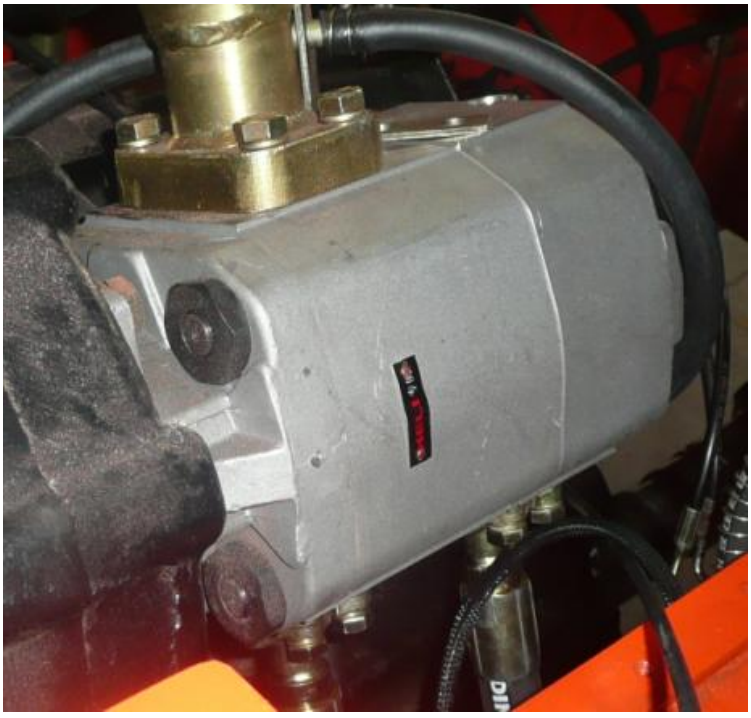


Fig. 7.2 gear pump

7.2.2 Control valve

Italy WALVOIL EXP200 series control valve is adopted by the control valve. Control mode of the main valve element: pilot control; the set pressure of the main safety valve: 23Mpa; set pressure of the secondary overflow of the third and fourth piece: 14Mpa.

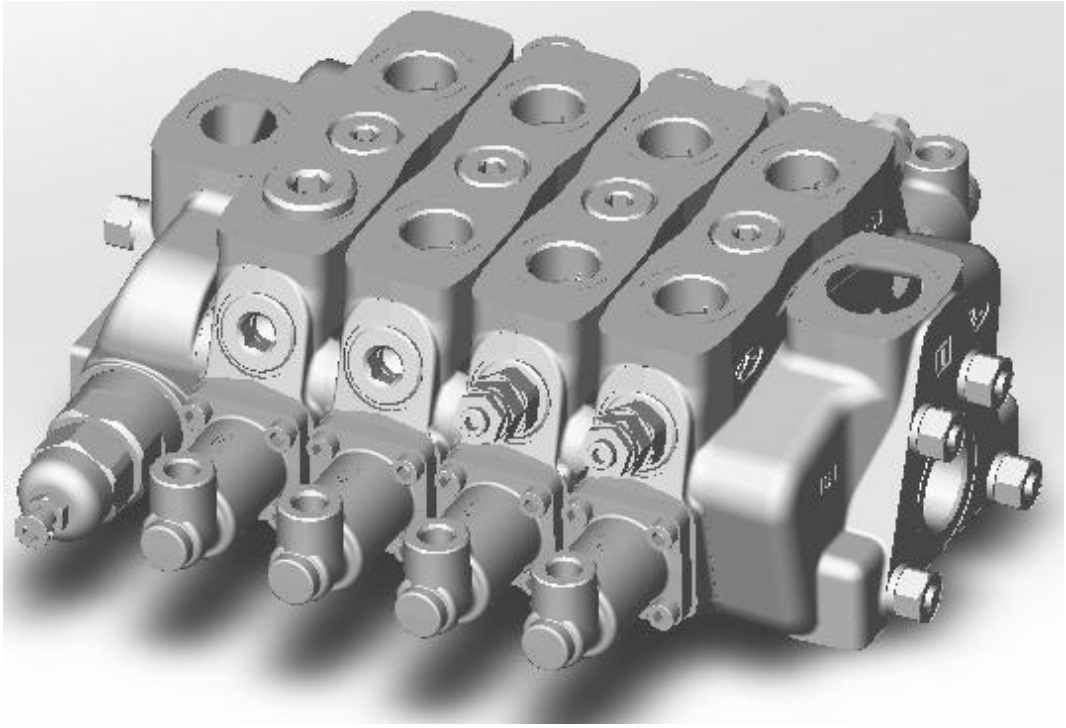


Fig. 7.3 Control valve

7.2.3 Balance valve

American Parker 376 series balance valve is adopted to ensure the stable action of the mast during forward tilting. What is more, there will be no danger even mis operation and the safety of the whole truck is improved.

Fig. 7.4 balance valve

7.2.4 Pilot control knob

The EXP 400 series pilot knob of the Italy WALVOIL is adopted in this truck. The control valve is connected to the pilot oil port on the main valve and each valve

block corresponds to the different functions. In that case, the lifting and lowering operation, tilting operation and side shifting operation are achieved. Each valve or valve bock are equipped with two pressure reducing valve. The precise of the valve make the internal leakage to the min. amount under any case. Only small operation force is needed to control the control valve easily.

Fig. 7.5 Pilot control valve

7.2.5 Priority valve

The set pressure of its safety valve is 17.5Mpa.

The port mark and corresponding meaning:

Port P: the oil inletting port of the priority valve

Port T: the oil returning port of the priority valve

Port LS: the signal port of the wholly hydraulic powered steering unit

Port CF: the oil supplying port to the steering unit

Port EF: the oil flow port when the steering does not work

The structure of the priority valve which is mainly made up of safety valve, spring, valve element and valve body is shown in figure a.

Refer to the figure b for its working principle. The P port is the oil inletting port of the steering pump; CF port is connected to the oil inletting port of the steering unit; EF port is connected to the oil inletting port of the control valve; LS port is connected to the control port of the steering unit; T port is the oil returning port of the safety valve. When the oil flows to P port, the hydraulic oil is supplied to CF port preferentially through valve element 3. The CF port is closed when the steering unit does not work. And at that time, the pressure at the LS port is zero and the oil flows to

the right end of the valve element. The right end of the valve overcomes the pre pressure of the spring 2 with the hydraulic power to make the valve element moves to the left. Then the P port is connected with the EF port and the oil of the steering pump flows together to the working system. When the steering unit works, CF port is connected to the steering cylinder through steering unit and the inletting oil of the steering pump flows to the steering cylinder, and thus the steering is achieved. The pressure signal of the LS port acts on the left end of the valve element through the throttle hole and at that time the pressure at the right end of the valve element is lower than the existing port of the steering unit. The hydraulic oil is supplied to the steering preferentially when the high rotation speed of the steering unit make the valve element move to the right until it is closed because of the change the two ends' pressure difference of the valve element and the action of the spring. When the steering load exceeds the rated value, the pressure oil of the LS port make the safety valve opens and the inletting oil of the steering pump flows to the working system. When the working system does not work, the neutral position through the control valve unloads.

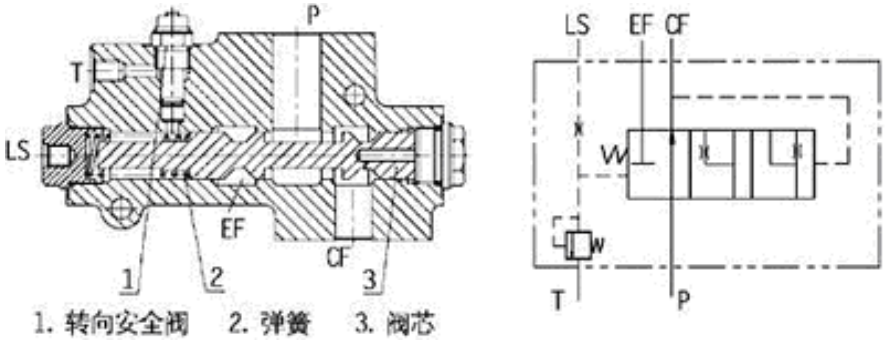


Fig. 7.6 priority valve (a. structure diagram b. principle diagram)

7.2.6 1L accumulator

The accumulator is a device storing and releasing the hydraulic power. Proper using the accumulator is one way to save the energy. Bag type accumulator is adopted in the light type 15-16t forklift truck and its recharging pressure is 1.5Mpa.

The function of the accumulator in the hydraulic system:

- Auxiliary energy
- Make up for the leakage to make the pressure stable
- Absorb the hydraulic shock
- clear the pulsation of the hydraulic pump
- be the power in emergency case

Refer to the figure 7.7 for the accumulator inner structure:

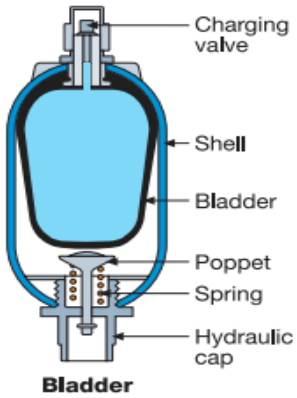


Fig. 7.7 the inner structure of the accumulator

The charging (releasing) process of the accumulator is below:

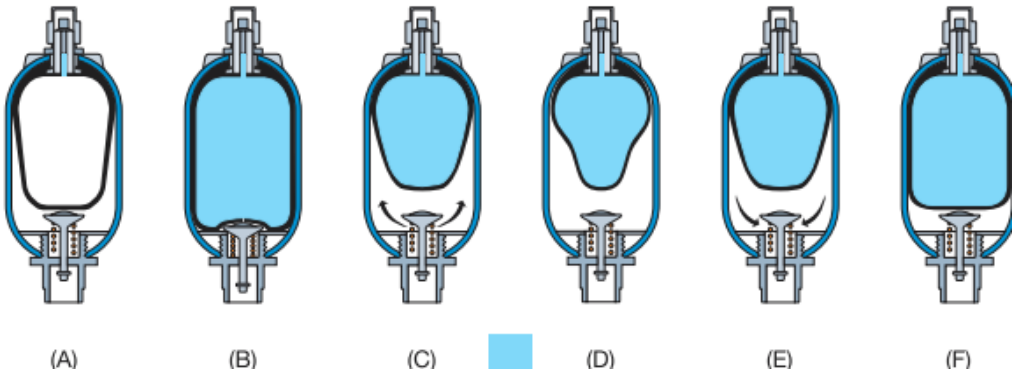


Fig. 7.8 The charging (releasing) process of the accumulator

7.2.7 Air cleaner

Air cleaner which is the breather of the oil tank is to ensure the pressure balance inside and out of the oil tank. Cavitation erosion will arise if the oil pump is blocked which may reduce the service life of the oil pump remarkably.

The SAP series air cleaner which is easy to install and has large ventilation of the

MP Company is adopted in the truck.

Fig. 7.9 air cleaner

7.2.8 Returning oil filter

As the main cleaning devices of the hydraulic oil, returning oil filter plays the key part in the cleanness of the hydraulic oil and the normal working of the hydraulic elements. The main specifications of the returning oil filter are followed:

Rated flow: 300L/min

The filtering precise: 10μm

The opening pressure of the bypass valve: 0.35MPa (avoiding the occasion that the oil can not return to the oil tank because of the block of the filter element)

Working pressure: 1.6MPa

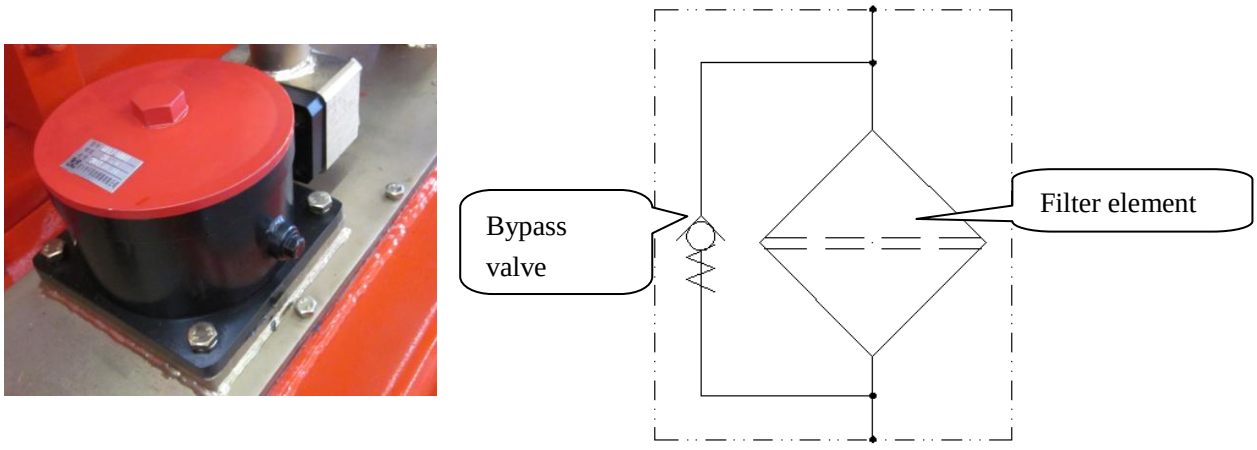


Fig. 7.10 returning oil filter and its principle diagram

7.3 Usage and maintenance

Periodical maintenance which includes checking the sealing condition of the

system and changing the filter and hydraulic oil regularly of the hydraulic system of the light type 15-16t forklift truck is the important guarantee of stable working of the system.

1) The filter element of the returning oil filter

Change the filter according to the actual working condition of the hydraulic oil.

2) Air cleaner element

Air cleaner element is fixed in the hydraulic oil tank to prevent the dirt in the air fall into the oil tank. Change the element every 800h. Every 500h change the element if working in the mining area or other bad working condition.

Air cleaner which is the breather of the oil tank is to ensure the pressure balance inside and out of the oil tank. Cavitation erosion will arise if the oil pump is blocked which may reduce the service life of the oil pump remarkably.

3) Change the hydraulic oil. Change the hydraulic oil every 2000h or one year.

SUGGESTION:

It is prohibited to use the mixed hydraulic oil from different company. Add additives after changing the hydraulic oil. The adding amount of the additives is 3%-6% of the oil adding amount.

7.4. Trouble analysis and troubleshooting

Trouble	Cause	Trouble shooting
Insufficient Lifting Capacity or Unable to Lift	(1) Excessive wearing between the oil pump gear and pump body and wider-than-normal gap. (2) Wearing and wider-than-normal gap of the piston sealing part in the lifting cylinder, excessive inner leakage. (3) Failure of safety valve spring of control valve. (4) Excessive oil leakage due to wearing between the control valve rod of control valve and valve body. (5) Oil leakage among valve bodies of the control valve . (6) Oil leakage in hydraulic pipe.	(1) Replace the wearable parts or oil pump. (2) Replace with new piston sealing ring. (3) Replace with new spring. (4) Chromium plating the valve rod to couple with the hole with the gap at 0.01～0.02. (5) Change the sealing ring, screw tight the screw in sequence. (6) Check to see whether there is

		damage to the sealing ring or connecting nut and screw tight the pipe joint.
	(7) Higher-than-normal temperature of hydraulic oil, excessive oil dilution and insufficient flow.	(7) Replace the unqualified hydraulic oil, stop operation to lower oil temperature and try to find the cause of over high oil temperature.
	(8) Excessive load.	(8) Lift load according to requirements.
The piston rod of the lifting cylinder falls sharply.	(1) The YX seal ring of the lifting cylinder's piston leaks inside. (2) The slide valve of the control valve leaks inside. (3) Some lifting pipelines leaks. (4) The valve element of the flow regulator can not return.	(1) Change the YX seal ring. (2) Chang the O ring in the slide valve. (3) Change the O ring where leaks. (4) Regulate or replace the valve element.
Insufficient Pressure of Oil Pump	(1) Oil leakage due to wearing of ring seal at fasteners. (2) Hydraulic oil is contaminated with air to form foam, air leakage at oil suction pipe-work, insuffi- cient hydraulic oil. (3) Damaged ring seal inside the pump cover groove. (4) Wearing of the end face of bearing sleeve. (5) Oil pump gear wears. (6) Wrong rotation direction of oil pump.	(1) Replace the ring seal. (2) Discharge air and add hydraulic oil. (3) Replace. (4) Replace. (5) Replace the oil pump. (6) Correct.
Excessive Self Tilting of the Tilting Cylinder	(1) Inner leakage of control valve. (2) Inner leakage due to the damaged O-ring seal of piston rod of the tilting cylinder. (3) Oil leakage due to the damaged YX-ring seal and O-ring seal in the pilot sleeve.	(1) Replace O-ring seal, repair valve rod and reassign the coupling gap between valve rod and hole to the regulated value. (2) Replace. (3) Replace.
Abnormal noise of the oil returning pipe	(1) Small flow of the flow regulator. (2) The oil returning pipeline is not free.	(1) Adjust the spring in the flow regulator. (2) Regulate the oil returning pipeline.
Heavy	(1) No oil supply to the steering.	(1) Check he oil out letting port on

Steering	(2) No oil supply to the LS signal oil circuit. (3) The steering is damaged. (4) The set pressure of the safety valve on the steering unit is low.	the priority valve. (2) Check the corresponding ports on the priority valve. (3) Change (4) Reset the pressure value.
The pilot does not act.	(1) The pilot knob is damaged. (2) The pilot pressure is low.	(1) Change the pilot knob. (2) Check or change the hydraulic integrated block.

8. Lifting Cylinder and Tilting Cylinder

Model / Truck				
Item			CPCD150-160-Wx-06II	CPCD150-160-Cu-06III
Lift Cylinder	Type		Single-acting piston type	
	Cylinder bore dia.	mm	φ 110	
	O.D. of piston rod		φ 85	
	Stroke		1500	
Tilt Cylinder	Type		Double-acting piston type	
	Cylinder bore dia.	mm	φ 135	
	O.D. of piston rod		φ 70	
	Stroke (6°/12°)		290	

8.1 Lift Cylinder

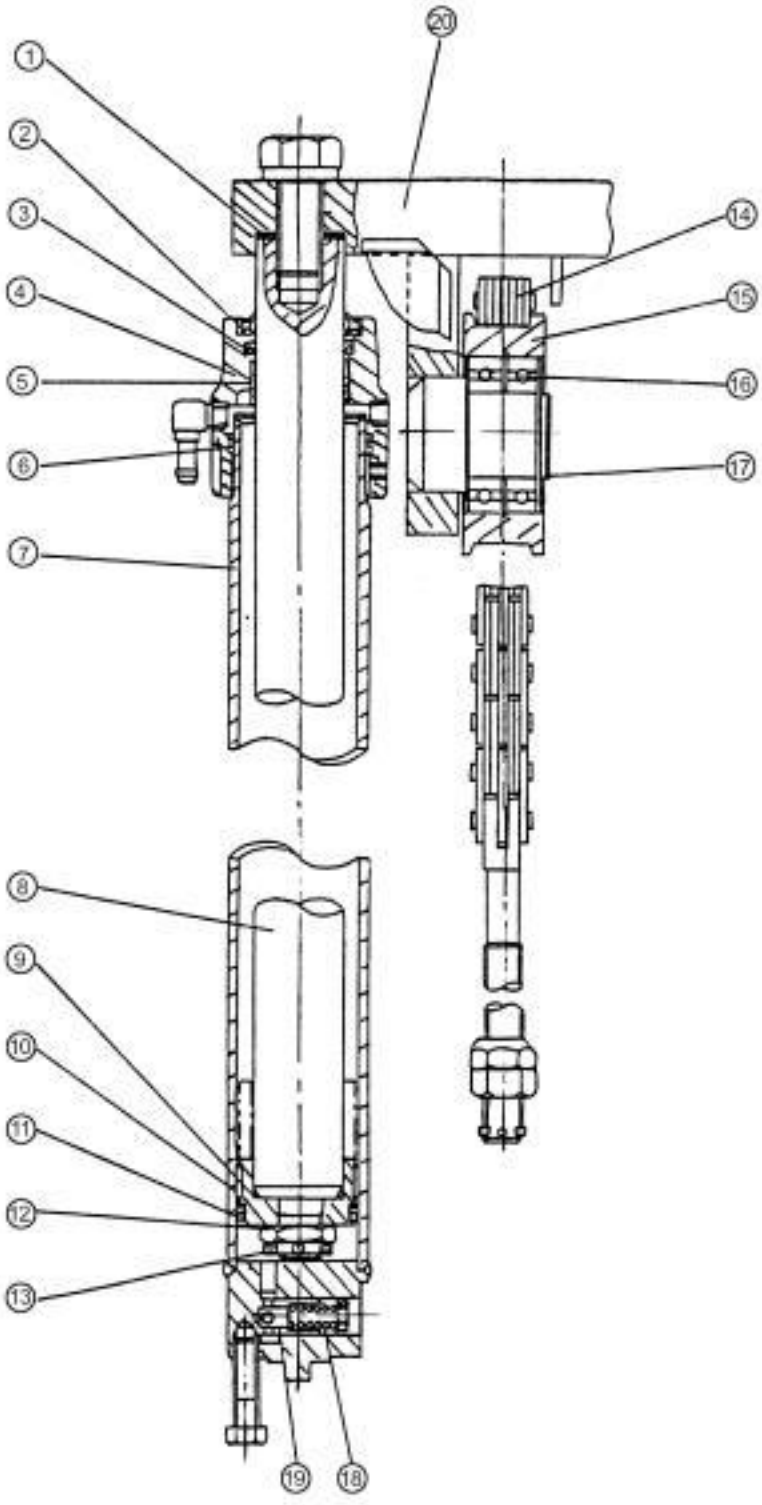
Each lift cylinder is located behind each side of outer mast frame, cylinder bottom fixed upon the cylinder bracket of outer mast, the upper end of the piston rod is connected with beam set bolts. The travel distance of two lift cylinders should be equal to in-phase, otherwise, adjust the set bolts of the top of cylinder. (See Fig.8.1)

The lift cylinder assembly consists primarily of a cylinder body, piston, piston rod and cylinder cap. At the lower part of the cylinder body is arranged an inlet for high-pressure oil, and at the upper part there is an outlet for low-pressure oil above the piston packing, to which a return pipe is connected.

The piston is fastened to the piston rod with steel wire, snap ring, cotter pin, together with an O-ring. An oil seal and bushing are installed on the cylinder cap which is screwed into the cylinder body. The wearing supports the piston rod, and the

Dust seal prevents dust from entering the cylinder. The upper end of the piston rod is locked with piston head set bolts on the crossbeam.

When the lift lever is pulled backward, high-pressure oil is sent into the lift cylinders through their inlets to push up the piston rods, the piston head and beam, rising the forks and side suspenders by chains. As the lift lever pushed forward, the pistons of the lift cylinders descend by the weights of the piston rods, lift bracket and forks, pushing oil under the piston to flow out of the cylinders. The oil discharged off the cylinders is regulated by the flow regulator and returns through the control valve to the oil tank.



(1) Shim
(2) Dust ring
(3) Yx-ring seal
(4) Cover
(5) Bushing
(6) O-ring seal
(7) Cylinder body
(8) Piston rod
(9) O-ring seal
(10) Support ring
(11) Yx-ring seal
(12) Nut, lock
(13) Cotter pin
(14) Chain
(15) Sheave
(16) Bearing
(17) Snap ring
(18) Spring
(19) Cut-off valve
(20) Upper beam

Fig.8.1 Lift Cylinder

8.2 Flow Regulator Valve

Flow Regulator（throttle）is located between the control valve and the high pressure ports of the two lift cylinders, near the left lift cylinder (refer to 8.2). Flow

regulator is used to limit the fall speed of forks and side suspenders when over loading. The structure of the flow regulator is shown in Fig.8.3.

The flow regulator acts as the safety device except for controlling the lowering speed. If the rubber pipe is damaged between the control valve and the lifting cylinder, the flow regulator avoids the danger of goods falling.

The operation of the flow regulator valve is given below:

See Fig.8.2, With the forks upraised, high pressure oil leads from the control valve then flows into the chamber A， and pushes the sleeve to the left. This opens the opening G, and allows the high pressure oil to flow along the two routes (ABGDE and ABCDE), and both flows of oil lead to the lift cylinders. In this case, the flows of oil is not regulated. When the forks or the spenders begin to descend, oil discharged off the lift cylinders enters the chamber E and pushes the sleeve to the right until it contacts the nipple. This closes the opening G, so that oil flows through E,D,H,C,B and A to the tank. If the flows of oil discharged off the lift cylinders is rapidly increased, the pressure in the chamber F rises, and moves the piston to the right in spite of the spring force, narrowing the opening H. So the flow of oil from the chamber D to the chamber C is decreased so that the descending speed of the forks is controlled.

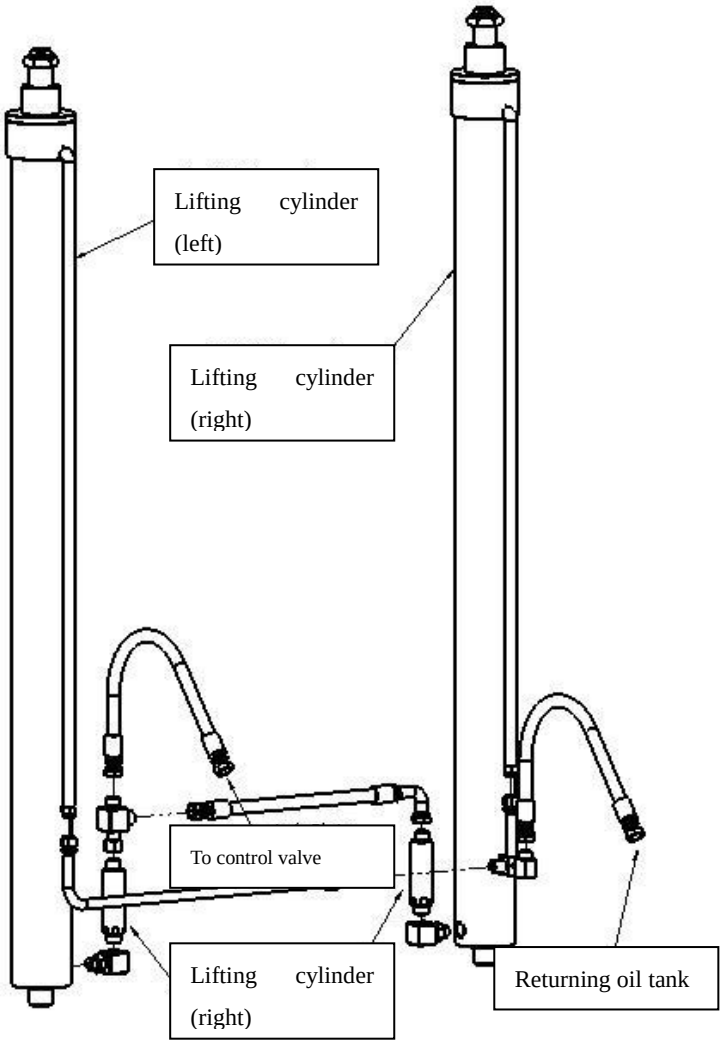


Fig. 8.2 the installing position of the flow regulator

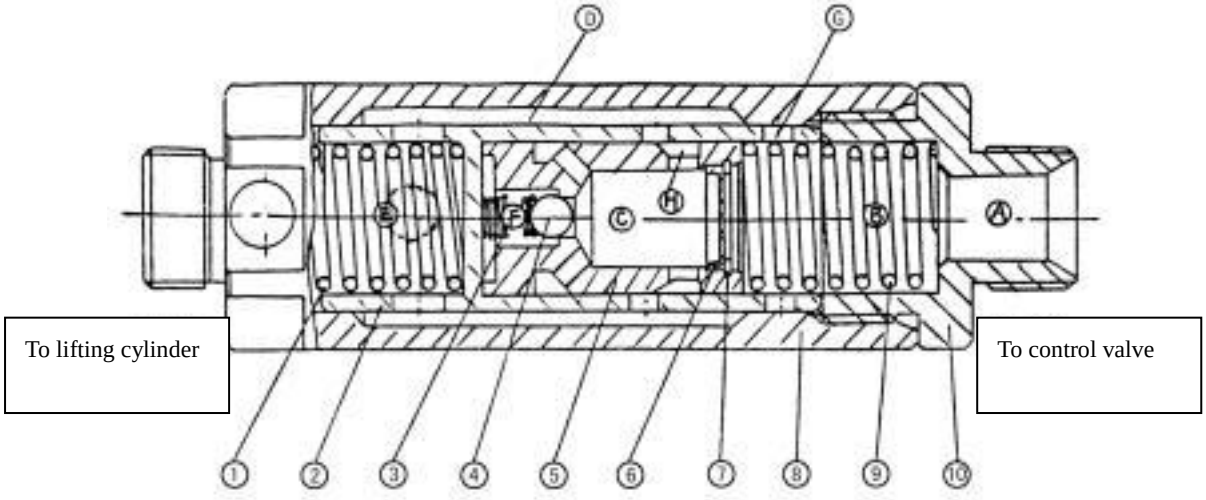


Fig.8.3 The Flow Regulator

(1)Spring (2)Valve sleeve (3)Spring (4)Nylon ball (5)Valve core (6)Throttle plate (7)Snap ring (8)Valve body (9)Spring (10)Connector

8.3 Tilt Cylinder

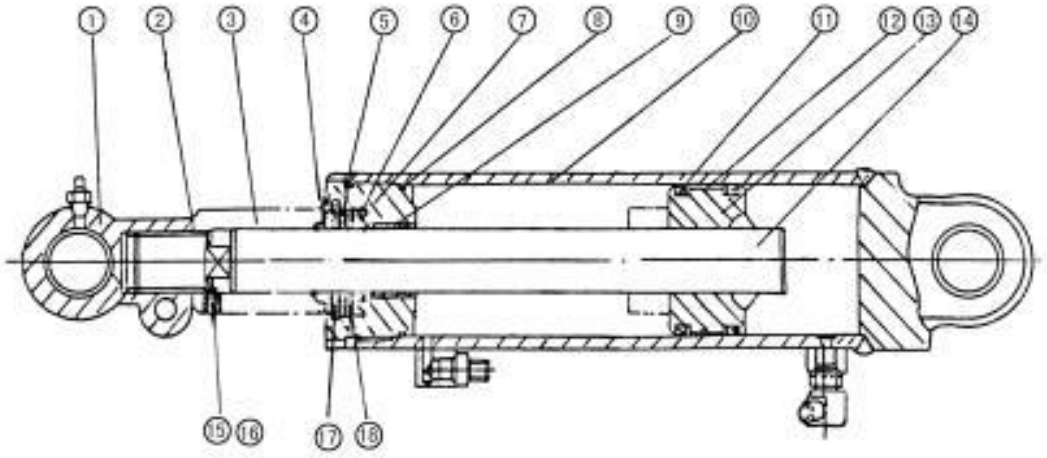


Fig.8.4 Tilt Cylinder

(1) Ear ring (2) Shim (3)Adjust sleeve (4)Dust ring (5)Snap ring

(6) Yx-ring seal (7) Guide Sleeve (8)O-ring seal (9)Bushing

(10)Cylinder body (11) Yx-ring seal (12)Wearing (13)Piston

(14)Piston rod (15)Plug (16)Screw (17)Snap ring (18)Snap ring

Two tilt cylinders of double acting type are mounted on each side of the frame. The front end of the piston rod is installed on the mast and the cylinder tail is on the frame by pins. The tilt cylinder assembly consists primarily of a cylinder body, cylinder cap, piston and piston rod.

The piston is welded to the piston rod. The piston, of which the outside periphery is given two Yx-rings and a dust seal. Rings and dust seal is used for preventing leak and dust (between piston rod and guide sleeve). The guide sleeve, fitted with an O-ring on the outer periphery, is screwed into the cylinder body and fastened with a lock ring.

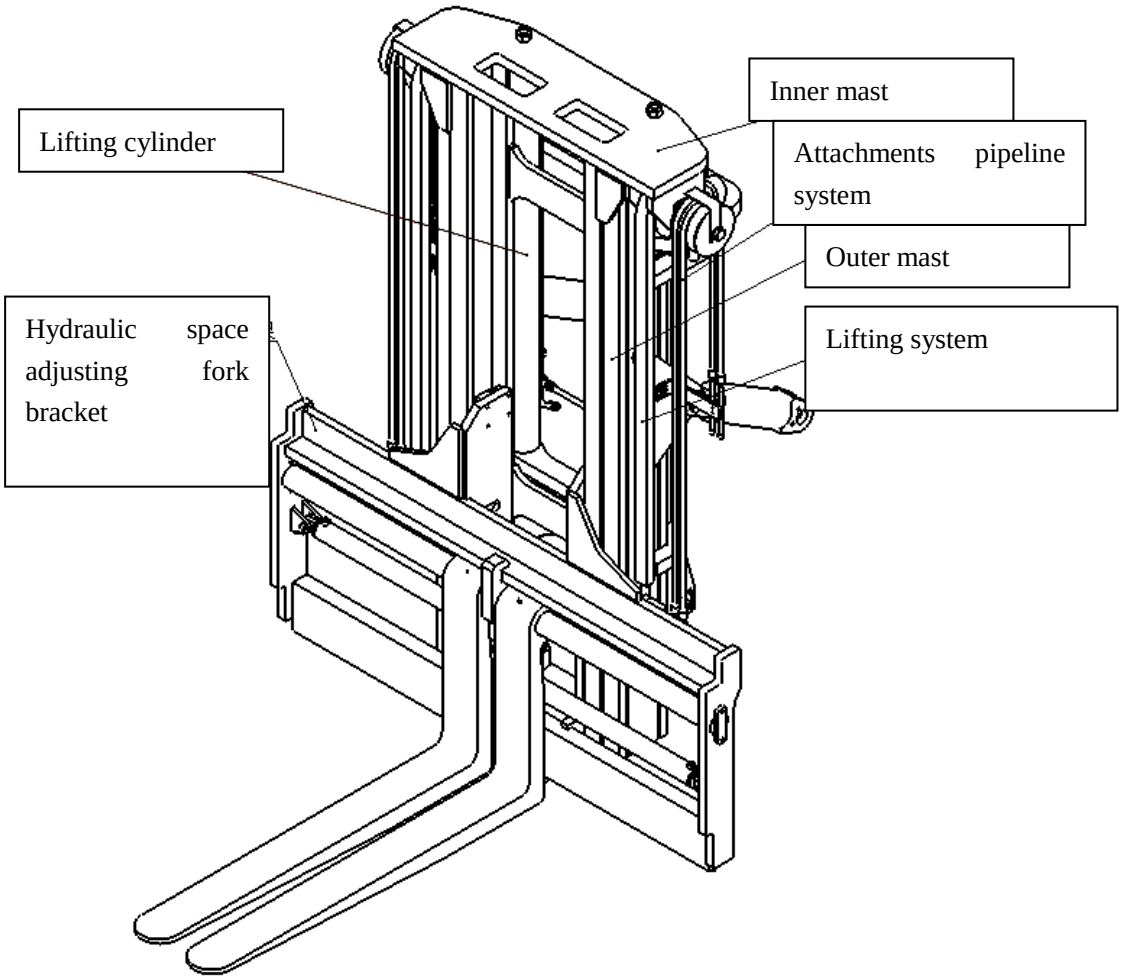
When the tilt lever in the driver’s room is pushed forward, high pressure oil enters from the cylinder tail side to shifts the piston forward, tilting the mast forward 6 degrees. As the tilt lever pulled backward, high pressure oil enters from the cylinder guide sleeve. This shifts the piston to the rear, causing the mast to lilt backward 12 degrees.

9. Lifting System

9.1 General Description

The lifting system is adopted the two-stage, rolling telescopic mast type. It

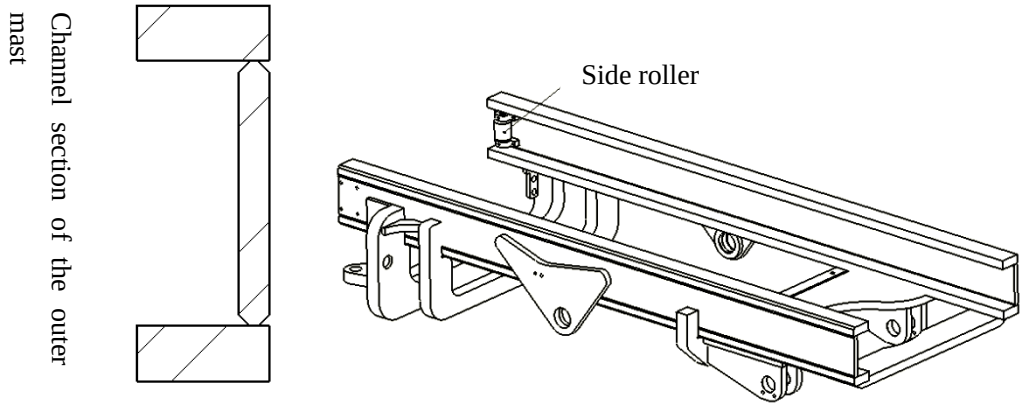
consists of outer mast, inner mast, lift cylinder, fork bracket, chain and attachment pipes. Refer to the figure below.



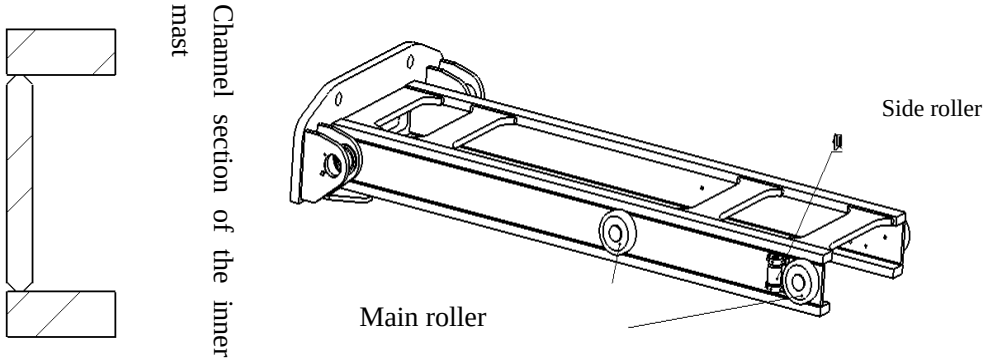
(1) Inner and outer mast

Inner and outer masts are all welded parts. Outer mast bottom is fixed at driving axle with pin. The middle part of outer mast is connected with frame by tilted cylinder and can be tilted forward and backward under the action of tilted cylinder.

Outer mast channel steel is a weldment of common low-alloy structural steel with C-section and with its upper part being fixed with a pair of side roller.

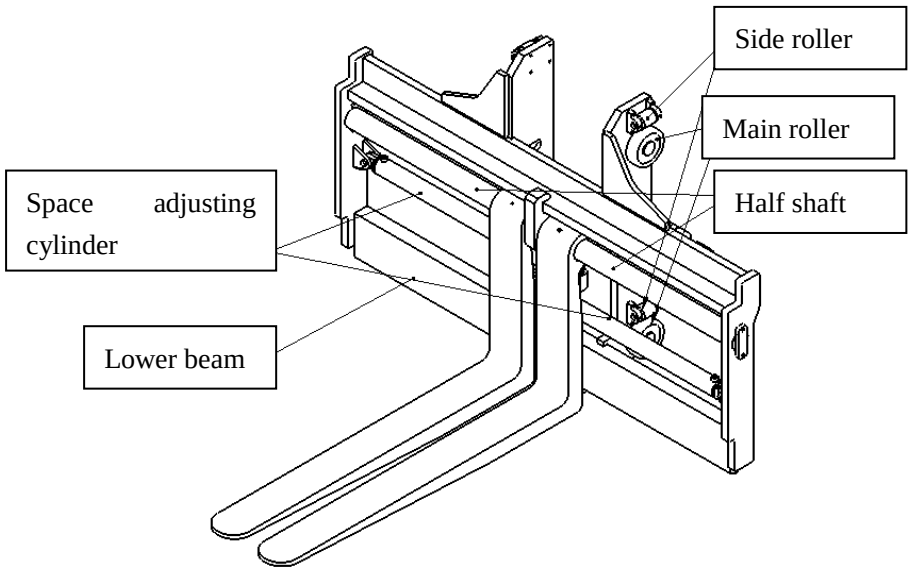


Inner mast channel steel is C-form with its outside being fixed with two pairs of main roller and a set of side roller.



(3) Fork bracket

The bracket rolls in the inner mast through main rollers. The side rollers can be adjusted with gaskets. The vertical load shall be borne by the main rollers, while the horizontal load shall be on the side rollers. Two cylinders are assembled on the fork bracket. One cylinder's piston rod head is fixed on the left fork while the other cylinder's piston rod head is fixed to the right fork. Operate the operating handle to achieve space adjusting. Lubricating grease is applied onto the lower beam and main shaft to reduce resistance when adjusting fork space.



9.2 Maintenance and Lubrication

(1) Moving parts of main roller and side roller of inner and outer masts need to be lubricated with grease.

(2) Carry out following work every 50 hours

Clean and lubricate the main roller and side roller of hoist system, chain of lifting cylinder and chain wheel shaft at the top of mast. Ensure that lubricating oil or grease is injected to special parts connected with the abovementioned components to avoid the roller and pin being stuck.

Check and lubricate the mast and frame. Check if there are any abnormalities at the connections between the tilting cylinders and mast or cylinders and frame.

(3) Carry out following work every 400 hours

Check carefully if the rollers and sheaves are working normally. Check if there is any distortion, abnormal wearing or cracking of welding seams on whole mast, carriage and fork structure. Attention shall be paid especially to the firmness of all axis pins and tightness of pins. Make sure that lifting cylinder and tilting cylinder are working normally. The operation should be stopped if there is any abnormality and can only resume after the troubles are eliminated.

(4) Chain

● Introduction

The forklift is provided with chain, which must be checked and maintained regularly according to requirements shown in the following table.

Maintenance	Inspection
Lubrication	Working conditions of parts
Adjustment of arrangement and degree of tightness	Abrasion

● Lubrication

To maintain chain in good working conditions, it is necessary to make regular and proper lubrication of chain and other sliding parts. The two objectives of lubrication are as follows:

a) Anti-friction

Lubrication brings about a film on sliding face, reduces direct contact of two metallic surfaces and then friction and abrasion. Lack of lubrication will lead to production of abnormal noise and affect the efficiency of vehicle in use.

b) Protection

The film produced by lubrication can isolate metallic surface from oxygen.

● Practice

After loosening the chain, usually daub lubricating oil onto the chain surface with brush so that the oil can seep into the joints of chain between chain pieces, as a result, wearing parts between pins and chain piece holes can be well lubricated. It is necessary to clean chain carefully with diluents before lubrication.

● Lubrication type

For usual lubrication, the option can be lubricating oil with viscosity indication ISO VG46460. The oil with less viscosity can be applied to lower outdoor temperature and smaller chain. Compared with more viscous lubricating oil, the diluted oil enters into the chain joints easily and achieves better result of lubrication.

After a long interval without lubrication, liquid grease diluted with diluent can be used. The advantage is that the diluted grease is more mobile and permeable. After the diluent volatilizes, a viscous smooth layer is left on the surface.

High pressure resistance is one of the obvious features of chain. Some friction-proof solid paints are very useful. Lubrication effect remains even if lubricating solution disappears completely. Under poor or outdoor circumstances, it is important that they can prevent the surface of outer chain pieces from oxidation.

To better protect chain, it should be lubricated with more diluted oil at first and then coated with viscous water-proof oil for the whole surface. In special conditions such as temperature below zero ℃ or above 80℃, proper lubricating oil should be chosen.

- Time interval for lubrication

It is hard to give a definite time interval for chain lubrication. In fact, this interval depends on the pressure between pin shaft and chain piece, type of lubricating oil, method to perform lubrication and working environment of vehicle, as well as on actual working conditions, residues of lubricating oil at chain joints and other factors. Normally, we propose lubrication once every 50 hours.

- Adjustment of tightness and arrangement

Every time for lubrication operation, you can adjust the tightness of chain and check its arrangement, auxiliaries and pulley if needed. Uneven arrangement is very dangerous, for it puts the chain under over big stress. To adjust the tightness of chain, the first step is to place spreader at the lowest level, adjust the chain top joint and nuts, keeping two chains in equal tightness.

- Checking chain parts

Take the chain apart regularly to clean it completely and check if there is any trouble with it and then lubricate the whole chain again if possible.

- Cracks and damages of chain pieces

Usually, visual check is only limited to the outer chain piece and chain piece fringe, overlooking cracks on pin shaft and chain piece hole fringe. Permeable solution can be used to inspect fine cracks unperceivable by naked eye. Parts near auxiliary unit or under pressure should be more carefully checked. .

Even without obvious anomaly, extreme fatigue of chain cannot be excluded. The reason is that, as mentioned above and the inspection is impossible to cover all parts.

At the same time, check all parts to see if they are in proper positions, preventing fall of chain piece from pin shaft and make sure that the hinge joints are securely locked.

At least after every 12 months or 1000 hours:

● Checking abrasion of chain for such parts as listed below:

a) Hinge joints, chain extension;

b) Fringe of disc connecting wheel and guide pulley system;

c) Fringe or pivot head of outer disc connecting pulley flange or side guide pulley unit.

● Checking chain extension due to abrasion

To control chain extension caused by abrasion, we propose some adjustments to do. Remembering the data of primary dimensions of chain as reference for measurements, you can figure out the most wearing parts after several times of measurement. Pay much attention to such parts later and measure them with band tape or rule having enough length. Pin shaft head or chain piece fringe values can be used for reference.

Before measurement, put a light object (of about the forklift weight) on the straight and flat part of chain, fix the maximum extension limit at 2% although 3% is reachable in normal conditions. The fixing of the extension limit will take the following points into account:

a) Abrasion of parts affects the strength of chain;

b) Hard face abrasion.

● Checking abrasion of chain piece fringe

After visually discovering evident abrasion, you can measure its actual conditions with tool and compare it with original state. Maximum abrasion limits are given in following table:

Abrasion type	Difference between the first and last measurement %	
	Normal use	Undue use
Only one-side abrasion 【（H-H1）/H1】x100	3%	2%
Only one-side abrasion 【（H-H1）/H2】x100	5%	3.5%

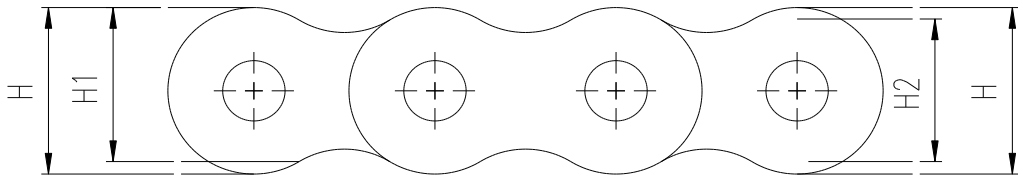


Fig.9.5 Abrasion of Chain Piece Fringe

High pressure between chain piece fringe and pin shaft head leads not only to abrasion, but also chain piece curling, thus jamming the hinge joints. If part of hinge joints jams, the chain must be changed.

● Abrasion of chain

Abrasion is resulted from poor engagement of chain interfaces with pulley or side pulley. Pulley side abrasion is generally caused by load deviated from central position or guide pulley/lift hook unit not in straight arrangement. Abraded pin shaft head is unable to firmly fix chain pieces and abrasion around chain pieces will affect disc similarly. If pin shaft head abrasion exceeds 25% or the outside abrasion of chain piece is over 20% of its thickness, you are required to check if there is any fault with it and change the chain.

- Interval

Check abrasion conditions at least every 6 months or 1000 hours. Remember to change chain timely if abnormal phenomenon occurs or abrasion value approximates the abovementioned limit.

(5) Fork checking

The forks shall be checked every 12 months. The check shall be carried out every 6 months if the equipment is used frequently under heavy load. If the tips of the forks are distorted and the left and right forks are uneven, the equipment should be stopped for check. It is mainly to check if there is any crack at the root of the forks, especially the crack at the welding seams. The forks shall be changed if they are excessively worn out.

Warning:

(1) Fork positioning must be done without load. Load after positioning through operating the control valve lever. Positioning with load is strictly prohibited.

(2) Side shifter facilitates the goods stacking, improving working efficiency. Side shifting can be done both with load and without load. Side shifting can not be done with fork positioning at the same time.

Appendix: Truck electric system and hydraulic system maintenance table

Truck daily maintenance table is based on standard working time(8 hours for one day or one shift one day, 40 hours for one week) and working condition. If truck is applied in high intensity work or under harsh environment, please maintain the truck ahead scheduled time. Please refer to engine maintenance manual for its maintenance. Carry out the maintenance based on the first coming time.

Electric system daily maintenance table

Item	Checks	Daily（every 8 hours or one shift ）	Weekly（every 40hours ）	Quarterly（every 600 hours）	Yearly（every 2400hours ）	Note
Starting motor	Small gears mesh condition			○		Please pay attention to harness and plug condition.
	Check electric circuit condition		○			
Starting switch	Check if switch can return back	○				
Generator	Check engine connection condition		○			
	Check if generator belt is loose or damaged.			○		
	Check generator working condition.				○	
Electric box	Inner and outer cleanness			○		
	Check electric units condition		○			
	Check control box and plug water proof condition.		○			
	Check fuse		○			
Battery	Check battery surface cleanness		○			
	Check if battery cable head is loose		○			
Heater plug	Check electric circuit connection condition		○			
	Check fuse and preheating contactor		○			
Electric circuit	Check if harness is loose or damaged.		○			
	Check electric circuit connection condition		○			
	Harness replace period	● If truck is applied in high intensity work or under harsh environment, change the truck harness every 2 years.				
Meter	Meter working condition	○				Parts are truck safety assisted indicators. Be sure they are well.
Signal and lights	Working and installment condition	○				
Horn and backward buzzer	Working and installment condition	○				

Hydraulic system daily maintenance table

Item	Checks	6 weeks	12 months
		250h	2000h
Cylinder	cylinder loose or damaged condition	T	
	Check cylinder deformation or damage condition	I	
	Cylinder working state	I	
	Glide amount and self tilting amount	M	
	Cylinder leakage and damage condition	I	
	Cylinder supports fatigue or damaged condition	I	
	Lifting speed	M	
	Hydraulic shake	I	
Return oil filter	Block condition	I	
Hydraulic oil tank	Oil level or pollution	I	
	Oil tank and filter		C
	Hydraulic oil leakage	I	
Operating lever	Connection condition	I	
	Working condition	I	
Control valve	Hydraulic oil leakage	I	
	Pressure relief measurement	I	M
	Relief valve and tilting lock valve condition	I	
Hydraulic pipeline	Leakage	I	
	Pipeline deformation and damage	I	
	Connection condition	T	
Fuel pipeline	Leakage	I	
	Pipeline deformation and damage condition	I	
	Connection condition	T	

I: check, change or repair if necessary; M: measure, repair or adjust is necessary;

T: retighten C: clean

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