RUTHZIL TRATOR COMERCIAL DE PEÇAS LTDA 11 97083-6812 ROLANDO CITRANGULO

LiuGong 柳工

201701001

JANEIRO 2017

CLG835H
WHEEL LOADER

SERVICE MANUAL

Applicable type and model: CLG835H PERKINS Engine 1204F-E44AT/ LIUGONG Wet Axle/ ZF 4WG158 Gearbox

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How to Use the Manual

This manual is written for an experienced technician. Essential tools required in performing certain service work are identified in this manual and are recommended for use.

This is the safety-alert symbol. When you see this symbol on the machine or in this manual , be alert to the potential for person injury.

Technical manuals are divided in several parts : repair and test . Repair sections tell how to repair the components. Tests sections help you identify the majority of routine failures quickly.

Information is organized in groups for the various components requiring service instruction. At the beginning of each group are summary listings of all applicable essential tools, service equipment and tools, other materials needed to do the job, service part kit , specifications ,wear tolerances, and torque values.

Technical Manuals are concise guides for specific machines. They are on-the-job containing only the vital information needed for diagnosis, analysis, testing, and repair .

Fundamental service information is available from other sources covering basic theory of operation, fundamentals of troubleshooting, general maintenance, and basic type of failures and their causes.

Other reference manuals

- Parts manual
- Use and maintenance manual
- Cummins engine parts manual
- Cummins engine overhaul manual
- ZF axle case overhaul manual

User's Guidance

- Because the influences to the machine from area or processing are different, it shall confirm which machine is applicable, and what work implements it has.
- Some accessories and optional parts in the Manual may not be transported to relevant areas, and consult your local LiuGong dealer if required.
- The materials and technical specifications in the Manual are changed with variation of products, and all information, diagrams and specifications in the Manual are the latest product information obtained at the time of publication. The company reserves the right to make modification without any notice. If it needs to obtain the latest technical information, please consult the dealer of LiuGong in local area or Service Department of LiuGong Wheel Loader Marketing Co., Ltd.

Important Safety Information

Most accidents involving product operation, maintenance and repair are caused by failure to observe safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

Improper operation, lubrication, maintenance or repair on this product can be dangerous and could result in injury or death.

Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintain and repair information.

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or other persons.

The hazards are identified by the "Safety Alert Symbol" and followed by a "Signal Word" such as "WARNING" as shown following.

⚠WARNING

The meaning of this safety alert symbol is as follows:

Attention. Be alert. Your safety is involved.

The message that appears under the warning, explaining the hazard, can be either written or pictorially presented.

Operations that may cause product damage are identified by NOTICE labels on the product and in this publication.

LiuGong cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are therefore not all inclusive. If a tool, procedure, work method or operating technique not specifically recommended by LiuGong is used, you must satisfy yourself that it is safe for you and others. You should also ensure that the product will not be damaged or made unsafe by the operation, lubrication, maintenance or require procedures you choose.

The information, specification, and illustrations in this publication are on the basis of information available at the time when it was written. The specification, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service given to the product. Obtain the complete and most current information before starting any job. LiuGong has the most current information available.

CALIFORNIA PROPOSITION 65

Diesel engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects and other reproductive harm.

Battery post, terminal and related accessories contain lead and lead compounds, Always wash hands after handling.

Manual Identification

IMPORTANT: Use only supporting manuals designed for your specific machine. If incorrect manual is chosen, improper service may occur. Verify product identification number (PIN) and engine model number when choosing the correct manual.

Choosing the Correct Supporting Manuals

LiuGong wheel loaders are available in different machine configurations based on the various markets into which they are sold. Different supporting manuals exist for different machine configurations.

When necessary, product serial numbers and engine model numbers are listed on the front covers of loader manuals. These numbers are used to identify the correct supporting manual for your machine.

Product Serial Number Identification

The product identification number (PIN) plate is located on left side of machine front frame under the pin of boom . Each machine has a 17- character PIN or shown on this plate and under this plate, The last 6 characters of the PIN represent the machine's product serial number.

Figure 1 PIN Plate Location



Figure 2 Pin Plate (17-character with CE mark)



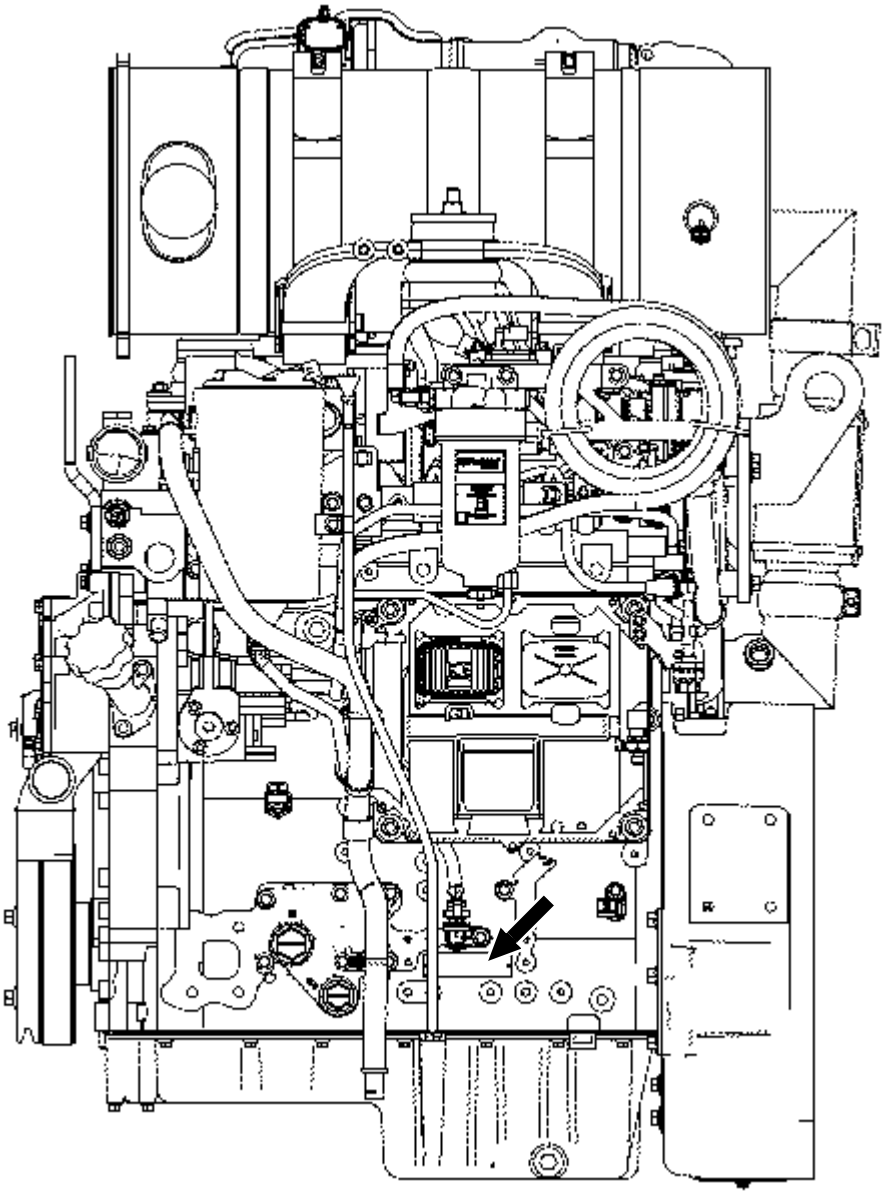
Engine Identification

The engine serial number plate is located on the right side of engine model 1204F. Each engine has two engine numbers (LIST NO. and SERIAL NO.) shown on this plate.

Engine Emission Level Identification

EMISSION CONTROL INFORMATION: In the U.S., this engine is solely for export and is therefore exempt under 40 CFR 1068.230 from emission standards and related requirements. Outside the U.S., the engine may be subject to other emission regulations.

Figure 3 Engine Serial Number Plate Location



P11000003

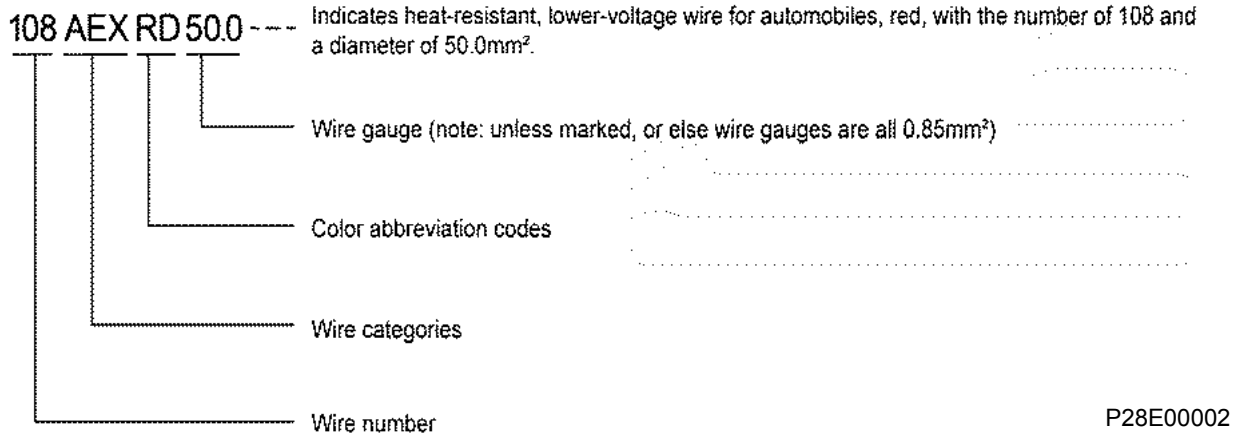
Figure 4 Engine Serial Number Plate



P11000004

Cable Code Identification

The wire in circuit diagram is marked in combination with wire No., wire categories, color abbreviation codes and wire gauge for maintenance. For example:



Wire No.

Wire No. is digital code for marking wire with three Arabic numbers in accordance with certain rules.

Wire categories

The wire categories selected for engineering machinery are AEX, AV, AVS, AVSS, and QVR in general. For applicable range of ambient temperature of various wires, see following table.

S/N	Wire type	Wire name	Description	Heat resistance
1	QVR	Low-voltage wire for road vehicles	70 °C (158°F) heat-resisting, copper core PVC-insulated	≤ 70°C(158°F)
2	AVSS	Thin-wall insulated low-voltage wire for vehicles	The thickness of insulation layer is 0.30~0.40mm	≤ 80°C(176°F)
3	AVS	Thin-wall insulated low-voltage wire for vehicles	The thickness of insulation layer is 0.50~0.70mm	≤ 80°C(176°F)
4	AV	Insulated low voltage wire for vehicles	The thickness of insulation layer is 0.60~2.0mm	≤ 80°C(176°F)
5	AEX	Heat-resisting low voltage wire for vehicles	Heat resistance and cross-linking polyethylene	≤ 110°C(230°F)

Color abbreviation codes

Color	English	Abbreviation	Color	English	Abbreviation
Black	BLACK	BK	Blue	BLUE	BU
Grey	GREY	GY	Green	GREEN	GN
Red	RED	RD	Yellow	YELLOW	YL
Brown	BROWN	BR	Pink	PINK	PK

Color	English	Abbreviation	Color	English	Abbreviation
Violet	VIOLET	VT	Orange	ORANGE	OR
White	WHITE	WH	Light blue	LIGHT BLUE	LTBU
Red/green	RED/GREEN	RD/GN	Yellow/blue	YELLOW/BLUE	YL/BU

Remarks: The code composed of 2 colors indicates double-color wire
For example: "RD/GN" shows red-green wire.

Wire specifications

Allowable current and voltage drop of AV wire, and approximate performances of AVS, AVSS, and QVR shall be executed uniformly according to the following table.

Ambient temperature		30°C(86°F)		40°C(104°F)		50°C(122°F)		60°C(140°F)		70°C(158°F)	
Allowable current/ voltage drop		A	mV/m	A	mV/m	A	mV/m	A	mV/m	A	mV/m
Nominal sectional area(mm^2)	0.85	18	463	16	412	14	360	11	283	8	206
	1.25	23	407	21	372	18	319	14	248	10	177
	2	31	338	28	305	24	262	20	218	14	153
	3	42	291	38	263	33	228	27	187	19	132
	5	57	248	51	222	44	192	36	157	25	109
	8	74	213	66	190	57	164	47	135	33	95
	15	103	176	92	157	30	137	65	111	46	79
	20	135	148	121	133	105	116	85	94	60	66
	30	188	121	168	108	146	94	119	77	84	54
	40	210	112	188	110	163	87	133	71	94	50
	50	246	103	220	92	190	60	155	65	110	46
	60	272	97	243	87	211	75	172	62	121	43
	85	335	90	300	80	260	70	212	57	150	40
	100	399	83	356	74	309	65	252	53	178	37

Circuit type and color abbreviation code

For general corresponding rules between circuit type and wire color, see the following table.

Circuit type	Color abbreviation codes
Power line	OR, RD
Signal line	WH
Earthing	BK, GY
Communication line	RD/GN, YU/BU

Coating Materials

Name	Specification	Main features and purposes
1277 Thread locker sealants	1277	● Features: anaerobic and fast air drying ● Purposes: used for parts not frequently removed
1243 Thread locking sealant	1243	Used for removable parts (speed sensor in general)
Long-term anti-rust agent	LONG#2 light yellow	● Features: rust protection for a long time ● Purposes: used for mounting face of pump, sensor, hydraulic fitting, etc
Efficient cleaning agent 1755	1755	● Features: strong ability of cleaning ● Purposes: used for pump and motor
Anaerobic pipe thread sealant	1567	● Feature: it has features of high-temperature resistance, self-lubrication and medium resistance and is used for medium (sealing oil, air, vapor, water) pipeline cone/taper thread ● Purposes: used for water temperature sensor and oil pressure sensor
Cleaning agent for electro-mechanical equipment	HD-10	Used for cleaning oil pipe connectors, etc.
Diesel engine sealant	1515	Used for mounting face of diesel engine flange
Polyurethane sealant	1924	Used for waterproof of start motor and assembling clearance
Mobilux EP	None	Used for rust protection of rear cover hinge

Paint standard:

There are two main kinds of colors that applied to 835H:

Yellow: matte (50%) RAL1006 yellow

Grey: matte (40%) RAL7021 grey

The standard of paint quality is as follows (for more information, see QJ/LG 08.44-2013):

S/N	Items	Indicator	Testing method	Remarks
1	Paint film appearance	Paint film shall be uniform color, and no blistering, crack, wrinkle, under screen, rust, damage, dirt and so on	Visual check	Refer to the requirements at all levels of surface for details of allowable defects
2	Paint film gloss	Meet the minimum requirements of paint film gloss at all levels of surface	Visual/gloss meter	For details, see the requirements at all levels of surface. For matte paint, refer to the special requirements
3	Paint film thickness	Meet the minimum requirements of paint film thickness at all levels of surface	Thickness gauge of paint film	For details, please see the requirements at all levels of surface

S/N	Items	Indicator	Testing method	Remarks
4	Adhesion of paint film	Good adhesion and no peeling in detection of paint film	Use single cutting edge or scriber to perform the cross cut on the paint film with five horizontal and vertical lines. The distance between the scribing lines is 1 mm~1.5 mm and the depth can reach the steel plate substrate. Then stick the transparent adhesive tape and compact, then tear off the tape	Approval standard: No the whole piece of grid film drops. (Little film drop around the scribing lines can be allowable.)
5	Color difference	Meet color difference requirements at all levels of surface	Visual check/Color difference meter	For details, please see the requirements at all levels of surface
6	Shield	There is no paint contamination, mechanical impurity, rust and dirts	Visual check	
7	Decal	The decal should be correct, complete, decorous, firm, smooth and no popping	Visual check	

Weight Table

The following table indicates the reference value of the weight of each component. When using the lifting equipment , please refer to the following table to select the sling.

Component	Weight (kg)
Engine	571kg\ 1259 lb
Radiator	285 kg \ 628 lb
Fuel tank	122 kg\ 269 lb
Front axle assembly	788 kg\ 1738 lb
Rear axle assembly	779 kg\ 1718 lb
Tire rim	295 kg\ 650 lb
Drive shaft	83 kg\ 183 lb
Gearbox & torque converter assembly (oil bearing)	510 kg\ 1125 lb
Cab	685 kg\ 1510 lb
Seats	29 kg\ 64 lb
Engine hood as	210 kg\ 463 lb
Left rear fender	27 kg\ 60 lb
Right rear fender	30 kg\ 66 lb
Air conditioner	100 kg\ 221 lb
Steering pump	34 kg\ 75 lb
Control valve	45 kg\ 99 lb
Fan drive motor	12 kg\ 26 lb
Hydraulic oil tank	130 kg\ 287 lb
Boom cylinder assembly (single)	122 kg\ 269 lb
Bucket tilting cylinder assembly	124 kg\ 283 lb
Secondary steering pump	20 kg \ 44 lb
Ride control accumulator	41 kg\ 90 lb
Rocker arm	138 kg\ 304 lb
Boom	662 kg\ 1460 lb
Front frame	942 kg\ 2077 lb
Rear frame	882 kg\ 1945 lb
Battery box-lh	71 kg\ 157 lb
Battery box-rh	71 kg\ 157 lb
Counterweight	152 kg\ 335 lb
Work implement	880 kg\ 1940 lb
Linkage	34 kg\ 75 lb
Quick coupler frame	267 kg\ 589 lb
Quick Coupler Bucket	734 kg\ 1618 lb
Tooth	190 kg\ 419 lb
Movable blade(*6)	15 kg\ 33 lb
Battery(*2)	18 kg\ 40 lb

Unit Conversion Table

The Manual uses ISO International System of Units, and ISO international units are converted into British units as shown in following figure:

Parameters	Metric unit	British unit	Multiple
Length	mm	In	0.03937
	mm	ft	0.003281
Capacity	L	US gal	0.2642
	L	US qt	1.057
	m^3	Yd3	1.308
Weight	kg	lb	2.205
Intensity	N	kgf	0.10197
	N	lbf	0.2248
Torque	Nm	kgf·m	0.10197
	Nm	lbf·ft	0.7375
Pressure	MPa	kgf/cm^3	10.197
	MPa	psi	145.0
Power	kW	PS	1.360
	kW	HP	1.341
Temperature	°C	°F	°C ×1.8+32
Speed	km/h	mph	0.6214
	min^{-1}	rpm	1.0
Flow	L/min	US gpm	0.2642
	mL/rev	cc/rev	1.0

Standard Torque Table

TORQUE SPECIFICATIONS – METRIC HARDWARE

Use the following torques when specifications are not given.

These values apply to fasteners with coarse threads as received from supplier, plated or unplated, or when lubricated with engine oil, These values do not apply if graphite or Moly disulfide grease or oil is used.

Grade 8.8 Bolts , Nuts , and Studs	
Size	**N.m \ lbf·ft**
M6	7.7±1.1 N.m \ 5.67±0.81 lbf·ft
M8	19±2.9 N.m \ 14.01±2.13 lbf·ft
M10	72±6 N.m \ 53±4 lbf·ft
M12	120±10 N.m \ 89±7 lbf·ft
M14	195±15 N.m \ 144±11 lbf·ft
M16	305±25 N.m \ 225±18 lbf·ft
M18	415±35 N.m \ 306±26 lbf·ft
M20	600±50 N.m \ 443±37 lbf·ft
M22	800±70 N.m \ 590±52 lbf·ft
M24	1020±100 N.m \ 752±74 lbf·ft
M27	1500±100 N.m \ 1106±77 lbf·ft
M30	1850±150 N.m \ 1364±111 lbf·ft
M33	2900±400 N.m \ 2139±295 lbf·ft
M36	3100±250 N.m \ 2286±184 lbf·ft

Grade 10.9 /12.9 Bolts , Nuts , and Studs	
Size	**N.m**
M10	72±6 N.m\ 53±4 lbf·ft
M12	120±10 N.m\ 89±7 lbf·ft
M14	195±15 N.m\ 144±11 lbf·ft
M16	305±25 N.m\ 225±18 lbf·ft
M18	415±35 N.m\ 306±26 lbf·ft
M20	600±50 N.m\ 443±37 lbf·ft
M22	800±70 N.m\ 590±52 lbf·ft
M24	1020±100 N.m\ 752±74 lbf·ft
M27	1500±100 N.m\ 1106±77 lbf·ft
M30	1850±150 N.m\ 1364±111 lbf·ft
M33	2900±400 N.m\ 2139±295 lbf·ft
M36	3100±250 N.m\ 2286±184 lbf·ft

Tightening torque of 24° cone O-ring sealed hose connector

Series	Thread size	Hose inner diameter mm	Tightening torque	
			N.m	kgf.m
Light-type	M12×1.5	5	16±1	1.6±0.1
	M14×1.5	6.3	16±1	1.6±0.1
	M16×1.5	8	26±2	2.7±0.2
	M18×1.5	10	37±2	3.8±0.2
	M22×1.5	12.5	47±2	4.8±0.2
	M26×1.5	16	89±4	9.1 ±0.4
	M30×2	19	116±5	11.8±0.5
	M36×2	25	137±6	14.0±0.6
	M45×2	31.5	226±11	23.1±1.1
	M52×2	38	347±16	35.4±1.6
Heavy type	M14×1.5	5	26±2	2.7±0.2
	M16×1.5	6.3	42±2	4.3±0.2
	M18×1.5	6.3	53±2	5.4±0.2
	M20×1.5	8	63±3	6.4±0.3
	M22×1.5	10	79±4	8.1 ±0.4
	M24×1.5	12.5	84±4	8.6±0.4
	M30×2	16	126±6	12.9±0.6
	M36×2	19	179±8	18.3±0.8
	M42×2	25	263±12	26.8±1.2
	M52×2	31.5	368±17	37.6±1.7

Tightening torque of flange-type sealed hose connector bolt

Series	Bolt	Bolt performance level	Tightening torque	
			N.m	kgf.m
Light-type	M8	8.8	25.2±1.2	2.57±0.12
	M10		52.5±2.5	5.35±0.25
	M12		96.6±4.6	9.85±0.47
	M16		220±10	22.5±1.07
	M8	10.9	33.6±1.6	3.42±0.16
	M10		73.5±3.5	7.5±0.35
	M12		136±6	12.8±0.6
	M16		310±15	31.6±1.5

Series	Bolt	Bolt performance level	Tightening torque	
			N.m	kgf.m
Heavy type	M8	8.8	25.2±1.2	2.57±0.12
	M10		52.5±2.5	5.35±0.25
	M12		96.6±4.6	9.85±0.47
	M16		220±10	22.5±1.07
	M20		420±20	42.8±2.0
	M8	10.9	33.6±1.6	3.42±0.16
	M10		73.5±3.5	7.5±0.35
	M12		136±6	12.8±0.6
	M16		310±15	31.6±1.5
	M20		577±27	58.9±2.8

Tightening torque of thread angle type sealed hose connector

Material of fastenings	Carbon steel, alloy steel		Aluminum product	
Thread size	Tightening torque		Tightening torque	
	N.m	kgf.m	N.m	kgf.m
G1/8	8.75±1.25	0.90±0.12	/	/
G1/4	36±2	3.67±0.2	29.3±2.2	3.0±0.2
G3/8	73.5±4.5	7.5±0,46	49±3	5.0±0.3
G1/2	110±10	11.2±1.0	55±5	5.6±0.5
G3/4	165±15	16.8±1.5	74±4	7.5±0.4
G1	225±25	23.0±2.55	/	/
G1-1/4	275±25	28.0±2.55	/	/
G1-1/2	285±15	29.1±1.5	/	/

Connector tightening torque

Thread size	Tightening torque	
	N.m	kgf.m
M12	24±2	2.4±0.2
M14	30±2	3.1±0.2
M16	30±2	3.1±0.2
M18	30±2	3.1±0.2

Oils use specifications

Fluids and lubricants for CLG835H-T4F

Category		Name	Capacity	Application parts	Remarks
Engine oil	≥-10°C(14°F)	★ SAE 15W/40 CJ-4	12L\ 3 US gal	Diesel engine	
	≤-10°C(14°F)	SAE 5W/40 CJ-4			
Engine fuel	≥-10°C(14°F)	★ 10# Ultra low sulfur diesel	190L\ 50 US gal	Diesel engine	
	≤-10°C(14°F)	35# Ultra low sulfur diesel			
Adblue		★ RD-11	19L\ 5 US gal	Diesel engine def tank	
Hydraulic oil	-15~40°C(5~104°F)	★ HM-46 Anti-wear hydraulic oil	120L\ 32 US gal	Work hydraulic system, steering hydraulic system	
	-25~40°C(-13~104°F)	HV-46 low-temperature anti-wear hydraulic oil			
Torque converter oil	≥-10°C(14°F)	★ SAE 15W-40 Mobil Delvac 1300	40L\ 11 US gal	Torque converter and power shift gearbox	
	≤-10°C(14°F)	S4 TXM 10W-30			
Gear oil	≥-10°C(14°F)	★ SAE 80W-90/LS Heavy-load wheel gear oil	34L\ 9 US gal	Front and rear axle bevel gear and wheel reducer	LiuGong bridge
	≤-10°C(14°F)	75W-90/LS Heavy-load wheel gear oil			
Refrigerant		★ R134a	2.5Kg\ 5.5 lb	Air conditioner	
Grease	Manual lubrication	★ 2# Molybdenum disulfide lithium grease	2L\ 1 US gal	Roller bearing, slide bearing, pin shaft of work implement, pin shaft of steering cylinder, pin shaft of vehicle frame, swing frame of rear axle, spline of drive shaft, cardan joint, and water pump shaft	
	≤-10°C(14°F)	0# Composite lithium base grease			
	Central lubrication	2# Composite lithium base grease			
Coolant		★ Shell anti-freezing solution	22L\ 6 US gal		

★ refers to the standard configuration

NOTE 1 : DO NOT use an alternate oil in the axle , the transmission box ,the engine . the parts could be damaged as a result of using an alternate oil.

NOTE 2: SEE your dealer for winter fuel requirements in your area , if the temperature of fuel below the cloud point , will cause the engine lose power or not start.

NOTE 3: Low sulfur fuel should be used. the wrong fuel used will cause the engine damaged as a result.

Specifications for acceptable Diesel Fuel

Perkins Specification for Distillate Diesel Fuler			
Property	**Units**	**Requirements**	
Aromatics	%Volume	35% maximum	“ISO”3837
Ash	%Weight	0.01% maximum	“ISO”6245
Carbon Residue on 10% Bottoms	%Weight	0.35% maximum	“ISO”4262
Cetane Number	_	40 minimum	“ISO”5165
Cloud Point	°C	The cloud point must not exceed the lowest expected ambient temperature.	“ISO”3015
Copper Strip Corrosion	–	No. 3 maximum	“ISO”2160
Density at 15°C (59°F)	Kg/m^3	801 minimum and 876 maximum	“ISO”3675 “ISO”12185
Distillation	°C	10% at 282°C (539.6°F) maximum 90% at 360°C (680°F) maximum	“ISO”3405
Flash point	°C	Legal limit	“ISO”2719
Thermal Stability		Minimum of 80% reflectance after aging for 180 minutes at 150°C (302°F)	No equivalent test
Pour Point	°C	6°C (42.8°F)minimum below ambient temperature	“ISO”3016
Sulfur	% mass	0.0015	“ISO”20846 “ISO”20884
Kinematic Viscosity	mm2/s(cSt)	The viscosity of the fuel that is delivered to the fuel injection pump.”1.4 minimum/4.5 maximum”	“ISO”3405
Water and sediment	%weight	0.1% maximum	“ISO”
Water	%weight	0.1% maximum	No equivalent test
Sediment	%weight	0.05% maximum	“ISO”3735
Gums and Resins	mg/100ml	10 mg per 100 ml maximum	“ISO”6246
Lubricity corrected wear scar diameter at 60°C (140°F)	mm	0.52 maximum	“ISO”12156-1

MAINTENANCE SCHEDULE

SERVICE INTERVAL	SERVICE POINTS	INITIAL SERVICE	FREQUENCY IN HOURS						
			CHECK	CLEAN	CHANGE	DRAIN	LUBRICATE	REPLACE	ADJUST
As Required	Radiator Coolant Level		★						
	Tires		★						
	Hydraulic Filter		★						
	Air Cleaner		★	★					
	Alternator , AC ,Drive Belt		★						
	Fire Extinguisher		★						
Every 10 Hours	Check Engine Oil Level		10						
Every 50 Hours	Check Engine Coolant Level		50						
	Check Transmission Oil Level		50						
	Check Hydraulic Oil Level		50						
	Grease Bucket Mounting Fittings						50		
	Bleed Fuel Filter of Condensation					50			
First 100 Hours	Change Engine Oil and Filters	100							
	Replace Fuel Filters	100							
	Change Hydraulic Filter	100							
	Change Transmission Oil and Filter	100							
	Change Oil in Axles	100							
Every 100 Hours	Grease Front Drive Shaft Support Bearing						100		
	Grease Steering Cylinder Pivots (4 Fittings)						100		
	Grease Lift & Tilt Cylinder Pivots (6 Fittings)						100		
	Grease Articulation Fittings						100		
Every 250 Hours	Check Cab Fresh Air Filter		250	★					
	Check AC Return Air Filter		250	★					
	Check Radiator Coolant Level		250						
	Check Tire Pressure & Wheel Torque		250						
	Check Drive Belts		250						
	Check Air Filter		250						
Every 500 Hours	Check Axle Oil Level		500						
	Check Battery Volt and Nuts Torque		500						
	Change Engine Oil and Filter				500				
	Replace Fuel Water Separator							500	
	Replace Fuel Filter							500	

SERVICE INTERVAL	SERVICE POINTS	INITIAL SERVICE	FREQUENCY IN HOURS						
			CHECK	CLEAN	CHANGE	DRAIN	LUBRICATE	REPLACE	ADJUST
Every 1000 Hours	Replace Hydraulic Oil Filter	500						1000	
	Replace Pilot Hydraulic Oil Filter	500						1000	
	Change Front & Rear Axle Oil				1000				
	Replace Cab Fresh Air Filter							1000	
	Replace AC Return Air Filter							1000	
	Change Transmission Oil and Filter	100			1000				
	Check Accumulator Nitrogen Press	500	1000						
	Clean Fuel Tank	100		1000					
Every 2000 Hours	Change Hydraulic Oil & Filter				2000				
	Change Coolant				2000				

Note: ★ means service as required.

Technical Specification of the Machine



P11000006

Application

This loader is a kind of engineering machinery mainly used for loading & unloading loose materials. It is mainly used for loading, unloading, bulldozing and traction operation etc. at mine areas, ports and docks, capital construction, road repair and steel & iron enterprises etc. It is a kind of multi-purpose and high efficiency engineering machinery.

This loader is a kind of general-purpose engineering machinery and is not suitable for the flammable, explosive, dusty and air poisonous environments.

Requirements of Work Environments

1. Altitude: ≤ 3000 m
2. Environmental temperature: -15°C~40°C (The cold starting Aid device is not available)
3. Water Depth: ≤ 630 mm

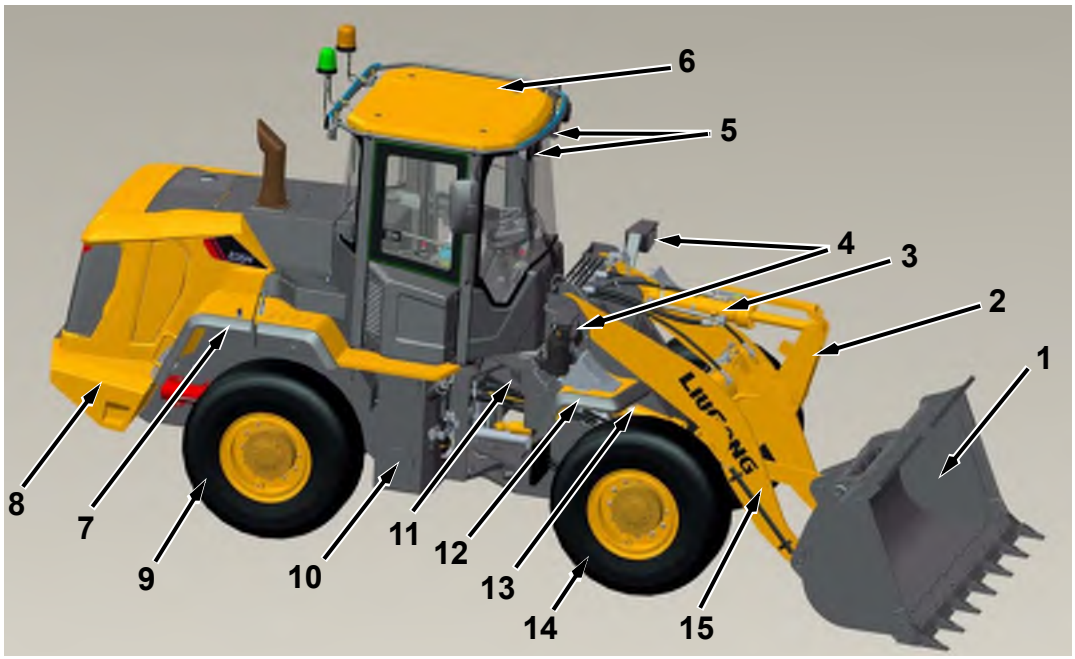
⚠WARNING

Do not operate machine in conditions with rollover or falling object risk.

⚠CAUTION

Preventive measures for operation, maintenance and safety rules outlined on this manual are only suitable for the stipulated applications of the machine. Do not use the machine beyond the stipulated application scope, Guangxi LiuGong Machinery Co., Ltd will not bear any safety liability, and these safety liabilities will be born by users. Under any cases, do not use the forbidden operation outlined in this manual.

Main Components





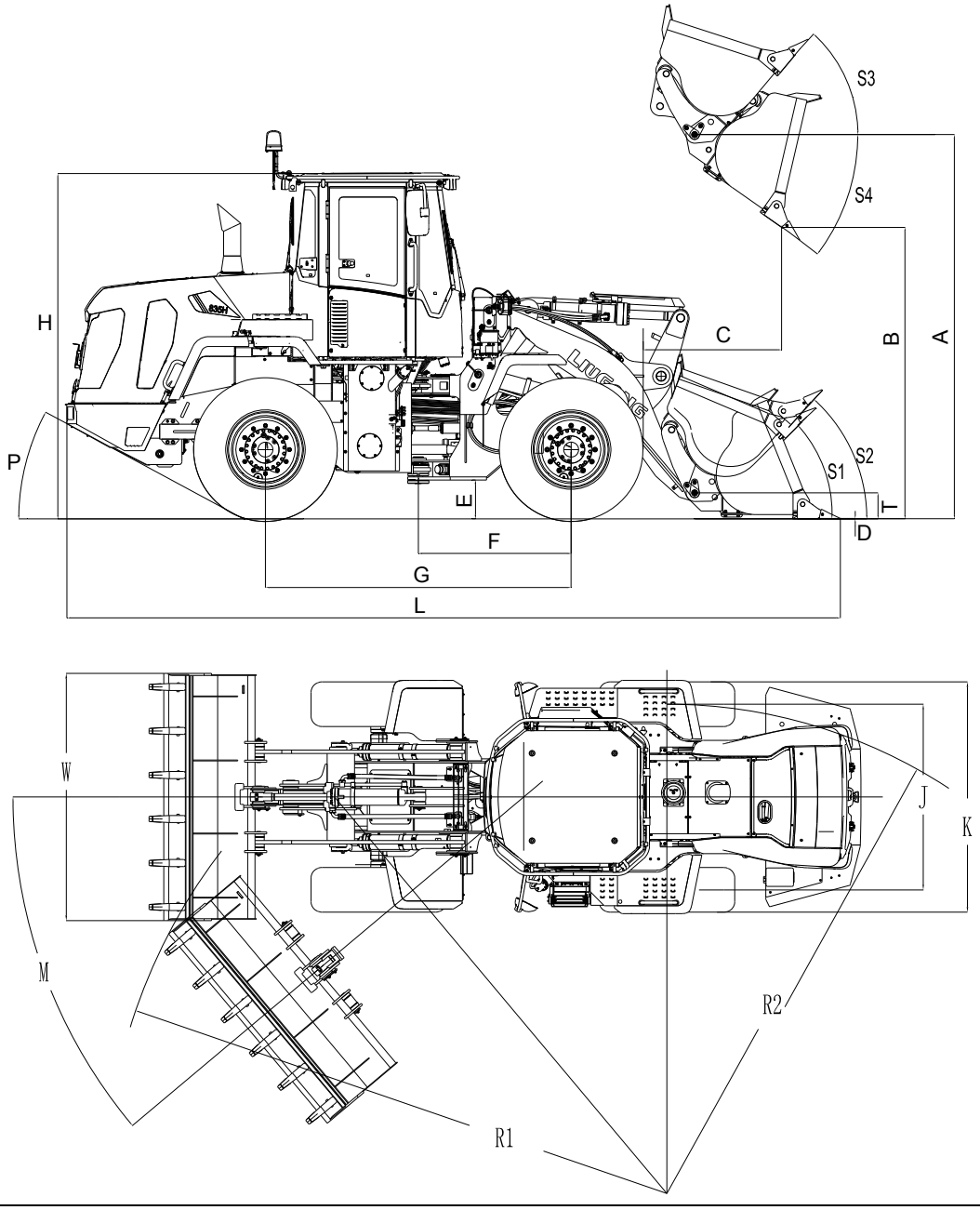
1. Bucket
2. Rocker arm
3. Bucket cylinder
4. Front combination lights
5. Front work lights
6. Cab
7. Rear fender
8. Counterweight
9. Rear wheel
10. Hydraulic oil tank
11. Front frame
12. Front fender
13. Boom cylinder
14. Front wheel
15. Boom
16. Engine hood
17. Rear combination lights
18. Ladder
19. Rear work lights

Performance Parameters

All rated lift capacities are based on the criteria of the machine being leveled on a hard and flat ground. When the machine is operated in conditions that deviate from these criteria (e. g. on soft or uneven ground, on a slope or when subject to slide loads), these conditions shall be taken into account by the operator.

The following table lists the specifications in standard collocation, please refer to the appendix of this section for the specification change parts of the other special collocations (such as larger bucket, longer boom, and side dump bucket).

Exterior Drawing



Machine Specifications

NO.	Item	Unit	CLG835H T4f	
			Quick coupler	Pin On
1	Rated load weight	kg (lb)	3000 (6615)	3000 (6615)
2	Rated power	kW	97.9	97.9
3	Operating mass	kg (lb)	11200 (24696)	10800 (23814)
4	Rated bucket capacity	m^3	1.9	1.9
5	Dumping height	mm (In)	2700 (106)	2800 (110)
6	Max. breakout force (bucket tilting)	kN (lbf)	85 (19108)	90.1 (20254)
7	Tipping load (aligning)	kg (lb)	7700 (16979)	9452 (20842)
8	Tipping load (full steering)	kg (lb)	6600 (14553)	7369 (16249)
9	Boom lifting time (full load)	s	5.5	5.5
10	Total time	s	9.7	9.7
11	Max. traveling speed	km/h(mph)	38.6 (23.9)	38.6 (23.9)
12	Max. gradeability	°	28	28
13	Min. turning radius (outside of front wheel)	mm (In)	4920 (194)	4920 (194)
Overall Dimensions				
Parameters below are for Z-bar or 8-bar machine			Z-bar	Z-bar
1	A: Height to hinge pin, fully raised	mm (In)	3720 (146)	3720 (146)
2	B: Dumping height, fully raised	mm (In)	2700 (106)	2800 (110)
3	C: Dumping reach, fully raised	mm (In)	1150 (45)	1076 (42)
4	D: Max. digging depth	mm (In)	100 (4)	80(3)
5	E: Min. ground clearance (at articulation joint)	mm (In)	325 (13)	325 (13)
6	F: Distance from centre of rotation to the centre of the front wheels	mm (In)	1435 (56)	1435 (56)
7	G: Wheel base	mm (In)	2870 (113)	2870 (113)
8	H: Overall height (top of cab)	mm (In)	3200 (126)	3200 (126)
9	J: Tread width	mm (In)	1855 (73)	1855 (73)
10	K: Overall width (outside of wheel)	mm (In)	2450 (96)	2450 (96)
11	L: Over length (bucket on ground)	mm (In)	7265 (286)	7115 (280)
12	M: Max. steering angle	°	38	38
13	W: Overall width (outside of bucket)	mm (In)	2530 (100)	2530 (100)
14	R1: Turning radius (outside of bucket)	mm (In)	5650 (222)	5050 (199)
15	R2: Turning radius (center of rear wheel)	mm (In)	4622.5 (182)	4622.5 (182)
16	P: Departure angle	°	28	28
17	S1: Bucket tilt back angle (on ground)	°	45	45
18	S2: Bucket tilt back angle (in transport position)	°	48	48
19	S3: Bucket tilt back angle (in highest position)	°	60	60
20	S4: Dumping angle (in highest position)	°	45	45
21	T: Bucket articulation height (in transport position)	mm (In)	450 (18)	450 (18)

Main Components Specifications

Engine			
1	Manufacturer	/	Perkins
2	Model	/	1204F-E44TA
3	Type	/	Electronic fuel injection
4	Displacement	L (US gal)	4.4 (1.16)
5	Rated power	KW (hp)	97.9 (131.3)
6	Emission level	/	Tier 4f
7	Number of cylinders and arrangement	/	Straight-four cylinders
8	Intake type	/	Turbocharged & inter-cooling
9	Rated speed	r/min	2200
10	Max. rotating speed (no-load)	r/min	2376
11	Min. rotating speed (no-load)	r/min	800
12	Rotating speed at max. torque	r/min	1400
13	Max. torque	N.m (lbf·ft)	530 (391)
14	Start motor	V-Kw	24V-5.5 KW
15	Alternator	V-A	24V- 70A
Power train system			
1	Torque converter	Type	Single turbine, three members
2	Transmission	Manufacturer	ZF
3		Model	4WG158A
4		Type	Fixed shaft type, power shift
5		Number of gears	Four forward gears and three reverse gears
6		Operating pressure of shift oil pump (gear pump)	1.6~1.8MPa (232~261psi)
7	Drive axle	Manufacturer	LiuGong
8		Model	LiuGong 3T wet-type axle
9		Type	Wet-type alxe
10		Max. traction force	100kN (22480lbf)
11		Front & rear axle reduction ratio	20.2656
12		Rear axle swing angle	12°
13	Wheels	Tire model	17.5-25 PR16/TL L-3
14	Traveling speed	F1/ R1	7.1/ 7.1km/h (4.4/ 4.4mph)
15		F2/ R2	12.3/ 12.3km/h (7.6/ 7.6mph)
16		F3/ R3	25.1/ 25.1km/h (15.6/ 15.6mph)
17		F4	38.6km/h (23.9/ 23.9mph)
Work hydraulic system			
1	Work pump	Type	Piston pump
2	Work pump displacement	ml/r (cc/rev)	100 (100)

Main Components Specifications

3	System pressure	Mpa (psi)	19 (2755)
4	Control valve	/	Three spools
5	System flow	L/min (US gpm)	210 (55.48)
6	Lifting time (full load)	s	5.5
7	Dumping time	s	1.5
8	Float lowering time	s	3.5
9	Total time	s	9.7
Steering hydraulic system			
1	Steering angle	°	38
2	Steering pump	Type	Piston pump
3	Steering pump displacement	ml/r (cc/rev)	Share with work pump
4	Steering system pressure	Mpa (psi)	19 (2755)
5	Steering system flow	L/min (US gpm)	210 (55.48)
6	Secondary steering pump	Type	Gear pump
7	Secondary steering pump displacement	ml/r (cc/rev)	10 (10)
8	Secondary steering system pressure	Mpa (psi)	16 (2320)
9	Secondary steering system flow	L/min (US gpm)	22-25l/min (5.8-6.6gpm) @52bar
Brake hydraulic system			
1	Service brake	Type	Full hydraulic wet type brake
2	Brake pump	Type	Gear pump
3	Brake pressure	Mpa (psi)	6 (870)
4	Nitrogen pre-charge pressure of service brake accumulator	Mpa (psi)	5.5 (797.5)
5	Parking brake	Type	Drum type parking brake
6	Parking brake control mode	/	Hydraulic control
7	Nitrogen pre-charge pressure of parking brake accumulator	Mpa (psi)	9.2 (1334)
Air conditioner system			
1	Type	/	Cooling & heating A/C
2	Heating capacity	W	5800
3	Cooling capacity	W	5000
4	Refrigerant	Model	R134a
Electrical system			
1	System voltage	/	DC 24V
Refill capacities			
1	Fuel tank	L (US gal)	190 (50.2)
2	Engine oil	L (US gal)	12 (3.17)
3	Cooling system	L (US gal)	22 (5.8)

Main Components Specifications

4	Transmission oil	L (US gal)	40 (10.57)
5	Drive axle oil	L (US gal)	34 (8.98)
6	Hydraulic oil	L (US gal)	120 (31.7)
7	AdBlue	L (US gal)	19 (5.02)
Other specifications			
1	Cooling pump type	/	Gear pump
2	Cooling pump displacement	ml/r (cc/rev)	27 (27)
3	Cooling pump flow	L/min (US gpm)	59.4 (15.7)
4	Cooling motor displacement	ml/r (cc/rev)	35 (35)
5	Cooling motor flow	L/min (US gpm)	77 (20)
6	Nitrogen pre-charge pressure of pilot oil supply valve accumulator	Mpa (psi)	0.6 (87)
7	Nitrogen pre-charge pressure of ride control accumulator	Mpa (psi)	2.5 (362.5)

Note:

1. Continuing improvement and advancement are made to LiuGong products. All the specifications are the latest product information obtainable at the time of publication. LiuGong will reserve the right to make change without notice.
2. The above parameters are the theoretical values, the tolerance ranges during testing are provided by LiuGong standard.

Machine Inspection Table

Inspection item	S/N	Inspection method and acceptance criteria
Inspection before test run	1	Complete machine information: visual check the complete machine number for compliance with description of model
	2	Fastening bolt: visual check whether the left and right mounting bolts of front axle are tightened firmly in place; visually check whether the left and right front rim bolts are firmly tightened
	3	Fastening bolt: visual check the mounting bolts between front drive shaft and front axle, output flange of transmission and middle bearing fastened;
	4	Fastening bolt: visual check whether the emergency braking flexible shaft is connected reliably; brake cylinder for oil leakage and connected reliably;
	5	Fastening bolt: visual check whether mounting bolts of upper and lower hinge are tightened
	6	Fastening bolt: visual check the left and right mounting bolts of rear axle are tightened; visually check the left and right rear rim bolts are firmly tightened
	7	Water level: anti-freeze level shall be over the middle line in the level window of expansion tank
	8	Oil: pull out the oil dipstick and the engine oil level shall be between the MIN and MAX marks of the dipstick, and the oil is not in white
	9	Hydraulic oil: lay flat the bucket, lower the boom to the minimum at idling, and visual check the oil level of the hydraulic oil tank is within the green scale and the oil is not in white 5 min after the engine stalls
	10	Transmission fluid: when the engine is idling and the transmission fluid temperature is not more than 40 ℃ (104 ℉), check that the level shall be between cold fluid MAX and MIN marks. Then, place the shift lever at four gear and depress the brake, then the accelerator to run the transmission for 5~8min resulting in the transmission fluid temperature reaching 100~110℃(212~230℉). Release the accelerator and place the shift lever at neutral gear, then check that the level is between hot oil MAX and MIN marks when the transmission fluid reaches a temperature more than 80 ℃ (176 ℉).
	11	Air-tightness: visual check each hydraulic line, cylinder, transmission, axle, oil tank, radiator, diesel engine for no leakage during inspection
Climbing up the cab	1	Open and close the left and right doors of cab, and no seizing or abnormal sound should occur.
	2	Shake the interior of the cab by hand and no looseness should occur
	3	Turn on/off the dome light, radio, front and rear sunshade, cigarette lighter, and they should function normally
	4	Inflatable seat (option): the height and front & rear adjustment distance of the seat is obvious; adjustment angle of left and right backrest armrest is obvious; move upward the handle at the front of suspension, the suspension rises, otherwise goes down. There is no abnormal sound and parts interference during air-filled detection.
	5	Turning on the electric lock: turn on the front floodlight, work light, alarm light, parking light by order and get off the vehicle to check if they function normally
	6	Starting the complete machine: operate the engine speed adjustment switch and visual check the corresponding change to the speed of the tachometer on the instrument panel.
	7	Starting the complete machine: operate the switch of LCD to switch the voltage and timing display
	8	Visual check: timer displays and record the time
	9	Steering wheel: it can be adjusted front and rear, upper and down normally; no looseness after locking. Lift the steering wheel upwards by hand and no axial runout occurs (≤3mm);

Inspection item	S/N	Inspection method and acceptance criteria
Climbing up the cab	10	Horn: press the horn button on the lever of the horn button/control lever on the combination lever horn button/steering wheel and listen, no abnormal sound and failure to the horn should occur
Air conditioning system	1	The air volume switch, temperature setting switch, defrost setting switch, air mode switch, auto mode switch on the A/C panel functions normally and is indicated correspondingly on the LCD; the temperature, air volume, direction at the air outlet is the same with setting value on the panel.
	2	Self-diagnosis of A/C: press the "OFF" switch on the LCD panel, and the temperature setting and air volume icon on the display disappears; press the up/down regulation button " " and " " on the temperature setting switch "TEMP" simultaneously for more than 3 seconds. If "E-" appears on the LCD, it indicates no failure, while "E1" appears, it indicates failures
Driving test	1	Starting the complete machine: it starts normally, and listen to the engine and air filter, no abnormal sound is heard, and it turns off normally without delay; observe the engine under the diesel engine idling and top speed, and it shall not stall
	2	Starting the complete machine: adjust the complete machine operating idle speed to a level more than 950rpm and the engine does not stall with the bucket lifted
	3	Starting the complete machine: visual check that no trouble code appears on the LCD of instrument panel, and no indicating identification, alarm and flashing appears on the instrument panel or normally on.
	4	Rearview instrument system (option): when placing the shift lever at reverse, the rearview instrument activates automatically and the image shall be clear
	5	Control lever: there is no seizing and interference with other parts when operating the FNR handle boom to rise, drop, take back and dump the bucket
	6	Pilot shutoff function: the pilot shutoff lever is at OFF position, operate the pilot lever and the work implement shall not act; the pilot shutoff lever is not installed reversely and has no interference with housing;
	7	Detection of bucket automatic reset: the bucket is unloaded, lift the boom to the highest position to make the bucket under discharging state and then take back the bucket and it should stop moving automatically and then control lever returns back to neutral position when the bucket comes near to the switch and bucket limitation magnet. Then lower the boom to place the bucket on the ground, at this time, check the bucket and it should be horizontal to the ground; and the engine is at full throttle during this process
	8	Detection of boom automatic reset: boom limitation: lift the boom and it should stop rising when it reaches the setting highest position; the control lever returns back to neutral position automatically. The engine is at full throttle during this process
	9	Work implement limitation: visual check that the bucket limit block contacts with boom and rocker arm limit block when the boom is lifted to the highest position for discharging; take back the bucket when the boom descends to a position that its front pin is about 500mm(19.7In) away from ground, visual check that boom limit block contacts after taking back the bucket and the clearance between boom and bucket is more than 5mm(0.197In)
	10	Inspection of work implement running: lift the boom during which no abnormal sound shall occur; no twisting to the bucket during taking and holding back the bucket when the boom is lifted to the highest position and lowest position;
	11	Floating function and inner leakage detection: when jacking up the bucket backward, visual check that the boom does not drop quickly; when the bucket is jacked up, push the control lever to the boom lowering, floating position, and the control lever shall close, visually check that the boom shall be floating and lowering

Inspection item	S/N	Inspection method and acceptance criteria
Driving test	12	Ride control (option): park the machine on the level ground, disconnect the ride control system button, jack up the shovel head; after 5 seconds, connect the ride control system button, and the boom shall perform automatic lowering operation.
	13	Visual check and listening: when turning to the maximum left and right steering angle, the limit block contacts and no abnormal sound shall occur; visually check that there is no interference between the armrest of cab and front frame, front and rear frame when turning to the maximum left and right steering angle; there is no interference and pulling between hydraulic line&electrical circuit and other sharp edges
	14	W/steering cushion: turn the complete machine to the limit position, and the steering cushion is compressed (8-12) mm
	15	Secondary steering (option): turn on the electric lock without starting, the secondary steering indicator on the instrument panel comes on when the secondary steering switch is pressed, and the steering can be normally performed
	16	Gear inspection: Manual 1) Place the manual/auto shift rocker switch to "Manual" 2) Start the complete machine and idle; 3) Release the parking brake; 4) Operate the shift lever and all the gears shall be available freely;
	17	Gear inspection: Semi-automatic shift 1) Place the manual/auto shift rocker switch at neutral position; 2) Start the complete machine and idle; 3) Release the parking brake; 4) Operate the shift lever, and place it at F1 position, and the gear to complete machine transmission shall be F1 5) Operate the shift lever, and place it at F2 position, and the gear to complete machine transmission shall be F2; 6) Operate the shift lever, and place it at F3 position, and the gear to complete machine transmission shall still be F2, depress the accelerator gradually to the maximum and hold it, increase the speed of complete machine, and when it reaches a certain value, the gear shall automatically shift up to F3; 7) Keep the opening of throttle, and continuously increase the vehicle speed and operate the shift lever and place it at F4, and when the speed reaches a certain value, the gear shall automatically shift up to F4 from F3; (the corresponding gear is displayed on the gear display during the above operation; and the corresponding speed is displayed on the LCD of instrument panel)
	18	Gear inspection: Full-automatic shift 1) Place the manual/auto shift rocker switch at "Auto" position; 2) Start the complete machine; 3) Release the parking brake; 4) Operate the shift lever, and place it at F3 position, depress the accelerator gradually to the maximum and hold it, when speed reaches a certain value, the gear shall automatically shift up to F3 from F2; 5) Keep the opening of throttle, and continuously increase the vehicle speed and operate the shift lever and place it at F4, and when the speed reaches a certain value, the gear shall automatically shift up to F4 from F3; (the corresponding gear is displayed on the gear display during the above operation; and the corresponding speed is displayed on the LCD of instrument panel)
	19	KD function test: Place the shift lever at 2 with low speed, test the key KD on the control lever and FNR respectively, press the key KD and the gear is switched to I
	20	FNR lever test: place the control lever at N2 firstly. And then push the key of FNR lever to N. The FNR function is activated after the enable key of the FNR lever is pressed. When the FNR function is activated, the FNR lever can be used to perform F(forward)\N(neutral)\R(reverse) and KD function operation
	21	Power shutoff function 1) place the power shutoff function selection switch at enable state; 2) release the parking brake; 3) operate the shift lever and place it at F1 or F2 and drive the vehicle; 4) depress the service brake pedal and when it reaches a certain level, the gear shall shift down to neutral; and the power shutoff indicator on the instrument panel comes on; 5) release the brake pedal, and the gear shall return back to F1 or F2; 6) the power shutoff fails when the shift lever is placed at F3 or F4.

Inspection item	S/N	Inspection method and acceptance criteria
Driving test	22	Backup alarm: when the shift lever is placed at reverse, the reverse alarm begins to perform buzzing alarm immediately.
	23	Brake system: Drive the vehicle for 10 laps, during which depress the brake pedal and the complete machine is braked, two times per lap; no seizing shall be felt when depressing the accelerator and brake pedal during driving
	24	Fault alarm inspection: observe that no axle oil pressure, oil pressure, service brake, emergency brake, transmission fluid pressure, hydraulic oil temperature alarm indicator on instrument panel indicates alarm during driving; visual check that torque converter oil temperature, engine water and oil temperature is displayed at green area;
	25	Steering during driving: no seizing and heavy, floating is felt when turning to the left and right during driving
	26	Power train system inspection: listen to the diesel engine operation for abnormal sound; front and rear axle for abnormal sound; gearbox & torque converter assembly for abnormal sound during driving
	27	Emergency brake: apply hand brake after climbing 15% of slope (for hand brake with lever, it needs to pull the hand brake latch for 2/3 travel), and then release the brake valve, the complete vehicle shall stay for 5 seconds and remain stationary
	28	Pressure maintaining of hydraulic system: extend and retract all oil cylinders to the maximum with control lever remained open at each end of travel to obtain safety valve pressure, which is remained for about 5 seconds, continuously check it for 120 times with interval more than 10 seconds
	29	Fan's positive and negative rotation (option): the engine is idling, press the fan's positive and negative rotation switching switch for less than 60 seconds, and then fan can be switched to negative rotation with indicator on; press the switch again for less than 60 seconds and the fan is switched to positive rotation with the indicator off, no abnormal sound occurs during switching
	30	Detection of rear axle swing angle: reverse the complete vehicle with single wheel on the slope of vehicle inspection slot, visual check that the tire has no interference with frame, fender, rear cover (with clearance more than 20 mm) pipe on axle has no interference with diesel engine after stopping the vehicle
	31	Centralized lubrication line: 1) fastened to pin lubrication pipe joints without oil leakage; 2) centralized lubricator time is correctly set; 3) oil pipe is not bent and twisted; 4) oil pipe runs smoothly without interference with proper length and beautiful appearance; there is no pulling interference during turning and operation of work implement

Inspection item	S/N	Inspection method and acceptance criteria
Static check	1	Visual check: gap of lapped surface at hinge between boom and frame, oil cylinder, rocker and tie rod light is ≤1mm
	2	Touch: there is no oil leakage at big cavity and small cavity pipe and joint of left and right boom oil cylinder pipeline; visual check that there is no oil leakage at big cavity and small cavity pipe and joint of bucket tilting cylinder pipeline
	3	Touch: there is no oil leakage at left and right front axle clamp; no oil leakage at front axle input flange; no oil leakage at axle housing and brake line joint on axle
	4	Touch: ride control accumulator is installed firmly with the joint free of oil leakage
	5	Touch: there is no oil leakage at transmission front output flange, transmission filler mounting face, shift control valve, level window, level mouth, breather and brake cylinder
	6	Touch: there is no oil leakage at steering gear and joint, pressure regulating valve, flow amplifying valve, unload valve, combination valve, electric proportioning valve, steering pump, priority valve, pilot valve, charge valve, mounting face of working pump and pipe joint; there is no water leakage at heater pipe and water return pipe joints
	7	Touch: there is no oil leakage at safety valve and oil inlet and return pipe joints to the boom, bucket tilting, control valve, pilot hose joint on the control valve; visually check that there is no interference between oil inlet and return pipe of control valve, pilot control pipe and other sharp edges, moving parts
	8	Touch: there is no oil leakage at left and right steering oil cylinder pipe and joint; visually check that there is no interference between steering and brake pipe and other sharp edges, moving parts
	9	Touch: there is no oil leakage at accumulator in transmission and brake pipe joint, pilot accumulator, transmission oil filter and its joint, charge valve and its joint and hydraulic rising mechanism
	10	Touch: there is no oil leakage at bottom of hydraulic oil tank, flange, plug, level window, oil inlet and return pipe joint and flange face
	11	Touch: there is no oil leakage at diesel fuel tank and outlet pipe joint, diesel fuel tank body and flange, plug
	12	Visual check: the left and right semi-circles fender and rear fender is matched flush without shaking
	13	Visual check: rear cover with lifting mechanism is raised smoothly during which there is no interference with other parts; there is no interference between lifting jack and frame, radiator baffle; there is no oil leakage at lifting cylinder joint
	14	Visual check: rear cover is symmetrical at left and right sides; bottom of rear cover is attached with counterweight, rear frame, left and right plate

Inspection item	S/N	Inspection method and acceptance criteria
Static check	15	Visual check: there is no interference between hydraulic oil tank and cab; there is no interference between left and right hydraulic oil tank guard, foot pedal and driver
	16	Visual check: diesel engine mounting bolt is fastened and there is no oil leakage at parts on left side and oil pan; there is no interference between diesel engine oil pan and sub frame, rear frame beam; no interference between diesel engine torque converter assembly oil return pipe joint and intermediate plate of frame
	17	Visual check+touch: there is no water leakage at upper and lower water pipe, cool and warm water pipe and water valve; there is no oil leakage at pipe joints of filter, high pressure oil pump, flywheel housing cover;
	18	Visual check: there is no interference between brake line at left side of engine, filter and sharp edges (harness is far away from high temperature area and not interfered with fuel pipe); there is no interference between filters and sharp edges and other parts, and the hoses are not twisted;
	19	Visual check: urea heating pipe, cool water pipe, diesel particle filter water pipe runs smoothly without interference and is far away from high temperature area.
	20	Visual check: arrow of solenoid water valve shall face the urea tank.
	21	Visual check: harness at upper side of diesel particle filter is far away from high temperature area.
	22	Visual check: A/C pipe runs smoothly and is not interfered with other parts, diesel engine high temperature area and the exposed A/C aluminium pipe is not interfered with other parts.
	23	Visual check: the pulley belt is not twisted and peeled off; and the A/C compressor pulley is in the same horizontal plane with diesel engine pulley;
	24	Visual check: clearance between engine fan and shroud is ≥10mm, fan guard ≥15mm; the pulley is not interfered with fan guard
	25	Visual check + touch: there is no water and oil leakage at radiator assembly and its radiator pipe joint;
	26	Visual check+touch: there is no oil leakage at rear axle input flange, axle housing and plug, pipe on axle, left and right clamp, breather; axle brake hose joint is not interfered with oil pan;
	27	Visual check+touch: there is no oil leakage at radiator pipe at right side of engine, fuel pipe, brake pipe, filter; there is no interference between filters and sharp edges and other parts, and the hoses are not twisted
	28	Visual check +touch: there is no oil leakage at radiator pipe reversing valve, fan pump joint;
	29	Inspection of quick coupler: lower the bucket to the ground, shut it off and close the pilot shutoff valve to OFF position. Turn the spool lever to COUPLER, start the machine, open the pilot shutoff valve to OPEN. Operate the multi-functional pilot lever, and check the quick coupler frame movable pin for free extending and retracting. Turn the engine off, close the pilot shutoff valve to OFF position, and turn the spool lever to Aux position.

Power System

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Basic Information

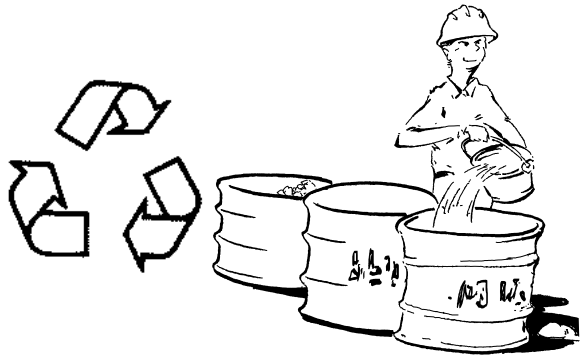
Safety

Compressed Air

Compressed air may cause personal injury. When using the compressed air for cleaning, wear the mask, protection suits and shoes. The maximum pressure of the compressed air for cleaning should be lower than 25psi (0.2MPa).

Safe Disposal of Waste Fluids

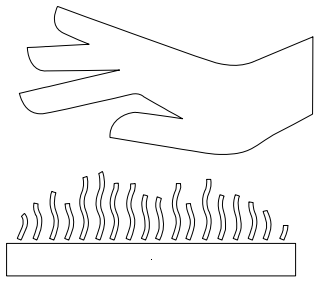
- Improper treatment of waste engine oil, waste diesel and waste DEF is harmful to environment and ecosystem. Treatment shall conform with the local laws and regulations.
- It is mandatory and necessary to collect the liquid with containers spattered during the inspection, maintenance, test, adjustment and repair of machine. Proper container shall be prepared well before opening any fluid cavity or disassembling the parts containing liquid. Use proper container when draining liquid.
- Do not use the food or drink containers because they may be drunk by others by mistake.



P19M00059

Preventing Burns

After running for some time, parts of the machine will be hot,such as, engine, DPF (Diesel Particulate Filter) and inter-cooler steel pipe, those parts which are cooled down later shall be inspected or repaired.

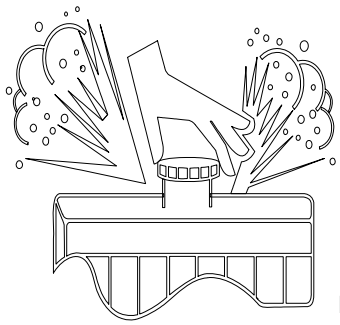


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Coolant

At working temperature, the coolant of the engine is at high temperature and has pressure, the radiator and all the pipes connected to the radiator contain hot water or vapor, if you touch them, serious burn would occur.

- When checking the coolant level, the engine shall be shut off and the filler cap shall be cooled to the extent that it can be opened by bare hands. Slowly loosen the filler cap of cooling system to release the pressure.
- Coolant contains alkali which may causing injury and do not let it contact your skin, eyes and mouth.

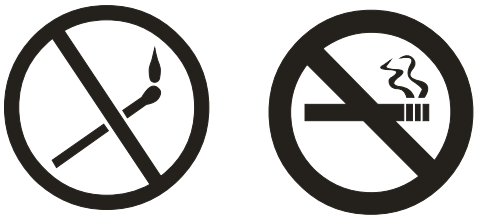


P11000147

Fire & Explosion Prevention

- All fuels, such as most of lubricants and some cooling agent are flammables.

- Fuel leaking onto the hot surface or electrical elements may cause fire.
- Do not smoke when refilling or within refiling area, and in the place storing flammables.



P11000157

- Store the fuel, lubricant into containers with relevant marks to avoid use by non-working personnel.
- Put the cleaning cloth or other combustible materials with oil soaked into protective container, and set it at a safe place.
- Do not perform welding or flame cutting onto the pipe containing flammable liquid. Before welding or cutting, it shall be shall be cleaned completely with flammable liquid.
- Accumulated flammable materials such as fuel, lubricant or other scattered materials on the machine shall be cleaned up.
- Diethyl ether (Warning: Do not use diethyl ether to start the engine)
- Any approach which attempts to start the engine by use of diethyl ether may cause serious damage to engine or casualties.



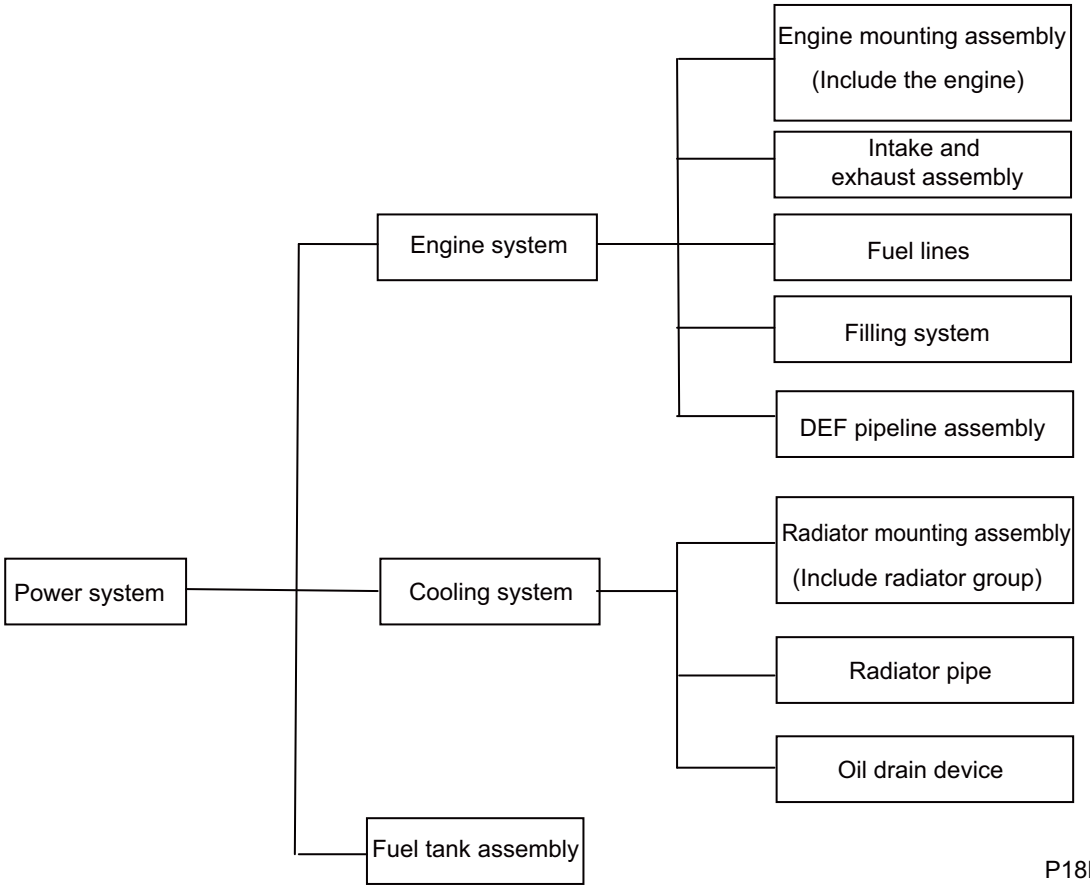
P11000158

Overview-components and position

Components and position

Power system has the function of converting chemical energy of fuel into mechanical energy to be supplied to the machine. Power system includes engine system, radiator system and fuel tank assembly. Among them, the engine mounting consists of engine, and the radiator mounting consists of cooler components.

Module structure figure of power system



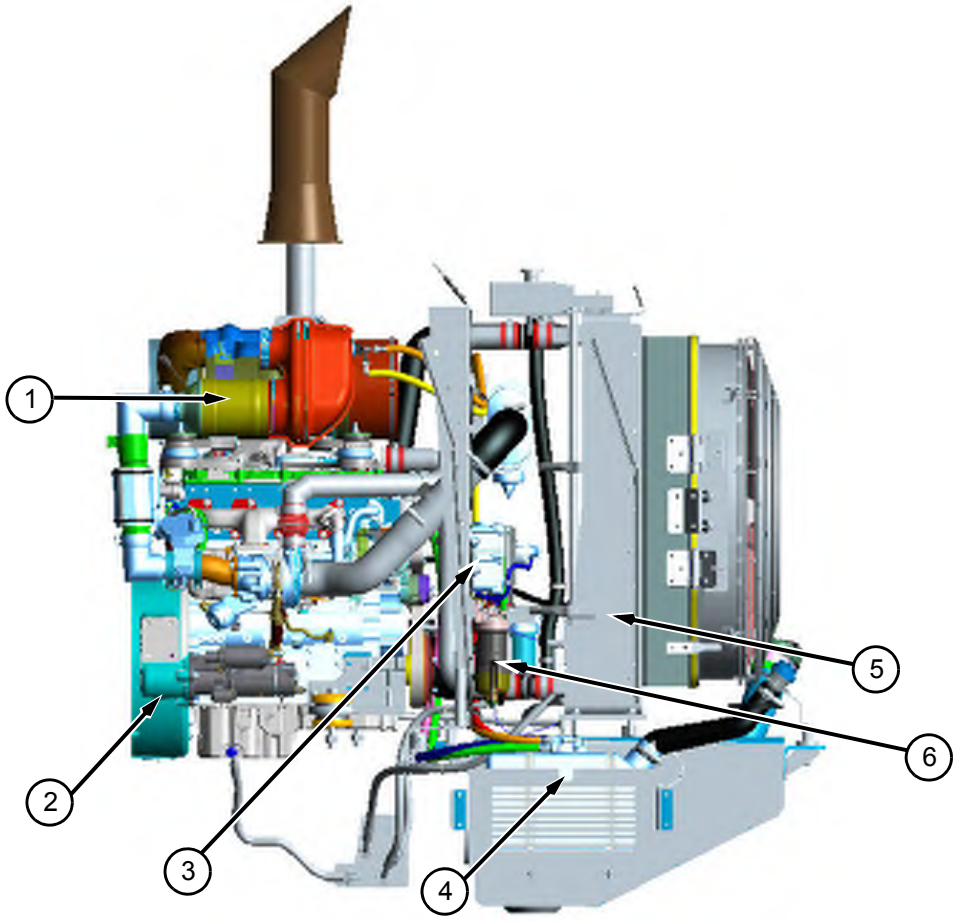
Position figure of power system in the machine



P18P00007

1. Engine system
2. Cooling system
3. Fuel tank assembly

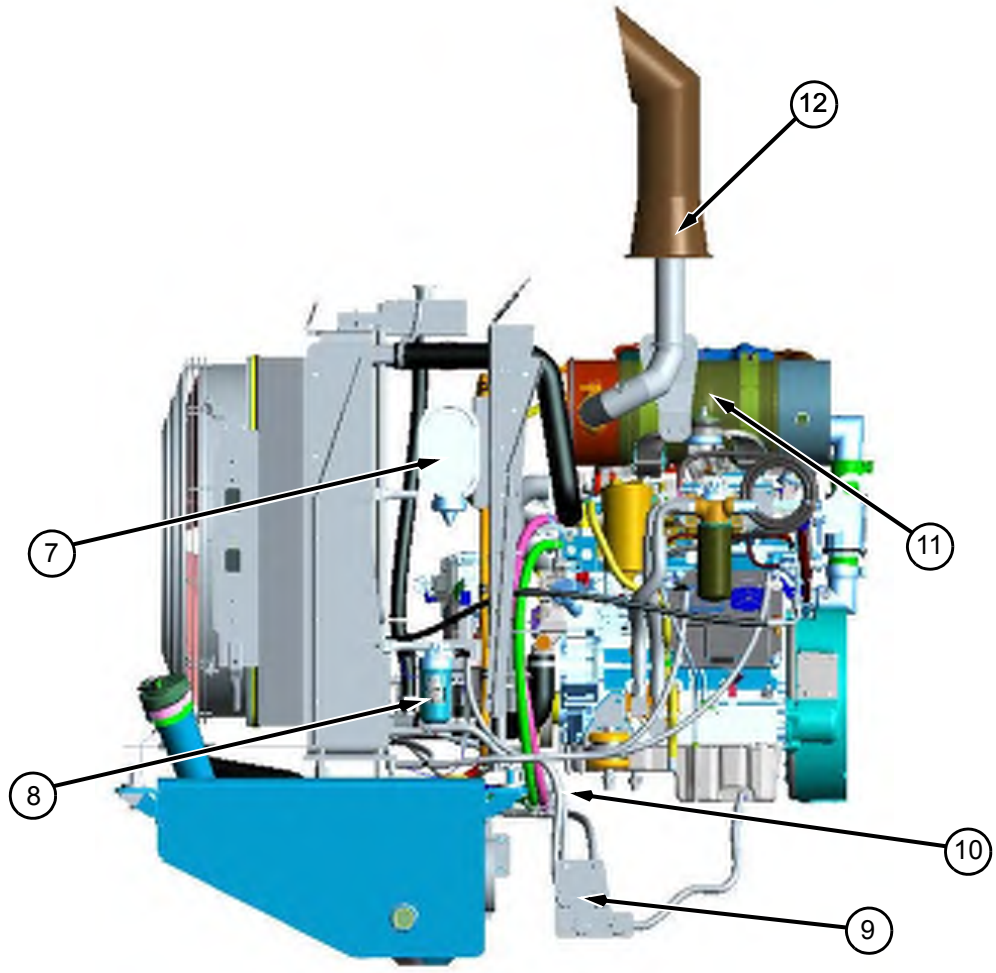
Components of power system



P18P00008

1. Diesel particle filter DOC
2. Diesel engine
3. DEF pump
4. DEF tank
5. Radiator mounting assembly
6. Oil-water separator

Components of power system



P18P00009

7. Air filter	9. Oil drain device	11.Diesel particle filter SCR
8. Fuel fine filter	10.Solenoid water valve	12.Exhaust pipe

System technical parameters

Engine	Model	Perkins 1204F-E44AT
	Type	In line-four cylinders, four-stroke, turbocharged
	Emission	EPA Tier4 Final
	*Rated power	97.9kW/2200r/min(133.144PS/2200rpm)
	*Maximum idling speed	2376±50rpm
	*Minimum idling speed	800±50rpm
	Engine oil level	7.7L (2.03434USgal)
	Direction of rotation	Clockwise (viewed from the fan end to flywheel housing end)
Cooling system	Fan	Diameter of 880mm(34.6456In), 12 pieces of blades, air suction type
	Thermostat	Opening temperature: 82°C(179.6°F) Fully open temperature: 94°C(201.2°F)
Engine oil system	Oil filter	Full flow type and replaceable (filter can rotate)
Preheating system	Preheating method	Grid heater
Water radiator	Core type	Plate-fin type
	Core size (height × width × thickness)	870mm X 454mm X 120mm (34.2519In X 17.87398In X 4.7244In)
Hydraulic oil radiator	Core type	Plate-fin type
	Core size (height × width × thickness)	870mm X 166mm X 120mm (34.2519In X 6.53542In X 4.7244In)
Torque converter oil radiator	Core type	Plate-fin type
	Core size (height × width × thickness)	870mm X 264mm X 120mm (34.2519InX 10.39368In X 4.7244In)
Air-air intercooler	Core type	Plate-fin type
	Core size (height × width × thickness)	870mm X 178mm X 120mm (34.2519In X 7.00786In X 4.7244In)

Notes: Data marked with * is based on engine with fuel system and water pump under intake resistance of 380 mm H2O (3.72 kPa) and exhaust resistance of 160.5 mm Hg (21 kPa) not including alternator, fan, optional configurations and drive components.

Universal tool, tooling list

Name	Specification
Open-end wrench	7#, 8#,10#, 11#, 12#, 13#, 16#, 18#, 19#, 20#, 22#, 24#, 30#
Ratchet wrench, socket	Ratchet wrench, 10#, 11#, 12#, 13#, 16#, 18#, 19#, 20#, 22#, 24# and 30# socket
Torque wrench	120±6N.m(12±0.6kgf.m), 1020±6N.m(102±0.6kgf.m)
Traveling crane	More than 2t (4410lb)
Wire rope with hooks	Weight load over 840Kg (1852.2Kg)
Steel ruler	Steel ruler
Straight screw-driver	
Cross screwdriver	T25
Lifting eye	
Plastic sealing membrane	
Waste oil tank	
Remarks:	

Precautions on removal and installation:

1. Assembly and disassembly must be carried out when engine is cool. In general, open engine hood after engine is shut down, and wait for 15 minutes before the engine is cooled down.
2. Measurement equipment and tools such as torque wrench, etc. shall have compliance certificates issued by metrological department;
3. Because many other related components on the complete machine are concerned during the removal and installation of each component, removed components (especially standard parts) shall be reasonably placed to avoid wrong installation, neglected installation, part missing, etc. during reassembly.
4. If the removal and installation of other components on the complete machine are concerned in the removal and installation of each component, tools are referred to the tool list for the removal and installation of other components and not listed in the tool list of this component;
5. If the expected effect can be reached in the ways of using open-end wrench, blower gun and socket as well as ratchet wrench and socket to remove and install, anyone can be chosen.

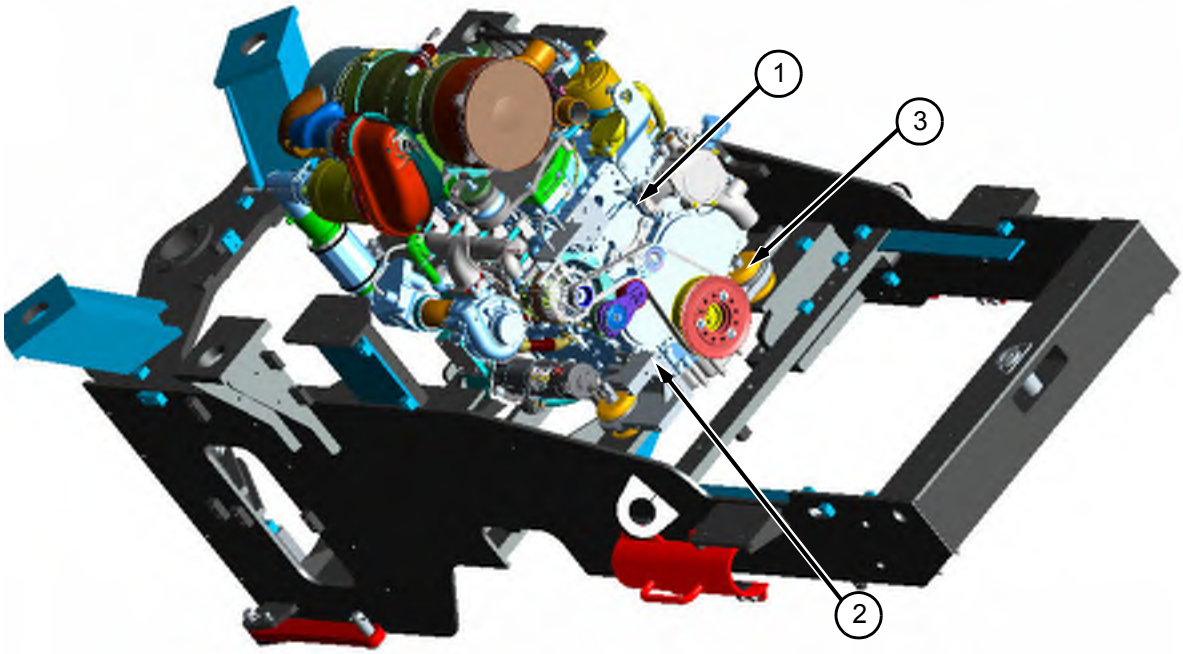
Structure Function Principle

Engine system

Overview

Components and position

The diesel engine mounting assembly is composed of diesel engine, bracket and shock absorber.



P18P00009

1. Diesel engine
2. Bracket
3. Shock absorber

Working principle description

Engine mounting as has the function of realizing effective installation of engine.

The working principle of engine as is as follows: engine is fixed on complete machine via engine mounting composed of mounting support and shock absorber, engine has excellent working environment through shock isolating action of shock absorber, vibration of engine transferred to complete machine is reduced, and riding comfort is improved.

Generally, requirements for the engine assembly are as following.

1. Active and static loads can be supported under all working conditions, and engine assembly has displacements in all directions within acceptable range and does not interfere with other parts on chassis. Meanwhile, before repairing the engine, there are no damaged parts.
2. Vibration generated by engine can be sufficiently isolated from being transferred to frame and cab, and cab operating comfort and service life of complete machine components are improved.

3. Impact generated by uneven roads can be effectively isolated from being transferred to engine through engine mounting, and influence of road impact on engine is reduced.

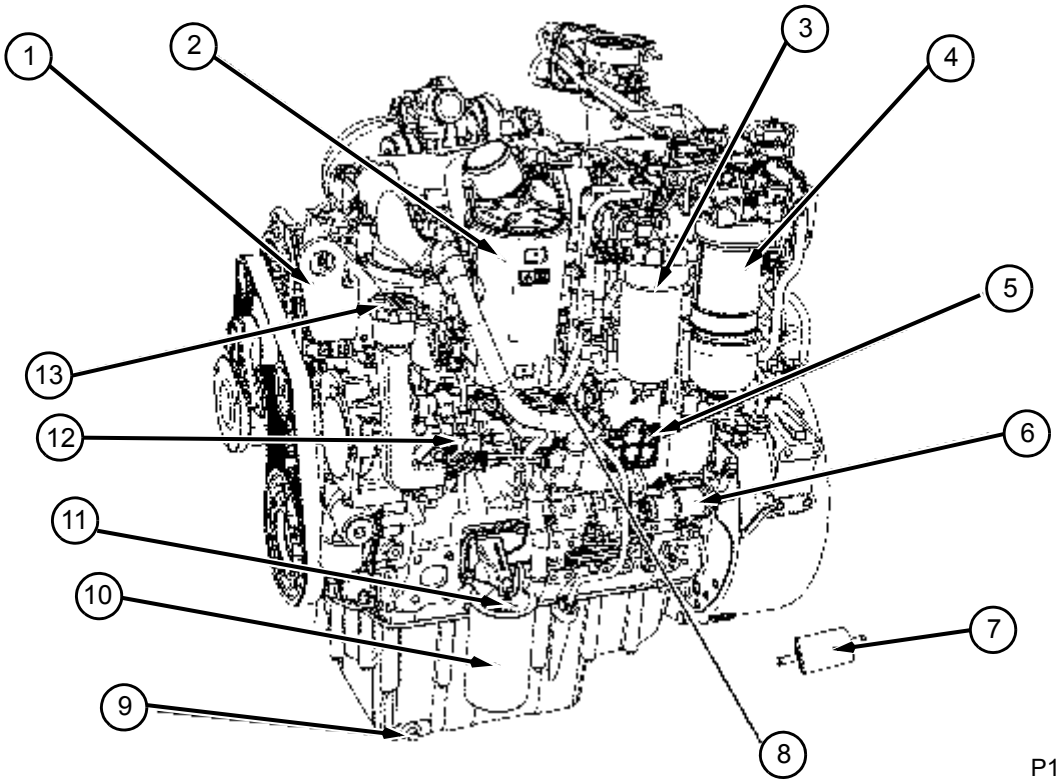
Diesel engine

Technical parameters

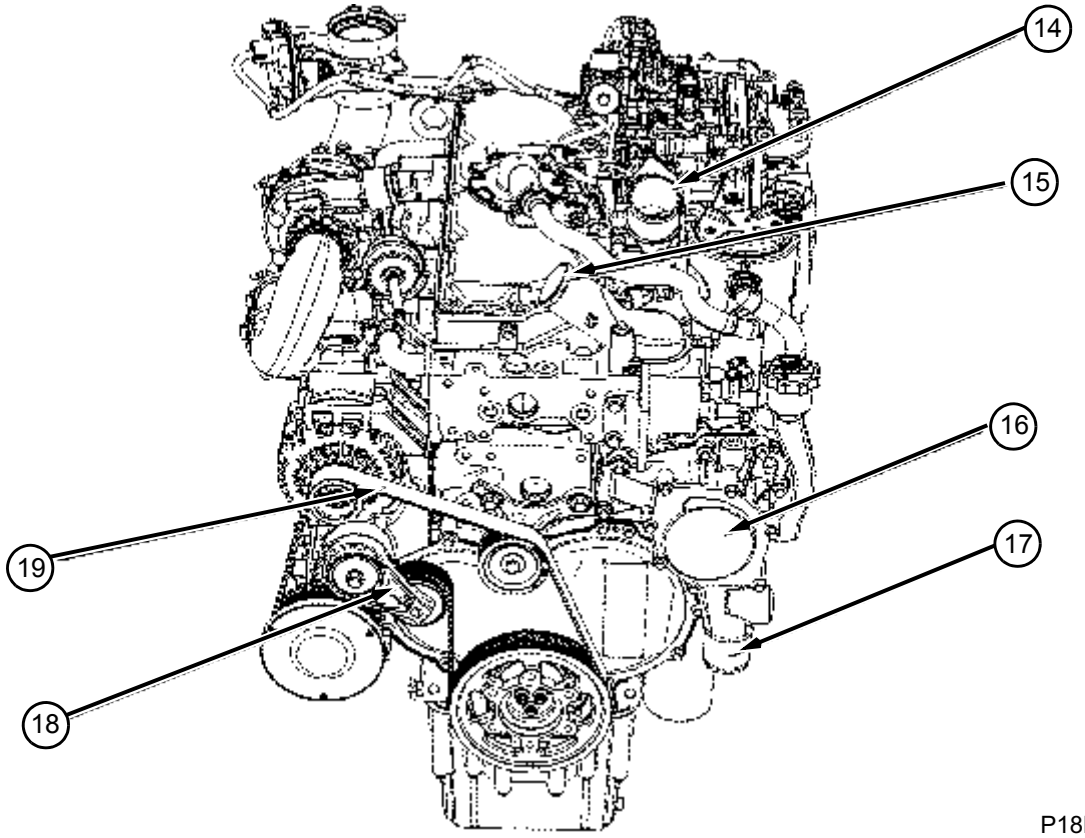
Model	Perkins 1204F-E44TA
Number of cylinder	4
Cylinder diameter	105 mm (0.344505ft)
Stroke	127 mm (0.416687ft)
Displacement	1.16248USgal
Suction mode	Turbocharged inter-cooled
*Rated power	97.9kW/2200r/min (133.144PS/2200rpm)
*Maximum idling speed	2376±50rpm
*Minimum idling speed	800±50rpm

Part Structure and Principle Introduction

External view of Perkins engine 1204F-E44TA

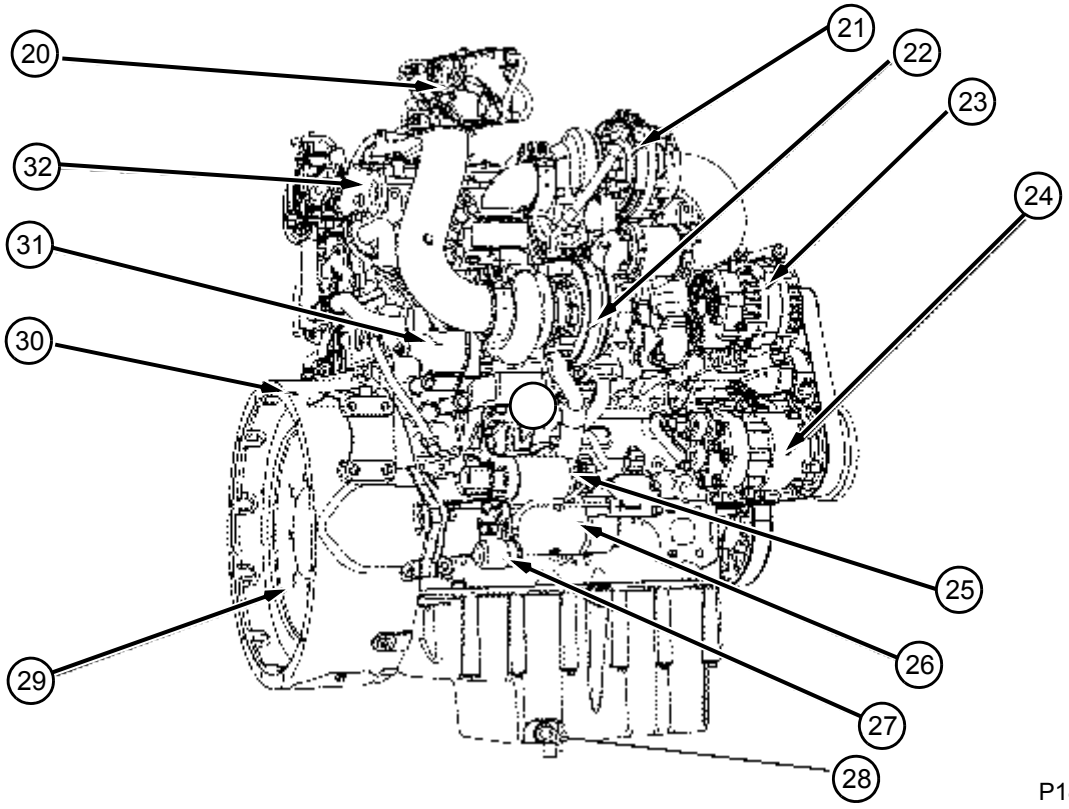


1. Front lifting eye
2. Crankcase breather
3. Secondary fuel filter
4. Primary fuel fitter
5. Electronic Control Module
6. Pnmiog/trarferfuel pump
7. In line fuel fitier
8. Oil level gauge (dipstick)
9. Oil drain plug
10. Oil filter
11. Oil sampling vafve
12. High-pressure fuel pump
13. Oil filler



P18P00012

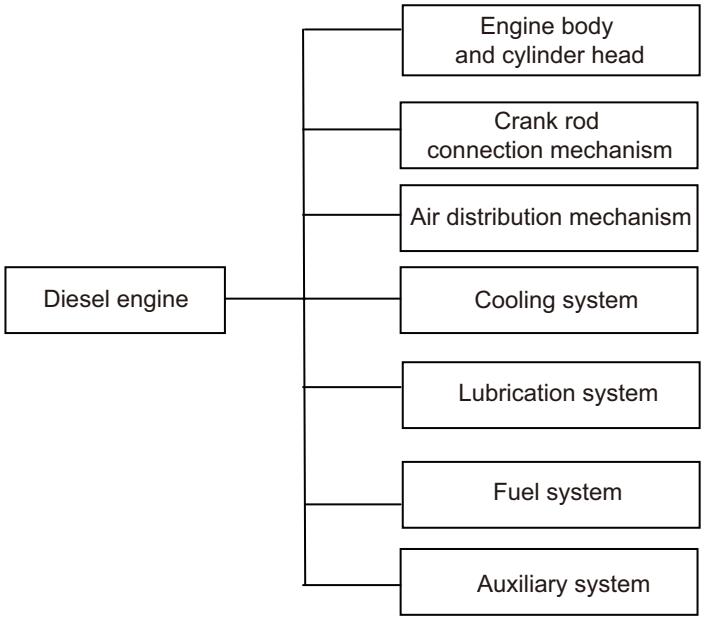
14.Air intake
15.Coolant outlet
16.Water pump
17.Coolant intake
18.Tensioner
19.Belt



P18P00012

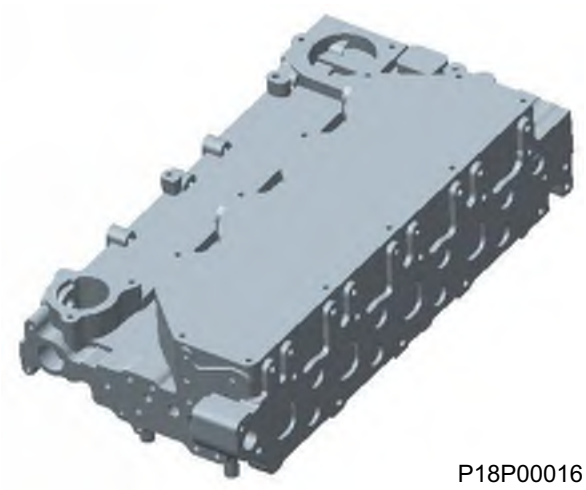
20.Back pressure valve
21.Htgh-pressure turtoocharger
22.Low-pressure turbocharger
23.Alternator
24.Refrigerant compressor
25.Starter solenoid
26.Starting motor
27.Starter relay
28.Oil dram tap
29.Flywheel
30.Flywheel housing
31.NOx reduction cooler
32.Rear lifting eye

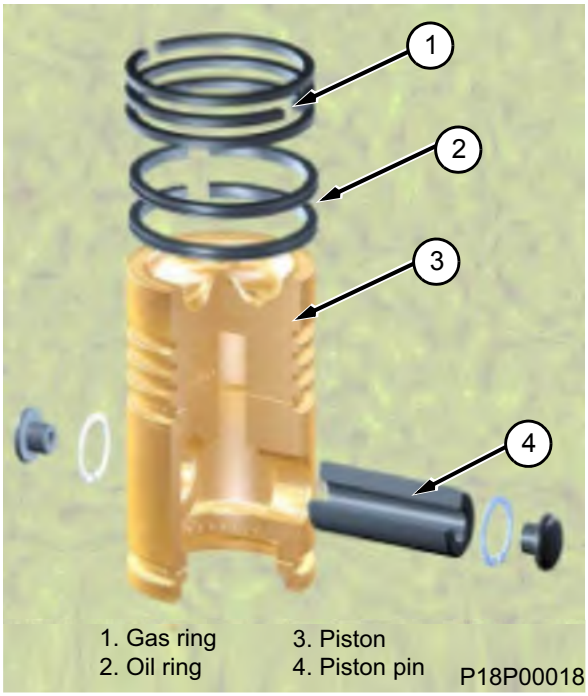
The diesel engine is generally composed of two major mechanisms and four systems:

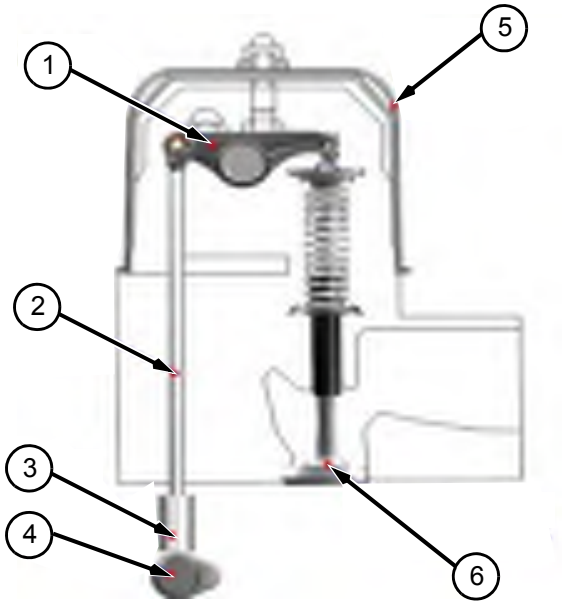


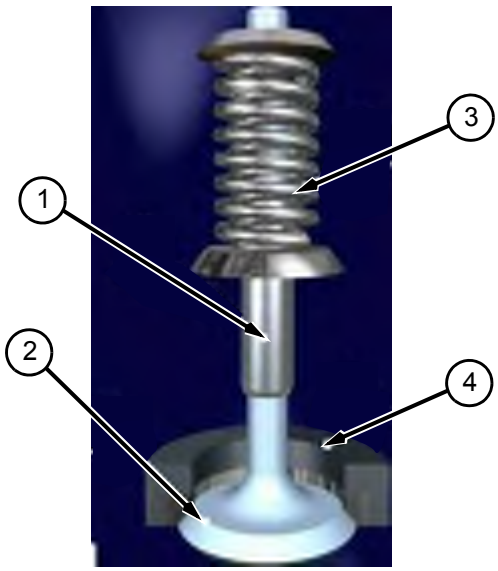
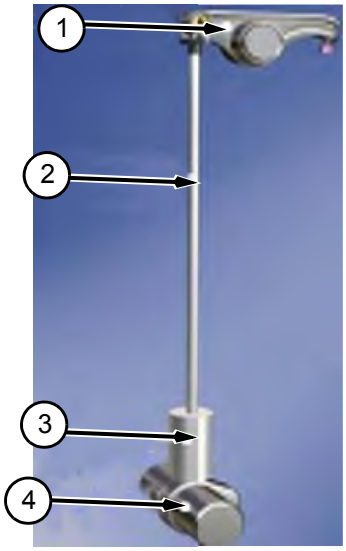
P18P00014

Basic body of engine		Engine body and cylinder head
 P18P00014	It is the frame of engine, and composed of cylinder block, crankshaft case and oil pan.	Engine body

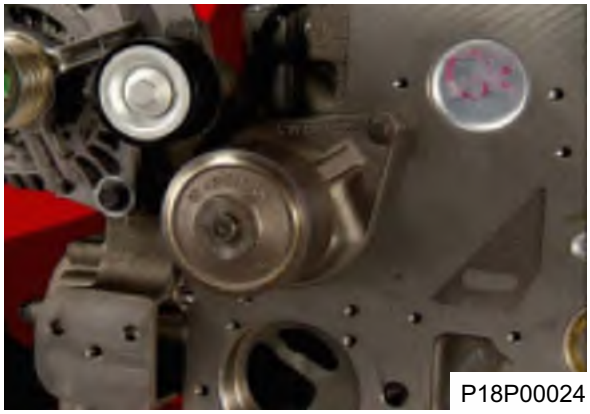
 P18P00016	It is located at top of cylinder block, and used for sealing the cylinder head, and forms a combustion chamber together with cylinder and piston. It is usually installed with nozzle, air intake/ exhaust valve, intake/exhaust pipe and rocker arm shaft assembly.	Cylinder head
 P18P00017	Machine body and work component, which is composed of piston group, connecting rod group, crankshaft flywheel group, and used for converting the chemical energy of fuel into mechanical energy for output.	Crank rod connection mechanism

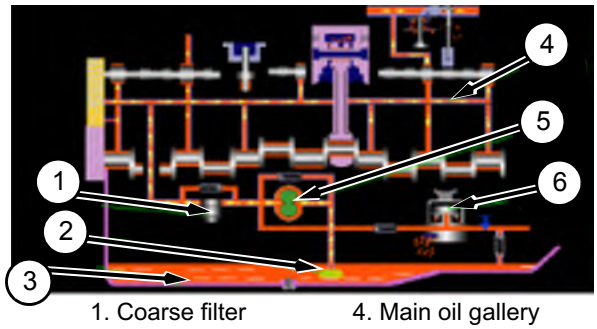
 1. Gas ring 2. Oil ring 3. Piston 4. Piston pin P18P00018	It is composed of piston, piston ring and piston pin. Piston: piston head is a part of combustion chamber, with the shape of dome head, flat head, crown head	Piston group
 P18P00019	It is composed of connecting rod, connecting rod bolt and connecting rod bearing. The connecting rod is used for converting the reciprocating motion of piston into the rotation motion of crankshaft, and transferring the force of piston to crankshaft.	Connecting rod group

 P18P00020	It is composed of crankshaft, fly-wheel and torsion damper	Crankshaft fly-wheel group
 1. Bucket lever 2. Push rod 3. Ejector pole 4. Cam 5. Air valve chamber cover 6. Air valve P18P00021	It is composed of valve group and valve train, and mainly used for controlling the intake/ exhaust process of engine and ensuring that the fresh air is filled into the cylinder timely and making the exhaust gas out of the cylinder in time.	Air distribution mechanism

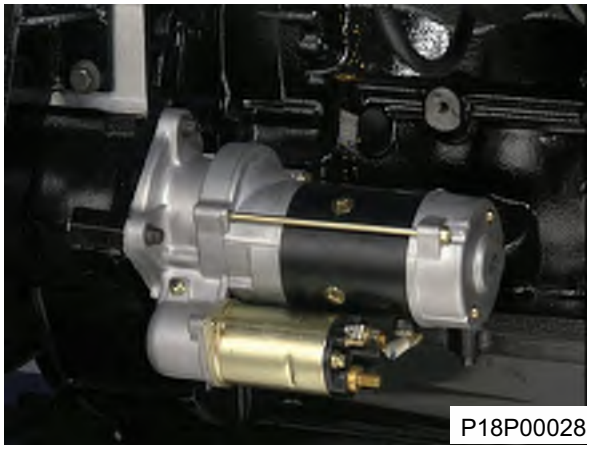
 1. Valve guide pipe 3. Valve spring 2. Valve 4. Valve seat ring P18P00022	It is composed of valve, valve guide, valve seat ring, valve spring, valve rotating mechanism	Valve group
 1. Bucket lever 2. Push rod 3. Ejector pole 4.Cam shaft P18P00023	It is composed of camshaft, tappet, push rod, rocker arm, timing gear	Valve train

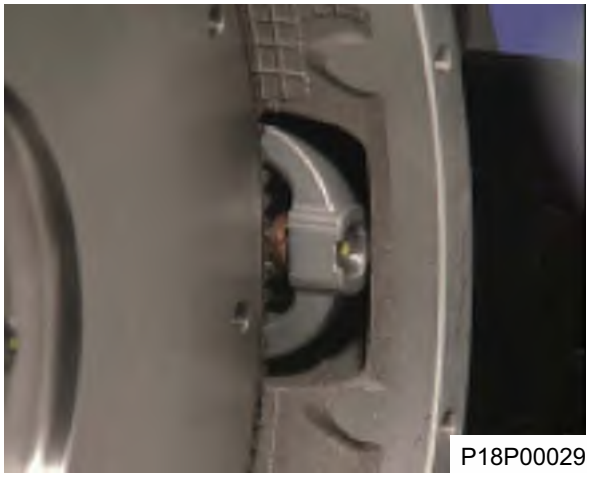
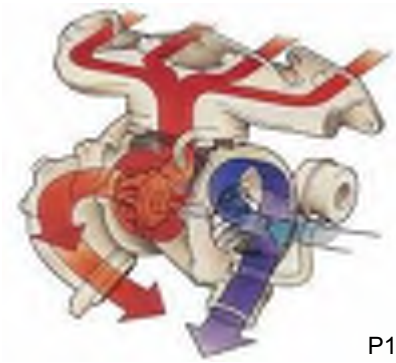
	Guarantee working under suitable temperature. It is composed of water pump, thermostat and water channel	Cooling system

 P18P00024	It is used for increasing the pressure of cooling water to accelerate the cycle of cooling water in the cooling system to enhance the heat radiating ability	Water pump
 P18P00025	It is used for controlling the cooling water to pass major cycle or minor cycle depending on the cooling water temperature to make the engine operate under the proper temperature	Thermostat
	It is built into the machine body to allow the cooling water flow over each component to be cooled	Water channel

 1. Coarse filter 2. Fine filter 3. Engine oil pan 4. Main oil gallery 5. Engine oil pump 6. Secondary filter P18P00026	Components: Oil pan, oil pump, oil radiator, oil filter Function: It is used for transferring the proper amount of lubricant to the system where the part to be lubricated locates and its attachment to ensure the normal operation of engine	Lubrication system

	It is composed of fuel coarse filter (oil-water separator),fuel delivery pump,fuel fine filter,fuel injection pump,injector,fuel pipe and combustion chamber,and used for supplying fuel to engine.	Fuel system
 P18P00027	It is used for filtering the larger particles of impurity and installed at the front of fuel inlet line (fuel delivery pump)	Fuel coarse filter (oil-water separator)

	Start and generate power, etc.	Auxiliary system
 P18P00028	The starter motor is energized and rotates to drive the crankshaft of engine to rotate and allow it transmitted to a state of running itself from static state.	Starting system

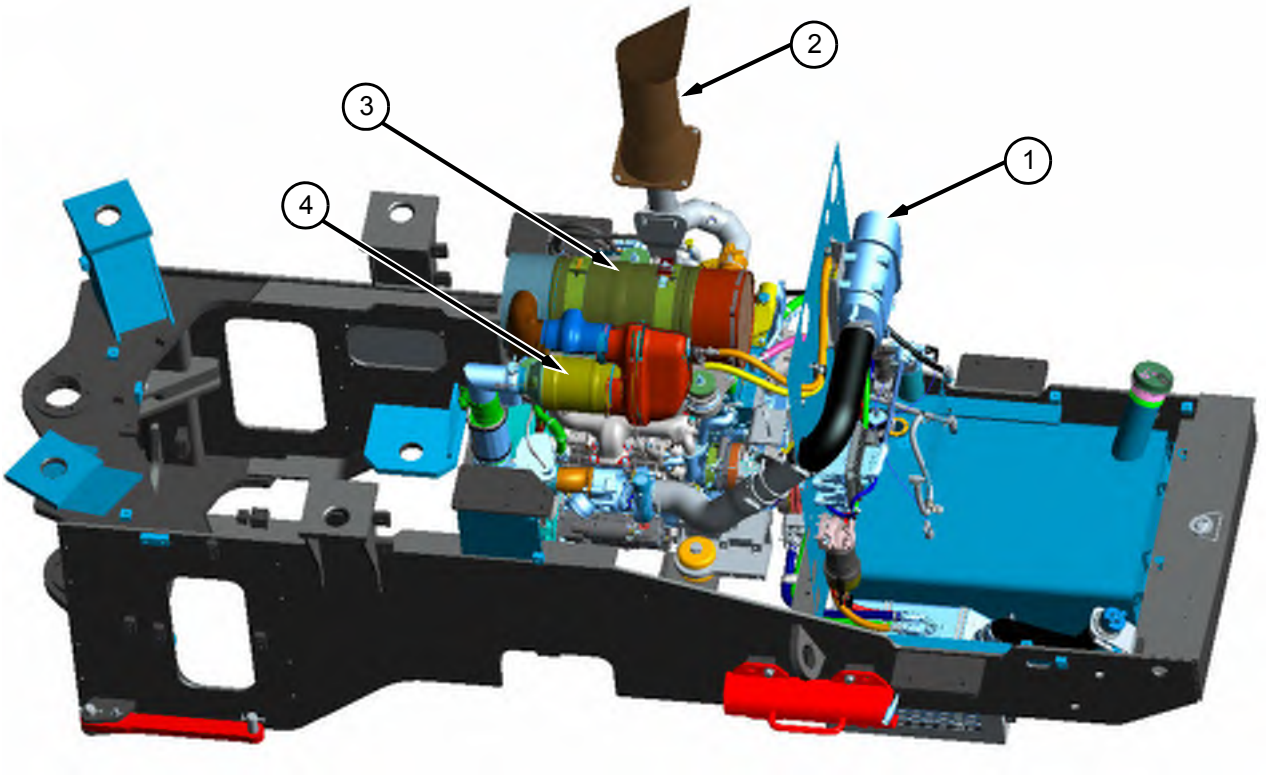
 P18P00029		
 P18P00030	It is used for charging the battery when the engine operates to ensure that the battery can provide high enough voltage during the engine cranking	Alternator
 P18P00031	It pushes the turbo to drive the vane rotating at high speed by using the high speed of exhaust to increase intake pressure and improve intake quantity (intake density), and finally improve engine power and economy.	Turbocharger

Intake and exhaust system

Intake and exhaust assembly

Components and position

Intake and exhaust assembly consists of air pre-filter, air filter, diesel oxidation catalyst (DOC), selective catalytic reducer (SCR) and exhaust pipe.



P18P00032

1. Air filter
2. Exhaust pipe
3. Selective catalytic reducer (SCR)
4. Diesel oxidation catalyst (DOC)

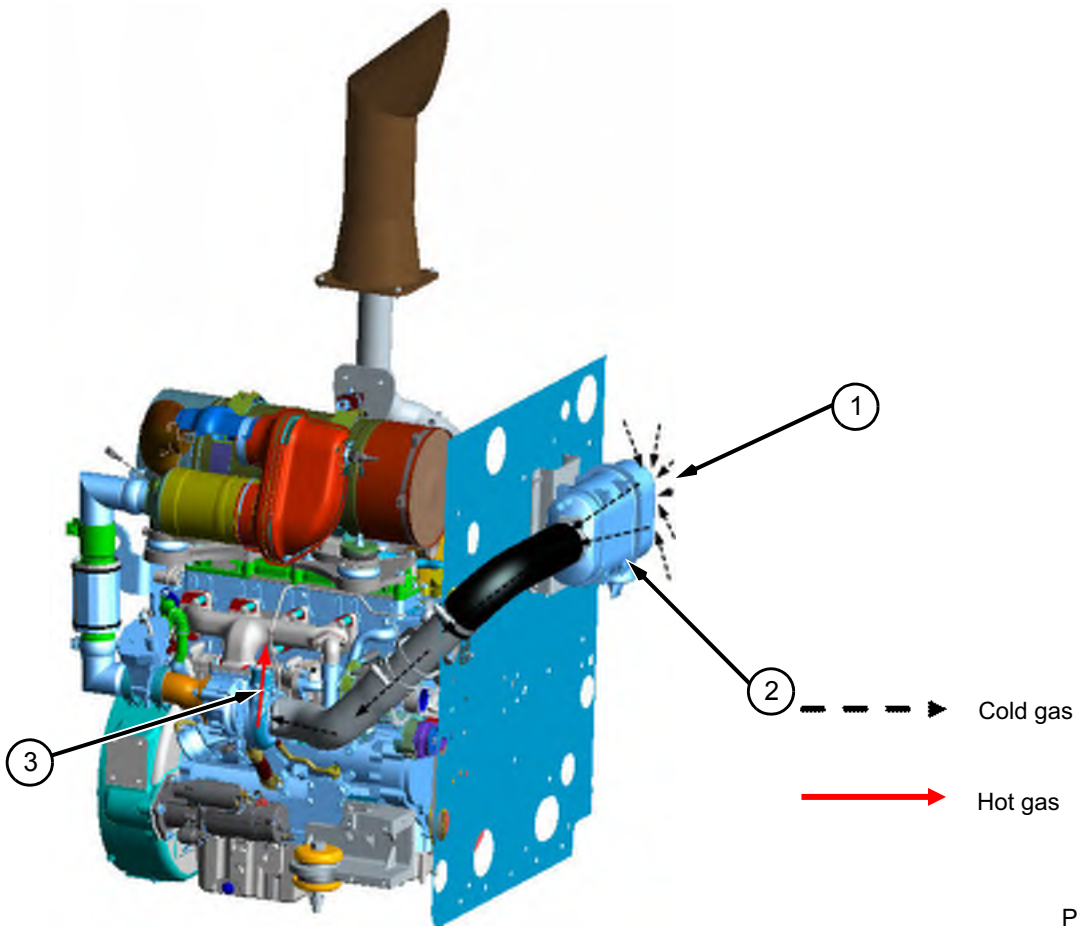
Description of principle diagram and working principle

The functions of the intake and exhaust assembly are:

1. Supply clean and dry air with proper temperature for engine to burn so as to minimize engine wear and optimize engine performance;
2. Keep all exhaust gases safely away from engine and discharge them into atmosphere quietly while optimizing engine performance.

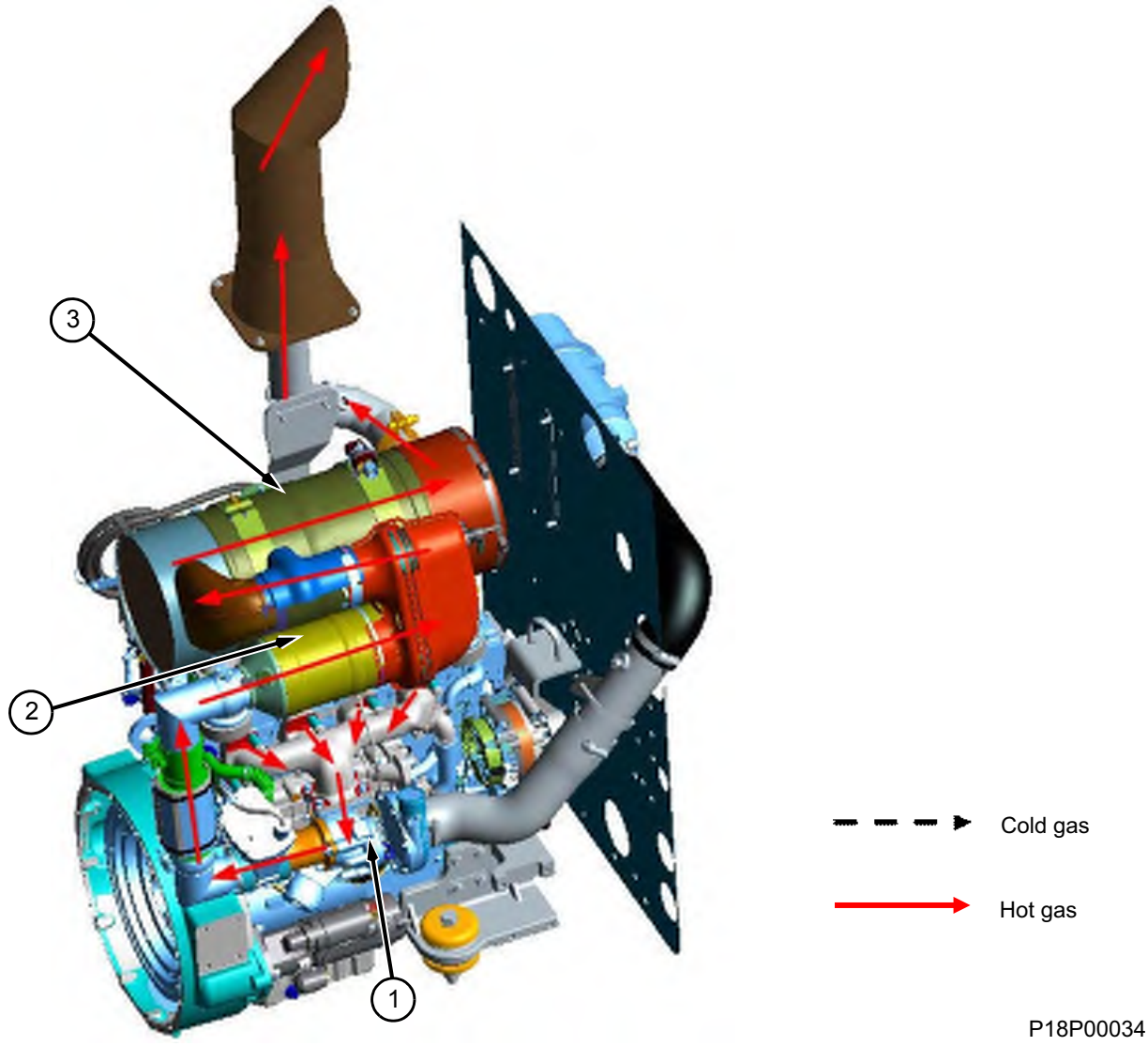
Working principle of the intake and exhaust assembly: air is taken in through air pre-filter. There are rotating blades inside the air pre-filter, which can discharge big dust in intake air from the bottom of air pre-filter. Intake air reaches air filter, filter element removes small dust and moisture to obtain clean and dry air to be sent to turbocharger, the turbocharger is driven by engine exhaust to pressurize intake air and increase intake quantity, and sufficient combustion of fuel can be ensured. Air coming out of turbocharger goes through air-air intercooler in cooling system and electric heater of engine itself to obtain proper temperature and then enters engine block to burn. Exhaust gas generated after combustion reaches turbocharger via exhaust manifold, drives turbocharger to pressurize intake air and is then discharged to DPF (Diesel Particle Filter). When exhaust gas gets to diesel particle filter DOC, particulates will be oxidized to CO2. Then enters into decomposition reactor tube (DRT). Urea solution injected to DRT from the outside will break down to form ammonia gas and mingle with exhaust gas. When gas mixture including exhaust gas and ammonia gas enters into diesel particle filter SCR, under the reaction of catalyzer, nitride oxides will be broken down into nitrogen and water. Finally, exhaust gas pollutants content injected into the atmosphere will be greatly reduced, conforming with Euro IV emission requirement.

Air intake path figure of engine:



1. Air pre-filter
2. Air filter
3. Turbocharger

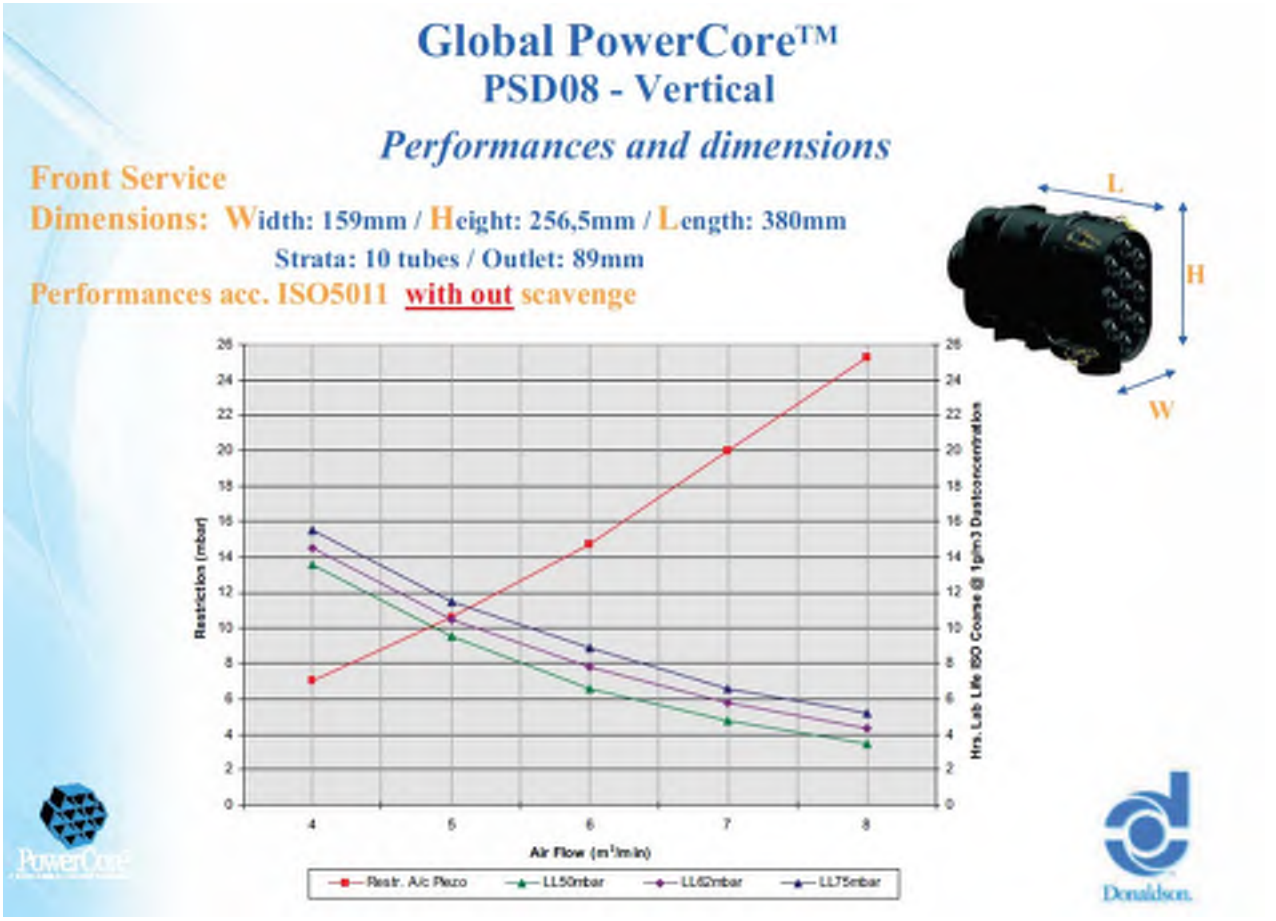
Exhaust path figure of engine:



1. Turbocharger
2. Diesel oxidation catalyst DOC
3. Selective catalytic reducer SCR

Air filter

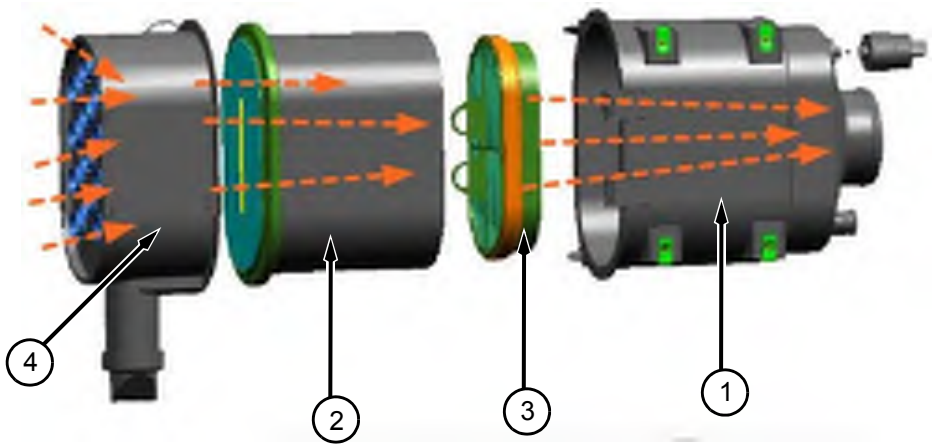
Technical parameters



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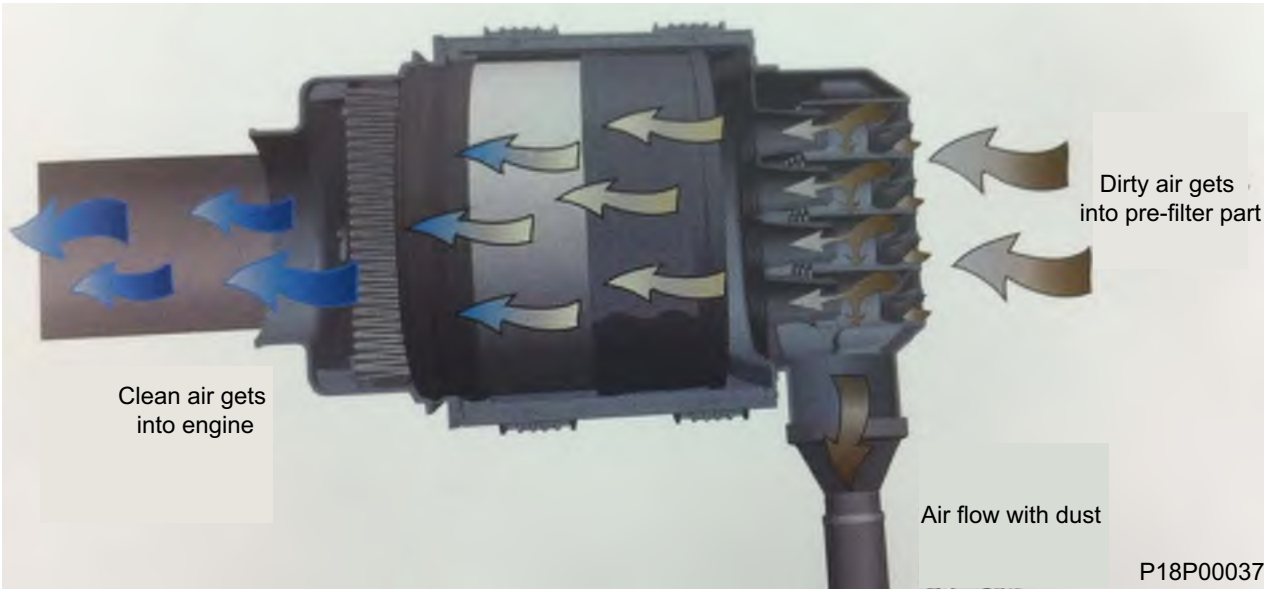
Part Structure and Principle Introduction

The air filter is composed of housing, main filter,safety filter and end cover. Air filter ensures clean and dry air to enter engine through main filter element and safety filter element. When engine operates, air enters air filter through pre-filter, and is filtered by main filter element and is then secondarily filtered by safety filter element,as shown in figure below:



P18P00036

1. Shell
1. Main filter element
2. Safety filter element
3. Cover



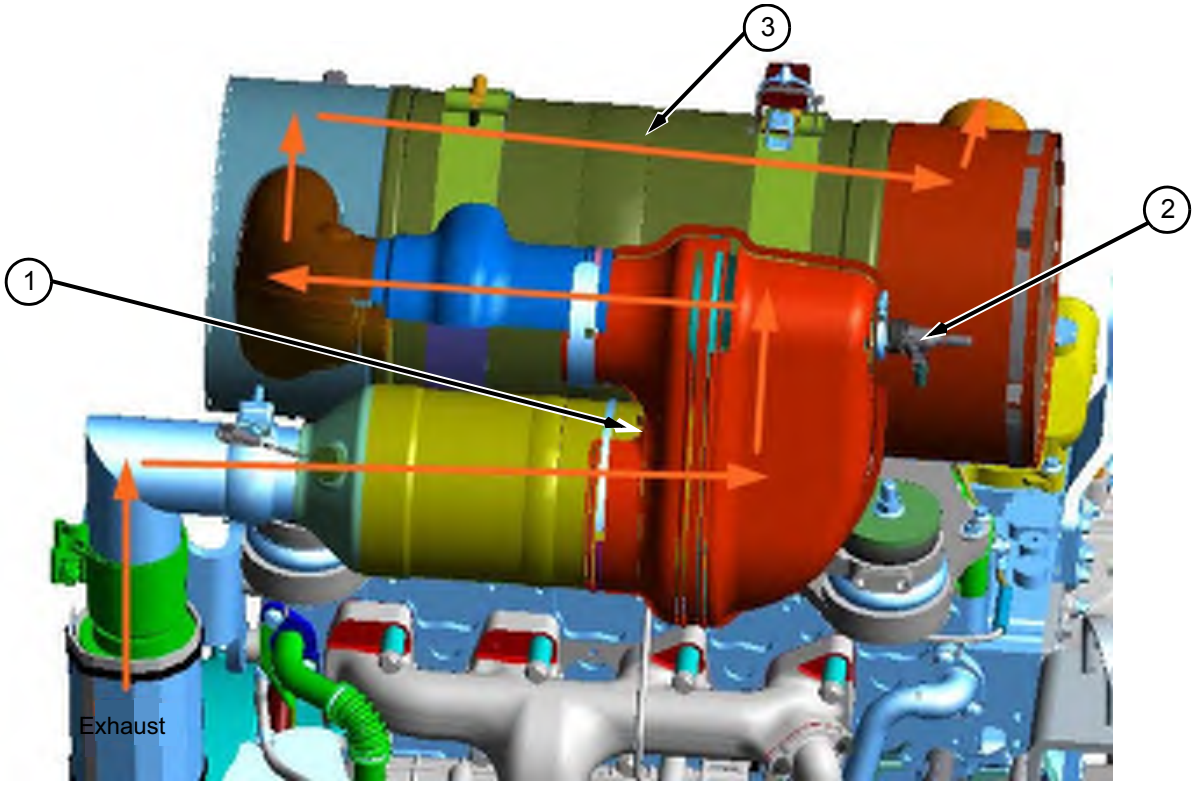
P18P00037

Air filter blocked alert of this machine is the electronic induction type. When the filter works for a period of time, much dust is accumulated on filter element, and air resistance through filter is increased. When circulating air resistance is above 6.2KPa (0.0632214kgf/cm³), air filter blockage sensor installed between air filter and turbocharger will transmit signal to air filter alert indicator on instrument panel. When the indicator goes on, air filter shall be maintained.

Diesel Particle Filter System

Part Structure and Principle Introduction

The main function of DPF (Diesel Particle Filter) is to reduce the harmful substance of engine exhaust in order to conform with emission standard. Particulates and NOx emission of the model conform with the emission standard of Tier 4Final/Euro Stage IV.



P18P00038

1. DOC
2. DEF nozzle
3. SCR

Terminology:

DOC: Diesel Oxidation Catalyst

SCR: Selective Catalytic Reduction

Diesel particle filter of the model adopts DOC+SCR routine. When exhaust passes DOC, under the function of catalyzer, hydrocarbon HC is oxidized to CO2 and water. When exhaust passes SCR, nitride oxides NOx is reduced to nitrogen and water.

The reaction in the DOC:

HC (Hydrocarbon Compounds) + O2 → H_2O + CO_2

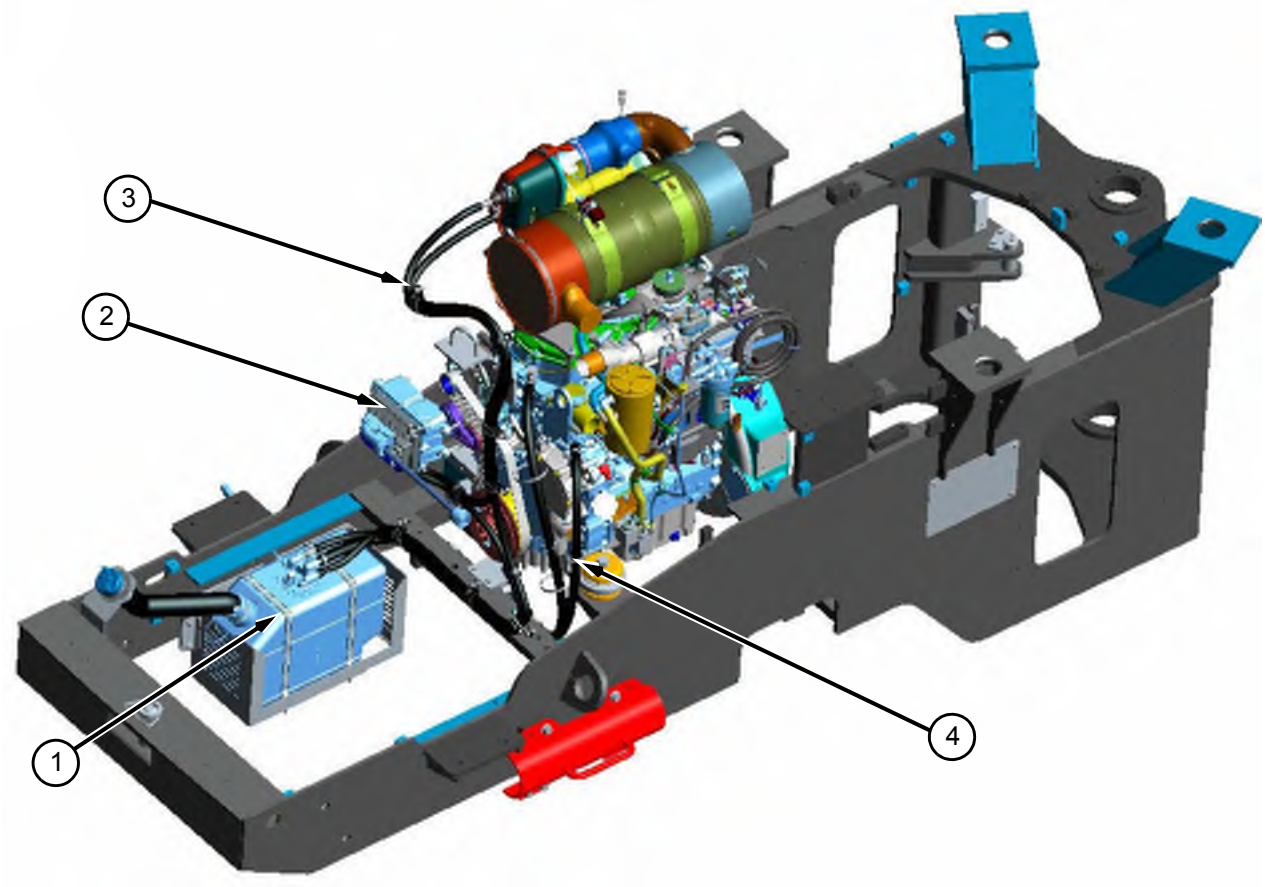
The reaction in the SCR:

NO_x(nitrogen oxides) + NH_3(ammonia)+ O_2 → (catalytic reaction) → N_2 + H_2O.

DEF pipeline assembly

Components and position

DEF pipe-line assembly includes DEF tank, DEF pump, DEF pipe-line and water way.

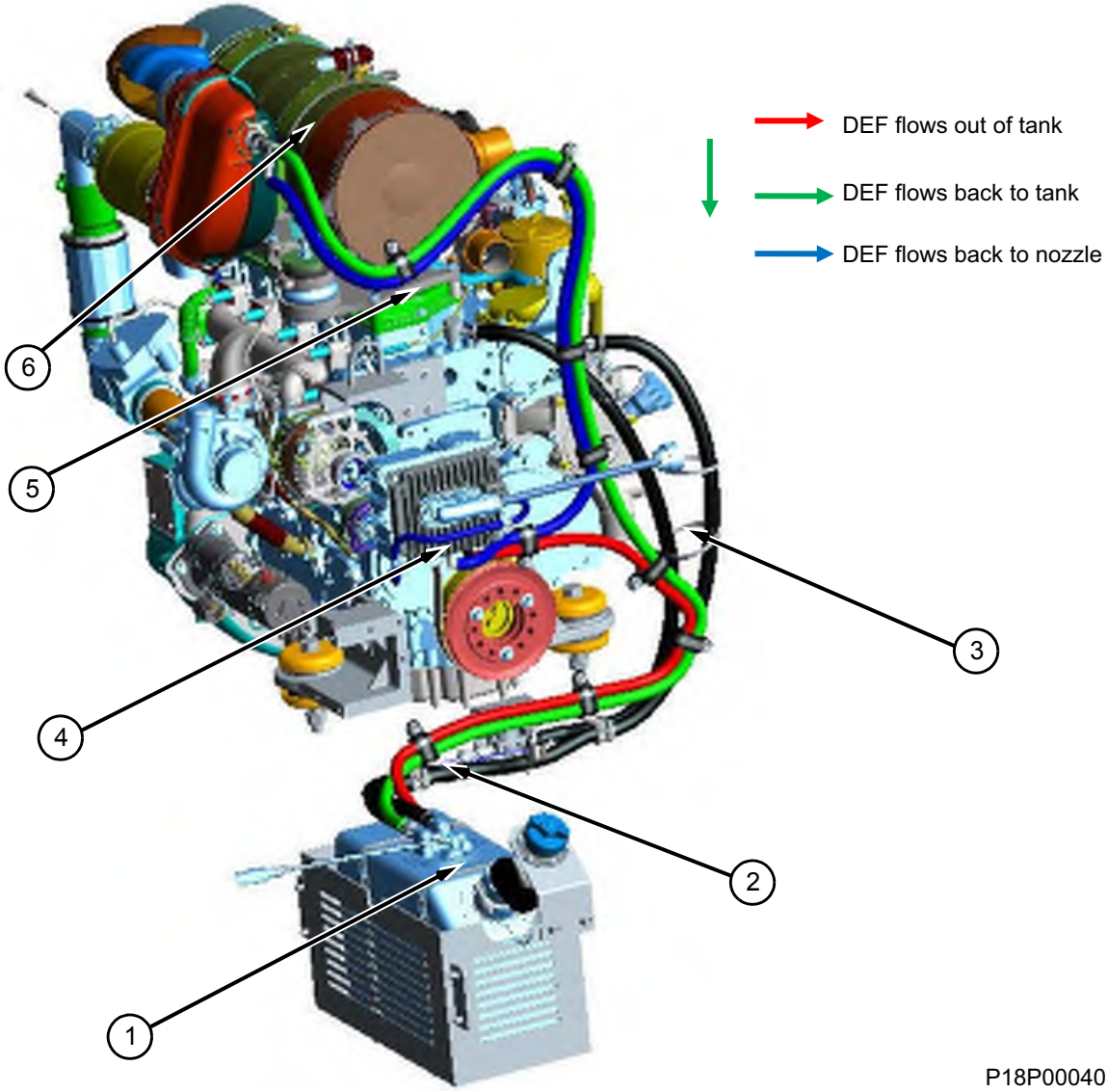


P18P00039

1. DEF tank
2. DEF pump
3. DEF pipe-line
4. Water way

Description of principle diagram and working principle

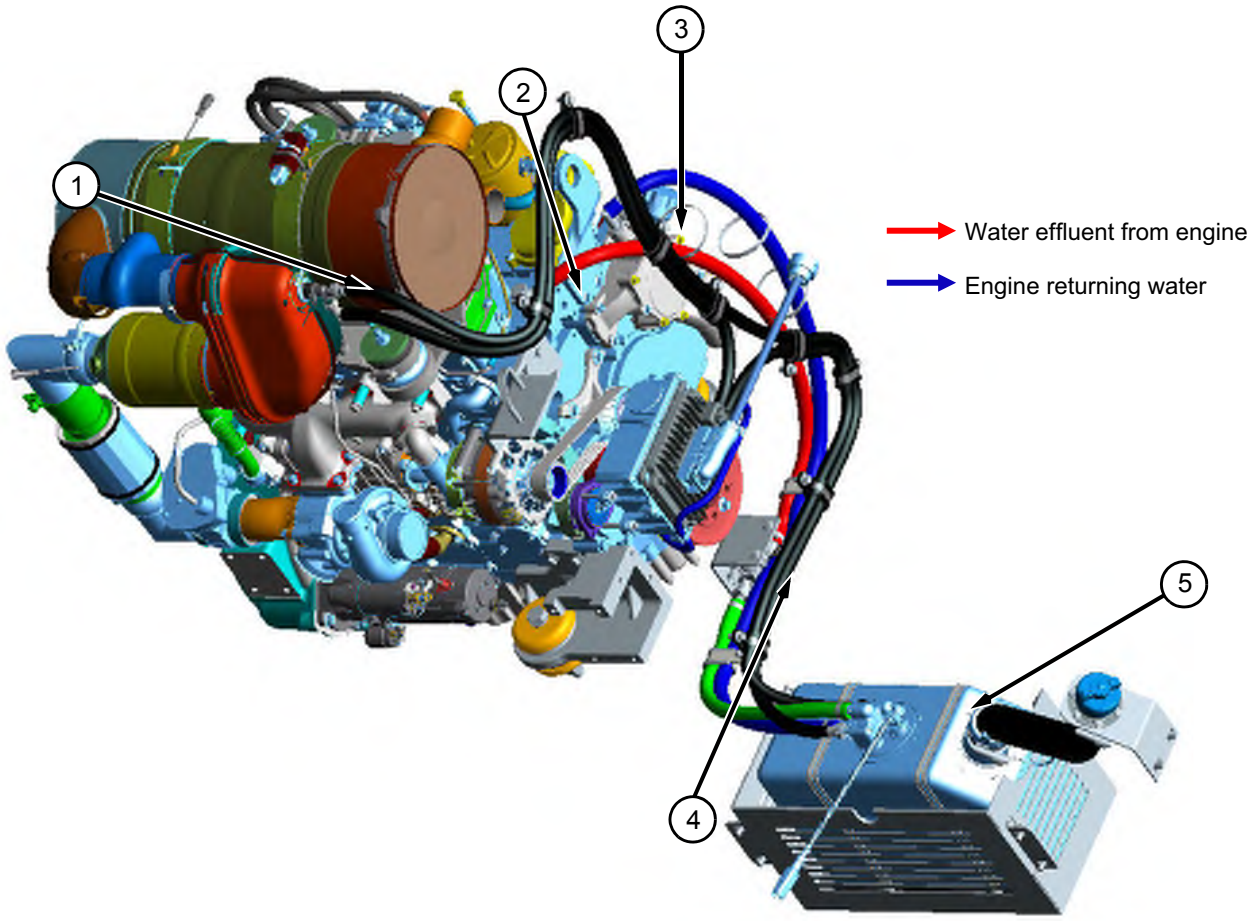
The function of DEF pipe-line is to provide appropriate amounts of DEF for DPF (Diesel Particle Filter) system in order to reduce nitride oxides content of exhaust. DEF is pumped to DEF pump from DEF tank via outlet pipe and then transported to injector via pressure pipe. Excess urea returns urea pump from the return pipe.



P18P00040

1. DEF tank
2. DEF outlet pipe
3. DEF liquid return pipe
4. DEF pump
5. DEF pressure pipe
6. Nozzle

Water way is used to transfer engine coolant to DEF tank and heat the DEF solution avoiding the crystallization. When urea temperature is less than -8°C(17.6°F), the solenoid water valve of water way opens, and engine coolant enters into urea tank to prevent urea solution from freeze, however, when urea temperature exceeds 5°C(41°F), the solenoid water valve of water way closes to prevent urea solution from precipitation out because of being excessively heated.



P18P00041

1. DEF nozzle
2. Engine water outlet
3. Engine returning water inlet
4. Solenoid water valve
5. DEF tank

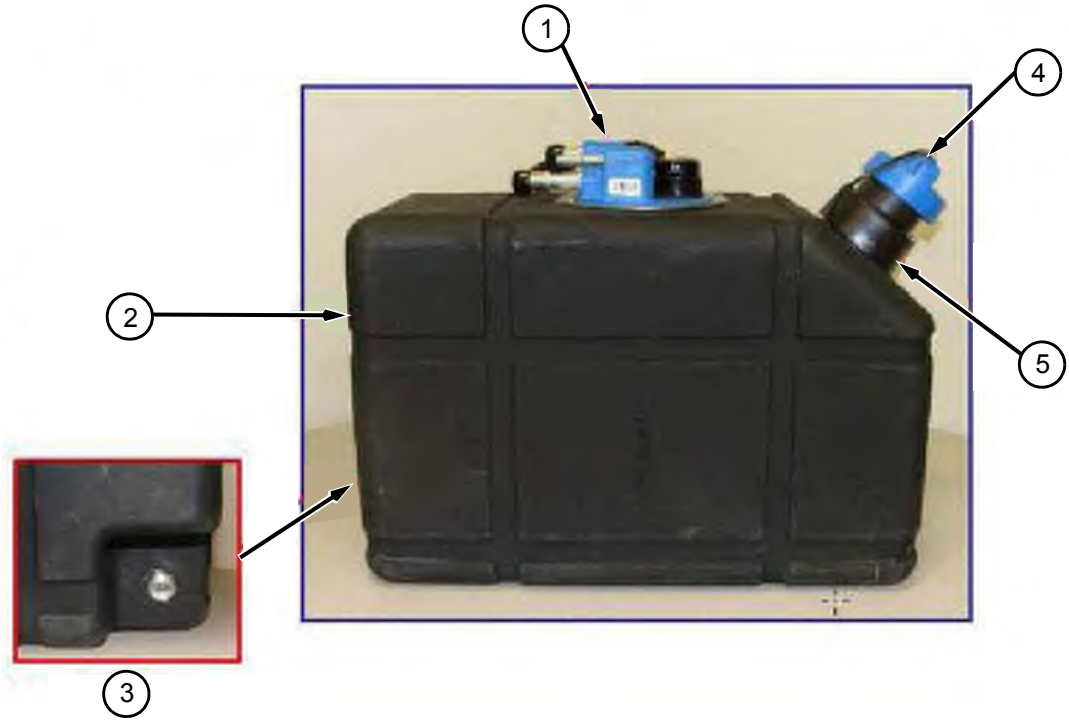
DEF tank

Technical parameters

USABLE VOLUME	19.3L
ELECTRICAL CONNECTOR:	DEUTSCH DT04-4P PIN #1: CAN LOW PIN #2: CAN HIGH PIN #3: GROUND PIN #4: POWER

Part Structure and Principle Introduction

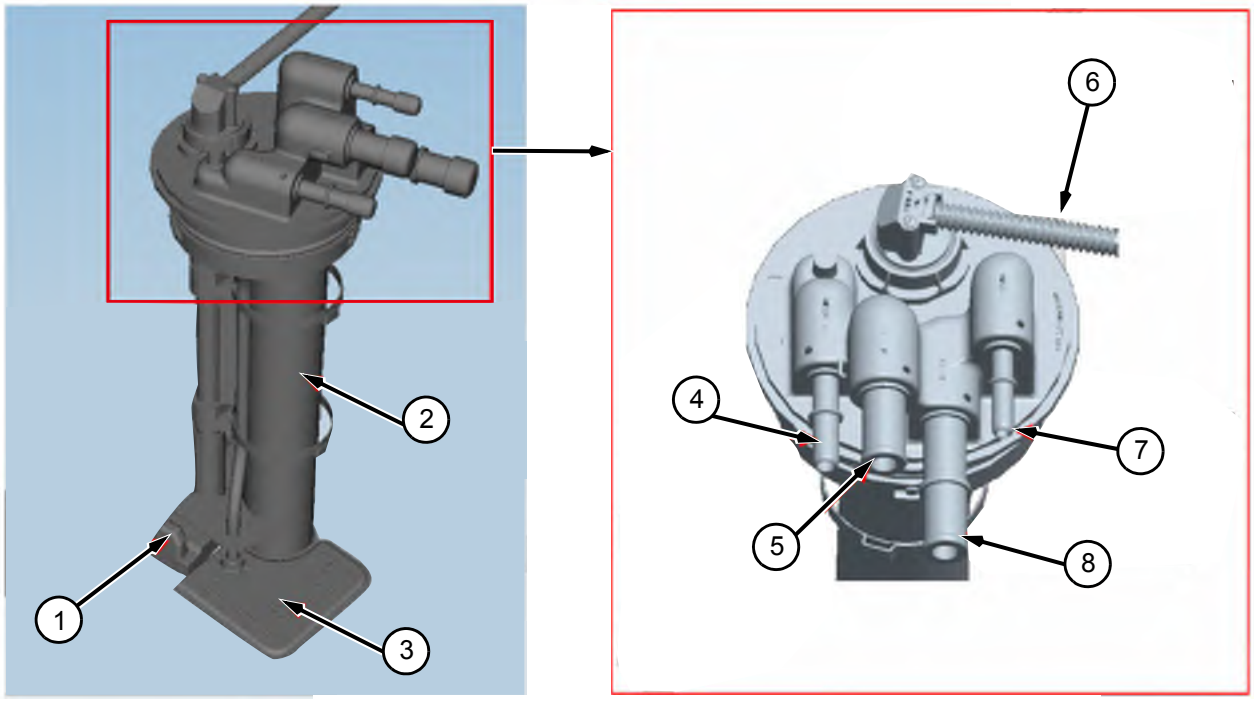
The function of DEF tank is to store DEF solution and provide DEF for DPF (Diesel Particle Filter) during the machine operates. DEF tank consists of shell, multi-functional head unit and cover. There are three sensors in the multi-functional head unit: temperature sensor, liquid level sensor and quality sensor. Temperature sensor detects DEF solution temperature and transports signal to ECM, when DEF temperature is less than -8°C, the solenoid water valve is opened, and engine coolant enters into def tank to prevent DEF solution from freezing, however, when DEF temperature exceeds 5°C, the solenoid water valve is closed to block coolant entering and prevent DEF solution from being excessively heated. Fuel level sensor detects the surplus of DEF solution and transports signal to ECM, if DEF fuel lever is less than alarm value, the situation will trigger low fuel lever alarm and remind the operator of adding DEF. Mass sensor detects DEF mass, if user wrong adds other oils or water,or the concentration of DEF solution is unqualified, these situations will lead to alarm and remind the operator of adding DEF.



P18P00042

1. Multifunction DEF Header Unit
2. Tank
3. Drain Plug
4. Fill Cap
5. Fill Port Adapter

Multi-functional head unit



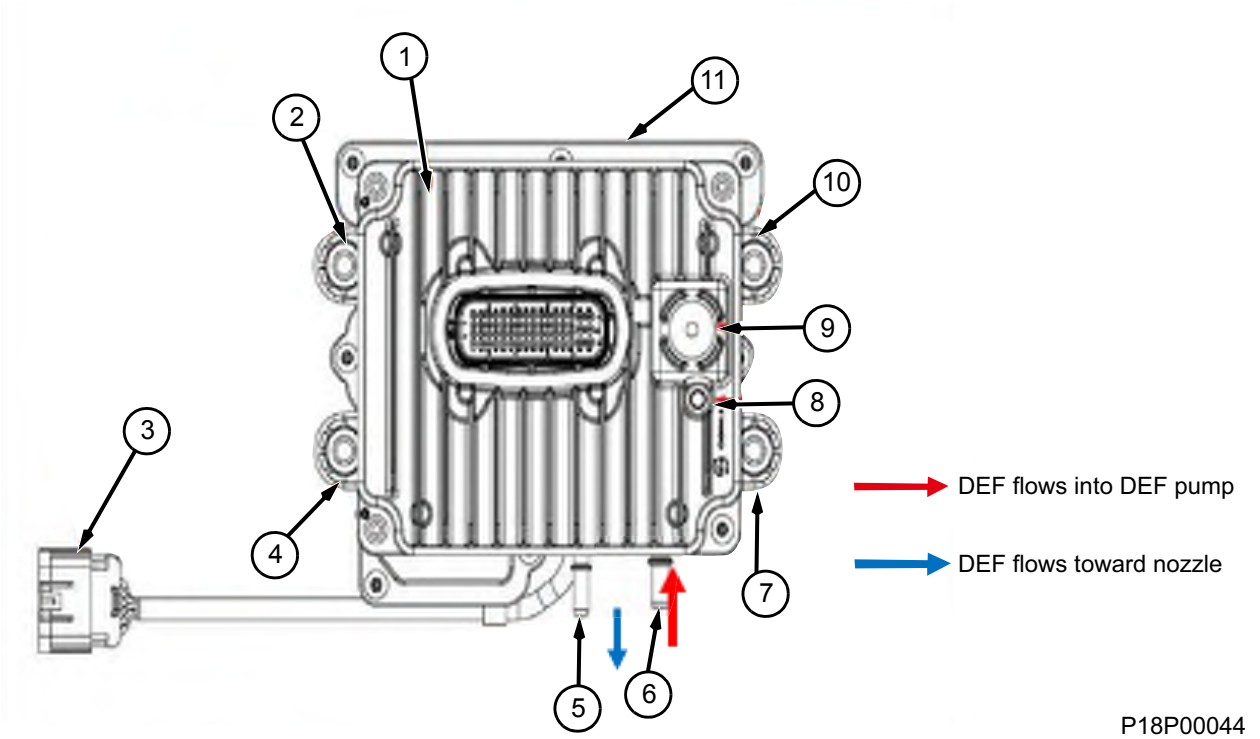
P18P00043

1. DEF level and temp sensor assembly
2. DEF tank heating tube (engine coolant flow internally)
3. DEF suction filter on pick up
4. DEF outlet
5. Coolant inlet
6. Electrical connection flying lead - 375mm long
7. DEF inlet
8. Coolant outlet

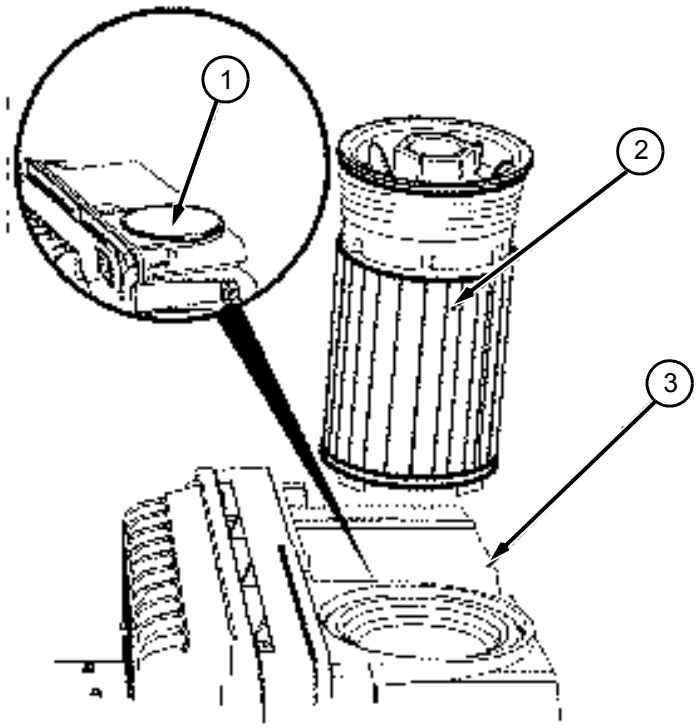
DEF pump

Part Structure and Principle Introduction

Urea pump will pump urea solution from urea tank, and the urea solution is transported to the nozzle of diesel particle filter after filtering.



1. DCU
2. Mounting Tab
3. PEU Harness Connectror
4. Mounting Tab
5. DEF Outlet to injector
6. DEF inlet from Tank
7. Mounting Tab
8. Harness Restraint
9. Vent
10. Mounting Tab
11. Cap for serviceable filter on top of unit



P18P00045

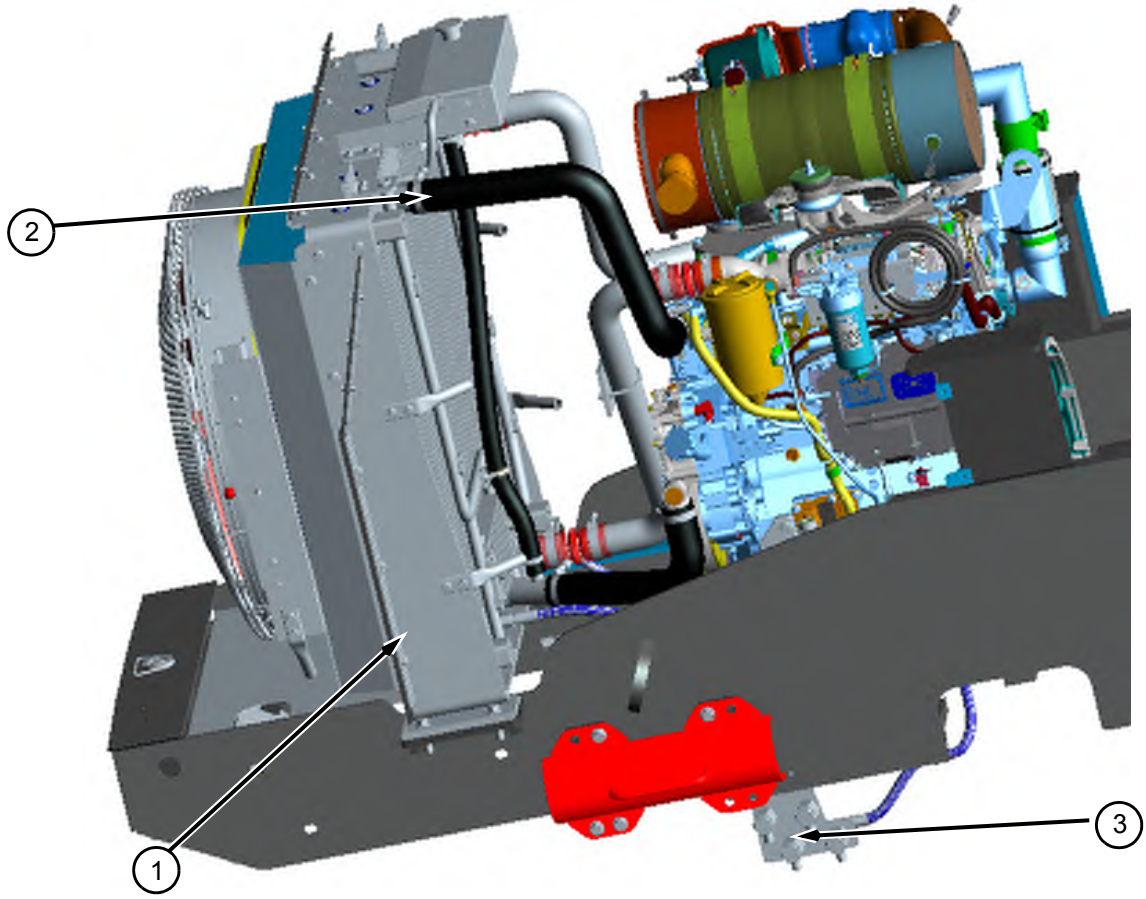
1. Protection shield
2. Strainer assembly
3. Housing

Cooling system

Overview

Components and position

The radiator system is composed of radiator mounting, radiator pipe and oil drain device.



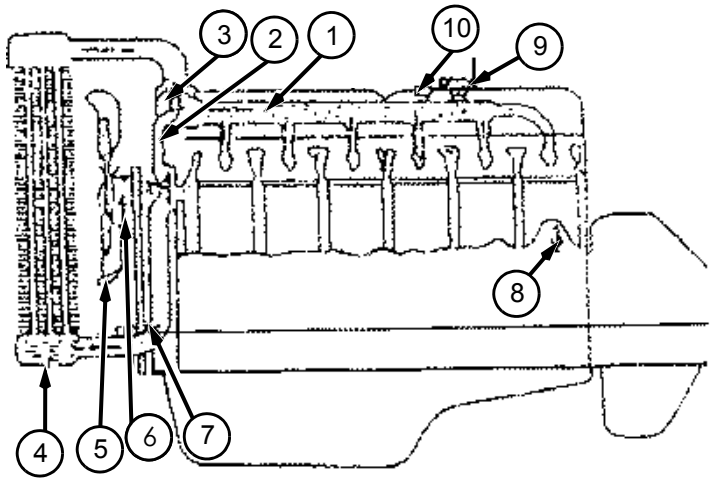
P18P00046

1. Radiator mounting
2. Radiator pipe
3. Oil drain device

Description of principle diagram and working principle

Cooling system comprises a radiator and corresponding connecting lines, where the radiator is composed of a water radiator, an air-air intercooler, a hydraulic oil radiator and a torque converter oil radiator. Its function is to radiate heat produced by each part (or system) into the air along with cooling air in order to ensure each part works properly in appropriate temperature range.

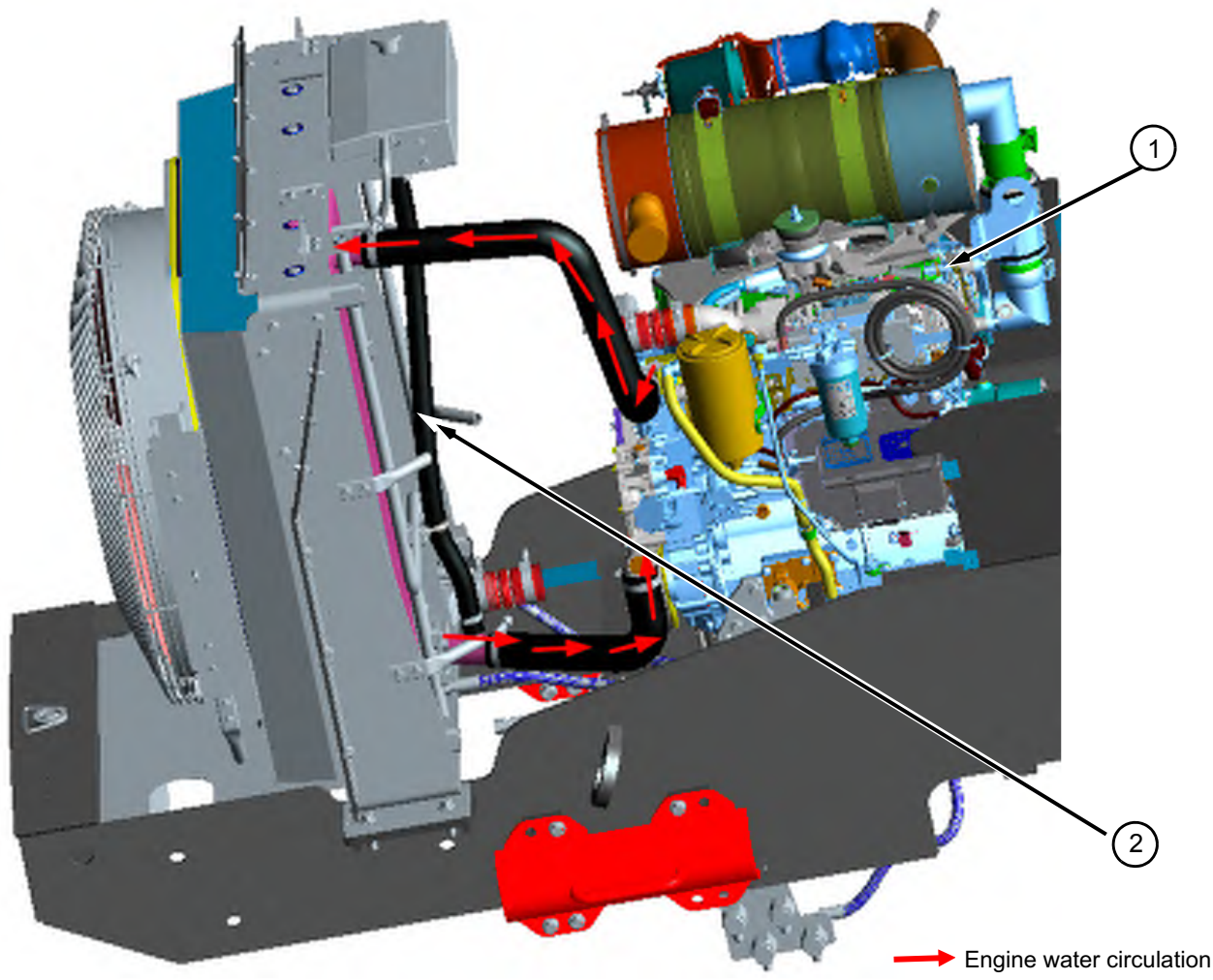
As shown below, diesel engine cooling system mainly comprises a radiator (water tank), a water pump, a fan, a thermostat, an engine oil cooler, water intake and outtake pipes, etc.



P18P00047

1. Water outlet pipe assembly
2. Small circulation
3. Thermostat
4. Radiator
5. Fan
6. Water pump
7. Engine oil radiator
8. Water drain valve
9. Heating valve
10. Water temperature sensor

Cooling system of this machine adopts hydraulic to drive fan and adopts suction mode to cool. The system adopts forced closed circulating water cooling system. Working principle of system is as follows: water outlet at lower part of cooler is connected with water inlet of engine oil cooler via water hose, water outlet of engine oil cooler is connected with water pump via water hose, water pump pumps coolant into cylinder block water passage, coolant firstly cools cylinder through water jacket inside cylinder block, then flows up to cool cylinder head, and is collected by water outlet header pipe to reach thermostat. When coolant temperature is lower than 84°C(183.2°F), thermostat is closed, and all coolant is bypassed to water pump inlet. At the moment, coolant is only circulating between cylinder block and cylinder head, so that warm-up can be quickly realized. When coolant temperature is above 82°C(179.6°F), thermostat starts to be opened, part of coolant flows to water inlet at upper part of cooler and enters radiator to be cooled by cooling fan. When coolant temperature is above 95°C(203°F), thermostat is totally opened, bypass hole is closed, and all coolant is cooled by radiator. The coolant flowing direction at the moment is shown in the chart.

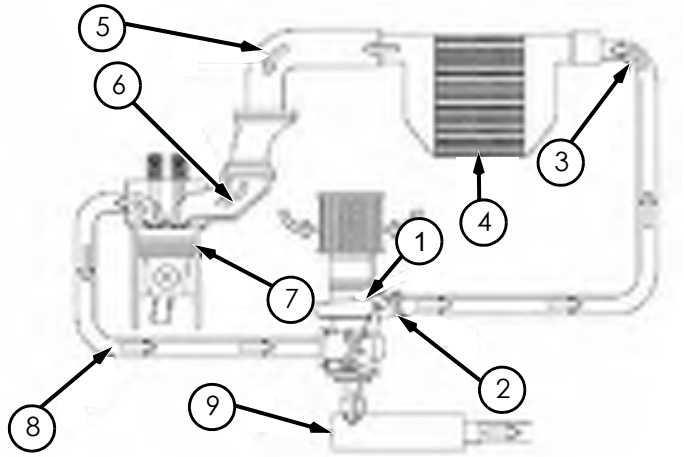


P18P00048

1. Engine
2. Water radiator

Air-air intercooler radiator

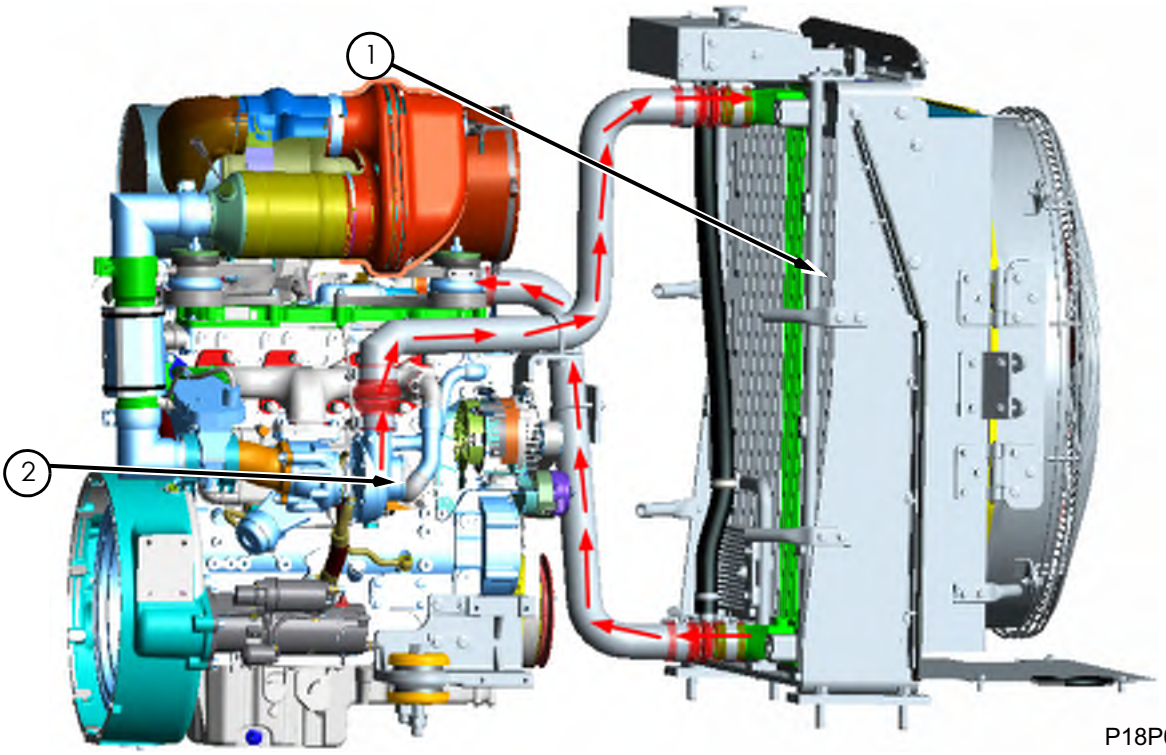
Air-air intercooler has the main function of cooling high-temperature high-pressure gas across turbocharger and reducing temperature of air entering engine combustion chamber to increase air density. Its working principle is shown in Fig. below. After air is pressurized by turbocharger, temperature rises up sharply, pressure is increased, air flows into air-air intercooler from left air pipe and passes across core of air-air intercooler, external cooling air flows by outside the core to bring away heat of air inside intercooler so as to reduce its temperature to be lower than 80°C(176 °F), and then, the air flows into engine intake manifold and cylinder from right air pipe of air-air intercooler.



P18P00049

1. Booster air inlet
2. Booster air outlet
3. Pressurized cold air
4. Air-air intercooler radiator
5. Pressurized hot air
6. Intake branch pipe
7. Cylinder
8. Exhaust gas
9. Muffler

The air-air inter cooler radiating system of the vehicle arranged as the drawing below.



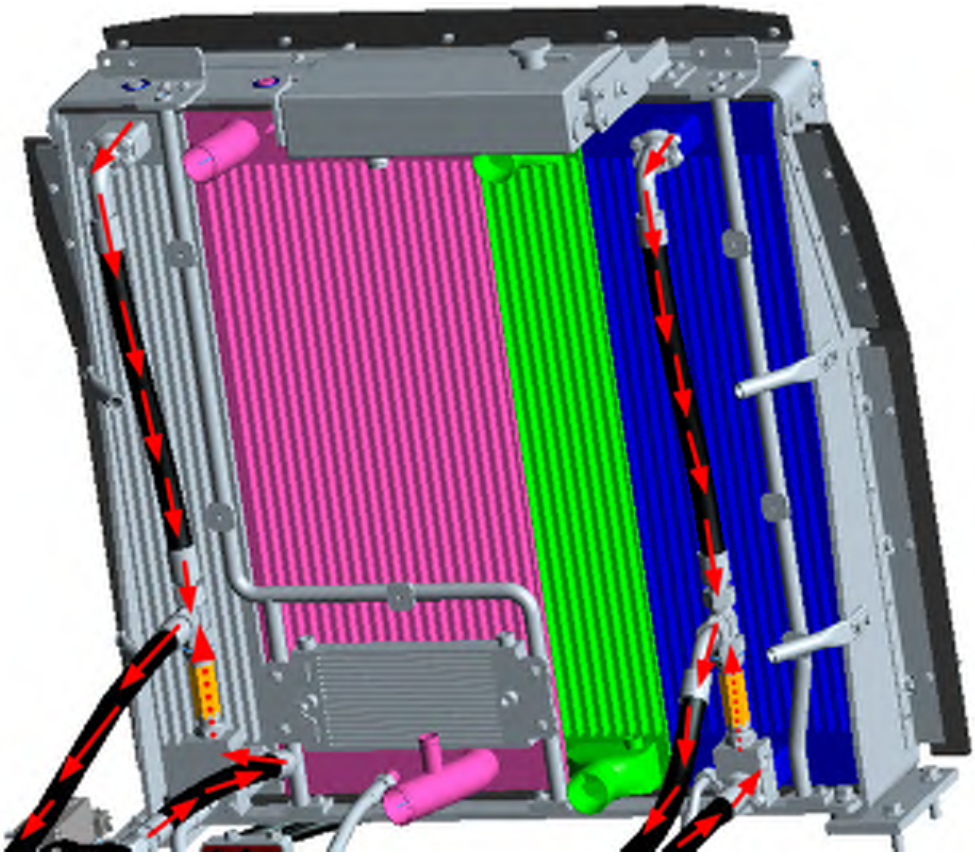
1. Air-air intercooler
2. Turbocharger

Hydraulic oil radiator

Hydraulic oil radiator has the main function of radiating heat generated by hydraulic oil during the working of hydraulic system to avoid temperature of hydraulic oil line from being too high.

Torque converter oil radiator

Torque converter oil radiator has the main function of radiating heat generated by torque converter oil during the working of transmission and torque converter to avoid temperature of torque converter and transmission from being too high and ensure normal working of machine.



P18P00051

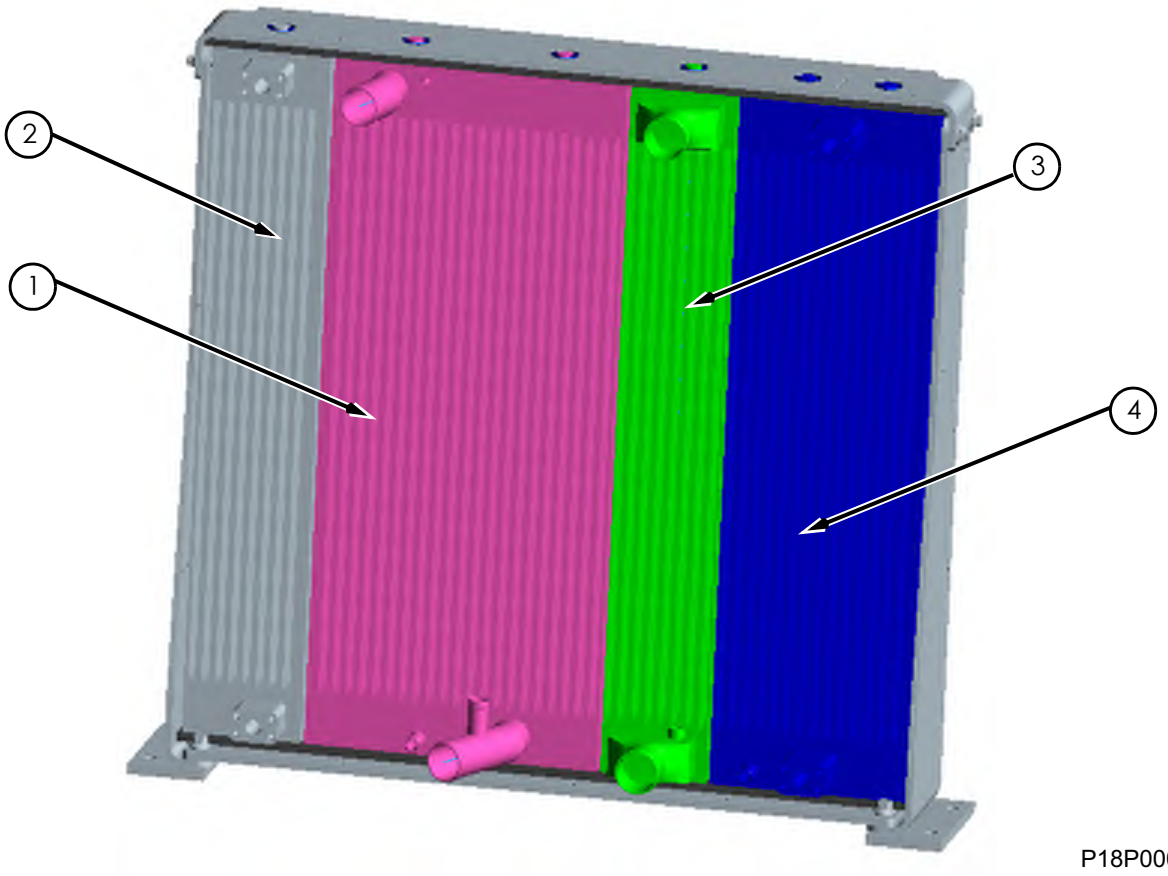
Radiator group

Technical parameters

Water radiator	Core type	Plate-fin type
	Core size (height × width × thickness)	870mm X 454mm X 120mm (34.2519In X 17.87398In X 4.7244In)
Hydraulic oil radiator	Core type	Plate-fin type
	Core size (height × width × thickness)	870mm X 166mm X 120mm (34.2519In X 6.53542In X 4.7244In)
Torque converter oil radiator	Core type	Plate-fin type
	Core size (height × width × thickness)	870mm X 264mm X 120mm (34.2519InX 10.39368In X 4.7244In)
Air-air intercooler	Core type	Plate-fin type
	Core size (height × width × thickness)	870mm X 178mm X 120mm (34.2519In X 7.00786In X 4.7244In)

Part Structure

The radiator assembly is composed of air-air intercooler, water radiator, hydraulic oil radiator and torque converter oil radiator.



P18P00052

1. Water radiator
2. Hydraulic oil radiator
3. Air-air intercooler
4. Torque converter oil radiator

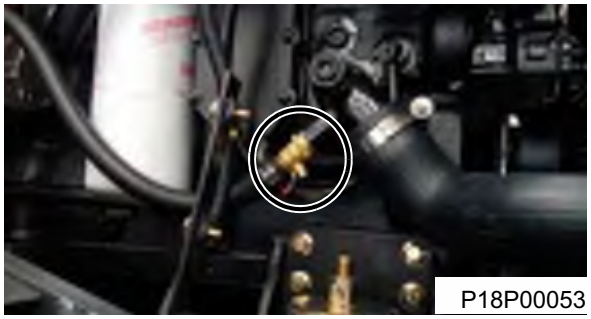
Fan

Technical parameters

	Number of vane	Diameter	Mode
Fan	12	880mm\ 34.6456In	Induced draft

Refilling and replacement of coolant

1. Completely mix water and anti-freeze in advance according to selected cooling proportion.
2. Park machine on flat ground, apply parking brake and shut down engine.
3. Turn on the power switch (-); insert the key into the start switch and turn to 1st gear clockwise to power on the machine, pull the change-over switch of air conditioning system to heating position.
4. Open engine hood, and turn the manual valve on the water inlet pipe of engine to ON position (at which, valve handle is consistent with line route).


P18P00053

5. (Only operate this step in replacing coolant.) Put a container with the capacity of about 35 L at rear left side of machine, connect one hose into water drain valve of drain hose, unscrew auxiliary tank cover, loosen water drain valve so that coolant flows into the container, and tighten water drain valve after draining coolant.
6. Slowly open auxiliary tank cover (wait until engine coolant temperature drops to be below 50°C\122°F), slowly add coolant until coolant level is within 1 cm higher than wellhead bottom, and remain stable within ten minutes.


P18P00054



P18P00055

7. Tighten auxiliary tank cover, start engine, firstly operate it for 5 minutes at low idle speed, then operate it for 5 minutes at high idle speed, and increase coolant temperature to be above 85°C(185°F).
8. Check coolant level through inspection window once again, and after engine coolant temperature drops to be below 50°C(122°F), continue to refill coolant until level is within 1 cm higher than wellhead bottom as necessary.
9. Close the engine hood.

⚠CAUTION

Do not only use the water as coolant

When filling coolant, air in engine cooling system pipe shall be discharged,

Do not refill coolant into hot engine to avoid possible damages to engine body. Wait until engine temperature is below 50°C(122°F).

Fuel System

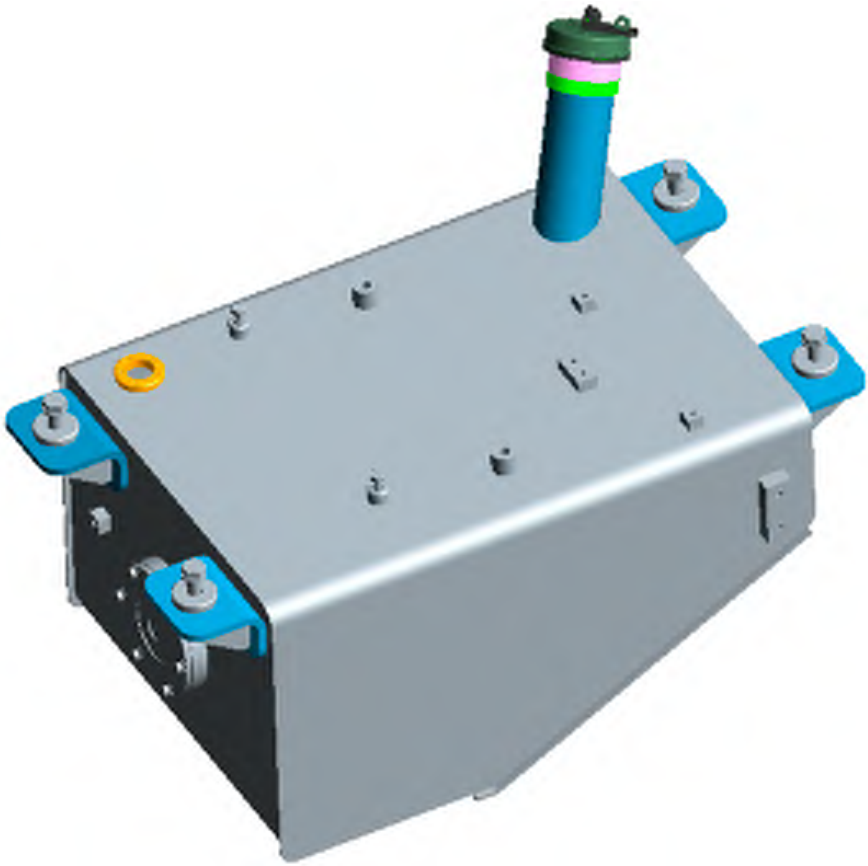
Fuel Tank Assembly

Technical parameters

Effective volume	193L (50.9906USgal)

Part Structure and Principle Introduction

The fuel tank assembly is mainly composed of fuel tank, filler pipe, breather pipe, fuel tank cover.

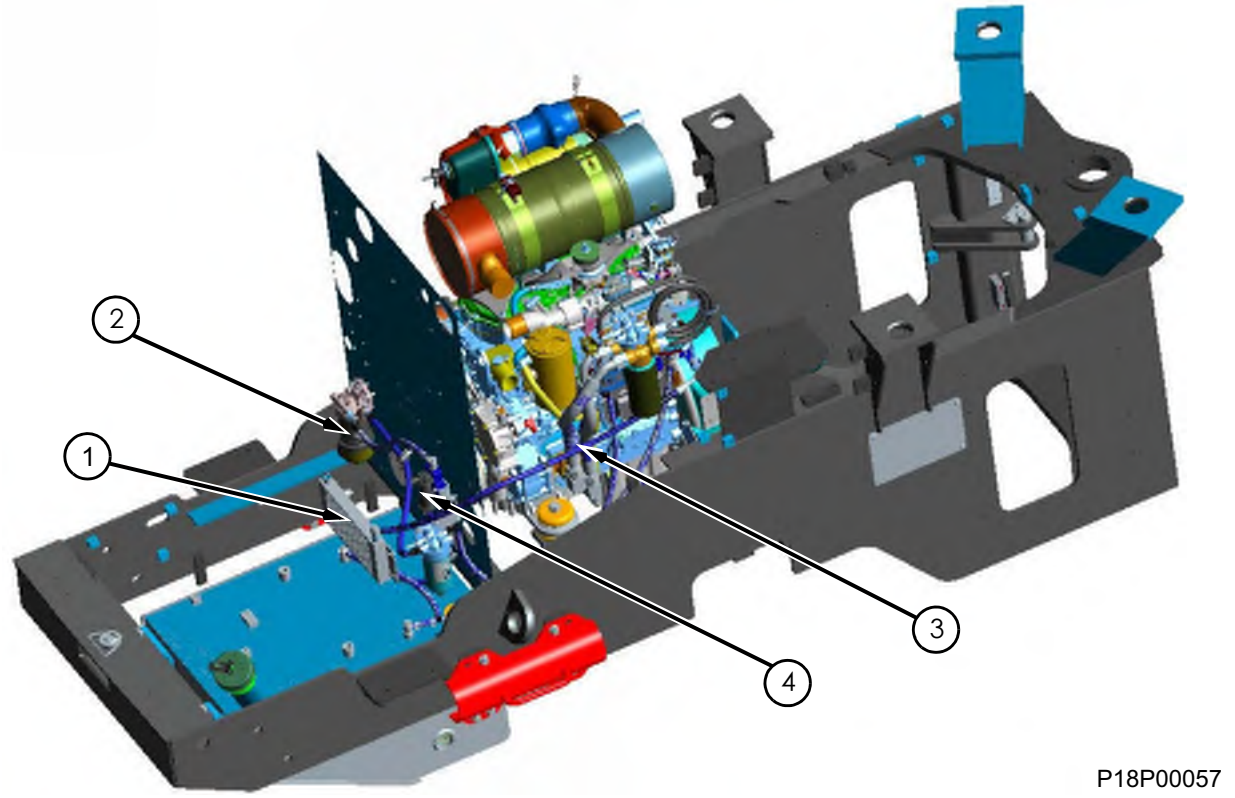


P18P00056

Fuel Lines

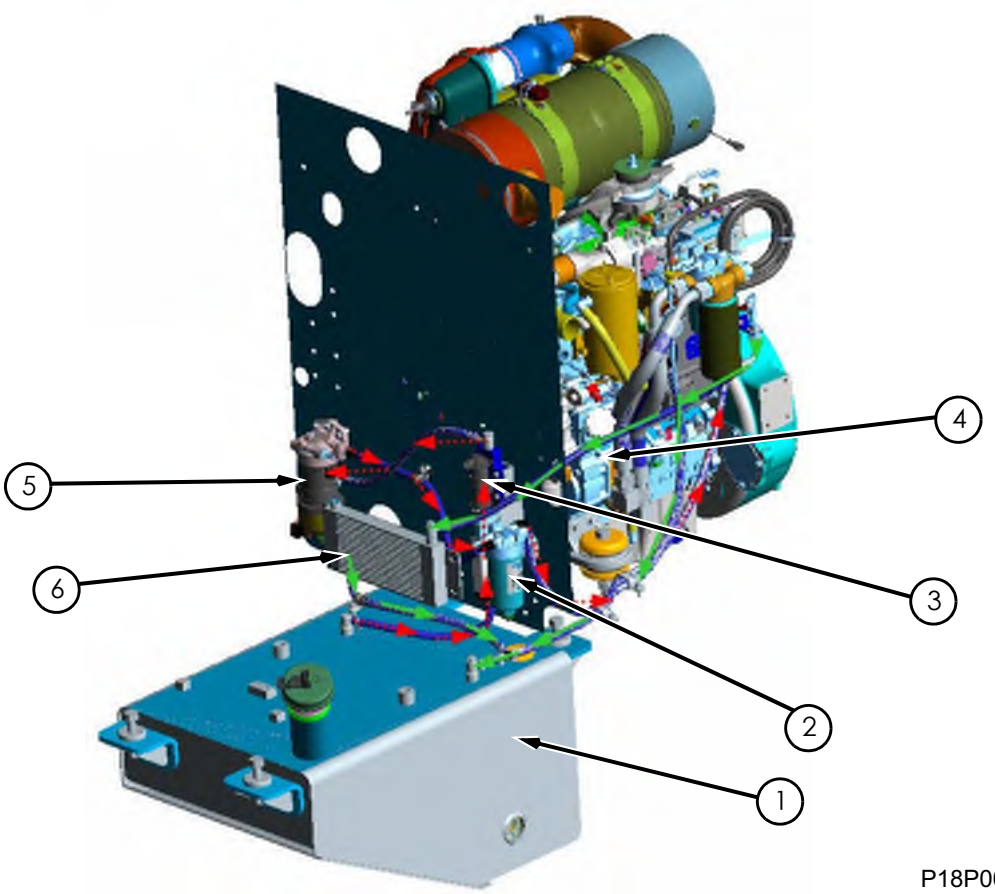
Overview-components and position

The fuel line is composed of fuel hose, fuel filter and fuel radiator.



1. Fuel radiator
2. Oil-water separator
3. Fuel hose
4. Fuel pump

Description of principle diagram and working principle



P18P00058

1. Fuel tank
2. Fuel filter
3. Oil transfer pump
4. High-pressure fuel pump
5. Oil-water separator
6. Fuel radiator

Fuel system acts to provide engine with clean and sufficient fuel, which thus ensures proper operation of engine. Its working principle is shown above: when engine works, oil transfer pump sucks fuel from fuel tank, then oil-water separator eliminates water from fuel, next fuel filter eliminates Impurities from fuel, and finally fuel enters high pressure fuel pump. The fuel is pressurized by the high pressure fuel pump and filled into high pressure common rail. Then, the fuel in the common rail enters into injector, while the spare fuel returns back to the outlet of high pressure fuel pump. The injector is controlled by ECM. The diesel fuel is injected into combustion chamber, while the spare fuel returns back to the outlet of high pressure fuel pump and then back to fuel tank after cooled.

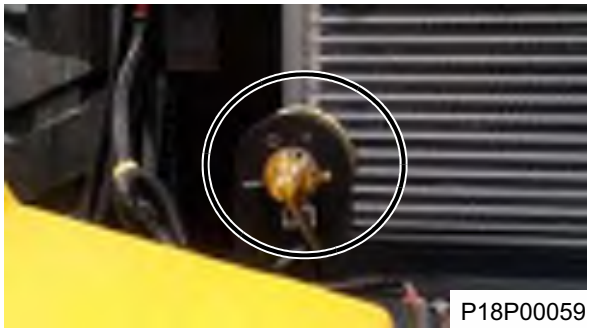
Fuel radiator

The fuel radiator is used for cooling the hot fuel that returns back from engine fuel pump to avoid the hot fuel directly flowing back to the fuel tank and heating the fuel in it.

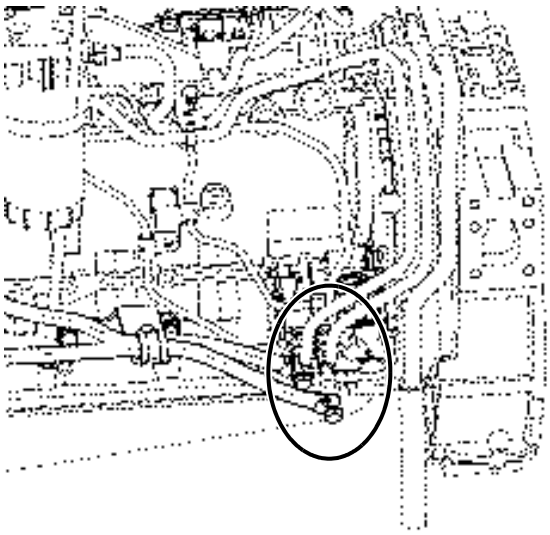
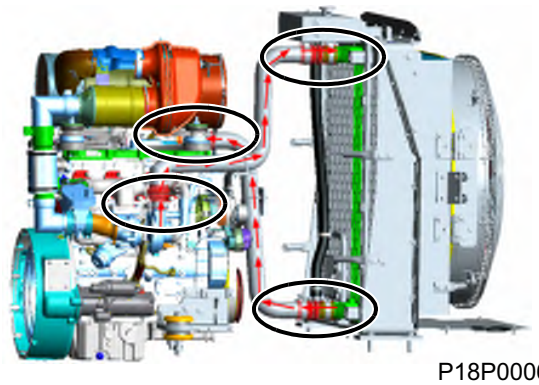
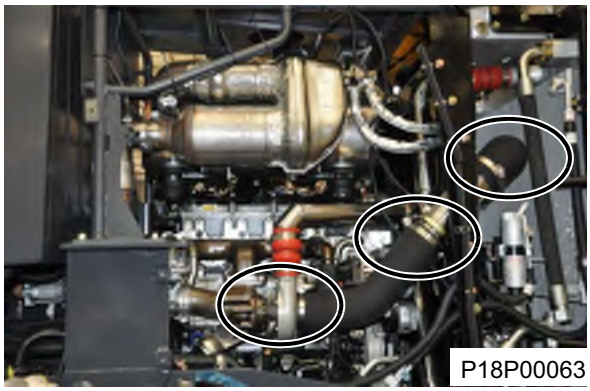
Removal and Installation

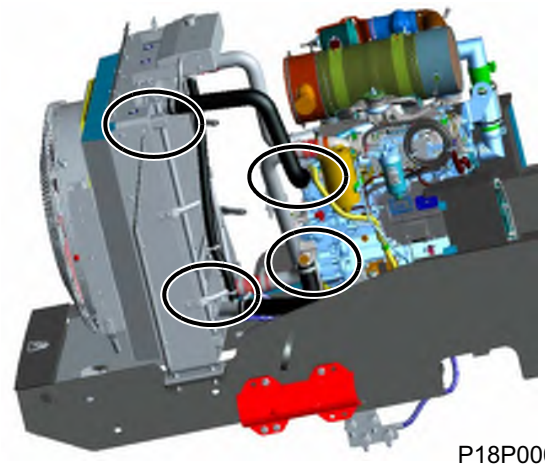
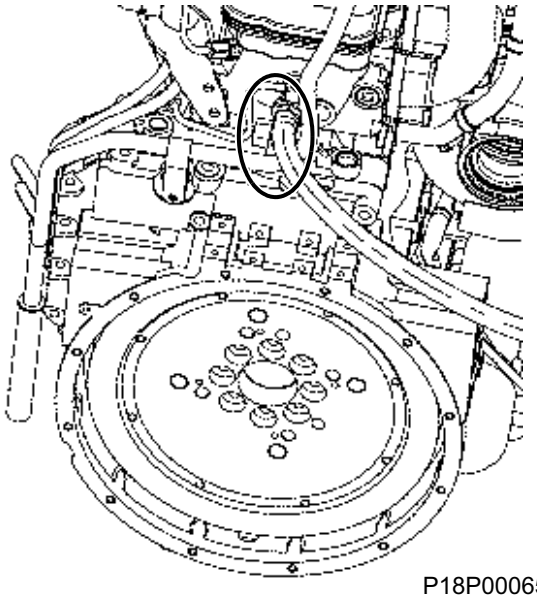
Removal and installation of diesel engine

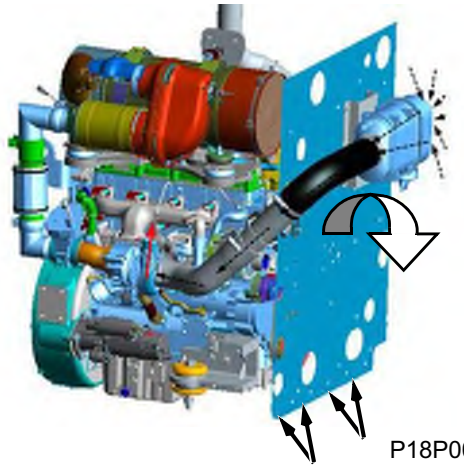
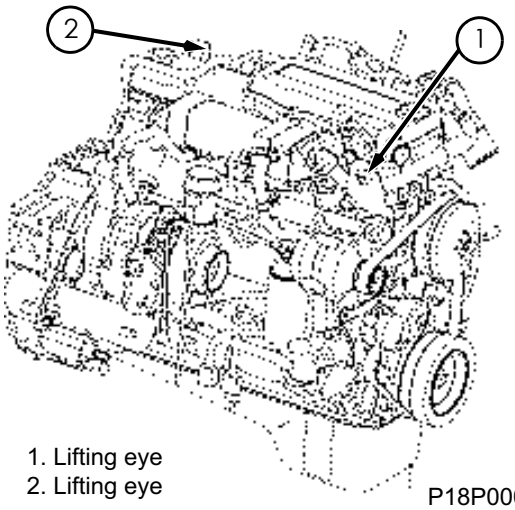
Removal

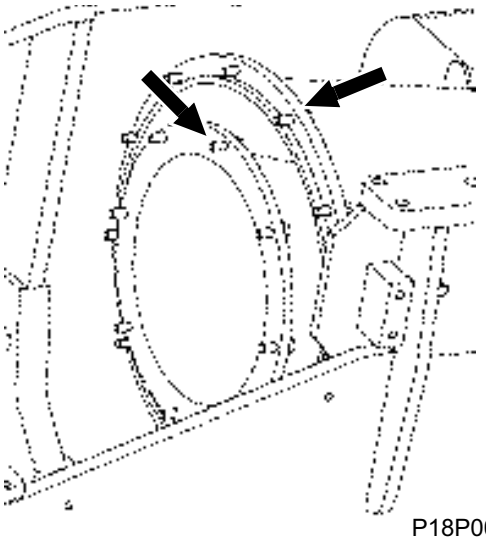
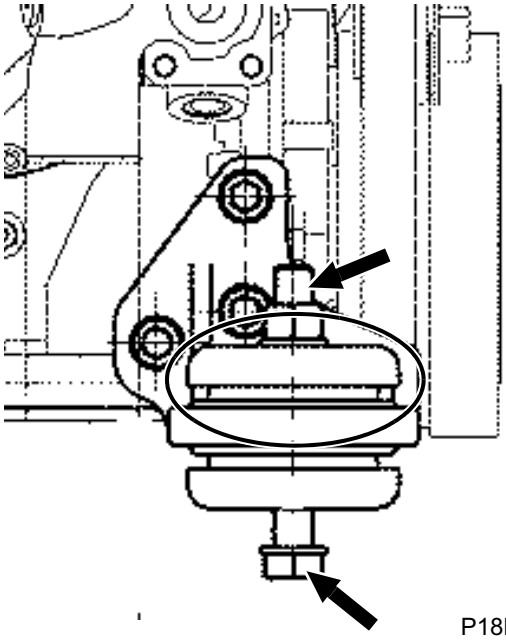
Figures	Contents	Tools
 P18P00059  P18P00060	1. Turn off the negative electrode switch, and hang on a "No operating" warning board.	

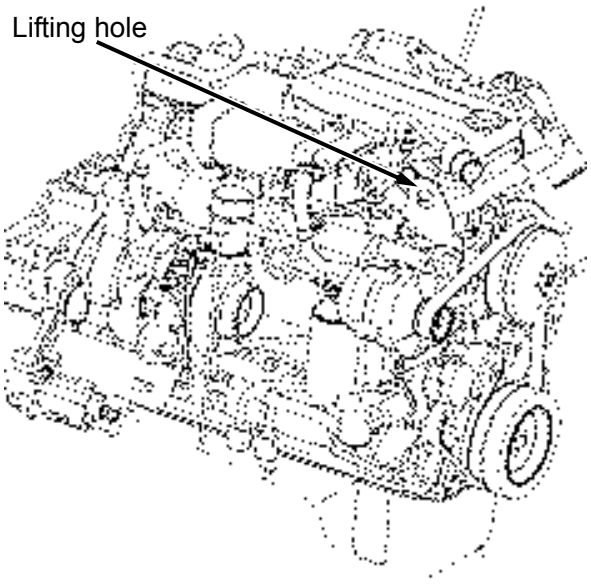
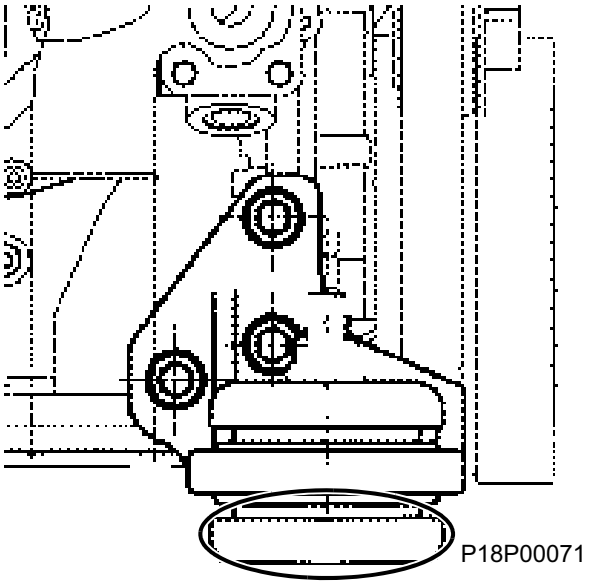
Figures	Contents	Tools
	1. Remove the engine hood top cover according to removal and installation requirements and steps of engine hood. 2. Remove air filter according to the removal steps of air filter and seal every port with plastic seal membrane as required. 3. Remove diesel particle filter and connecting pipe according to the removal steps of diesel particle filter and seal every port with plastic seal membrane as required. 4. Drain the cooled water in the engine to oil collection dish for unified disposal. 5. Remove electrical connector and wiring on engine according to removal and installation requirements and steps of electrical system. 6. Remove A/C compressor, A/C pipe and warm air hose from the engine according to removal and installation requirements and steps of air conditioning system, and seal every ports with plastic sealing membrane as required.	Plastic sealing membrane Oil collecting basin

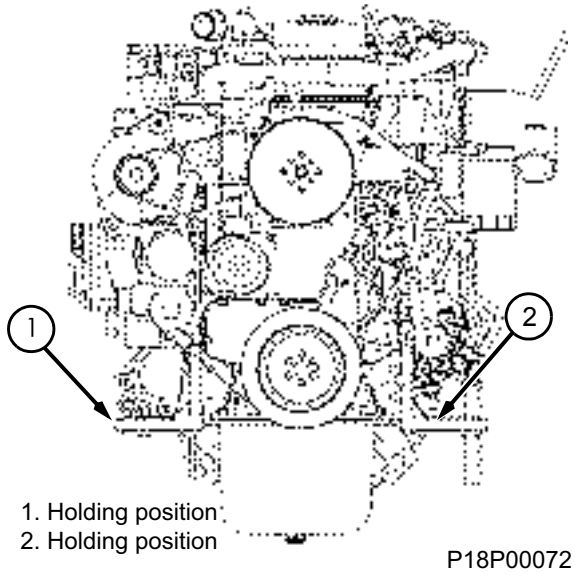
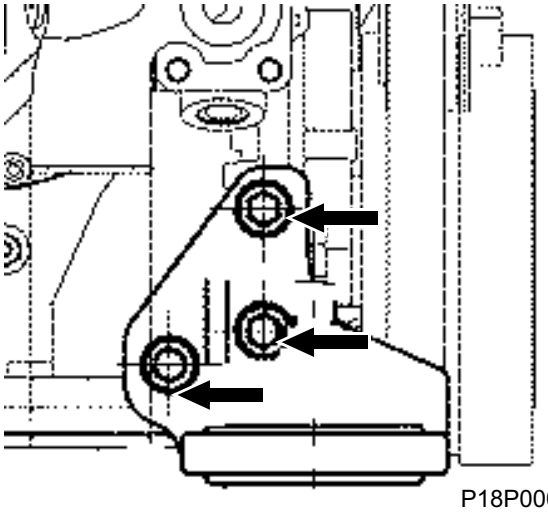
Figures	Contents	Tools
 P18P00061	7. Unscrew the fuel pipe joint screw connected to the diesel engine fuel pump with wrench. Remove the screw, seal gasket and keep them in a plastic bag. Mask the fuel pipe joint with sealing membrane.	Tool: Open-end wrench 19# Plastic sealing bag Plastic sealing membrane
 P18P00062	8. Unscrew the intercooler pipe fixing clamp and bracket. Unscrew the clamps at both ends of intercooler pipe, unplug the pipe and seal every port with plastic seal membrane.	Tool: Open-end wrench 12#, 16# Plastic sealing membrane
 P18P00063	9. Unscrew the clamp at the connection of intake pipe and engine, unplug the intake pipe. Unscrew the connecting clamp between intake pipe and intake hose, take off the intake pipe. Seal every port with plastic sealing membrane.	Tool: Open-end wrench 8# Plastic sealing membrane

Figures	Contents	Tools
 P18P00064	10. Unscrew the clamp at the connection of water inlet pipe, outlet pipe and engine, unplug the water inlet pipe, outlet pipe and seal every port with plastic seal membrane.	Tool: Open-end wrench 8# Plastic sealing membrane
 P18P00065	11. Unscrew the clamp at the connection of water inlet pipe and engine, unplug the water inlet pipe and seal every port with plastic seal membrane.	Tool: Open-end wrench 7# Plastic sealing membrane

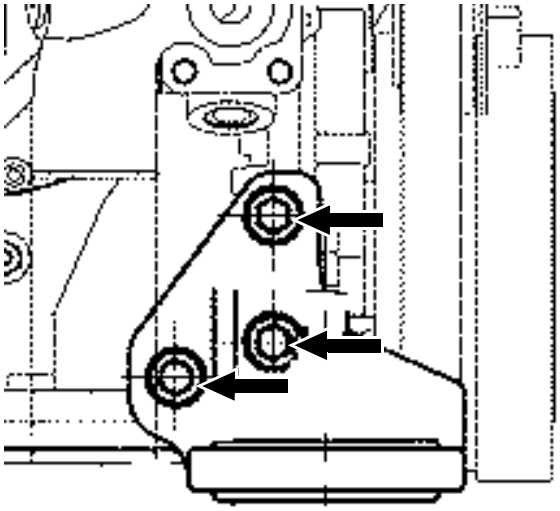
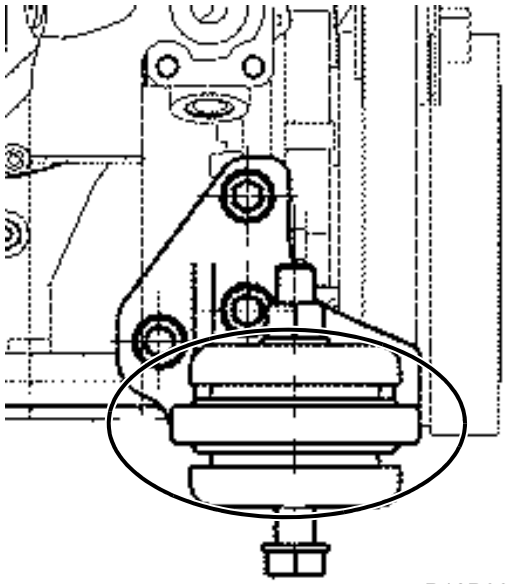
Figures	Contents	Tools
 P18P00066	12. Unscrew the 4 bolts on the heat insulation bracket, and tilt it to the radiator direction by an angle to avoid interference when lifting the engine.	
 1. Lifting eye 2. Lifting eye P18P00067	13. Slowly operate traveling crane, hang lifting eye on engine with hook on wire rope, and tauten wire rope without lifting engine.	Tool: Traveling crane Wire rope with hooks

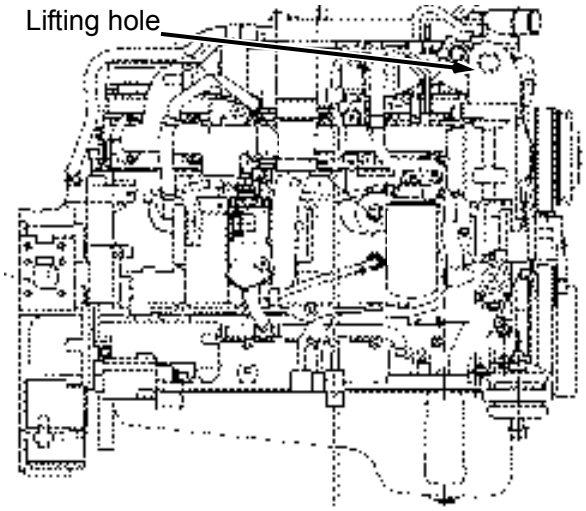
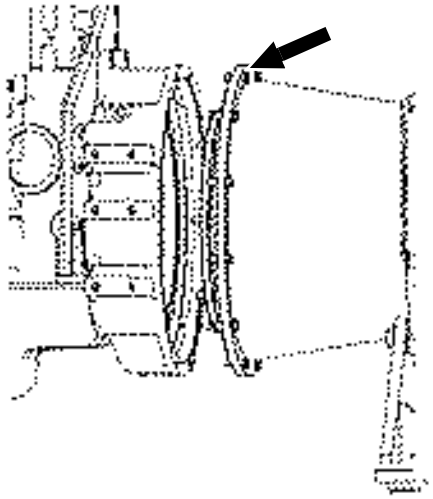
Figures	Contents	Tools
 P18P00068	14. Remove captive bolts on connecting surface of engine and torque converter & engine flywheel according to removal and installation requirements and steps of transmission & torque converter assembly.	
 P18P00069	15. Hold fixing nut of engine with an open-end wrench, and remove captive bolt of engine from under engine mounting support with a blower gun, a rod and a socket. And take down the upper shock absorber and its cover from the engine mounting support.	Tool: Open-end wrench 30#

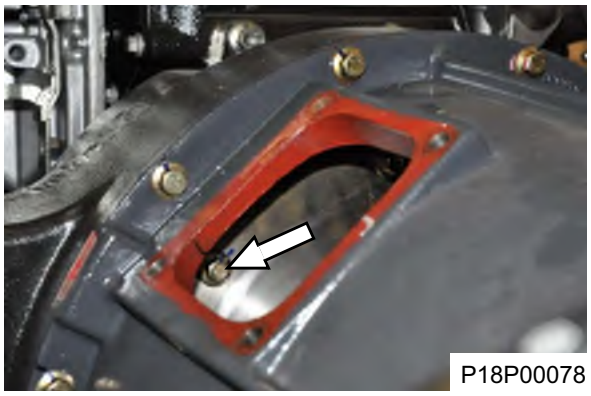
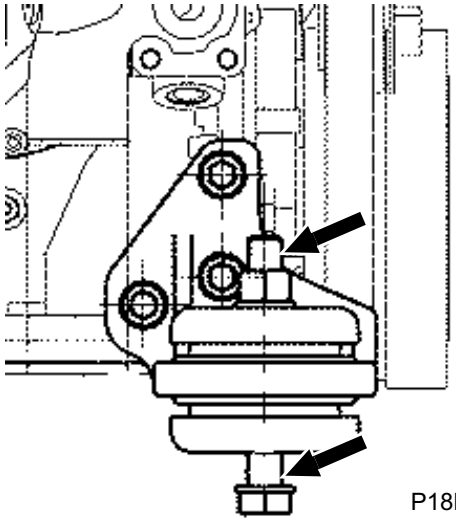
Figures	Contents	Tools
 P18P00070	16. Operate wire rope on traveling crane for lifting hook to pass hook through lifting hole at pulley side of engine, and lift engine as slowly as possible. It is recommended that lifting height is not more than 5 mm.	Traveling crane Wire rope with hooks
 P18P00071	17. Take out the shock absorber and cover under the mounting support of the engine.	

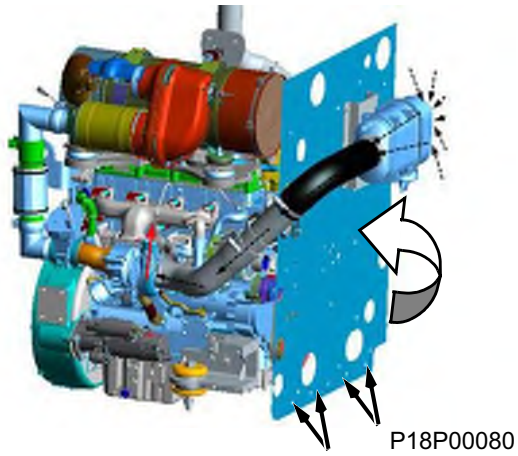
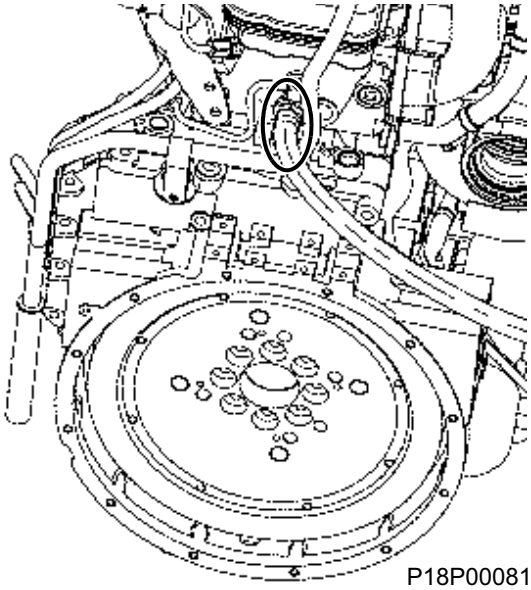
Figures	Contents	Tools
 1. Holding position 2. Holding position P18P00072	18. Slowly operate traveling crane and hold both sides of engine in order to ensure that engine is slowly and steadily lifted out of complete machine and will not collide with other parts of complete machine.	
 P18P00073	19. Loosen captive bolt of engine mounting support with an open-end wrench and take it out, then take down engine mounting support.	Tool: Open-end wrench 16#

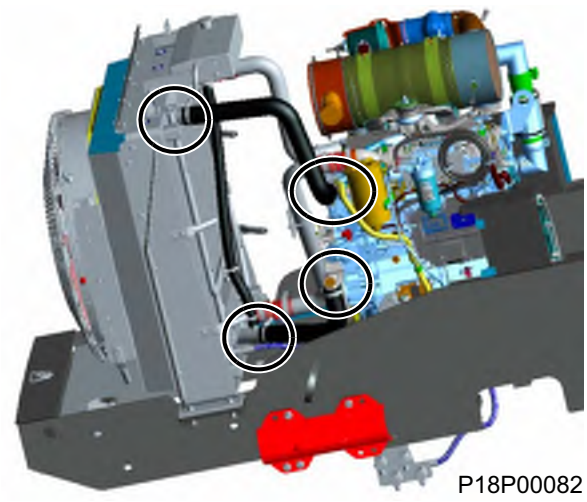
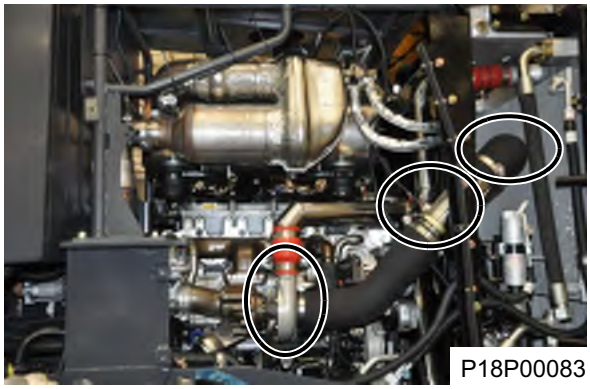
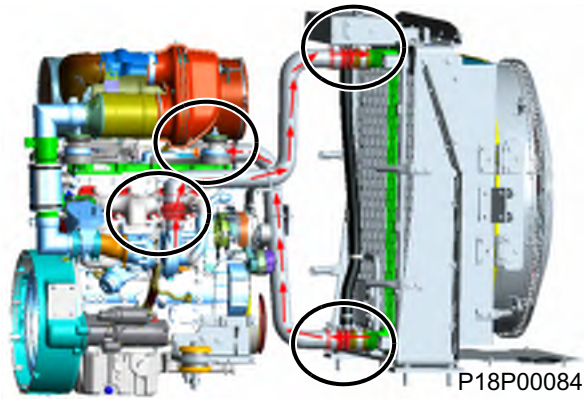
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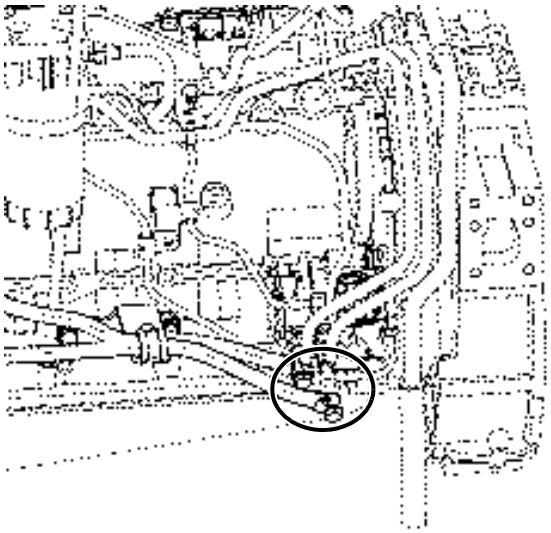
Figures	Contents	Tools
 P18P00074	1. Install engine mounting support on engine with captive bolt for engine mounting support, and pre-tighten captive bolt with an open-end wrench. 2. Tighten mounting base captive bolt of engine with a torque wrench to torque of 120±50N.m (12±5kgf.m).	Tool: Open-end wrench 16#, torque wrench 120±6N.m(12±0.6kgf.m)
 P18P00075	3. Place shock absorber and cover at upper and lower sides of engine mounting support respectively, and adjust shock absorber so that it is installed into hole of mounting support.	

Figures	Contents	Tools
 P18P00076	4. Operate the traveling crane and put down the engine as slow as possible to match the engine surface and gearbox & torque converter assembly surface, and align the holes.	
 P18P00077	5. Install and tighten the bolts and hard washer of the torque converter housing & the engine housing. Tightening torque: 72±6Nm (7.2±0.6kgf.m).	Tool: 16# socket, pneumatic impact wrench, open-end 16# fixed torque spanner

Figures	Contents	Tools
 P18P00078	6. Crank the engine flywheel case to make the torque converter align with mounting threaded hole on the engine flywheel, screw and tighten the fastening bolts and washer for attaching the torque converter to the engine flywheel by hand with a torque of 60±5Nm (6±0.5kgf.m).	Tool: 16# Socket, pneumatic impact wrench, open-end 16# fixed torque spanner
 P18P00079	7. Assemble shock absorber, cap and engine mounting support together by passing engine fasteners such as captive bolt and nut through them. 8. Hold nut with an open-end wrench, and pre-tighten captive bolt of engine from under engine mounting support with a blower gun, a rod and a socket. 9. Re-tighten captive bolt of transmission with a torque wrench according to removal and installation requirements and steps of transmission. 10. Tighten captive bolt of engine with a torque wrench to torque of 1020±6N.m (102±0.6 kgf.m) .	Tool: Open-end wrench 16# 1020±6N.m (102±0.6 kgf.m) torque wrench

Figures	Contents	Tools
 P18P00080	11. Push the heat-insulation bracket to installation position and tighten the 4 anchor bolts.	Tool:
 P18P00081	12. Insert the water inlet pipe into hot water inlet of engine, then clamp it with a clamp.	Tool: Open-end wrench 7#

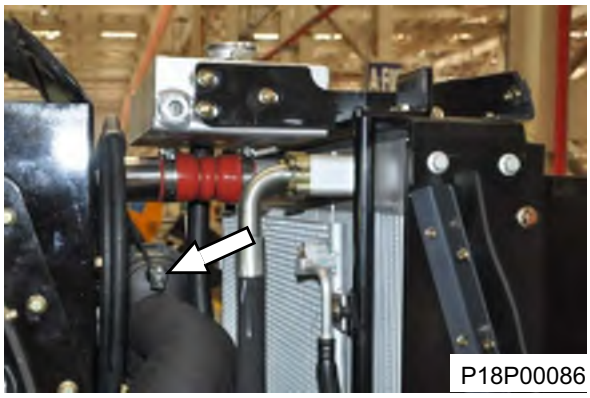
Figures	Contents	Tools
 P18P00082	13. Insert the water outlet pipe into water outlet of engine, the water inlet pipe into water inlet of engine, then clamp it with a clamp.	Tool: Open-end wrench 8#
 P18P00083	14. Insert the intake pipe into air inlet of engine, then clamp it with a clamp. Insert the intake pipe into intake hose and clamp it with a clamp.	Tool: Open-end wrench 8#
 P18P00084	15. Insert the intercooler pipe into silicone hose on the engine and radiator and clamp it with a clamp. Fix the intercooler pipe bracket on the intake/exhaust bracket and pre-tighten it with bolts. Fix the intercooler pipe on the bracket with U-clamp and tighten it with a nut. Tighten the intercooler pipe bracket mounting bolt.	Tool: Open-end wrench 12#, 16#

Figures	Contents	Tools
 P18P00085	16. Fix the diesel joint on the engine fuel pump with screw and seal gasket. The pipe connected to the oil-water separator is fuel inlet pipe and is connected to the fuel inlet of fuel pump with only the inlet marked "in" .	Tool: Open-end wrench 19#
	17. Install the A/C compressor, A/C pipe and warm air water pipe to the engine according to the installation requirements and steps of air conditioning system. 18. Install the electrical connector and circuit to the engine according to the removal and installation requirements and steps of electrical system described. 19. Install the diesel particle filter and connecting pipe according to the installation steps of diesel particle filter described.	

Figures	Contents	Tools
	20. Install the air filter according to the installation steps of air filter described. 21. Install the engine hood according to installation steps of engine hood. 22. Open the engine hood and fill the anti-freeze. 23. Close the engine hood and take off the warning board "No operating".	

Removal and installation of air filter

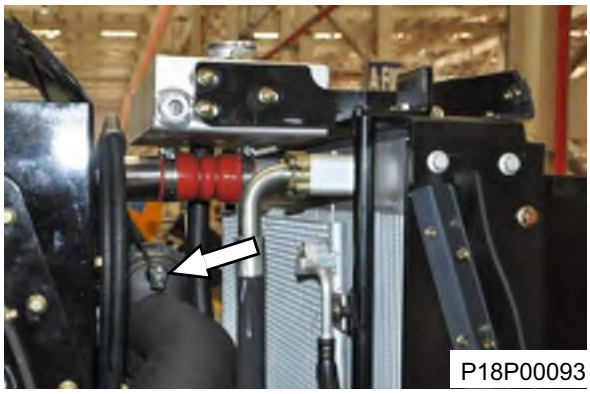
Removal

Figures	Contents	Tools
 P18P00086	1. Put out the harness connector on the air filter, and seal every ports with plastic sealing membrane as required.	Tool:
 P18P00087	2. Loosen the clamp connecting air filter and intake pipe with wrench, and remove the clamp. Pull out the intake pipe and seal the ports with plastic membrane.	Tool: Open-end wrench 8#

Figures	Contents	Tools
 P18P00088	3. Loosen the bolts of the air filter mounting plate with wrench, then remove the air filter with mounting plate.	Tool: Open-end wrench 13#
 P18P00089	4. Remove captive bolts of air filter with open-end wrench, and remove air filter. Remove the blocking indicator of air filter from the air filter.	Tool: Open-end wrench 10#

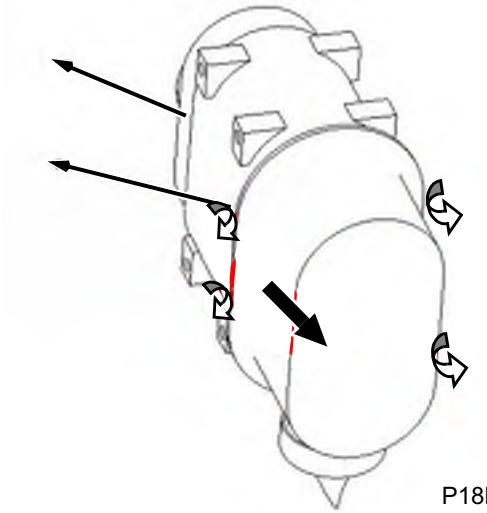
Installation

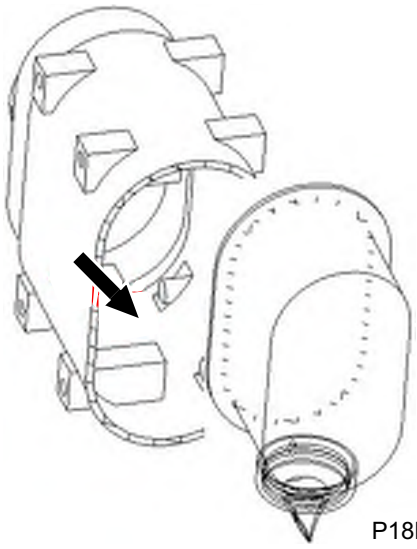
Figures	Contents	Tools
 P18P00090	1. Fix the air filter on the mounting plate with bolts.	Tool: Open-end wrench 10#
 P18P00091	2. Install the air filter with the mounting plate on the heat insulation bracket.	Tool: Open-end wrench 13#
 P18P00092	3. Install the intake pipe in the both ends of air filter, and hold them with clamps.	Tool: Open-end wrench 8#

Figures	Contents	Tools
 P18P00093	4. Install the blocking indicator of air filter on the air filter, and press the indicator end face to reset it.	Tool:
	5. Check the inner of connectors on the air filter and indicator for water or sand. If any, clean them up. Plug the harness connector on the two connectors.	Tool: Open-end wrench 10#

Disassembly and assembly of air filter

Disassembly

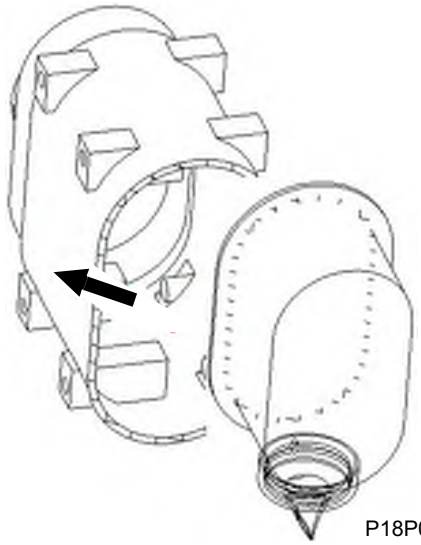
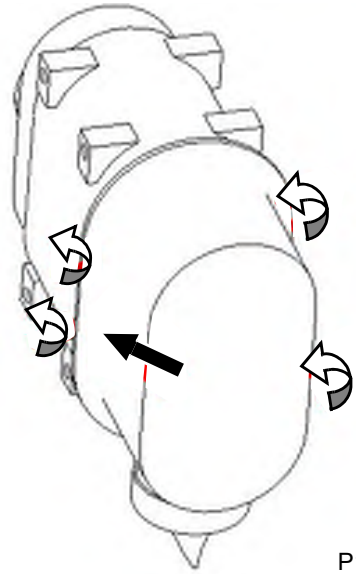
Figures	Contents	Tools
 P18P00094	1. Open the lock buckle, and remove the end cover on the air filter;	It needs no other tooling or tools in the disassembly process.

Figures	Contents	Tools
 P18P00095	2. Take out the main filter element along the direction of housing. It can be taken out directly by hand, and then take out the main filter element by sequence.	
 P18P00096	3. Take out the safety filter element along the direction of housing. Use the handle on the surface of safety filter element to pull the filter element towards the housing center, and remove it.	

Check

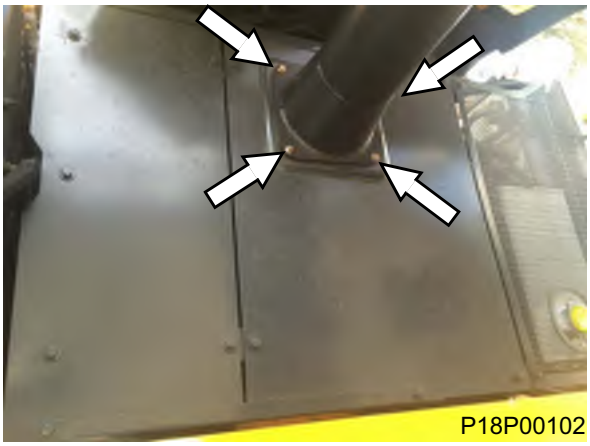
Check the main and safety filter element before installation. Visually check the sealing surface for cut, tear or indentation. If there is any visible damage, do not install them.

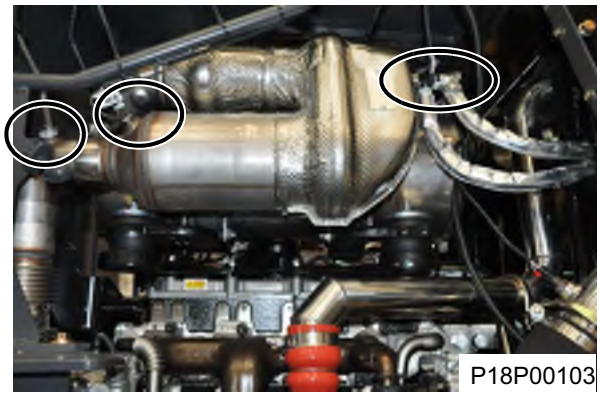
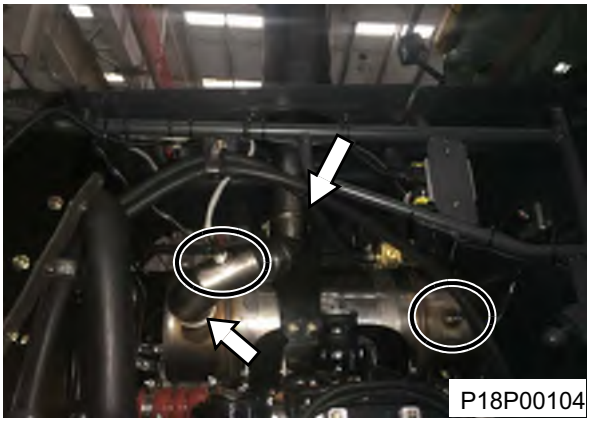
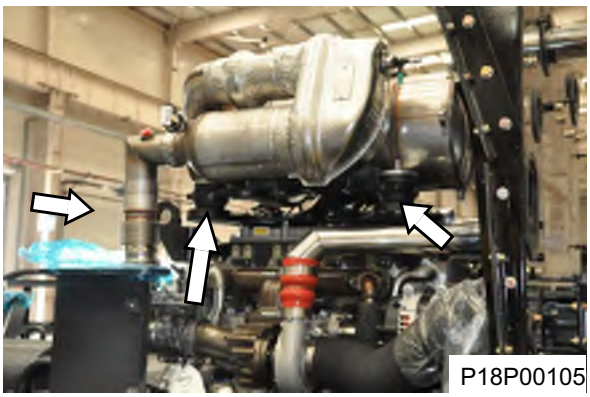
Assembly

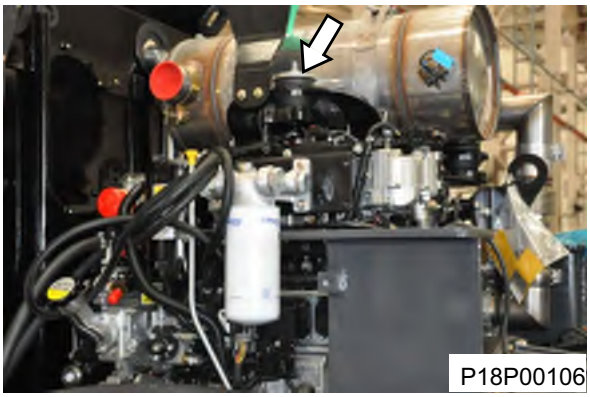
Figures	Contents	Tools
 P18P00097	1. Use the handle of safety filter element to make the filter element slide into the outlet side at an oblique angle and push it to the position, until the filter element is already firm and flat in the housing.	It needs no other tooling or tools in the assembly process.
 P18P00098	2. Insert the main filter element. Push downward the filter element at 5° angle, until it hit the end of housing.	
 P18P00099	3. Install cover of air filter and tighten the lock buckle. If uncovered, remove the cover and re-check the filter element position. If the installation of filter element is incorrect, it will be difficult to install the cover.	

Removal and installation of DPF (Diesel Particle Filter)

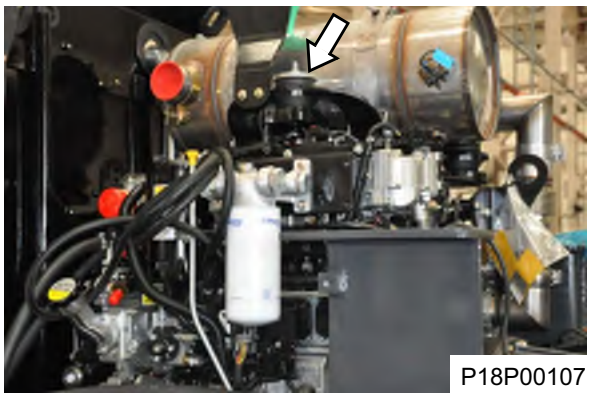
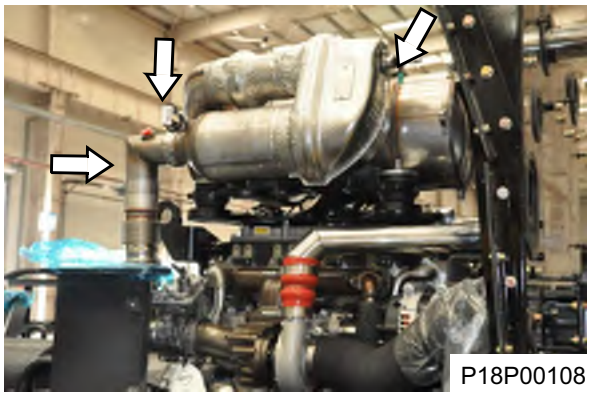
Removal

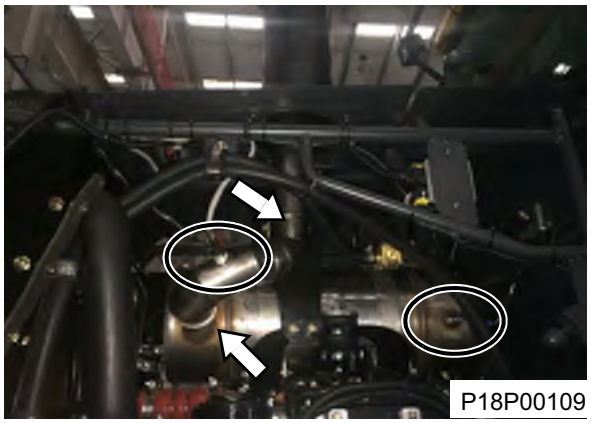
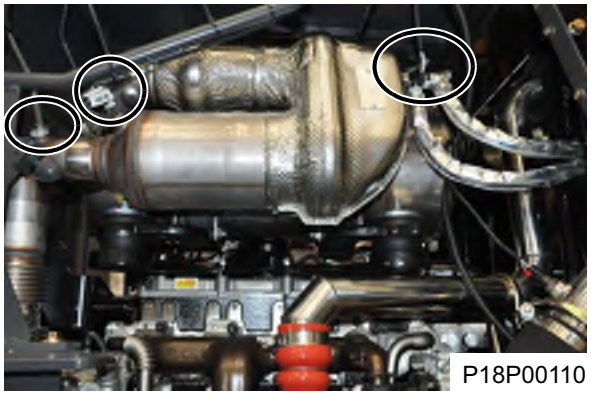
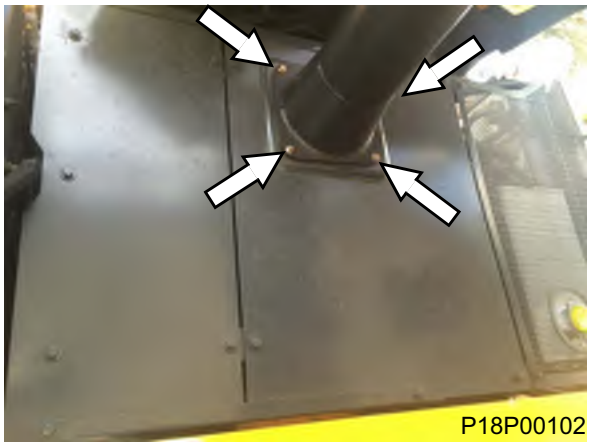
Figures	Contents	Tools
 P18P00100  P18P00060	1. Turn off the negative electrode switch, and hang on a "No operating" warning board.	
 P18P00102	2. Remove the mounting bolt of the exhaust pipe, and take off the exhaust pipe.	Tool: Open-end wrench 13#
	3. Remove the engine hood and top cover according to removal and installation requirements and steps of engine hood.	

Figures	Contents	Tools
 P18P00103	4. Remove the DEF(diesel exhaust fluid) pipe joint and electrical connector on the DOC.	
 P18P00104	5. Unplug the exhaust pipe and SCR electric connector, Remove the U-clamp and clamp, take off the exhaust pipe.	Tool: Open-end wrench 11#
 P18P00105	6. Loose the clamp of DOC & bellow, and unscrew the captive bolts of brackets.	Tool: Open-end wrench 11# Open-end wrench 18#

Figures	Contents	Tools
 P18P00106	7. Unscrew the captive bolts on one side bracket of SCR and lower the diesel particle filter. Take care of the clamp and seal gasket, and mask each port with plastic seal membrane.	Tool: Open-end wrench 18# Traveling crane Wire rope with hooks Plastic sealing membrane

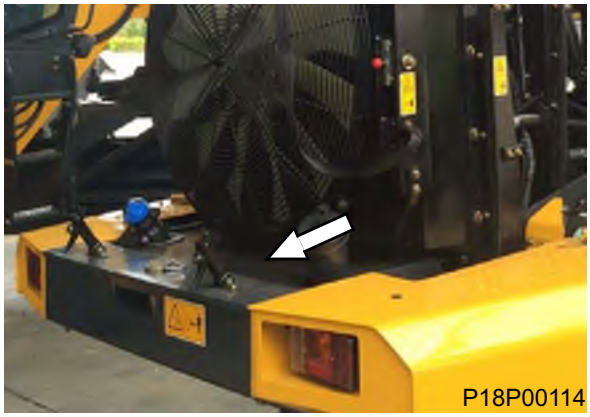
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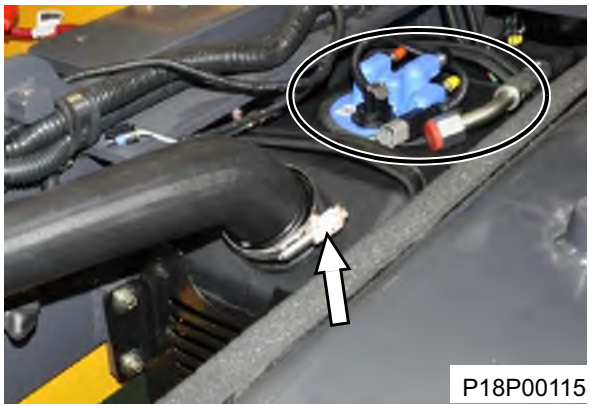
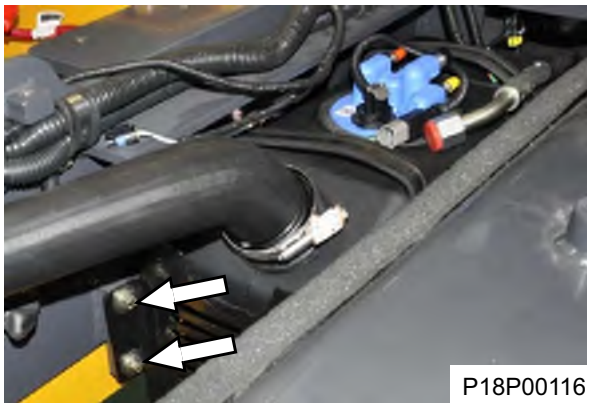
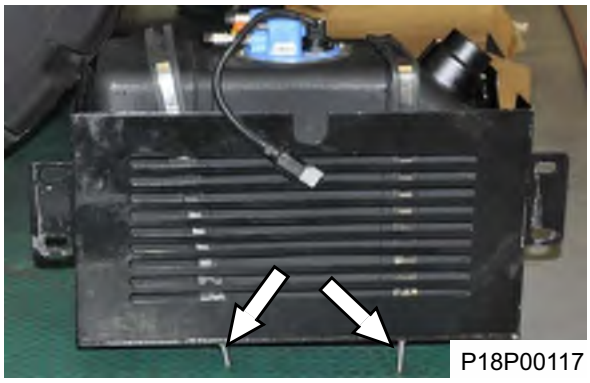
Figures	Contents	Tools
 P18P00107	1. Lift the diesel particle filter, put it to installing position, install the bracket bolts and pre-tighten the clamp.	Tool: Open-end wrench 11# Open-end wrench 18# Traveling crane Wire rope with hooks
 P18P00108	2. Adjust the diesel particle filter position, and tighten the clamp.	

Figures	Contents	Tools
 P18P00109	3. Insert the exhaust pipe into SCR outlet port, tighten the clamp and U-clamp, and insert the electric connector.	Tool: Open-end wrench 11#
 P18P00110	4. Connect the DEF pipe, and insert the electric connector.	
	5. Install the engine hood and top cover according to removal and installation requirements and steps of engine hood.	
 P18P00102	6. Fix the exhaust pipe to the engine top cover.	Tool: Open-end wrench 13#

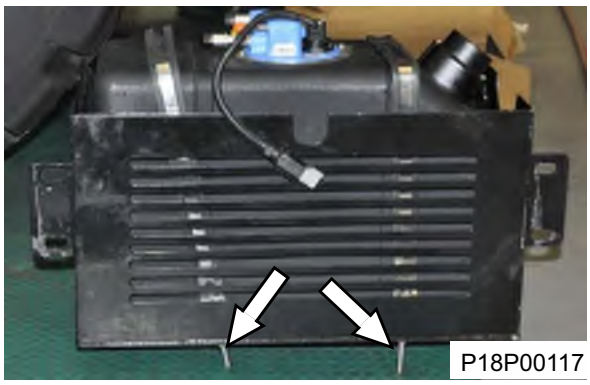
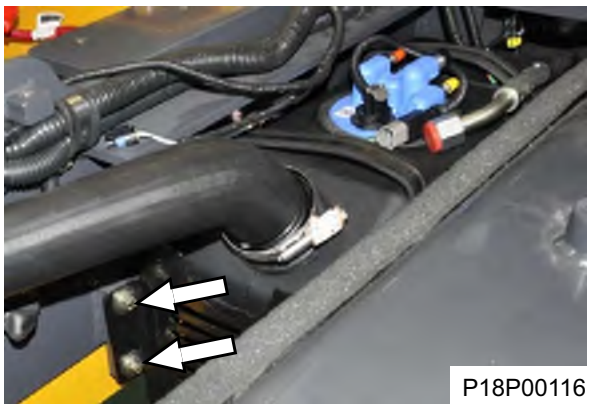
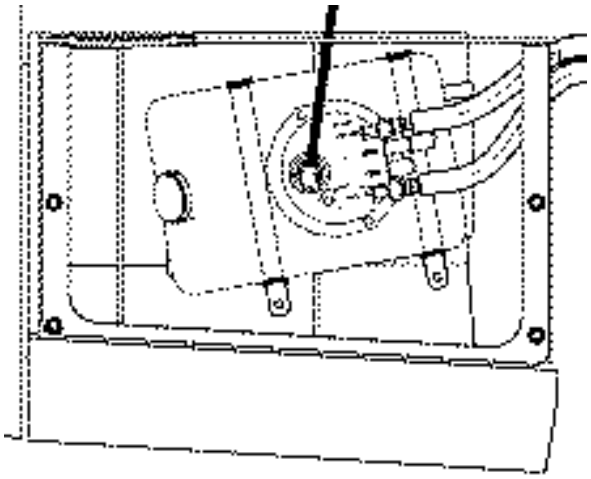
Removal and installation of DEF pump

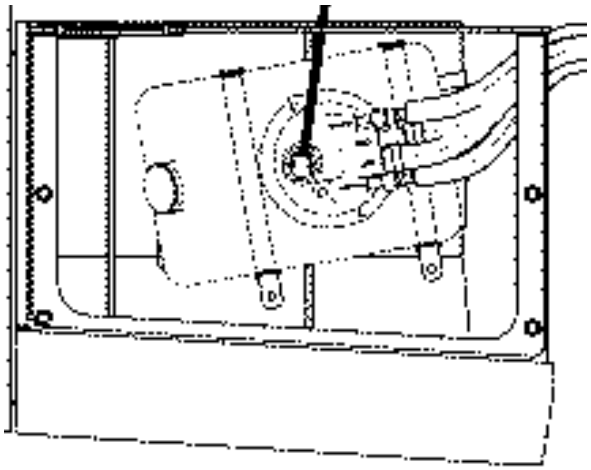
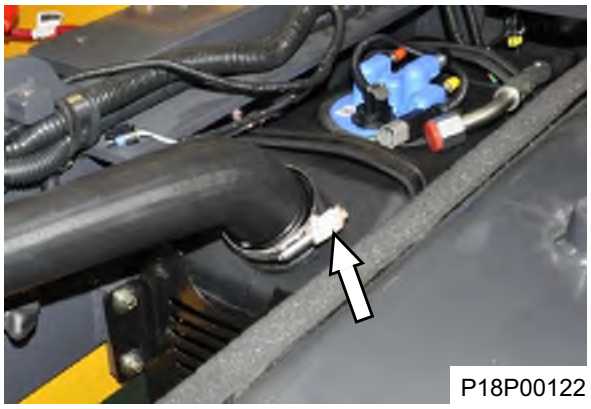
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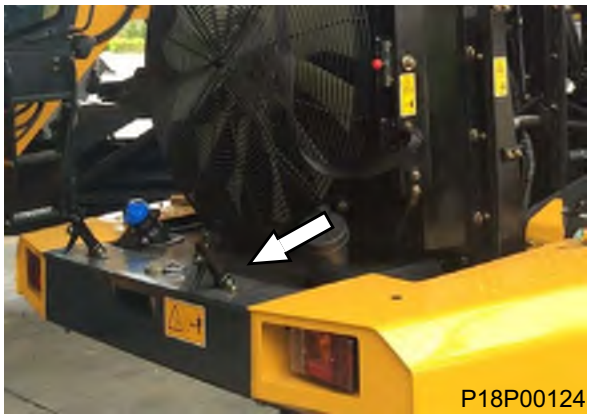
Figures	Contents	Tools
 P18P00112  P18P00060	1. Stop the vehicle, and turn off the negative electrode switch, and hang on a "No operating" warning board when the urea pump stops operating.	
 P18P00114	2. Open the engine hood, and remove the protection plate from the fuel tank.	Tool: Open-end wrench 13#

Figures	Contents	Tools
 P18P00115	3. Unscrew the clamp of urea pipe with straight screw-driver, and then pull out the pipe from the urea tank. Seal every port with plastic sealing membrane as required.	Tool: Straight screw-driver Plastic sealing membrane
 P18P00116	4. Remove the 4 captive bolts from the DEF bracket, and take out the DEF tank from the counterweight bottom.	Tool: Open-end wrench 13#
 P18P00117	5. Unscrew the mounting strap bolt of the DEF tank and the tank can be taken out.	Tool: Open-end wrench 10#

Installation

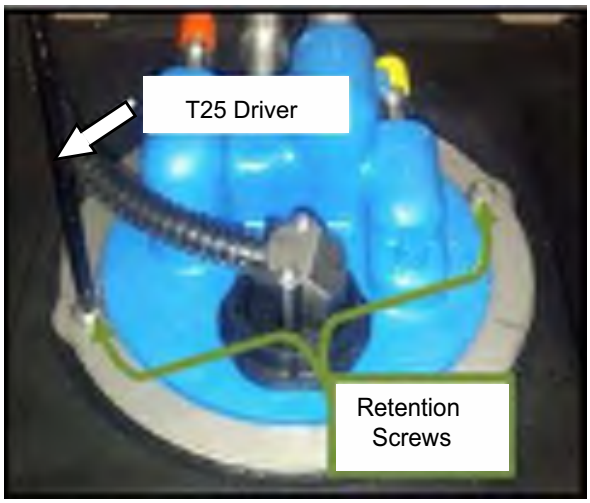
Figures	Contents	Tools
 P18P00117	1. Put the DEF tank into the bracket, get the strap through the tank body and tighten the strap bolt.	Tool: Open-end wrench 10#
 P18P00116	2. Put the DEF tank into installing position from the counterweight bottom and tighten the 4 captive bolts	Tool:
 P18P00120	3. Insert the quick joint of urea pipe to the joint of urea tank. It is not in place until a sound is heard. The two joints is different in specification, and can not be inserted if inversely connected.	Tool:

Figures	Contents	Tools
 P18P00121	4. Connect the water pipe to the water pipe joint of urea tank, and clamp it with clamp. The pipe connected to solenoid water valve is inlet pipe, which is connected to the water inlet on the urea tank with arrow indicated.	Tool: Straight screwdriver
 P18P00122	5. Insert the urea filler to the urea tank and clamp it with a clamp.	Tool: Straight screwdriver
 P18P00123	6. Insert the DEF(diesel exhaust fluid) tank joint to the vehicle wiring harness.	

Figures	Contents	Tools
 P18P00124	7. Put on the fuel tank protection plate and tighten with bolts.	Tool: Open-end wrench 13#

Disassembly and assembly of DEF tank

Disassembly

Figures	Contents	Tools
 P18P00125	1. Unscrew the retention screws that secure the Retaining Ring to the reservoir.	tool: T25 Torx Driver

Figures	Contents	Tools
 P18P00126		
 P18P00127	2. Using a flathead screwdriver, gently pry around where the head unit is connected to the reservoir while simultaneously pulling on the top of the unit. Continue until DEF mounting base is free from reservoir. DO NOT pull on the wires or fittings.	tool: flathead screwdriver

Figures	Contents	Tools
 P18P00128	3. Pull the DEF head unit out until the bottom of the header is at the bottom of the tank bore.	
 P18P00129		

Figures	Contents	Tools
 P18P00130  P18P00131	4. Angle the heel of Tri-function sensor foot upward and rotate the header until the bottom of the header is positioned inside the tank bore. When the bottom of the header is in the tank bore, fold the filter downward towards the interior of the tank. Continue to carefully remove the header out of the tank bore until completely freed. DO NOT pull directly out as this might damage the DEF head and bore seal.	

Check

Check the surface of filter element, and clean it if has sundries. If the filter element is found with cracks or big hole, replace it with new one.

Assembly

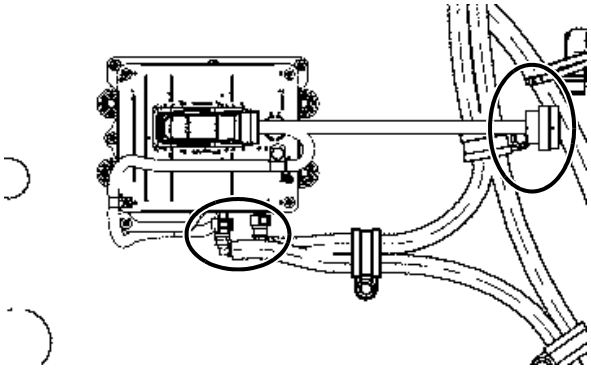
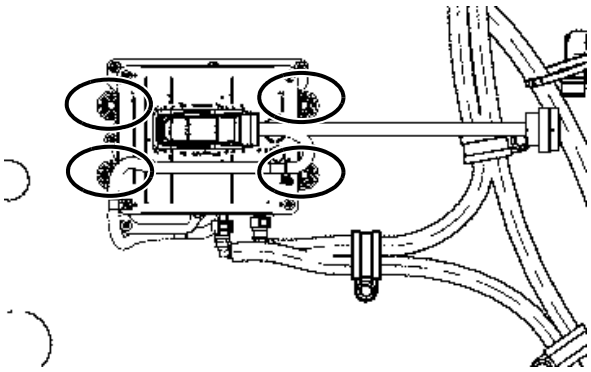
Figures	Contents	Tools
 P18P00132	1. Apply a thin layer of O-ring lubrication to the Bore seal O-ring.	
 P18P00133	2. Fold the Filter element in half towards the bottom of the Tri-Function Sensor. Tilt the header to an approximate 45° angle, with respect to the top of the tank. With the heel of the Tri-Function Sensor foot angled upward, place the filter edge and the toe of the Tri-Function Sensor into the tank bore. Gradually work the bottom portion of the DEF head into the Bore opening until completely inserted in the tank. DO NOT push the MFHU directly into the tank as this could damage the unit.	

Figures	Contents	Tools
 P18P00134  P18P00135		
 P18P00136	3. Position the DEF head unit in the desired orientation and press on the top of the blue mounting base until it is completely seated in the tank bore. DO NOT press directly on the fittings.	

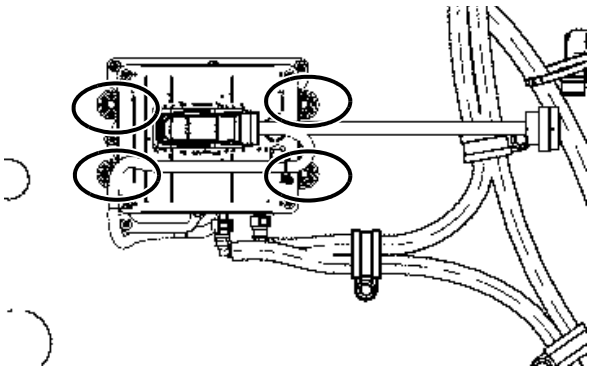
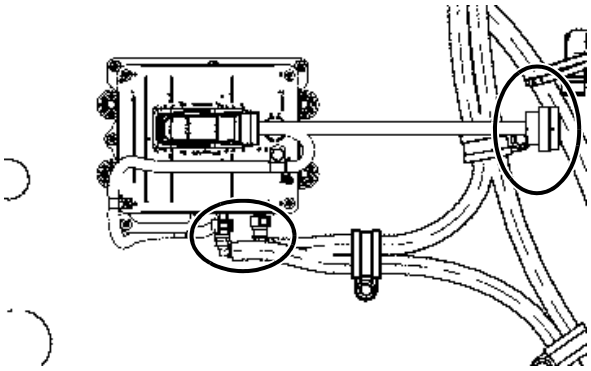
Figures	Contents	Tools
 P18P00137  P18P00138	4. Position the retaining ring on Head unit and install the retention screws using the T25 Torxwrench. Recommended torque on screws is 20 - 30 in-lbs (2.26 − 3.38 N m).	Tool: T25 Torx wrench

Removal and installation of DEF(diesel exhaust fluid) pump

Removal

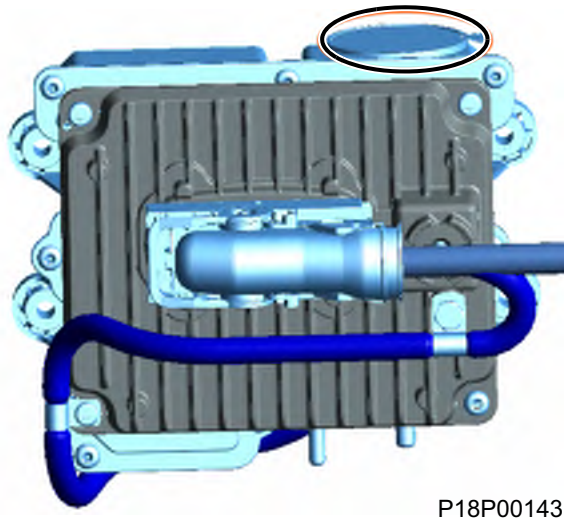
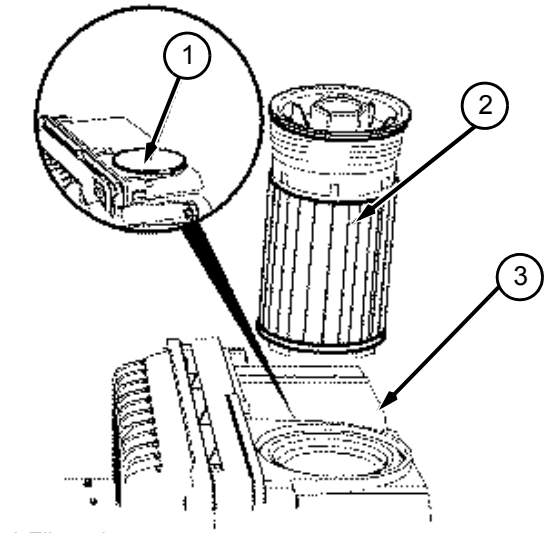
Figures	Contents	Tools
 P18P00139	1. Write 1, 2, 3 on the stickers respectively and stick them on the three DEF pipes from left to right. Pull out the urea pipe, harness connector from the urea pump. Seal every port with plastic sealing membrane.	Tool: Plastic sealing membrane Sticker
 P18P00140	2. Unscrew the urea pump mounting bolt from the bracket. Then remove the urea pump.	Tool: Wrench 13#

Installation

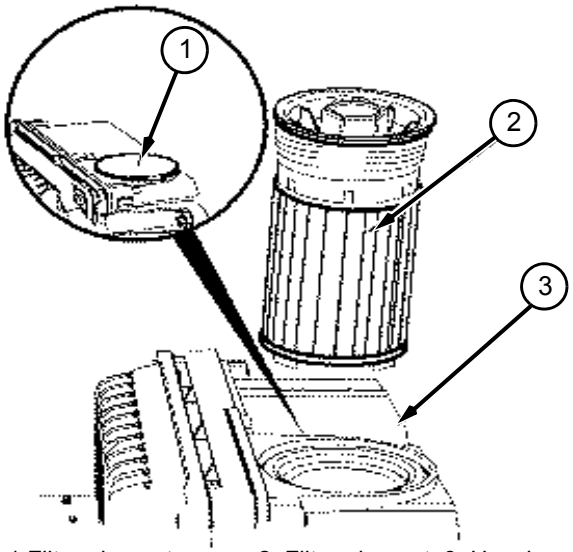
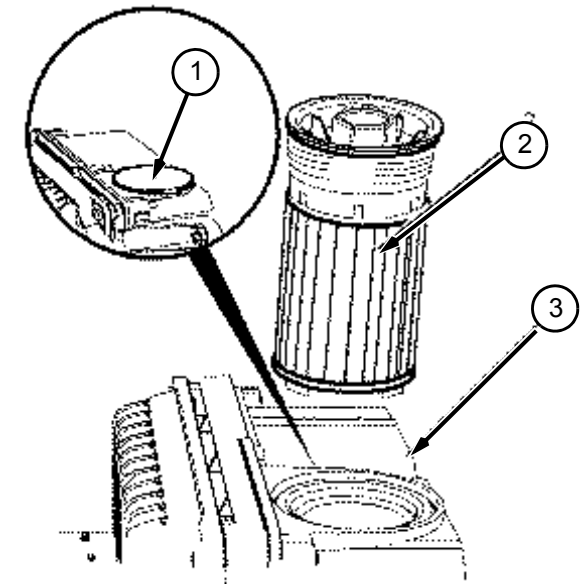
Figures	Contents	Tools
 P18P00141	1. Fix the urea pump on the bracket and tighten it with bolts. The recommended tightening torque is 15.2 – 22.8 N · m.	Tool: Wrench 13#
 P18P00142	2. Insert the three urea pipes to the urea pump by the order 1, 2, 3 from left to right until a sound is heard. Insert the urea pipe joint to the position of urea pump joint.	

Disassembly and assembly of DEF pump

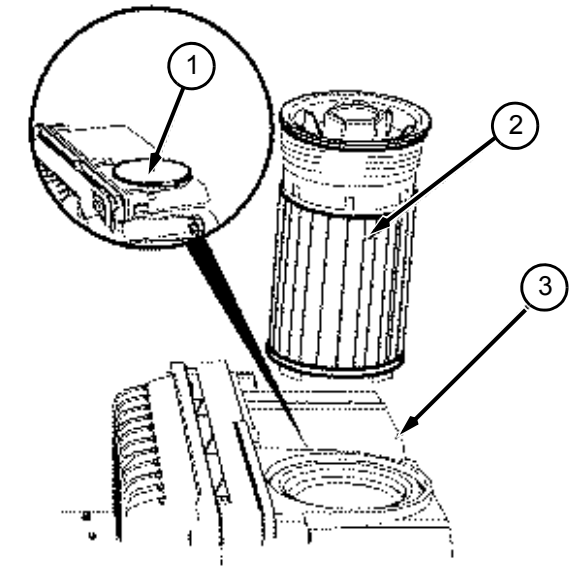
Disassembly

Figures	Contents	Tools
 P18P00143	1. Unscrew the filter element cover by hand.	
 1.Filter element cover 2.Filter element 3.Housing P18P00144	2. Take out the filter element assembly upward and vertically.	

Check

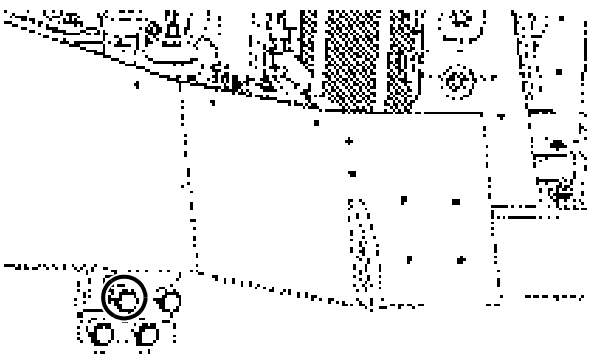
Figures	Contents	Tools
 1.Filter element cover 2. Filter element 3. Housing P18P00145	1. Check the filter element cover for cracks or hole. These cracks or holes may cause urea leakage. Check the thread of filter element cover for damage, and if does, replace it with a new one. Check the thread of urea pump body. If the thread is damaged, replace the complete urea pump.	
 1.Filter element cover 2. Filter element 3. Housing P18P00146	2. Clean the filter element cover with warm water and soft gauze.	

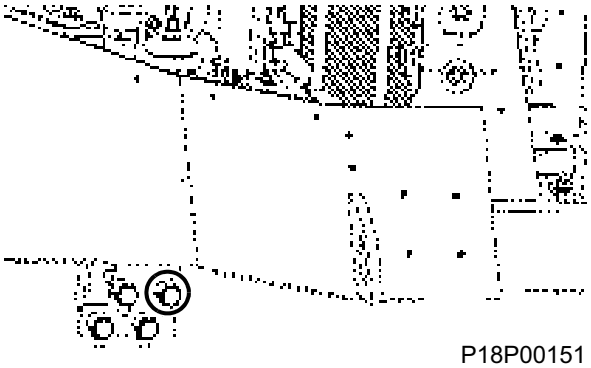
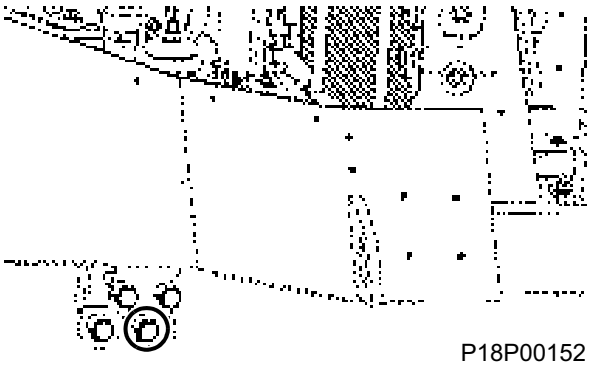
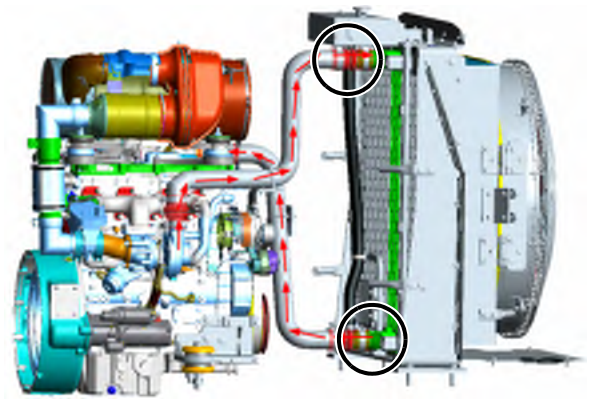
Assembly

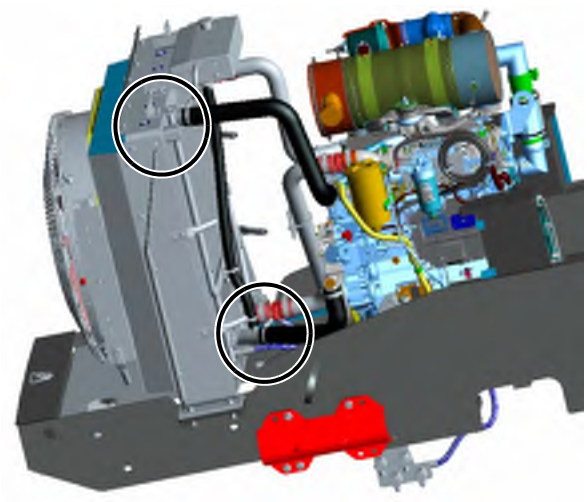
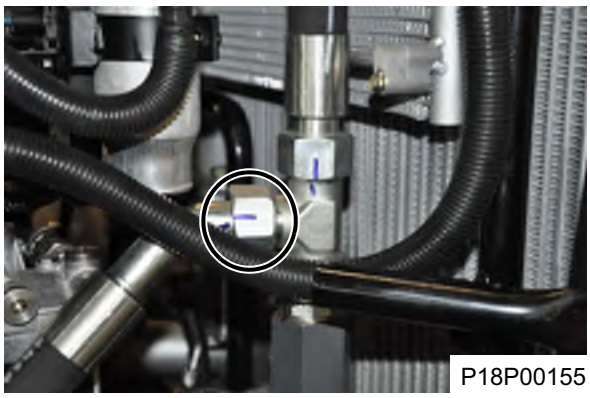
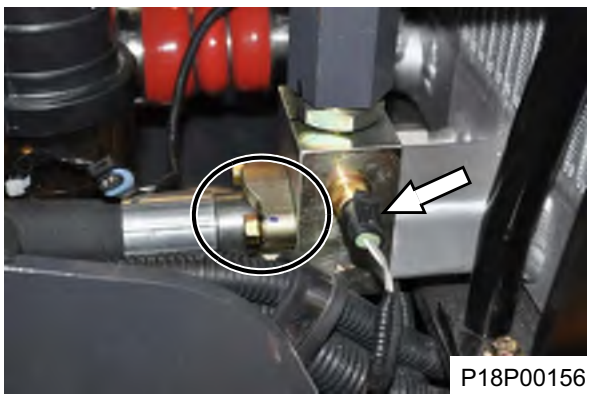
Figures	Contents	Tools
 1.Filter element cover 2 Filter element 3. Housing P18P00147	1. Install the filter element assembly into the DEF pump housing with filter element assembly tightening torque 14N.M(124lbin), and then tighten the protective cover.	Tool: Open-end wrench 27#
	2. Turn on the negative (-) switch and start the engine, check the urea pump for leakage. If there is leakage, please refer to the above steps of disassembly and inspection.	

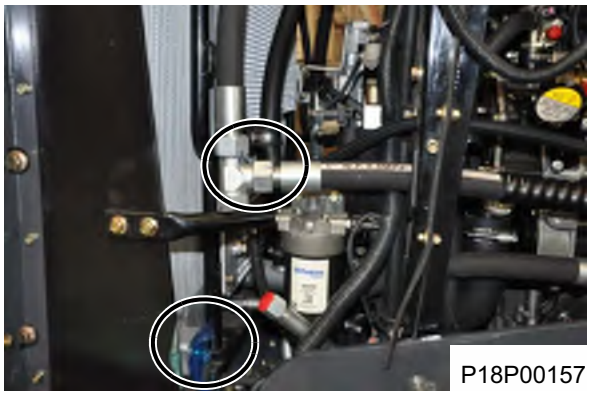
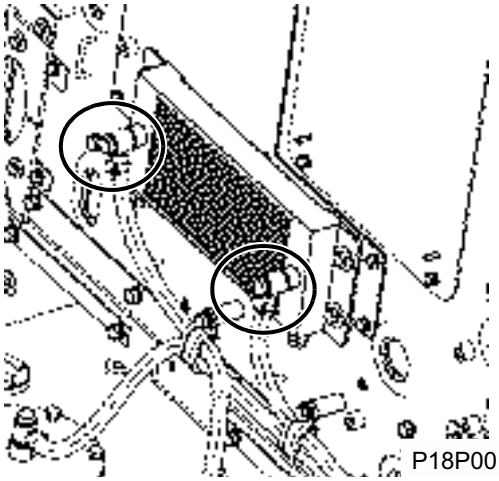
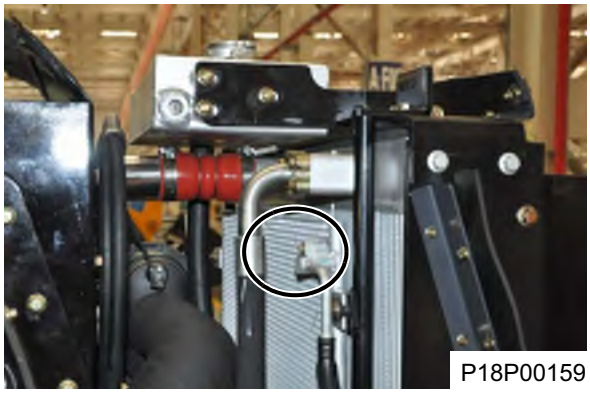
Removal and installation of radiator

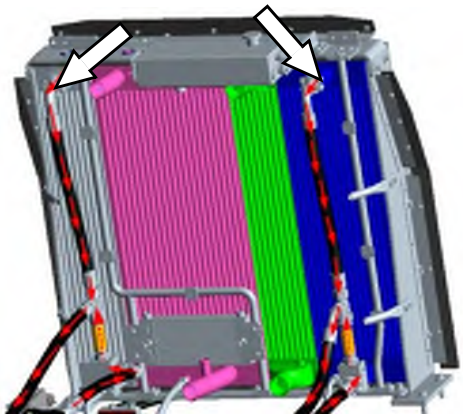
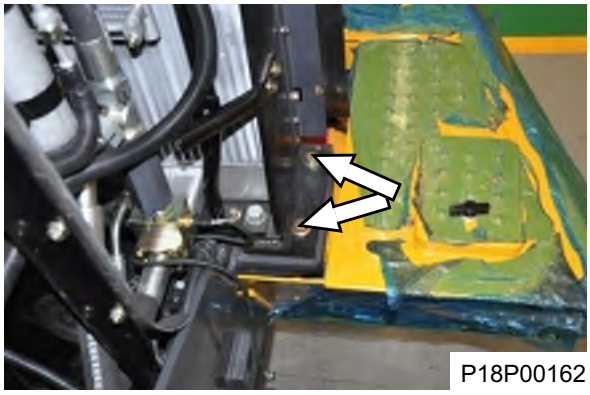
Removal

Graph	Contents	Tools
 P18P00148  P18P00060	1. Turn off the negative electrode switch, and hang on a "No operating" warning board.	
	2. Remove the engine hood and top cover according to removal and installation requirements and steps of engine hood.	
 P18P00150	3. Unscrew the drain connector to drain the engine cooling water.	Tool: Open-end wrench 36# Water tank

Graph	Contents	Tools
 P18P00151	4. Unscrew the hydraulic oil drain connector to drain the hydraulic oil in the radiator.	Tool: Open-end wrench 36# Oil tank
 P18P00152	5. Unscrew the torque converter oil drain connector to drain the torque converter oil in the radiator.	Tool: Open-end wrench 36# Oil tank
 P18P00153	6. Unscrew the clamp of intercooler pipe, unplug the silicone hose at radiator side and seal every port with plastic seal membrane.	Tool: Open-end wrench 12# Plastic sealing membrane

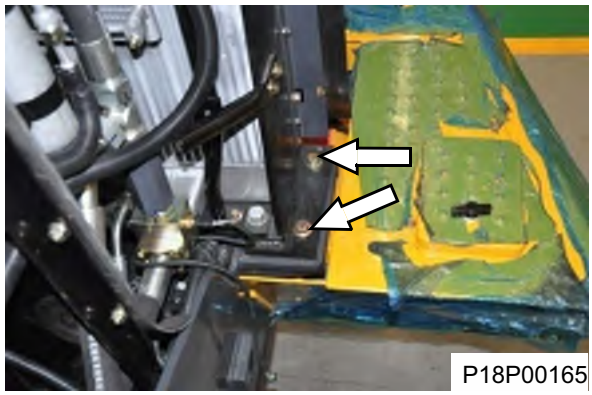
Graph	Contents	Tools
 P18P00154	7. Unscrew the water pipe clamp and pull out the water pipe from the radiator. Seal every port with plastic sealing membrane.	Tool: Open-end wrench 8# Plastic sealing membrane
 P18P00155  P18P00156	8. Remove the oil inlet/return pipes of the torque converter oil radiator & drain pipe joint, unplug the temperature sensor connector and seal each port with plastic seal membrane.	Tool: Outer hexagon wrench 8# Plastic sealing membrane

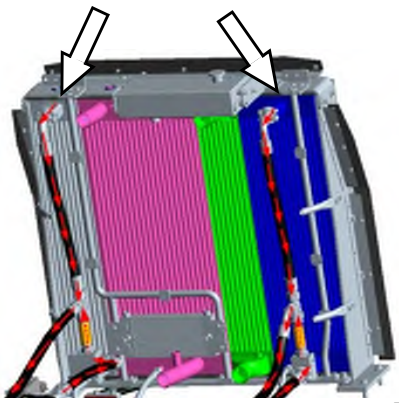
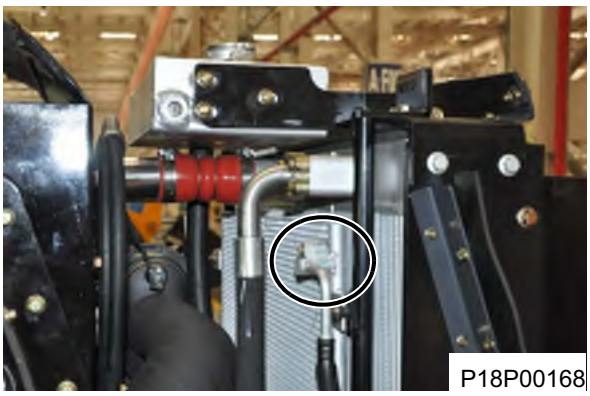
Graph	Contents	Tools
 P18P00157	9. Remove the oil inlet/return pipe joints of the hydraulic oil radiator and drain pipe joint, unplug the temperature sensor connector and seal each port with plastic seal membrane.	Tool: Open-end wrench Plastic sealing membrane
 P18P00158	10. Remove the oil inlet/return pipe connectors of the fuel radiator and seal each port with plastic seal membrane.	Tool: Open-end wrench Plastic sealing membrane
 P18P00159	11. Remove the condensing agent inlet/outlet connectors of the A/C radiator, and seal each port with plastic seal membrane.	Tool: Open-end wrench Plastic sealing membrane

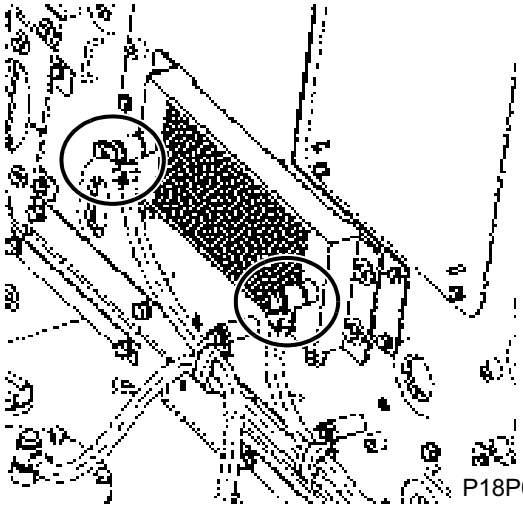
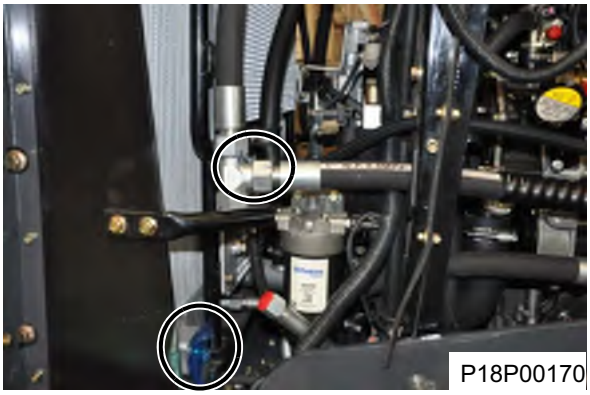
Graph	Contents	Tools
 P18P00160	12. Remove the oil inlet/outlet/ return pipe connectors of cooling motor and seal each port with plastic seal membrane.	Tool: Open-end wrench Plastic sealing membrane
 P18P00161	13. Slowly operate traveling crane, hang lifting eyes with wire rope, and tauten wire rope but not lift yet.	Tool: Traveling crane Wire rope
 P18P00162	14. Remove 4 anchor captive bolts from the radiator assembly.	Tool: Open-end wrench 24# Traveling crane

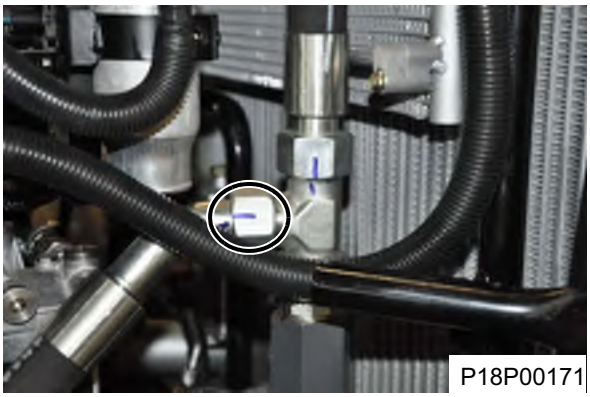
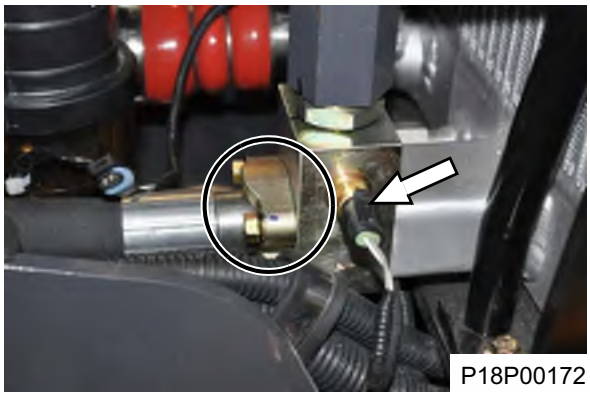
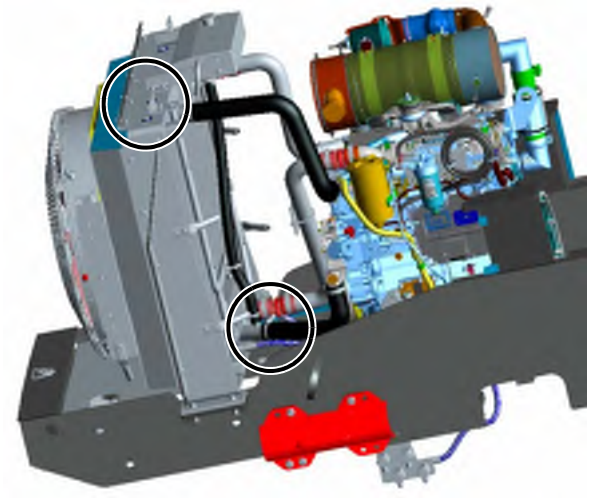
Graph	Contents	Tools
 P18P00163	15. Uplift the traveling crane, lift out the radiator assembly slowly and put it on flat ground.	Tool: Traveling crane

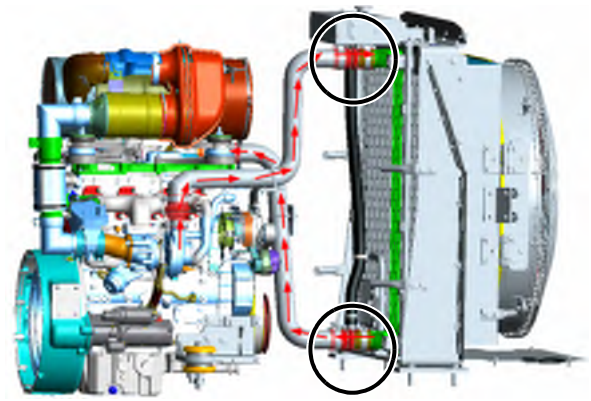
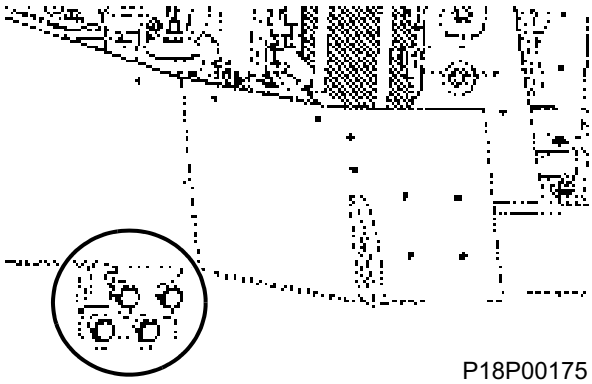
Installation

Graph	Contents	Tools
 P18P00164	1. Uplift the traveling crane, lift the radiator assembly to installing position.	Tool: Traveling crane Wire rope
 P18P00165	2. Tighten the radiator mounting bolts with the tightening torque 305 ± 25N.m.	Tool: Open-end wrench 24#

Graph	Contents	Tools
 P18P00166	3. Loose the wire rope	Tool:
 P18P00167	4. Install the oil inlet/outlet/ return pipe connectors of cooling motor	Tool: Open-end wrench
 P18P00168	5. Install the condensing agent inlet/outlet connectors of the A/C radiator.	Tool: Open-end wrench

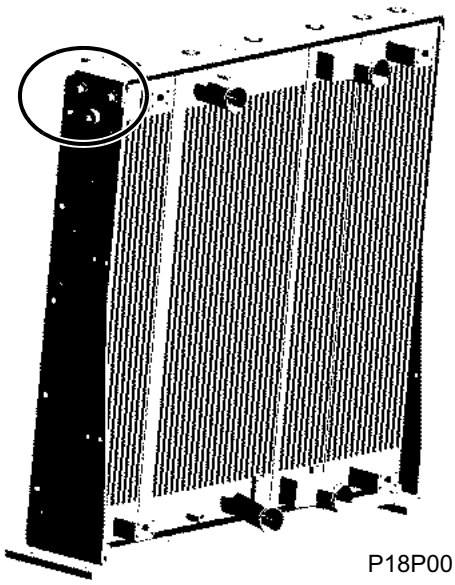
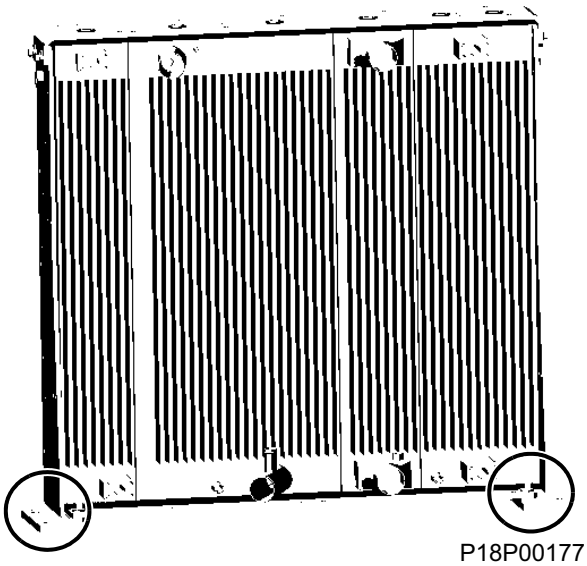
Graph	Contents	Tools
 P18P00169	6. Install the oil inlet/outlet connectors of fuel radiator.	Tool: Open-end wrench
 P18P00170	7. Install the oil inlet/return pipes of the hydraulic oil radiator & drain pipe joint, insert the temperature sensor connector.	Tool: Open-end wrench

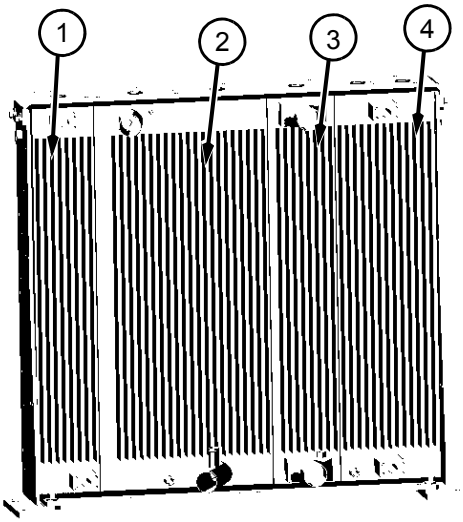
Graph	Contents	Tools
 P18P00171  P18P00172	8. Install the oil inlet/return pipes of the torque converter oil radiator & drain pipe joint, insert the temperature sensor connector.	Tool: Open-end wrench
 P18P00173	9. Insert the water inlet/ outlet pipes into the water radiator about 50mm, and then clamp the water pipe with clamp.	Tool: Open-end wrench 8#

Graph	Contents	Tools
 P18P00174	10. Connect the intercooler pipe and air-air intercooler with silicone hose and then clamp it with a clamp.	Tool: Open-end wrench 12#
 P18P00175	11. Tighten the radiator water draining switch, torque converter oil draining switch and hydraulic oil draining switch.	Tool:
	12. Replenish the coolant, hydraulic oil and torque converter oil as required.	
	13. Install the engine hood and top cover according to removal and installation requirements and steps of engine hood.	

Disassembly and assembly of radiator

Disassembly

Graph	Contents	Tools
 P18P00176	1. Unscrew the 4 fixing bolts on the upper connecting plate, remove the bolts and connecting plate.	Tool: Open-end wrench 16#
 P18P00177	2. Unscrew 4 captive bolts (do not remove) of lower connecting plate, so that left and right supports and lower connecting plate can rotate relatively.	Tool: Open-end wrench 18#

Graph	Contents	Tools
 1. Hydraulic oil cooler 3. Air-air intercooler 2. Water radiator 4. Torque converter oil cooler P18P00178	3. Push the radiator to right by the order 4321 with the aid of straight screwdriver, successively take out torque converter oil radiator, air-air intercooler, water radiator and hydraulic oil cooler and collect sponge and shock absorber. **CAUTION: Hold radiator assembly by someone or use corresponding stabilizing equipment to prevent radiator components from tilting when above 1, 2 and 3 operations are carried out.**	Tool: Straight screwdriver

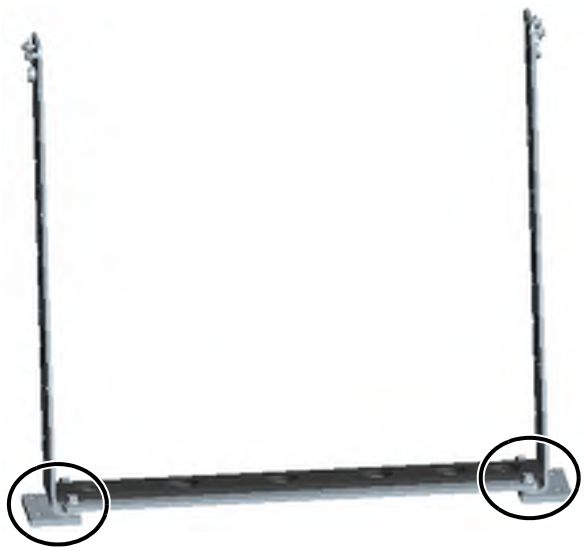
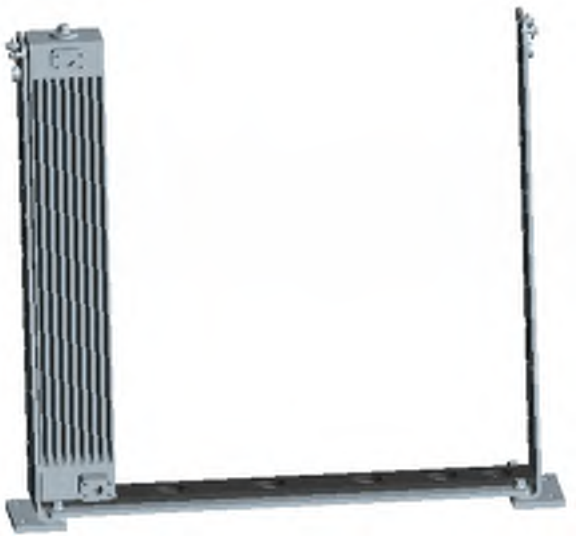
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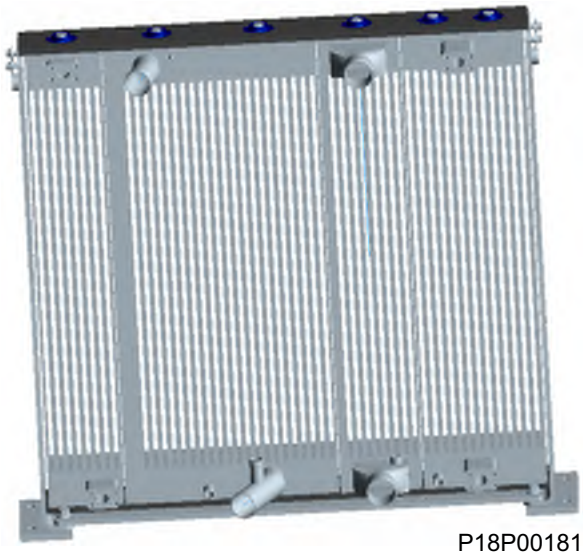
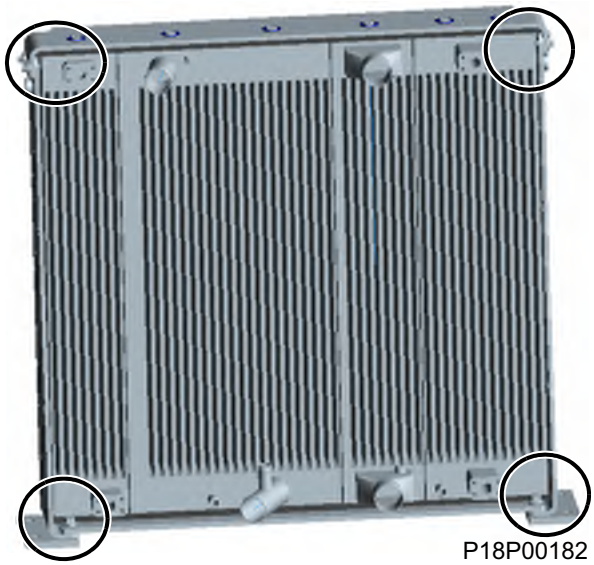
Check the radiator passage wall for cracks, and if does, it is necessary to perform the repair welding and replace the radiator.

Check the radiator fin, and if the fin is bent for a large area and blocks the passage, it is necessary to flat the fin by the wind direction or replace the radiator.

Check the radiator passage for blocking by debris or impurities, and if does, it is necessary to blow it clean with compressed air. Please notice that the direction of compressed air shall be inverse with that of air which passed through the radiator during normal operation of the machine.

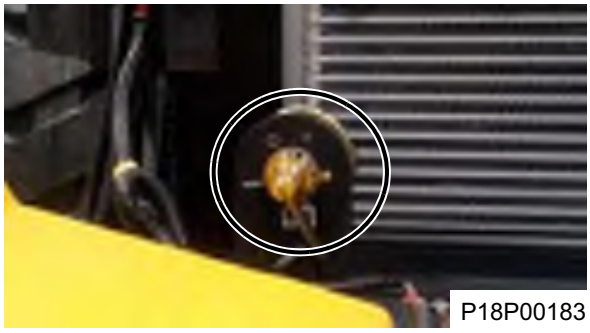
Assembly

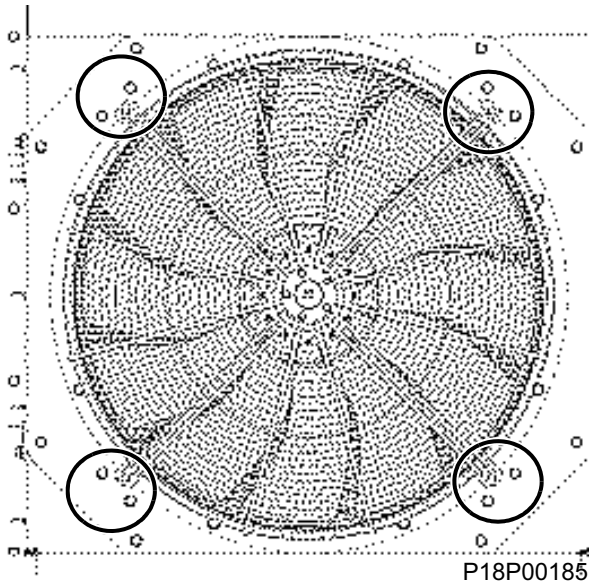
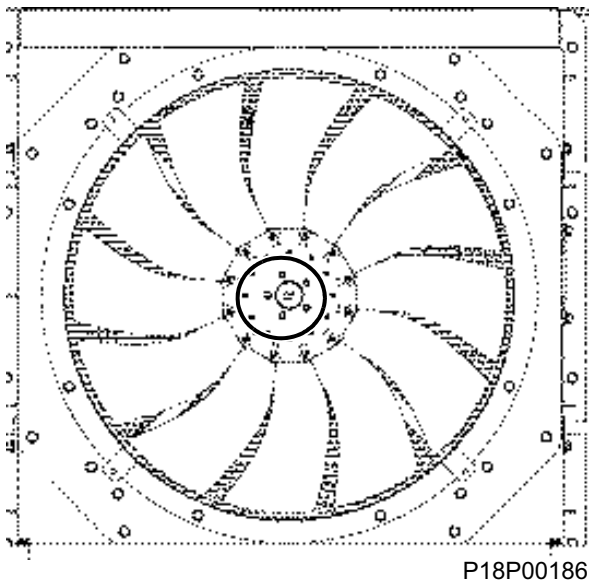
Graph	Contents	Tools
 P18P00179	1. Connect the left and right supports to the lower connecting plate with bolts, but not tighten the bolts, so that left and right supports and lower connecting plate can rotate relatively, and place the sponge on the lower backing plate.	
 P18P00180	2. Put the shock cushions to the lower plate holes and insert the radiator to the lower plate holes rightly. Perform the same assembly method for the other radiators.	

Graph	Contents	Tools
 P18P00181	3. Put the shock cushion on top of radiator to the radiator and put the sponge.	Tool: Open-end wrench 16#
 P18P00182	4. Install the upper plate and tighten the 4 captive bolts of the upper and lower connecting plates. **⚠ CAUTION: The radiator assembly shall be held by someone or using corresponding stabilizing equipment to prevent radiator assembly from tilting when above 1, 2, 3, 4 operations are carried out.**	Tool: Open-end wrench 18#

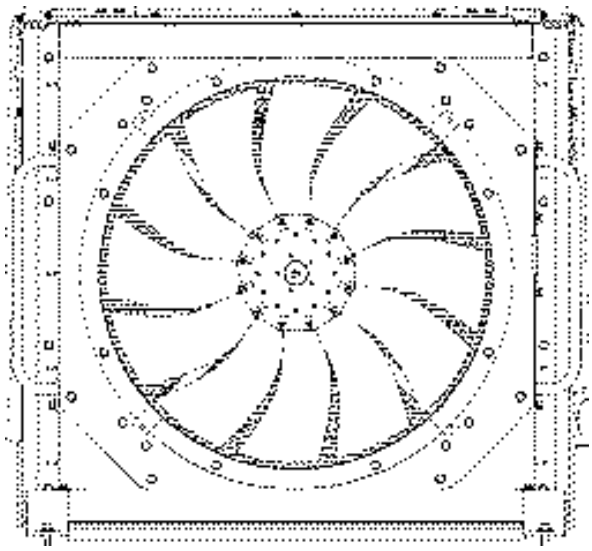
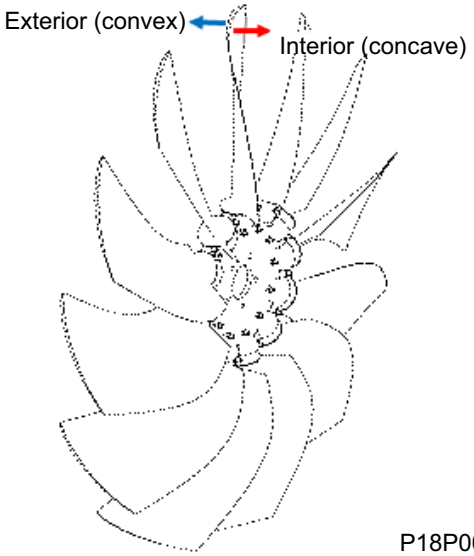
Removal and installation of fan

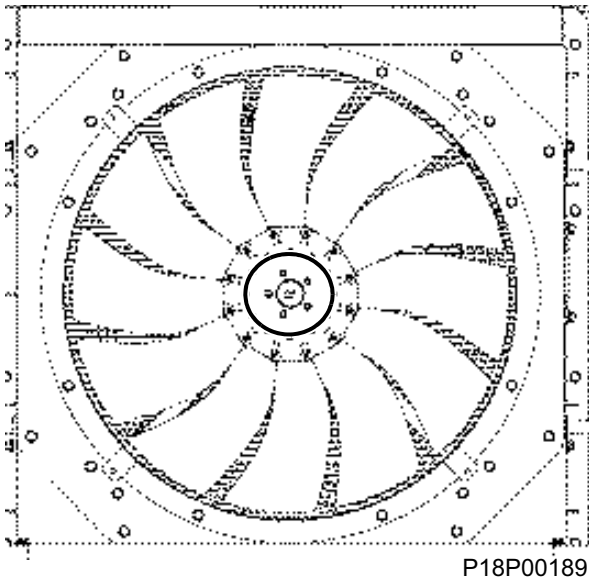
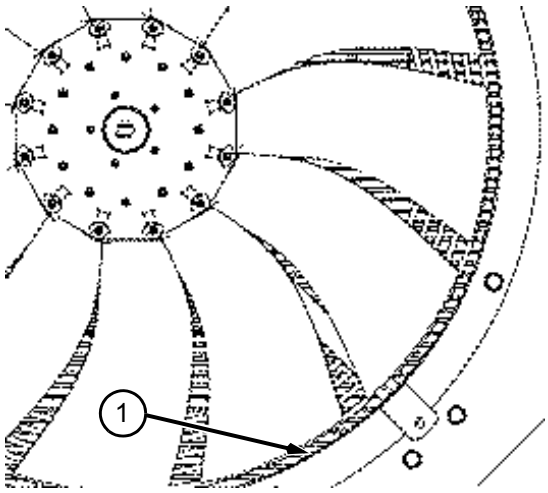
Removal

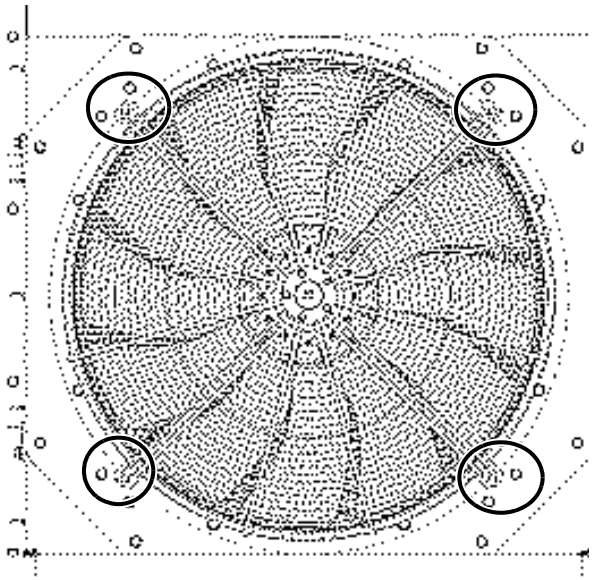
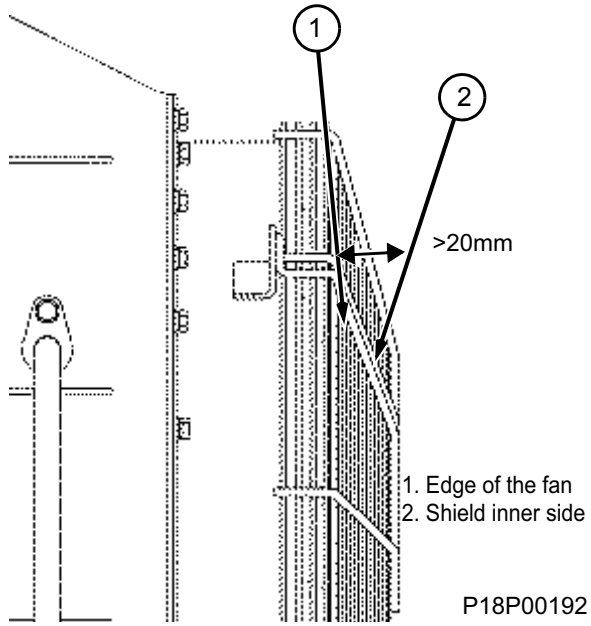
Graph	Contents	Tools
 P18P00183  P18P00060	1. Turn off the negative electrode switch, and hang on a "No operating" warning board.	
	2. Open engine hood	

Graph	Contents	Tools
 P18P00185	3. Unscrew the mounting bolt of shield and remove the shield.	Tools Open-end wrench 16#
 P18P00186	4. Unscrew the mounting bolt of fan, catch the root of fan vane and shake slightly to make the fan separate from the flange plate and then remove the fan.	Tools Open-end wrench 10#

Installation

Graph	Contents	Tools
 P18P00187  P18P00188	1. Install the fan to the flange with the inner side (concave side) of arc surface of fan facing the rear of complete machine.	

Graph	Contents	Tools
 P18P00189	2. Fix the fan on the flange with bolts.	Tools Open-end wrench 10#
 1. Clearance between fan and shroud >10mm P18P00190	3. Measure clearances between fan and shroud and it should be more than 10mm(0.3937In).	Tools Steel ruler

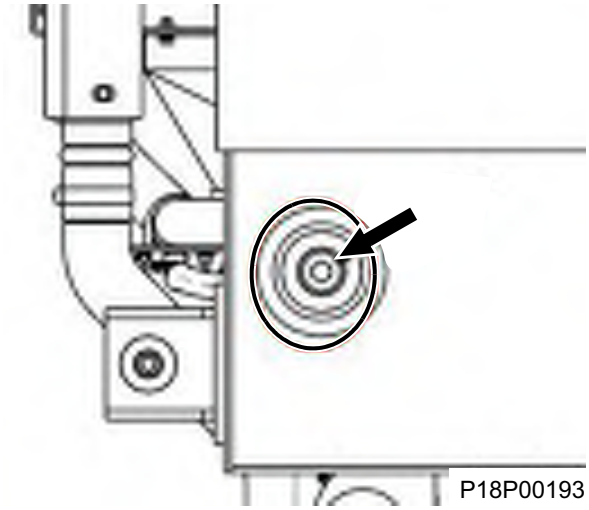
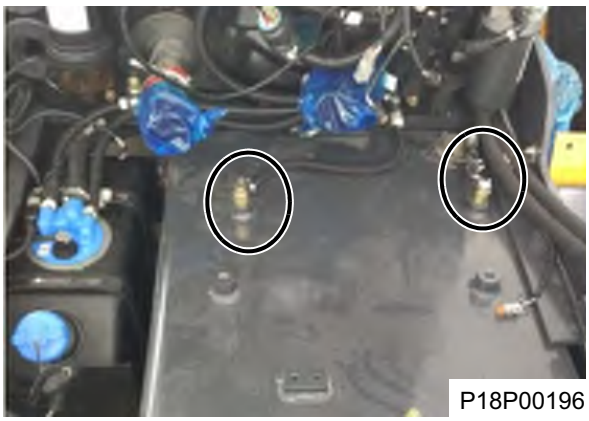
Graph	Contents	Tools
 P18P00191	4. Install the shield to the shroud and tighten it with bolts.	Tools Open-end wrench 16#
 1. Edge of the fan 2. Shield inner side P18P00192	5. Measure clearances between fan and shield and it should be more than 20mm (0.7874In).	Tools Steel ruler

Check

Check the fan vane for damage or scratches, the connection of fan vane and fan & hub for cracks, and if the fan is damaged, it is necessary to replace it with a new one with the same part number.

Removal and installation of fuel tank

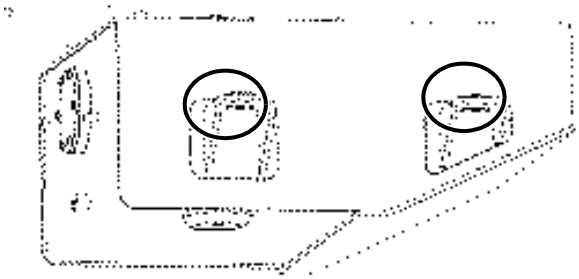
Removal

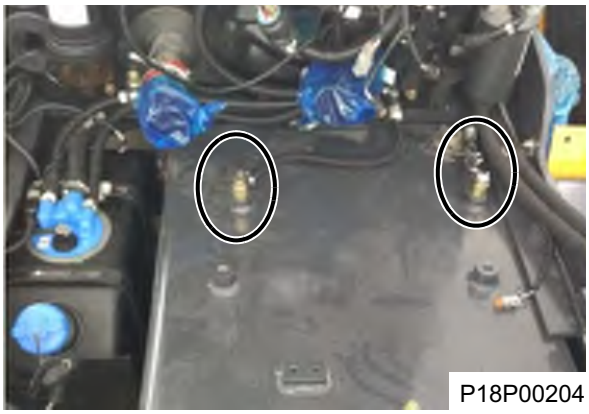
Graph	Contents	Tools
 P18P00193	1. Drainage of diesel fuel: Clean drain hole of fuel tank, place a clean oil container under the fuel tank, and unscrew drain plug. After fuel is drained, fix drain plug back to fuel tank. Drained fuel should be strictly sealed for preservation to prevent pollution to fuel.	Tool: 24# socket, socket wrench, oil tank
	2. Removal of pipe clamp: Remove all of hydraulic pipe or electric harness bolts, remove clamps, and loose the pipes and harness.	Tool: Open-end wrench 16#, 18#
 P18P00196	3. Remove the fuel lines of suction and return port: After fuel is drained, remove screw of fuel hose at fuel tank end, take down fuel hose of that end, and fix the screw back to fuel return hole. Block the fuel hose with clean plastic bag.	Tool: Open-end wrench 19#

Graph	Contents	Tools
 P18P00197	4. Removal of fuel sensor wire harness: Remove the harness connector of fuel tank sensor.	
 P18P00198	5. Removal of fuel tank: Remove the 4 mounting bolts and nuts from the fuel tanks. **⚠ Caution: Fuel tank is connected to frame through bolts and nuts in four mounting points. After mounting bolts are loosened, fuel tank will separate from frame. Before removal, use a reliable tool (e.g., forklift) with sufficient bearing capacity to support fuel tank.** **Before step 5, make sure steps 2~4 have been done; otherwise, corresponding parts will be damaged, and even a safety accident will occur.**	Tool: Open-end wrench 30#, Carrier tool or tooling

Graph	Contents	Tools
 P18P00199  P18P00200		

Installation

Graph	Contents	Tools
 P18P00201	1. Install the cushion to the four brackets of diesel fuel tank.	
 P18P00202	2. Transfer the diesel fuel tank to the position under the rear frame with carrier tool to align the hole of diesel fuel tank with the diesel fuel tank mounting hole on the rear frame. Fix the diesel fuel tank on the rear frame with bolts, hard washer, locknut with the tightening torque of fuel tank mounting bolt of 600 ± 50N•m (60 ± 5kgf.m).	Tool: Open-end wrench 30#, Carrier tool or tooling
 P18P00203	3. Connect the fuel level sensor harness connector to the complete machine harness.	

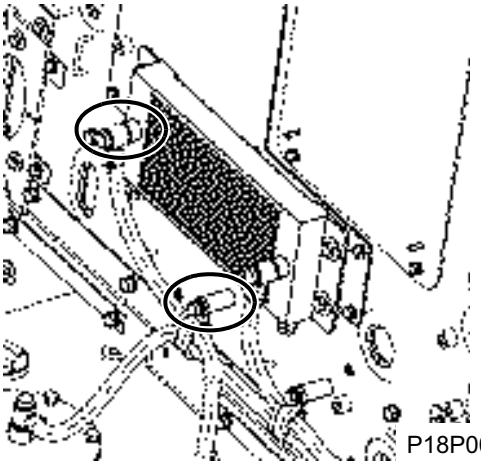
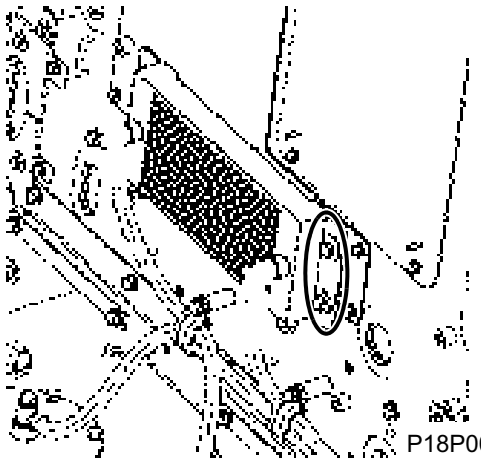
Graph	Contents	Tools
 P18P00204	4. Install the fuel pipe to the flange of the diesel fuel tank with screw, seal gasket.	Tool: Open-end wrench 19#
	5. Fix all of the hydraulic pipe or electric harness with clamps to corresponding positions, tighten and finish the fixing.	Tool: Open-end wrench 16#, 18#
	6. Refill the fuel.	

Cleaning

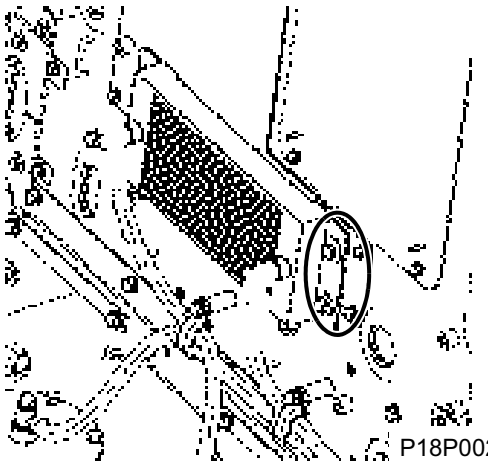
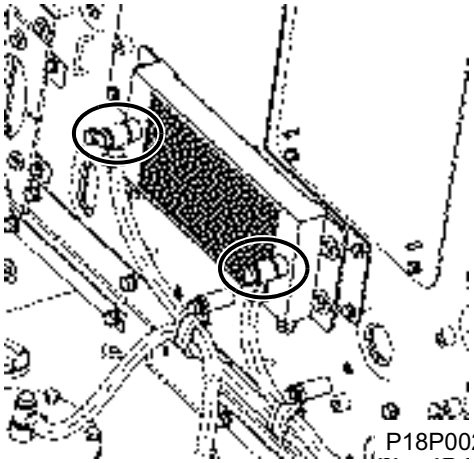
Remove the flange cover of washing port on the front end of fuel tank, use clean fuel to wash the inner oil tank surface. Unscrew drain plug at bottom of fuel tank to drain fuel (use a proper container to collect fuel). Rinse it by fuel repeatedly until the drained fuel is clean. Put drain plug back onto the floor of fuel tank.

Removal and installation of fuel radiator

Removal

Figures	Contents	Tools
 P18P00207	1. Unscrew the fuel pipe joint screw connected to the fuel radiator with wrench. Remove the screw, seal gasket and keep them in a plastic bag. Mask the fuel pipe joint with sealing membrane.	Tool: Open-end wrench 19# Plastic sealing bag Plastic sealing membrane
 P18P00208	2. Unscrew the mounting bolt of fuel radiator with wrench and remove the fuel radiator.	Tool: Open-end wrench 16#

Installation

Figures	Contents	Tools
 P18P00209	1. Install the fuel radiator on the support and tighten it with bolts.	Tool: Open-end wrench 16#
 P18P00210	2. Install the fuel pipe joint on the fuel radiator with screw, and please notice that the joint shall be added with seal gasket at both sides.	Tool: Open-end wrench 19#

Check

1. Check the fuel radiator, and if the radiator fin is blocked with dirt, please clean it with compressed air.
2. Check the fuel radiator, and if the fuel pipe is found damage, replace it with a new one.

Test Requirements

1. When the fuel radiator is installed, start the machine to allow it run for several minutes, observe the radiator for leakage.
2. If the leakage occurred at joint, there is a possibility that the screw is not tightened or the seal gasket is damaged, and it is necessary to tighten the screw or replace the seal gasket. If the leakage occurred at radiator itself, there is a possibility that the fuel line is damaged and it is necessary to replace the radiator with a new one.

Fault Diagnosis and Trouble-shooting

Precautions for fault diagnosis

Park the machine on the flat ground, check whether the locking pin, cushion block and parking brake are fixed firmly.

When two or more workers are operating, follow the agreed signal strictly, and any unauthorized people are not allowed to get close.

If the radiator cover is removed when the engine is still hot, the hot coolant may spray out which will cause scald. Therefore, start the fault diagnosis when the engine is cooled.

Specially notice that do not touch any hot components or do not be jammed by any rotating components.

When disconnecting the wire, be sure to disconnect the negative pole (-) of the battery first.

Be sure to release the inner pressure when removing the plug or cover where the oil pressure, water pressure or air pressure may exist. When installing the measuring device, make sure that it is connected correctly.

Common fault code and trouble-shooting

For common fault codes and troubleshooting, refer to Troubleshooting Manual of Perkins Engine1204F-E44TA&1204F-E44TTA.

Power Train System

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Basic Information

Safety

Many accidents in operation, maintenance, repair and other aspects are caused by fail to observe the basic safety rules and precautions. If the case of potential risk is fully aware in advance, these accidents usually can be avoided. The operators must pay attention to these potential risks, and be trained for relevant skills before properly and safely operating, maintaining and repairing the machine.

- Any improper operation, maintenance and repair methods may lead to hazardous condition, cause personal injury and even death.
- Be sure to read and understand the relevant security measures and precautions before operating, maintaining and repairing the machine.
- Please strictly obey the safety warning information listed in this Manual and on the machine during operating, maintaining and repairing the machine, otherwise heavy casualties will occur.

Safety warning information in the Manual is indicated by the following symbols

⚠WARNING

This word means existing potential danger, and if no avoidance, it may cause death or serious personal injury.

⚠ DANGER

This word means danger will occurred immediately, and if no avoidance, it may cause death or serious personal injury.

⚠CAUTION

This word means existing potential danger, and if no avoidance, it may cause slight or medium personal injury.

"Caution" is also used for reminding the safety attentions of unsafe operation possibly causing personal injury. "Danger" represents the worst dangerous conditions. Safety sign of "danger" or "warning" is an attachment set at the specific dangerous location. General precautions are listed on the safety sign of "Caution".

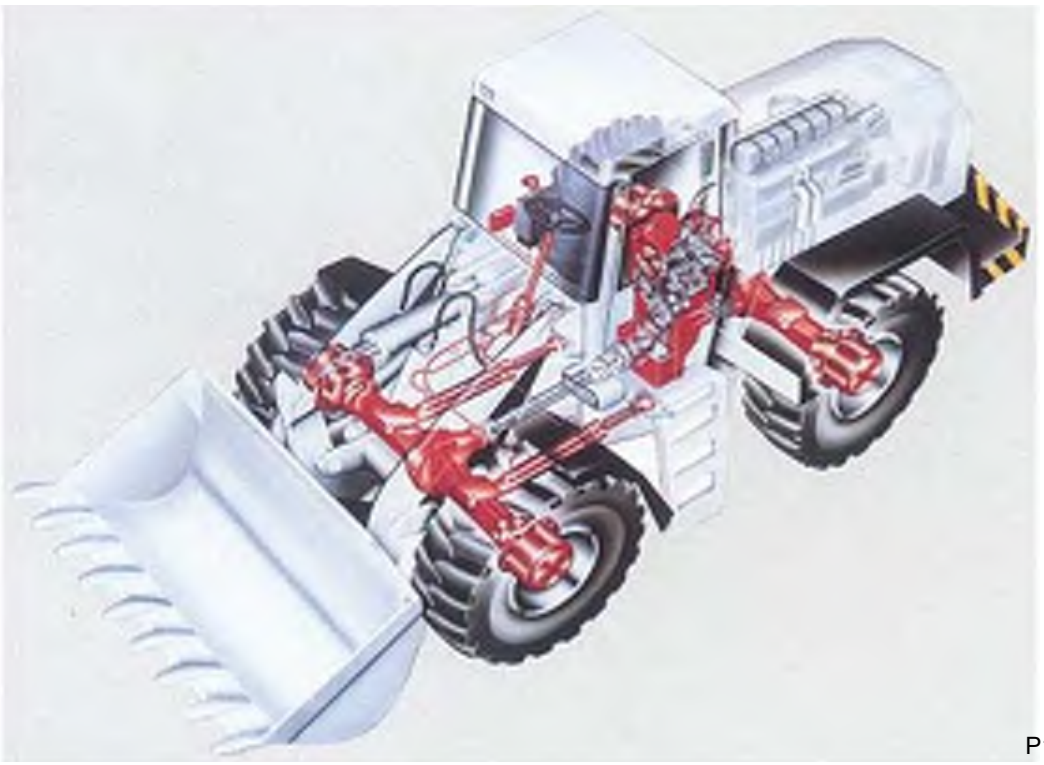
In addition, please carefully follow the "Cautions" listed in this Manual, otherwise, it may result in great damage to the machine. We are unable to enumerate all the possible risks (including potential dangers), and the warnings in the Manual and product do not cover all the risks and dangers. If the tools, operation procedures, methods or techniques are not specially recommended by our company, it is necessary to ensure the personal safety of every one, and protect the machine against any damage.

The contents herein are provided based on the status of the machine at the time when the Manual was written, whereas, all products are updating, and this machine is no exception. Any modification will influence the operation, maintenance and repair of the machine, therefore, please contact the LiuGong dealers for latest and most comprehensive service information before operating, maintaining and repairing the machine.

System composition and position

The power train system is a critical part of a loader, like a heart, and it is located at portion between the engine and tire, as shown in red in the figure below. It mainly consists of three majority components: gearbox, drive shaft and drive axle.

Fig 3-1 Schematic diagram of position for wheel loader



P18T00001

System technical parameters

Main technical parameters for the power train system of this machine are listed in Table 3-1.

Table 3-1: Main technical parameter table for power train system

System components	Items	Parameters	Remarks
Gear box	Model	ZF 4WG158	
	Type	Fixed shaft type	
	Control mode	Full-auto electro hydraulic control	
Torque converter	Type	Single-turbo, three-element	
Drive axle	Drive mode	Spiral gear level-I reduction, wheel planetary gear reduction	
	Brake mode	Wet brake	

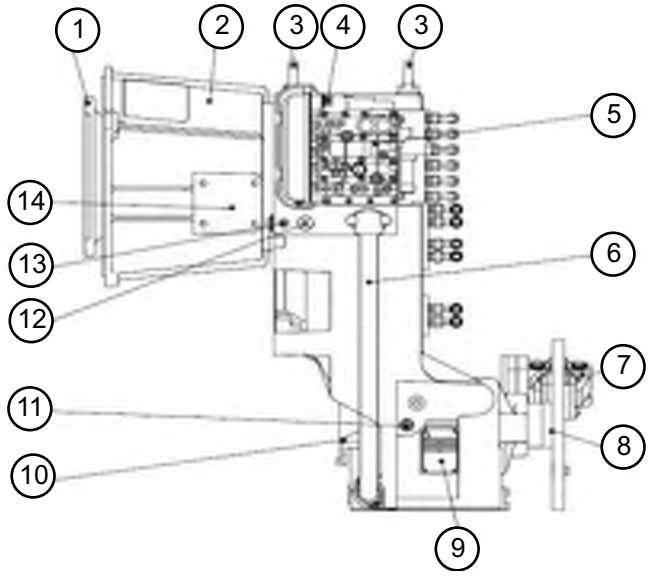
Table 3-1: Main technical parameter table for power train system

System components	Items	Parameters	Remarks
Tire	Tire structure	Radial tire	Tubeless bias tire or tubed bias tire is optional
	Specification	17.5R25 two star L3	
	Level	\	
	Type of tread	L-3	Ordinary block
Rim	Specification	25-14.00/1.5	

System schematic diagram and working principle description

The torque converter -gearbox assembly equipped in this machine is ZF 4WG158 full auto type, and the drive axle is 30 wet axle, whose structure diagram are shown as below:

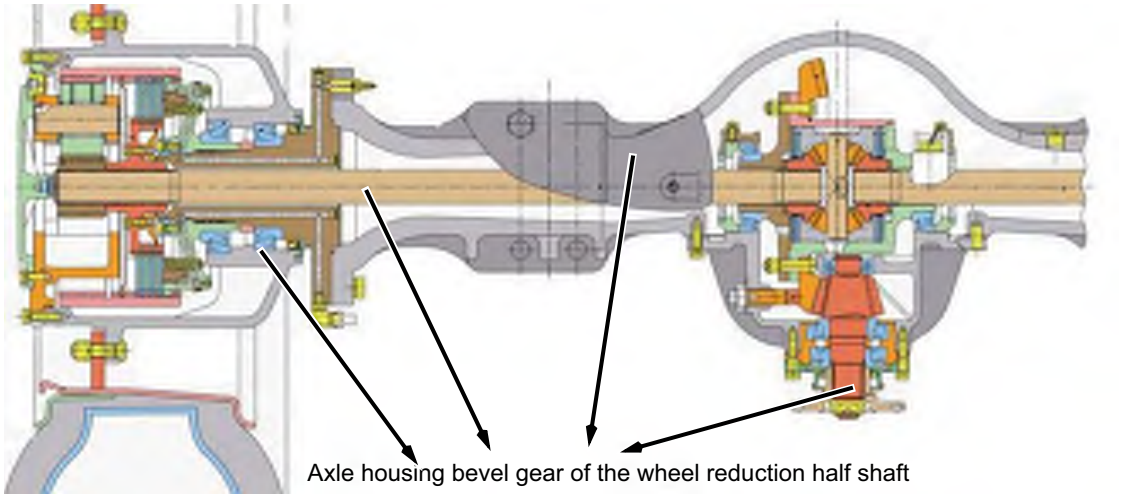
Figure 3-2 Diagram for gear box assembly composition



P18T00002

1. Coupling device
2. Torque converter housing
3. Lifting eye
4. Control harness interface
5. Electro-hydraulic shift control valve
6. Suction tube
7. Brake
8. Output plate
9. Nameplate
10. Output flange
11. Speed sensor
12. Oil outlet of torque converter
13. Torque converter outlet oil temperature sensor
14. Cover

Fig 3-3 Structure diagram for drive axle assembly



P18T00003

As shown in the above figure, the engine is coupled with the torque converter of the torque converter-gear box assembly, a part of engine power is used to drive the torque converter to work and another part is used to drive the hydraulic pump so as to provide power for the hydraulic system.

When the engine works together with torque converter, the engine output power is input into the gear box via the torque converter. Under the control of its electro-hydraulic shift control valve, the gear box can output power and speed at different positions with gear shafts and clutches.

The power output from the gear box is transmitted to the main drive of drive axle via a drive shaft, and then transmitted to wheel reducer by left and right axle shafts via main drive differential, and further to tire rim assembly by decelerating and increasing torsion, thus finally to drive the loader to travel and work.

Overview of transmission fluid

The oil product used for wheel loader is divided into four categories, i.e. the lubricant, grease, brake fluid and fuel, each of which can play a different role in the use of loader.

The lubricant, used in the loader, has two effects , one is to lubricate the parts and reduce the pressure, so as to prolong the service life of parts; the other is to dissipate the heat of parts produced by friction, so as to make the parts work normally. The lubricant is composed of various petroleum-based additives. The wheel loader use a kind of lubricant which has four classes , i.e, diesel oil, gear oil, hydraulic drive shaft and hydraulic fluid. The applications of the lubricant used in the power train system of this machine are shown in the table below:

Table 3-2 Table of lubricant application

Category	Ambient temperature										Recommended brand	Application parts
	-40	-30	-20	-10	0	10	20	30	40	50		
Torque converter - gearbox assembly											Mobil Delvac Super 1300 engine oil (-15°C~+50°C)\ (-5°F~122°F) Mobil ATF 220 (-35°C~+50°C)\ (-31°F~122°F)	ZF torque converter & transmission assembly uses SAE 15-40 in general areas and in hot desert areas; and uses Mobil ATF220 in arctic areas.
Gear oil											Mobil gear oil 80W-90/LS with additives (-15°C~+50°C)\ (-5°F~122°F); Mobil gear oil 424 (-40°C~+50°C) \ (-40°F~122°F)with additives Shell SPIAX S6 AXME 75W-90/LS (-40°C~+50°C)\ (-5°F~122°F)	LiuGong axle uses SAE 80W-90/LS in general and hot areas, and Mobil 424 with additives and Shell SPIAX S6 AXME 75W-90/LS in arctic areas. LS means the additives are inclusive

Maintenance and replacement of gearbox and drive axle oil

The oil product added to the torque converter - gearbox assembly must be consistent with oil list TE-ML 03 recommended by ZF, the oil level shall be checked once a week by the following methods:

1) Park the machine on level ground;
2) Place the gear box gear in the neutral position;
3) Torque converter - gearbox oil is at 80-95°C\176°F~203°F;
4) The engine is idling 800rpm);
5) Observe the oil level gauge of gearbox and it shall be in the "HOT" zone;

After the torque converter and gearbox assembly co-work for the first 100h, the oil shall be replaced every 1000h or at least once a year. Oil can be replaced by the methods as below:

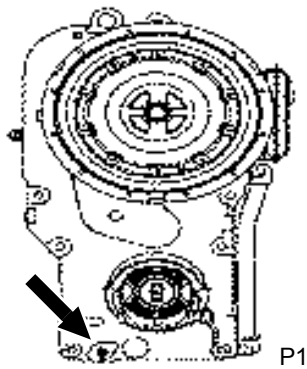
1) Unscrew the drain plug on the torque converter - gearbox assembly to drain the oil.

⚠CAUTION

The waste oil shall be collected in a container during oil drainage, in order to avoid environmental contamination;

The oil shall be fully cooled before oil drainage, in order to avoid personal injury due to hot oil splashing onto the body.

Figure 3-4 Gearbox drain plug



P18T00004

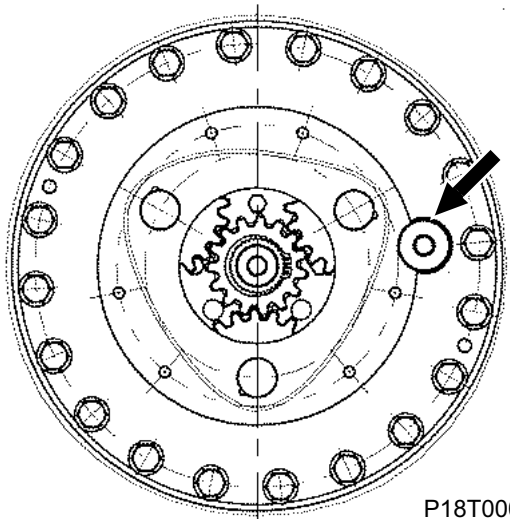
2) After the Oil sump tank of the gear box completely gets empty, wipe clean the mating surface on drain plug and gearbox housing that contacting with O ring of the oil drain plug. After the O-ring of the oil drain plug is replaced, reassemble and tighten it.
3) Add the oil in accordance with the oil list TE-ML 03 as recommended by ZF;
4) Check the oil level by the method as specified for transmission.

The fine oil filter is also replaced every time the oil change is done for the gear box. The oil filter may be installed by the following method:

1) Apply a small amount of the gear box oil on the oil seal of oil filter;
2) The oil filter is screwed in until the oil seal of oil filter contacts the filter head, tighten it 1/3 to 1/2 turn by hand.

The oil product added in the drive axle must be in accordance with the oil list of 85W-90 heavy-load wheel gear oil (GL-5) recommended by LiuGong. The oil level of LiuGong axle may be checked by the following methods:

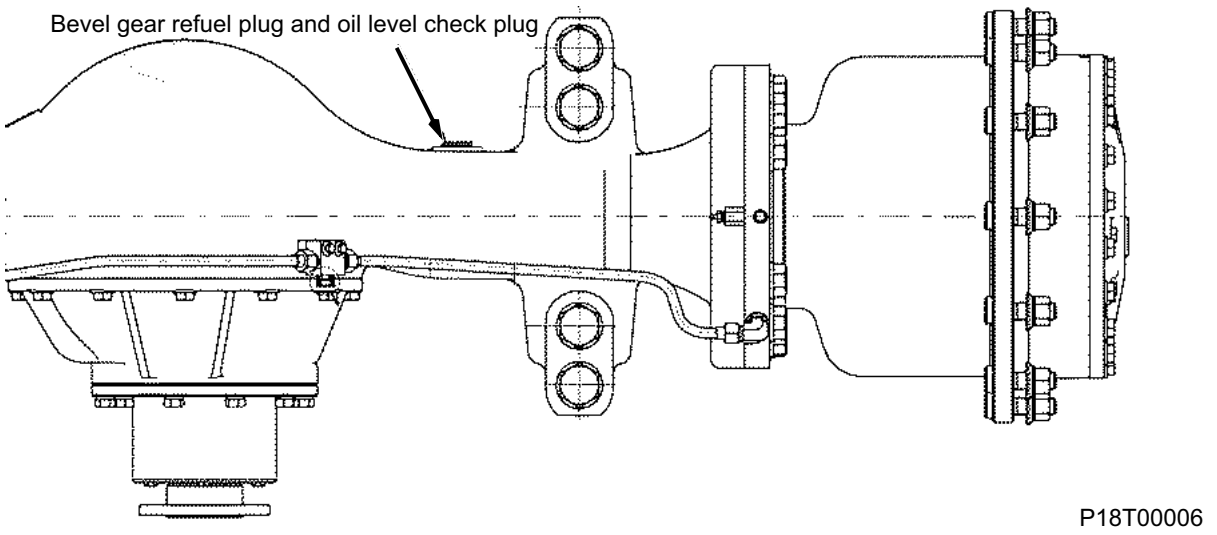
Figure 3-5 Wheel drain plug and oil level check plug



P18T00005

1) Wheel reducer: place the axle according to the installation position, and turn the hub to keep the oil level in a horizontal position, fill oil from left and right hubs respectively until the oil overflows the oil level plug; park the reducer for ten minutes after the drive axle running, and then check the oil level, and add enough lubricating oil.

Figure 3-6 Bevel gear refuel plug and oil level check plug



2) Axle housing: the oil is added into axle housing until it overflows from the oil filler.

The axle oil shall be replaced at the first 500h, after that once every 1000h, or at least once a year.

Universal tool, tooling list

For the universal tools, tooling list, please see the torque converter-gear box system, drive axle system and drive shaft system.

Special tool, tooling list

For the special tool, tooling list, please see "ZF Box Overhaul Manual" for details.

Structure Function Principle

Torque Converter - Gearbox System

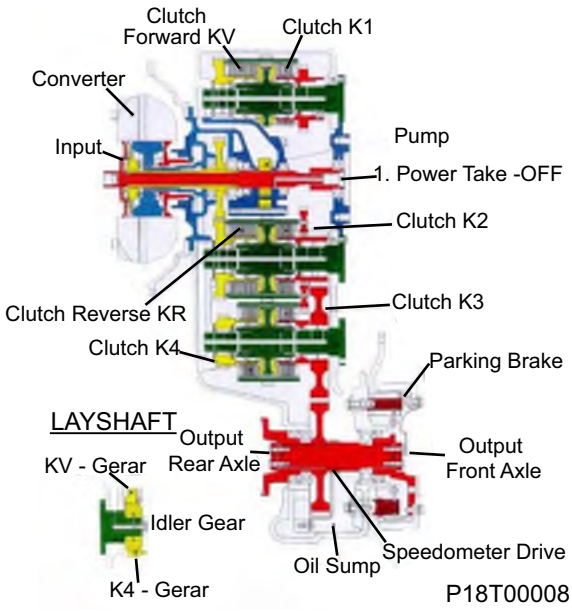
The torque converter -gearbox system equipped in this machine is ZF 4WG158 full auto type, which mainly consists of a three-element, single-turbo torque converter, mechanical gear box with four forward gears, three reverse gears and electro hydraulic shift control system, as shown below:

Figure 3-7 External view of torque converter - gear box assembly



P18T00007

Figure 3-8 Structural schematic diagram of torque converter - gear box assembly



P18T00008

System technical parameters

The technical parameters of ZF 4WG158 torque converter - gear box assembly in this machine are listed in Table 3-3.

Table 3-3 Technical parameter table of torque converter - gear box assembly

Component	Items	Parameters	Remarks
Gearbox	Model	ZF 4WG158	
	Type	Fixed shaft type	
	Gears	Four forward gears, three reverse gears	
	Torque converter-gear box assembly Quality (oil not included) /kg\lb	430\ 948.15	
	Type of emergence parking brake	Shoe brake	
Torque converter	Type	Single-turbo, three-element	
	Circulation circle diameter of torque converter/mm\In	340\ 13.39	
	Inlet pressure of torque converter/MPa\ psi	0.85\ 123.25	
	Outlet pressure of torque converter/MPa\ psi	0.50\ 72.5	
Shift control system	System voltage/V	24	
	Shift control mode	Auto electro hydraulic power shift	
	System working pressure/MPa\ psi	1.6+0.2\ 232+29	

System schematic diagram and working principle description

The torque converter of this system is a three-element with single-turbo structure, and the diagram for its structure and working principle is as follows:

Figure 3-9 Structure diagram for torque converter

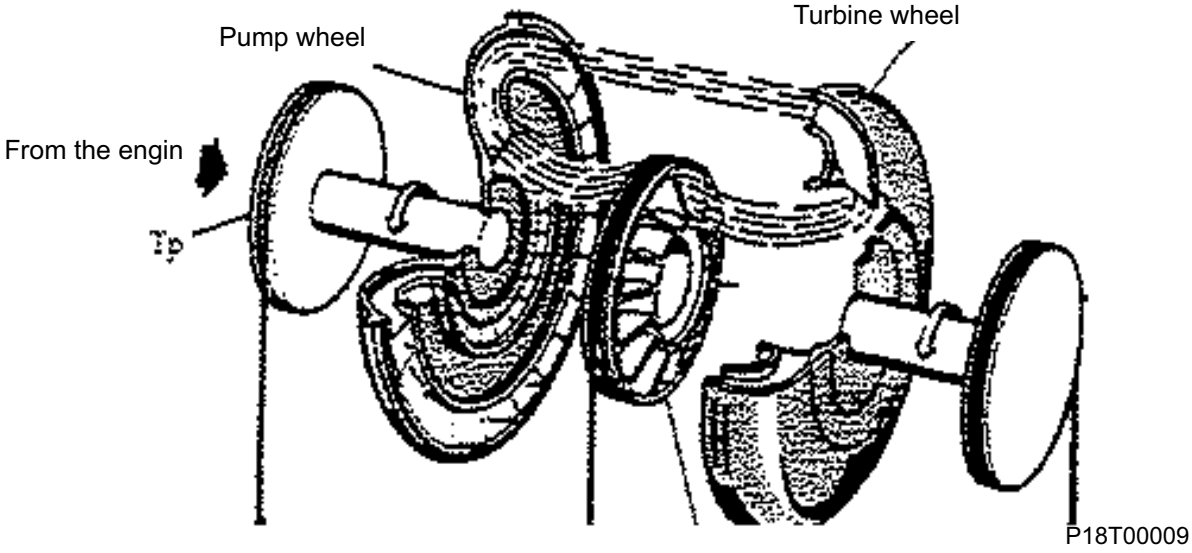
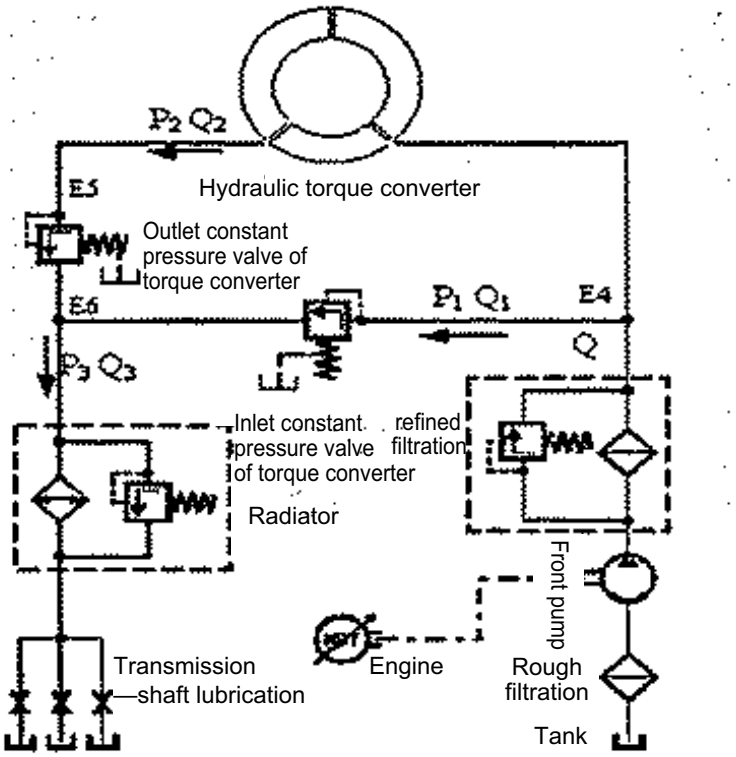


Figure 3-10Schematic diagram for torque converter hydraulic



We can see from structure diagram for torque converter, a three-element, single-turbo torque converter mainly consists of pump wheel, guide wheel and a turbine. As the pump wheel of torque converter is directly coupled with and driven by the engine, the hydrodynamic drive oil between pump wheel and turbine forms complex flow under rotation of pump wheel. The mechanical energy is converted into kinetic energy of oil fluid. The fluid flow with kinetic energy strikes against the turbine at a high speed. The turbine absorbs its kinetic energy and restores it to mechanical energy for gearbox. The guide wheel is stationary. When the fluid flow(which is from the turbine and has some kinetic energy) passes through the curved blade of the guide wheel, the torque formed by the impact force and counterforce produced on the blade acts on the engine base, and equivalent to the sum of increased torque of turbine from counterforce and reduced torque of pump wheel from impact force. It is possible that the output torque of turbine is greater than input torque of pump wheel, based on which, the torque converter is variable.

The working oil of torque converter is imported into the torque converter through the coarse and fine filters from the oil tank by the variable pump. There is a constant pressure valve (safety valve) set at the inlet of torque converter, whose main role is to avoid excessive pressure in the torque converter to damage the parts. There is another constant pressure valve (back pressure valve) at the outlet of torque converter, whose main role is to ensure the torque converter is full of working oil in order to avoid cavitation appeared during operation and impact on the performance of torque converter.

An electro-hydraulic shift control valve is installed on the gear box assembly, see figure 3 -11 and 3-12 for structure composition and operating hydraulic pressure schematic diagram.

Figure 3-11 Diagram for structure and composition of electro-hydraulic shift control valve

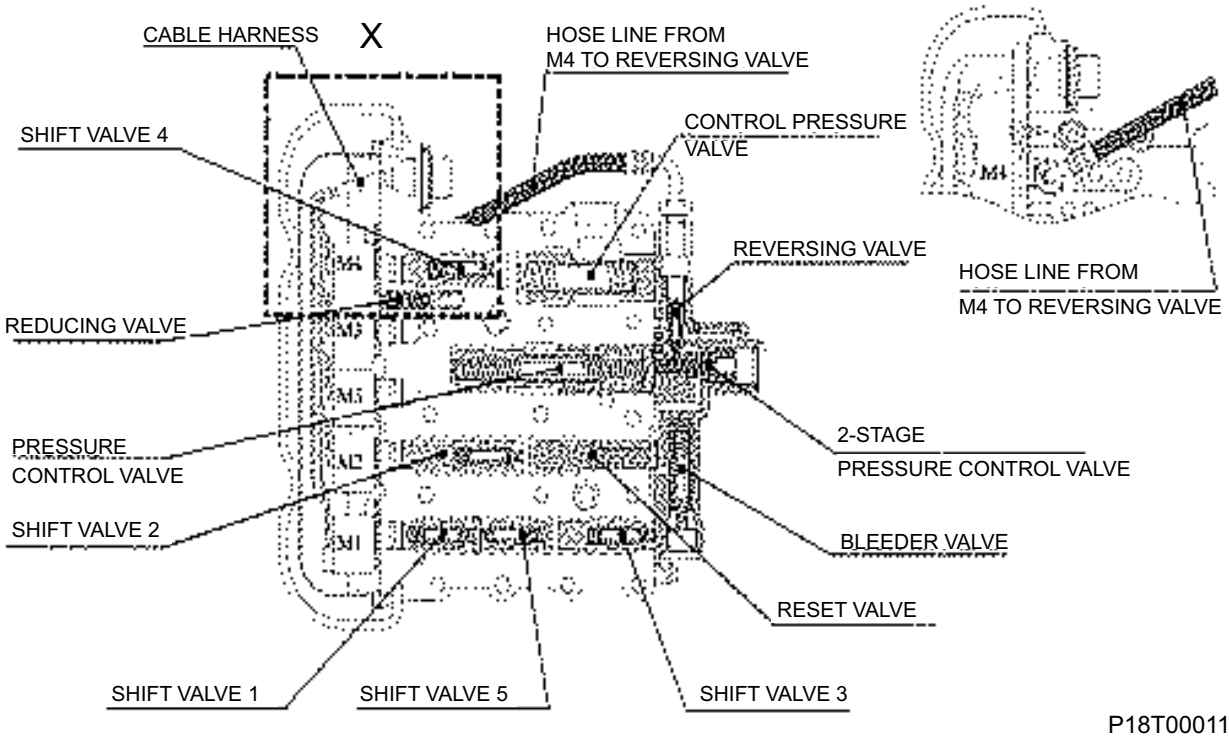
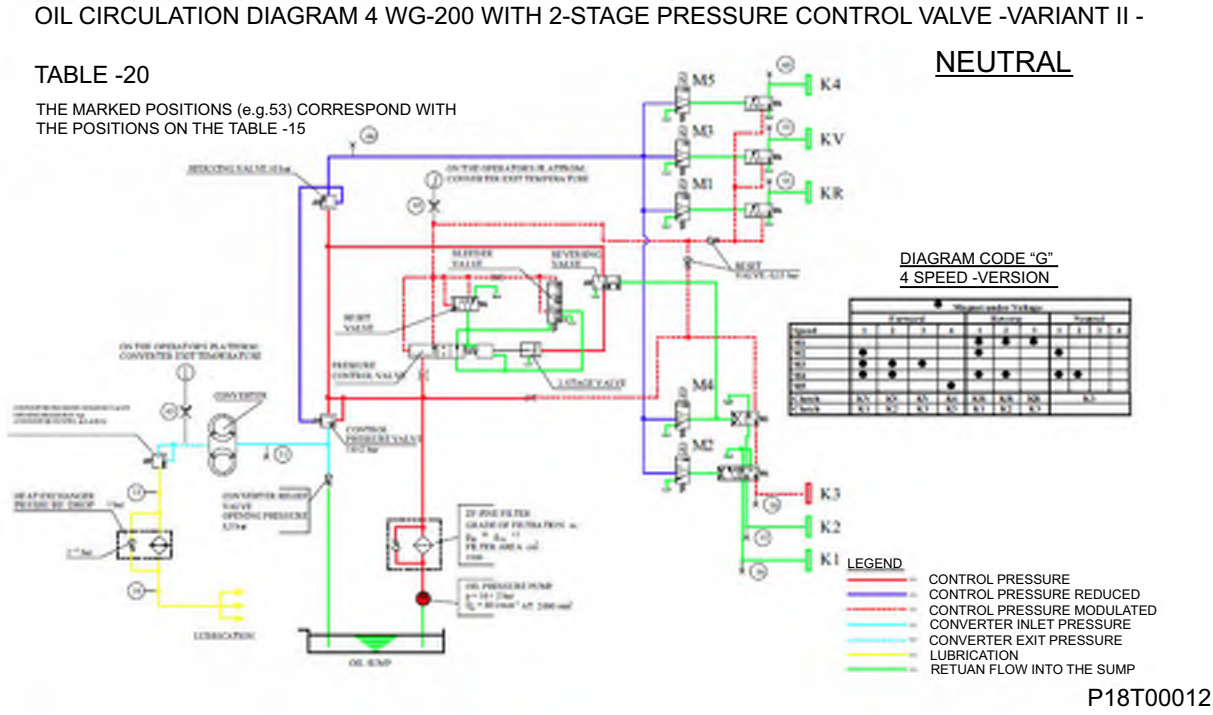


Figure 3-12 Schematic diagram for hydraulic pressure of torque converter - gear box assembly



The electro-hydraulic shift control valve consists of solenoid valves M1, M2, M3, M4, M5, valve stem and body. When the electro-hydraulic shift control valve is operating, the fluid flow in the valve stem oil passage is controlled by the power of solenoid valves, which finally control the engagement and disengagement of clutch in the gear box, thus to make the gear box achieve different shifts. For the power transferring line and gear engagement with the gear box in different gears, please see the figure of the power transferring line for each gear as the following figure 3-13 to 3-19.

Figure 3-13 Drive line of forward gear 1

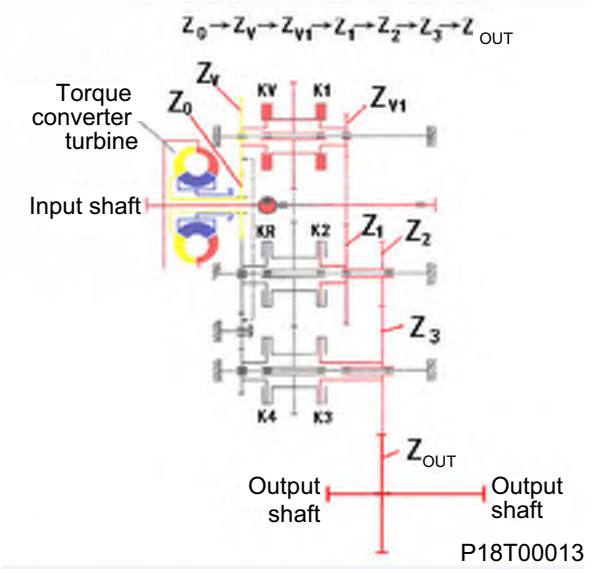


Figure 3-14 Drive line of forward gear 2

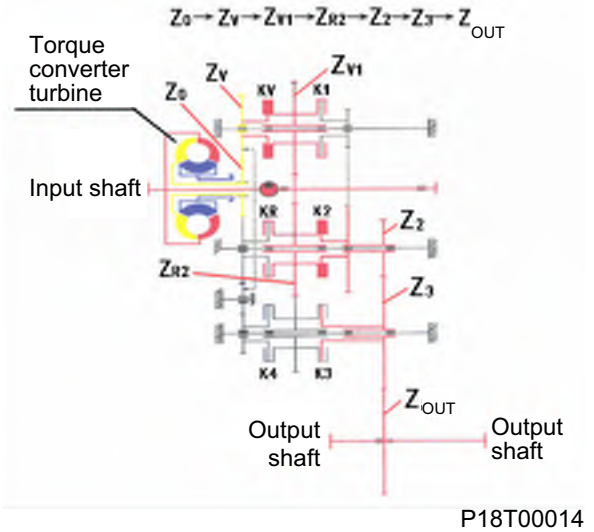


Figure 3-15 Drive line of forward gear 3

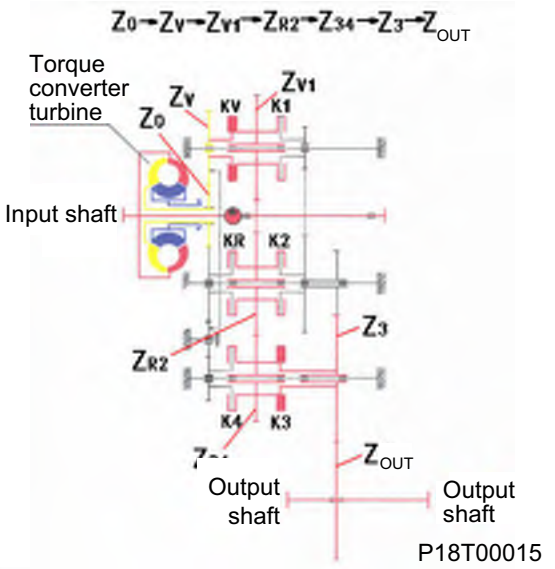


Figure 3-16 Drive line of forward gear 4

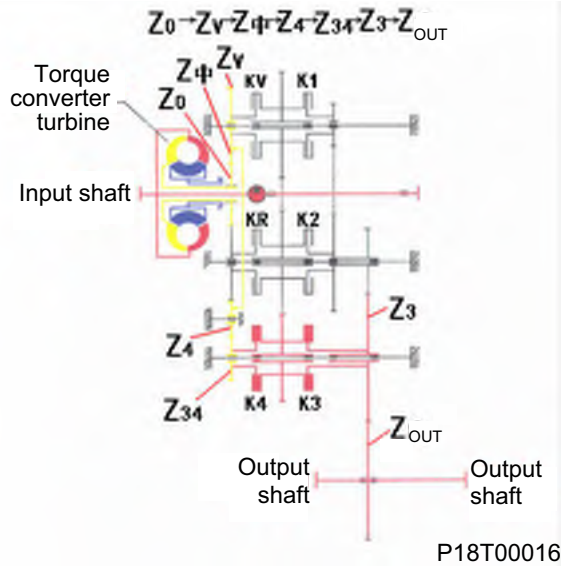


Figure 3-17 Drive line of reverse gear 1

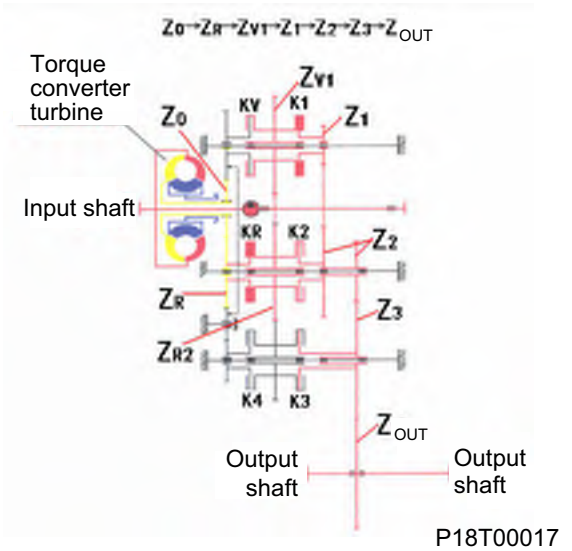


Figure 3-18 Drive line of reverse gear 2

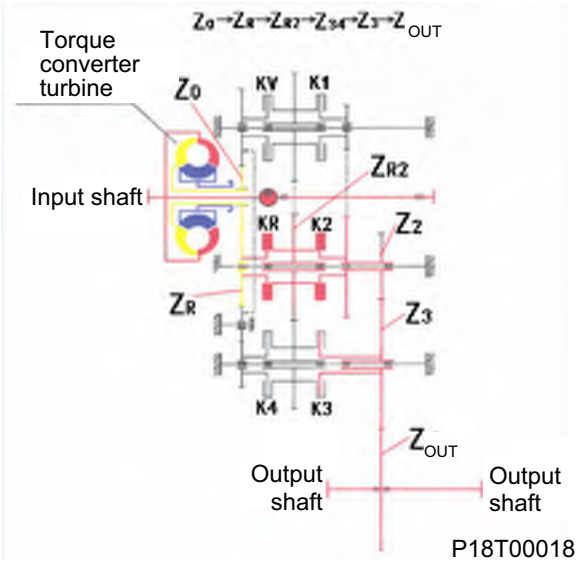
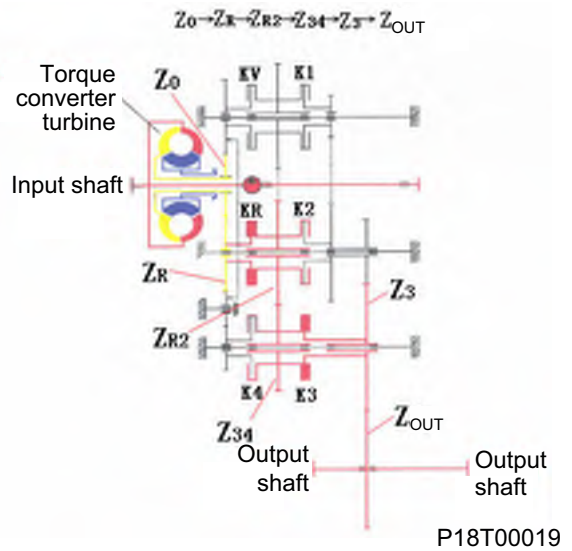


Figure 3-19Drive line of reverse gear 3



Drive axle system

Composition and position of drive axle system

The basic function of drive axle for wheel loader is to reduce the gear box input speed with main drive and wheel reducer and increase the torsion, thus to meet the requirements of driving, operating speed and traction of the base machine. And also, change the straight line motion to vertical-lateral motion via main drive, so that the drive wheel can be driven to rotate to make the base machine drive along the straight route. The differential helps balance the speeds of left and right tires to make sure the machine can still drive when the driving resistances on both sides are different.

In addition to basic features of drive axle for wheel loader, it is also a load-bearing unit for complete machine, a support device for road wheel and mounting & support device for service brake. The drive axle system mainly consists of front axle, rear axle and brake lines. The swing axle also includes front, rear swing brackets, support shaft and other parts.

System technical parameters

Major technical parameters for the drive axle system of this machine are listed in Table 3-4.

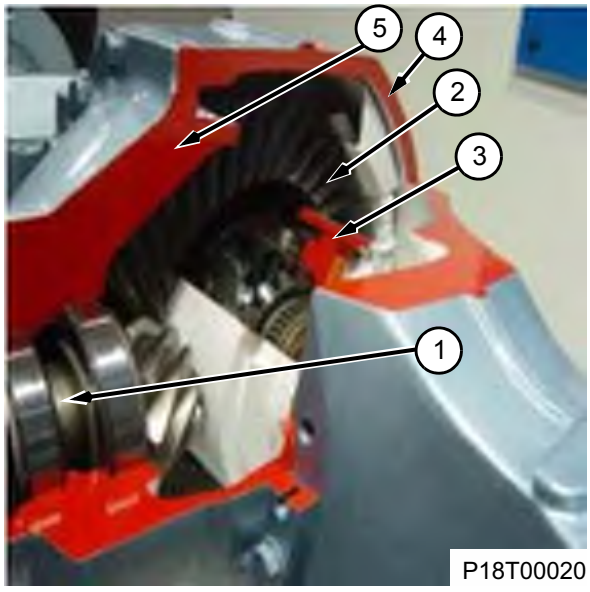
Table 3-4 Main technical parameter table for drive axle

System components	Items	Parameters	Remarks
Front axle	Drive mode	Spiral gear level-I reduction, wheel planetary gear reduction	
	Brake mode	Built-in wet multi-plate type	
	Brake pressure /MPa\psi	1450	
Rear axle	Drive mode	Spiral gear level-I reduction, wheel planetary gear reduction	
	Brake mode	Built-in wet multi-plate type	
	Brake pressure /MPa\psi	1450	

System schematic diagram and working principle description

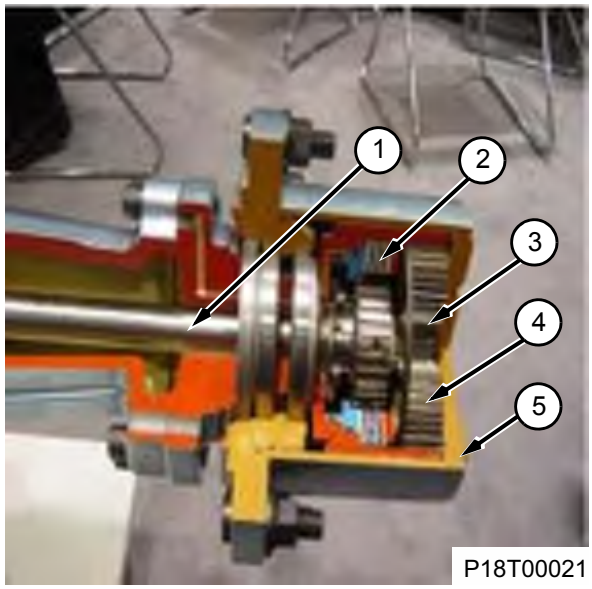
The drive axle for wheel loader is classified into two classes, i.e. front axle and rear axle, the main difference between which is the spiral directions of the spiral bevel gear pairs in the main drive. The driving spiral bevel gear of front axle is left-handed, and that of rear axle is right-handed. The structure diagram for bevel gear and wheel reducer of this machine is as shown in figure 3-20 and 3-21.

Figure 3-20 Structure diagram of the bevel gear



1. Driving spiral bevel gear
2. Axle housing
3. Driven spiral bevel gear
4. Carrier
5. Differential

Figure 3-21 Diagram of the wheel reducer



1. Axle shaft
2. Planetary gear
3. Brake
4. Hub
5. Sun gear

The bevel gear structure is shown in Figure 3-21. The bevel gear includes two parts, one is the bevel gear composed of driving spiral bevel gear and large size spiral bevel gear; the other is the differential composed of cross axle and bevel gear. The power is transmitted to the driving spiral bevel gear by the gear box through drive shaft, thus to drive the large size spiral bevel gear with differential to rotate together. The half shaft gear of differential passes the power to left/ right half shaft which is connected with the splines, and further to the wheel reducer. The power is then transmitted to hub and finally to drive the tire to rotate after further speed reduction, increasing torsion through wheel reducer.

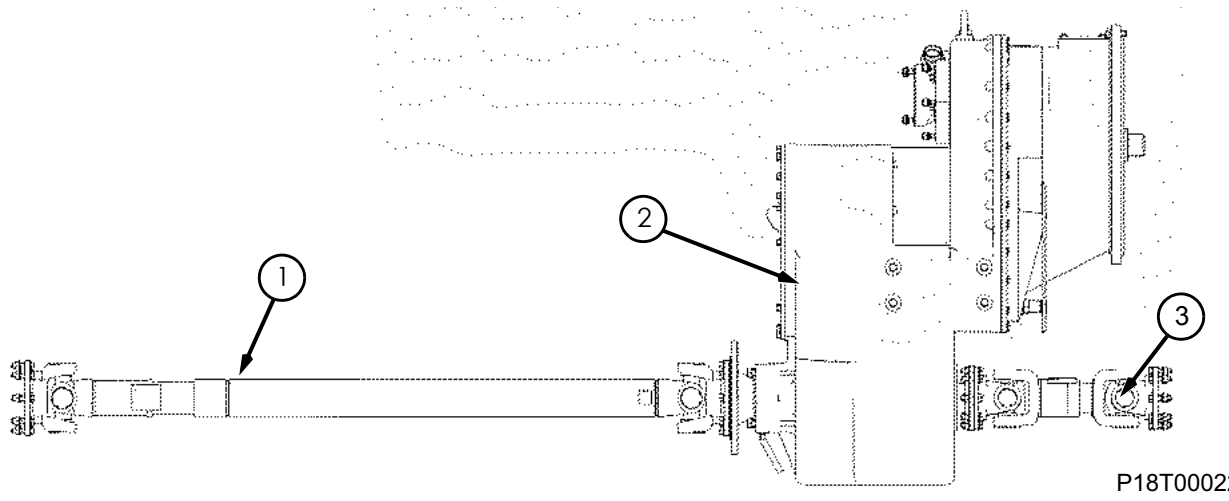
Drive Shaft System

In the wheel loader, the drive shaft system is mainly used to deliver the power between the two connected shafts, of which the relative position changes constantly during operation. Because of the special transmission characteristics of universal joint, the drive shaft may connect two transmission parts with nominal concentric axial line. However, an error may occur during installation and axial line deviates from the original position when operating, the drive shaft is widely used in shoveling transportation machine.

System composition and position

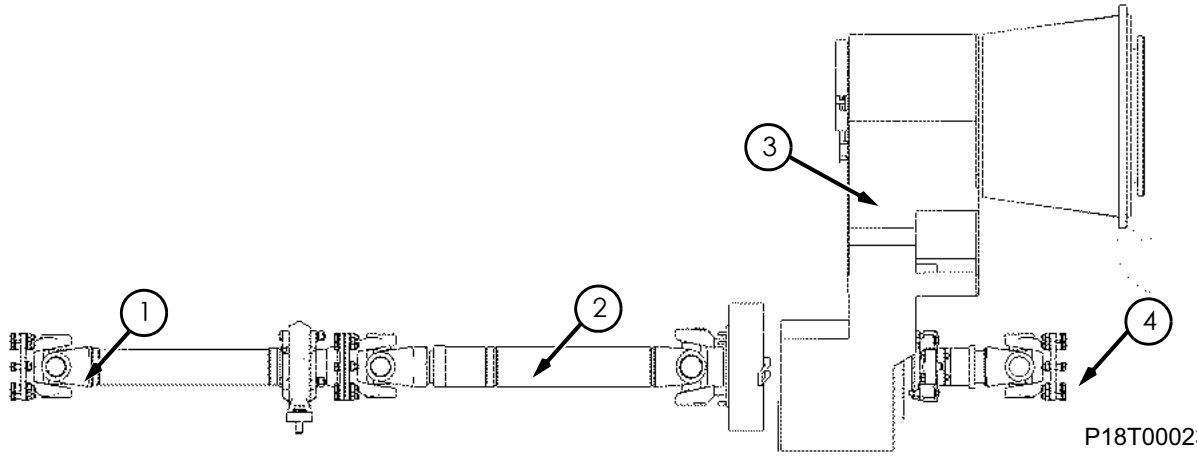
The drive shaft system of wheel loader is composed by the following two structural types in accordance with its formal layout, the drive shaft system shown in Figure 3-25 consists of rear and front drive shafts, the one shown in Figure 3-26 consists of rear, front, intermediate shafts and support assembly.

Figure 3-22 Drive shaft system



1. Front drive shaft
2. Torque converter-gear box assembly
3. Rear drive shaft

Figure 3-23 Drive shaft system



1. Front drive shaft&support assembly
2. Intermediate drive shaft
3. Torque converter-gear box assembly
4. Rear drive shaft

System technical parameters

The technical parameters for the drive shaft system are listed in Table 3-5.

Table 3-5 Technical parameter table for drive shaft system

Parts name	Input-end coupling type	Output-end coupling type
Rear drive shaft	7C FLANGE	7C FLANGE
Intermediate drive shaft	180 round flange	150 round flange
Front drive shaft&support assembly	150 round flange	150 round flange

Tire&rim system

System composition and position

Tire & rim system are both components bearing weight of a complete machine and direct components driving the complete machine to walk. Tires can be classified into bias tires with an inner tube, bias tires without an inner tube, radical tires, solid tires, etc. in accordance with it structural layouts. They can also be classified into block pattern tires, traction pattern tires, skidding tires, etc. according to pattern form.

System technical parameters

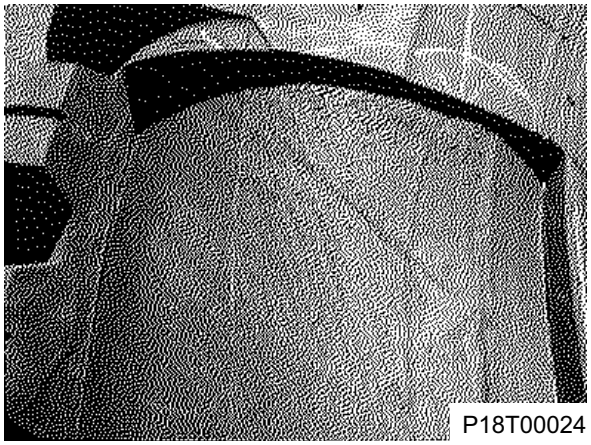
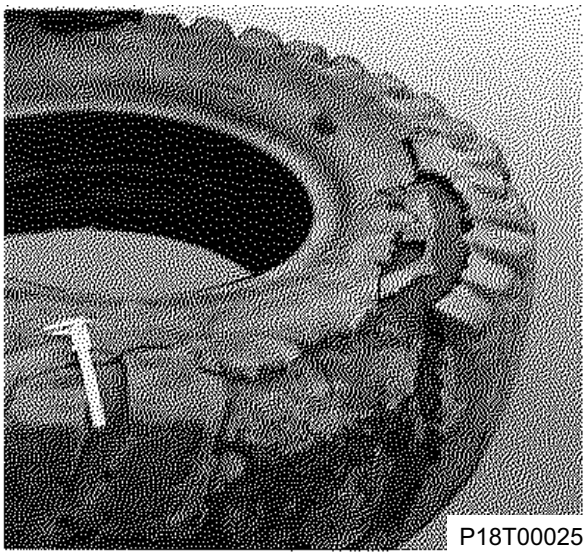
The technical parameters for the tire & rim system equipped in this machine are listed in Table 3-6.

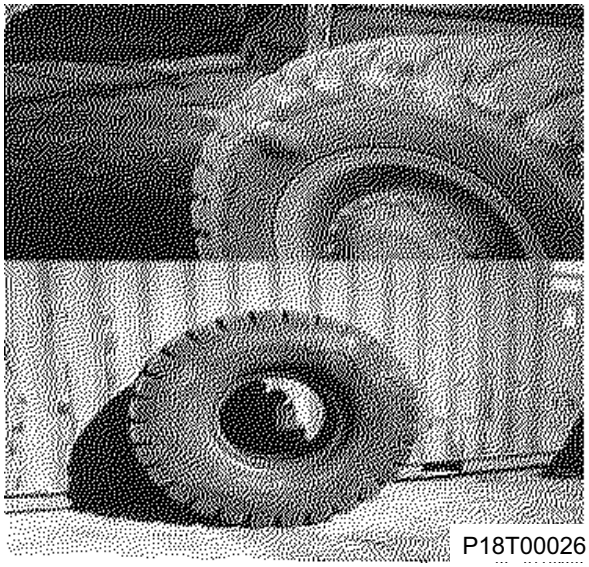
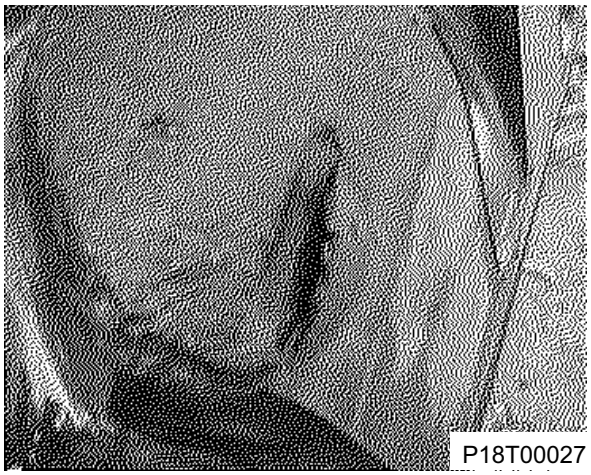
Table 3-6 Technical parameters of tire&rim system

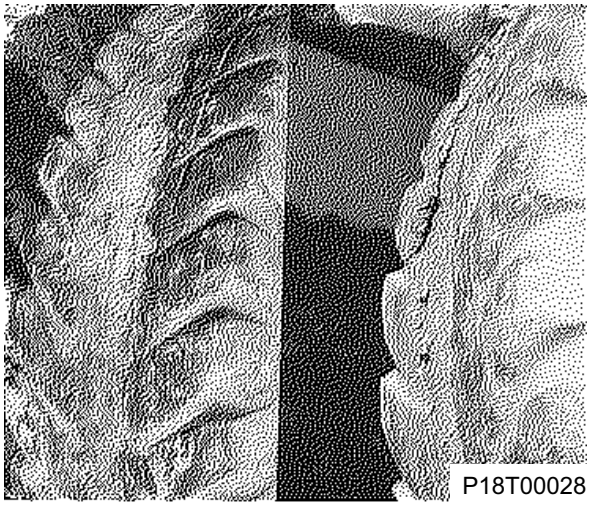
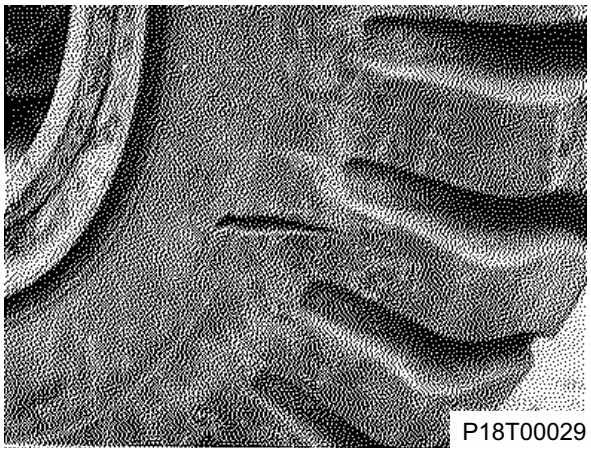
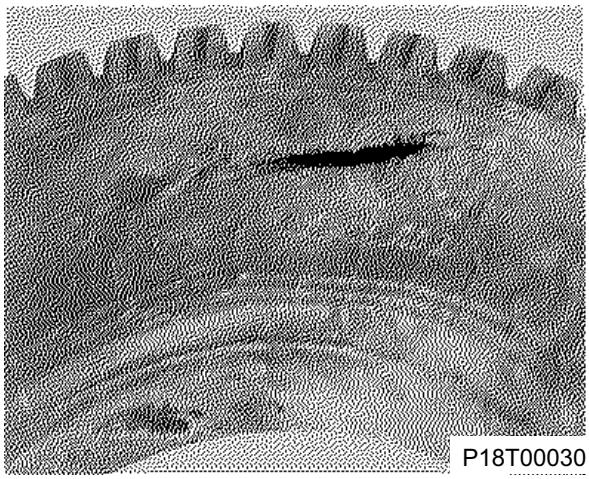
System components	Items	Parameters	Remarks
Tire	Tire structure	Radial tire	Tubeless bias tire or tubed bias tire is optional
	Specification	17.5R25 two star L3	
	Level	\	
	Type of tread	L-3	Ordinary block
	Tire pressure (MPa)\(psi)	Front wheel:0.55-0.58\79.75-84.10 Rear wheel: 0.52-0.55\75.40-79.75	
Rim	Specification	25-14.00/1.5	

Common failure modes of tire and reasons

Common failure mode of tire and reasons are as follows:

Typical pictures	Failure mode	Main reasons
 P18T00024	Delaminating of crown	1. Reasons for manufacture: there is impurities, oil stains or water in the tread rubber or cord ply or not firmly compressed when being molded, or gasoline does not fully volatilize. 2. Reasons for usage: speed is too fast (beyond specified speed), and directive pattern is traveling in reverse direction.
 P18T00025	Shoulder delamination blasting	1. Reasons for manufacture: there is impurities, oil stains or water in sidewall rubber or cord ply or not firmly compressed, or gasoline does not fully volatilize. 2. Traveling with insufficient air will intensify wear of tire shoulders and cause excessive heat, which will separate sidewall rubber from cord ply and cause an explosion when problem gets worse.

Typical pictures	Failure mode	Main reasons
 P18T00026	Delaminating of sidewall	1. Reasons for manufacture: there is impurities, oil stains or water in sidewall rubber or cord ply or not firmly compressed when being molded or gasoline does not fully volatilize. 2. Traveling on uneven road with insufficient air or overload or operating in severe working conditions will cause tire body to deform badly and cause excessive heat in partial sidewall so that sidewall peels off or explodes.
 P18T00027	Double skin	Major reasons: mixing of extruded tread compound is uneven, surfaces of semi-finished product have impurities, vulcanization mold has oil stains, and isolating agent is unevenly applied.

Typical pictures	Failure mode	Main reasons
 P18T00028	Wearing of crown	Major reasons: traveling with too high pressure will cause earthed area reduction of tire crown, local load increase and wear intensification.
 P18T00029	Trauma	Major reasons: during traveling, outer tube is scratched by pointed objects or is stabbed evenly by pointed objects.
 P18T00030	Side trauma	Major causes: the vehicle speeds up when steering, the tire side rubs the roadside obstacles; and installed tire is stuck with hard objects; the machinery is damaged during transportation, installation.

Testing and adjustment

Power Train Test

Detection point layout of torque converter - gear box assembly as is shown in Figure 3-25, and names and parameters of each detection point can be found in Table 3-7.

Figure 3-25 Measuring point layout

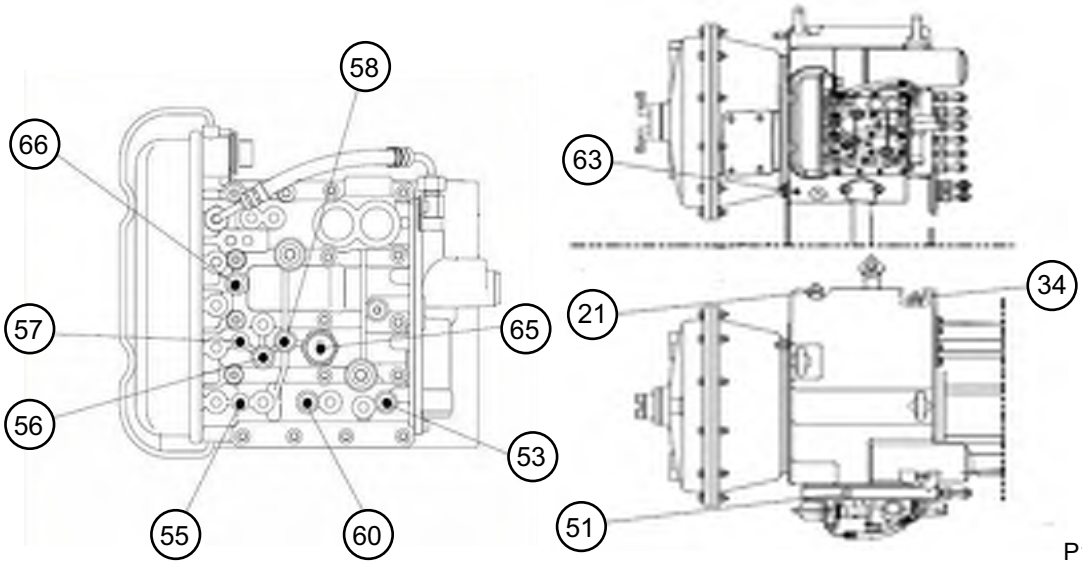


Table 3-7 Parameter list of the measuring point

S/N of the measuring point	Name of the measuring point	Theoretical value	S/N of the measuring point	Name of the measuring point	Theoretical value
21	Input sensor of the gear box	\	55	Reverse gear clutch	1.6-1.8MPa
34	Output sensor of the gear box	\	58	Gear 3 clutch	1.6-1.8MPa
51	Inlet pressure of torque converter	Opening pressure: 0.85	56	Gear 1 Clutch	1.6-1.8MPa
53	Forward gear clutch	1.6-1.8MPa\232-261psi	57	Gear 2 Clutch	1.6-1.8MPa
65	Pressure of shift control system	1.6-1.8MPa\232-261psi	63	Outlet pressure of torque converter	Opening pressure: 0.5
60	Gear 4 Clutch	1.6-1.8MPa\232-261psi			

Logical relations between gear states and working conditions of shift control valve solenoid valve can be found in Table 3-8.

Table 3-8 Logical relations between gear states and working conditions of shift control valve solenoid valve

Solenoid valve	Electric condition of the solenoid valve										
	Forward gear				Reverse gear			Neutral gear			
	1	2	3	4	1	2	3	1	2	3	4
M1					●	●	●				
M2	●				●			●			
M3	●	●	●								
M4	●	●			●	●		●	●		
M5				●							
Clutch	KV	KV	KV	K4	KR	KR	KR	K3			
Clutch	K1	K2	K3	K3	K1	K2	K3				

Remarks: ● means the solenoid valve is energized;

Test Requirements:

Testing dynamic unbalance value

After the drive shaft is repaired, a professional dynamic unbalance test must be performed.

Torque Converter - Gearbox System

1. Leakage check

Start up the machine and operate it for several minutes, observe whether there is sign of leakage from the hose assembly coupled with gear box assembly, if so, re-tighten it.

2. Test of gear box shift pressure

Power on the machine, now the oil pressure warning light of gear box flashes on the instrument panel, and after startup of machine, the warning light shall go out, if not, inspect the oil level of gear box once again.

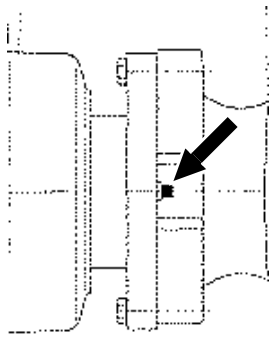
Drive axle system

1. Leakage check

Start up the machine, step on the service brake pedal for several times after the air pressure of energy accumulator gets normal, observe whether there is sign of leakage at the joint of steel pipe of front axle brake and service brake hose.

2. Exhaust

Figure 3-24 Rear axle ventilation plug



1) Loosen the exhaust plugs at both ends of axle.

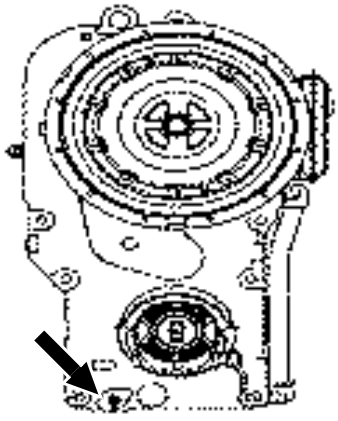
2) Start up the machine and step on the service brake pedal until the oil overflows from the exhaust plug.

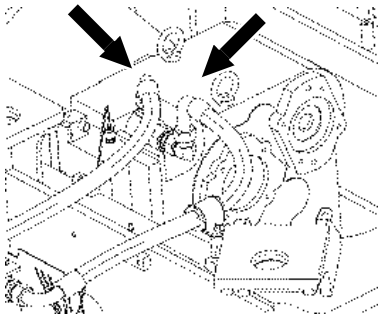
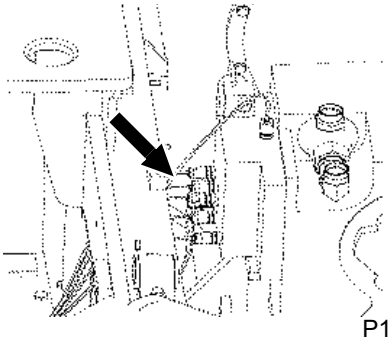
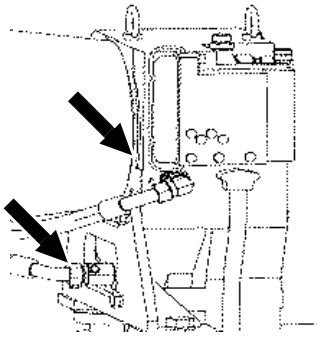
3) Tighten the exhaust plug.

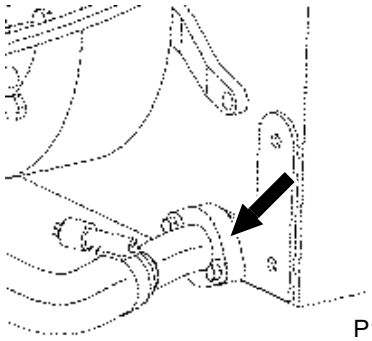
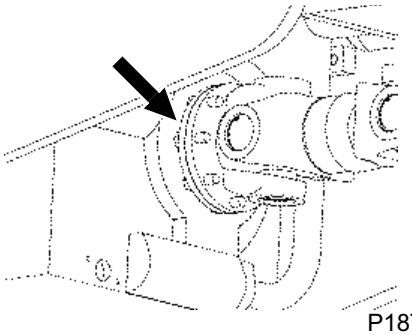
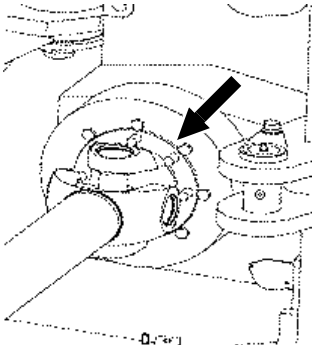
Removal and Installation

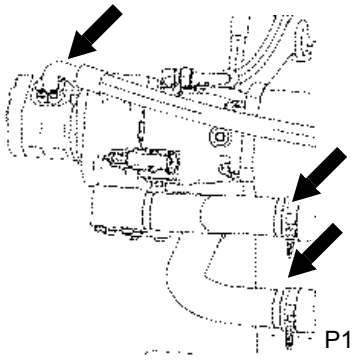
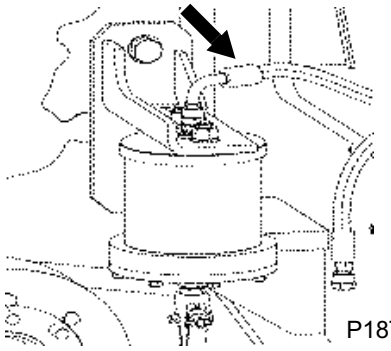
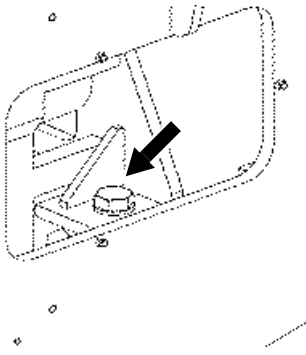
Removal and installation of torque converter-gearbox system

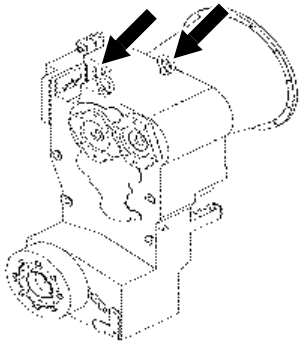
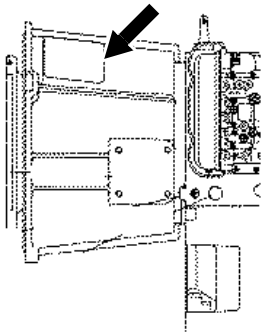
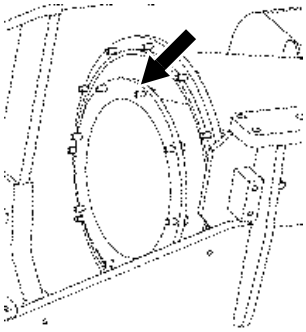
Removal of torque converter - gearbox system

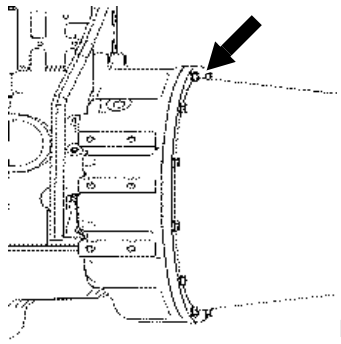
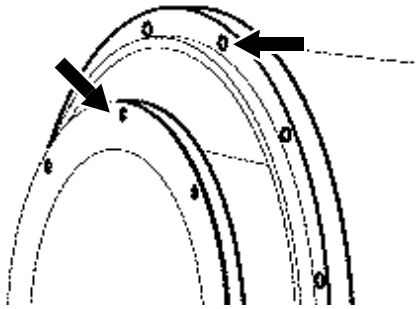
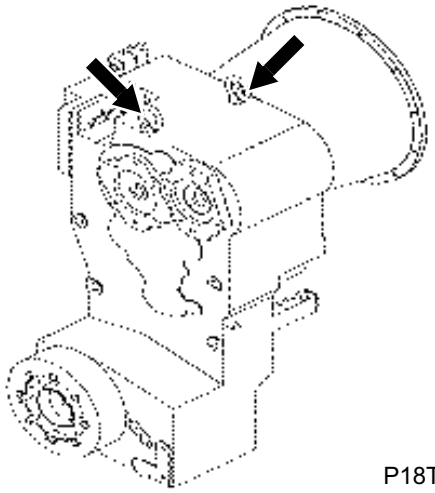
Reference picture	Operation step	Tools required (Remarks)
	1. Stop the machine on a level ground, put the work implement, bucket levelly, and pull up the emergency parking brake lever. 2. Turn off the engine and remove the key.	
 P18T00032	3. Remove the drain plug of gear box assembly to drain the oil. **⚠ Caution: The waste oil shall be recovered in a container during removal, in order to avoid environmental contamination. The removed hose is shielded to avoid contamination of parts.** **⚠ Danger: It is sure that the hose pressure is fully discharged and the oil is cooled sufficiently before removal of hose, in order to avoid personal injury of hose pressure and hot oil during removal.**	34# socket, 13# socket, pneumatic impact wrench
	4. Remove the cab assembly of machine, see section “Removal and Installation of Cab” for removal steps.	

Reference picture	Operation step	Tools required (Remarks)
 P18T00033	5. Remove the hose assembly connecting the oil filter pipe to the gear box assembly with wrench. **⚠ Caution: The waste oil shall be recovered in a container during removal, in order to avoid environmental contamination.** **The removed hose is shielded to avoid contamination of parts.**	41# wrench
 P18T00034	6. Remove the test line connected to gear box assembly and test hose.	18# Wrench
 P18T00035	7. Remove the hose assembly with a wrench.	41# Wrench

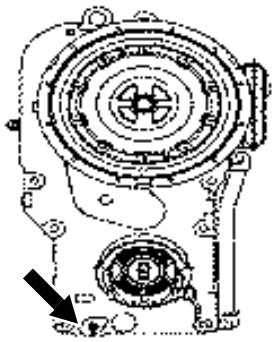
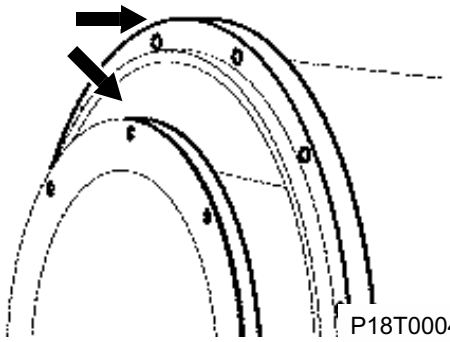
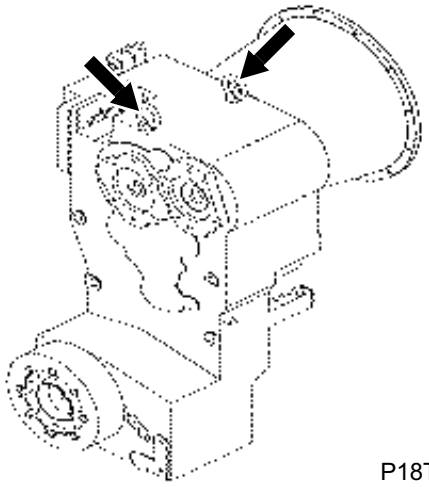
Reference picture	Operation step	Tools required (Remarks)
 P18T00036	8. Remove the clamping bolt fixing the oil filler steel-pipe with a wrench.	10# Wrench
 P18T00037	9. Remove the coupling lock-nut between rear drive shaft and rear output flange of gear box assembly. **⚠ Caution: The drive shaft assembly is composed of slidable spline sleeve, please take care to avoid personal injury caused by falling of slide shaft fork during removal.**	18# Wrench
 P18T00038	10. Remove the coupling lock-nut between intermediate drive shaft and front output flange of transmission assembly.	21# Wrench

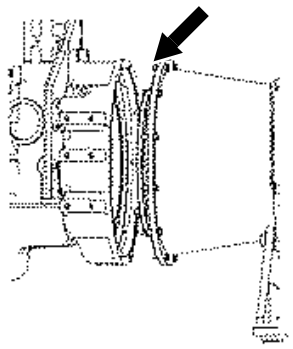
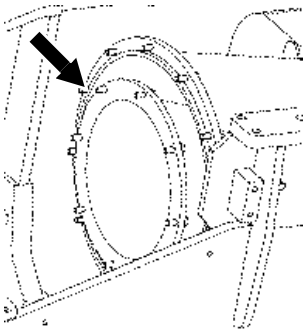
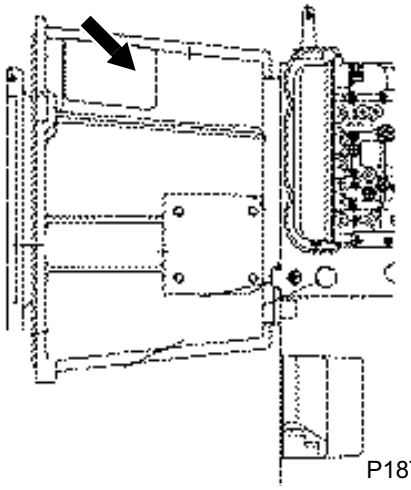
Reference picture	Operation step	Tools required (Remarks)
 P18T00039	11. Remove the hose assembly or the hose connected with hydraulic pump from the gearbox assembly, and refer to removal of hydraulic system for detailed procedures.	
 P18T00040	12. Remove the hose assembly connected with brake system from the emergency parking brake chamber.	24# Wrench
 P18T00041	13. Remove the bolts and washer for attaching the transmission mount to the frame with an air gun.	46# wrench, 46# socket, pneumatic impact wrench

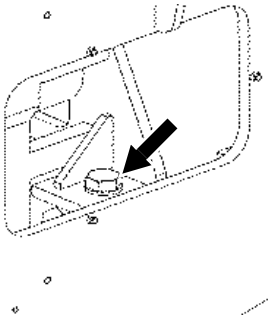
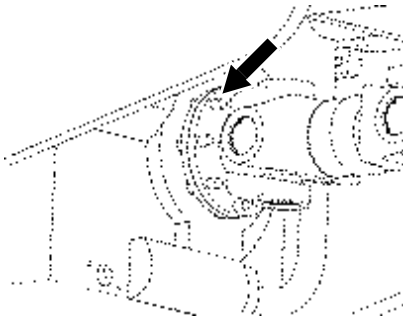
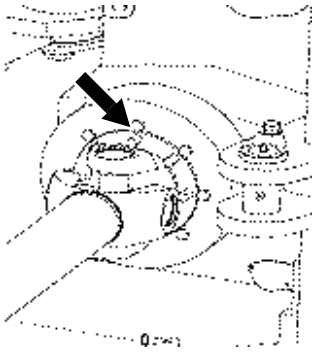
Reference picture	Operation step	Tools required (Remarks)
 P18T00042	14. Pre-lift the gear box assembly through the lugs with lifting device.	Sling (2 tons)
 P18T00043	15. Remove the cover plate from the transmission assembly with a wrench.	13# Wrench
 P18T00044	16. Remove the fastening bolts used to attach the gear box assembly to the engine flywheel with a wrench.	16# Wrench

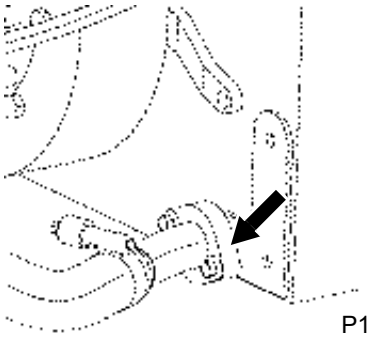
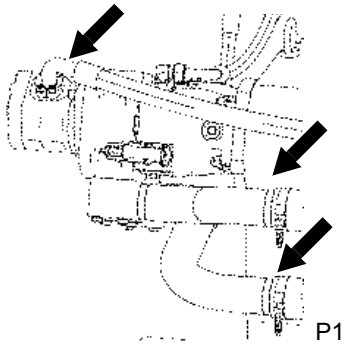
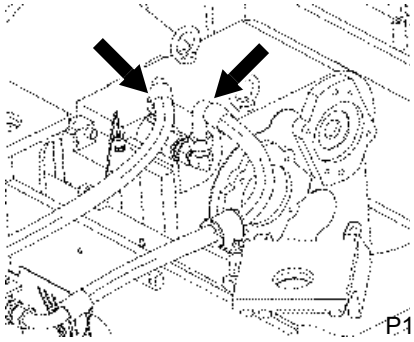
Reference picture	Operation step	Tools required (Remarks)
 P18T00045	17. Remove the fastening bolts used for attaching the gear box assembly-torque converter case to the engine housing with an blower gun and socket.	16# socket, pneumatic impact wrench
 P18T00046	18. Separate the transmission assembly from the engine, and secure the torque converter case and core through the bolt holes with ropes and steel wires.	Steel wire
 P18T00047	19. Lift up the gear box assembly from the machine through the lugs with the hoisting device and ropes and place it in a safe area.	Sling (2 tons)

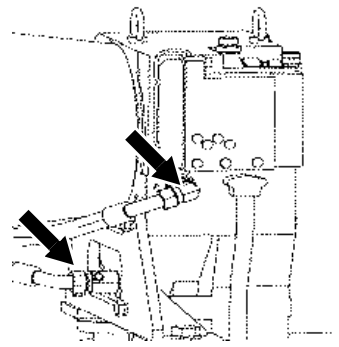
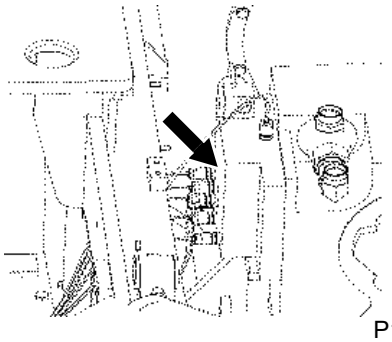
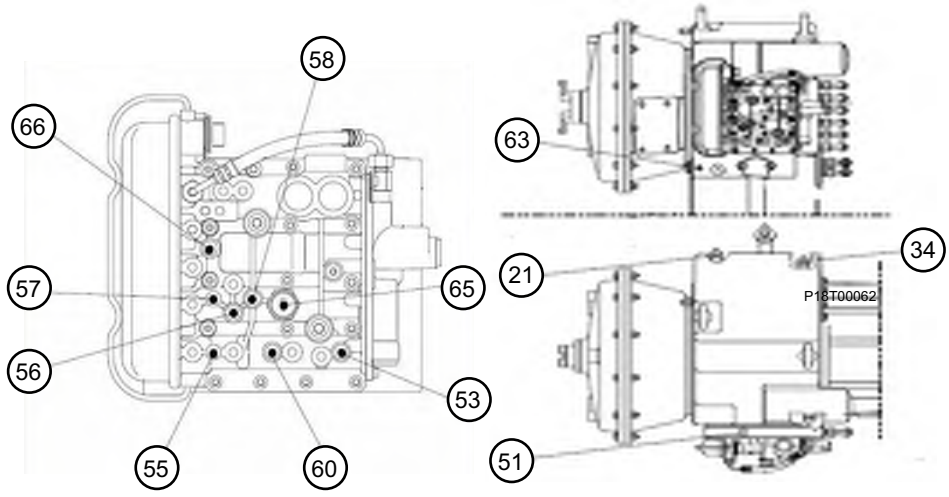
Installation of torque converter-gear box system

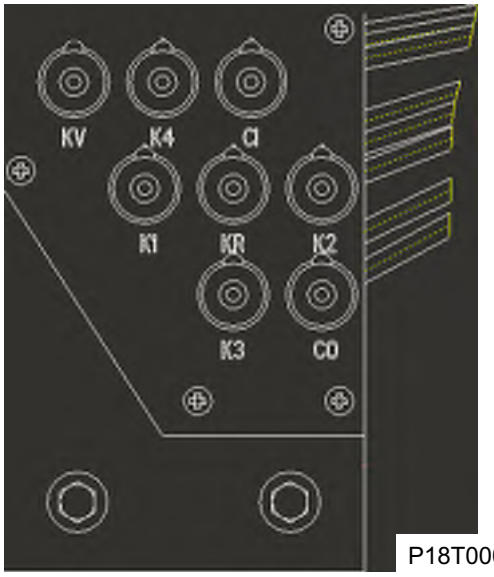
Reference picture	Operation step	Tools required (Remarks)
 P18T00048	1. Wipe clean the drain plug of gear box, and then install it in the threaded hole of gear box and tighten it with a torque of 600±70Nm\ 442.5±51.6 lbf•ft.	34# socket, 13# socket, pneumatic impact wrench, open-end 34# fixed torque spanner
 P18T00049	2. Secure the torque converter to its housing through threaded holes with the steel wire or ropes. **⚠ Danger: The torque converter can slide freely on the guide wheel seat. When lifting up it, the torque converter and its housing must be secured firmly with the steel wire or ropes, in order to avoid personal injury due to falling of torque converter.**	Steel wire
 P18T00050	3. Lift up the gear box assembly onto the machine through the lugs of gear box assembly with the hoisting device and ropes.	Sling (2 tons)

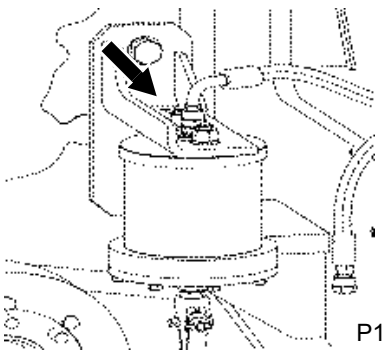
Reference picture	Operation step	Tools required (Remarks)
 P18T00051	4. Move gear box assembly to fit it with engine flywheel housing, and install the bolts and hard washer used for tightening the torque converter case to the engine housing and then tighten them. Tightening torque: 72±6Nm\ 53.1±4.4 lbf•ft.	16# socket, pneumatic impact wrench, open-end 16# fixed torque spanner
 P18T00052	5. Crank the engine flywheel case to make the torque converter align with mounting threaded hole on the engine flywheel, screw and tighten the fastening bolts and washer for attaching the torque converter to the engine flywheel by hand with a torque of 60±5Nm\ 44.25±3.7 lbf•ft	16# socket, pneumatic impact wrench, open-end 16# fixed torque spanner
 P18T00053	6. Install the mounting hole cover plate on the gear box.	13# Wrench

Reference picture	Operation step	Tools required (Remarks)
 P18T00054	7. Screw and tighten the bolts and washer for fastening the gear box mount to the frame with the torque of 2035±170Nm\ 1500.8±125.38 lbf•ft.	46# wrench, 46# socket, pneumatic impact wrench, open-end 46# fixed torque spanner
 P18T00055	8. Attach the mounting end flanges of drive shaft and gear box to the rear output flange of gear box, and tighten the locknut to 132±10Nm\ 97.35±7.38 lbf•ft.	18# wrench or open-end 18# fixed torque spanner
 P18T00056	9. Attach the intermediate drive shaft to front output flange of gear box and tighten the locknut to 200±15Nm\ 147.5±11.06 lbf•ft.	21# wrench or open-end 21# fixed torque spanner

Reference picture	Operation step	Tools required (Remarks)
 P18T00058	10. Install the oil filler steel-pipe on the gear box and tighten the set bolts with a torque of 26±3Nm\ 19.18±2.21 lbf•ft.	13# wrench or open-end 13# fixed torque spanner
 P18T00058	11. Install the hose referring to the hydraulic installation and hydraulic pump.	
 P18T00059	12. Install the hose assembly used for attaching the oil filter pipe to the gear box, and the tightening torque of hose joint is 137±6Nm\ 101.04±4.43 lbf•ft. **⚠ Caution: Two hose assemblies are respectively connected to the inlet, outlet of fine oil filter in directions as required, avoiding installation error.**	41# wrench or open-end 41# fixed torque spanner

Reference picture	Operation step	Tools required (Remarks)
 P18T00060	13. Install the hose assembly used for attaching the radiator pipe to the gear box, and the tightening torque of hose joint is 137±6Nm\ 101.04±4.43 lbf•ft.	41# wrench or open-end 41# fixed torque spanner
 P18T00061	14. Install the hose assembly used for attaching the test pipe to the gearbox, as shown in the following figure and table.	18# Wrench
Layout of test points of shift control valve  P18T00062		

<table>
<tr><th>Reference picture</th><th>Operation step</th><th>Tools required (Remarks)</th></tr>
<tr><td colspan="2">Logic diagram of test points and gear clutch
<table>
<tr><th>Decal marker</th><th>Meanings</th><th>Theoretical value</th><th>S/N in the corresponding valve</th></tr>
<tr><td>PRESSURE OF IN FRONT OF THE CONVERTER</td><td>Inlet pressure of torque converter</td><td>Opening pressure: 1.1 MPa</td><td>51</td></tr>
<tr><td>PRESSURE OF KV CLUTCH</td><td>KV clutch pressure</td><td>1.6-1.8MPa</td><td>53</td></tr>
<tr><td>PRESSURE OF KR CLUTCH</td><td>KR clutch pressure</td><td>1.6-1.8MPa</td><td>55</td></tr>
<tr><td>PRESSURE OF K1 CLUTCH</td><td>K1 clutch pressure</td><td>1.6-1.8MPa</td><td>56</td></tr>
<tr><td>PRESSURE OF K2 CLUTCH</td><td>K2 clutch pressure</td><td>1.6-1.8MPa</td><td>57</td></tr>
<tr><td>PRESSURE OF K3 CLUTCH</td><td>K3 clutch pressure</td><td>1.6-1.8MPa</td><td>58</td></tr>
<tr><td>PRESSURE OF K4 CLUTCH</td><td>K4 clutch pressure</td><td>1.6-1.8MPa</td><td>59</td></tr>
</table></td><td></td></tr>
<tr><td>Mapping diagram of centralized measuring point mounting plate and measuring point


P18T00063</td><td></td><td></td></tr>
<tr><td>
P18T00064</td><td>15. Install the hose assembly used for attaching emergence parking brake chamber to the brake system, the tightening torque is 37±2Nm\ 27.29±1.48 lbf•ft.</td><td>24# wrench or open-end 24# fixed torque spanner</td></tr>
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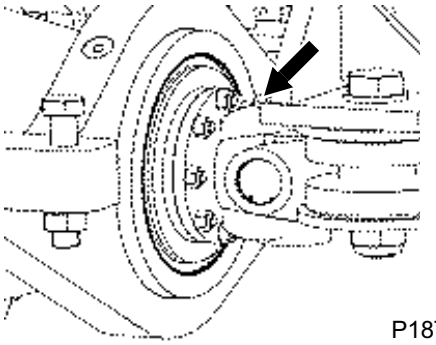
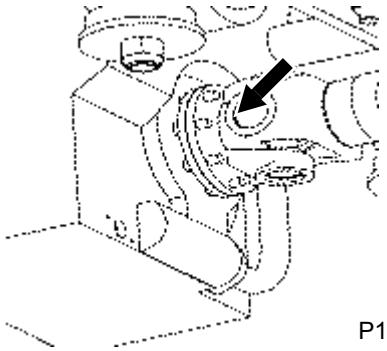
Reference picture	Operation step	Tools required (Remarks)
	16. Fill the gear box by referring to the Operation Manual of this machine, and check the oil level according to the specified method.	

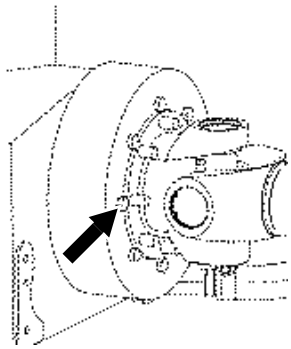
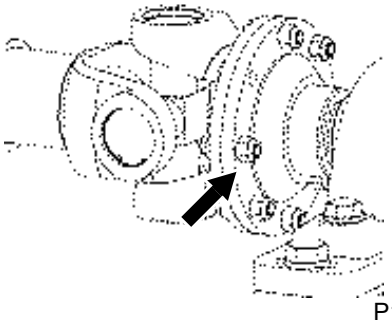
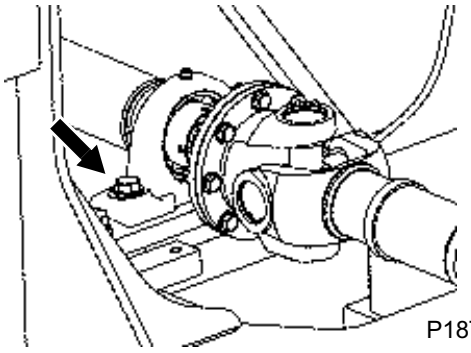
Disassembly and assembly of torque converter-gearbox assembly

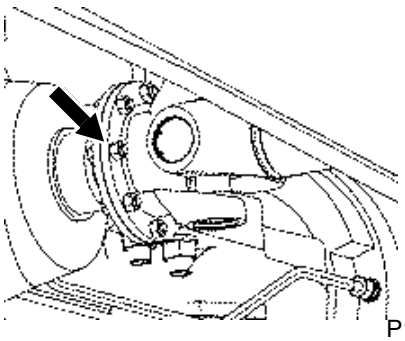
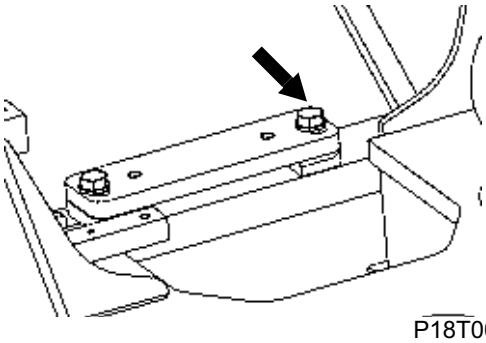
For disassembly and assembly of torque converter-gear box assembly in this machine, refer to "ZF Gear Box Overhaul Manual".

Removal and installation of drive shaft system

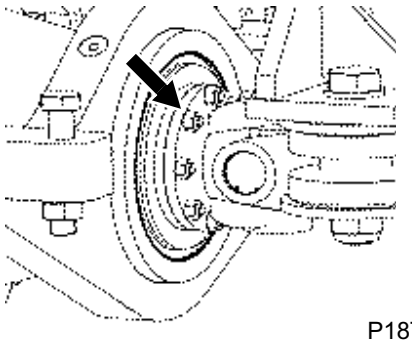
Removal of drive shaft system

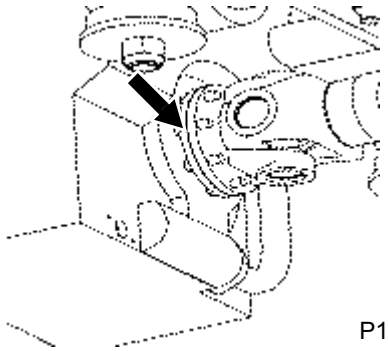
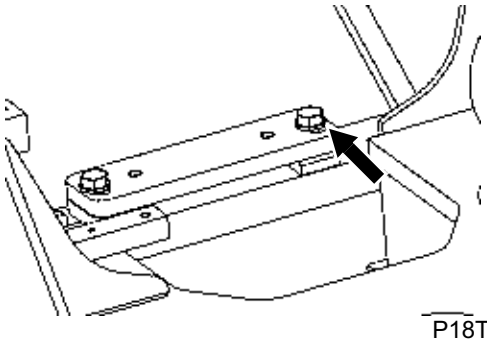
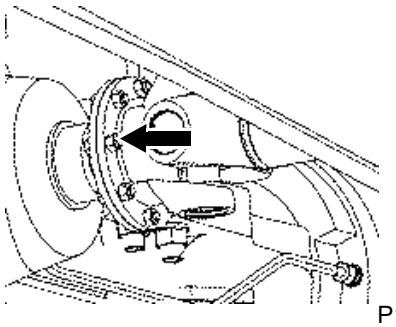
Reference picture	Operation step	Tools required (Remarks)
	1. Park the machine on a level ground, turn off the engine, and place the gear box handle in neutral position, pull up the emergency parking brake lever and place the wedges. **⚠ Caution: The drive shaft assembly is composed of slidable spline sleeve, please take care to avoid personal injury caused by falling of slide shaft fork during removal.**	
 P18T00065	2. Remove the connecting locknut between the rear drive shaft and rear axle input flange with a wrench.	18# Wrench
 P18T00066	3. Remove the connecting locknut between rear drive shaft and rear output flange of gear box with a wrench, and place the rear drive shaft assembly in a safe area.	18# Wrench

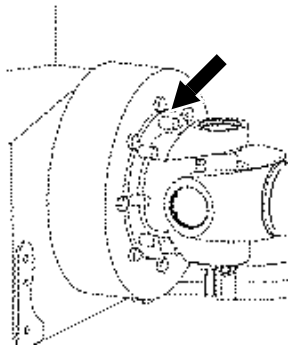
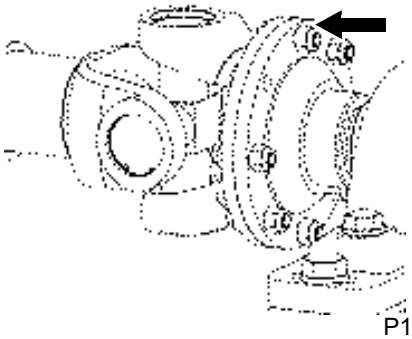
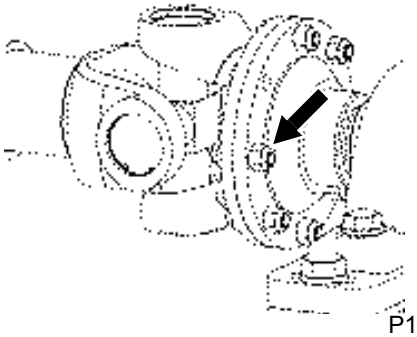
Reference picture	Operation step	Tools required (Remarks)
 P18T00067	4. Remove the connecting locknut between intermediate drive shaft and front output flange of gear box assembly with a wrench.	21# Wrench
 P18T00068	5. Remove tightening bolt and nut between intermediate drive shaft and front drive shaft & bearing assembly, and remove the intermediate drive shaft from machine with a wrench.	18# Wrench
 P18T00069	6. Remove the bolts and washer securely connecting the front drive shaft and support assembly to middle support plate with a wrench.	18# Wrench

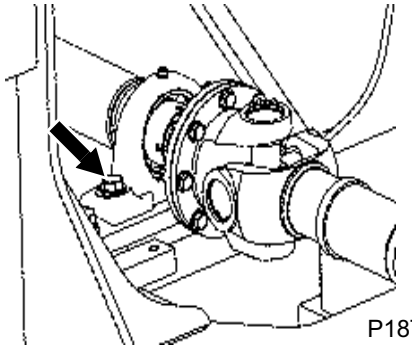
Reference picture	Operation step	Tools required (Remarks)
 P18T00070	7. Remove the bolts and nuts securely connecting the front drive shaft and support assembly and front axle, and remove front drive shaft and support assembly from machine with a wrench.	18# Wrench
 P18T00071	8. Remove the tightening bolts and washers of the support plate and frame with a blower gun or a wrench.	24# socket, pneumatic impact wrench or 24# wrench

Installation of drive shaft system

Reference picture	Operation step	Tools required (Remarks)
 P18T00072	1. Wipe clean the surface, install rear drive shaft and rear axle input flange, and align the the mounting holes, then insert the tightening bolt and screw in the nut and tighten it with a torque of 132±10Nm\97.35±7.38 lbf•ft.	18# wrench or open-end 18# fixed torque spanner

Reference picture	Operation step	Tools required (Remarks)
 P18T00073	2. Wipe clean the surface, install the rear drive shaft and rear output flange of the gear box, and align the mounting holes, screw in the locknut and tighten it with a torque of 132±10Nm\ 97.35±7.38 lbf•ft. **⚠ Caution: When assembling, please make sure to pay attention to the white arrows on the identification of drive shaft, both of which must be aligned after assembly!**	18# wrench or open-end 18# fixed torque spanner
 P18T00074	3. Wipe clean the two mounting surfaces of support plates, and then pre-install it onto the front frame. Set the front drive shaft and support assembly with middle support bearing on the front frame middle support bearing seat support plate.	
 P18T00075	4. Wipe clean the surface, install the front drive shaft and support assembly with front axle input flange, and align the mounting hole, screw in the locknut and tighten it with a torque of 132±10Nm\97.35±7.38 lbf•ft.	18# wrench or open-end 18# fixed torque spanner

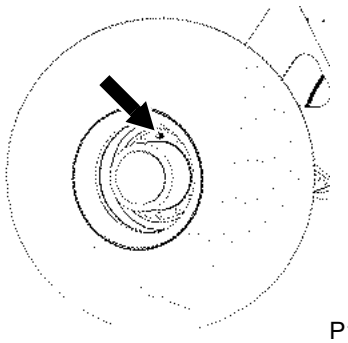
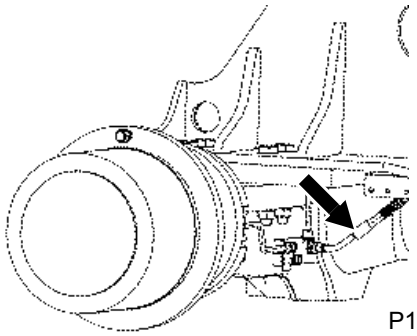
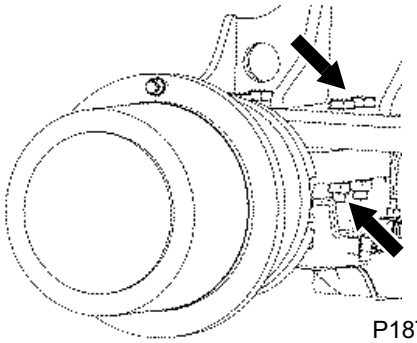
Reference picture	Operation step	Tools required (Remarks)
 P18T00076	5. Wipe clean the mounting surfaces of front output flange of gear box and intermediate drive shaft flange, and install the intermediate drive shaft to the front output flange bolts of gear box, screw in the locknut and tighten it with a torque of 200±15Nm\ 147.5±11.06 lbf•ft.	21# wrench or open-end 21# fixed torque spanner
 P18T00077	6. Install the middle drive shaft, front drive shaft and support assembly, and align the mounting holes. Insert the tightening bolt and screw in the locknut, and then tighten them to 132±10Nm\ 97.35±7.38 lbf•ft. ⚠ **Caution: The intermediate drive shaft middle shaft fork must be aligned with the fork which is coupled with front axle on the front drive shaft and support assembly!**	18# wrench or open-end 18# fixed torque spanner
 P18T00078	7. Adjust the front&rear, left&right positions of intermediate, front drive shafts and support assembly to make sure that the bolts between support plate and frame can be screwed in smoothly with torque of 132±10Nm\97.35±7.38lbf•ft.	Open-end 18# fixed torque spanner or 18# wrench

Reference picture	Operation step	Tools required (Remarks)
 P18T00079	8. Install the tightening bolts and washer of the middle support bearing seat and support plate, and tighten them to 22494±18.44 lbf•ft.	24# socket, fixed torque blower gun or open-end 24# fixed torque spanner

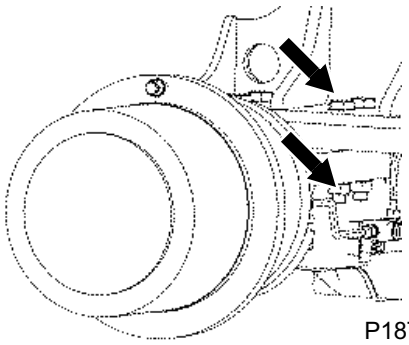
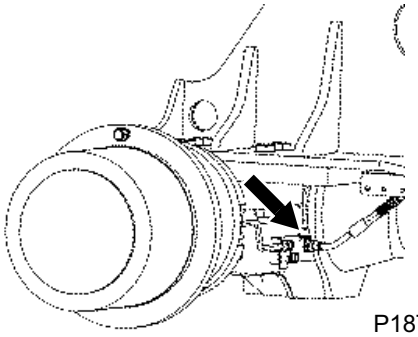
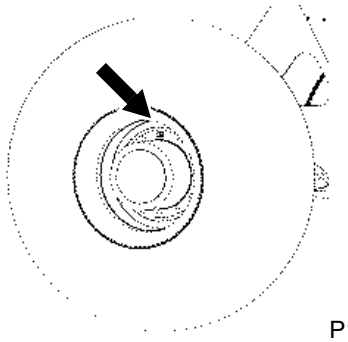
Removal and installation of front axle assembly

Removal of front axle assembly

Reference picture	Operation step	Tools required (Remarks)
	1. Stop the machine on a level ground, put the work implement, bucket levelly, and pull up the emergency parking brake lever. 2. Turn off the engine, step on the service brake pedal for several times, so as to release the pressures of energy accumulator and axle brake pipe. 3. Lift up the machine with a lifting device, and support it up with a supporting device with 4 tires off the ground	Sling (12 tons)

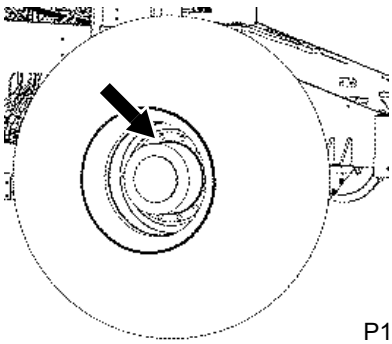
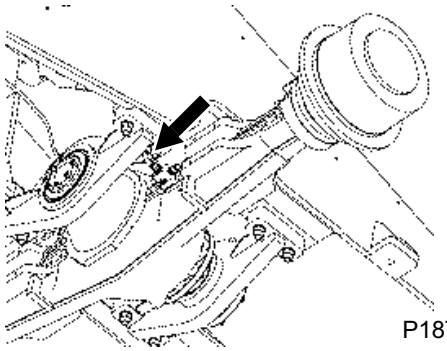
Reference picture	Operation step	Tools required (Remarks)
 P18T00080	4. Pre-lift up the tires with a hoist, remove the bolts and nuts used for tightening the rim and axle. 5. Lift the tires away from machine and put them in a safe area. 6. Repeat steps (4), (5), remove another tire installed on the front axle.	Sling(2 tons)30# socket, pneumatic impact wrench or open-end 30# wrench
 P18T00081	7. Remove the hose assembly connected to service brake system and the front axle. **⚠ Caution: The waste oil shall be recovered in a container during removal, in order to avoid environmental contamination. The removed hose is shielded to avoid contamination of parts.** **⚠ Danger: It is sure that the hose pressure is fully discharged and the oil is cooled sufficiently before removal of hose, in order to avoid personal injury of hose pressure and hot oil during removal.**	24# Wrench
 P18T00082	8. Pre-lift the front axle assembly with a sling. 9. Remove the bolts and nuts for connecting the front axle assembly to the front frame with a blower gun. 10. Put the axle assembly onto the ground slowly with a lifting device. 11. Remove the axle assembly from the bottom of machine with a handling equipment, and then put it on the appliance for axle assembly.	Sling(2 tons)40# socket, pneumatic impact wrench, 40# wrench

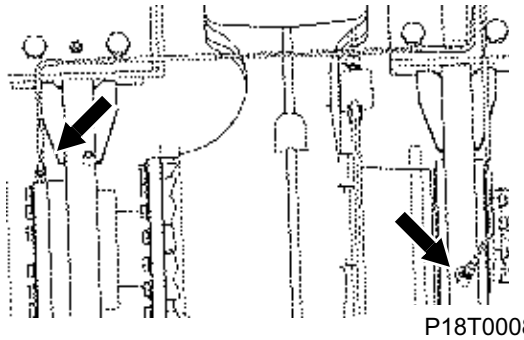
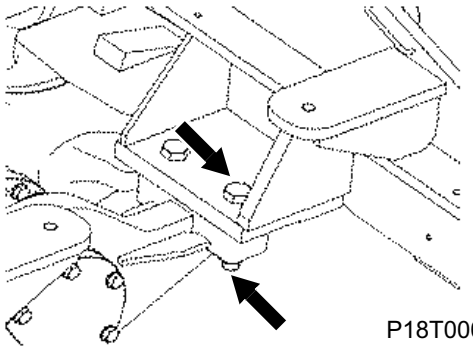
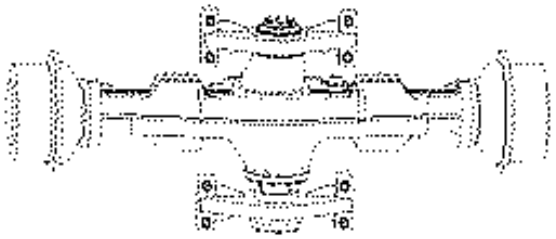
Installation of front axle assembly

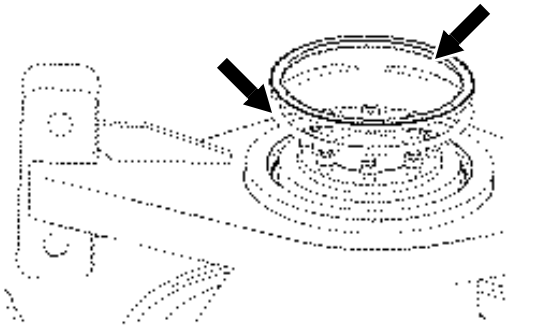
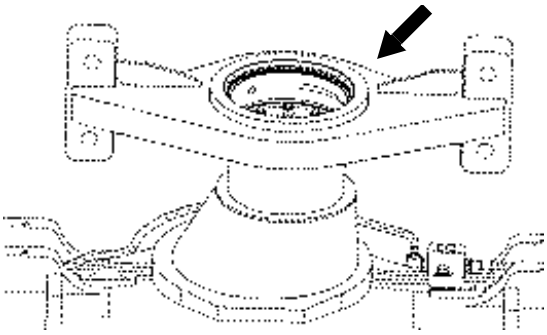
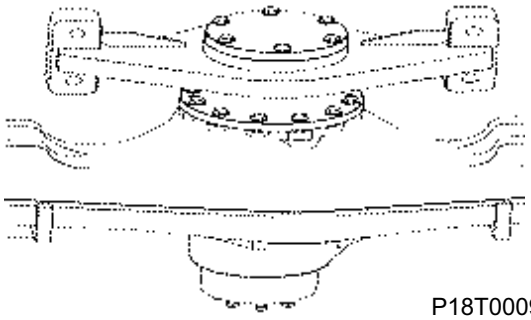
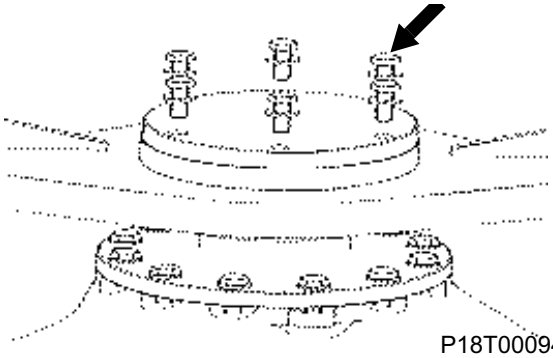
Reference picture	Operation step	Tools required (Remarks)
 P18T00083	1. Take the front axle assembly out of placed area with a handling device, and position it under its mounting point. 2. Lift up the front axle assembly with a hoist, and install it on the frame. 3. Install the tightening bolts and nuts and tighten them with torque of 2035±170Nm\ 1500.8±125.38 lbf•ft.	Sling(2 tons) 46# socket, pneumatic impact wrench, open-end 46# fixed torque spanner
 P18T00084	4. Install the front axle brake pipe and service brake hose. Tightening torque: 37±2Nm\ 27.29±1.48 lbf•ft.	Open-fixed 24# fixed torque spanner
 P18T00085	5. Lift up the tire with a hoist and install it onto the axle, and then install the rim nut and tighten it to 600±60Nm\ 442.5±44.25 lbf•ft.	Sling (2 tons)30# socket, pneumatic impact wrench, open-end 30# fixed torque spanner
	6. Lift the machine with a hoist, remove the support device, and put the machine onto the ground.	Sling (12 tons)

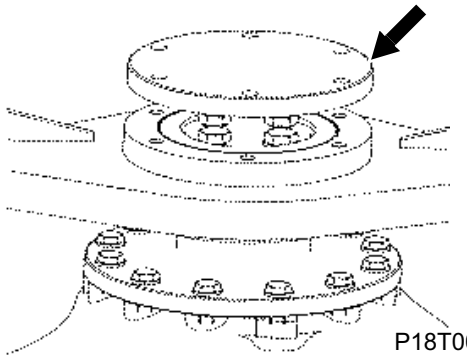
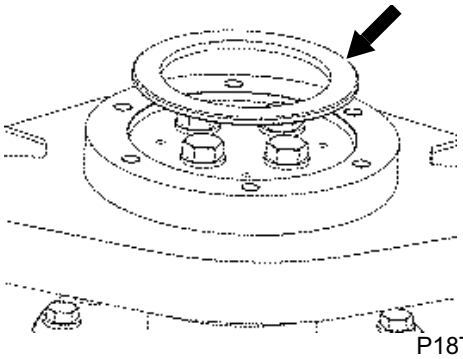
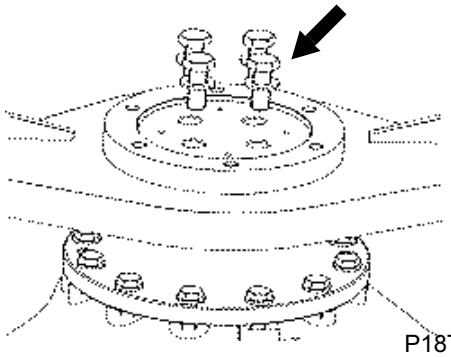
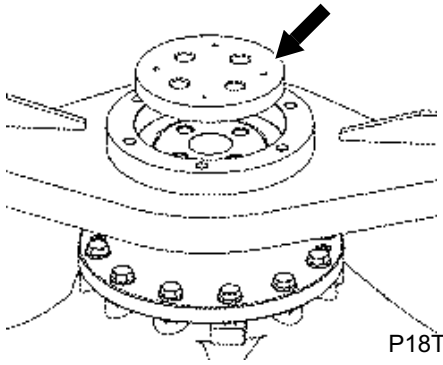
Removal and installation of rear axle assembly

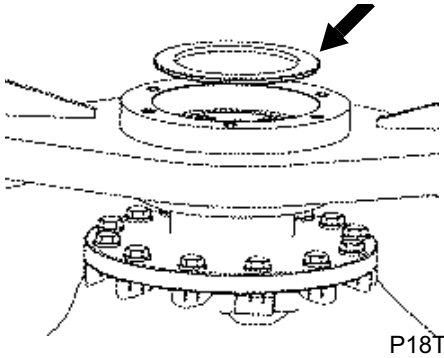
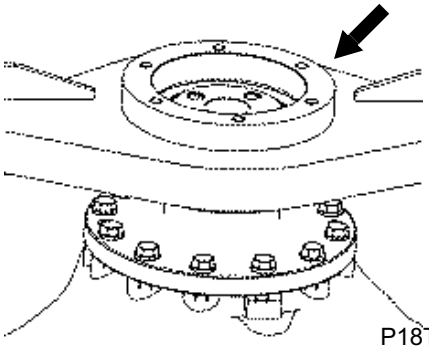
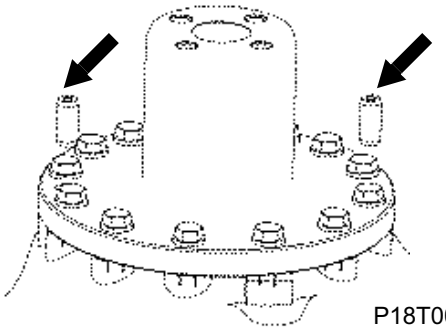
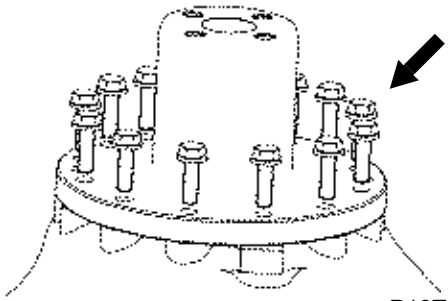
Removal of rear axle assembly

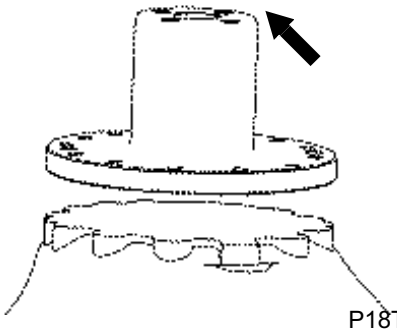
Reference picture	Operation step	Tools required (Remarks)
	1. Stop the machine on a level ground, put the work implement, bucket levelly, and pull up the emergency parking brake lever. 2. Turn off the engine, step on the service brake pedal for several times, so as to release the pressures of energy accumulator and axle brake pipe. 3. Lift up the machine with a lifting device, and support it up with a supporting device with 4 tires off the ground	Sling (12 tons)
 P18T00086	4. Pre-lift up the tires with a hoist, remove the bolts and nuts used for tightening the rim and axle. 5. Lift the tires away from machine and put them in a safe area. 6. Repeat steps (4), (5), remove another tire installed on the rear axle.	Sling (2 tons)30# socket, pneumatic impact wrench or open-end 30# wrench
 P18T00087	7. Remove the the rear axle and hose assembly connected to service brake system.	24# Wrench

Reference picture	Operation step	Tools required (Remarks)
 P18T00088	8. Remove the steel pipe connected to the rear axle and centralized lubricating system.	Open-end 16# wrench
 P18T00089	9. Pre-lift the rear axle assembly with a sling. 10. Remove the bolts and locknuts for connecting the rear axle assembly to the rear frame. 11. Put the axle assembly onto the ground slowly with a lifting device. 12. Remove the axle assembly from the bottom of machine with a handling equipment, and then put it on the appliance for axle assembly.	Sling (2 tons) 36# socket, pneumatic impact wrench, 36# wrench,
 P18T00090	13. Place the axle assembly as shown in the left figure to make front swing frame support shaft upward, and rear swing frame support shaft downward.	

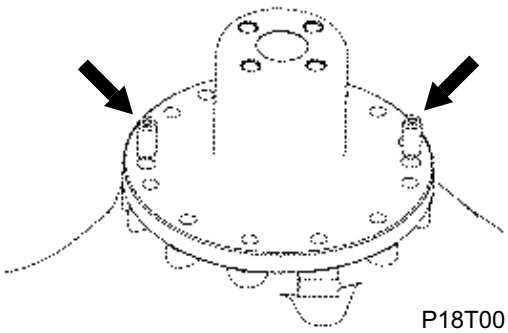
Reference picture	Operation step	Tools required (Remarks)
 P18T00091	14. Remove the seal ring and snap ring from the front swing support rack with a screwdriver.	Straight screwdriver
 P18T00092	15. Remove the front swing support rack from axle assembly with a lifting device and place it in a safe area.	Sling (2 tons)
 P18T00093	16. Place the axle assembly as shown in the left figure to make the rear swing support rack upward.	
 P18T00094	17. Remove the bolts, washers with a wrench or an pneumatic tool.	Open-end 18# wrench

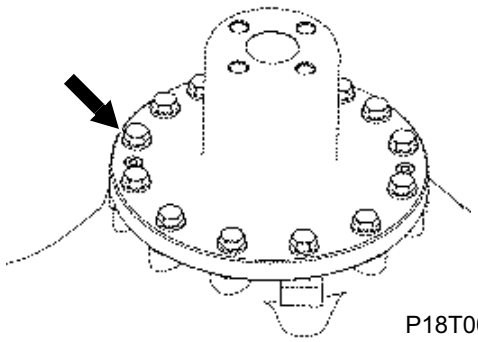
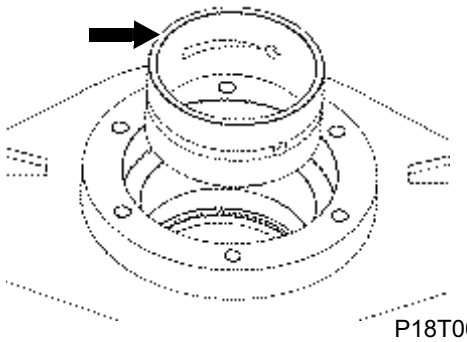
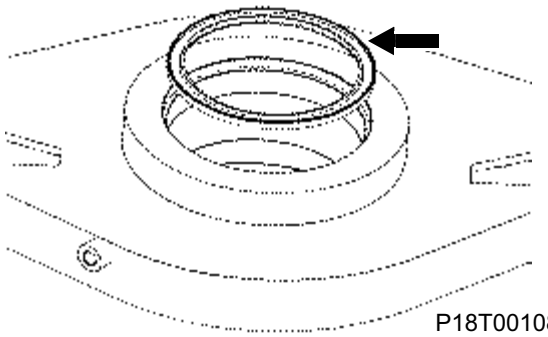
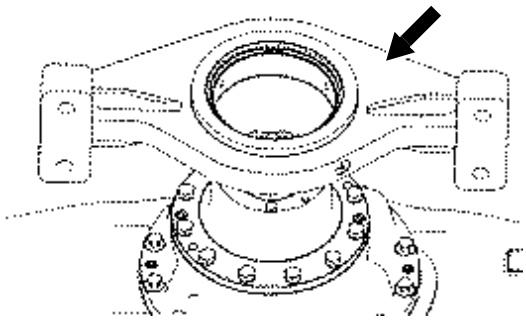
Reference picture	Operation step	Tools required (Remarks)
 P18T00095	18. Remove the cover.	Open-end 18# wrench
 P18T00096	19. Remove the thrust washer.	Straight screwdriver
 P18T00097	20. Remove the bolts and washer tightening the clamping plate.	Open-end 27# wrench or 27# socket, pneumatic impact wrench
 P18T00098	21. Remove the clamping plate.	Straight screwdriver

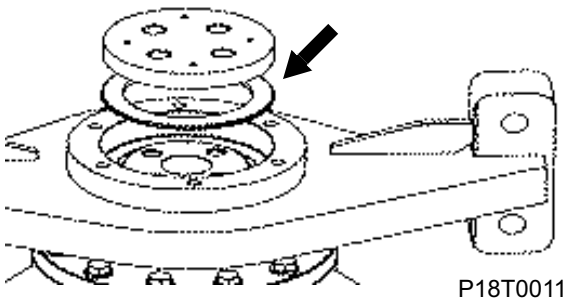
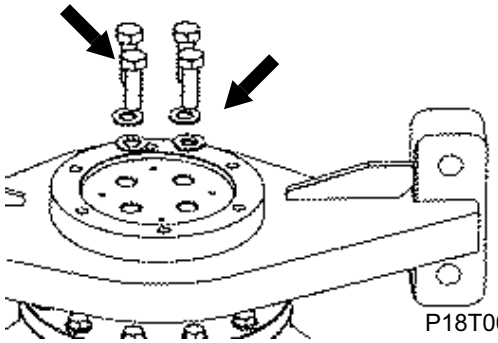
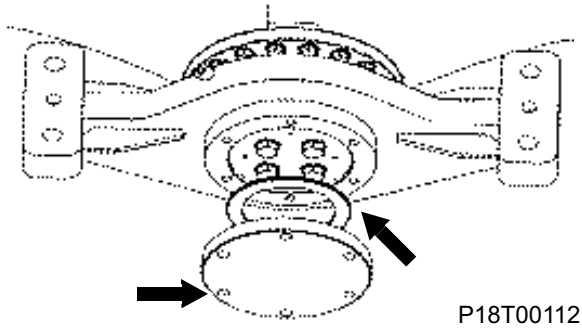
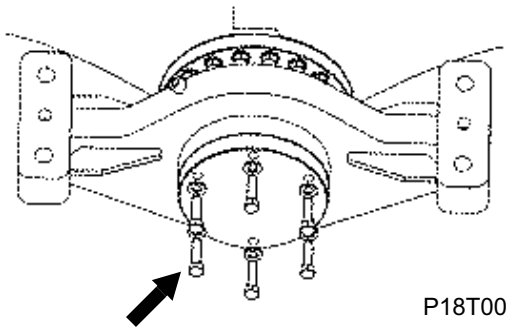
Reference picture	Operation step	Tools required (Remarks)
 P18T00099	22. Remove the thrust washer.	Straight screwdriver
 P18T00100	23. Remove the rear swing support rack with a lifting device.	Sling (2 tons)
 P18T00101	24. Screw the M8 bolt in the dowel and remove the dowel.	Open-end 13# wrench
 P18T00102	25. Remove the bolts and washers tightening the support shaft.	Open-end 21# wrench or 21# socket, pneumatic impact wrench

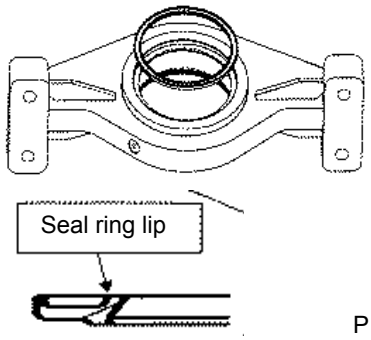
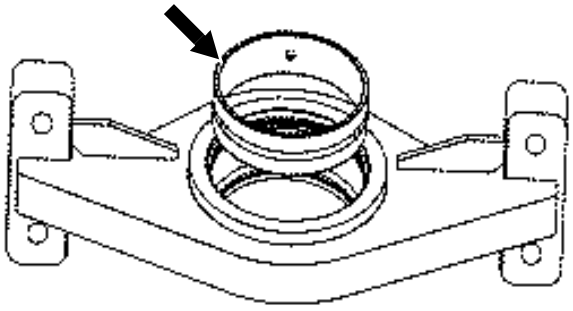
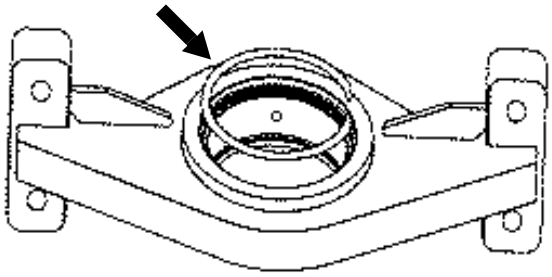
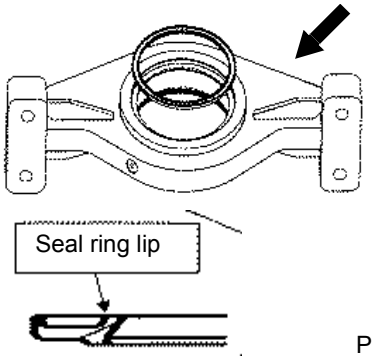
Reference picture	Operation step	Tools required (Remarks)
 P18T00103	26. Remove the support shaft with a lifting device.	Sling (2 tons)

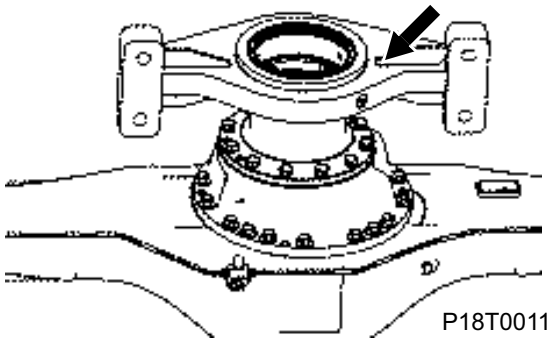
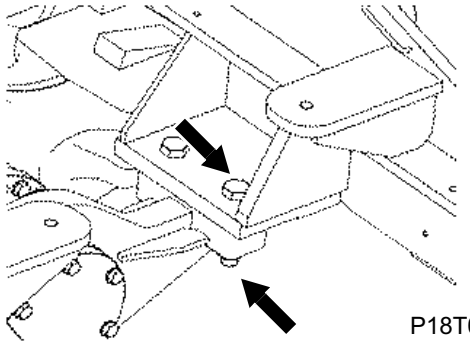
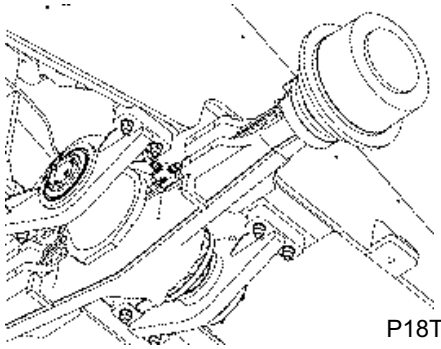
Installation of rear axle assembly

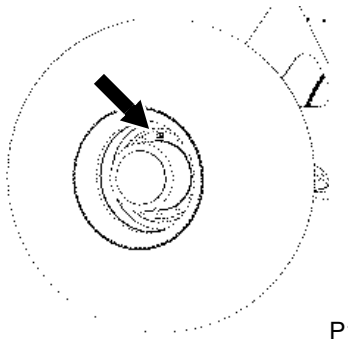
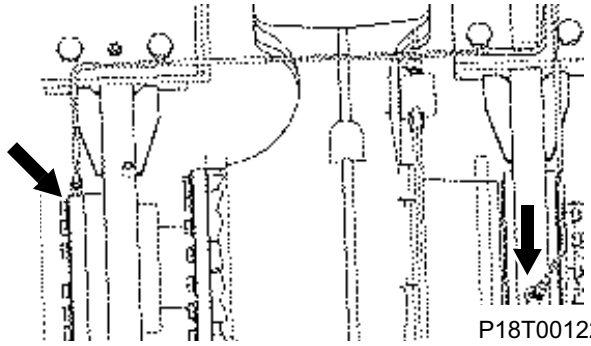
Reference picture	Operation step	Tools required (Remarks)
 P18T00104	1. Lift up the axle assembly and position it as shown in the left figure onto a special assembly device.	
 P18T00105	2. Wipe clean the mounting face between the support shaft and the axle case connected to it with a clean cloth, install the support shaft onto the axle and align two dowel pins accurately, strike it into the dowel pin with a copper bar.	Copper bar

Reference picture	Operation step	Tools required (Remarks)
 P18T00106	3. Apply thread lock sealant to thread portions of bolts, screw them into support thread holes by 2-3 threads by hand, and tighten them with an air gun. Tightening torque: 305±25Nm\ 22494±18.44 lbf•ft.	24# socket, pneumatic impact wrench, open-end 24# fixed torque spanner
 P18T00107	4. Horizontally place rear swing frame with the thread hole end upward, and install the bush into rear swing support rack.	
 P18T00108	5. Turn over swing frame by 180°, install seal ring and knock it to the end with nylon hammer.	Nylon hammer
 P18T00109	6. Turn over swing frame group by 180°, evenly apply molybdenum disulfide lithium base grease to bushing cone, and install rear swing frame group into spindle with lifting device.	

Reference picture	Operation step	Tools required (Remarks)
 P18T00110	7. Install thrust washer and pressing plate and align the holes well.	
 P18T00111	8. Apply thread lock sealant to thread portion of bolt, screw bolts and hard washers into the clamping plate thread holes by 2-3 teeth by hand, and drive them in symmetrically with pneumatic impact wrench with the tightening torque of 305±25Nm\ 224.94±18.44 lbf•ft.	24# socket, pneumatic impact wrench, open-end 24# fixed torque spanner
 P18T00112	9. Put a thrust washer and cover and align the holes well.	
 P18T00113	10. Apply thread lock sealant to thread of bolts, screw bolts and hard washers into cover thread holes by 2-3 teeth by hand, and drive them in symmetrically with pneumatic impact wrench with the tightening torque of 195±15Nm\ 143.81±11.06 lbf•ft.	21# socket, pneumatic impact wrench, open-end 21# fixed torque spanner

Reference picture	Operation step	Tools required (Remarks)
 P18T00114	11. Horizontally place front swing frame, and knock seal ring into front swing frame mounting hole to the end with nylon hammer. ⚠ **Caution: The seal ring lip faces outward.**	Nylon hammer
 P18T00115	12. Press the bushing into the front swing frame to the bottom ⚠ **Caution: The small hole of bushing must toward the lug end of front swing support.**	
 P18T00116	13. Install the snap ring into the groove with straight screwdriver.	Straight screwdriver
 P18T00117	14. Knock seal ring into front swing frame mounting slot to the end with nylon hammer; ⚠ **Caution:The seal ring lip faces outward.**	

Reference picture	Operation step	Tools required (Remarks)
 P18T00118	15. Evenly apply the molybdenum disulfide lithium base grease to bushing cone, and then lift and install the front swing support subassembly onto the bearing seat of the main transmission. 16. Place the axle assembly on a transport device with a lifting device, and right under mounting point of rear axle. 17. Install the axle assembly onto the rear frame with a lifting device and align the mounting holes.	Sling (2 tons)
 P18T00119	18. Install the mounting bolts, washers and nuts of the axle assembly and tighten them with an blower gun to 1122±90Nm\ 827.28±66.38 lbf•ft.	36# socket, pneumatic impact wrench, open-end 36# fixed torque spanner
 P18T00120	19. Install the axle and hose connecting the service brake pipe and tighten it to 37±2Nm\ 27.29±1.48 lbf•ft.	Open-end 24# wrench

Reference picture	Operation step	Tools required (Remarks)
 P18T00121	20. Lift up the tire with a hoist and install it onto the axle, and then install the rim nut and tighten it to 600±60Nm\ 442.5±44.25 lbf•ft.	30# socket, pneumatic impact wrench or open-end 30# fixed torque spanner
 P18T00122	21. Install the steel pipe connecting the centralized lubricating system and axle.	Open-end 16# wrench
	22. Lift the machine with a hoist, remove the support device, and put the machine onto the ground.	Sling (12 tons)

Disassembly and assembly of the drive axle

For disassembly and assembly of the drive axle in this machine, see "835H Drive Axle Service Manual" for details.

Fault Diagnosis and Troubleshooting Methods

	Fault features	Main reasons	Fault inspection and troubleshooting
1	The engine can not Activation	1. Start circuit of the base machine (such as power voltage, electric lock, startup relay and startup motor) has faults.	1. Check the circuit of the base machine.
		2. The lever is not at the neutral position.	2. Shift the lever to neutral position.
		3. The fuse to the control circuit on the base machine is burnt.	3. Replace the fuse.
		4. Poor contact of handle plug or the handle is failed.	4. Organize the plugs.
		5. Poor contact of controller plug or the controller is failed.	5. Organize the plugs.
2	Low shift pressure at all gears Low pressure	1. Oil pressure gauge is failed.	1. Replace the oil pressure gauge
		2. Insufficient tightening torque for bolt of shift control valve.	2. Tightening torque for M8-8.8 bolt of shift control valve is 26Nm.
		3. Spring of main pressure valve is broken.	3. Replace it.
		4. Gear shift pump is worn	4. Replace the gear shift pump.
		5. Fragments enter into shift control valve or valve is stuck	5. Replace the filter, and clean the control valve.
3	Too short shifting time at all gears	1. O-ring in throttle plug is damaged	1. Replace the O-ring
		2. The tightening torque of pressure control valve bolts is out of specified range	2. Tightening torque for M8-8.8 bolt of shift control valve is 26Nm.
4	Too long shifting time at all gears	1. Throttle plug is blocked.	1. Clean and dredge.
		2. Pressure control valve is stuck.	2. Wash and check.
5	The oil temperature of the torque converter is high	1. Oil temp sensor is failed.	1. Replace the part.
		2. Oil temperature gauge is failed.	2. Replace the part.
		3. Insufficient oil level.	3. Check oil level following the correct method.
		4. Air found in torque converter oil radiator.	4. Exhaust.
		5. Oil line from torque converter to radiator is poor.	5. Check oil pipe from radiator to gear box and radiator for blockage.
6	The oil temperature of the torque converter is high	1. Poor cooling capability of radiator.	1. Check whether cooling capability is sufficient, such as checking the degree of tightness for engine fan belt and dirt attached to outer surface of radiator.
		2. Back pressure valve of torque converter stuck.	2. Be careful to check hose connector from gear box to radiator. If hose connector enters housing too deeply, pushes spool of pressure valve and cause valve to stick, oil line will be getting blocked.

	Fault features	Main reasons	Fault inspection and troubleshooting
7	Vehicle does not move at any gear	1. Insufficient oil level.	1. Check oil level and add the oil by following the right operation.
		2. Elastic plate connecting engine and torque converter is torn, or power connection from torque converter to gear box input gear has faults.	2. Replace the elastic plate or replace the related damaged parts.
		3. Circuit failure of the complete machine.	3. Check the power voltage for abnormal and the cable for damage.
		4. Shift pressure is too low.	4. Refer to the troubleshooting above.
		5. Solenoid valve is damaged.	5. Check if the rated current of solenoid valve is 830 mA.
		6. Shift lever is damaged.	6. Refer to the troubleshooting for lever. Replace it.
		7. Controller is damaged.	7. Refer to the fault inspection of controller. Replace it

Power Train System

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Basic Information

Safety

Many accidents in operation, maintenance, repair and other aspects are caused by fail to observe the basic safety rules and precautions. If the case of potential risk is fully aware in advance, these accidents usually can be avoided. The operators must pay attention to these potential risks, and be trained for relevant skills before properly and safely operating, maintaining and repairing the machine.

- Any improper operation, maintenance and repair methods may lead to hazardous condition, cause personal injury and even death.
- Be sure to read and understand the relevant security measures and precautions before operating, maintaining and repairing the machine.
- Please strictly obey the safety warning information listed in this Manual and on the machine during operating, maintaining and repairing the machine, otherwise heavy casualties will occur.

Safety warning information in the Manual is indicated by the following symbols

⚠WARNING

This word means existing potential danger, and if no avoidance, it may cause death or serious personal injury.

⚠ DANGER

This word means danger will occurred immediately, and if no avoidance, it may cause death or serious personal injury.

⚠CAUTION

This word means existing potential danger, and if no avoidance, it may cause slight or medium personal injury.

"Caution" is also used for reminding the safety attentions of unsafe operation possibly causing personal injury. "Danger" represents the worst dangerous conditions. Safety sign of "danger" or "warning" is an attachment set at the specific dangerous location. General precautions are listed on the safety sign of "Caution".

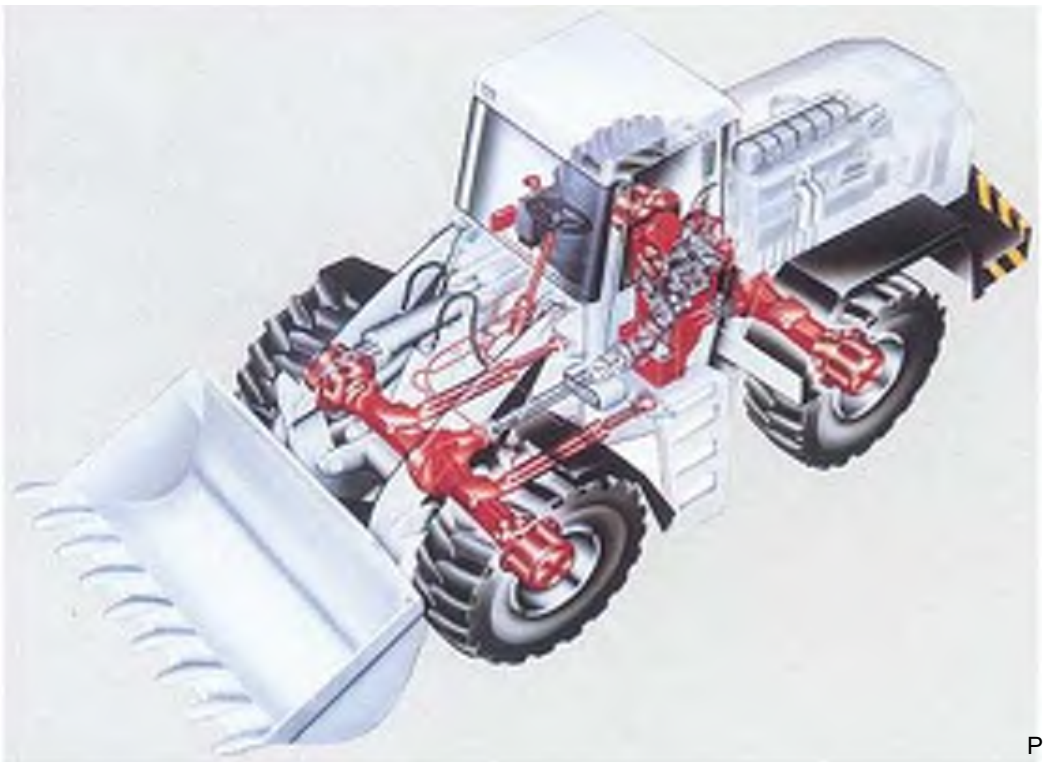
In addition, please carefully follow the "Cautions" listed in this Manual, otherwise, it may result in great damage to the machine. We are unable to enumerate all the possible risks (including potential dangers), and the warnings in the Manual and product do not cover all the risks and dangers. If the tools, operation procedures, methods or techniques are not specially recommended by our company, it is necessary to ensure the personal safety of every one, and protect the machine against any damage.

The contents herein are provided based on the status of the machine at the time when the Manual was written, whereas, all products are updating, and this machine is no exception. Any modification will influence the operation, maintenance and repair of the machine, therefore, please contact the LiuGong dealers for latest and most comprehensive service information before operating, maintaining and repairing the machine.

System composition and position

The power train system is a critical part of a loader, like a heart, and it is located at portion between the engine and tire, as shown in red in the figure below. It mainly consists of three majority components: gearbox, drive shaft and drive axle.

Fig 3-1 Schematic diagram of position for wheel loader



P18T00001

System technical parameters

Main technical parameters for the power train system of this machine are listed in Table 3-1.

Table 3-1: Main technical parameter table for power train system

System components	Items	Parameters	Remarks
Gear box	Model	ZF 4WG158	
	Type	Fixed shaft type	
	Control mode	Full-auto electro hydraulic control	
Torque converter	Type	Single-turbo, three-element	
Drive axle	Drive mode	Spiral gear level-I reduction, wheel planetary gear reduction	
	Brake mode	Wet brake	

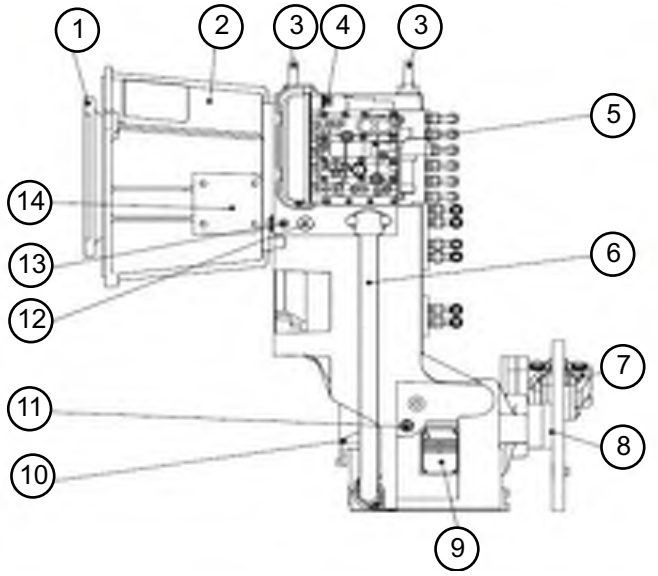
Table 3-1: Main technical parameter table for power train system

System components	Items	Parameters	Remarks
Tire	Tire structure	Radial tire	Tubeless bias tire or tubed bias tire is optional
	Specification	17.5R25 two star L3	
	Level	\	
	Type of tread	L-3	Ordinary block
Rim	Specification	25-14.00/1.5	

System schematic diagram and working principle description

The torque converter -gearbox assembly equipped in this machine is ZF 4WG158 full auto type, and the drive axle is 30 wet axle, whose structure diagram are shown as below:

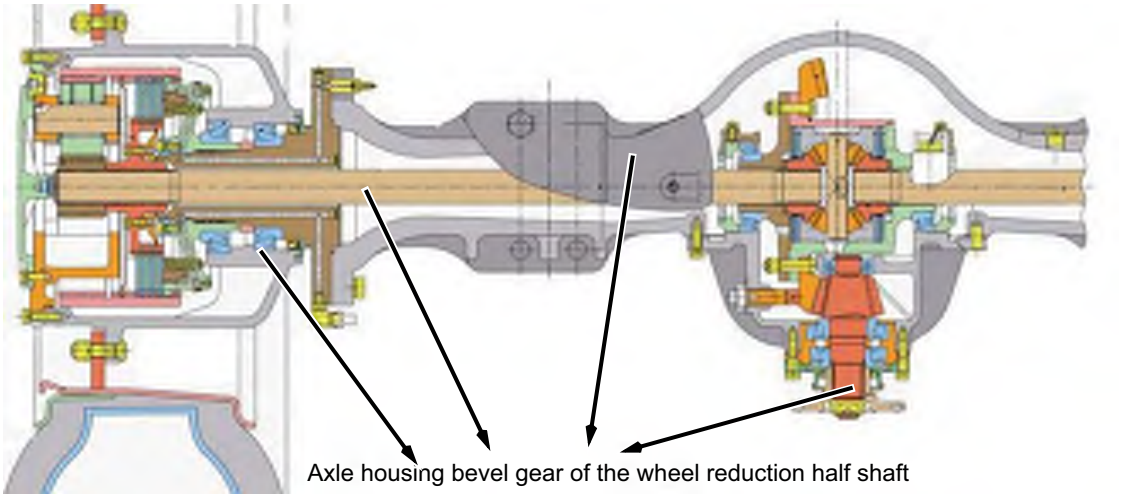
Figure 3-2 Diagram for gear box assembly composition



P18T00002

1. Coupling device
2. Torque converter housing
3. Lifting eye
4. Control harness interface
5. Electro-hydraulic shift control valve
6. Suction tube
7. Brake
8. Output plate
9. Nameplate
10. Output flange
11. Speed sensor
12. Oil outlet of torque converter
13. Torque converter outlet oil temperature sensor
14. Cover

Fig 3-3 Structure diagram for drive axle assembly



P18T00003

As shown in the above figure, the engine is coupled with the torque converter of the torque converter-gear box assembly, a part of engine power is used to drive the torque converter to work and another part is used to drive the hydraulic pump so as to provide power for the hydraulic system.

When the engine works together with torque converter, the engine output power is input into the gear box via the torque converter. Under the control of its electro-hydraulic shift control valve, the gear box can output power and speed at different positions with gear shafts and clutches.

The power output from the gear box is transmitted to the main drive of drive axle via a drive shaft, and then transmitted to wheel reducer by left and right axle shafts via main drive differential, and further to tire rim assembly by decelerating and increasing torsion, thus finally to drive the loader to travel and work.

Overview of transmission fluid

The oil product used for wheel loader is divided into four categories, i.e. the lubricant, grease, brake fluid and fuel, each of which can play a different role in the use of loader.

The lubricant, used in the loader, has two effects , one is to lubricate the parts and reduce the pressure, so as to prolong the service life of parts; the other is to dissipate the heat of parts produced by friction, so as to make the parts work normally. The lubricant is composed of various petroleum-based additives. The wheel loader use a kind of lubricant which has four classes , i.e, diesel oil, gear oil, hydraulic drive shaft and hydraulic fluid. The applications of the lubricant used in the power train system of this machine are shown in the table below:

Table 3-2 Table of lubricant application

Category	Ambient temperature										Recommended brand	Application parts
	-40	-30	-20	-10	0	10	20	30	40	50		
Torque converter - gearbox assembly											Mobil Delvac Super 1300 engine oil (-15°C~+50°C)\ (-5°F~122°F) Mobil ATF 220 (-35°C~+50°C)\ (-31°F~122°F)	ZF torque converter & transmission assembly uses SAE 15-40 in general areas and in hot desert areas; and uses Mobil ATF220 in arctic areas.
Gear oil											Mobil gear oil 80W-90/LS with additives (-15°C~+50°C)\ (-5°F~122°F); Mobil gear oil 424 (-40°C~+50°C) \ (-40°F~122°F)with additives Shell SPIAX S6 AXME 75W-90/LS (-40°C~+50°C)\ (-5°F~122°F)	LiuGong axle uses SAE 80W-90/LS in general and hot areas, and Mobil 424 with additives and Shell SPIAX S6 AXME 75W-90/LS in arctic areas. LS means the additives are inclusive

Maintenance and replacement of gearbox and drive axle oil

The oil product added to the torque converter - gearbox assembly must be consistent with oil list TE-ML 03 recommended by ZF, the oil level shall be checked once a week by the following methods:

1) Park the machine on level ground;
2) Place the gear box gear in the neutral position;
3) Torque converter - gearbox oil is at 80-95°C\176°F~203°F;
4) The engine is idling 800rpm);
5) Observe the oil level gauge of gearbox and it shall be in the "HOT" zone;

After the torque converter and gearbox assembly co-work for the first 100h, the oil shall be replaced every 1000h or at least once a year. Oil can be replaced by the methods as below:

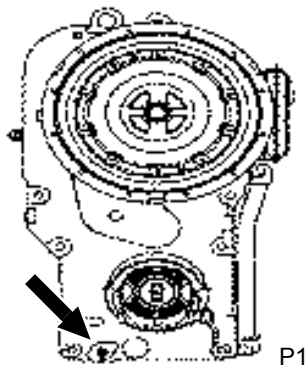
1) Unscrew the drain plug on the torque converter - gearbox assembly to drain the oil.

⚠CAUTION

The waste oil shall be collected in a container during oil drainage, in order to avoid environmental contamination;

The oil shall be fully cooled before oil drainage, in order to avoid personal injury due to hot oil splashing onto the body.

Figure 3-4 Gearbox drain plug



P18T00004

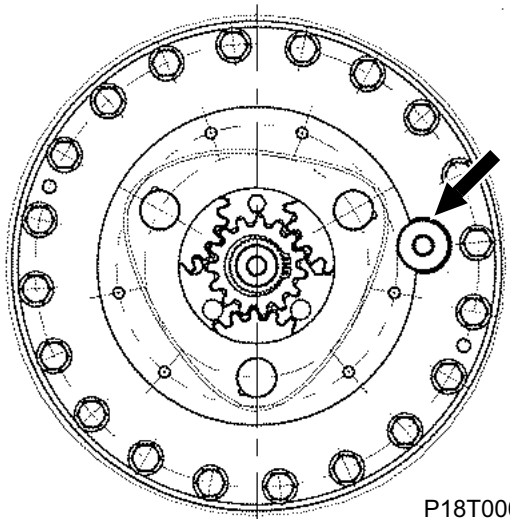
2) After the Oil sump tank of the gear box completely gets empty, wipe clean the mating surface on drain plug and gearbox housing that contacting with O ring of the oil drain plug. After the O-ring of the oil drain plug is replaced, reassemble and tighten it.
3) Add the oil in accordance with the oil list TE-ML 03 as recommended by ZF;
4) Check the oil level by the method as specified for transmission.

The fine oil filter is also replaced every time the oil change is done for the gear box. The oil filter may be installed by the following method:

1) Apply a small amount of the gear box oil on the oil seal of oil filter;
2) The oil filter is screwed in until the oil seal of oil filter contacts the filter head, tighten it 1/3 to 1/2 turn by hand.

The oil product added in the drive axle must be in accordance with the oil list of 85W-90 heavy-load wheel gear oil (GL-5) recommended by LiuGong. The oil level of LiuGong axle may be checked by the following methods:

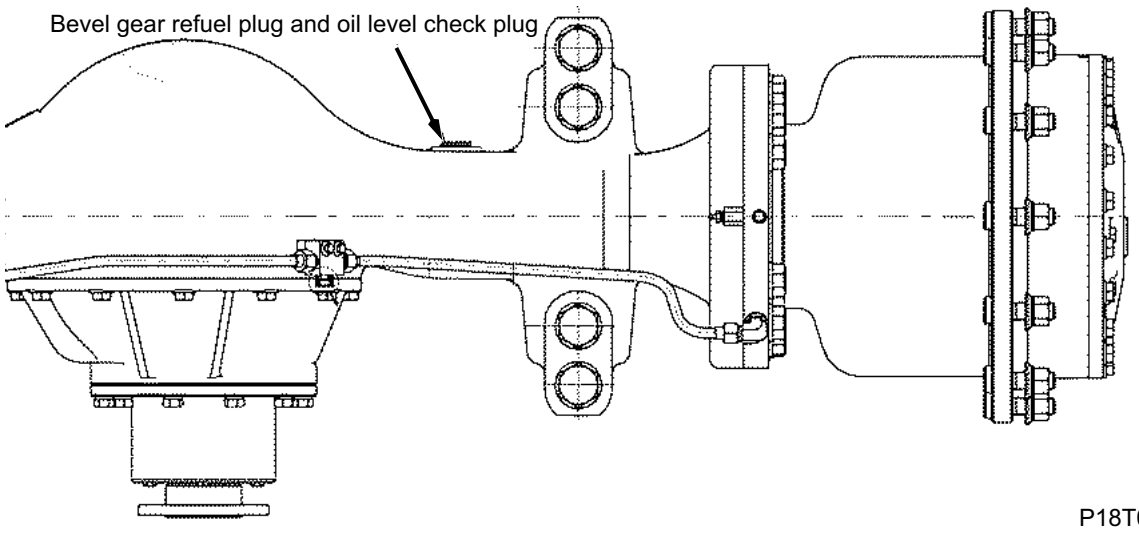
Figure 3-5 Wheel drain plug and oil level check plug



P18T00005

1) Wheel reducer: place the axle according to the installation position, and turn the hub to keep the oil level in a horizontal position, fill oil from left and right hubs respectively until the oil overflows the oil level plug; park the reducer for ten minutes after the drive axle running, and then check the oil level, and add enough lubricating oil.

Figure 3-6 Bevel gear refuel plug and oil level check plug



2) Axle housing: the oil is added into axle housing until it overflows from the oil filler.

The axle oil shall be replaced at the first 500h, after that once every 1000h, or at least once a year.

Universal tool, tooling list

For the universal tools, tooling list, please see the torque converter-gear box system, drive axle system and drive shaft system.

Special tool, tooling list

For the special tool, tooling list, please see "ZF Box Overhaul Manual" for details.

Structure Function Principle

Torque Converter - Gearbox System

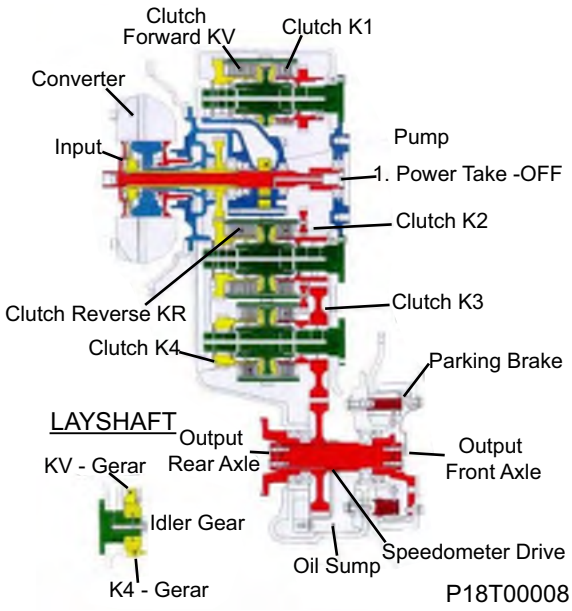
The torque converter -gearbox system equipped in this machine is ZF 4WG158 full auto type, which mainly consists of a three-element, single-turbo torque converter, mechanical gear box with four forward gears, three reverse gears and electro hydraulic shift control system, as shown below:

Figure 3-7 External view of torque converter - gear box assembly



P18T00007

Figure 3-8 Structural schematic diagram of torque converter - gear box assembly



P18T00008

System technical parameters

The technical parameters of ZF 4WG158 torque converter - gear box assembly in this machine are listed in Table 3-3.

Table 3-3 Technical parameter table of torque converter - gear box assembly

Component	Items	Parameters	Remarks
Gearbox	Model	ZF 4WG158	
	Type	Fixed shaft type	
	Gears	Four forward gears, three reverse gears	
	Torque converter-gear box assembly Quality (oil not included) /kg\lb	430\ 948.15	
	Type of emergence parking brake	Shoe brake	
Torque converter	Type	Single-turbo, three-element	
	Circulation circle diameter of torque converter/mm\In	340\ 13.39	
	Inlet pressure of torque converter/MPa\ psi	0.85\ 123.25	
	Outlet pressure of torque converter/MPa\ psi	0.50\ 72.5	
Shift control system	System voltage/V	24	
	Shift control mode	Auto electro hydraulic power shift	
	System working pressure/MPa\ psi	1.6+0.2\ 232+29	

System schematic diagram and working principle description

The torque converter of this system is a three-element with single-turbo structure, and the diagram for its structure and working principle is as follows:

Figure 3-9 Structure diagram for torque converter

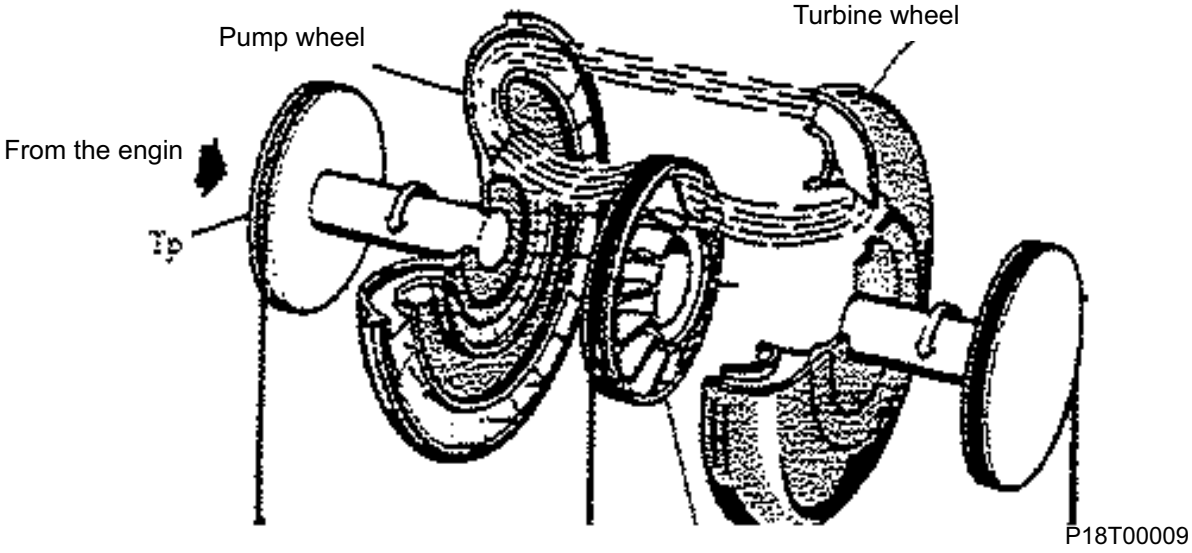
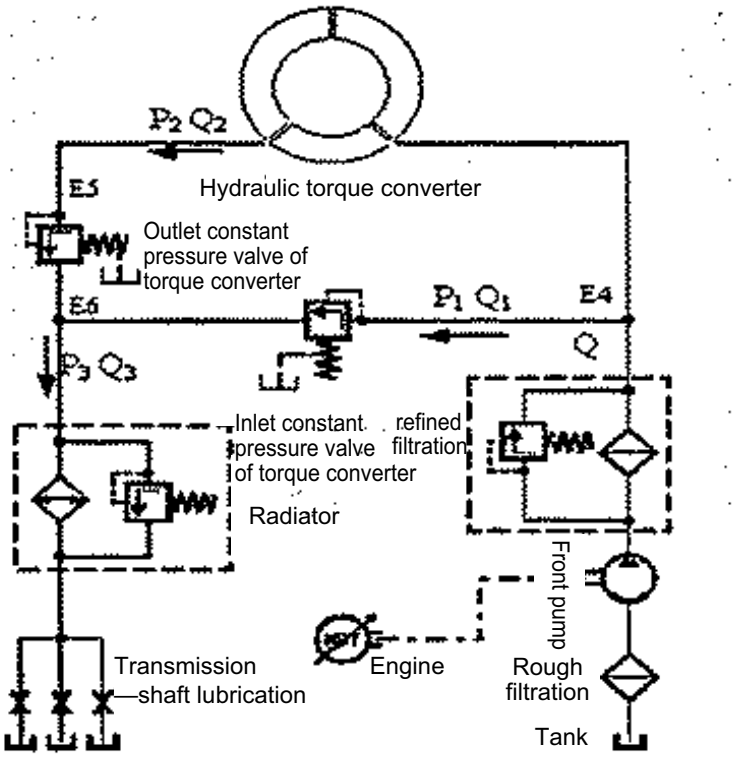


Figure 3-10Schematic diagram for torque converter hydraulic



We can see from structure diagram for torque converter, a three-element, single-turbo torque converter mainly consists of pump wheel, guide wheel and a turbine. As the pump wheel of torque converter is directly coupled with and driven by the engine, the hydrodynamic drive oil between pump wheel and turbine forms complex flow under rotation of pump wheel. The mechanical energy is converted into kinetic energy of oil fluid. The fluid flow with kinetic energy strikes against the turbine at a high speed. The turbine absorbs its kinetic energy and restores it to mechanical energy for gearbox. The guide wheel is stationary. When the fluid flow(which is from the turbine and has some kinetic energy) passes through the curved blade of the guide wheel, the torque formed by the impact force and counterforce produced on the blade acts on the engine base, and equivalent to the sum of increased torque of turbine from counterforce and reduced torque of pump wheel from impact force. It is possible that the output torque of turbine is greater than input torque of pump wheel, based on which, the torque converter is variable.

The working oil of torque converter is imported into the torque converter through the coarse and fine filters from the oil tank by the variable pump. There is a constant pressure valve (safety valve) set at the inlet of torque converter, whose main role is to avoid excessive pressure in the torque converter to damage the parts. There is another constant pressure valve (back pressure valve) at the outlet of torque converter, whose main role is to ensure the torque converter is full of working oil in order to avoid cavitation appeared during operation and impact on the performance of torque converter.

An electro-hydraulic shift control valve is installed on the gear box assembly, see figure 3 -11 and 3-12 for structure composition and operating hydraulic pressure schematic diagram.

Figure 3-11 Diagram for structure and composition of electro-hydraulic shift control valve

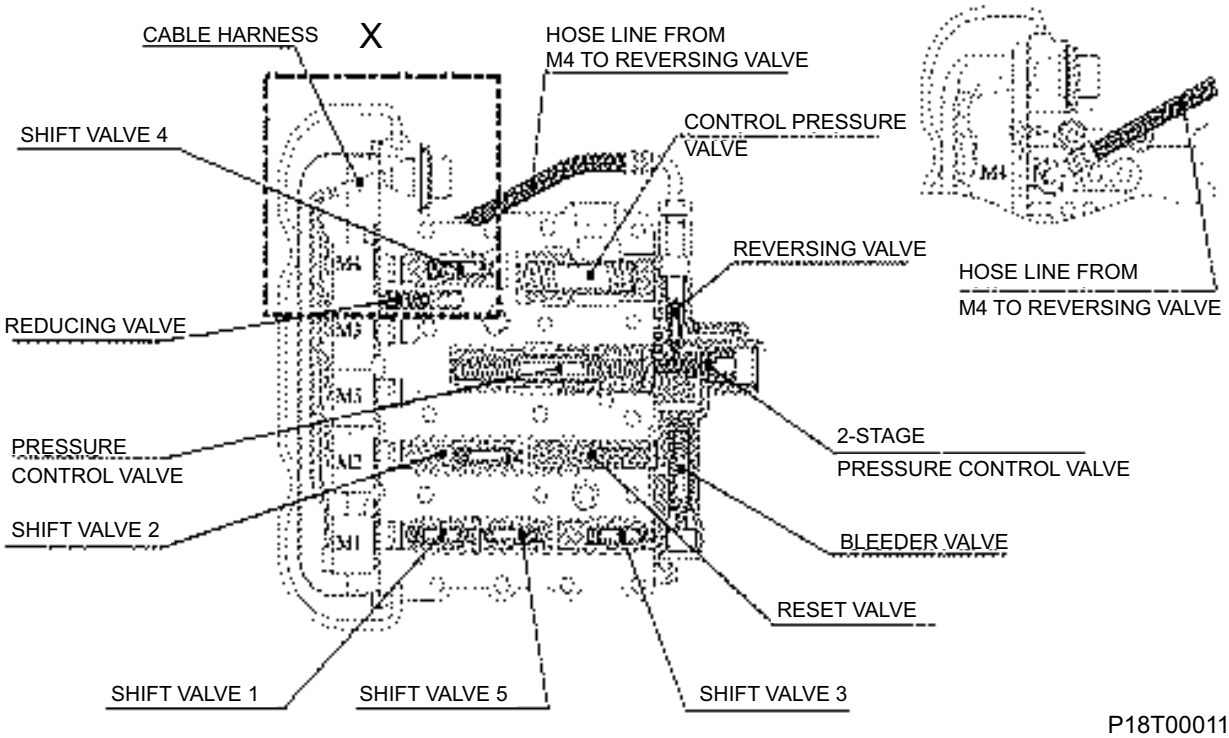
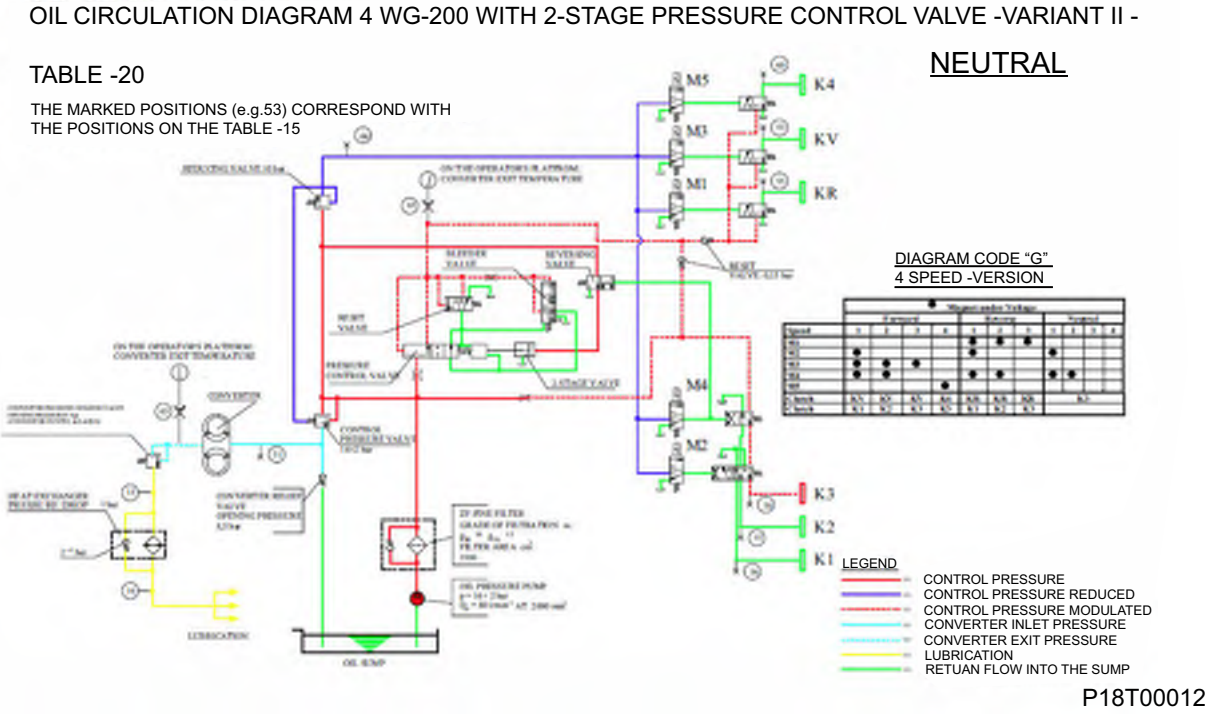


Figure 3-12 Schematic diagram for hydraulic pressure of torque converter - gear box assembly



The electro-hydraulic shift control valve consists of solenoid valves M1, M2, M3, M4, M5, valve stem and body. When the electro-hydraulic shift control valve is operating, the fluid flow in the valve stem oil passage is controlled by the power of solenoid valves, which finally control the engagement and disengagement of clutch in the gear box, thus to make the gear box achieve different shifts. For the power transferring line and gear engagement with the gear box in different gears, please see the figure of the power transferring line for each gear as the following figure 3-13 to 3-19.

Figure 3-13 Drive line of forward gear 1

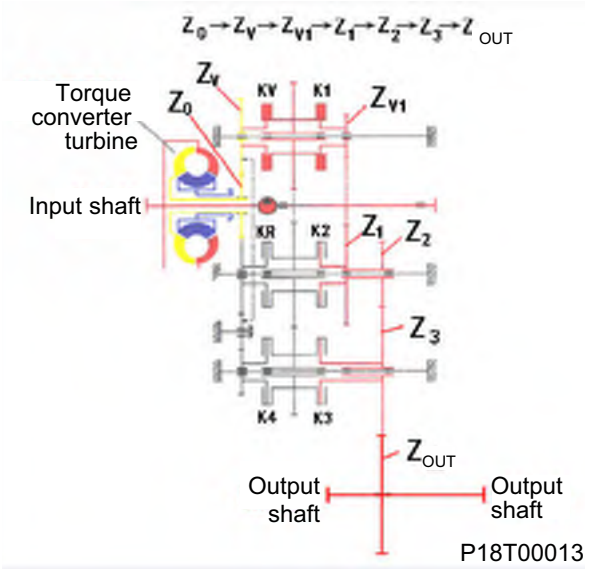


Figure 3-14 Drive line of forward gear 2

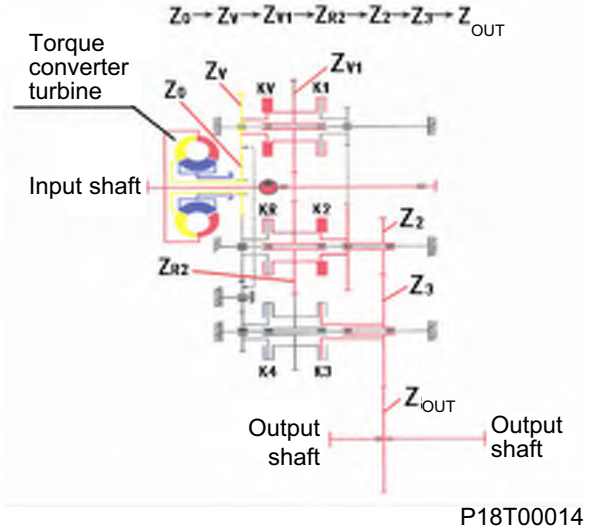


Figure 3-15 Drive line of forward gear 3

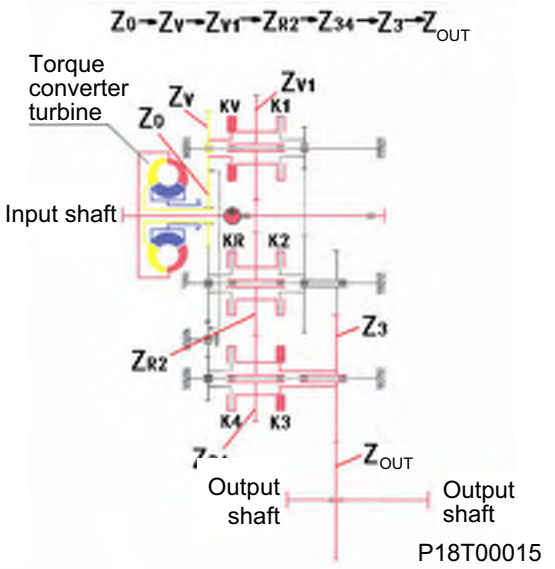


Figure 3-16 Drive line of forward gear 4

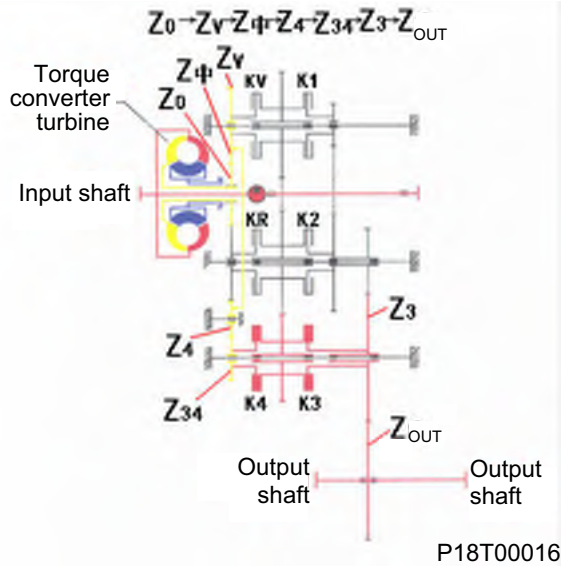


Figure 3-17 Drive line of reverse gear 1

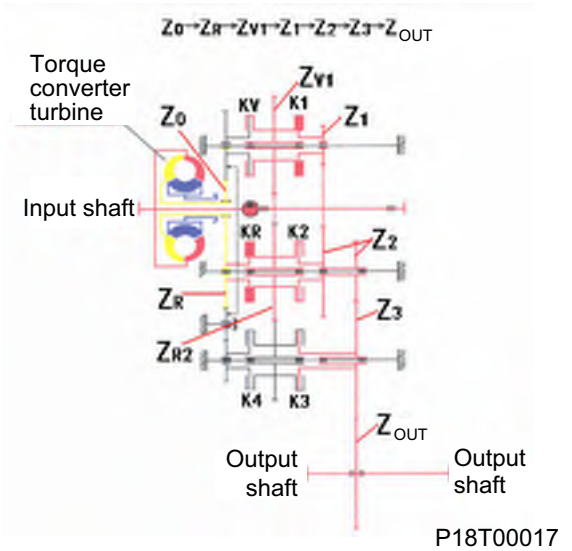


Figure 3-18 Drive line of reverse gear 2

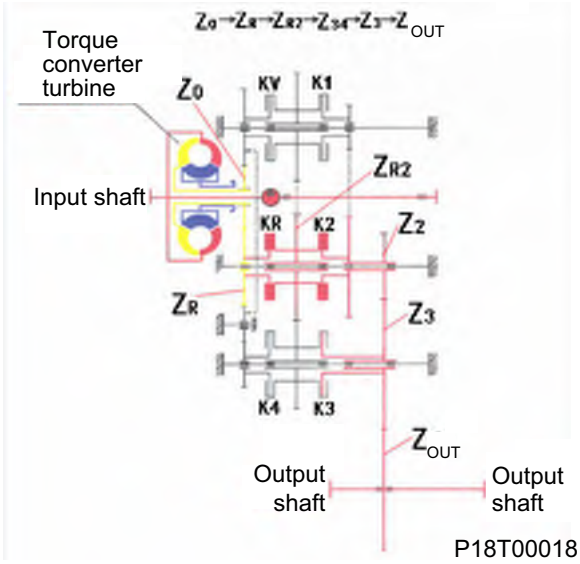
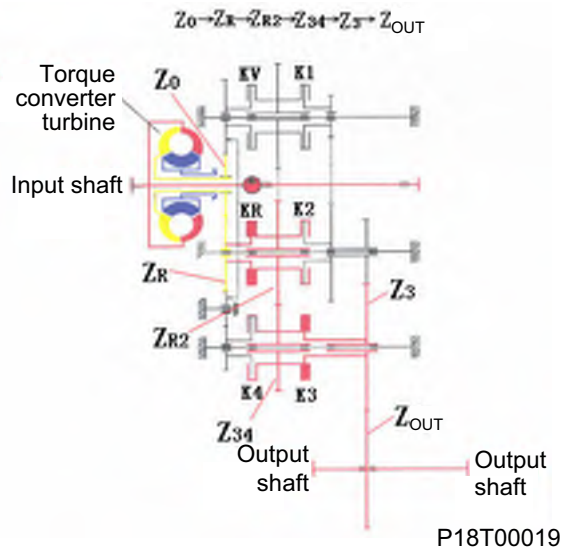


Figure 3-19Drive line of reverse gear 3



Drive axle system

Composition and position of drive axle system

The basic function of drive axle for wheel loader is to reduce the gear box input speed with main drive and wheel reducer and increase the torsion, thus to meet the requirements of driving, operating speed and traction of the base machine. And also, change the straight line motion to vertical-lateral motion via main drive, so that the drive wheel can be driven to rotate to make the base machine drive along the straight route. The differential helps balance the speeds of left and right tires to make sure the machine can still drive when the driving resistances on both sides are different.

In addition to basic features of drive axle for wheel loader, it is also a load-bearing unit for complete machine, a support device for road wheel and mounting & support device for service brake. The drive axle system mainly consists of front axle, rear axle and brake lines. The swing axle also includes front, rear swing brackets, support shaft and other parts.

System technical parameters

Major technical parameters for the drive axle system of this machine are listed in Table 3-4.

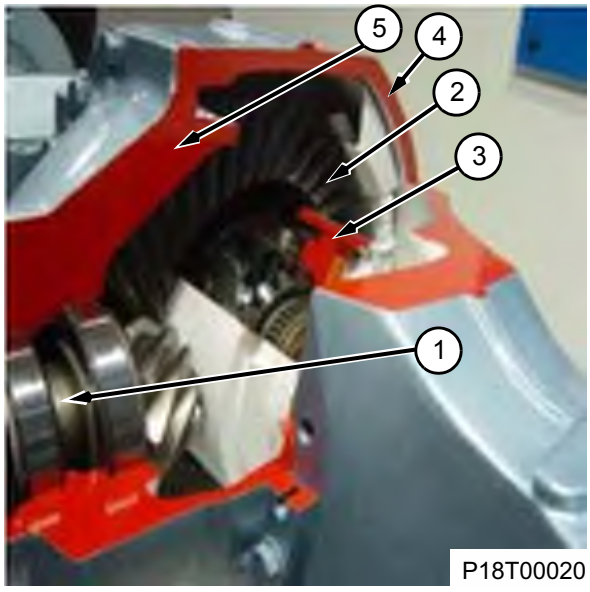
Table 3-4 Main technical parameter table for drive axle

System components	Items	Parameters	Remarks
Front axle	Drive mode	Spiral gear level-I reduction, wheel planetary gear reduction	
	Brake mode	Built-in wet multi-plate type	
	Brake pressure /MPa\psi	1450	
Rear axle	Drive mode	Spiral gear level-I reduction, wheel planetary gear reduction	
	Brake mode	Built-in wet multi-plate type	
	Brake pressure /MPa\psi	1450	

System schematic diagram and working principle description

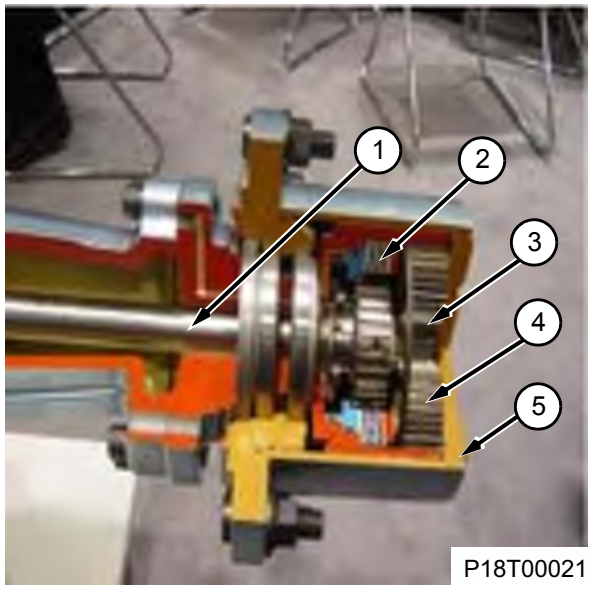
The drive axle for wheel loader is classified into two classes, i.e. front axle and rear axle, the main difference between which is the spiral directions of the spiral bevel gear pairs in the main drive. The driving spiral bevel gear of front axle is left-handed, and that of rear axle is right-handed. The structure diagram for bevel gear and wheel reducer of this machine is as shown in figure 3-20 and 3-21.

Figure 3-20 Structure diagram of the bevel gear



1. Driving spiral bevel gear
2. Axle housing
3. Driven spiral bevel gear
4. Carrier
5. Differential

Figure 3-21 Diagram of the wheel reducer



1. Axle shaft
2. Planetary gear
3. Brake
4. Hub
5. Sun gear

The bevel gear structure is shown in Figure 3-21. The bevel gear includes two parts, one is the bevel gear composed of driving spiral bevel gear and large size spiral bevel gear; the other is the differential composed of cross axle and bevel gear. The power is transmitted to the driving spiral bevel gear by the gear box through drive shaft, thus to drive the large size spiral bevel gear with differential to rotate together. The half shaft gear of differential passes the power to left/ right half shaft which is connected with the splines, and further to the wheel reducer. The power is then transmitted to hub and finally to drive the tire to rotate after further speed reduction, increasing torsion through wheel reducer.

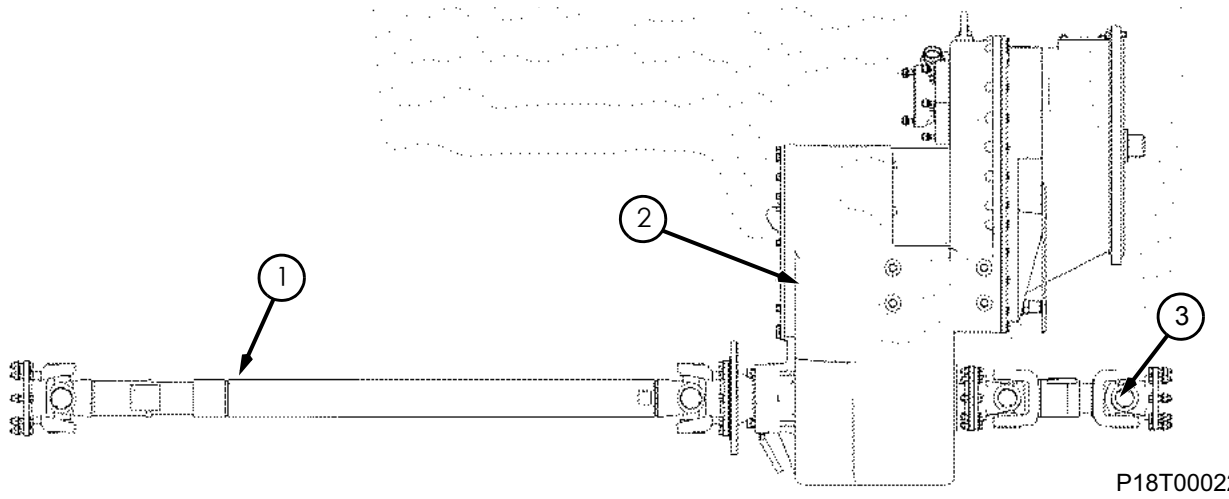
Drive Shaft System

In the wheel loader, the drive shaft system is mainly used to deliver the power between the two connected shafts, of which the relative position changes constantly during operation. Because of the special transmission characteristics of universal joint, the drive shaft may connect two transmission parts with nominal concentric axial line. However, an error may occur during installation and axial line deviates from the original position when operating, the drive shaft is widely used in shoveling transportation machine.

System composition and position

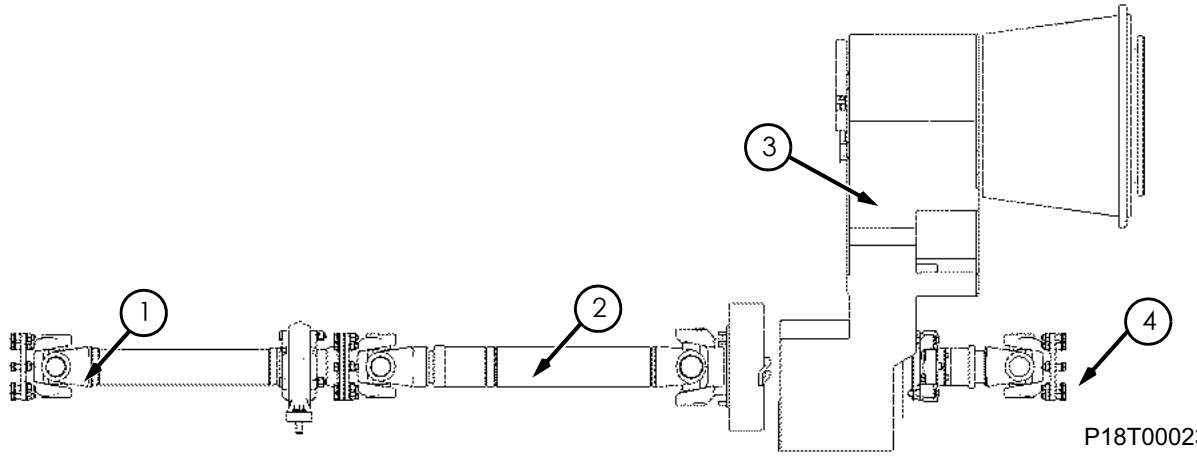
The drive shaft system of wheel loader is composed by the following two structural types in accordance with its formal layout, the drive shaft system shown in Figure 3-25 consists of rear and front drive shafts, the one shown in Figure 3-26 consists of rear, front, intermediate shafts and support assembly.

Figure 3-22 Drive shaft system



1. Front drive shaft
2. Torque converter-gear box assembly
3. Rear drive shaft

Figure 3-23 Drive shaft system



1. Front drive shaft&support assembly
2. Intermediate drive shaft
3. Torque converter-gear box assembly
4. Rear drive shaft

System technical parameters

The technical parameters for the drive shaft system are listed in Table 3-5.

Table 3-5 Technical parameter table for drive shaft system

Parts name	Input-end coupling type	Output-end coupling type
Rear drive shaft	7C FLANGE	7C FLANGE
Intermediate drive shaft	180 round flange	150 round flange
Front drive shaft&support assembly	150 round flange	150 round flange

Tire&rim system

System composition and position

Tire & rim system are both components bearing weight of a complete machine and direct components driving the complete machine to walk. Tires can be classified into bias tires with an inner tube, bias tires without an inner tube, radical tires, solid tires, etc. in accordance with it structural layouts. They can also be classified into block pattern tires, traction pattern tires, skidding tires, etc. according to pattern form.

System technical parameters

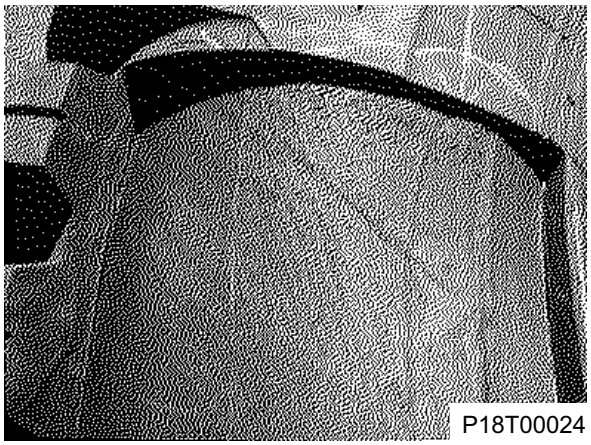
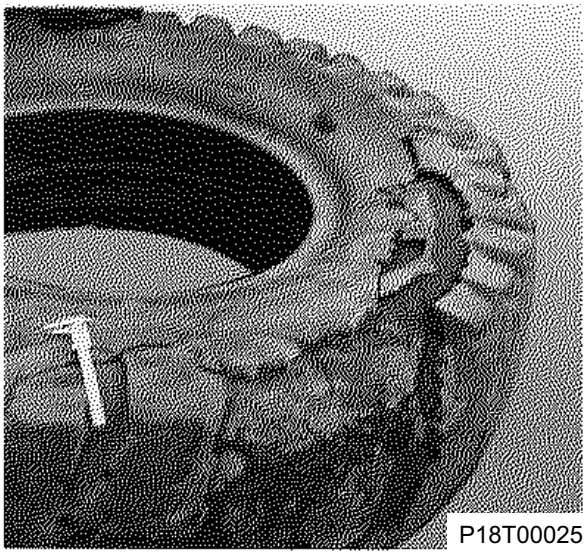
The technical parameters for the tire & rim system equipped in this machine are listed in Table 3-6.

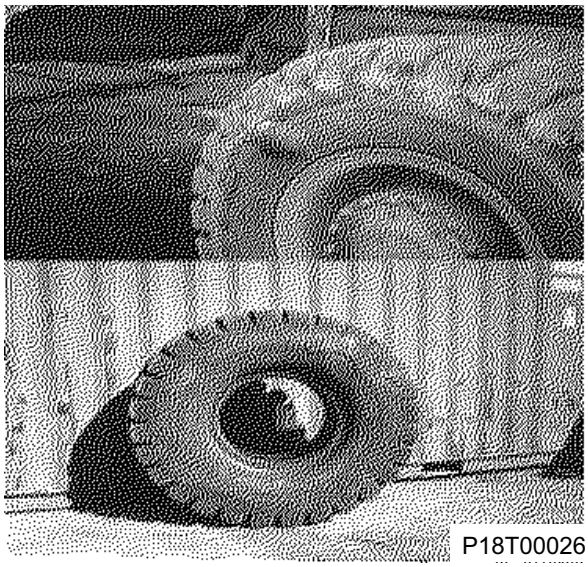
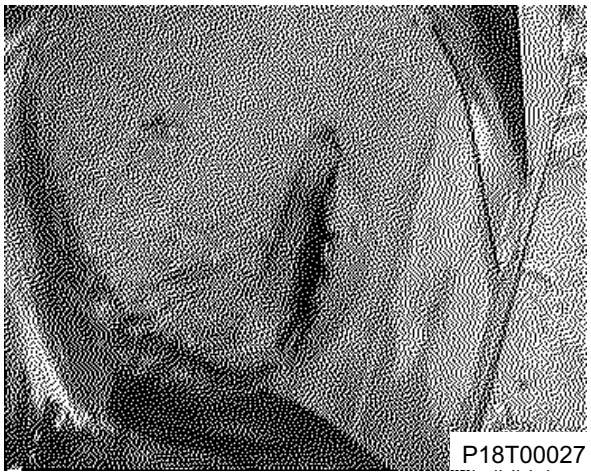
Table 3-6 Technical parameters of tire&rim system

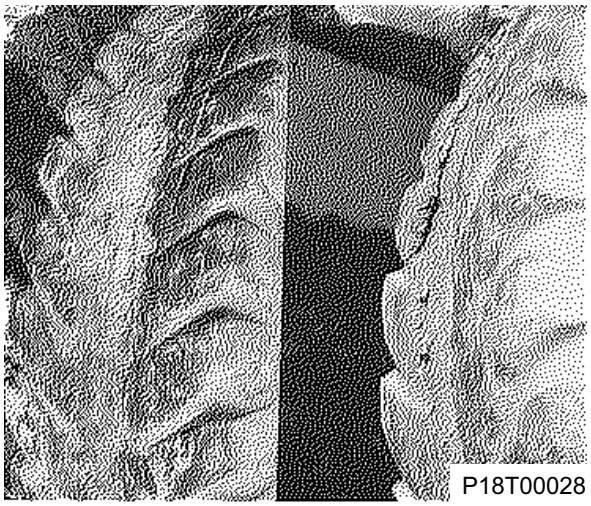
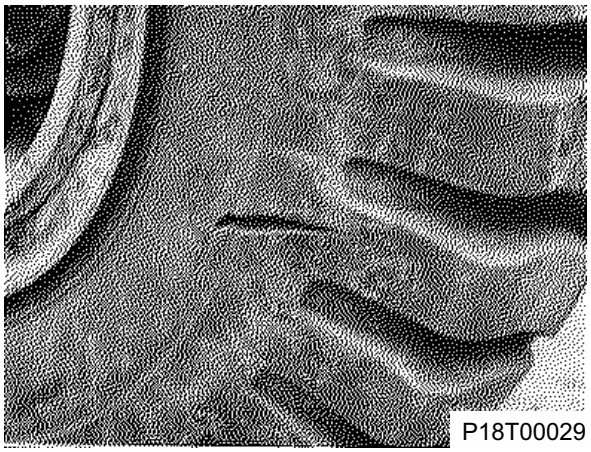
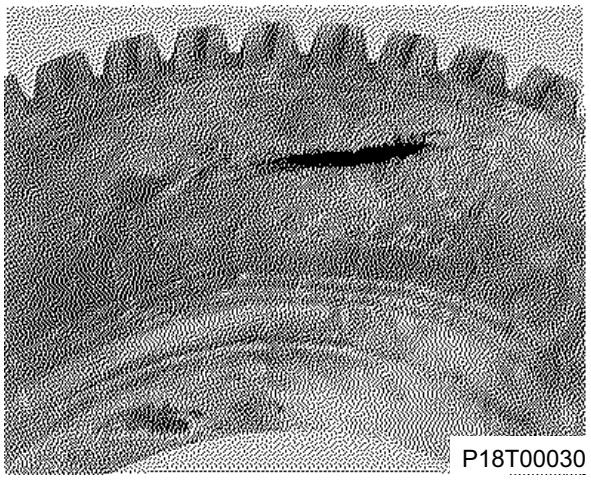
System components	Items	Parameters	Remarks
Tire	Tire structure	Radial tire	Tubeless bias tire or tubed bias tire is optional
	Specification	17.5R25 two star L3	
	Level	\	
	Type of tread	L-3	Ordinary block
	Tire pressure (MPa)\(psi)	Front wheel:0.55-0.58\79.75-84.10 Rear wheel: 0.52-0.55\75.40-79.75	
Rim	Specification	25-14.00/1.5	

Common failure modes of tire and reasons

Common failure mode of tire and reasons are as follows:

Typical pictures	Failure mode	Main reasons
 P18T00024	Delaminating of crown	1. Reasons for manufacture: there is impurities, oil stains or water in the tread rubber or cord ply or not firmly compressed when being molded, or gasoline does not fully volatilize. 2. Reasons for usage: speed is too fast (beyond specified speed), and directive pattern is traveling in reverse direction.
 P18T00025	Shoulder delamination blasting	1. Reasons for manufacture: there is impurities, oil stains or water in sidewall rubber or cord ply or not firmly compressed, or gasoline does not fully volatilize. 2. Traveling with insufficient air will intensify wear of tire shoulders and cause excessive heat, which will separate sidewall rubber from cord ply and cause an explosion when problem gets worse.

Typical pictures	Failure mode	Main reasons
 P18T00026	Delaminating of sidewall	1. Reasons for manufacture: there is impurities, oil stains or water in sidewall rubber or cord ply or not firmly compressed when being molded or gasoline does not fully volatilize. 2. Traveling on uneven road with insufficient air or overload or operating in severe working conditions will cause tire body to deform badly and cause excessive heat in partial sidewall so that sidewall peels off or explodes.
 P18T00027	Double skin	Major reasons: mixing of extruded tread compound is uneven, surfaces of semi-finished product have impurities, vulcanization mold has oil stains, and isolating agent is unevenly applied.

Typical pictures	Failure mode	Main reasons
 P18T00028	Wearing of crown	Major reasons: traveling with too high pressure will cause earthed area reduction of tire crown, local load increase and wear intensification.
 P18T00029	Trauma	Major reasons: during traveling, outer tube is scratched by pointed objects or is stabbed evenly by pointed objects.
 P18T00030	Side trauma	Major causes: the vehicle speeds up when steering, the tire side rubs the roadside obstacles; and installed tire is stuck with hard objects; the machinery is damaged during transportation, installation.

Testing and adjustment

Torque Converter - Gearbox System

1. Leakage check

Start up the machine and operate it for several minutes, observe whether there is sign of leakage from the hose assembly coupled with gear box assembly, if so, re-tighten it.

2. Test of gear box shift pressure

Power on the machine, now the oil pressure warning light of gear box flashes on the instrument panel, and after startup of machine, the warning light shall go out, if not, inspect the oil level of gear box once again.

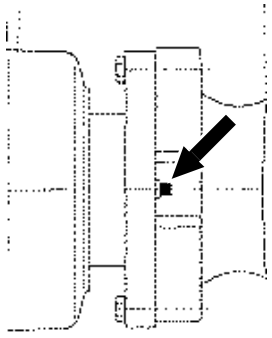
Drive axle system

1. Leakage check

Start up the machine, step on the service brake pedal for several times after the air pressure of energy accumulator gets normal, observe whether there is sign of leakage at the joint of steel pipe of front axle brake and service brake hose.

2. Exhaust

Figure 3-24 Rear axle ventilation plug

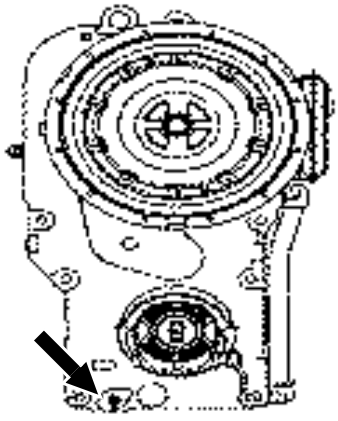


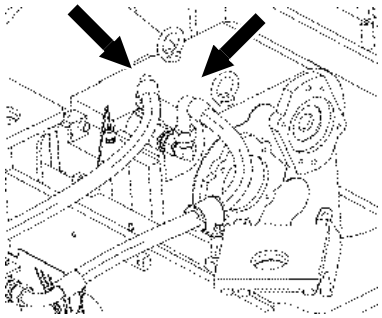
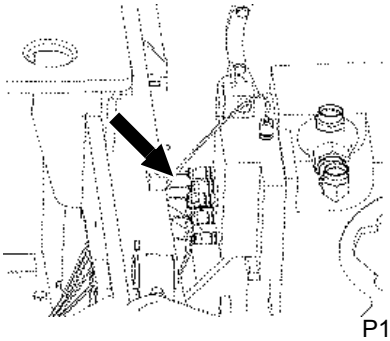
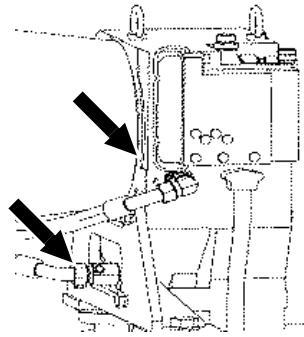
1) Loosen the exhaust plugs at both ends of axle.
2) Start up the machine and step on the service brake pedal until the oil overflows from the exhaust plug.
3) Tighten the exhaust plug.

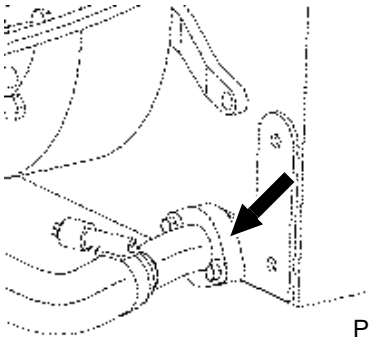
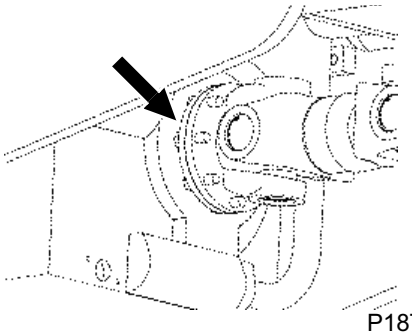
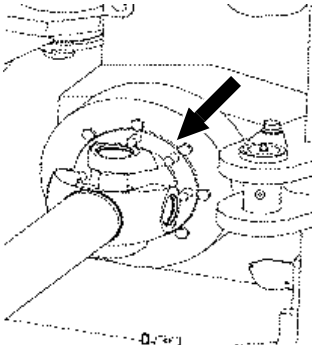
Removal and Installation

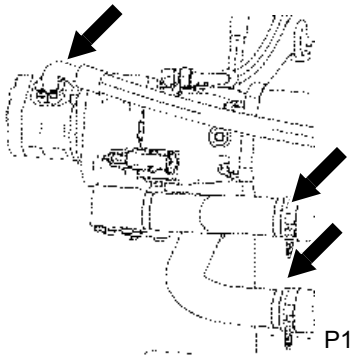
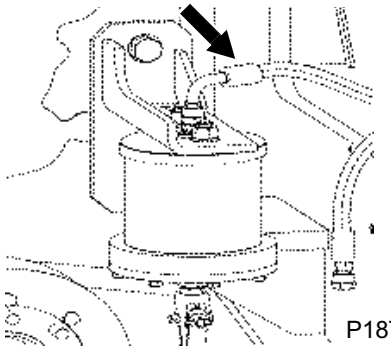
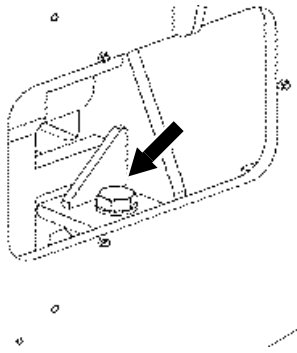
Removal and installation of torque converter-gearbox system

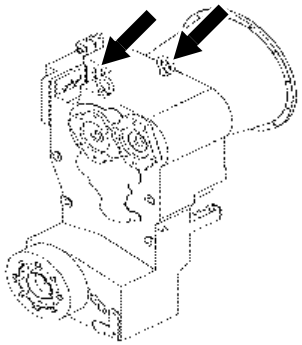
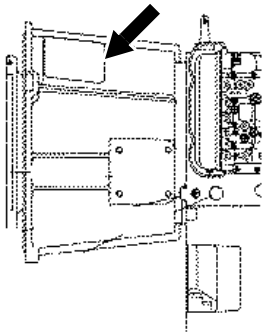
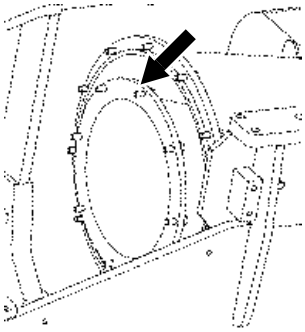
Removal of torque converter - gearbox system

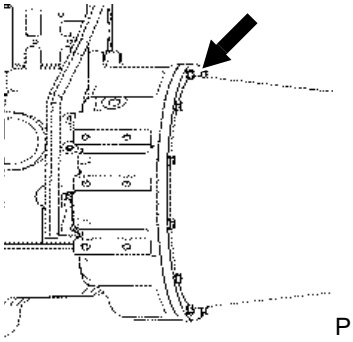
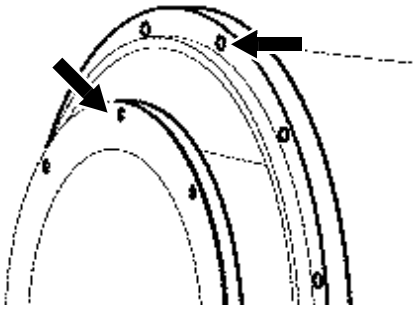
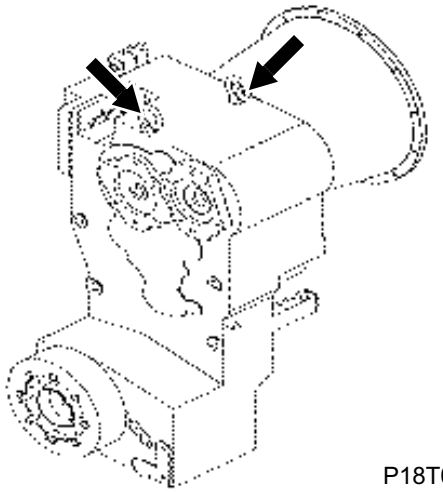
Reference picture	Operation step	Tools required (Remarks)
	1. Stop the machine on a level ground, put the work implement, bucket levelly, and pull up the emergency parking brake lever. 2. Turn off the engine and remove the key.	
 P18T00032	3. Remove the drain plug of gear box assembly to drain the oil. **⚠ Caution: The waste oil shall be recovered in a container during removal, in order to avoid environmental contamination. The removed hose is shielded to avoid contamination of parts.** **⚠ Danger: It is sure that the hose pressure is fully discharged and the oil is cooled sufficiently before removal of hose, in order to avoid personal injury of hose pressure and hot oil during removal.**	34# socket, 13# socket, pneumatic impact wrench
	4. Remove the cab assembly of machine, see section “Removal and Installation of Cab” for removal steps.	

Reference picture	Operation step	Tools required (Remarks)
 P18T00033	5. Remove the hose assembly connecting the oil filter pipe to the gear box assembly with wrench. **⚠ Caution: The waste oil shall be recovered in a container during removal, in order to avoid environmental contamination.** **The removed hose is shielded to avoid contamination of parts.**	41# wrench
 P18T00034	6. Remove the test line connected to gear box assembly and test hose.	18# Wrench
 P18T00035	7. Remove the hose assembly with a wrench.	41# Wrench

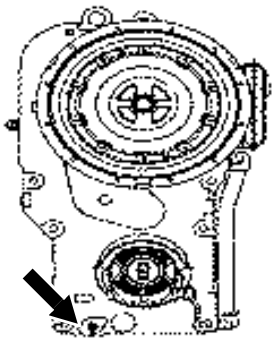
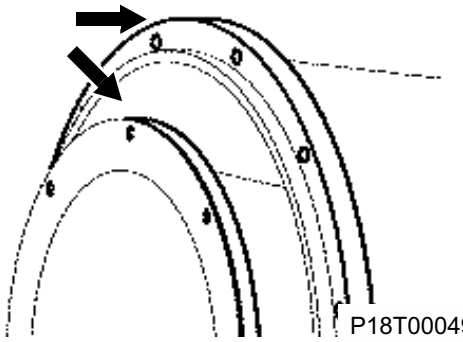
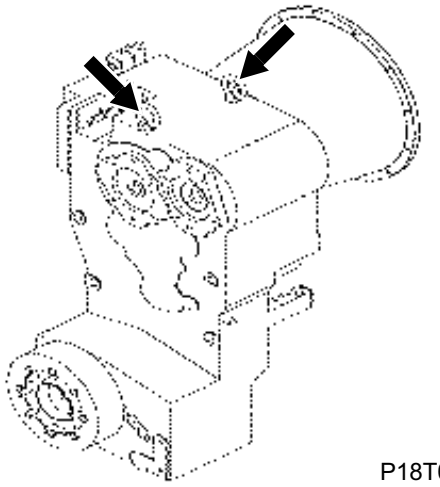
Reference picture	Operation step	Tools required (Remarks)
 P18T00036	8. Remove the clamping bolt fixing the oil filler steel-pipe with a wrench.	10# Wrench
 P18T00037	9. Remove the coupling lock-nut between rear drive shaft and rear output flange of gear box assembly. **⚠ Caution: The drive shaft assembly is composed of slidable spline sleeve, please take care to avoid personal injury caused by falling of slide shaft fork during removal.**	18# Wrench
 P18T00038	10. Remove the coupling lock-nut between intermediate drive shaft and front output flange of transmission assembly.	21# Wrench

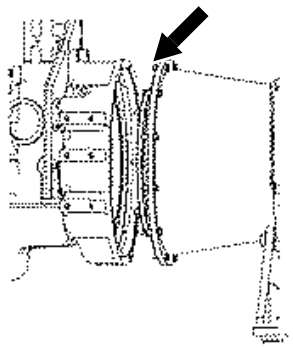
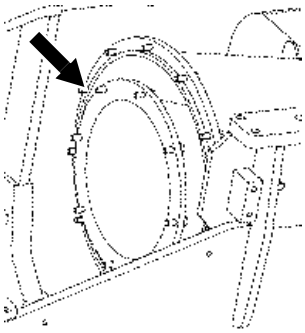
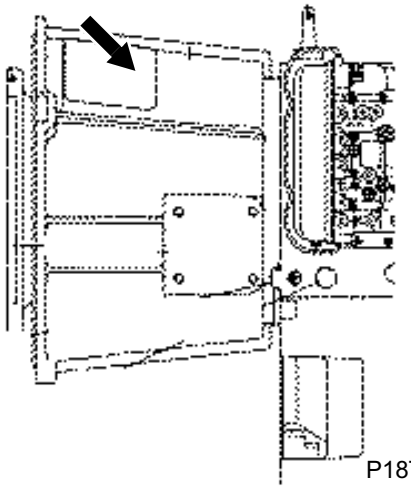
Reference picture	Operation step	Tools required (Remarks)
 P18T00039	11. Remove the hose assembly or the hose connected with hydraulic pump from the gearbox assembly, and refer to removal of hydraulic system for detailed procedures.	
 P18T00040	12. Remove the hose assembly connected with brake system from the emergency parking brake chamber.	24# Wrench
 P18T00041	13. Remove the bolts and washer for attaching the transmission mount to the frame with an air gun.	46# wrench, 46# socket, pneumatic impact wrench

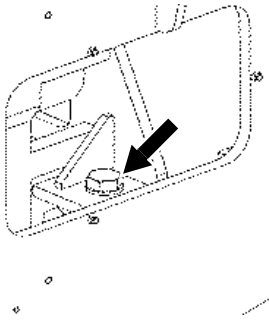
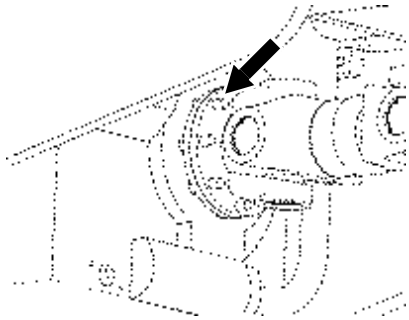
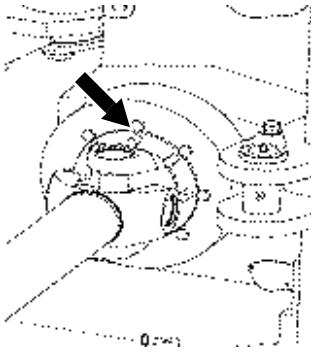
Reference picture	Operation step	Tools required (Remarks)
 P18T00042	14. Pre-lift the gear box assembly through the lugs with lifting device.	Sling (2 tons)
 P18T00043	15. Remove the cover plate from the transmission assembly with a wrench.	13# Wrench
 P18T00044	16. Remove the fastening bolts used to attach the gear box assembly to the engine flywheel with a wrench.	16# Wrench

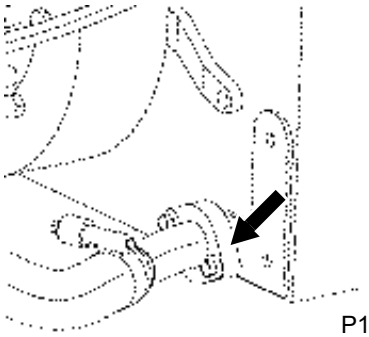
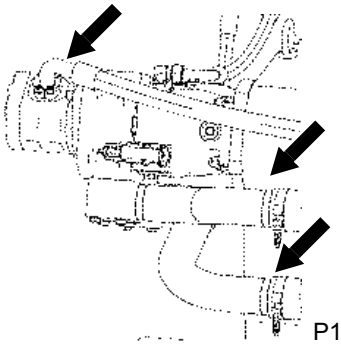
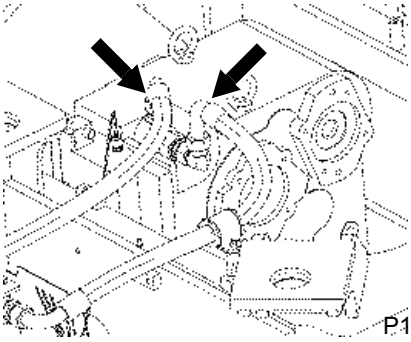
Reference picture	Operation step	Tools required (Remarks)
 P18T00045	17. Remove the fastening bolts used for attaching the gear box assembly-torque converter case to the engine housing with an blower gun and socket.	16# socket, pneumatic impact wrench
 P18T00046	18. Separate the transmission assembly from the engine, and secure the torque converter case and core through the bolt holes with ropes and steel wires.	Steel wire
 P18T00047	19. Lift up the gear box assembly from the machine through the lugs with the hoisting device and ropes and place it in a safe area.	Sling (2 tons)

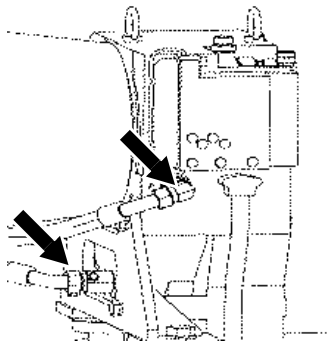
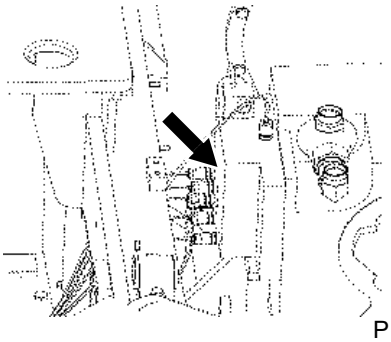
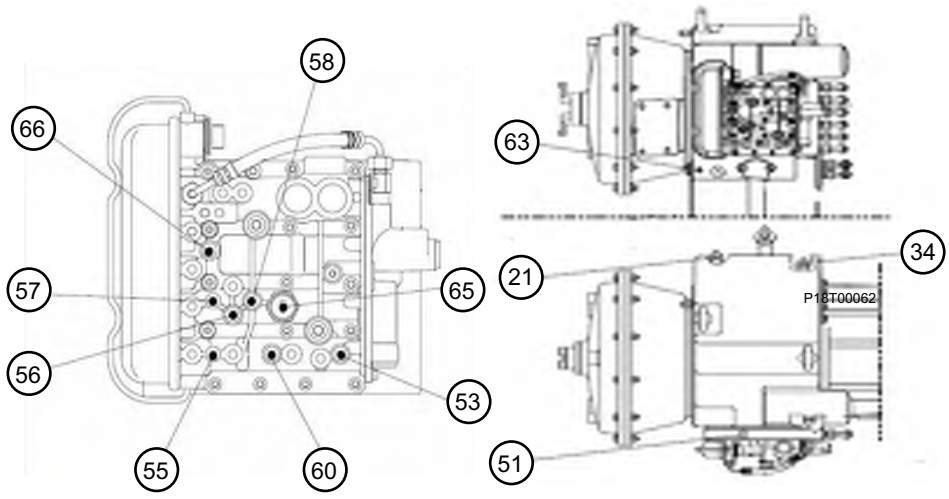
Installation of torque converter-gear box system

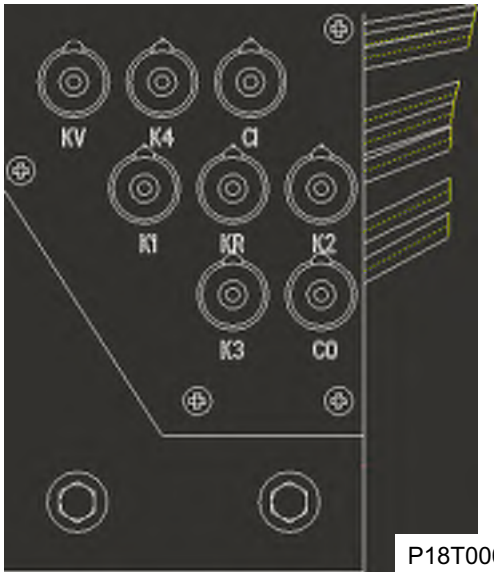
Reference picture	Operation step	Tools required (Remarks)
 P18T00048	1. Wipe clean the drain plug of gear box, and then install it in the threaded hole of gear box and tighten it with a torque of 600±70Nm\ 442.5±51.6 lbf•ft.	34# socket, 13# socket, pneumatic impact wrench, open-end 34# fixed torque spanner
 P18T00049	2. Secure the torque converter to its housing through threaded holes with the steel wire or ropes. **⚠ Danger: The torque converter can slide freely on the guide wheel seat. When lifting up it, the torque converter and its housing must be secured firmly with the steel wire or ropes, in order to avoid personal injury due to falling of torque converter.**	Steel wire
 P18T00050	3. Lift up the gear box assembly onto the machine through the lugs of gear box assembly with the hoisting device and ropes.	Sling (2 tons)

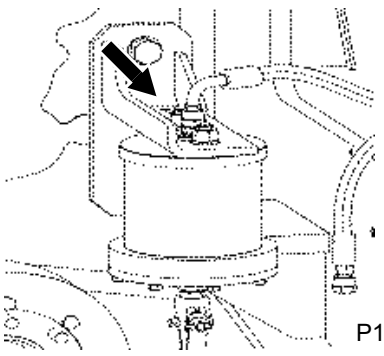
Reference picture	Operation step	Tools required (Remarks)
 P18T00051	4. Move gear box assembly to fit it with engine flywheel housing, and install the bolts and hard washer used for tightening the torque converter case to the engine housing and then tighten them. Tightening torque: 72±6Nm\ 53.1±4.4 lbf•ft.	16# socket, pneumatic impact wrench, open-end 16# fixed torque spanner
 P18T00052	5. Crank the engine flywheel case to make the torque converter align with mounting threaded hole on the engine flywheel, screw and tighten the fastening bolts and washer for attaching the torque converter to the engine flywheel by hand with a torque of 60±5Nm\ 44.25±3.7 lbf•ft	16# socket, pneumatic impact wrench, open-end 16# fixed torque spanner
 P18T00053	6. Install the mounting hole cover plate on the gear box.	13# Wrench

Reference picture	Operation step	Tools required (Remarks)
 P18T00054	7. Screw and tighten the bolts and washer for fastening the gear box mount to the frame with the torque of 2035±170Nm\ 1500.8±125.38 lbf•ft.	46# wrench, 46# socket, pneumatic impact wrench, open-end 46# fixed torque spanner
 P18T00055	8. Attach the mounting end flanges of drive shaft and gear box to the rear output flange of gear box, and tighten the locknut to 132±10Nm\ 97.35±7.38 lbf•ft.	18# wrench or open-end 18# fixed torque spanner
 P18T00056	9. Attach the intermediate drive shaft to front output flange of gear box and tighten the locknut to 200±15Nm\ 147.5±11.06 lbf•ft.	21# wrench or open-end 21# fixed torque spanner

Reference picture	Operation step	Tools required (Remarks)
 P18T00058	10. Install the oil filler steel-pipe on the gear box and tighten the set bolts with a torque of 26±3Nm\ 19.18±2.21 lbf•ft.	13# wrench or open-end 13# fixed torque spanner
 P18T00058	11. Install the hose referring to the hydraulic installation and hydraulic pump.	
 P18T00059	12. Install the hose assembly used for attaching the oil filter pipe to the gear box, and the tightening torque of hose joint is 137±6Nm\ 101.04±4.43 lbf•ft. **⚠ Caution: Two hose assemblies are respectively connected to the inlet, outlet of fine oil filter in directions as required, avoiding installation error.**	41# wrench or open-end 41# fixed torque spanner

Reference picture	Operation step	Tools required (Remarks)
 P18T00060	13. Install the hose assembly used for attaching the radiator pipe to the gear box, and the tightening torque of hose joint is 137±6Nm\ 101.04±4.43 lbf•ft.	41# wrench or open-end 41# fixed torque spanner
 P18T00061	14. Install the hose assembly used for attaching the test pipe to the gearbox, as shown in the following figure and table.	18# Wrench
Layout of test points of shift control valve  P18T00062		

<table>
<tr><th>Reference picture</th><th>Operation step</th><th>Tools required (Remarks)</th></tr>
<tr><td colspan="2">Logic diagram of test points and gear clutch
<table>
<tr><th>Decal marker</th><th>Meanings</th><th>Theoretical value</th><th>S/N in the corresponding valve</th></tr>
<tr><td>PRESSURE OF IN FRONT OF THE CONVERTER</td><td>Inlet pressure of torque converter</td><td>Opening pressure: 1.1 MPa</td><td>51</td></tr>
<tr><td>PRESSURE OF KV CLUTCH</td><td>KV clutch pressure</td><td>1.6-1.8MPa</td><td>53</td></tr>
<tr><td>PRESSURE OF KR CLUTCH</td><td>KR clutch pressure</td><td>1.6-1.8MPa</td><td>55</td></tr>
<tr><td>PRESSURE OF K1 CLUTCH</td><td>K1 clutch pressure</td><td>1.6-1.8MPa</td><td>56</td></tr>
<tr><td>PRESSURE OF K2 CLUTCH</td><td>K2 clutch pressure</td><td>1.6-1.8MPa</td><td>57</td></tr>
<tr><td>PRESSURE OF K3 CLUTCH</td><td>K3 clutch pressure</td><td>1.6-1.8MPa</td><td>58</td></tr>
<tr><td>PRESSURE OF K4 CLUTCH</td><td>K4 clutch pressure</td><td>1.6-1.8MPa</td><td>59</td></tr>
</table></td><td></td></tr>
<tr><td>Mapping diagram of centralized measuring point mounting plate and measuring point


P18T00063</td><td></td><td></td></tr>
<tr><td>
P18T00064</td><td>15. Install the hose assembly used for attaching emergence parking brake chamber to the brake system, the tightening torque is 37±2Nm\ 27.29±1.48 lbf•ft.</td><td>24# wrench or open-end 24# fixed torque spanner</td></tr>
</table>

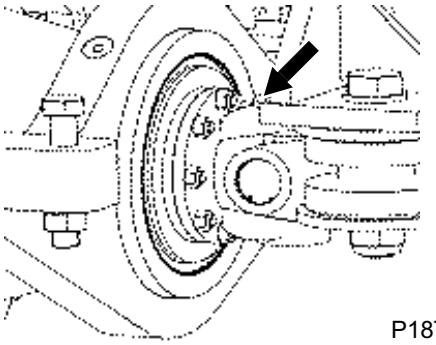
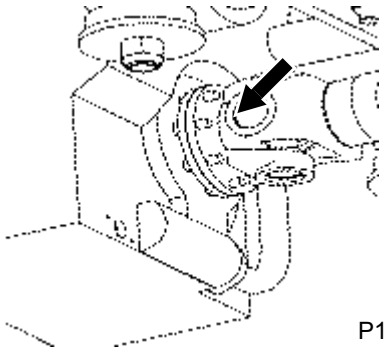
Reference picture	Operation step	Tools required (Remarks)
	16. Fill the gear box by referring to the Operation Manual of this machine, and check the oil level according to the specified method.	

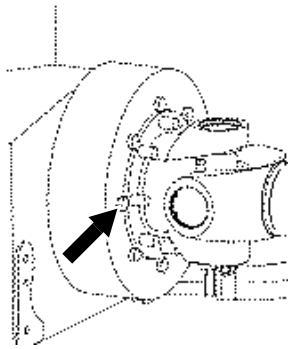
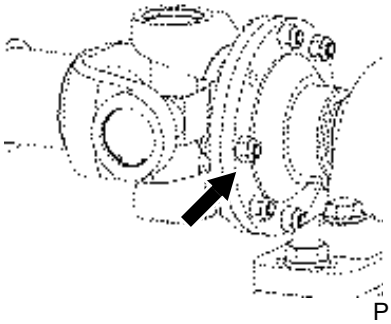
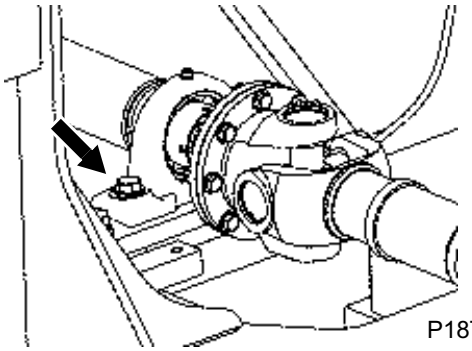
Disassembly and assembly of torque converter-gearbox assembly

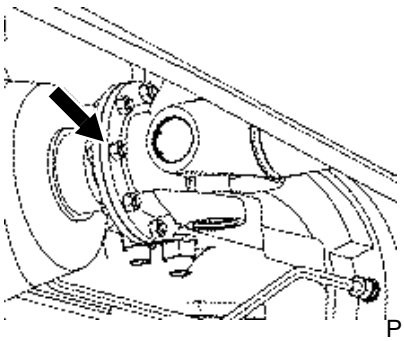
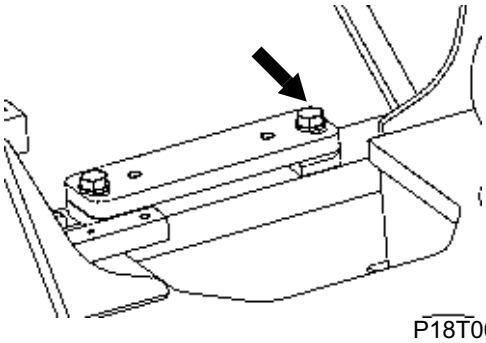
For disassembly and assembly of torque converter-gear box assembly in this machine, refer to "ZF Gear Box Overhaul Manual".

Removal and installation of drive shaft system

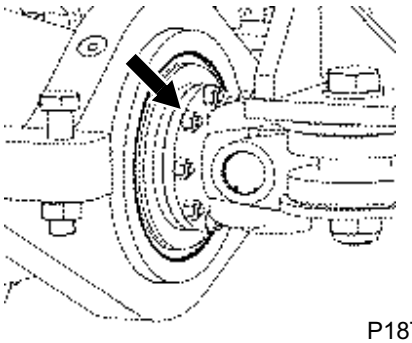
Removal of drive shaft system

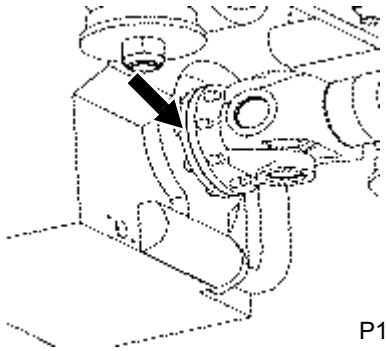
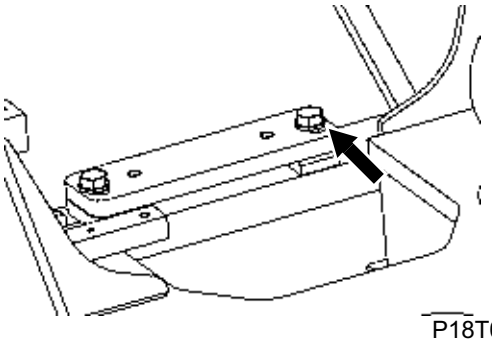
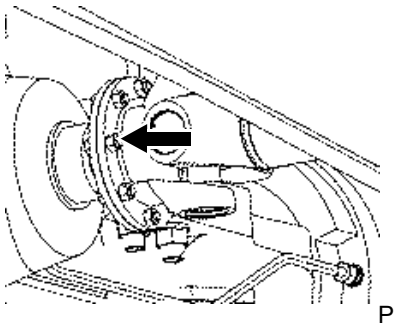
Reference picture	Operation step	Tools required (Remarks)
	1. Park the machine on a level ground, turn off the engine, and place the gear box handle in neutral position, pull up the emergency parking brake lever and place the wedges. **⚠ Caution: The drive shaft assembly is composed of slidable spline sleeve, please take care to avoid personal injury caused by falling of slide shaft fork during removal.**	
 P18T00065	2. Remove the connecting locknut between the rear drive shaft and rear axle input flange with a wrench.	18# Wrench
 P18T00066	3. Remove the connecting locknut between rear drive shaft and rear output flange of gear box with a wrench, and place the rear drive shaft assembly in a safe area.	18# Wrench

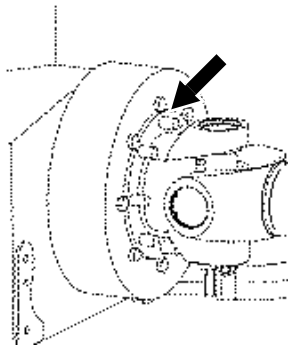
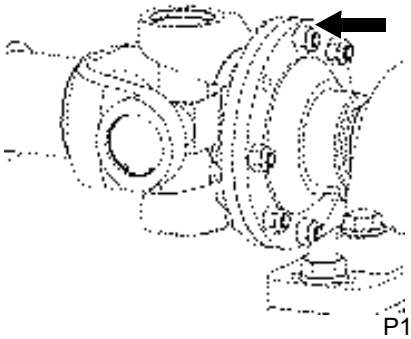
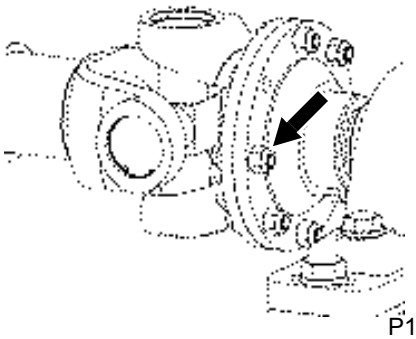
Reference picture	Operation step	Tools required (Remarks)
 P18T00067	4. Remove the connecting locknut between intermediate drive shaft and front output flange of gear box assembly with a wrench.	21# Wrench
 P18T00068	5. Remove tightening bolt and nut between intermediate drive shaft and front drive shaft & bearing assembly, and remove the intermediate drive shaft from machine with a wrench.	18# Wrench
 P18T00069	6. Remove the bolts and washer securely connecting the front drive shaft and support assembly to middle support plate with a wrench.	18# Wrench

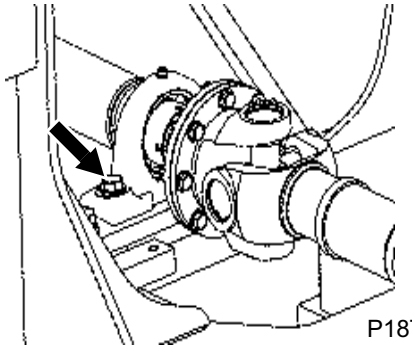
Reference picture	Operation step	Tools required (Remarks)
 P18T00070	7. Remove the bolts and nuts securely connecting the front drive shaft and support assembly and front axle, and remove front drive shaft and support assembly from machine with a wrench.	18# Wrench
 P18T00071	8. Remove the tightening bolts and washers of the support plate and frame with a blower gun or a wrench.	24# socket, pneumatic impact wrench or 24# wrench

Installation of drive shaft system

Reference picture	Operation step	Tools required (Remarks)
 P18T00072	1. Wipe clean the surface, install rear drive shaft and rear axle input flange, and align the the mounting holes, then insert the tightening bolt and screw in the nut and tighten it with a torque of 132±10Nm\97.35±7.38 lbf•ft.	18# wrench or open-end 18# fixed torque spanner

Reference picture	Operation step	Tools required (Remarks)
 P18T00073	2. Wipe clean the surface, install the rear drive shaft and rear output flange of the gear box, and align the mounting holes, screw in the locknut and tighten it with a torque of 132±10Nm\ 97.35±7.38 lbf•ft. **⚠ Caution: When assembling, please make sure to pay attention to the white arrows on the identification of drive shaft, both of which must be aligned after assembly!**	18# wrench or open-end 18# fixed torque spanner
 P18T00074	3. Wipe clean the two mounting surfaces of support plates, and then pre-install it onto the front frame. Set the front drive shaft and support assembly with middle support bearing on the front frame middle support bearing seat support plate.	
 P18T00075	4. Wipe clean the surface, install the front drive shaft and support assembly with front axle input flange, and align the mounting hole, screw in the locknut and tighten it with a torque of 132±10Nm\97.35±7.38 lbf•ft.	18# wrench or open-end 18# fixed torque spanner

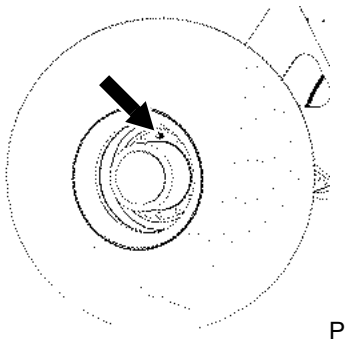
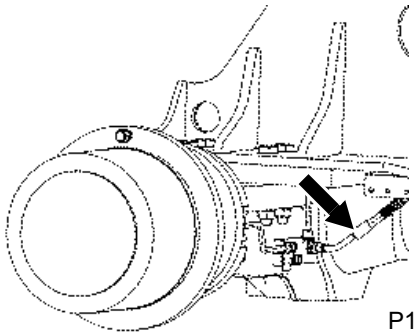
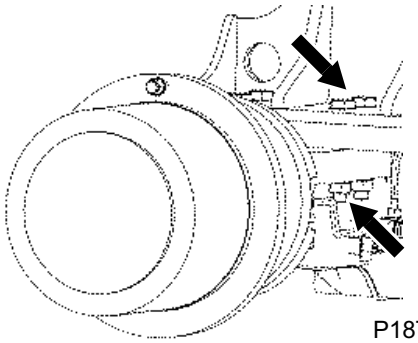
Reference picture	Operation step	Tools required (Remarks)
 P18T00076	5. Wipe clean the mounting surfaces of front output flange of gear box and intermediate drive shaft flange, and install the intermediate drive shaft to the front output flange bolts of gear box, screw in the locknut and tighten it with a torque of 200±15Nm\ 147.5±11.06 lbf•ft.	21# wrench or open-end 21# fixed torque spanner
 P18T00077	6. Install the middle drive shaft, front drive shaft and support assembly, and align the mounting holes. Insert the tightening bolt and screw in the locknut, and then tighten them to 132±10Nm\ 97.35±7.38 lbf•ft. **⚠ Caution: The intermediate drive shaft middle shaft fork must be aligned with the fork which is coupled with front axle on the front drive shaft and support assembly!**	18# wrench or open-end 18# fixed torque spanner
 P18T00078	7. Adjust the front&rear, left&right positions of intermediate, front drive shafts and support assembly to make sure that the bolts between support plate and frame can be screwed in smoothly with torque of 132±10Nm\97.35±7.38lbf•ft.	Open-end 18# fixed torque spanner or 18# wrench

Reference picture	Operation step	Tools required (Remarks)
 P18T00079	8. Install the tightening bolts and washer of the middle support bearing seat and support plate, and tighten them to 22494±18.44 lbf•ft.	24# socket, fixed torque blower gun or open-end 24# fixed torque spanner

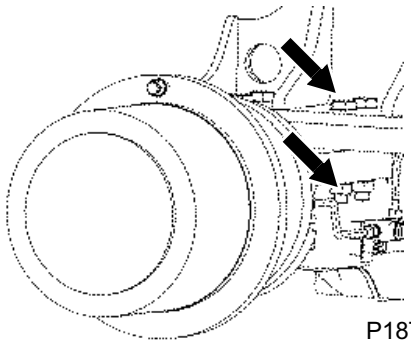
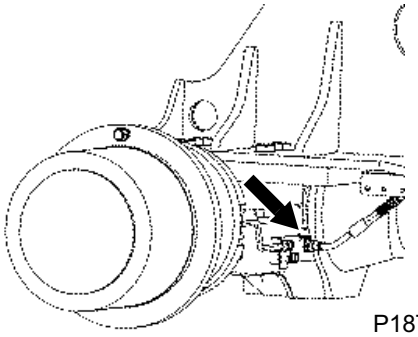
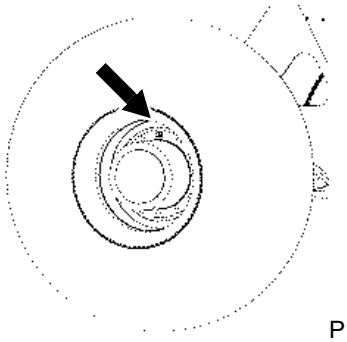
Removal and installation of front axle assembly

Removal of front axle assembly

Reference picture	Operation step	Tools required (Remarks)
	1. Stop the machine on a level ground, put the work implement, bucket levelly, and pull up the emergency parking brake lever. 2. Turn off the engine, step on the service brake pedal for several times, so as to release the pressures of energy accumulator and axle brake pipe. 3. Lift up the machine with a lifting device, and support it up with a supporting device with 4 tires off the ground	Sling (12 tons)

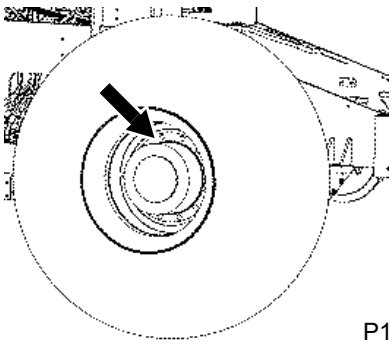
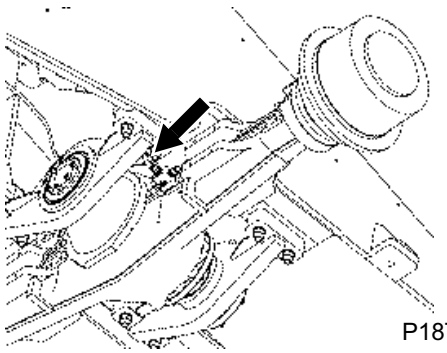
Reference picture	Operation step	Tools required (Remarks)
 P18T00080	4. Pre-lift up the tires with a hoist, remove the bolts and nuts used for tightening the rim and axle. 5. Lift the tires away from machine and put them in a safe area. 6. Repeat steps (4), (5), remove another tire installed on the front axle.	Sling(2 tons)30# socket, pneumatic impact wrench or open-end 30# wrench
 P18T00081	7. Remove the hose assembly connected to service brake system and the front axle. **⚠ Caution: The waste oil shall be recovered in a container during removal, in order to avoid environmental contamination. The removed hose is shielded to avoid contamination of parts.** **⚠ Danger: It is sure that the hose pressure is fully discharged and the oil is cooled sufficiently before removal of hose, in order to avoid personal injury of hose pressure and hot oil during removal.**	24# Wrench
 P18T00082	8. Pre-lift the front axle assembly with a sling. 9. Remove the bolts and nuts for connecting the front axle assembly to the front frame with a blower gun. 10. Put the axle assembly onto the ground slowly with a lifting device. 11. Remove the axle assembly from the bottom of machine with a handling equipment, and then put it on the appliance for axle assembly.	Sling(2 tons)40# socket, pneumatic impact wrench, 40# wrench

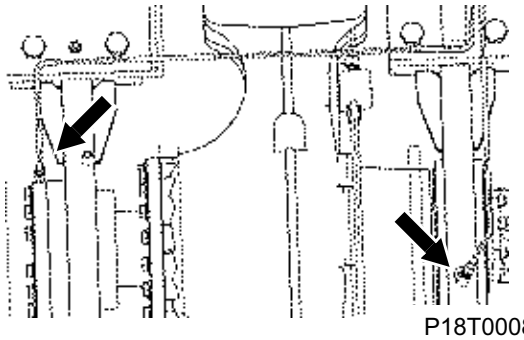
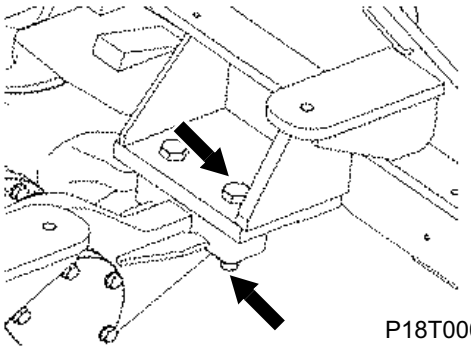
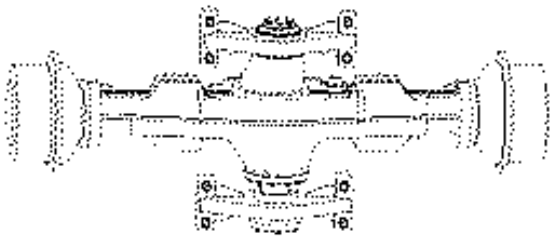
Installation of front axle assembly

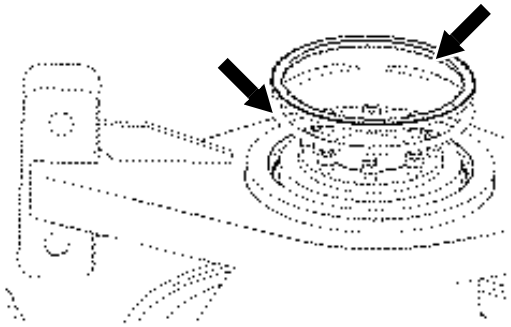
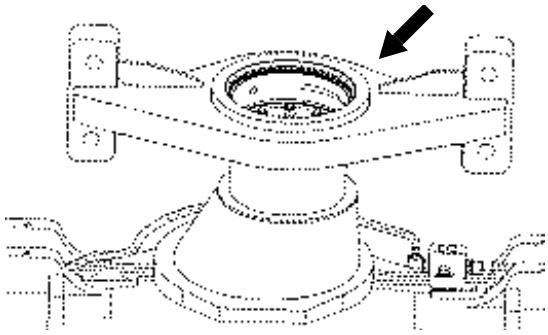
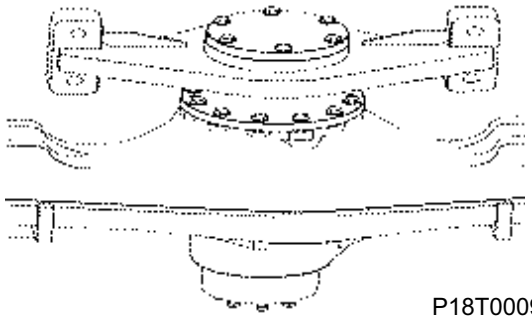
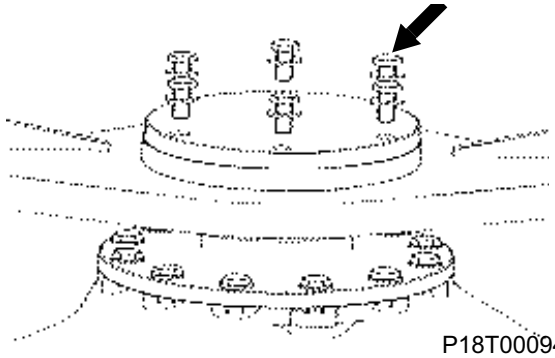
Reference picture	Operation step	Tools required (Remarks)
 P18T00083	1. Take the front axle assembly out of placed area with a handling device, and position it under its mounting point. 2. Lift up the front axle assembly with a hoist, and install it on the frame. 3. Install the tightening bolts and nuts and tighten them with torque of 2035±170Nm\ 1500.8±125.38 lbf•ft.	Sling(2 tons) 46# socket, pneumatic impact wrench, open-end 46# fixed torque spanner
 P18T00084	4. Install the front axle brake pipe and service brake hose. Tightening torque: 37±2Nm\ 27.29±1.48 lbf•ft.	Open-fixed 24# fixed torque spanner
 P18T00085	5. Lift up the tire with a hoist and install it onto the axle, and then install the rim nut and tighten it to 600±60Nm\ 442.5±44.25 lbf•ft.	Sling (2 tons)30# socket, pneumatic impact wrench, open-end 30# fixed torque spanner
	6. Lift the machine with a hoist, remove the support device, and put the machine onto the ground.	Sling (12 tons)

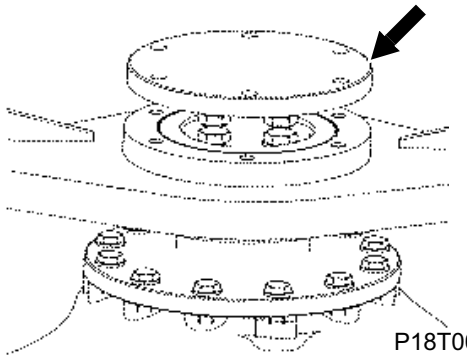
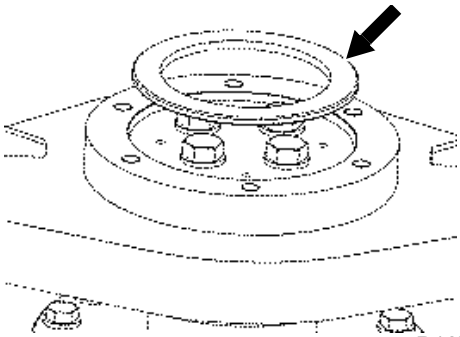
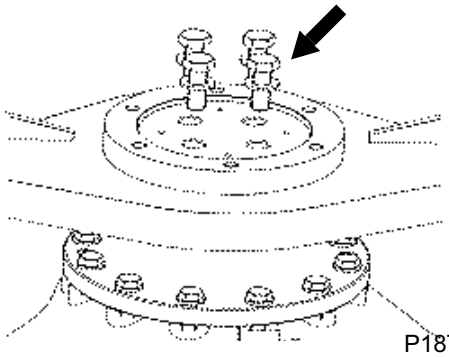
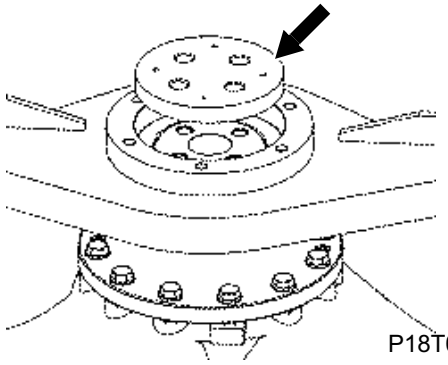
Removal and installation of rear axle assembly

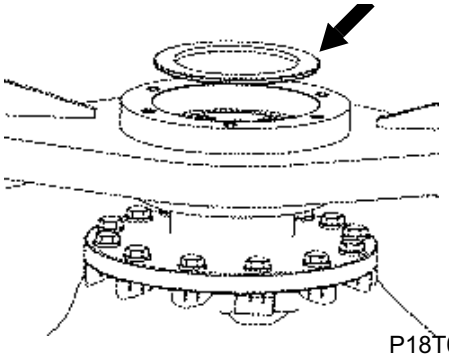
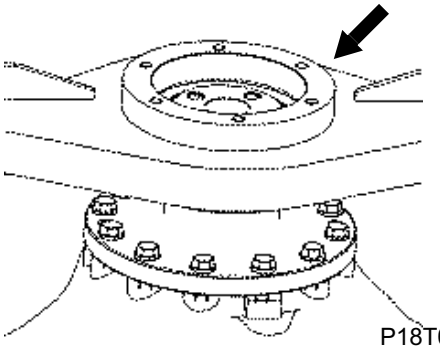
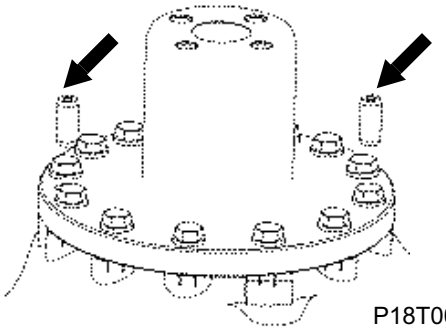
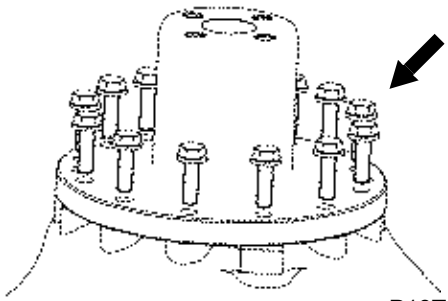
Removal of rear axle assembly

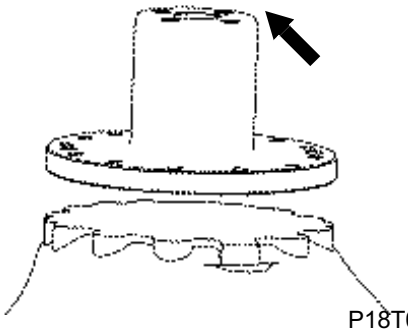
Reference picture	Operation step	Tools required (Remarks)
	1. Stop the machine on a level ground, put the work implement, bucket levelly, and pull up the emergency parking brake lever. 2. Turn off the engine, step on the service brake pedal for several times, so as to release the pressures of energy accumulator and axle brake pipe. 3. Lift up the machine with a lifting device, and support it up with a supporting device with 4 tires off the ground	Sling (12 tons)
 P18T00086	4. Pre-lift up the tires with a hoist, remove the bolts and nuts used for tightening the rim and axle. 5. Lift the tires away from machine and put them in a safe area. 6. Repeat steps (4), (5), remove another tire installed on the rear axle.	Sling (2 tons)30# socket, pneumatic impact wrench or open-end 30# wrench
 P18T00087	7. Remove the the rear axle and hose assembly connected to service brake system.	24# Wrench

Reference picture	Operation step	Tools required (Remarks)
 P18T00088	8. Remove the steel pipe connected to the rear axle and centralized lubricating system.	Open-end 16# wrench
 P18T00089	9. Pre-lift the rear axle assembly with a sling. 10. Remove the bolts and locknuts for connecting the rear axle assembly to the rear frame. 11. Put the axle assembly onto the ground slowly with a lifting device. 12. Remove the axle assembly from the bottom of machine with a handling equipment, and then put it on the appliance for axle assembly.	Sling (2 tons) 36# socket, pneumatic impact wrench, 36# wrench,
 P18T00090	13. Place the axle assembly as shown in the left figure to make front swing frame support shaft upward, and rear swing frame support shaft downward.	

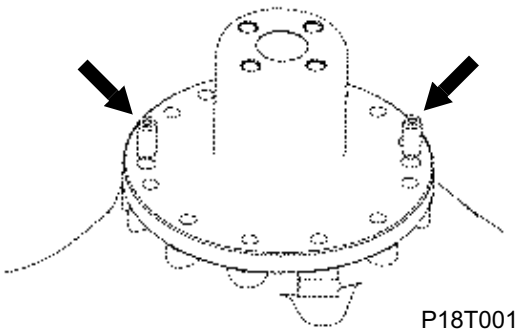
Reference picture	Operation step	Tools required (Remarks)
 P18T00091	14. Remove the seal ring and snap ring from the front swing support rack with a screwdriver.	Straight screwdriver
 P18T00092	15. Remove the front swing support rack from axle assembly with a lifting device and place it in a safe area.	Sling (2 tons)
 P18T00093	16. Place the axle assembly as shown in the left figure to make the rear swing support rack upward.	
 P18T00094	17. Remove the bolts, washers with a wrench or an pneumatic tool.	Open-end 18# wrench

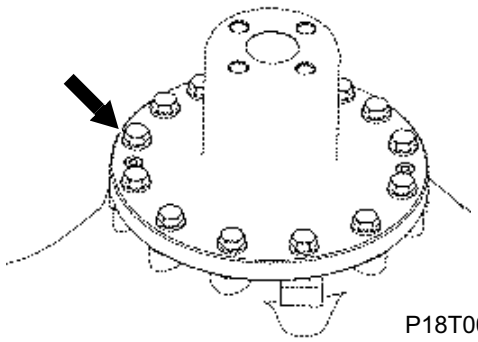
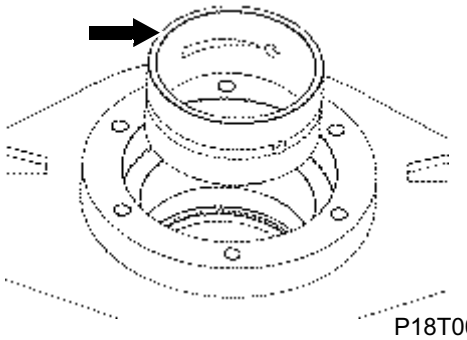
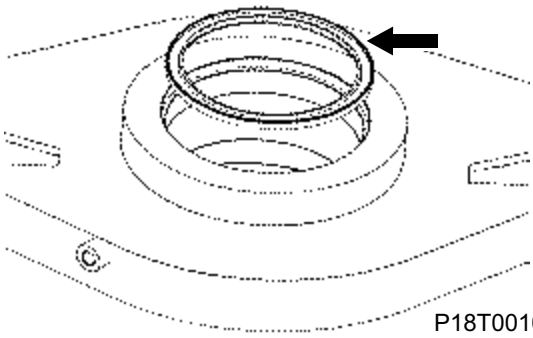
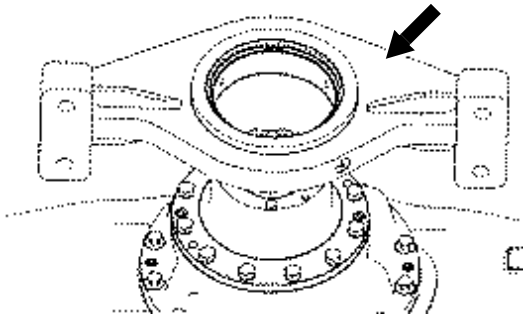
Reference picture	Operation step	Tools required (Remarks)
 P18T00095	18. Remove the cover.	Open-end 18# wrench
 P18T00096	19. Remove the thrust washer.	Straight screwdriver
 P18T00097	20. Remove the bolts and washer tightening the clamping plate.	Open-end 27# wrench or 27# socket, pneumatic impact wrench
 P18T00098	21. Remove the clamping plate.	Straight screwdriver

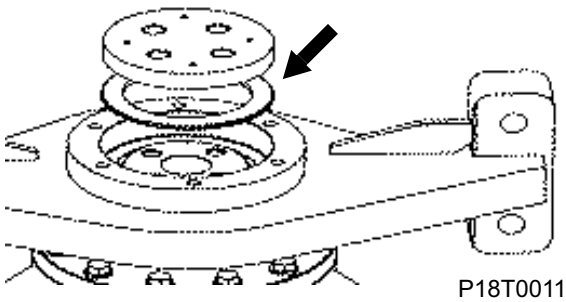
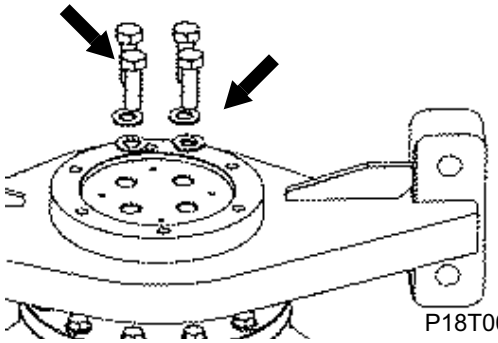
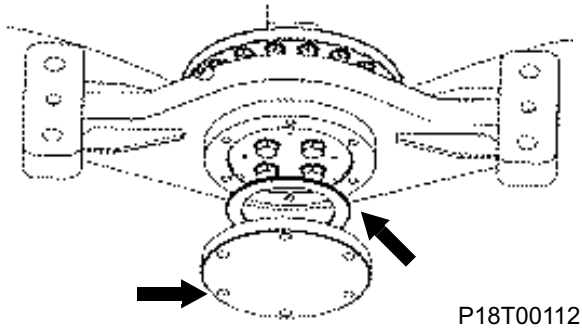
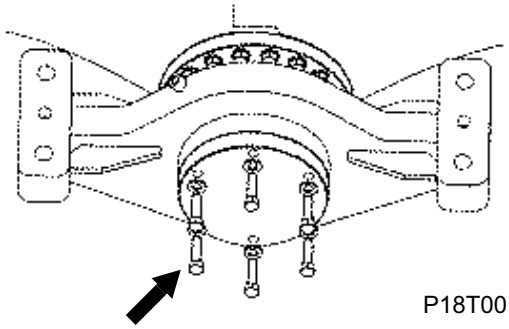
Reference picture	Operation step	Tools required (Remarks)
 P18T00099	22. Remove the thrust washer.	Straight screwdriver
 P18T00100	23. Remove the rear swing support rack with a lifting device.	Sling (2 tons)
 P18T00101	24. Screw the M8 bolt in the dowel and remove the dowel.	Open-end 13# wrench
 P18T00102	25. Remove the bolts and washers tightening the support shaft.	Open-end 21# wrench or 21# socket, pneumatic impact wrench

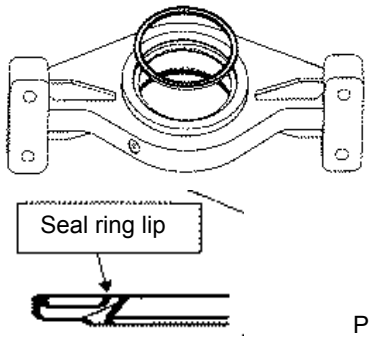
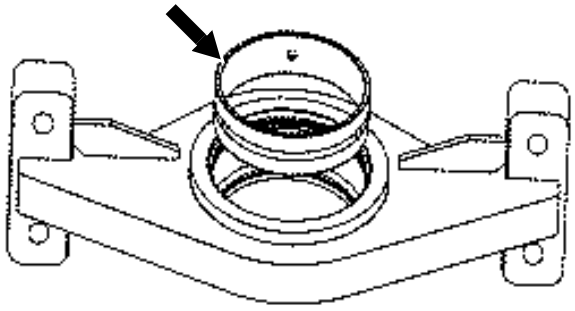
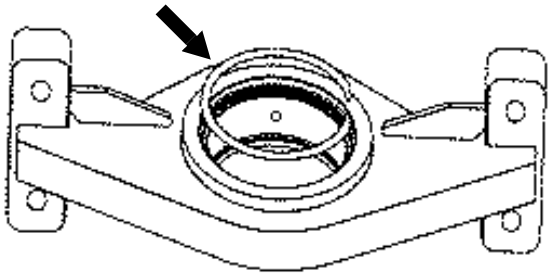
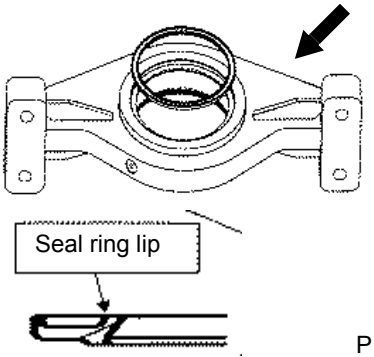
Reference picture	Operation step	Tools required (Remarks)
 P18T00103	26. Remove the support shaft with a lifting device.	Sling (2 tons)

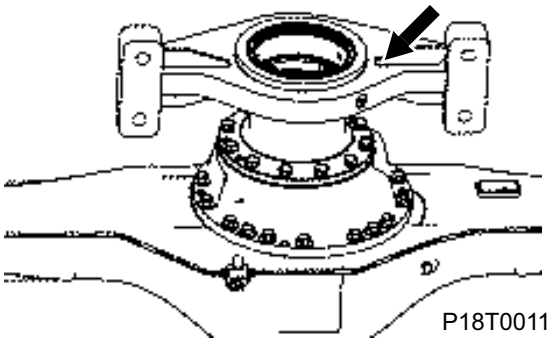
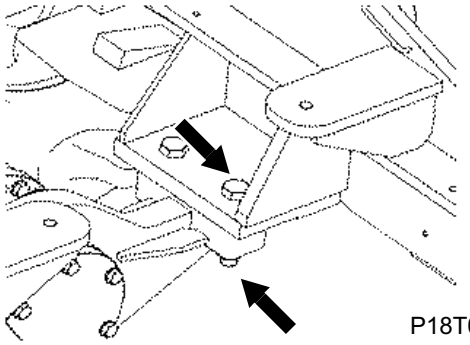
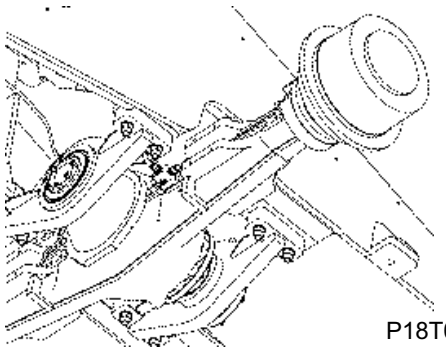
Installation of rear axle assembly

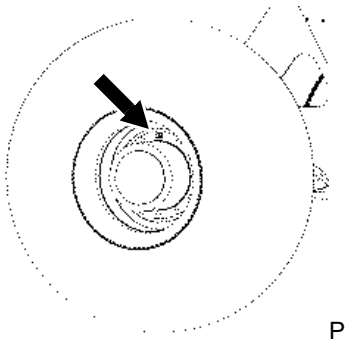
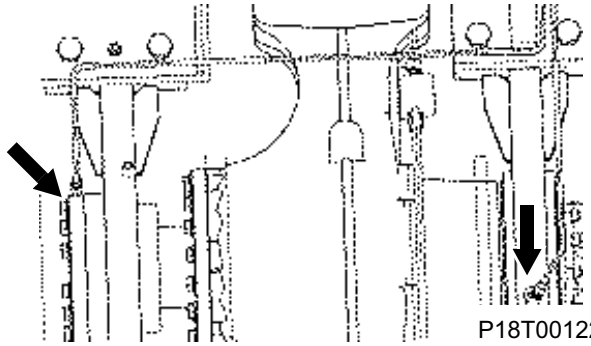
Reference picture	Operation step	Tools required (Remarks)
 P18T00104	1. Lift up the axle assembly and position it as shown in the left figure onto a special assembly device.	
 P18T00105	2. Wipe clean the mounting face between the support shaft and the axle case connected to it with a clean cloth, install the support shaft onto the axle and align two dowel pins accurately, strike it into the dowel pin with a copper bar.	Copper bar

Reference picture	Operation step	Tools required (Remarks)
 P18T00106	3. Apply thread lock sealant to thread portions of bolts, screw them into support thread holes by 2-3 threads by hand, and tighten them with an air gun. Tightening torque: 305±25Nm\ 22494±18.44 lbf•ft.	24# socket, pneumatic impact wrench, open-end 24# fixed torque spanner
 P18T00107	4. Horizontally place rear swing frame with the thread hole end upward, and install the bush into rear swing support rack.	
 P18T00108	5. Turn over swing frame by 180°, install seal ring and knock it to the end with nylon hammer.	Nylon hammer
 P18T00109	6. Turn over swing frame group by 180°, evenly apply molybdenum disulfide lithium base grease to bushing cone, and install rear swing frame group into spindle with lifting device.	

Reference picture	Operation step	Tools required (Remarks)
 P18T00110	7. Install thrust washer and pressing plate and align the holes well.	
 P18T00111	8. Apply thread lock sealant to thread portion of bolt, screw bolts and hard washers into the clamping plate thread holes by 2-3 teeth by hand, and drive them in symmetrically with pneumatic impact wrench with the tightening torque of 305±25Nm\ 224.94±18.44 lbf•ft.	24# socket, pneumatic impact wrench, open-end 24# fixed torque spanner
 P18T00112	9. Put a thrust washer and cover and align the holes well.	
 P18T00113	10. Apply thread lock sealant to thread of bolts, screw bolts and hard washers into cover thread holes by 2-3 teeth by hand, and drive them in symmetrically with pneumatic impact wrench with the tightening torque of 195±15Nm\ 143.81±11.06 lbf•ft.	21# socket, pneumatic impact wrench, open-end 21# fixed torque spanner

Reference picture	Operation step	Tools required (Remarks)
 P18T00114	11. Horizontally place front swing frame, and knock seal ring into front swing frame mounting hole to the end with nylon hammer. ⚠ **Caution: The seal ring lip faces outward.**	Nylon hammer
 P18T00115	12. Press the bushing into the front swing frame to the bottom ⚠ **Caution: The small hole of bushing must toward the lug end of front swing support.**	
 P18T00116	13. Install the snap ring into the groove with straight screwdriver.	Straight screwdriver
 P18T00117	14. Knock seal ring into front swing frame mounting slot to the end with nylon hammer; ⚠ **Caution:The seal ring lip faces outward.**	

Reference picture	Operation step	Tools required (Remarks)
 P18T00118	15. Evenly apply the molybdenum disulfide lithium base grease to bushing cone, and then lift and install the front swing support subassembly onto the bearing seat of the main transmission. 16. Place the axle assembly on a transport device with a lifting device, and right under mounting point of rear axle. 17. Install the axle assembly onto the rear frame with a lifting device and align the mounting holes.	Sling (2 tons)
 P18T00119	18. Install the mounting bolts, washers and nuts of the axle assembly and tighten them with an blower gun to 1122±90Nm\ 827.28±66.38 lbf•ft.	36# socket, pneumatic impact wrench, open-end 36# fixed torque spanner
 P18T00120	19. Install the axle and hose connecting the service brake pipe and tighten it to 37±2Nm\ 27.29±1.48 lbf•ft.	Open-end 24# wrench

Reference picture	Operation step	Tools required (Remarks)
 P18T00121	20. Lift up the tire with a hoist and install it onto the axle, and then install the rim nut and tighten it to 600±60Nm\ 442.5±44.25 lbf•ft.	30# socket, pneumatic impact wrench or open-end 30# fixed torque spanner
 P18T00122	21. Install the steel pipe connecting the centralized lubricating system and axle.	Open-end 16# wrench
	22. Lift the machine with a hoist, remove the support device, and put the machine onto the ground.	Sling (12 tons)

Disassembly and assembly of the drive axle

For disassembly and assembly of the drive axle in this machine, see "835H Drive Axle Service Manual" for details.

Fault Diagnosis and Troubleshooting Methods

	Fault features	Main reasons	Fault inspection and troubleshooting
1	The engine can not Activation	1. Start circuit of the base machine (such as power voltage, electric lock, startup relay and startup motor) has faults.	1. Check the circuit of the base machine.
		2. The lever is not at the neutral position.	2. Shift the lever to neutral position.
		3. The fuse to the control circuit on the base machine is burnt.	3. Replace the fuse.
		4. Poor contact of handle plug or the handle is failed.	4. Organize the plugs.
		5. Poor contact of controller plug or the controller is failed.	5. Organize the plugs.
2	Low shift pressure at all gears Low pressure	1. Oil pressure gauge is failed.	1. Replace the oil pressure gauge
		2. Insufficient tightening torque for bolt of shift control valve.	2. Tightening torque for M8-8.8 bolt of shift control valve is 26Nm.
		3. Spring of main pressure valve is broken.	3. Replace it.
		4. Gear shift pump is worn	4. Replace the gear shift pump.
		5. Fragments enter into shift control valve or valve is stuck	5. Replace the filter, and clean the control valve.
3	Too short shifting time at all gears	1. O-ring in throttle plug is damaged	1. Replace the O-ring
		2. The tightening torque of pressure control valve bolts is out of specified range	2. Tightening torque for M8-8.8 bolt of shift control valve is 26Nm.
4	Too long shifting time at all gears	1. Throttle plug is blocked.	1. Clean and dredge.
		2. Pressure control valve is stuck.	2. Wash and check.
5	The oil temperature of the torque converter is high	1. Oil temp sensor is failed.	1. Replace the part.
		2. Oil temperature gauge is failed.	2. Replace the part.
		3. Insufficient oil level.	3. Check oil level following the correct method.
		4. Air found in torque converter oil radiator.	4. Exhaust.
		5. Oil line from torque converter to radiator is poor.	5. Check oil pipe from radiator to gear box and radiator for blockage.
6	The oil temperature of the torque converter is high	1. Poor cooling capability of radiator.	1. Check whether cooling capability is sufficient, such as checking the degree of tightness for engine fan belt and dirt attached to outer surface of radiator.
		2. Back pressure valve of torque converter stuck.	2. Be careful to check hose connector from gear box to radiator. If hose connector enters housing too deeply, pushes spool of pressure valve and cause valve to stick, oil line will be getting blocked.

	Fault features	Main reasons	Fault inspection and troubleshooting
7	Vehicle does not move at any gear	1. Insufficient oil level.	1. Check oil level and add the oil by following the right operation.
		2. Elastic plate connecting engine and torque converter is torn, or power connection from torque converter to gear box input gear has faults.	2. Replace the elastic plate or replace the related damaged parts.
		3. Circuit failure of the complete machine.	3. Check the power voltage for abnormal and the cable for damage.
		4. Shift pressure is too low.	4. Refer to the troubleshooting above.
		5. Solenoid valve is damaged.	5. Check if the rated current of solenoid valve is 830 mA.
		6. Shift lever is damaged.	6. Refer to the troubleshooting for lever. Replace it.
		7. Controller is damaged.	7. Refer to the fault inspection of controller. Replace it

Testing and adjustment

Power Train Test

Detection point layout of torque converter - gear box assembly as is shown in Figure 3-25, and names and parameters of each detection point can be found in Table 3-7.

Figure 3-25 Measuring point layout

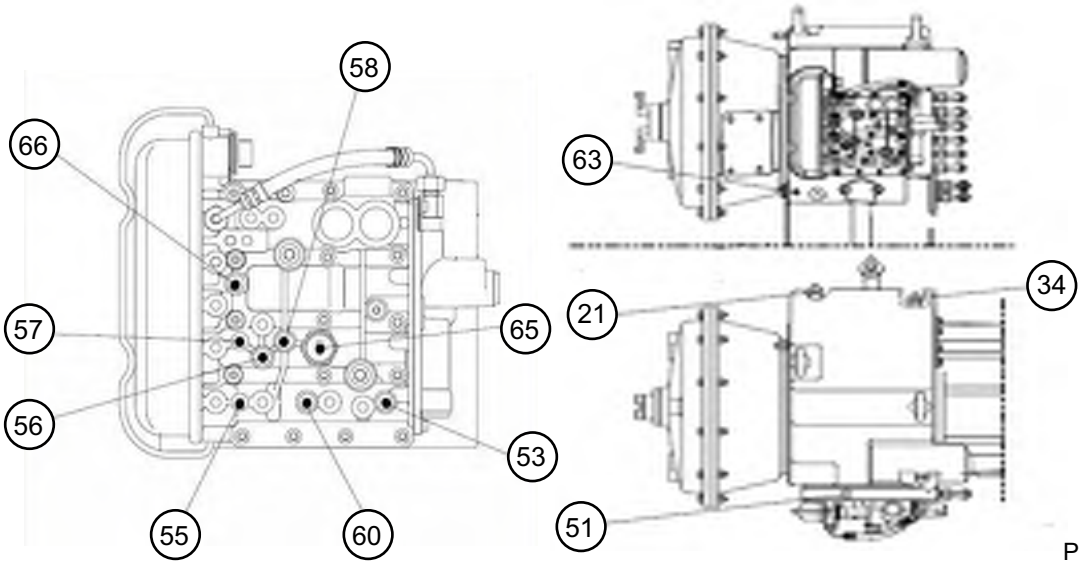


Table 3-7 Parameter list of the measuring point

S/N of the measuring point	Name of the measuring point	Theoretical value	S/N of the measuring point	Name of the measuring point	Theoretical value
21	Input sensor of the gear box	\	55	Reverse gear clutch	1.6-1.8MPa
34	Output sensor of the gear box	\	58	Gear 3 clutch	1.6-1.8MPa
51	Inlet pressure of torque converter	Opening pressure: 0.85	56	Gear 1 Clutch	1.6-1.8MPa
53	Forward gear clutch	1.6-1.8MPa\232-261psi	57	Gear 2 Clutch	1.6-1.8MPa
65	Pressure of shift control system	1.6-1.8MPa\232-261psi	63	Outlet pressure of torque converter	Opening pressure: 0.5
60	Gear 4 Clutch	1.6-1.8MPa\232-261psi			

Logical relations between gear states and working conditions of shift control valve solenoid valve can be found in Table 3-8.

Table 3-8 Logical relations between gear states and working conditions of shift control valve solenoid valve

Solenoid valve	Electric condition of the solenoid valve										
	Forward gear				Reverse gear			Neutral gear			
	1	2	3	4	1	2	3	1	2	3	4
M1					●	●	●				
M2	●				●			●			
M3	●	●	●								
M4	●	●			●	●		●	●		
M5				●							
Clutch	KV	KV	KV	K4	KR	KR	KR	K3			
Clutch	K1	K2	K3	K3	K1	K2	K3				

Remarks: ● means the solenoid valve is energized;

Test Requirements:

Testing dynamic unbalance value

After the drive shaft is repaired, a professional dynamic unbalance test must be performed.

Hydraulic System

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Structure Function Principle 4-18

Work hydraulic system 4-18
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- Plunger pump 4-20
- Boom cylinder 4-22
- Bucket cylinder 4-22
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Basic Information

Safety precautions for hydraulic system

Compressed air

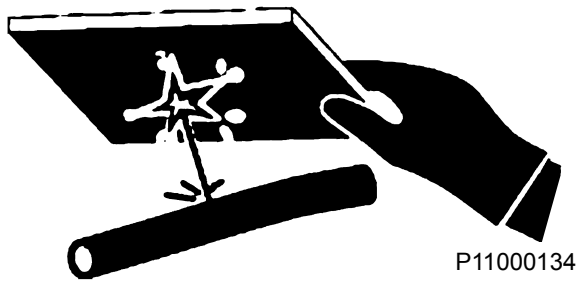
Compressed air may cause personal injury. When using the compressed air for cleaning, wear the mask, protection suits and shoes. Do not point the compressed air at yourself or anyone. The compressed air may penetrate the skin and lead to severe injury or even death. The maximum pressure of the compressed air for cleaning should be lower than 0.2 Mpa(29psi).

High-pressure solution

Prevent from being scalded by high-pressure oil. When overhauling or replacing the pipes of hydraulic system, check whether the pressure of system had been released. Hydraulic oil under pressure will damage your skin severely when it spattered on you.

Take care when remove the hydraulic pipelines or connectors. When the oil spouts, the released high-pressure oil may lead to the continuous movement of the hoses.

Please wear safety glasses and leather gloves when checking for leakages. Do not use bare hands to check the leakage but plate or paper plate.



P11000134



P11000204

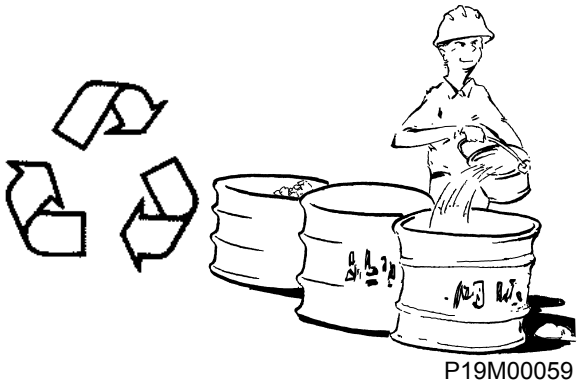
Even if the pressured liquid is leaked from a hole as small as a pin hole, it may penetrate the muscles and lead to death. If shot by the spouted high-pressure oil, please contact a doctor and take a medical treatment immediately.

Safe disposal of waste liquid

Inappropriate disposal of waste liquid will endanger environment and ecology. Please observe local laws and regulations when dispose the waste liquid.

It is mandatory and necessary to collect the liquid with containers spattered during the inspection, maintenance, test, adjustment and repair of machine. Proper container shall be prepared well before opening any fluid cavity or disassembling the parts containing liquid. Use proper container when draining liquid.

Do not use the food or drink containers because they may be drunk by others by mistake.



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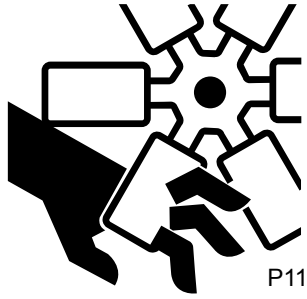
Precautions for accumulator application

The dangerous high-pressure nitrogen is contained in the accumulator, so read the following requirements and properly use the accumulator.

The accumulator shall be checked before charge of nitrogen. It is prohibited to charge the accumulator with gas if the accumulator does not have a nameplate, or the words on the nameplate are missed so that its type can not be identified, or if the steel seal marks are incomplete or cannot be read clearly, or if there is defect with the housing and therefore safe use cannot be ensured.

The accumulator can only be filled with nitrogen other than oxygen, compressed air or other flammable air to avoid explosion.

Slowly charge the nitrogen into the accumulator so as to avoid the breakage of the rubber bag.



P11000190

The air valve of the accumulator shall be installed upward vertically. The accumulator shall be stably fixed on the bracket without being welded.

Do not drill any hole on the accumulator or carry open fire or heat sources close to the accumulator.

Do not conduct any welding operation on the accumulator.

Since the accumulator is a high-pressure container, it shall be replaced and repaired by professional operators.

Release the air before discarding the waste accumulator.

Preventing extruding or cut off

Do not have your hands, arms or any other bodies placed between moving parts. For example, between work implement and cylinder, between machine and working implement.

When working under the work implement, you shall support the equipment properly. Do not support the work implement depending on hydraulic cylinder. If control mechanism moves or hydraulic oil line leaks, work implement will drop. If it is necessary to remove the shield, you shall fix it well after the repair.

Unless otherwise stated, any adjustment is not permitted to be performed when machine or engine is running. If the repair procedure must be performed when machine is running, do not let the machine stay in an unattended status. Arrange one operator seated in the seat and prepare to shut down the engine at any time.

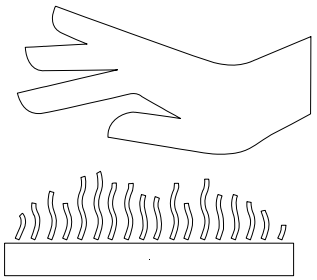
Do not use twisted or worn wire rope. Wear gloves during operation and move.

When forcing to extrude the bayonet, you shall make sure no one is standing around it. You shall wear safety goggles in order to protect your eyes.

When knocking object with hammer, please make sure the flying debris will not hurt others.

Oil

Hot oil and parts will cause personnel injury, and do not let the hot oil and parts contact your skin.



P11000148

At working temperature, the hydraulic oil tank is hot and contains pressure. When opening oil filler cap of hydraulic oil tank, shut off the engine and cool the filler cap down until it can be opened by bare hands. Remove the tank cover slowly to release the pressure of hydraulic oil tank so as to prevent from being scalded by hot oil.

Release pressure of the system before disassembling all pipes, connector, or relevant parts.

Pipeline, pipe and hose

Do not warp or knock the high-pressure pipeline, and do not install the abnormally warped or broken pipe or hose onto the machine.

Repair the loose or damaged pipe and hose of fuel and lubricant pipeline and hydraulic system in time. Leakage will cause fire hazard, and if repair or replacement is necessary, please contact the authorized dealer by LiuGong Machinery Co., Ltd.

If following problems occur, it shall be replaced.

- Damage or leakage of connector.
- The outer layer of hose is worn or cracked, and reinforced steel wires are exposed.
- Partial bulge of hose.
- The hose is twisted or flattened.
- The hose reinforcement steel has embedded to the outer layer.
- Misplacement of the end connectors.

Make sure all clamps, guard and heat shield are installed correctly to prevent shaking or overheating by friction with other parts.

Otherwise, it will generate toxic gases resulting in poisoning.

Precautions for accessories

It shall be installed and commissioned by qualified personnel; the operator shall be trained, and his/her operation and maintenance shall be performed strictly according to the operation instructions for accessories.

When installing and using the spare accessory, please read related instructions, manuals and informations about the accessories.

Incorrect installation or purchase of accessories will not only cause safety issues, but also have the negative effect on service life and operation of the machine.

Do not use the accessories unauthorized by LiuGong. Using unauthorized accessories will cause safety issues, do harm on the normal operation of machine and influence its service life.

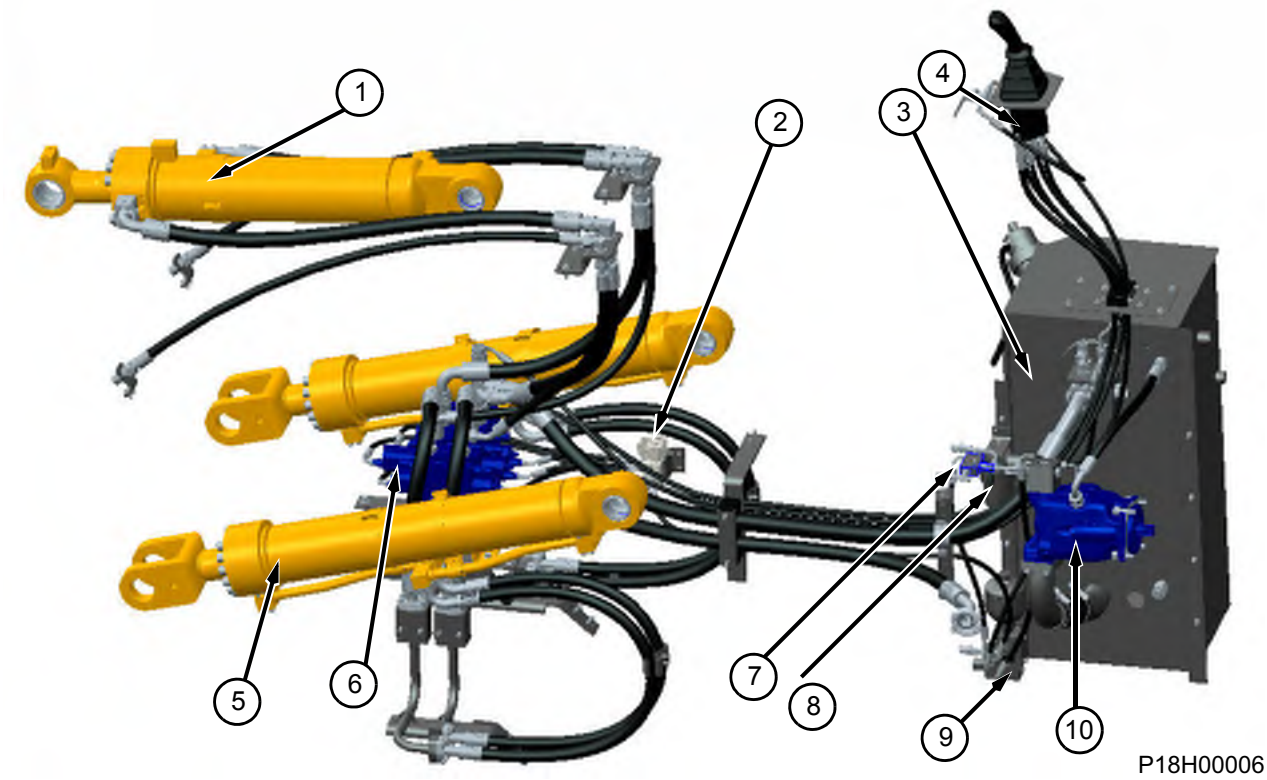
It is forbidden to make any refit on the accessories without permissions; otherwise you shall bear the responsibility.

LiuGong Machinery Co., Ltd will not be responsible for the injury, accident and damage of machine due to using unauthorized accessories.

Overviews of hydraulic system

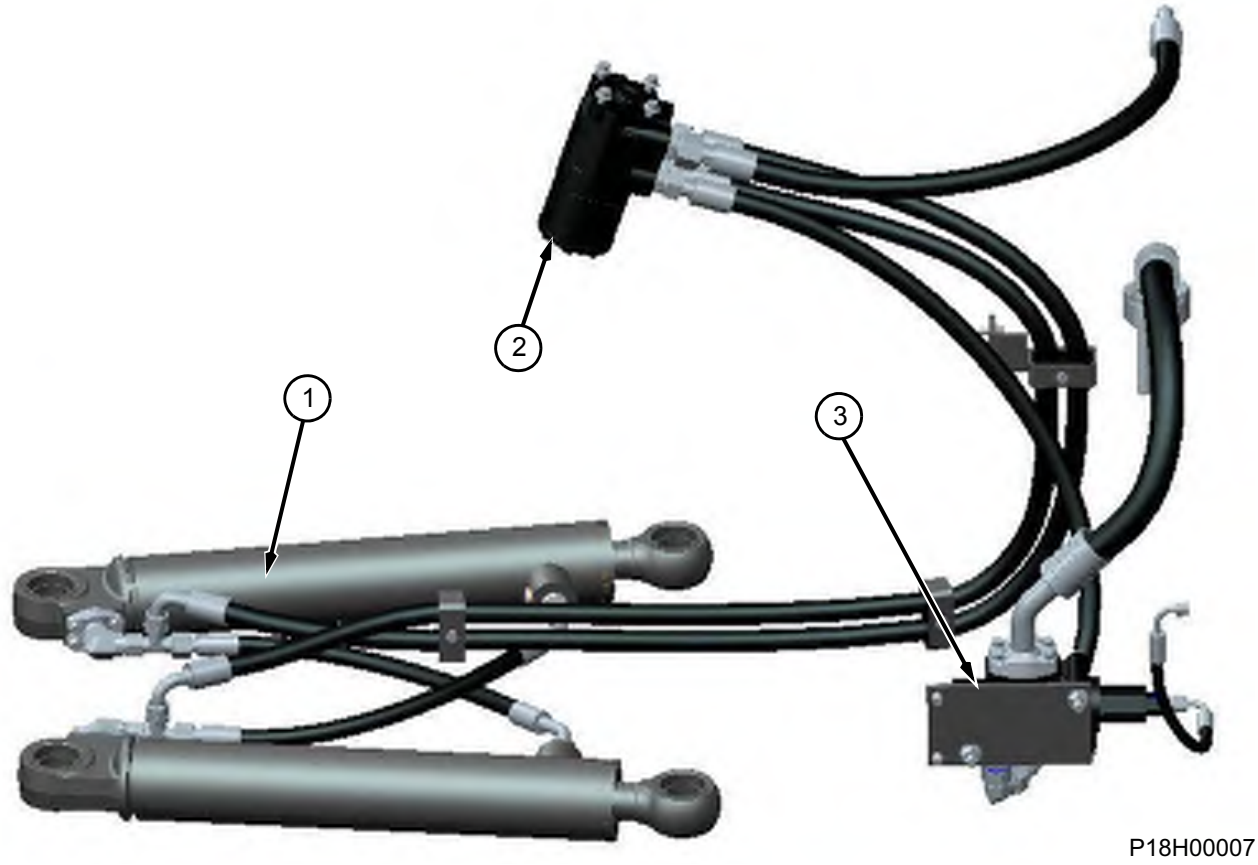
The hydraulic system is the actuator of the loader, mainly composed of four functional modules, i.e. a work implement hydraulic system, a steering hydraulic system, a brake system and a hydraulic cooling system. Where, the steering hydraulic system supplies oil for the steering circuit preferentially through the priority valve to ensure steering function; the work hydraulic system controls the coordinated actions of all oil cylinders through the control valve so that the loader can adapt to the requirements of different working conditions; the brake system can realize the function of service brake and parking brake; the hydraulic cooling system cools the hydraulic oil to ensure oil temperature within the reasonable scope of work. Layout of CLG835H-T4F hydraulic system is as follows:

CLG835H-T4f Work hydraulic system



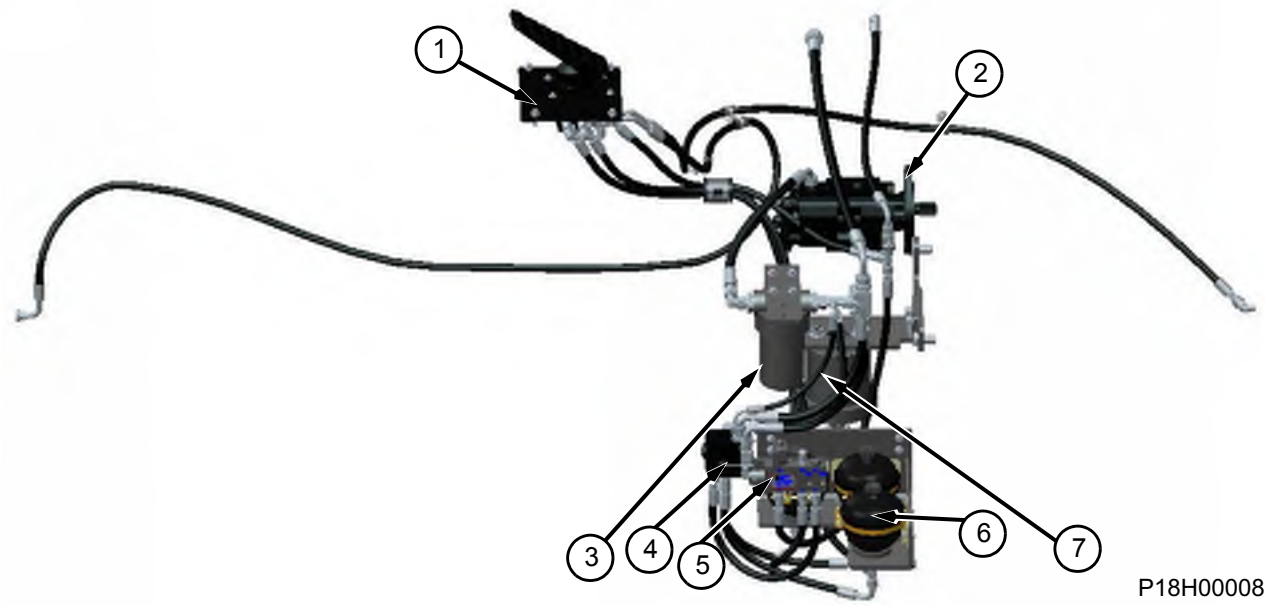
1. Bucket cylinder
2. Proportional pressure-reducing valve
3. Hydraulic oil tank
4. Pilot valve
5. Boom cylinder
6. Control valve
7. Shuttle valve
8. Pilot oil filter
9. Pilot oil supply valve
10. Plunger pump

CLG835H-T4f Steering hydraulic system



1. Steering cylinder
2. Metering pump
3. Priority valve

CLG835H-T4f brake system



1. Brake valve
2. Gear pump
3. High-pressure oil filter
4. Charge valve
5. Brake valve assembly
6. Accumulator assembly
7. Brake cylinder

Technical parameters of hydraulic system

Main technical parameters of CLG835H-T4F hydraulic system

	Items	Unit	Theoretical value
Work hydraulic system	Type		Single-pump variable hydraulic system
	Working pressure of the system	Mpa\psi	19\2755
	Pilot working pressure	Mpa\psi	3.5\507.5
	Displacement of working pump	ml/r\cc/r	100\100
	Rated speed of the working pump	r/min	2200
	Boom cylinder (cylinder number -- cylinder bore × stroke)	mm\in	2-φ125×728\2-φ4.92×28.66
	Bucket cylinder (cylinder number - cylinder bore × stroke)	mm\in	1-φ140×520\1-φ5.51×20.47
Steering hydraulic system	Type		Articulation frame and full hydraulic steering system
	Working pressure of the system	Mpa\psi	17.5
	Displacement of steering pump	ml/r\cc/r	100\100
	Rated speed of the steering pump	r/min	2200
	Metering pump	ml/r\cc/r	739/739
	Amplification ratio of metering pump		1.6
	Steering angle	°	38°±1°for both left and right sides
	Steering cylinder (cylinder number -- cylinder bore × stroke)	mm\in	2-φ80×420\2-φ3.15×16.54
Service brake system	Type		Dual-circuit full-hydraulic wet brake
	System oil pressure	Mpa\psi	6±0.4\870±58
Parking & emergency brake system	Type		Push-button hydraulic brake
	System oil pressure	Mpa\psi	16\2320
Working medium	Hydraulic oil	L\US gal	105\27.7
	Cleanliness	NAS1638	≤Grade 9

Hydraulic System Principle Schematic

Refer to attached drawing in Chapter 9 for schematic of hydraulic system

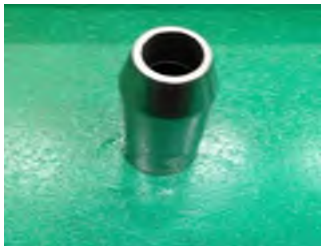
Universal tools and tooling for hydraulic maintenance

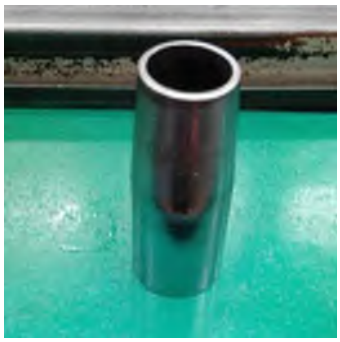
Common tools table

Name	Specifications (Qty.)
Open-end wrench	8#, 13#, 15#, 17#, 19#, 21#, 22#, 24#, 27#, 30#, 32#, 36#, 41#, 44#, 46#
Straight screwdriver	
Cross screwdriver	
Pliers	
Torque wrench	20~100N•m\ 14.75~73.75lbf•bt, 90~300N•m\ 66.38~221.25lbf•bt, 160~680N•m\ 118~501.5lbf•bt
Inner hexagon spanner	One set in metric standard and one set in British standard
Lifting equipment	2t
Sling	2t
Caution: the removed standard parts should be placed with relevant material together to avoid being mixed.	

Special tools and tooling for hydraulic maintenance

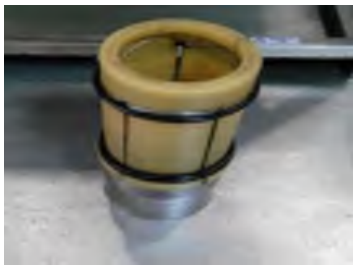
List of special tools and tooling for boom and bucket cylinder

S/N	LiuGong No.	Tool description	Figures	Purpose	Quantity for full-time service dealers
1	SP130702	Pry bar		For assembling the O-ring of piston	1
2	SP129313	Rubber hammer		For assembling dust ring of cylinder head	1
3	SP130917	Tooling for compressing dust ring		For compressing dust ring of cylinder head	1
4	SP130915	Guide sleeve		For assembling the O-ring of piston rod	1

S/N	LiuGong No.	Tool description	Figures	Purpose	Quantity for full-time service dealers
5	SP130700	Guide sleeve		For assembling cylinder head assembly onto piston rod	1
6	SP129308	Positioning tool		For aligning flange bolt hole with cylinder head through hole	1
7	SP130698	Dowel pin		For aligning flange bolt hole with cylinder head through hole	1
8	SP133205	Blower gun		For pre-tightening bolt	1
9	SP129309	Socket		For tightening bolt	1

S/N	LiuGong No.	Tool description	Figures	Purpose	Quantity for full-time service dealers
10	SP130929	Steel wire scissors		For snap ring of cylinder head	

List of special tools and tooling for steering cylinder:

S/N	LiuGong No.	Tool description	Figures	Purpose	Quantity for full-time service dealers
1	SP130702	Tooling for press fitting of friction ring		For pressing and fitting the friction ring onto piston	1
2	SP129313	Tooling for compressing friction ring		For compressing the friction ring	1
3	SP130917	Guide sleeve		For assembling cylinder head assembly onto piston rod	1
4	SP130915	Guide sleeve		For assembling the O-ring of piston rod	1

S/N	LiuGong No.	Tool description	Figures	Purpose	Quantity for full-time service dealers
5	SP130700	Tooling for press fitting of bushing		For assembling the bushing onto cylinder block	1
6	SP129308	Cylinder block support		For supporting the cylinder block and pressing the bushing to the cylinder block	1
7	SP130698	Bushing detection		For detecting the size of bushing which is assembled onto the cylinder block	1
8	SP133205	Blower gun		For tightening the nylon locknut	1
9	SP129309	Copper bar		For pressing the piston rod into the cylinder block	

S/N	LiuGong No.	Tool description	Figures	Purpose	Quantity for full-time service dealers
10	SP130929	Hook spanner		For pre-tightening the cylinder head assembly	
11	SP129306	Socket		For locking the cylinder head assembly	

Structure Function Principle

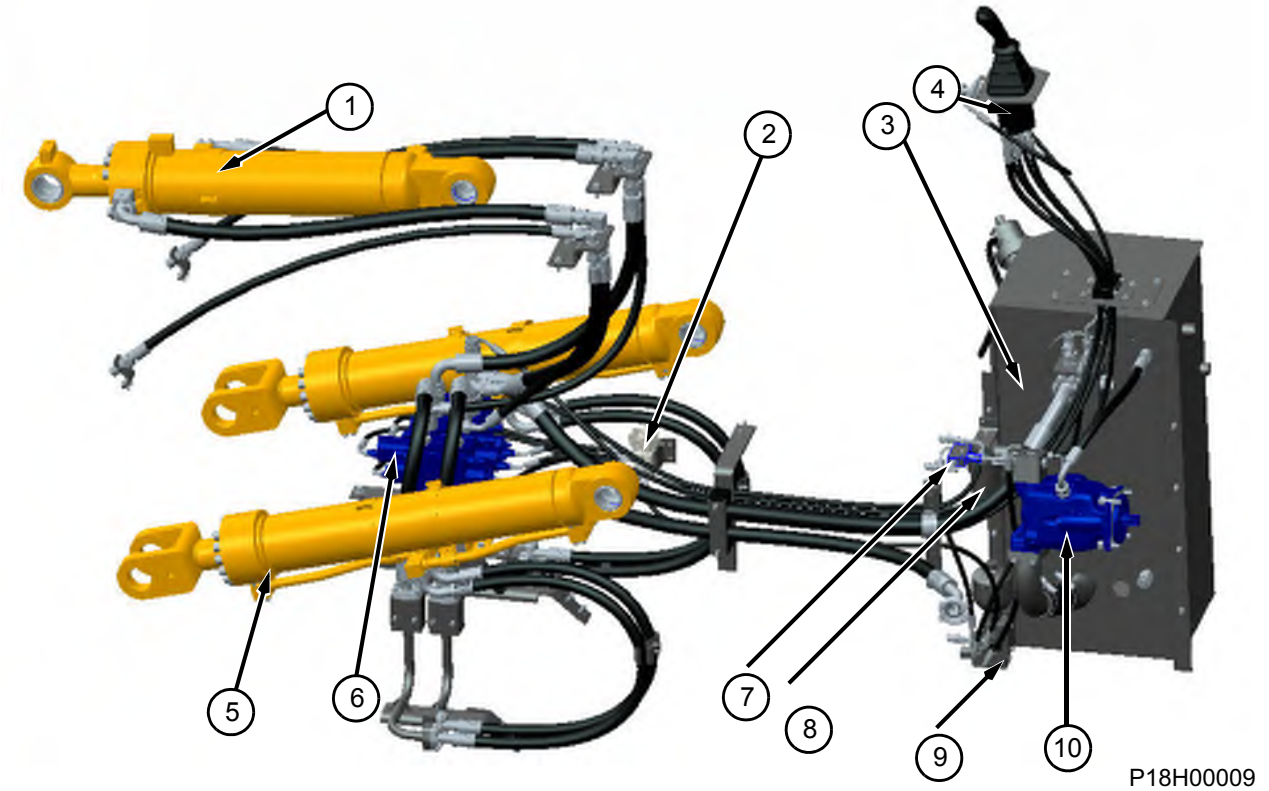
Work hydraulic system

A: Overview-components and position

The work hydraulic system is used to control the actions of the boom and bucket of the loader work implement and other additional work implement. It is a single-pump load sensing system (see schematic diagram of work hydraulic system). It is composed of one hydraulic oil tank, one variable plunger pump, one load sensing control valve and oil cylinders and pipelines of all work implements. The hydraulic oil from the tank flows into the plunger pump, after passing through the priority valve, it flows into the control valve by which controls telescoping of all cylinders so as to further control the loader work implement's actions of tilting back and dumping of the bucket and raise, lowering and floating lowering of the boom.

Layout drawing of CLG835H_T4f work hydraulic system is as follows: refer to attached drawing in Chapter 9 for schematic of hydraulic system

Layout drawing of work hydraulic system



1. Bucket cylinder
2. Proportional pressure-reducing valve
3. Hydraulic oil tank
4. Pilot valve
5. Boom cylinder
6. Control valve
7. Shuttle valve
8. Pilot oil filter
9. Pilot oil supply valve
10. Plunger pump

1. When there is no action in the work hydraulic system, i.e. boom reversing valve and bucket reversing valve in the control valve are in neutral position, and variable plunger pump is at minimum displacement position, the variable pump hardly has oil to output (only the minimum displacement required to keep self-running), oil passages of the control valve connected to both of big and small cavities of the boom cylinder and bucket cylinder are sealed, and boom and bucket are kept in original position.
2. Operate the boom reversing valve controlled by the pilot valve to lift, lower or float the boom and manipulate the bucket tilting reversing valve controlled by the pilot valve to tilt the bucket forward or backward. There is an automatic leveling device of bucket installed on bucket hydraulic cylinder.
3. Big and small cavities double-acting safety valves are installed in oil lines of the control valve connected with big and small cavities of the bucket cylinder to protect the big and small cavities of the bucket cylinder from overload and fill oil and play the role of stabilizing system work and protecting the relevant elements of the system.

B: Technical parameters of work system

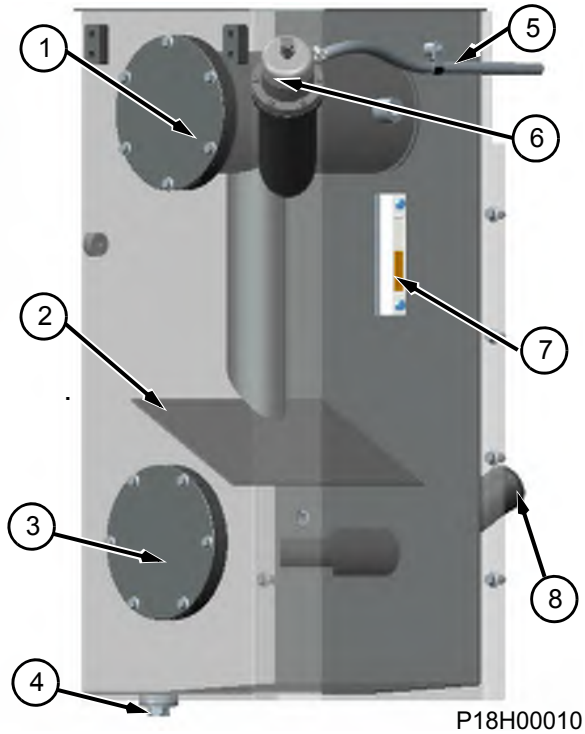
Items	Parameters
System pressure	19±0.3Mpa\2755±43.5psi
System flow	210L/min@2200r/min
Pressure of overload valve at A1 port	23±0.3MPa\3335±43.5psi
Pressure of overload valve at B1 port	23±0.3MPa\3335±43.5psi
Pressure of overload valve at A2 port	23±0.3MPa\3335±43.5psi
Pressure of overload valve at B2 port	23±0.3MPa\3335±43.5psi
Pressure of overload valve at A3 port	23±0.3MPa\3335±43.5psi
Pressure of overload valve at B3 port	23±0.3MPa\3335±43.5psi
Pressure of main safety valve	21±0.3MPa\3045±43.5psi

Hydraulic oil tank

Installation position and functional structure

The hydraulic oil tank is side-sited type, which is located on the rear frame in the middle of a machine, the right side of a cab. The main function is to store the hydraulic oil required for work cycle of the hydraulic system and precipitate the pollutant of oil in hydraulic tank, separate the air from oil and cool the hydraulic oil. A return oil filter has been set in the oil tank to filter the pollutant in oil lines of the hydraulic system so as to guarantee the cleanliness of hydraulic oil. Structural diagram of hydraulic oil tank is as follows:

Structural diagram of hydraulic oil tank



1. Oil return chamber and oil return filter
2. Baffle
3. Washing port
4. Oil drain hole
5. Ventilated oil conduit
6. Oil filler, oil filter element and breather
7. Sight glass
8. Oil suction port

In which, the oil return chamber is used to temporarily store the hydraulic oil that returns from the system to effectively reduce the back-flow velocity so as to avoid bubbles in the hydraulic oil tank resulted from too fast oil return. The oil return filter mainly filters the oil returning to the hydraulic oil tank to prevent pollutant from entering into the system through the oil tank to cause pollution. The baffle is used to form isolation circulation for cold and hot oil in the oil tank to prevent oil shake from generating large quantities of bubbles and isolate oil suction port from oil return port to ensure gas separates out of hydraulic oil return. Washing port is used to clean the dirt in the oil tank. Oil drain hole is used to drain fluid out of oil tank when replace oil or clean oil tank. Oil suction port is used to supply oil for hydraulic pump. The ventilated oil conduit is used for exhalation of a breather and to lead the oil vapor exhaled by the breather to underbody. Hydraulic oil is filled from the oil filler after filtration by the oil filter vehicle. Oil filler filter element is used to prevent large particles from entering into oil tank when replacing and filling hydraulic oil. The function of the breather is that it sucks air from atmosphere to fill the air space when the air pressure in oil tank is negative and that exhaust extra air to realize the protection function when the air pressure in oil tank is out of limit. Oil level gauge is used to observe the oil level of oil tank. Oil suction port is used to supply oil for hydraulic pump.

Plunger pump

Main technical parameters

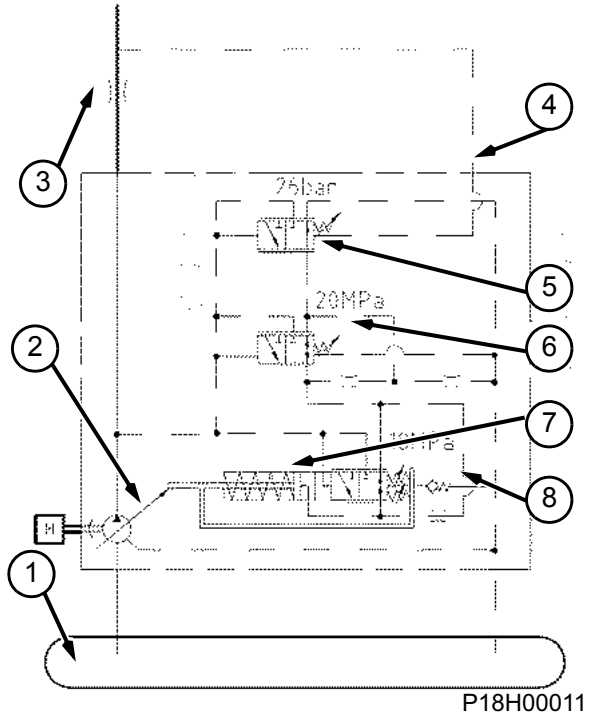
Items	Parameters	Remarks
Rated pressure	19Mpa\ 2755psi	
Displacement	100ml/r\ 100cc/r	
Direction of rotation	Left rotation	
Rated speed	2200rpm	
Pressure of the shut-off valve	20Mpa\ 2900psi	
Pressure of flow compensator valve	2.6Mpa\ 377psi	
Operating fluid	Anti-wear hydraulic oil	46#

Structure and working principle of plunger pump

Same pump is used for the plunger pump of work hydraulic system and that of steering hydraulic system, that is, work hydraulic system and steering hydraulic system share one pump. The plunger pump is located under cab and installed on the right power take-off of the transmission and tightened it by stud and nut. It is driven by engine via torque converter and transmission to supply oil for work and steering hydraulic system.

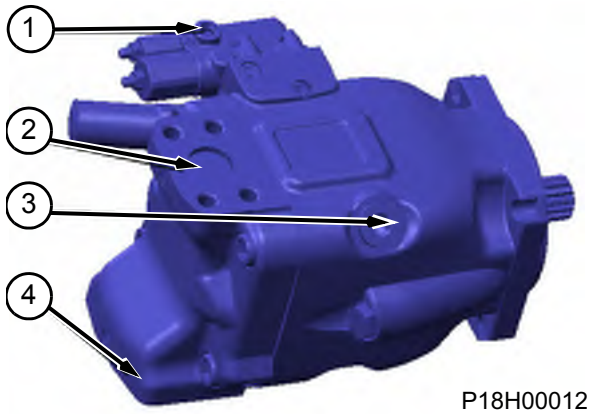
Outline diagram and working principle of plunger pump:

Schematic of working pump



1. Hydraulic oil tank
2. Swashplate
3. Control valve (simplified)
4. Load sensing port
5. Flow compensation valve
6. Pressure shut-off valve
7. Variable cylinder
8. Power control valve

Exterior drawing of working pump



1. Load sensing port
2. Oil outlet
3. Housing return oil
4. Oil suction port

1. Before starting, the pressure of pump opening P=0, the pressure of load sensing port 4 P_{LS}=0, the pressure difference between both ends of control valve 3 ΔP= P- P_{LS} =0 and the swashplate is in the maximum displacement position.
2. After starting, when the control valve 3 has no opening, P_{LS}=0, the pressure P of pump opening acts on left end of flow compensator valve 5, the flow compensator valve 5 moves rightwards, oil enters big cavity of variable cylinder 7, the swashplate turns anticlockwise and the displacement of pump is reduced to the minimum. The pressure P of the pump opening is generally set to 2.6Mpa\ 377psi at this time, i.e. the setting pressure of the flow compensator valve 5, in order to improve the response speed of the system and compensate a small amount of leak.
3. When the control valve 3 has an opening to some extent, P_{LS} occurs, ΔP starts to decrease from the maximum value, the flow compensator valve 5 moves leftwards under the action of its spring force P_K. The big cavity of differential variable cylinder 7 returns oil gradually, the swashplate turns clockwise and the displacement of pump starts to increase.
4. When the opening of the control valve 3 increases further, throttling effect fades, ΔP decreases, flow compensator valve 5 moves leftwards under the action of its spring force P_K, the big cavity of differential variable cylinder 7 returns oil gradually, the swashplate turns clockwise and the displacement of pump starts to increase. ΔP is also increased with the increase of displacement (flow), when flow of the system is stable, ΔP= P_K = fixed value, otherwise, balance of the flow compensator valve 5 will be disturbed.
5. When the opening of the control valve 3 decreases, throttling effect becomes enhanced, ΔP increases, the flow compensator valve 5 moves rightwards under the action of ΔP, oil enters big cavity of variable cylinder 7, the swashplate turns anticlockwise and the displacement of pump is reduced to the minimum. When the system is stable, ΔP= P_K = fixed value.
6. When the load pressure increases up to the setting pressure value of the system, the pressure shut-off valve 6 opens the pump pressure oil way to the big cavity of variable cylinder 7 so as to reduce the displacement of the pump rapidly. As shown, the action of the pressure shut-off valve has the priority to the flow compensator valve 5, that is, it works as long as the pressure reaches the setting value.
7. From above, we can learn that the flow compensator valve is in balanced state when the flow of the system is stable: ΔP= P_K = fixed value (without change). Therefore, the displacement of the pump is only related with the opening of main control valve other than the load (i.e. pressure). This is the pump load sensing control.
8. When pressure of pump opening reaches setting value, power control valve 8 moves rightwards, pressure oil at pump opening enters into big cavity of variable cylinder 7 via power control valve 8, swashplate turns anticlockwise and the displacement of pump starts to decrease.

Boom cylinder

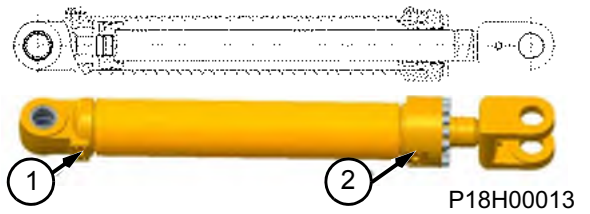
Main technical parameters

Items	Parameters	Remarks
Cylinder bore (mm\in)	125\4.92	
Rod diameter (mm\in)	80\3.15	
Stroke (mm\in)	728\28.66	
Minimum mounting distance (mm\in)	1287\50.67	

Structure and working principle of boom cylinder

The boom cylinder, which is installed at the articulated joint of boom cylinder on the front frame and the articulated joint of boom cylinder, is the actuator of the work hydraulic system. It realizes the raise and lowering of the bucket through pushing the boom to move up and down by piston rod telescoping actions of the boom oil cylinder.

Structure of boom cylinder



1. Oil port of big cavity
2. Oil port of small cavity

Bucket cylinder

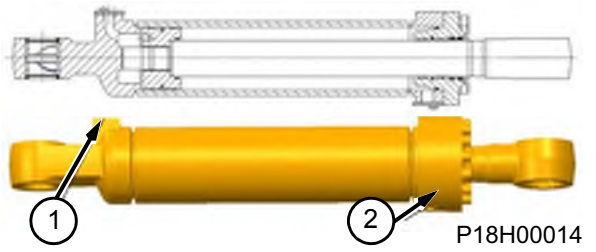
Main technical parameters

Items	Parameters	Remarks
Cylinder bore (mm\in)	140\5.51	
Rod diameter (mm\in)	80\3.15	
Stroke (mm\in)	520\20.47	
Minimum mounting distance (mm\in)	1110\43.70	

Structure and working principle of bucket cylinder

The bucket cylinder, which is installed at the articulated joint of the front frame and bucket cylinder and the articulated joint of bucket lever and cylinder, is the actuator of the work hydraulic system. It realizes the tilting forward and backward of the bucket through the movement of bucket lever pushed by piston rod actions of the bucket cylinder.

Structure of bucket cylinder



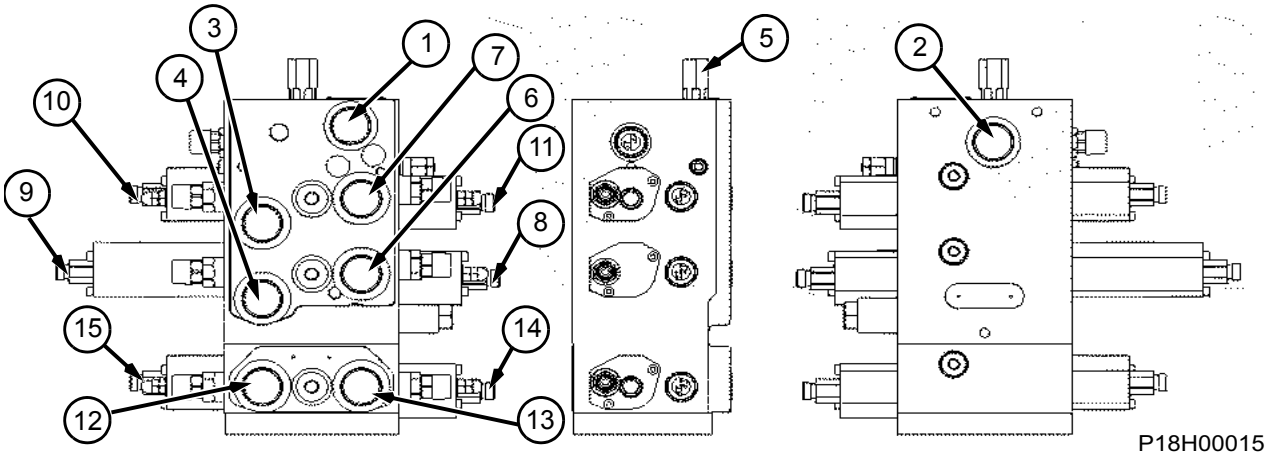
1. Oil port of big cavity
2. Oil port of small cavity

Control valve

Main technical parameters

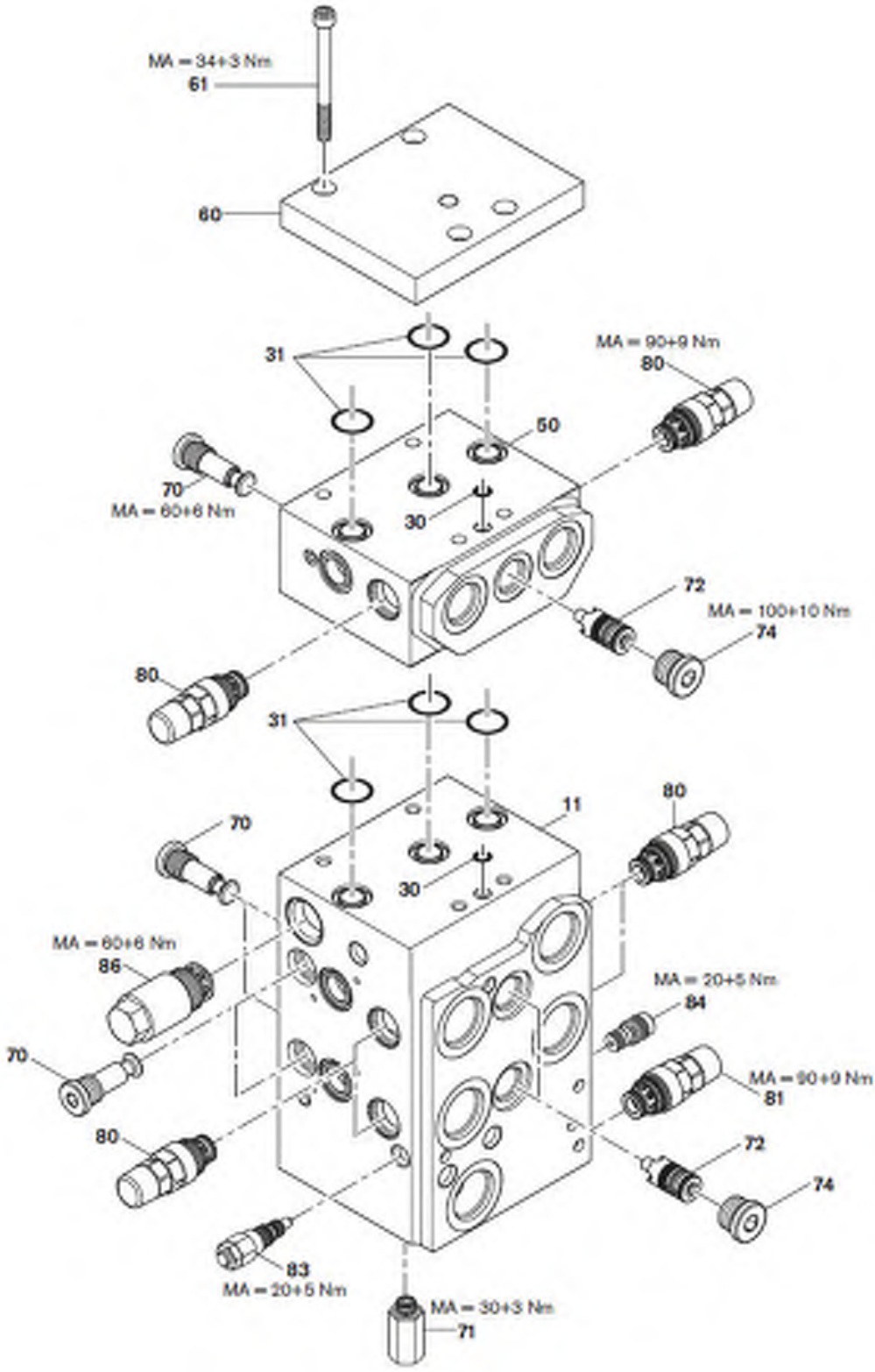
Items	Parameters	Service conditions	Remarks
Rated flow (L/min\ US gpm)	180\ 47.56	/	/
Pressure loss under rated flow △P (Mpa\psi)	2.5\ 362.5		
Setting pressure of main safety valve (MPa\psi)	21\ 3045	/	/
Pressure of safety valve of bucket cylinder small cavity (Mpa\ psi)	23\ 3335	/	/
Pressure of safety valve of bucket cylinder big cavity (Mpa\ psi)	23\ 3335	/	/
Operating fluid	Anti-wear hydraulic oil	HM46/HV46	/

Structure and working principle of control valve



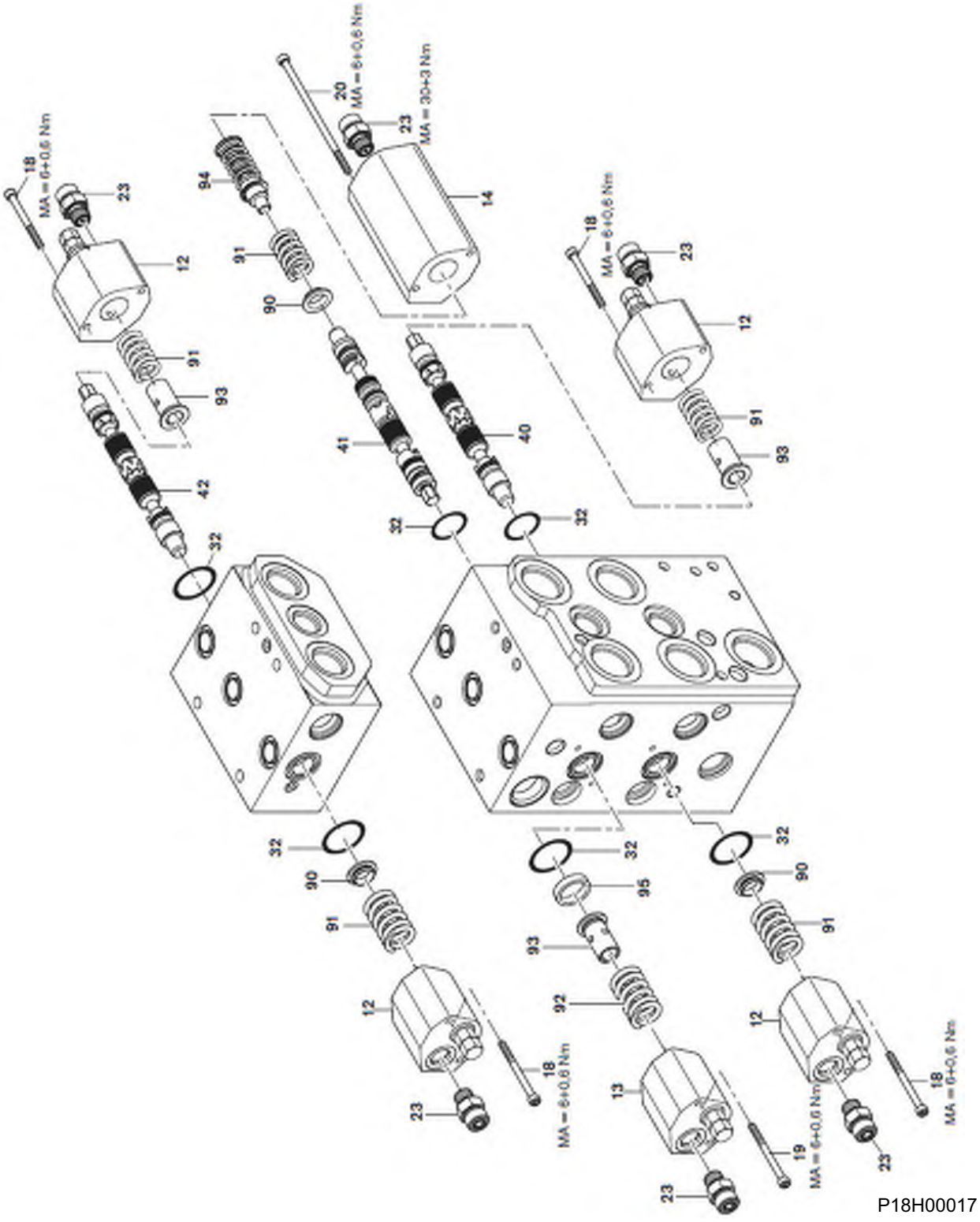
1. Control valve oil return port
2. Control valve oil inlet
3. Oil outlet of bucket big cavity
4. Oil outlet of boom big cavity
5. Control valve LS port
6. Oil outlet of boom small cavity
7. Oil outlet of bucket small cavity
8. Boom lowering pilot port
9. Boom lifting pilot port
10. Bucket tilting and retracting pilot port
11. Bucket tilting and tipping pilot port
12. Oil outlet of multi-functional way big cavity
13. Oil outlet of multi-functional way small cavity
14. Oil outlet of multi-functional way small cavity
15. Oil outlet of multi-functional way big cavity

Exploded view of control valve

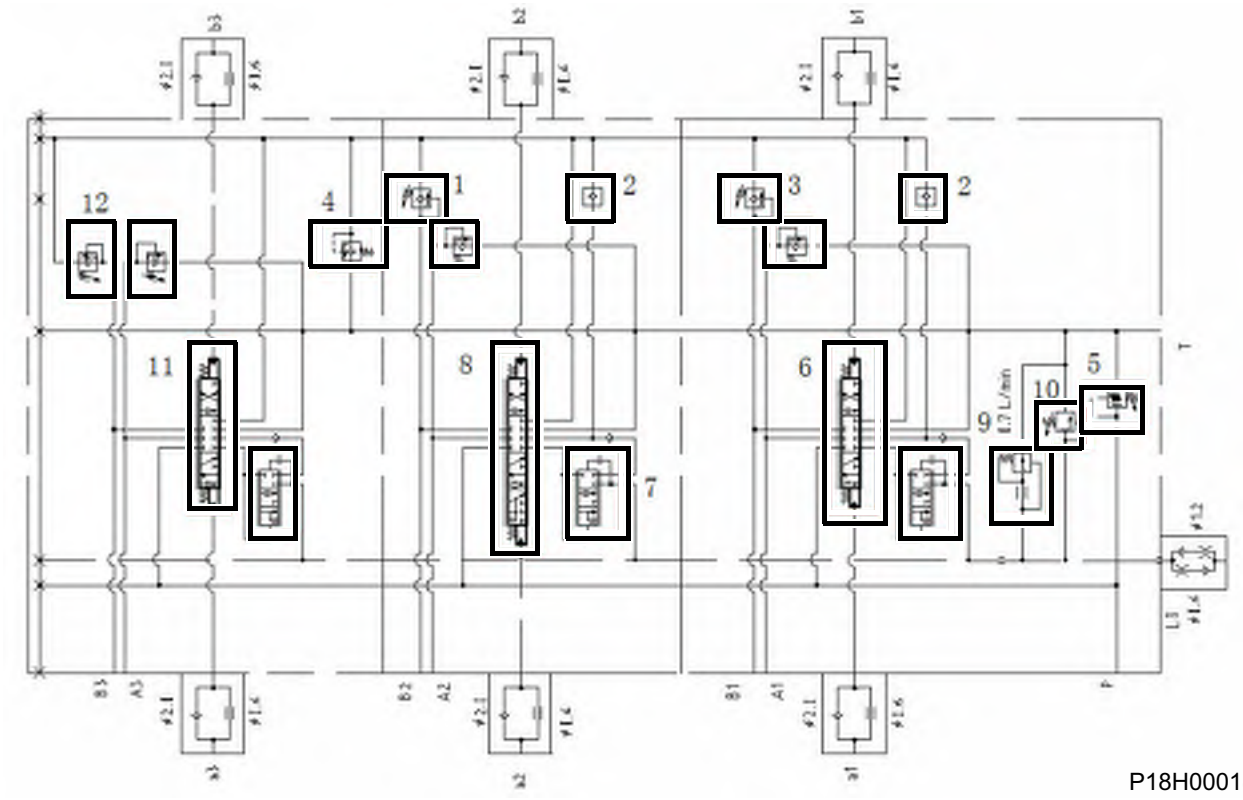


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Exploded view of control valve



Hydraulic schematic of control valve



1. Boom overload valve
2. Oil supplement valve
3. Bucket overload valve
4. Backpressure valve
5. Main safety valve
6. Bucket way
7. Pressure compensation valve
8. Boom
9. LS flow controller
10. LS Relief valve
11. Multi-functional way
12. Multi-functional union overload valve

Installation position and working principle

The control valve is installed on the mounting board in front frame. The function of the control valve is to control moving direction and speed of the bucket cylinder and the boom cylinder by changing the flowing direction of oil so as to satisfy loader's working requirements under different work conditions.

Configuration: whole tandem closed neutral position slide valve;

Oil lines type: cascade and paralleling bucket tilting priority ;

Main components: bucket reversing valve, boom reversing valve, safety valve, pressure compensation valve, LS relief valve, LS flow controller, etc.

The bucket reversing valve is a three-stack valve, which can control three actions of the bucket, i.e. to tilting forward, backward and keeping.

The boom reversing valve is a four-stack valve, which can control four actions of the boom, i.e. raising, keeping, lowering and floating lowering.

The safety valve controls the pressure of system. When the pressure of system exceeds the setting value, oil will overflow to the oil tank to protect system from being damaged.

Pressure compensation valve, operated in multiple circuit, can guarantee that the flow of main valve can not be changed by different loads so that the system has the performance of composite operation.

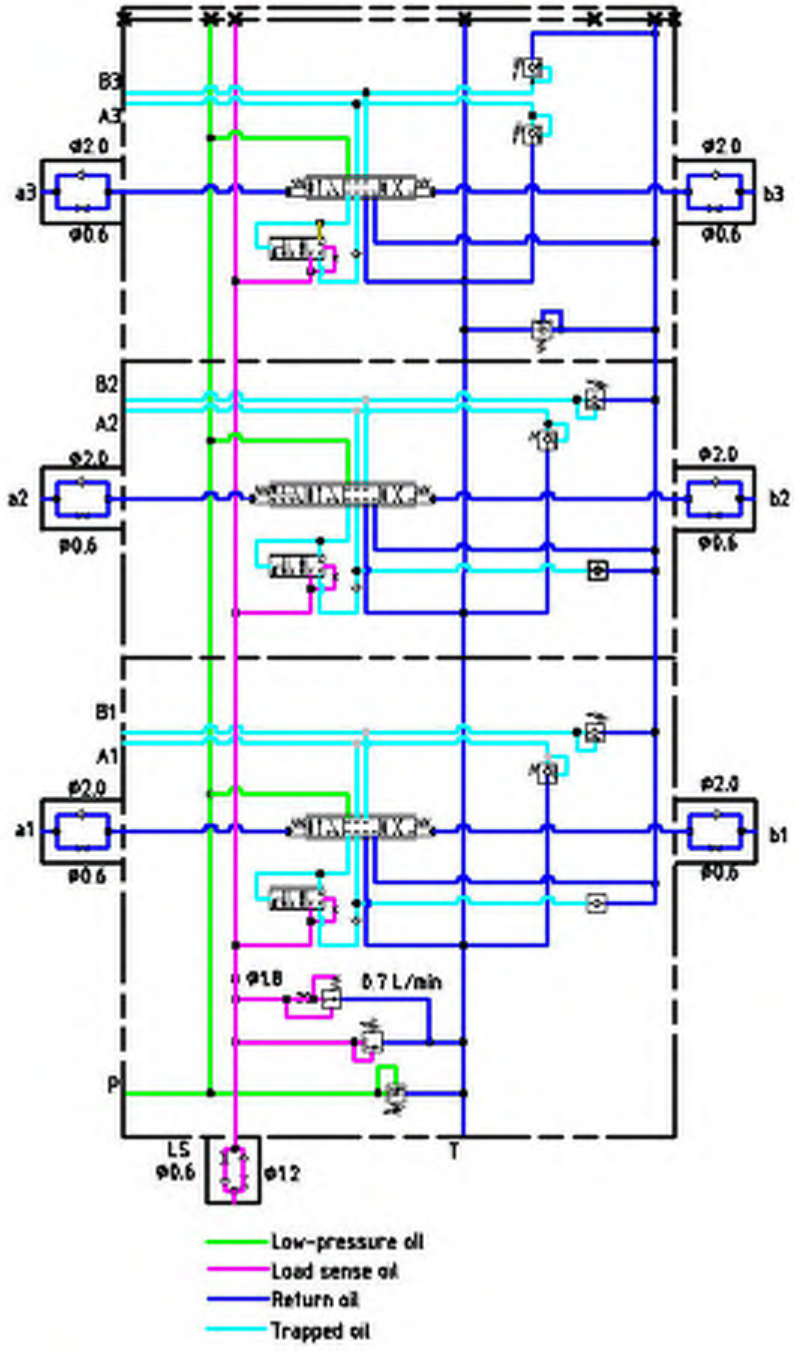
LS relief valve controls the pressure of LS oil line. When the LS pressure exceeds the setting value, oil will overflow to the oil tank. The pressure of work system is the sum of setting pressure of LS relief valve and the pump flow control valve in work hydraulic system.

LS flow controller can guarantee that the LS oil line has continuous flow and improve the response speed of LS oil line.

Back pressure valve increases the oil return pressure at the time of bucket dumping and boom descending and improves the stability of bucket dumping and boom descending.

1. Neutral position of control valve

When the control valve is in neutral position, bucket valve rod 6 and boom union valve rod 8 are in neutral position. As for the closed neutral position structure, LS pressure is zero, the variable pump under the action of pump outlet pressure is in minimum displacement and the pump is in low-pressure standby state.



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As for the closed neutral position structure of valve rod, oil line between big & small cavities of cylinder and valve rod is kept closed, the pressure of control valve oil inlet, which is the same as that of pump outlet, is in low-pressure state.