

ZOOMLION

ZS1623RT

Service and Maintenance Manual

August 2020 Version A

Foreword

The Service and Maintenance Manual applies to the self-propelled rough-terrain scissor lifts.

This manual describes proper inspection, servicing and maintenance. Users must fully understand and apply the contents described in this manual to maximize the performance and ensure the long-term safe and efficient use.

The manual includes the structure and schematic diagram of the main components. If it is necessary to repair and replace the components, the material code of the required replacement parts can be found in Parts Manual.

This manual should be considered a permanent part of your machine and should remain the machine at all times.

⚠ CAUTION

Do not repair the parts marked with professional maintenance. Zoomlion AWP Machinery Company does not take the consequence for wrong maintenance.

⚠ WARNING

The highest criterion users must keep in mind is: Safety first! Pay special attention to the safety control device for regular inspection. Do not operate the machine when the safety device fails or working abnormally. Do not modify the structure or add additional parts for more functions. Otherwise, you will be responsible for any personal injury or damage caused by the unauthorized modification.

The warranty period for the aerial work platform is as specified in this Service and Maintenance Manual. When maintenance is required, our company provides on-site service or please go to our designated maintenance point for maintenance.

Our company reserves the right to continually revise the contents of this manual with technical improvements. Any changes are subject to change without notice. Some of the pictures in this manual may not match the actual product due to design improvement, etc., but it does not affect your use. The product status is subject to the actual product.

Foreword

Symbols and their description:

⚠ DANGER

Danger indicates an imminently dangerous situation. If not avoided, will result in death or serious injury.

⚠ WARNING

Warning indicates a potential hazardous situation. If not avoided, will result in death or serious injury.

⚠ CAUTION

Caution indicates a potential hazardous situation. If not avoided, will result in minor or moderate injury.

NOTICE

Caution indicates a situation that could cause damage to the equipment, personal property, and / or the environment, or cause the equipment to operate improperly. Failure to comply strictly may result in damage to property and machine parts, or reduced mechanical performance.

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Section 1 Maintenance Safety Instruction



SECTION 1 MAINTENANCE SAFETY INSTRUCTION

Your proper maintenance is an important prerequisite for the use of the aerial work platform. Read and understand this manual before attempting to any maintenance procedure. Conduct daily and regular maintenance in accordance with the contents and requirements of this manual. Zoomlion's marketing network throughout the world will provide you with professional consulting, maintenance and repair services. This section introduces the scope of responsibility for maintenance.

1.1 Maintenance Cycle Instruction

Daily maintenance is conducted everyday or every week, and maintenance with a period of more than one week is called regular maintenance. Maintenance work must be cycled on a regular basis and strictly follow the technical requirements and techniques in this manual.

1.2 User Responsibility

Please conduct daily and regular maintenance in accordance with the contents and requirements of this manual for good performance and personal safety. The responsibilities you must perform include but are not limited to:

- a) Operate and use the machine in accordance with the Maintenance Manual.
- b) Conduct daily and regular maintenance in accordance with the contents and requirements of this manual, professional technical maintenance must be performed at an authorized Zoomlion dealer service center.
- c) Use formal Zoomlion accessories.
- d) When the aerial work platform fails, the information should be promptly and accurately fed back to the designated service center.
- e) Please provide workplace, equipment and tools for on-site service.
- f) When your equipment is transferred, you must promptly inform the service centers that are transferred to and from the place of departure.

1.3 Service Center Obligation

Service centers are dedicated to providing you with a full range of after-sales services, including:

- a) Professional product technical support.
- b) Provide formal Zoomlion accessories.
- c) Warranty service under warranty agreement.
- d) Perform major abnormal faults and incident handling.
- e) Provide equipment maintenance services.

1.4 Disclaimer

Zoomlion does not assume any responsibility for direct or indirect losses caused by the following actions:

- a) Wrong operations or applications.
- b) Unauthorized modification and parameter adjustment of the machine.
- c) Do not use Zoomlion's original accessories and dedicated oils.
- d) Maintenance is not performed in accordance with the contents and requirements of this manual.

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Section 2 Specifications



SECTION 2 SPECIFICATIONS

2.1 Operating Performance

The operating specifications of the whole machine are shown in Table 2-1.

Table 2-1 Performance

Rated load	680kg	1500lbs
Max travel speed (slope)	40%	
Max travel speed (side slope)	40%	
Max platform height	16m	52ft 6in
Travel height-lifted	9m	29ft 6in
Turning radius (inside)	2.75m	9ft
Max hydraulic system pressure	25Mpa	250bar
Max wind speed	12.5m/s	28 mph
Max manual force	400N	90 lbs force
Voltage of electrical system	12V DC	
Gross weight	8650kg	19070lb

2.2 Size and Performance

The size and performance of this unit are shown in Table 2-2.

Table 2-2 Size and Performance

Platform size (length×width)	3.98m×1.83m	13ft 1in×6 ft
Extension deck	Front/rear 1.30m	Front/rear 4ft 3in
Overall height (fold×unfold)	3.15m/2.47m	10ft 4in×8ft 1in
Overall length with outrigger	4.88m	16ft
Overall width	2.29m	7ft 6in
Ground clearance	0.36m(center)/0.26m	1ft 2in(center)/10in
Wheelbase	2.86m	9ft 4in
Drive speed (stowed)	6.5km/h	4mph
Drive speed (raised)	0.5km/h	0.3mph
Max working slope	2°/3°	
Up/down time	60s/65s	
Max tire capacity	2420kg	5335lbs

2.3 Capacity

Table 2-3 Capacity

Fuel tank	103L	27.2 us gal
Hydraulic reservoir	105L	27.7 us gal
Engine oil capacity	10L	2.6 us gal

2.4 Components Data

2.4.1 Engine

Table 2-4 V2403-M-DI-E3B-ZML-2(Kubota) Engine parameter

Type	HPCR	
Fuel	No.0 National IV	
Engine oil capacity	10L	2.6 us gal
Engine speed	1500r/min (low speed) 2500r/min (high speed)	
Output current	14V,40A	
Horse power	51	
Cold system capacity	Cold water, about 2.8L	Cold water, about 0.7 us gal

2.4.2 Battery

Table 2-5 Specifications

Rated voltage	12 V
20 hour rate capacity	90 Ah
Cold start current	600 A @ 0°F (-18℃)

2.5 Tire

Table 2-6 Specification

Size	Type	Ply	Max capacity		Weight (tire and wheel)
			10km/h(6mph)	0km/h(0mph)	
315/55 D20	Foam-filled	12	3568kg/7866lbs	4375kg/9645lbs	143kg/315lbs

2.6 Torque requirements

When maintenance is needed or the fastener is loose, please determine the appropriate torque value according to the torque table 2-7 and 2-8. The bolt pre-tightening force is not marked, please follow DIN267-27.

Table 2-7 Torque requirements

Bolt diameter	Bolt strength level and corresponding torque value	
	8.8 grade	10.9 grade
M8	24.5Nm/18ftlb	34.5 Nm/25.4ftlb
M10	48.3 Nm/35.6ftlb	68 Nm/50.2ftlb
M12	84.3 Nm/62.2ftlb	118 Nm/87ftlb
M14	135 Nm/99.5ftlb	189 Nm/139.4ftlb
M16	209 Nm/154.2ftlb	294 Nm/217ftlb
M18	288 Nm/212.4ftlb	405 Nm/298.7ftlb
M20	408 Nm/301ftlb	538 Nm/396.8ftlb
M22	555 Nm/409.4ftlb	780 Nm/575.3ftlb
M24	705 Nm/520ftlb	992 Nm/731.7ftlb
M27	1032 Nm/761.2ftlb	1450 Nm/1069.5ftlb
M30	1400 Nm/1032.6ftlb	1970 Nm/1453ftlb

Table 2-8 Special torque requirements

Instruction	Torque value	Time interval
Wheel hub bolts M16	294 Nm/217ftlb	50 hours after the first run, every 150 hours or 3 months thereafter
Outrigger bolts M20	520 Nm/384ftlb	50 hours after the first run, every 150 hours or 3 months thereafter

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Section 3 Maintenance Requirements



SECTION 3 MAINTENANCE REQUIREMENTS

3.1 General

- a) Perform necessary oil inspection and replacement. Conduct regular inspections to ensure that components are in good condition.
- b) Require appropriate equipment for maintenance and repair, and obey relevant rules and instructions in Operator's manual.
- c) If the safety equipment is removed during maintenance, reinstall the safety equipment and inspect it immediately after the maintenance work is completed.
- d) Ensure that fuel, lubricants, and replaced parts are safely disposed of in accordance with environmental regulations.
- e) Maintenance purpose:
 - 1) Prepare for operation.
 - 2) Maintain stable performance.
 - 3) Prevent downtime.
 - 4) Maintain use value.
 - 5) Reduce maintenance cost.

3.2 Maintenance Personnel Duties, Requirements and Safety Equipment

3.2.1 Duties

The maintenance personnel must maintain the aerial work platform and to be responsible for the safe use and normal operation. The Maintenance and Service Manual provided by the company shall be observed and all necessary maintenance shall be carried out under the safe working system.

3.2.2 Basic requirements

Maintenance personnel should meet the following conditions:

Inspectors and maintenance personnel should have appropriate qualifications or authorization.

Experienced technicians or professional engineers.

Familiar with the aerial work platforms maintenance and the potential danger.

Received appropriate education and training, including courses related to the use of special equipment.

Familiar with the relevant maintenance procedures and safety precautions of aerial work platforms.

CAUTION

1. **Only the trained and qualified personnel who have obtained the qualification certificate can repair the aerial work platform.**
2. **Do not perform any maintenance when you cannot work properly after being unwell, drinking or taking medicine.**

3.2.3 Personnel safety equipment

- The operator must use safety equipment when operating the machine.
- Select suitable safety equipment such as helmets, gloves, protective goggles, safety belts, boots and hearing protection devices according to the work site conditions.

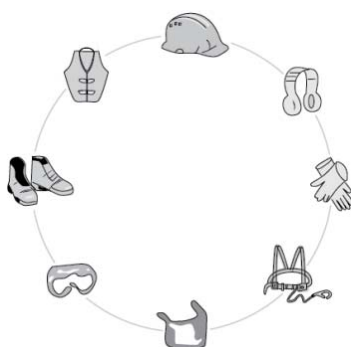


Figure 3-1 Personnel safety equipment

- Check safety equipment before and after operation, and perform maintenance according to specified procedures or replacement if necessary.
- Keep inspection and maintenance records if needed.
- Certain safety equipment (such as helmets and seat belts) might be damaged after prolonged use and should be inspected and replaced periodically.

CAUTION

- Inspect safety equipment regularly, replace damaged parts if necessary.**
- All personal protective equipment does not provide 100% protection.**
- Please wear protective gear properly and be familiar with the various hazards that may be encountered during the operation for safety consideration.**
- Periodic maintenance and repair must be carried out by professional maintenance personnel.**

WARNING

Inspection or maintenance in a space-constrained, poorly ventilated location may result in poisoning.

3.3 Precautions

3.3.1. General precautions

- Wear working clothes for maintenance work.
- Machine parked on a firm, level surface.
- Pay attention to ventilation.

Ventilation is required when starting the engine in a space-constrained site. Connect a hose to the exhaust pipe to discharge the smoke to the outside. Open the doors and windows to keep air flowing.

- d) Clean up the work site.

Inspection and maintenance are required Implementing in a messy work site, if not implement, may result in personal injury or a fall accident. All obstacles should be removed before operation.

- e) Prevent dust and dirt from entering the system when inspecting or servicing the hydraulic system.
- f) If you find any items that require immediate repair and adjustment, perform maintenance immediately.
- g) Contact local Zoomlion service center for repairing.
- h) Please use the accessories and grease specified by our company for good performance.
- i) Timely replacement of consumables, such as filter element to prevent failures due to delays.
- j) Please contact our local office for any difficult problems identified during inspection or maintenance.

3.3.2 Safety precautions

- a) Prevent fire:
 - 1) Use non-flammable cleaning fluids for parts and components cleaning.
 - 2) Store fuel and grease items away from flames or sparks.
 - 3) No smoking.
 - 4) Do not allow flames or sparks to get close to flammable objects.
 - 5) Have a fire extinguisher and understand how to use it.
 - 6) Use explosion-proof lights when checking fuel, oil and battery fluids.
 - 7) Keep flammable objects away from flying sparks or molten metal during grinding or welding.
- b) Perform inspection or maintenance after the machine cooling off.

Contact with the components might cause burn hazard, as the temperature of components goes high when the machine is running. These components include engines, mufflers, engine coolant, radiators, hydraulic oil, reducers, hydraulic kits and hydraulic accessories. These components or parts should be allowed to cool off before starting inspection or maintenance.



Figure 3-2 Mind burn hazard

c) Use clean grease.

- 1) The room where grease is stored should be kept clean and no dust, water, etc. should enter the container. Ensure that the grease used does not contain water.

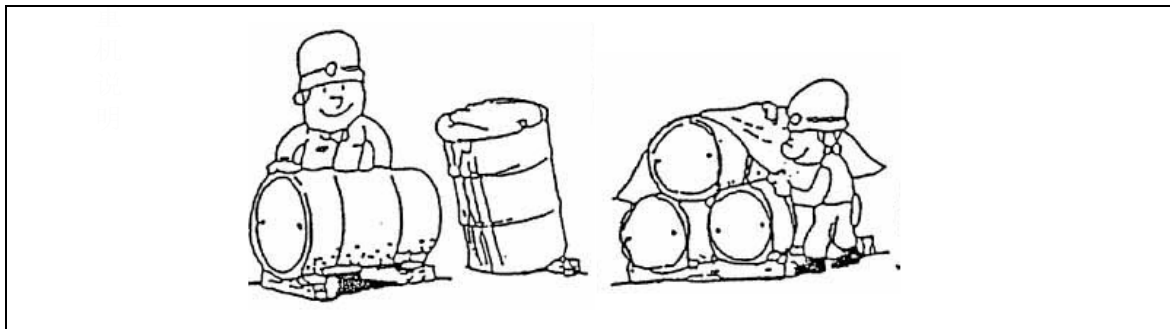


Figure 3-3 Clean grease check

- 2) Use specified grease. Use the recommended grade or the same grade of oil and grease when replenishing or replacing. The combination of different grades of grease will result in a chemical reaction that changes the properties of the grease and adversely affects the mechanical properties. When using a grease that is different from the grade used in the machine, remove the original grease thoroughly before adding new grease.

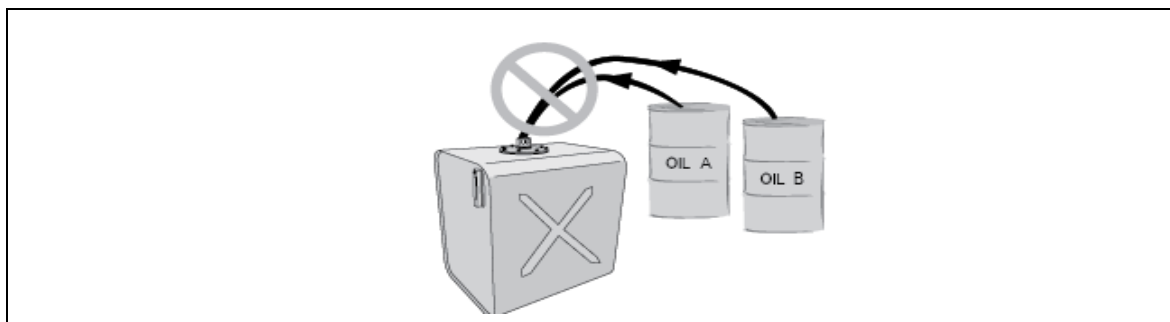


Figure 3-4 Prohibition of mixing oil

d) Keep the machine clean.

Clean the machine with clean water to find oil leaks, cracks, loose connections and other abnormalities. Keep grease nipples, vents and dipsticks clean to prevent dust. Dust or debris not only makes it difficult to find faulty components, but also easily mixes into the components during operation. In addition, dust or mud can cause injury to the eyes or cause personnel to slip.

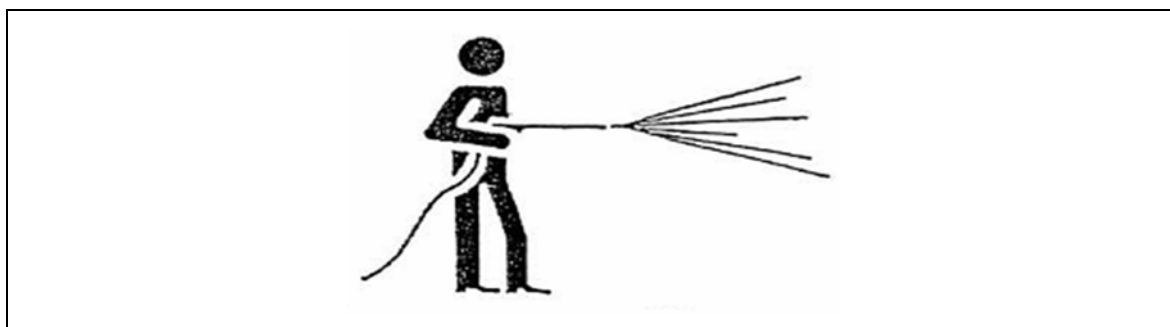


Figure 3-5 Clean the machine

⚠ WARNING

Never direct water or water vapour jets at electrical components and connectors! Otherwise there is a danger of electric shock!

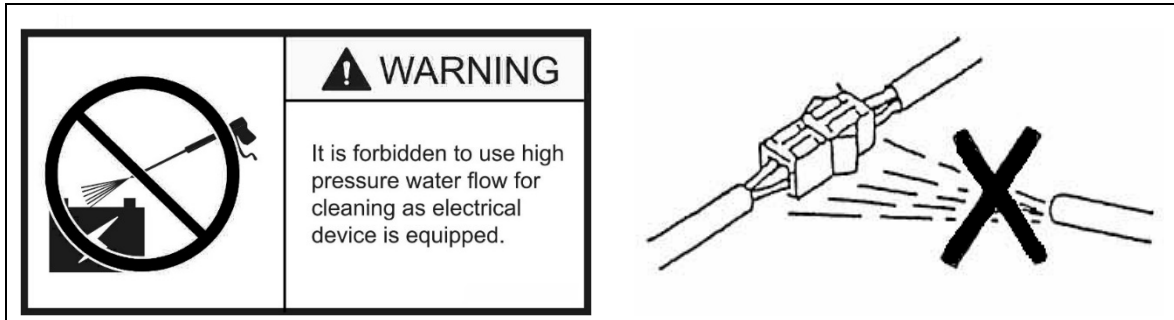


Figure 3-6 DO NOT spray water at the electric shock or joint

⚠ CAUTION

1. Lubricate the steering knuckles after cleaning.
 2. Clean the control panel with warm water containing detergent only. DO NOT use corrosive cleaning agent.
- e) Shut off the engine before inspection or maintenance.

Do not run the engine when inspecting or maintaining to prevent accidents.

⚠ DANGER

Perform all locks, turn the power switch to off position and remove the switch keys during machine inspection and maintenance. And place a warning sign of “No Operation” on the door or in the panel.

If not comply with the rules, could result in serious injury or death.

⚠ WARNING

During inspection or maintenance operations, any unrelated person accidentally starting the engine may cause mechanical damage or personal injury.

If the inspection or maintenance work must be performed while the engine is running, at least two people should be assigned to complete the work. one of them must be in front of the ground or platform control panel so that the engine can be stopped at any time when necessary and another person will implement inspection Or maintenance. Personnel should maintain close contact with each other to complete the task safely.

- f) Welding or repairing of any components and wear-resistant parts of this unit should be conducted by trained technicians.

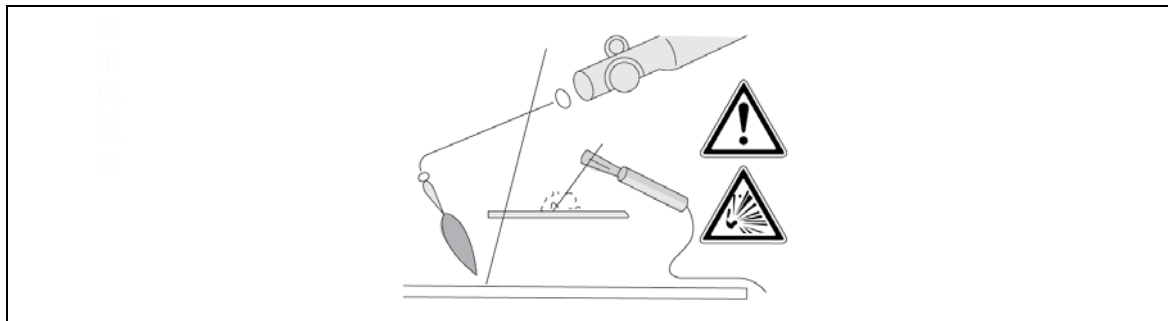


Figure 3-7 Beware of explosion

⚠ WARNING

The positive and negative wires of the battery must be removed when welding to prevent the positive and negative poles of the welder from forming a loop with the machine body, thereby burning electrical components such as controllers and sensors. The company does not take the consequences for wrong operation.

It is forbidden to use the machine as a ground wire during welding.

- g) Pay attention to the installed position of parts when unloading. Technicians performing the installation must be familiar with each part to ensure proper installation.

⚠ CAUTION

It is strictly forbidden to disassemble electronic components.

Do not allow tools or parts to fall into the inspection hole. do not allow objects to fall into the holes during work. Falling objects can damage the machine or cause the machine to malfunction. Any tools or objects that fall into the inspection hole must be removed.

If electrical, circuit or hydraulic components (valves, pump, etc.) need to be replaced, the replaced parts should be checked and adjusted according to the data on the machine schematic.

⚠ WARNING

Manufacturer-approved parts must be used, especially those that affect load bearing performance and safety performance.

The components that affect the stability, strength and performance of the platform could be modified only after obtaining the approval of the manufacturer, such as structural parts, carriers, electrical components, and hydraulic components. Otherwise, any modification to the aerial work platform are prohibited.

- h) Clean oil stain.

When filling or replacing fuel, hydraulic oil, grease, or replacing the filter element, oil may spill. Wipe the spilled oil in time to prevent fire.

- i) Check the discharged waste oil and old filter.

Check for metal chips or foreign objects when replacing the oil or filter element.

j) Prevent dust intrusion.

The dismantled hydraulic tubing and hydraulics must be protected with a blockage or seal to prevent dust.



Figure 3-8 Dust prevention

k) Clean joint surface.

Removing the O-ring or other gasket, clean the sealing surface and replace with a new seal. Apply a thin layer of oil to the seal when reassembling.

l) Pay attention to high pressure oil.

High pressure fuel or hydraulic oil can cause serious damage to the skin or eyes. To avoid this danger, the following instructions should be followed:

- 1) Remove the pressure before disassembling pipes, joints or other related components with internal pressure, such as hydraulic systems, compressed air systems, etc.



Figure 3-9 Notice internal pressure

- 2) Wear goggles and protective gloves when checking for leaks. Leakage of high pressure oil may not be visible, use cardboard or wood chips to confirm oil leakage. DO NOT use your hand to check for leaks.



Figure 3-10 Prevent burns from high pressure oil

m) Mind the high temperature part of the cooling system.

If the cover of the radiator is removed while the engine coolant temperature is high, steam or hot water will be ejected, causing burns. Waiting for the temperature drop of coolant, stand in front of the radiator cover and slowly loosen the cover to release the steam, pressure before removing the cover.

n) Remove the cable from the battery before inspecting or maintaining the electrical system.

Inspection or maintenance of the electrical system without removing the cable of the battery may cause a short circuit and damage the wiring, electrical components and electronic components of the electrical system.

The cable on the negative terminal side (ground side) must be removed before the inspection or maintenance work on the electrical system.

o) Mind battery liquid.

Battery fluid contains dilute sulfuric acid. Battery fluid can cause blindness when it enters the eyes, and burns when it comes into contact with skin. Wear goggles, protective gloves long-sleeved overalls when handling the battery.

If the eyes or skin are in contact with the battery fluid, rinse immediately with plenty of water and get medical attention promptly.



Figure 3-11 mind battery fluid

p) Precautions after maintenance

After maintenance, the operation function must be confirmed to detect the oil leakage or malfunction in the early stage.

It is necessary to confirm the machine movement, oil leakage, loose bolts and other problems on the mechanically maintained parts.

Restore or reset the safety device and recalibrate the safety device if necessary.

Remove the tools and equipment for maintenance, replace parts and scattered objects, and clean up the site.

It should always be borne in mind that all maintenance should include mandatory confirmation of normal mechanical movement.

NOTICE

1. **Handle hazardous wastes according to law such as oil, filter, battery, hydraulic oil, etc., reasonable recycling of used oil, coolant or filter element to save resources and protect the environment.**

2. It is forbidden to dump waste liquid at the sewage pipe, ground surface, river, etc. at will. The waste liquid should be discharged into a suitable container for proper disposal.
3. The disposal of hazardous substances should be in compliance with all environmental regulations, otherwise it will be fined or punished by relevant departments.

q) Check the records.

Conduct and record regular inspections to learn the operation condition of the machine and components (Inspection should be conducted in machine's first use or initial use after long-term suspension or after repair).

3.4 Pre-delivery Inspection

It is the responsibility of the dealer to perform the Pre-delivery Preparation.

Pre-delivery Preparation is performed prior to each delivery. The inspection is designed to discover if anything is apparently wrong with a machine before it is put into service.

A damaged or modified machine must never be used. If damaged or any variation from factory delivered condition is discovered, the machine must be tagged and removed from service.

Repairs to the machine may only be made by a qualified service technician, according to the manufacturer's specification. Scheduled maintenance inspections shall be performed by qualified service technicians, according to the manufacturer's specifications and the requirements listed in the responsibilities manual.

3.5 Maintenance Intervals Instructions

All maintenance work is done intermittently that the Intermittent period is the maintenance period. Maintenance intervals are determined based on two aspects:

- a) Certain running time of functional components (hours).
- b) The Gregorian time (day, month, year) at which the machine is working and stored.

Maintenance intervals of Zoomlion Scissor Lifts are generally determined by the certain running time of functional components, and the special content needs to be determined in the latter way.

Table 3-1 Maintenance Intervals

Maintenance Intervals	Running Time (hours)	Maintenance Intervals Instruction
Daily (D)	8	Before and after operation
Weekly (W)	About 40	Once a week
Monthly (M1)	About 100	Once a month
Quarterly (M3)	About 250	Once every three months
Every 6 months (M6)	About 500	Once every six months
Annually (M12)	About 1,000	Once a year
Every two years (M24)	About 2,000	Once every 24 months

3.6 Maintenance Schedule

Table 3-2 Maintenance Schedule

Items	Work Description	Maintenance					
		Daily	Weekly	Quarterly	Every 6 months	Annually	Every Two years
		D	W	M3	M6	M12	M24
3.7.1.1	Check manual and decals	★					
3.7.1.2	Pre-operation inspection	★					
3.7.1.3	Functional test	★					
3.7.1.4	Battery Inspection	★					
3.7.1.5	Check hydraulic oil level	★					
3.7.1.6	Check engine oil level	★					
3.7.1.7	Check engine fuel	★					
3.7.1.8	Check coolant level	★					
3.7.1.9	Check engine belt	★					
3.7.1.10	Check axle system	★					
3.7.2.1	Check intake system		★				
3.7.2.2	Check engine air filter		★				
3.7.3	Maintenance after 30 days	▲ After using for the first time for 30 days or 50 hours					
3.7.4.1	Battery maintenance						
3.7.4.2	Inspect electrical wires						
3.7.4.3	Replace hydraulic filters						
3.7.4.4	Replace hydraulic tank air filter						

Instruction: ★ Regular maintenance intervals ▲ Initial maintenance time

Table 3-2 Maintenance Schedule

Items	Work Description	Maintenance					
		Daily	Monthly	Quarterly	Every 6 months	Annually	Every Two years
		D	W	M3	M6	M12	M24
3.7.4.5	Inspect tires and wheels			★			
3.7.4.6	Inspect emergency stop function			★			
3.7.4.7	Test key switch			★			
3.7.4.8	Test braking function			★			
3.7.4.9	Test the horn			★			
3.7.4.10	Test high driving speed-stowed			★			
3.7.4.11	Test driving speed-elevated			★			
3.7.4.12	Test slow driving speed-stowed			★			
3.7.4.13	Analyze hydraulic oil			★			
3.7.4.14	Check ventilation system of hydraulic tank			★			
3.7.4.15	Check ventilation system of fuel tank			★			
3.7.4.16	Check the door lock components on both sides of the chassis			★			
3.7.4.17	Test the down limit switch and angle sensor			★			
3.7.4.18	Test the up limit switch			★			

Instruction: ★ Regular maintenance intervals ▲ Initial maintenance time

Table 3-2 Maintenance Schedule

Items	Work Description	Maintenance					
		Daily	Monthly	Quarterly	Every 6 months	Annually	Every Two years
		D	W	M3	M6	M12	M24
3.7.4.19	Check drive hub lubrication grease and bolts			★			
3.7.5.1	Inspect platform overload system				★		
3.7.5.2	Replace hydraulic tank exhaust cover				★		
3.7.5.3	Replace engine oil and filter				★		
3.7.5.4	Replace fuel filter element				★		
3.7.5.5	Valve clearance inspection and adjustment				★		
3.7.5.6	Clean or replace engine air filter				★		
3.7.6.1	Check scissor arm wear-resistant slider					★	
3.7.6.2	Replace drive hub lubrication grease					★	
3.7.7.1	Test or replace hydraulic oil						★
3.7.7.2	Refill or replace engine coolant						★

Instruction: ★ Regular maintenance intervals ▲ Initial maintenance time

3.7 Maintenance Inspection

3.7.1 Daily inspection

3.7.1.1 Check manual and decals

Ensuring that the operation and maintenance manual is in good condition. Each unit is stored with operation and maintenance manuals. Manuals should be stored in the platform container. Manuals with illegible or missing pages do not provide sufficient information to ensure safe operation.

Ensure that all safety decals are intact. Decal alerts the operator to the safety hazard of using the machine. It also provides operational and maintenance information to the user. Blurred decals will not serve as a warning and may result in a dangerous operating environment.

- a) Check and ensure that the operation and maintenance manual is in the storage box of the platform.
- b) Ensure that there is no illegible or missing pages.
 - Result: the manual matches the model, all manuals are legible and there are no missing pages.
 - Result: the manual does not match the model, or the manual is illegible or there are missing pages.
 - Stop using the machine before the manual is replaced.
- c) Check the Decal Inspection section in manual. Ensure the decal is legible and intact.
 - Result: all decals are clear and complete.
 - Result: decal is missing, illegible or damaged. Stop using the machine before the manual is replaced.
- d) Put it back in the storage box after using the manual.
- e) Reminder: if need to replace the manual or label, please contact Zoomlion or Zoomlion dealer.

3.7.1.2 Pre-start inspection

It is important to implement pre-start inspection for safety operation. The pre-operation check is done visually before the machine is running. This inspection is used to find out if there are obvious problems with the machine before the functional test. It could be used to decide whether to perform routine maintenance procedures.

3.7.1.3 Functional test

It is important to implement functional test for safety operation. The function test is used to find out whether the machine has a functional defect before operation, and the defective machine cannot be used. Once a functional defect is found, immediately mark the machine and stop using it.

See detailed inspecting procedure in “Functional Test” section.

3.7.1.4 Battery inspection

This inspection is conducted every 8 hours or once a day, whichever comes first.

Proper battery condition is essential to good machine performance and safety operation. Improper fluid level or damaged cables and connections can result in component damage and hazardous conditions.

⚠ CAUTION

Machines with sealed or maintenance-free batteries are not required for this check.

⚠ WARNING

1. Contact with electrically charged circuits could result in death or serious injury. Remove all rings, watches or other jewelry.
2. Batteries fluid is highly corrosive. Avoid spilling or contacting battery acid. Neutralize battery acid spills with baking soda and water.

⚠ CAUTION

Fully charge the battery before performing the following inspections.

- a) Only qualified riggers should rig the machine.
- b) Only certified crane operators should lift the machine and only in accordance with the applicable crane regulations.
- c) Be sure that the battery retainers are tight.
- d) Remove the battery vent caps.
- e) Check the battery acid level. If needed, replenish with distilled water from the battery fill hole. Do not overfill.
- f) Install the vent caps.

3.7.1.5 Check hydraulic oil level

This inspection is conducted every 8 hours or once a day, whichever comes first.

Proper hydraulic fluid level is very important for operating the machine. Improper hydraulic oil level could damage hydraulic components. Through the daily inspection, the inspector can determine the change of the hydraulic oil levels that can indicate problems with the hydraulic system.

⚠ CAUTION

Conduct the inspection in stowed position.

- a) Visually inspect the hydraulic oil level on the side of the hydraulic tank.
Result: the hydraulic oil level should be at the mark of the fuel tank.
- b) Add oil as needed. Do not overfill.

3.7.1.6 Check engine oil level

This inspection is conducted every 8 hours or once a day, whichever comes first.

Observe the oil safety regulations and local regulations. Dispose of spilled oil and filter elements in accordance with regulations. Waste oil must not penetrate the ground. Implement test run after each operation, pay attention to tightness and lubricating oil pressure, and then check the engine oil level.

⚠ WARNING

1. **Never work on a running engine!**
2. **No smoking and open flames!**
3. **Be careful when contacting hot oil, there is a danger of burns!**

Insufficient or excessive oil can cause engine damage. When the oil level is lower than the lower engraved line of the dipstick or higher than the upper engraved line of the dipstick, it is not allowed to start the diesel engine. Check the oil level only when the engine is level and turned off to allow the oil to fully flow back to the bottom case. If the engine is hot, turn off the engine and check the oil level after 5 minutes. If the engine is cold, check it immediately.

- a) Wipe the oil measuring rod with a clean, non-fiber cloth.
- b) Insert the oil measuring rod to the end.
- c) Pull out the oil measuring rod and read the oil level.
- d) The oil level should always be between H and L marks.

Fill the oil to the maximum level if necessary.

3.7.1.7 Check engine fuel

This inspection is conducted every 8 hours or once a day, whichever comes first.

Observe the fuel safety regulations and local regulations. Dispose of spilled fuel and filter elements in accordance with regulations. Fuel must not penetrate the ground.

⚠ WARNING

1. **Never work on a running engine!**
2. **No smoking and open flames!**
3. **Be careful when contacting hot oil, there is a danger of burns!**

⚠ DANGER

1. **Engine fuel is flammable. When performing inspections, the machine should be in an open and well-ventilated place. Keep the machine away from heaters, sparks, flames and burning tobacco, and place a qualified fire extinguisher in an easily accessible place.**
2. **If a fuel leak is found, prevent any other person from entering the leak area, and it is strictly forbidden to operate the equipment. Repair the leak immediately.**

3.7.1.8 Check coolant level

This inspection is conducted every 8 hours or once a day, whichever comes first.

Observe the coolant safety regulations and local regulations. Dispose of spilled fuel and filter elements in accordance with regulations. The coolant must not penetrate the ground. The cooling system is under pressure and the cover can only be opened when it is cool. The coolant must have the specified cooling system protectant concentration. Never run the engine without coolant, even for an extremely short period of time.

⚠ DANGER

High temperature coolant may result in burn hazards.

- a) Observe the coolant page through the glass hole.
- b) When the cooling liquid is not enough, open the filling port cover to add the cooling liquid.

3.7.1.9 Check engine belt

This inspection is conducted every 8 hours or once a day, whichever comes first.

⚠ WARNING

1. **Only work on the belt when the engine is stationary.**
2. **Burn hazards. Beware of engine parts, contact with hot engine parts can cause severe burns.**
 - a) Visually check whether all belts are too tight or too loose, and whether they are damaged.
 - b) Replace damaged parts.
 - c) Reinstall protective devices if necessary.
 - d) For the newly installed belt, pay attention to whether the position is correct. After running for 15 minutes, check the tension.

3.7.1.10 Check axle system

This inspection is conducted every 8 hours or once a day, whichever comes first.

The axle system can keep the four wheels in contact with the ground at all times, improving the stability of the entire machine. Problems with the axle system will cause the aerial work platform to tip over.

⚠ CAUTION

Conduct the test when the extension deck is retracted and there is no load on platform.

- a) Start the engine on platform control, and select high idle speed function.
- b) Test axle system in stowed position.
 - 1) Drive the left wheel on a 10cm/4in step.
Result: four tires are in contact with the ground at all times.
 - 2) Drive the right wheel on a 10cm/4in step.
Result: four tires are in contact with the ground at all times.

- c) Test the axle system with platform raised.
- 1) Hold the function enable switch on control handle, and raise the platform by 2m/6ft 7in
 - 2) Drive the left wheel into a 10cm/4in deep hole.
Result: four tires are in contact with the ground at all times.
 - 3) Drive the right wheel into a 10cm/4in deep hole.
Result: four tires are in contact with the ground at all times.

There should be no fault code on ground display when implementing this test.

3.7.2 Maintenance every week

3.7.2.1 Check intake system

Check the intake hose every week.

Check whether the air intake hose is aged and cracked, and whether the clamp is loose. Tighten or replace parts as necessary to ensure tightness of the air intake system.

3.7.2.2 Check engine air filter

Check the alarm of the air filter every week.

⚠WARNING

Only work on the belt when the engine is not running!

Check the maintenance indicator of the air filter. When the indicator turns in red, clean or replace the filter element. See 3.7.5.6 for maintenance steps.

3.7.3 Maintenance after 30 days

30-day maintenance is a one-time maintenance after the first 30 days or 50 hours of machine operation. Continue the scheduled maintenance after this one-time maintenance.

Perform the following maintenance:

- a) Tires and hubs.
- b) Replace the hydraulic filter.

3.7.4 Maintenance every 3 months

3.7.4.1 Battery maintenance

Proper battery condition is essential for good machine performance and safety operation. Improper fluid levels or damaged cables and connections can result in component damage and hazardous conditions.

⚠WARNING

1. **Contact with electrically charged circuits could result in death or serious injury. Remove all rings, watches or other jewelry.**
2. **Batteries fluid is highly corrosive. Avoid spilling or contacting battery acid. Neutralize battery acid spills with baking soda and water.**

- a) Maintenance method of liquid storage battery:
 - 1) Put on protective clothing and eye wear.
 - 2) Open the battery box door.
 - 3) Be sure that the battery cable connections are free of corrosion.

Add terminal protectors and a corrosion preventative sealant will help eliminate corrosion on the battery terminals and cables.

- 4) Be sure that the battery retainers and cable connections are tight.
 - 5) Remove the battery vent caps and check the specific gravity of each battery cell with a hydrometer.
 - 6) Check the battery acid level. If needed, replenish with distilled water to 3mm/0.1in below the bottom of the battery fill tube. Do not overfill.
 - 7) Install the vent caps and neutralize any electrolyte that may have spilled.
- b) Maintenance-free battery:
 - 1) Check whether the connection between the battery and the wiring harness terminal is reliable, and keep the battery surface clean and dry.
 - 2) When the engine is not running, try to reduce the use of electrical appliances for the whole machine, prevent the battery from over-discharging, and ensure that the battery is always running at a higher capacity state to extend the battery life.
 - 3) Check whether the exhaust hole on the battery cover is vented. If it is blocked, the generated hydrogen and oxygen cannot be discharged, which can easily cause bulging and affect the battery life.
 - 4) When the whole machine is parked for a long time, the main power switch should be disconnected, and the inspection and maintenance should be performed every three months. The battery terminal voltage $\geq 12.5V$ is normal, otherwise it should be replenished in time.

Consult Zoomlion after-sale service team for more relevant problems.

3.7.4.2 Inspect electrical wiring

This inspection is conducted every 250 hours or quarterly, whichever comes first.

Maintaining electrical wiring in good condition is essential to safe operation and good machine performance. Failure to find and replace burnt, chafed, corroded or pinched wires could result in unsafe operating conditions and may cause component damage.

⚠WARNING

Contact with electrically charged circuits could result in death or serious injury. Remove all rings, watches and jewelry.

- a) Inspect that if the ground wire under the chassis is missing or damaged.
- b) Inspect the following areas for burnt, chafed, corroded pinched and loose wires:
 - 1) Ground control box interior.
 - 2) Hydraulic manifold wiring in hydraulic tray.

- 3) Battery wiring in battery tray.
- 4) Platform control box interior.
- c) Turn the key switch to Platform Control and pull out the red Emergency Stop button to the on position at both the ground and platform controls.
- d) Raise the platform approximately 4m/13ft 1in from the ground.
- e) Lift the safety arm, move the safety arm to the middle of the scissor bushing and rotate it up to the vertical position.
- f) Lower the platform until the safety arm is in full contact with the bushing.

⚠WARNING

Keep hands away from the safety arm when lowering the platform.

- g) Check the chassis and scissor arm for burns, scratches, corrosion, bends, and loose wires.
- h) Inspect the following areas for burnt, chafed, corroded pinched and loose wires:
 - 1) Scissor arm wiring.
 - 2) ECU to platform.
 - 3) All wire harness connectors to platform control box.
 - 4) Engine.
- i) Lift the platform, replace the safety arm to installation position.
 - 1) Wiring harness connector between ECU and platform.
 - 2) All wiring harness connectors for level sensors
- j) Raise the platform, retract the scissor arm to installed position.
- k) Lower the platform, and turn off the machine.

3.7.4.3 Replace hydraulic filters

This inspection is conducted after 50 hour of usage. Implement this inspection or replacement every 250 hours or quarterly thereafter. If the working site is dusty, inspect or replace the hydraulic filter more frequent.

Proper filter condition is essential to good machine performance and service life. Dirty or clogged filters will affect machine performance and damage components. Under hostile environment and bad operating conditions, the filter should be checked and replaced frequently.

⚠WARNING

- 1. **Beware of hot oil. Contact with hot oil can cause serious burns.**
- 2. **Do not conduct this inspection if the engine is running.**
 - a) Replace hydraulic return oil filter and refueling filter element:
 - 1) Clean the hydraulic fluid that is spilled around the filter. Use a wrench to remove the filter.
 - 2) Apply a layer of hydraulic oil to the seal of the new filter.
 - 3) Install a new filter and tighten it by hand.
 - 4) Use the marker to mark the replacement time and date on the filter replacement form.

- 5) Turn the key switch to Ground Control and pull out the red Emergency Stop button to the on position at both the ground and platform controls.
 - 6) Press and hold down the lift function selection button.
 - 7) Check the leak of filter.
 - 8) Clean the hydraulic fluid that is spilled around the filter.
- b) Replace high pressure filter element:
- 1) Place a suitable container under the filter.
 - 2) Use a wrench to remove the nut at the bottom of the filter cover and remove the filter cover.
 - 3) Remove the filter element from the filter cover.
 - 4) Check the tightness of the filter cover and replace it if necessary.
 - 5) Install a new high-pressure filter element and tighten it.
 - 6) Scrub away any oil droplets sprayed out during installation.
 - 7) Inspect the filter housing and related components to ensure that there are no leaks.

3.7.4.4 Replace hydraulic tank air filter

This inspection is conducted every 250 hours or quarterly, whichever comes first. If the working site is dusty, conduct this inspection frequently.

WARNING

Do not conduct this inspection if the engine is running.

- a) Remove the air filter element.
- b) use a damp cloth to scrub the inside and end of the barrel.
- c) Install new air filter element.

3.7.4.5 Inspect the tires and wheels

This inspection is conducted every 250 hours or quarter, whichever comes first.

Maintaining the tires and wheels is essential to safe operation and good performance. Tire and/or wheel failure could result in a machine tip-over. Component damage may also result if problems are not discovered and repaired in a timely fashion.

- a) Check all tire treads and sidewalls for cuts, cracks, punctures and unusual wear.
- b) Check each wheel for damage, bends and cracked welds.
- c) Check whether the tyre craft screws have fallen off. If there is a trace or no filler leaking after the screws fall off, and the tire body is not significantly deformed, the user can use a hammer with a screw slightly larger than the diameter of the exhaust hole (5mm/0.2in). That is, if a large amount of filler is found to leak and a large amount of deformation of the tire body occurs, the height of the working platform needs to be reduced, and the tire must be replaced in time.
- d) Check the pressure of the pneumatic tire and inflate the tire if necessary.

3.7.4.6 Inspect emergency stop function

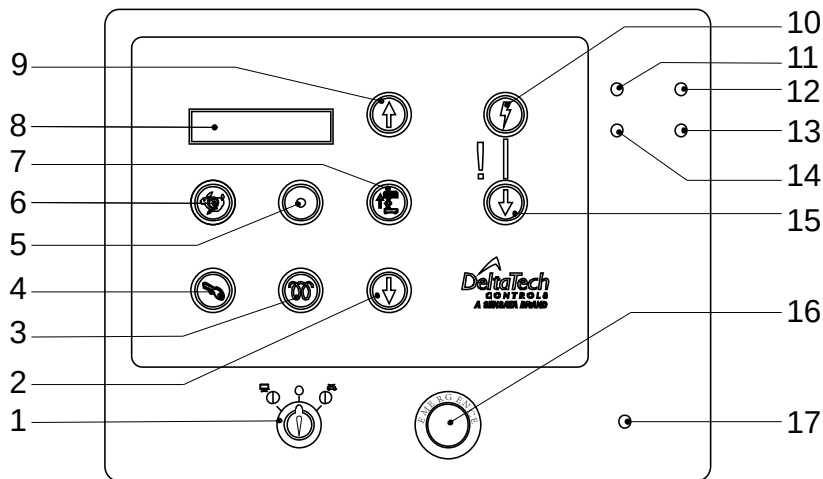


Figure 3-12 Ground control panel

Table 3-3 Ground Control Panel Instruction

No.	Name	No.	Name
1	Key switch	10	Auxiliary power enable button
2	Platform down button	11	Breaker
3	Engine pre-heating button	12	Breaker
4	Engine start button	13	Breaker
5	Overload indicator	14	Breaker
6	Engine idle speed select button with indicator	15	Auxiliary power lower button
7	Lifting enable button	16	Red Emergency Stop button
8	Breaker LCD display	17	Breaker
9	Platform up button		

This inspection is conducted every 250 hours or quarter, whichever comes first.

Proper emergency stop function is essential to safe operation. Invalid emergency stop cannot shut off the power supply and cannot stop all functions of the machine, resulting in a dangerous situation.

When selecting and operating a ground controller, its safety functions take precedence over the platform controller.

- a) Turn the key switch to Ground Control and pull out the red Emergency Stop button to the on position at both the ground and platform controls,
- b) Press the red Emergency Stop button to the off position at ground control.
Result: the machine has no movements.
- c) Turn the key switch to Platform Control and pull out the red Emergency Stop button to the on position at both the ground and platform controls,
- d) Press the red Emergency Stop button to the off position at platform control.
Result: the machine has no movements.

The red Emergency Stop button can stop all operations of the machine.

3.7.4.7 Test key switch

This inspection is conducted every 250 hours or quarter, whichever comes first.

Proper key switch action and response are essential to the safe operation. The key switch can be switched by the ground controller or platform controller. Invalid key switch could result in dangerous operation.

Operator must use the platform controller on the ground when performing this step.

- a) Pull out the red Emergency Stop button to the on position at both the ground and platform controls.
- b) Turn the key switch to platform control.
- c) Check any function on the ground controller.
Result: the machine has no movements.
- d) Turn the key switch to ground control.
- e) Check any function on the ground controller.
Result: the machine has no movements.
- f) Turn the key switch to off position.
Result: the machine has no movements.

3.7.4.8 Test braking function

This inspection is conducted every 250 hours or quarter, whichever comes first.

Proper brake action is essential to safe machine operation. The drive brake should operate smoothly, free of hesitation, jerking and unusual noise. There is no difference in the appearance of the tire before and after the release of the brakes.

Select a test area that is firm, level and free of obstructions. Be sure the platform extension deck is fully retracted and the platform is in the stowed position.

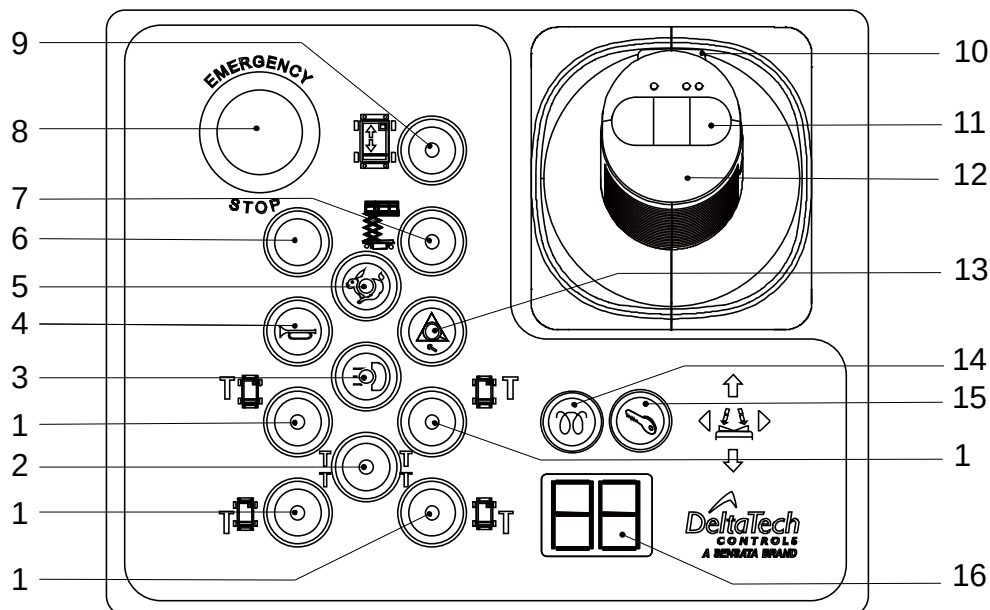


Figure 3-13 Platform control panel

Table 3-4 Platform control panel instruction

NO	Item	NO	Item
1	Outrigger function enable button with indicator	9	Drive function switch
2	Outrigger auto-leveling button	10	Function enable switch
3	Light	11	Thumb rocker switch for steering
4	Horn button	12	Proportional control handle
5	Engine idle speed button with indicator	13	Machine tilt button with indicator
6	Reserved	14	Engine preheating button
7	Lift enable button with indicator	15	Engine start button
8	Red Emergency Stop button	16	Breaker LED display

- Mark a test line on the ground for reference.
- Turn the key switch to Platform Control and pull out the red Emergency Stop button to the on position at both the ground and platform controls.
- Start the engine on platform.
- Lower the platform to stowed position.
- Press the drive function selection button.
- Choose a point on the machine (i.e., contact patch of a tire) as a visual reference for use when crossing the test line.
- Bring the machine to top drive speed before reaching the test line. Release the drive joystick when your reference point on the machine crosses the test line.

- h) Measure the distance between the test line and your machine reference point. The maximum braking distance on flat ground is $75\text{cm} \pm 10\text{cm}$ / $2\text{ft } 6\text{in} \pm 4\text{in}$, the maximum braking distance on slope braking is $150\text{cm} \pm 10\text{cm}$ / $5\text{ft} \pm 4\text{in}$.

Result: the machine will stop within the specified braking distance, passing the test.

Result: the machine will not stop within the specified braking distance.

The brakes must be able to hold the machine on any slope it is able to climb.

- i) Replace the brake. Repeat the above process from the step a until the test qualified.

3.7.4.9 Test the horn

This inspection is conducted every 250 hours or quarter, whichever comes first.

Horn is used to alert operators and ground personnel of machine proximity and motion. A malfunctioning horn cannot alert the ground personnel to a dangerous or unsafe condition.

- a) Turn the key switch to Platform Control and pull out the red Emergency Stop button to the on position at both the ground and platform controls,
- b) Press the horn button at the platform control.

Result: the horn should sound.

3.7.4.10 Test high driving speed-stowed

This inspection is conducted every 250 hours or quarter, whichever comes first.

Proper drive function is essential to safe operation. The drive function should respond quickly and smoothly to operator control. Drive performance should also free of hesitation, jerking and unusual noise over the entire speed range.

Select a test area that is firm, level and free of obstructions.

- a) Create start and finish lines by marking two lines on the ground 10m apart.
- b) Turn the key switch to Platform Control and pull out the red Emergency Stop button to the on position at both the ground and platform controls.
- c) Start the engine on platform.
- d) Lower the platform to stowed position.
- e) Press the drive function selection button.
- f) Choose a point on the machine (i.e., contact patch of a tire) as a visual reference for use when crossing the test line.
- g) Continue at full speed and begin to recording the time when your reference point crosses the start line.
- h) Record the time when the machine reference point crosses the finish line. The time is between 5~7s.

3.7.4.11 Test driving speed-elevated

This inspection is conducted every 250 hours or quarter, whichever comes first.

Proper drive function is essential to safe operation. The drive function should respond quickly and smoothly to operator control. Drive performance should also free of hesitation, jerking and unusual noise over the entire speed range.

Select a test area that is firm, level and free of obstructions.

- a) Create start and finish lines by marking two lines on the ground 10m/4in apart.
- b) Turn the key switch to Platform Control and pull out the red Emergency Stop button to the on position at both the ground and platform controls.
- c) Start the engine on platform.
- d) Press the lifting function selection button.
- e) Press and hold the function enable button on the control handle, and push the handle to raise the platform to a safe height (the bottom of the platform is about 3.2m/10ft 6in above the ground).
- f) Press the drive function selection button.
- g) Choose a point on the machine (i.e., contact patch of a tire) as a visual reference for use when crossing the test line.
- h) Continue at full speed and beginning timing when your reference point crosses the start line.
- i) Continue at full speed and note the time when the machine reference point crosses the finish line. The time is between 75~120s.

3.7.4.12 Test slow driving speed-stowed

This inspection is conducted every 250 hours or quarter, whichever comes first.

Proper drive function is essential to safe operation. The drive function should respond quickly and smoothly to operator control. Drive performance should also be free of hesitation, jerking and unusual noise over the entire speed range.

Select a test area that is firm, level and free of obstructions.

- a) Create start and finish lines by marking two lines on the ground 10m/32ft 10in apart.
- b) Turn the key switch to Platform Control and pull out the red Emergency Stop button to the on position at both the ground and platform controls.
- c) Start the engine on platform.
- d) Lower the platform to stowed position.
- e) Press the drive function selection button and the drive speed select button.
- f) Choose a point on the machine (i.e., contact patch of a tire) as a visual reference for use when crossing the test line.
- g) Continue at full speed and beginning timing when your reference point crosses the start line.
- h) Continue at full speed and note the time when the machine reference point crosses the finish line, the time is between 20~24s.

3.7.4.13 Analyze hydraulic oil

This inspection is conducted every 250 hours or quarter, whichever comes first.

Replace or test hydraulic oil is essential to good machine performance and service life. Dirty hydraulic oil and suction filters can affect machine performance, and continuous use can damage components. This operation should be performed more frequently under severe working conditions.

See 3.7.7.1 Test or Replace Hydraulic Oil.

3.7.4.14 Check ventilation system of hydraulic tank

This inspection is conducted every 250 hours or quarter, whichever comes first.

Free-breathing tank is essential to good machine performance and service life. Unclean or clogged venting caps can cause poor machine performance. Extremely dirty conditions may require more often inspection.

- a) Remove the venting cap from the tank.
- b) Venting inspection.

Result: air passes through the venting cap.

Result: if air does not pass the venting cap, clean or replace the venting cap. Proceed to step c.

When checking for positive venting, air should pass freely through the venting cap.

- c) Carefully clean the tank vent cap with a mild solvent. Dry with low pressure compressed air. Repeat step b.
- d) Install the venting cap.

3.7.4.15 Check ventilation system of fuel tank

This inspection is conducted every 250 hours or quarter, whichever comes first.

Free-breathing tank is essential to good machine performance and service life. Unclean or clogged venting caps can cause poor machine performance. Extremely dirty conditions may require more often inspection.

⚠ DANGER

1. **Engine fuel is flammable. When performing inspections, the machine should be in an open and well-ventilated place. Keep the machine away from heaters, sparks, flames and burning tobacco, and place a qualified fire extinguisher in an easily accessible place.**
2. **If a fuel leak is found, prevent any other person from entering the leak area, and it is strictly forbidden to operate the equipment to repair the leak immediately.**
 - a) Remove the exhaust cover from the fuel tank.
 - b) Inspect the venting condition.

Result: if the air can pass through the cover, proceed step d.

Result: if the air cannot pass through the cover, clean or replace exhaust cover, and proceed step c.

The air should pass through the cover of fuel tank freely.
 - c) Carefully clean the fuel tank exhaust cap with a mild solvent and dry it with low-pressure compressed air. Repeat step b.
 - d) Reinstall fuel tank exhaust cover.

3.7.4.16 Check the door lock components on both sides of the chassis

This inspection is conducted every 250 hours or quarter, whichever comes first.

Maintaining the door lock components on both sides of the chassis in good condition is essential to good performance and service life. Damaged door lock components may result in module trays opening unexpectedly, creating an unsafe operating condition.

- a) Inspect each module tray latch and related components for wear.
- b) Using light oil, apply a few drops to each of springs and to the sides of the latch mechanism.

3.7.4.17 Test the down limit switch and angle sensor

This inspection is conducted every 250 hours or quarter, whichever comes first.

Proper limit switch is essential to good performance and safe operation. A faulty limit switch could cause result in reduced machine performance and a potential unsafe operating condition.

Select a test area that is firm, level and free of obstructions.

- a) Down limit switch.
 - 1) Turn the key switch to ground control.
 - 2) Raise the platform above safe working height greater than 3.2m/10ft 6in.
 - 3) Lower the platform.

Result: platform will stop raising at the height of 3.2m/10ft 6in. Press the down button again to lower the platform. Proper down limit switch.

Result: platform does not stop raising at the height of 3.2m/10ft 6in. Check if the down limit switch and metal activates on the fixed shaft are loose. OR replace down limit switch.

⚠ WARNING

Keep hands away from the safety arm when lowering the platform.

- b) Tilt sensor.
 - 1) Move the machine onto a grade which exceeds the rating angle of the level sensor, but not exceed $2^{\circ} / 3^{\circ}$. Refer to the serial label on the machine.
 - 2) Press the lift function button, attempt to raise the platform to approximately 3.2m/10ft 6in.

Result: the ground controls LCD displays "LL", the alarm sounds. The machine is functioning properly.

Result: diagnostic display does not show "LL", the alarm does not sound. Adjust or replace the level sensor.

3.7.4.18 Test the up limit switch

This inspection is conducted every 250 hours or quarter, whichever comes first.

Proper limit switch is essential to good performance and safe operation. A faulty limit switch could cause result in reduced machine performance and a potential unsafe operating condition.

Select a test area that is firm, level and free of obstructions.

- The zero point of the tape measure is fixed at a suitable position on the platform, and the tape measure body is placed on the ground.
- Turn the key switch to Ground Control, and pull out the emergency stop buttons on ground and platform.
- Press and hold the platform up button on ground control until the platform stopping raising automatically.
- Record the raised height.
- Lower the platform to stowed position.

Result: the max platform height is equal or small than 16m/52ft 6in. The machine is functioning properly.

Result: the max platform height is greater than 16m/52ft 6in. Adjust or replace up limit switch.

3.7.4.19 Check drive hub lubrication grease and bolts

Lubrication point: oiling plug.

Lubricant capacity: each wheel requires about 1L/0.3 us gal, which is about half the volume of the wheel.

Lubricant type:SAE80W/90 Industrial Gear Oil for Close Motor.

This inspection is performed every 250 hours or quarterly, whichever comes first.

Replacing drive hub lubrication is essential to extend service life and maintain good performance. Failure to change the lubricant regularly will result in reduced performance, and running the unit with insufficient lubrication will cause damage to components.

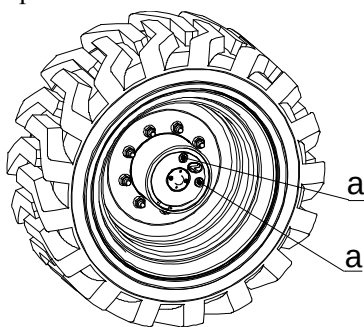


Figure 3-14 Oiling plug

- Drive the rough terrain scissor lift so that any one of the wheels' oiling holes is at the highest position and the other is at a horizontal position, as shown in Figure 3-14, a is the oiling plug.
- Take out the oil plug in horizontal position and check the position on the right side.
Result: the oil level is flush with the bottom position of the oil hole in the side position.
- If the oil level is lower than the lower surface of the oil hole at the side, remove the top oil plug and fill it with oil until the oil level is flush with the bottom of the side hole.
- Apply thread sealant to the oil filling plug, then screw it into the oil hole of the wheel hub and tighten it.
- Inspect the wheel hub bolts according to table 2-8.
- Repeat the above steps for the remaining drive hubs.

3.7.5 Maintenance every 6 months

3.7.5.1 Inspect platform overload system

This inspection is conducted every 500 hours or 6 months, whichever comes first. Check immediately when the machine has an overload fault.

Testing the platform overload system regularly is essential to safe machine operation. Continued use of an improperly operating platform overload system result in the system not sensing an overload platform condition. Machine stability could be compromised resulting in the machine tipping over.

The platform overload system is designed to prevent machine operation in the event the platform is overloaded. Platform overload system is composed of two electrical components: overload pressure transducer and the angel sensor.

The overload pressure transducer is used to determine the pressure for feedback to the platform overload system. When the pressure is too high, the pressure sensor will send a signal to ECU and all functions of the machine will stop until the excess load is removed from the platform.

Angle sensor, located at the scissor arm, is used to measure the tilt angle of the scissor to determine the height of the platform.

- a) Move the machine to a firm and level ground.
- b) Place heavy objects on the platform (748kg/1649lbs for ZS1623RT).
- c) Turn the key switch to Ground Control, and attempt to raise the platform to approximately 3.2m/10ft 6in.

Result: alarm will sound, display shows OL.

Result: alarm does not sound, and display does not show OL. Platform continues to raising

Perform load calibration again or contact professional service personnel.

3.7.5.2 Replace hydraulic tank exhaust cover

This inspection is conducted every 500 hours or 6 months, whichever comes first. Check immediately when the machine has an overload fault.

The hydraulic tank is a vented tank. There is an air filter inside the venting cap that may become clogged over time. If the vent cover fails or is improperly installed, once the impurities enter the hydraulic system, it may cause damage to the components. Extremely dirty conditions may require more often inspection.

- a) Remove the venting cap.
- b) Replace a new hydraulic tank venting cap.

3.7.5.3 Replace engine oil and filter

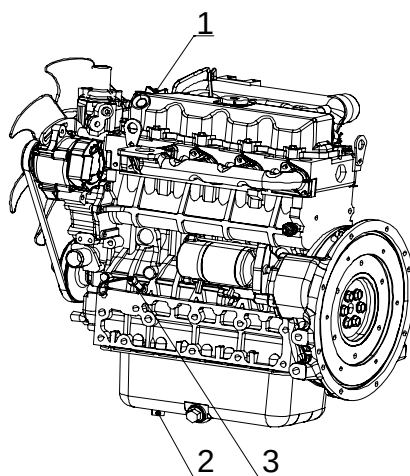
The first maintenance is conducted after 50-100 hours of usage, with an interval of 500 hours or 6 months. If the ambient temperature is continuously below -10° (14° F), or the oil temperature is below 60° C (84° F), or the sulfur content in diesel fuel is 0.5-1%, and the oil change interval is halved. If the oil does not reach the replacement interval within one year, then change the oil at least once a year.

⚠ WARNING

1. **Do not do the test if the engine is running!**
2. **No smoking and flame!**
3. **Beware of burn hazards when contacting hot oil.**

When working on the oil system, pay attention to the cleanliness of the external surface, carefully clean all areas involved, and blow dry the compressed area with compressed air.

Observe the oil safety regulations and local regulations. Dispose of spilled oil and filter elements in accordance with regulations. Waste oil must not penetrate the ground. Test run after each operation, pay attention to tightness and lubricating oil pressure, and then check the engine oil level.



1. Filling port. 2. Drain plug. 3. Oil measuring rod

Figure 3-15 Engine diagram

- a) Replace engine oil:
 - 1) Preheat and start the engine (oil temperature $> 80^{\circ}\text{C}/146^{\circ}\text{F}$).
 - 2) Place the engine horizontally.
 - 3) Turn off the engine.
 - 4) Put the receiving container under the oil drain plug.
 - 5) Unscrew the oil drain plug of the oil, and drain the old oil.
 - 6) Install a new seal ring for the oil drain plug, screw it in and tighten it.
 - 7) Add oil at the oil filling port, and the oil filling volume is 10L/2.6 us gal.
 - 8) Preheat and start the engine (oil temperature $> 80^{\circ}\text{C}/146^{\circ}\text{F}$).
 - 9) Place the engine horizontally.
 - 10) Check the oil level, adding oil if necessary.

- b) Replace engine oil filter:

Every time the oil is changed, the oil filter element must also be changed.

Never pre-fill the filter, there is a danger of contamination.

- 1) Remove the old oil filter.
- 2) Fill the new filter with clean engine oil.
- 3) Apply oil to the rubber pad before installing the new oil filter.
- 4) After the rubber pad contacts the base, tighten it 3/4 turn to 1 turn to seal it.
- 5) Start the diesel engine and check for leaks.

3.7.5.4 Replace fuel filter element

This inspection is conducted every 500 hours or 6 months, whichever comes first. Replace the filter more frequent in hostile working site.

⚠ WARNING

1. **Do not do the test if the engine is running!**
2. **No smoking and flame!**
3. **Beware of burn hazards when contacting hot oil.**

⚠ CAUTION

- a) Do not loosen the fuel injection line or high pressure line while the engine is running.
- b) Carefully clean all areas involved. Dry compressed areas with compressed air.
- c) Please observe the fuel safety regulations and relevant local regulations. Dispose of spilled fuel and filter elements in accordance with national regulations, and fuel must not leak onto the ground.
- d) After completing the work on the fuel system, exhaust the system, perform a trial operation and check the tightness.
- e) Check the battery electrolyte level. If necessary, replenish distilled water from the battery hole, do not add excess.
- f) Never pre-fill the filter, there is a risk of contamination.

⚠ DANGER

Engine fuel is flammable. When performing inspections, the machine should be in an open and well-ventilated place. Keep the machine away from heaters, sparks, flames and burning tobacco, and place a qualified fire extinguisher in an easily accessible place.

- a) Remove the old fuel filter element, if the water collection vessel installed on the filter can be reused, please remove the water collection vessel.
- b) Lubrication seal.

- c) Screw on the filter by hand until the seal is combined with the interface.
- d) Continue to twist the filter by hand until the filter is firmly installed (about 3/4 turns).
- e) exhaust until no bubbles appear.
- f) Conduct a leak test.

3.7.5.5 Valve clearance inspection and adjustment

This inspection is conducted after 50-100 hours of usage, and inspect it every 1,000 hours or year thereafter, whichever comes first.

The adjustment of the valve clearance is extremely important. If the valve clearance is too small, when the diesel engine is running, the valve will not close tightly due to thermal elongation, which will cause air leakage and reduce the power of the diesel engine. If the valve clearance is too large, the intake and exhaust will be reduced. The shortening of the door opening time results in insufficient intake air or unclean exhaust gas. At the same time, the power of the diesel engine is reduced, and the intake and exhaust valves, rocker arms, camshafts, etc. are strongly impacted.

The intake and exhaust valve clearances are both (0.3 ± 0.03) mm/ (0.01 ± 0.001) in. The adjustment of the valve clearance should be performed in a cold state. When adjusting, remove the cylinder cover and turn the crankshaft so that the top dead center scribe line on the crankshaft pulley is aligned with the pointer on the gear chamber cover. When the piston of the first cylinder is at the top dead center of the compression stroke, the intake and exhaust valve rings of the first cylinder are closed. At this time, the clearances of the first cylinder intake, exhaust valve, second cylinder intake valve and third cylinder exhaust valve can be used, that is, the clearances of the four valves 1, 2, 3 and 6 from front to back. After turning the crankshaft through a full circle, the fourth cylinder piston is at the compression stroke lock point, and the clearances of the fourth, fourth, fifth, seventh, and eighth valves from front to back can be checked.

3.7.5.6 Clean or replace engine air filter

Clean or replace every 500 hours or half a year (according to the operating conditions to shorten the cycle, the air filter alarm indicator, maintain the filter 5 times and replace the main filter).

⚠WARNING

Do not clean or replace the filter when the engine is running.

The engine must never be used without an air filter, otherwise dust and foreign matter may enter the diesel and cause premature engine wear.

The diesel engine must check the maximum intake resistance at the rated speed and full load operation. When the intake resistance reaches the maximum allowable limit, the filter element should be cleaned or replaced as required.

Remove the filter element from the air filter, and pat the end surface to make the dust fall. You can also blow back with compressed air as shown in Figure 3-16:

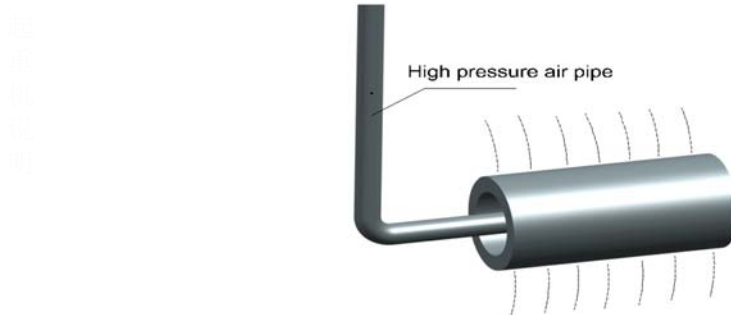


Figure 3-16 Compressed air cleaning filter

3.7.6 Maintenance every 12 months

3.7.6.1 Check scissor arm wear-resistant slider

The scissor wear-resistant slider inspection is performed every 1000 hours or every 12 months, whichever comes first.

The quality of the scissor wear-resistant slider is very important for the safe operation of the machine. Using worn wear-resistant sliders can cause component damage and unsafe work hazards

Check the wear-resistant slider with the platform closed.

- a) Measure the height of the wear-resistant slider on the chassis slide and platform slide.

Result: if the measurement result is greater than or equal to 6mm/0.2in, proceed step b.

Result: the measurement result is less than 6mm/0.2in. Replace the wear-resistant slider.

- b) Apply lubricant between the chassis slide and the wear-resistant slide, the platform slide and the wear-resistant slide.

3.7.6.2 Replace drive hub lubrication grease

Lubrication point: oiling plug.

Lubricant capacity: each wheel requires about 1L/0.3 us gal, which is about half the volume of the wheel.

Lubricant type: SAE80W/90 Industrial Gear Oil for Close Motor.

This inspection is performed every 1000 hours or yearly, whichever comes first.

Replacing drive hub lubrication is essential to extend service life and maintain good performance. Failure to change the lubricant regularly will result in reduced performance, and running the unit with insufficient lubrication will cause damage to components.

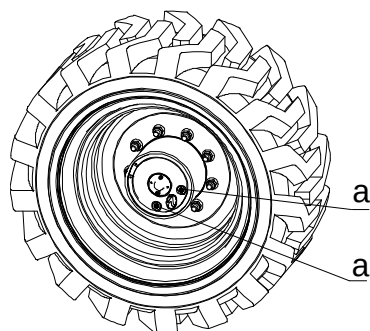


Figure 3-17 Oiling plug

- a) Unscrew the two oil filling plugs on the wheel, find an oil receiving container, and drain the oil.
- b) Drive the off-road scissor forklift so that any one of the oil filling holes of the wheels is at the highest position and the other is at the horizontal position.
- c) Add lubricating oil to the hub from the upper oil injection hole until the oil level is flat with the lower surface of the oil injection hole in the horizontal position.
- d) Apply thread sealant to the oil filling plug, then screw it into the oil hole of the wheel hub and tighten it.
- e) Repeat the above steps for the remaining drive hubs.

3.7.7 Maintenance every 24 months

3.7.7.1 Test or replace hydraulic oil

Good quality hydraulic oil is essential to good machine performance and service life. Dirty hydraulic oil and suction filters can affect machine performance, and continuous use can damage components. This operation should be performed more frequently in harsh working conditions.

If the hydraulic oil has not been replaced for two years, it should be tested once every quarter, and the hydraulic oil should be replaced if the test fails.

This procedure should be conducted once every quarter. The hydraulic oil should be replaced if the test fails.

We suggest that changing time of the hydraulic oil is as follows:

- a) First changing: operating for 500 hours after commissioning.
- b) Second and subsequent changing: run for 2000 hours or once every two years.

The above recommended intervals are suitable for most applications. Higher temperatures, pressures and adverse working conditions will accelerate oil failure, so hydraulic oil should be replaced earlier. For small load work, the oil change time can be extended.

For hydraulic oil types and models, please refer to Table 3-5 Hydraulic oil technical parameters (not used to specify the type and parameters of hydraulic oil). Please select the hydraulic oil of the appropriate brand and technical parameters according to the specific use environment of the equipment. For special environments or users with special requirements, please contact ZOOMLION or hydraulic oil manufacturers.

DO NOT mix oils of different brands or types, as they contain different additives which may cause negative effects. If mixing of hydraulic oils is unavoidable, permission must be obtained from the hydraulic oil manufacturer. After-sales service of ZOOMLION does not cover machine malfunction caused by hydraulic oil mixing.

Table 3-5 Technical Parameters of Hydraulic Oil

Technical Parameters Brand & Type	ISO Viscosity Grade	Pour Point °C/°F	Flash Point °C/°F	Kinematic Viscosity cSt(40°C/ 104°F)	Viscosity index
Great Wall 4632 grease non-flammable hydraulic oil N32 (Eco-Friendly)	32	-20/-4	270/518	28.8-35.2	180
Great Wall Ground 10 aviation hydraulic fluid	—	-55/-67	107/225	10.53(50°C/ /122°F)	120
Great Wall ZhuoLi L-HS 15 Ultra-low temperature hydraulic	15	-57/-71	164/327	15.35	172
Great Wall ZhuoLi L-HS 32 Ultra-low temperature hydraulic	32	-48/-54	224/435	31.35	166
Great Wall ZhuoLi L-HS 46 Ultra-low temperature hydraulic	46	-43/-45	238/460	45.81	170
Great Wall ZhuoLi L-HV 15 Low temperature hydraulic oil	15	-45/-49	173/343	15.51	140
Great Wall ZhuoLi L-HV 32 Low temperature hydraulic oil	32	-39/-38	231/448	33.4	150
Great Wall ZhuoLi L-HV 46 Low temperature hydraulic oil	46	-37/-35	240/464	48.7	150
Great Wall ZhuoLi L-HV 68 Low temperature hydraulic	68	-35/-31	238/460	70.47	150
Great Wall ZhuoLi L-HM 46 Anti-wear hydraulic oil (high pressure)	46	-15/5	240/464	45.8	97
Great Wall ZhuoLi L-HM 68 Anti-wear hydraulic oil (high pressure)	68	-13/9	245/473	67.4	98
Mobil SHC Aware H 32 (Eco-Friendly)	32	-30/-22	185/365	32	140

Table 3-5 Technical Parameters of Hydraulic Oil

Technical Parameters Brand & Type	ISO Viscosity Grade	Pour Point °C/°F	Flash Point °C/°F	Kinematic Viscosity cSt(40°C/ 104°F)	Viscosity index
Clarity Synthetic EA Hydraulic Oil	46	-44/-47	221/430	46	180
Mobil DTE 10 Ultra 22	22	-54/-65	224/435	22.4	164
Mobil DTE 10 Ultra 32	32	-54/-65	250/482	32.7	164
Mobil DTE 10 Ultra 46	46	-45/-49	232/450	45.6	164
Rando HDZ 15	15	-60/-76	150/302	15.7	144
Rando HDZ 32	32	-49/-56	204/399	33	150
Rando HDZ 46	46	-47/-53	216/421	46.7	153
Rando MV 15	15	-42/-44	154/309	15.8	155
Rando MV 32	32	-36/-33	210/410	33.5	154
Rando MV 46	46	-33/-27	214/417	44	154

Proper use of hydraulic oil: please note the corresponding oil viscosity and temperature limit. Under normal operating conditions, the recommended oil temperature should be controlled between 30°C/86°F and 60°C/140°F and the maximum is not more than 90°C/194°F. The oil temperature affects the oil viscosity and the thickness of the oil film. High temperatures also shorten the service life of oil seals and other rubber components, and the oil also evaporates and oxidizes.

Add the corresponding type of hydraulic oil according to the customer's requirements before ex-factory. When the working environment temperature changes beyond the working range of the hydraulic oil, please replace other suitable types of hydraulic oil according to the actual situation. Considering the safety of the components and the efficiency of the work, it is recommended that the starting temperature of the equipment is higher than the selected hydraulic oil pour point temperature of 25°C/77°F or more.

Cleanliness of the hydraulic oil upon delivery is NAS9 (ISO4406 18/15), and for normal operation, the cleanliness should not be lower than NAS10 (ISO4406 19/16). We suggest that the hydraulic oil should be checked every 6 months, and the oil should be sampled at least once upon the time for oil changing. The oil sample can be sent to the hydraulic oil manufacturer or qualified third-party testing agency for analysis and to determine whether it is still usable.

This procedure should be conducted once every quarter. The hydraulic oil should be replaced if the test fails.

- a) Disconnect the battery pack from the machine.

⚠WARNING

Operation in a live circuit can result in serious injury or death. Remove rings, watches and other jewelry.

- b) Open the hydraulic tray.
- c) Mark and disconnect the oil return tube from hydraulic filter to the hydraulic tank and remove the line from the tank. Cover the pipe joint to protect it from dust.
- d) Loosen the hydraulic tank fastener and remove the hydraulic tank.
- e) Remove the drain plug from the bottom of the hydraulic tank.
- f) Put the oil in a suitable container.

⚠WARNING

The jetted hydraulic oil can burn the skin. Slowly loosen the hydraulic joint to allow the oil pressure to gradually weaken. Do not let the oil spray out.

- g) Clean up and properly dispose any oil that may have spilled.
- h) Clean the hydraulic tank with a mild solvent and thoroughly air dry.
- i) Tighten the drain plug.
- j) Replace the hydraulic tank and install the fasteners that tighten the hydraulic tank.
- k) Oil the hydraulic pump and connect it to the tank.
- l) Connect the hydraulic pump tubing to the return filter.
- m) Start the oil pump and fill the entire hydraulic system with hydraulic oil to remove the air from the hydraulic system.

⚠WARNING

Operation without oil may result in damage to the hydraulic pump. When filling the hydraulic system, carefully evacuate the tank. Do not expose the hydraulic pump to cavitation.

3.7.7.2 Refill or replace engine coolant

Conduct this item every 2000 hours of usage or once every 2 years.

Observe the safety regulations for coolants and local regulations. Dispose of the spilled coolant as specified and do not leave it on the ground. The cooling system is under pressure and the cover can only be opened when it is cool. The coolant must have the specified cooling system protectant concentration. Never run the engine without coolant, even for an extremely short period of time.

⚠ WARNING

Hot coolant can cause burns.

- a) Drain the cooling system:
 - 1) Carefully open the cooler door.
 - 2) Place the receiving container under the coolant port.
 - 3) Drain the coolant.
 - 4) Reconnect and tighten the coolant connection.
 - 5) Close the cooler door.
- b) Refill coolant:
 - 1) Carefully open the cooling system door.
 - 2) Fill the coolant to the maximum mark or limit position.
 - 3) Turn on possible heating devices and adjust to the maximum position, so as to fill the heating circuit and exhaust.
 - 4) Close the cooler door.
 - 5) Warm start the engine to operating temperature.
 - 6) Shut down the engine.
 - 7) Check the coolant level when the engine is cooling, and fill to the max mark position if necessary.

ZOOMLION

Service and Maintenance Manual

Section 4 Electrical System Maintenance



Section 4 ELECTRICAL SYSTEM MAINTENANCE

4.1 Troubleshooting of Electrical Systems

If the platform controls LED or ground controls LCD diagnostic readout displays following codes, the fault condition must be repaired or removed before resuming machine operation.

4.1.1 Fault code

Table 4-1 Fault code list

Code	Display	Describe
01	01 Internal ECU Fault	Main system fault
02	02 Platform ECU Fault	Communication fault
08	08 Floating Coil Left Fault	Left floating solenoid valve coil failure
09	09 Floating Coil Right Fault	Right floating solenoid valve coil failure
14	14 Angle Sensor Fault	Angle sensor error
15	15 Pressure Sensor Fault	Pressure sensor error
20	20 Chassis Start Sw Fault	Chassis start switch error at start up
21	21 Chassis Choke Sw Fault	Turn off switch error at start up
22	22 Chassis Up Sw Fault	Elevated switch error at start up
23	23 Chassis Lift Sw Fault	Lift switch error at start up
24	24 Chassis Down Sw Fault	Down switch error at start up
25	25 Left Turn Switch Fault	Platform left turn switch error at start up
26	26 Right Turn Switch Fault	Platform right turn switch error at start up
27	27 Drive Enable Sw Flt	Platform enable switch error at start up
28	28 Off Neutral Drive Joystick	Platform handle is not in the zero position when starting
31	31 Platform Choke Sw Fault	Platform preheating switch error at start up
32	32 Platform Start Sw Fault	Platform start switch error at start up
33	33 Left Front Outrig Sw Flt	Outrigger left front switch error at start up
34	34 Right Front Outrig Sw Flt	Outrigger right front switch error at start up
35	35 Left Rear Outrig Sw Flt	Outrigger left rear switch error at start up
36	36 Right Rear Outrig Sw Flt	Outrigger right rear switch error at start up
37	37 Auto Level Switch Fault	Automatic level switch error at start up
42	42 9M Limit Switch Fault	9m limit switch error
43	43 Outrig Not Extended	Outriggers are not open
44	44 Float Limit Switch Fault	Float detection switch failure
49	49 Drive Coil 1 Fault	Drive coil 1 malfunction
50	50 Drive Coil 2 Fault	Drive coil 2 malfunction

Table 4-1 Fault code list

Code	Display	Describe
51	51 Drive Coil 3 Fault	Drive coil 3 malfunction
52	52 Func Prop Coil Fault	Proportional valve coil failure
54	54 Up Coil Fault	Lift up valve coil failure
55	55 Down Coil Fault	Lift down valve coil failure
56	56 Right Turn Coil Fault	Right turn valve coil failure
57	57 Left Turn Coil Fault	Left turn valve coil failure
58	58 Brake Coil Fault	Defective brake valve coil
59	59 Air Filter Fault	Air Filter clog failure
60	60 Forward 1 Coil Fault	Forward valve coil failure
61	61 Reverse 1 Coil Fault	Reverse valve coil failure
64	64 Low Fuel Pressure	Low fuel level failure
65	65 Oil-water Saporator Fault	Oil and water separated failure
66	66 Low Oil Pressure	Low oil pressure failure
67	67 High Coolant Temperature	High temperature failure
68	68 Low ECU Voltage	Low voltage failure
69	69 Low Engine RPM	Engine low speed failure
70	70 High Engine RPM	Engine high speed failure
81	81 Left Front Otrg Coil Flt	Left front leg solenoid valve coil failure
82	82 Left Rear Otrg Coil Flt	Left rear leg solenoid valve coil failure
83	83 Right Front Otrg Coil Flt	Right front leg solenoid valve coil failure
84	84 Right Rear Otrg Coil Flt	Right front leg solenoid valve coil failure
85	85 Outrigger Ext Coil Flt	Outrigger extending solenoid coil failure
86	86 Outrigger Ret Coil Flt	Outrigger retracting solenoid coil failure
88	88 Low Coolant Level	Low coolant level failure
91	91 2 Speed Coil Fault	High and low speed solenoid valve coil failure
93	93 Drive Fwd Prop Coil Fault	Forward proportional valve coil failure
94	94 Drive Rev Prop Coil Fault	Reverse proportional valve coil failure
95	95 Machine Type Fault	Machine Type Fault
98 or OL	98 Platform Overload	Platform overload failure
LL	/	Chassis tilt

4.1.2 Troubleshooting method

Table 4-2 Troubleshooting method

Code	Troubleshooting Method
01	Replace ECU
02	Inspect wiring, if the wiring is intact, replace the upper and lower controllers separately to determine which fault
08	Inspect wiring, Or replace the solenoid valve coil
09	Inspect wiring, Or replace the solenoid valve coil
14	Inspect wiring, or check sensor
15	Inspect wiring, or check sensor
20	Check switches and wiring
21	Check switches and wiring
22	Check switches and wiring
23	Check switches and wiring
24	Check switches and wiring
25	Check the switch and replace the upper controller
26	Check the switch and replace the upper controller
27	Check the switch and replace the upper controller
28	Check the handle and replace the upper controller
31	Check the switch and replace the upper controller
32	Check the switch and replace the upper controller
33	Check the switch and replace the upper controller
34	Check the switch and replace the upper controller
35	Check the switch and replace the upper controller
36	Check the switch and replace the upper controller
37	Check the switch and replace the upper controller
42	Check 9m limit, down limit and wiring
43	Extend the outrigger or lower the platform
44	Check the switch and wiring
49	Check the wiring and replace solenoid valve coil
50	Check the wiring and replace solenoid valve coil
51	Check the wiring and replace solenoid valve
52	Check the wiring and replace solenoid valve
54	Check the wiring and replace solenoid valve

Table 4-2 Troubleshooting Method

Code	Troubleshooting Method
55	Check the wiring and replace solenoid valve
56	Check the wiring and replace solenoid valve
57	Check the wiring and replace solenoid valve
58	Check the wiring and replace solenoid valve
59	Check if the air filter element is clogged, if so, replace filter element; or check the wiring
60	Check the wiring and replace solenoid valve
61	Check the wiring and replace solenoid valve
64	Check if the fuel level is too low, if so, add fuel; or replace level sensor
65	Check if the water-oil separator is full, drain it if so; or check the wiring
66	Check the wiring and replace the pressure sensor
67	Check the wiring and replace the temperature sensor
68	Check the wiring and battery, replace the battery
69	Check the wiring and engine
70	Check the wiring and engine
81	Check the wiring and replace solenoid valve
82	Check the wiring and replace solenoid valve
83	Check the wiring and replace solenoid valve
84	Check the wiring and replace solenoid valve
85	Check the wiring and replace solenoid valve
86	Check the wiring and replace solenoid valve
88	Check if the coolant level is too low, if so, add coolant; or check the wiring
91	Check the wiring and replace solenoid valve
93	Check the wiring and replace solenoid valve
94	Check the wiring and replace solenoid valve
95	Reset the machine model
98 or OL	Check if the counterweight is overweight
LL	Operate the outrigger to releve

4.1.3 ECU Pin definition

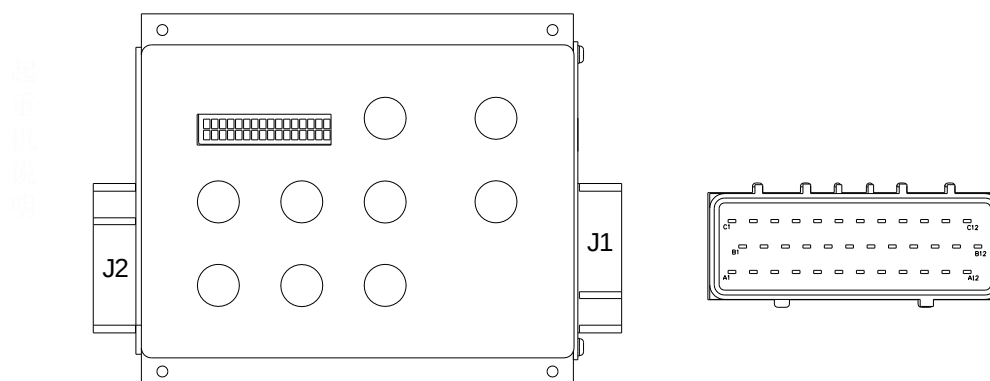


Figure 4-1 ECU Electrical Interface

Table 4-3 GCU J1 Interface pin definition

Pin	Type	Function	Pin	Type	Function
J1-1A	Output	Right-turn solenoid valve	J1-7B	Output	Outrigger retracting solenoid valve
J1-2A	Output	Left-turn solenoid valve	J1-8B	Output	Buzzer,electrical level and effective
J1-3A	Output	Lift solenoid valve	J1-9B	Output	Left front outrigger solenoid valve
J1-4A	Output	Brake solenoid valve	J1-10B	Output	Left rear outrigger solenoid valve
J1-5A	Output	/	J1-11B	Output	Right rear outrigger solenoid valve
J1-6A	Output	Light	J1-12B	Output	Float function valve
J1-7A	Output	Descend solenoid valve	J1-1C	Input	Coolant level signal
J1-8A	Output	/	J1-2C	Input	Right rear outrigger limit switch signal
J1-9A	Output	Horn(effective)	J1-3C	Input	Air filter block
J1-10A	Output	/	J1-4C	Input	Left front outrigger limit switch signal
J1-11A	Output	/	J1-5C	Input	Fuel tank low level alarm

Table 4-3 GCU J1 Interface pin definition

Pin	Type	Function	Pin	Type	Function
J1-12A	Output	Traveling speed solenoid valve	J1-6C	Input	Right front outrigger limit switch
J1-1B	Output	/	J1-7C	Input	Engine speed signal (pulse)
J1-2B	Output	Forward proportional solenoid valve (PWM)	J1-8C	Input	Water temperature switch signal
J1-3B	Output	Public proportional solenoid valve (PWM)	J1-9C	Input	Oil pressure switch signal
J1-4B	Output	Reverse proportional solenoid valve (PWM)	J1-10C	Input	/
J1-5B	Output	Right front outrigger solenoid valve	J1-11C	Output	/
J1-6B	Output	Outrigger extending solenoid valve	J1-12C	Output	/

Table 4-4 GCU J2 Interface pin definition

Pin	Type	Function	Pin	Type	Function
J2-1A	Input	Upper limit switchsignal	J2-7B	Output	Engine start
J2-2A	Input	Down limit switchsignal	J2-8B	Output	Engine ignition
J2-3A	Input	Manual descend switch Input1	J2-9B	Communication	GPS module Communication interface
J2-4A	Output	Manual descend switch Input2	J2-10B	Output	Engine throttle
J2-5A	Input	Key switch signal	J2-11B	Output	/

Table 4-4 GCU J2 Interface pin definition

Pin	Type	Function	Pin	Type	Function
J2-6A	Input	9m limit switch signal	J2-12B	Output	/
J2-7A	Input	Left rear outrigger Limit switch signal	J2-1C	Power	Power
J2-8A	Input	Oil-water separator	J2-2C	Power	Power
J2-9A	Output	Shutdown relay	J2-3C	Power	Power
J2-10A	Power	Ground	J2-4C	Output	Engine preheating
J2-11A	Communication	CANH- PCU	J2-5C	Communication	GPS module Communication interface
J2-12A	Communication	CANL- PCU	J2-6C	Input	X axis signal (Angle sensor)
J2-1B	Input	Angle sensor	J2-7C	Power	Ground
J2-2B	Power	Ground	J2-8C	Output	/
J2-3B	Input	Pressure sensor 1	J2-9C	Output	/
J2-4B	Power	Ground	J2-10C	Output	Auxiliary pump
J2-5B	Input	Pressure sensor 2	J2-11C	Output	Strobe light
J2-6B	Input	Y axis signal (Angle sensor)	J2-12C	Power	Power

4.1.4 Electrical Schematic

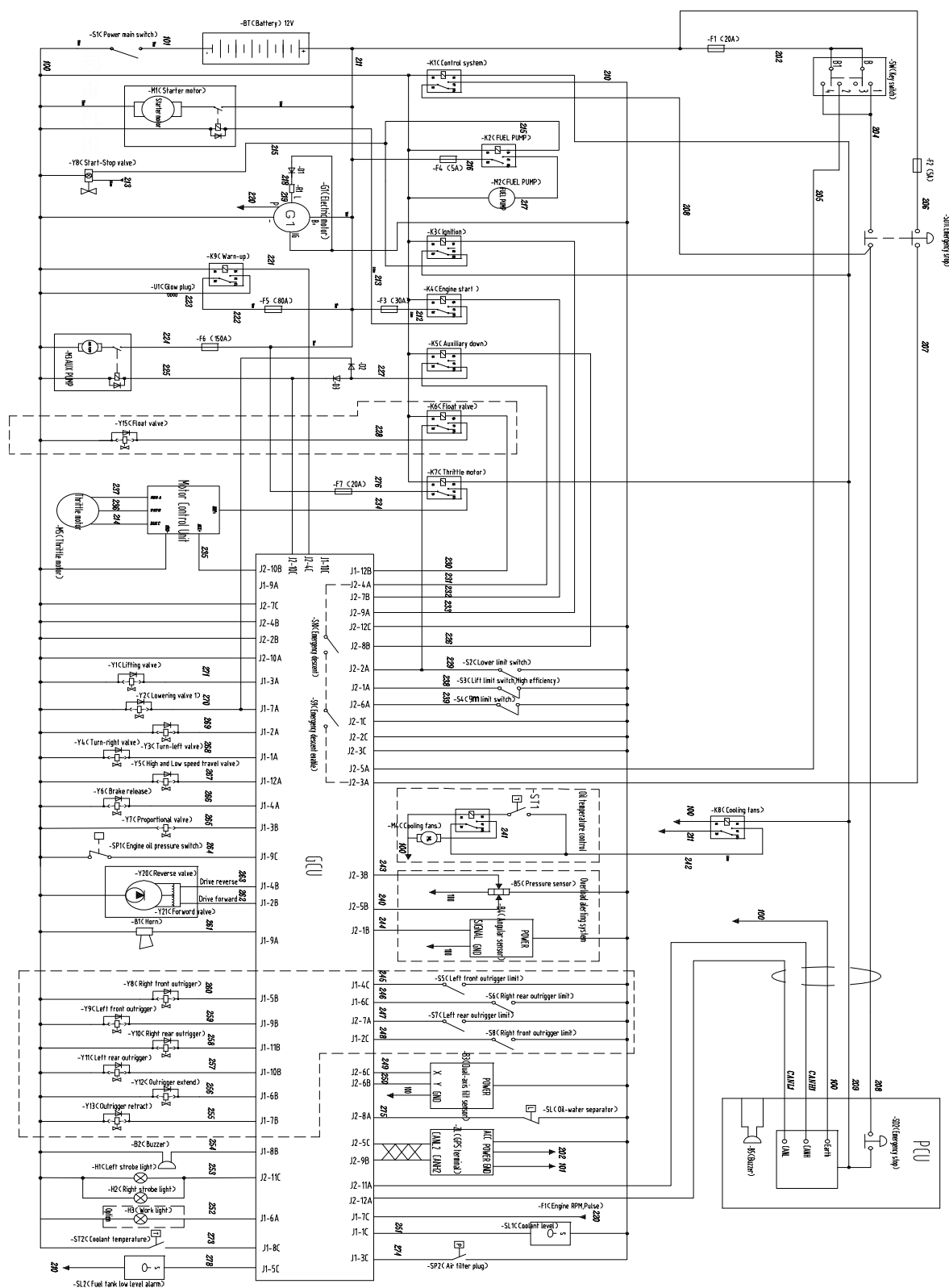


Figure 4-2 ZS1623RT Electrical Schematic

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Service and Maintenance Manual

Section 5 Hydraulic System Maintenance



SECTION 5 HYDRAULIC SYSTEM MAINTENANCE

5.1 Inspection and Maintenance of Hydraulic System

5.1.1 Routine inspection of hydraulic system

In order to keep the hydraulic system in good working condition for a long time, the hydraulic system needs to be maintained and maintained on time. The following are some routine inspections and maintenance:

Table 5-1 Hydraulic System Maintenance Intervals

No.	Inspection & maintenance items	Inspection Intervals (Working hours)							Remark
		5	25	100	250	500	1000	2000	
1	Hydraulic Oil Quantity Inspection	★							
2	Hydraulic oil sediment inspection				★				
3	Check for Clogging of Exhaust Cap of Hydraulic Oil Tank	★							
4	Oil leakage from hydraulic motor and pump, abnormal sound inspection	★							
5	Oil leakage inspection of hydraulic valve	★							

Table 5-2 Schedule replacement of hydraulic system parts

No.	Replacement parts	Replacement Intervals				Mounting position
		First time 50 H/30 D	250H /3 Months	500H /6 Months	Once every 24 months (not working)	
1	Filter Element for Oil Return Filter	★ (First time)	★			Oil circuit control
2	Filter Element for Exhaust Cover of Hydraulic Oil Tank		★ (First time)	★		Hydraulic tank
3	Replace Hydraulic Oil				Mandatory replacement	

In the routine maintenance of the hydraulic system, the following points should be noted:

- a) The functions of hydraulic oil in hydraulic system is transferring pressure, lubrication, cooling and sealing. The improper selection of hydraulic oil is the main reason for the early failure and durability decline of the hydraulic system. The hydraulic oil should be selected according to per requirements. When the use of substitute oil is needed in special circumstances, the property of the hydraulic oil should be as good as that of the original one. Different specifications of hydraulic oil cannot be mixed up, in case the hydraulic oil produced chemical reaction, or property change. If the hydraulic oil is dark brown, creamy or smelly, it cannot be used.
- b) To prevent solid impurities from mixing into the hydraulic system, the cleanness of hydraulic oil is the lifeblood of the hydraulic system. There are many precision couplings in the hydraulic system, some of them are provided with damping holes or gaps, etc. If the solid impurity intrudes, it will cause the precision couplings parts strain, block, oil duct jam and so on, which will endanger the safe operation of the hydraulic system. The invasion routes of common solid impurities are:
 - 1) Dirty hydraulic oils.
 - 2) Dirty oil charging tool.
 - 3) Carelessness during oil charge or maintenance.
 - 4) Hydraulic elements debris.
- c) Prevent air and water intrusion into hydraulic systems. At normal temperature and pressure, the air will come out from the oil when the volume ratio of air in hydraulic oil is 6%~ 8% as the pressure is lowered. The bubble rupture causes "cavitation" to the hydraulic element which produces noise. On the one hand, air also oxidizes the hydraulic oil and accelerates its deterioration. On the other hand, a large amount of air into the oil will make the "cavitation" phenomenon worse, and the compression of hydraulic oil increases, which give rise to unstable operation, low work efficiency, "crawling" actuating element and other adverse consequences. The following points should therefore be noted in preventing air intrusion:
 - 1) After maintenance and oil change, the air in the system is excluded as required.
 - 2) The seal of the pump driving shaft shall be good. When replacing the oil seal, use the "two-lip" quality oil seal, and "one-lip" oil seal is not allowed, because the "one-lip" oil seal can only one-way sealing oil, and do not have the function of sealing gas.
 - 3) The suction pipe of the hydraulic oil pump must not come out from the oil surface, and the suction pipe must be well sealed.
 - 4) Tighten the lid when oil storage barrel not in use and preferably place it upside down.
 - 5) Hydraulic oil with high water content should have multi-filtration, and dried filter paper should be used for each filtration.
 - 6) Oil charging tools should be clean and hydraulic oil must be filtered before charging. Do not remove the filter at the port of the hydraulic oil tank for faster filling up.

- 7) Oil supplier shall wear clean gloves and work clothes.
 - 8) The cleaning oil of the hydraulic system must use the same hydraulic oil as that used in the system and the cleaning oil temperature should be between 45°C/113°F and 80°C/176°F and the impurity in the system is carried away with the large flow as far as possible. The hydraulic system should be cleaned more than three times, and all cleaning oil should be let out from the system after each cleaning. Clean the filter after system cleaning, replace the filter element and fill up new oil.
- d) When removing the filler cap of the hydraulic oil tank, first remove the dirt around the fuel tank cap, loosen the fuel tank cap, and then remove the debris remaining at the joints. After confirming the cleaning, open the air filter and add oil.

5.1.2 Inspection of hydraulic oil tank

The side of the hydraulic oil tank is with scale, and the corresponding scale has the corresponding capacity value. Be sure to check the oil level of the hydraulic oil tank before the motor is started. When scissor structure in retracted position, the oil level of the tank should not be lower than the required level and also not higher than the maximum level.

If the amount of oil in the tank is found to be decreased too fast, it indicates that there is a leak in the pipeline or hydraulic components, check the hydraulic lines and components, find the leak point and prevent it from leaking before starting the engine.

When hydraulic oil is at low temperature of (below 20°C/68°F), fluidity of hydraulic oil is poor, and hydraulic components will be damaged due to over-urgent operation under this condition. the hydraulic oil will deteriorate more quickly if the temperature is too high (above 80°C/176°F), and the service life of the hydraulic components will be shortened. Therefore, after starting the engine in cold temperature environment, full preheating should be carried out to make the hydraulic oil temperature reach 20°C/68°F or so.

⚠ CAUTION

1. If hydraulic oil is found to be abnormal during inspection, no matter how long the machine runs, the hydraulic oil must be replaced. If the hydraulic oil contamination or deterioration time is too short, the cause should be identified first, and then change the oil.
2. In the course of maintenance, it is found that the amount of hydraulic oil is not enough, the oil to be replenished must be the same as that in the original tank, and the quantity specified in the oil leveler should be replenished.

5.1.3 Replace hydraulic filter

CAUTION

When replacing the filter element, please be careful not to reverse the filter inlet and outlet ports, otherwise it will cause serious consequences.

5.1.3.1 High pressure filter

Replace the filter element after 50 hours of usage, and replace the filter element every 250 hour thereafter.

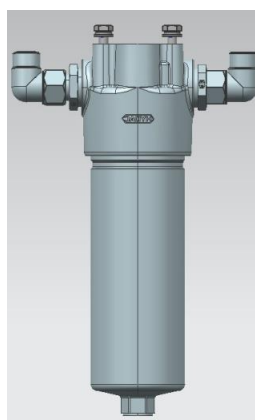


Figure 5-1 High pressure filter

5.1.3.2 Oil supplementary filter

Replace the filter element after 50 hours of usage, and replace the filter element every 250 hour thereafter.

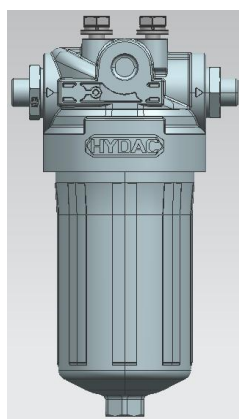


Figure 5-2 Oil supplementary filter

5.1.3.3 Return oil filter

Replace the filter element after 50 hours of usage, and replace the filter element every 250 hour thereafter.

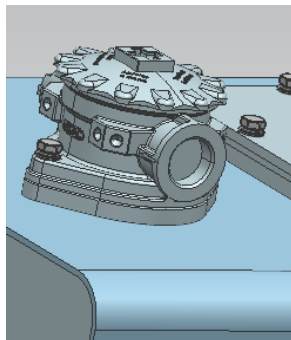


Figure 5-3 Return oil filter

5.1.4 Replace hydraulic oil

When delivery, the hydraulic oil tank has been filled up with hydraulic oil (oil type) according to customer or environment requirement.

Before changing the hydraulic oil, the work platform must be in horizontal position. Oil change steps are as follows:

- a) Switch off the motor and depressurize the hydraulic system.
- b) Install the oil exit pipe on the plug of the hydraulic tank and pump the oil into a suitable container. Take care to dispose of waste oil in an environmental friendly manner.
- c) To clean the tank with a chemical cleaning agent with pollution grade of solid particle no more than 18/15, and after cleaning and drying, rinse with a new hydraulic oil of pollution grade of solid particles no more than 18/15, then release the cleaning oil and charge new hydraulic oil into the hydraulic tank.
- d) Start the motor to run at low speed, and oil pump start working, then operate each mechanism. The new hydraulic oil discharges the old oil of each circuit of the system gradually, and the old oil discharged is not allowed to flow back to the hydraulic oil tank. When changing oil in each circuit, new oil should be added constantly into the hydraulic oil to prevent the oil pump from emptying.
- e) Install the oil plug, and prepare all the components in the initial working condition, then replenish the hydraulic oil to the specified oil level.
- f) Ensure all stop valves and quick couplings are open. All stop valves and quick couplings must be opened to keep the whole oil line open.

CAUTION

1. Hydraulic oil should not be used for more than 24 months, and after 24 months, the oil is not allowed to be used even after filtration.
2. Filter or replace hydraulic oil whenever it is found to be seriously contaminated.

3. Select appropriate hydraulic oil according to ambient temperature.
4. Hydraulic oil of different brands cannot be mixed with each other.
5. When changing oil, wash off all the old oil and take care not to mix the sand, dust, etc. with the oil tank.
6. When changing the oil in each circuit, pay attention to constantly replenishing the hydraulic fluid with new oil to prevent the pump from emptying.
7. When use the machine at cold area, it is important to have no-load start-up after reaching minimum start-up temperature. After the no-load operation, the system has reached its lowest operating temperature and then slowly increase the load and keep the system running above the lowest operating temperature.
8. Be environmentally friendly when dealing with hydraulic fluids.

5.1.5 Hydraulic system air exhaust

A large amount of air trapped in the pipeline should be discharged under low pressure conditions. There are two ways to vent air from the tubing under low pressure.

- a) On the main control valve, remove the oil inlet pipe from port "P" and remove the oil outlet pipe from port "T". Use a 15-22 connector to connect the two tubings together. Start the machine and let it run for about 10 seconds. Shut down, remove the 15-22 converter, and reconnect the tubing to the valve block.
- b) Remove the oil pipe from port "P", put it into a 15L/4 us gal bucket, and start the machine. The air should be expelled quickly (several seconds). Turn off the machine and reconnect the tubing.

CAUTION

1. Proceed step a and b to install new functional pump.
2. If a new functional pump is installed, the oil inlet pipe is connected without venting a large amount of oil from the oil pipe, and a large vacuum is generated in the pipe, and the operation of step "b" is not required.
3. When operating the platform lifting function, if the functional pump generates a lot of noise, and the lifting or lowering functions stop and move constantly, it means that there is a cavitation phenomenon, and the air passes the functional pump under high pressure, which will cause damage to the functional pump in a short time and contaminate the entire system. Ensure that all oil inlet lines are tight and that there are no leaks from the fuel tank and pump.

5.1.6 Hydraulic cylinder inspection

The cylinder of each auxiliary device should be inspected periodically. The inspection items shall include:

- a) Check for scratches on the piston rod.
- b) Check the seal between the piston rod and the cylinder for oil leakage, while doing corresponding auxiliary action.
- c) Check whether the piston rod of the longer stroke cylinder is bent.
- d) If there are oil leaks between the piston rod and the cylinder, the manufacturer or professional maintenance personnel should be called to perform the repair. Every effort should be made to prevent the piston rod from being scratched. When the piston rod is severely scratched and caused oil leakage, the manufacturer or professional maintenance personnel should be repaired. If it cannot be repaired, it should be replaced. When the piston rod is bent and cannot work properly, the manufacturer or professional maintenance personnel should be contacted to replace the cylinder.

When using and transporting hydraulic cylinders, the following aspects should be noted:

- e) The hydraulic cylinder should be packed during storage and transportation, and protection shall be added to the oil-joint face and the exposed part of the piston rod.
- f) Collision should be avoided during storage and transport..
- g) The lifting shall be secured so as not to drop and scratch.
- h) Before removing the hydraulic cylinder, the pressure in the hydraulic cylinder circuit shall be reduced to zero.
- i) When disassembling, prevent damage to the components of the hydraulic cylinder.
- j) Protect the outer surface of the piston rod, prevent bumps and scratches on the seal, and regularly clean the oil cylinder and the exposed piston rod of the dust-proof ring area. Prevent the non-easy-to-clean dirt on the piston rod surface from getting into the cylinder which could damage the piston, cylinder or seal.
- k) Regular inspection of the connection parts such as threads, bolts and immediately fastening if found loose.
- l) Frequent lubrication of the joint to prevent corrosion or abnormal wear without lubricant.

5.1.7 Hydraulic hose inspection

All hydraulic hoses need to be checked periodically for damage. During these visual inspection, all damaged hoses should be replaced immediately, even if very minor damage is found.

Possible problems with hydraulic hoses:

- a) Damage to the outer layer, e.g. abrasion, notches, cracks, etc..
- b) Ageing of the outer layer material and the formation of cracks.
- c) Deformations that do not correspond to the natural shape of the hose, such as surface relaxation, severe extrusion, distortion, etc..

- d) Leakage.
- e) Failure to comply with installation and positioning requirements (refer to the below matters needed attention of installation of hydraulic hoses).
- f) Damage to the fixtures of the hose unit.
- g) Corrosion, deformation or damage of hose unit.
- h) Exceeding storage time or service life.

Even if no damage is found, the hoses must be replaced every six years (including a maximum of two years of storage time) at the latest. For use or storage life, it should be based on the manufacturing date on the hydraulic hose.

When installing hydraulic hose, the following should be noted:

- 1) Avoid hose distortion:
 - ① The bearing pressure of the hose is lowered when it is twisted.
 - ② The twisted hose also loosens the connection to the connector.
 - ③ 7° twist to hose reduces hose life by 10%.

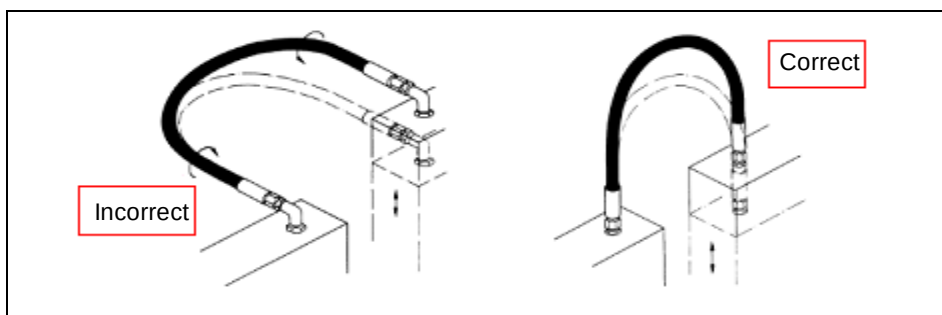


Figure 5-4 Prevent hose twisting

- 2) To increase the bending radius sufficiently:
 - ① To ensure smooth flow of fluid, effectively avoid hose damage.
 - ② Too small bending radius will greatly reduce the life of the hose assembly.

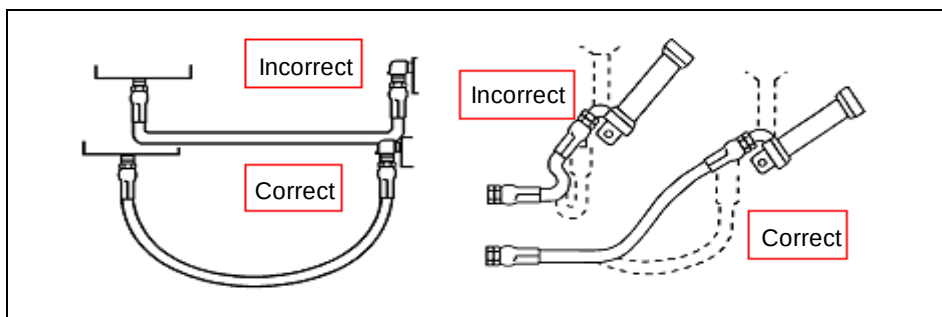


Figure 5-5 Proper bending radius

3) Use elbow and other connectors if necessary:

① Too long hose assembly can be avoided.

② To ensure that the installation is tidy and the maintenance is convenient in the future.

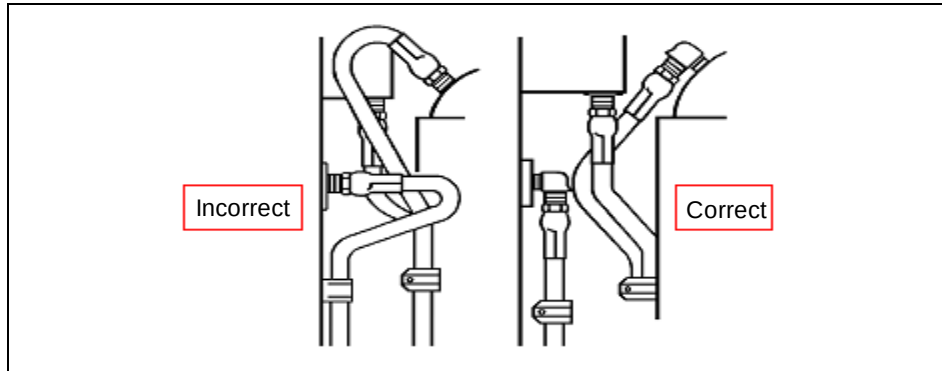


Figure 5-6 Use connectors

4) Use the clamp to ensure the hose is positioned:

Effectively reduces abrasion between hoses and associated components.

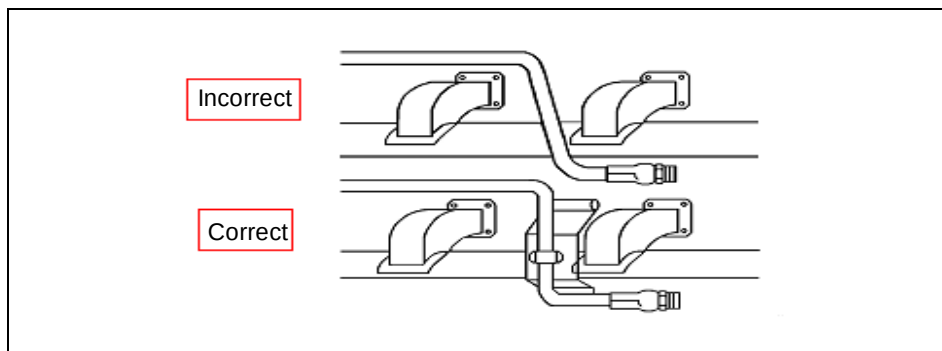


Figure 5-7 Fix with clip

5) Arrangement of Hose

① Avoid overheating surfaces and sharp edges.

② Avoid friction with parts.

③ There should be enough free length for flexion.

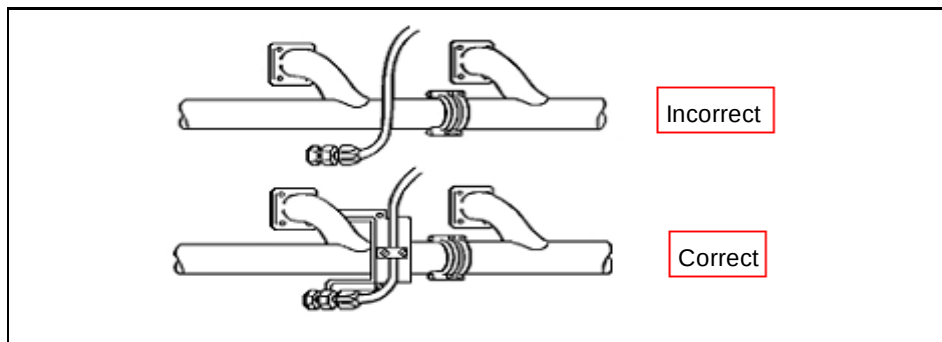


Figure 5-8 Prevent friction between parts

5.1.8 Hydraulic valves

a) Lift, steer and outrigger control valves.

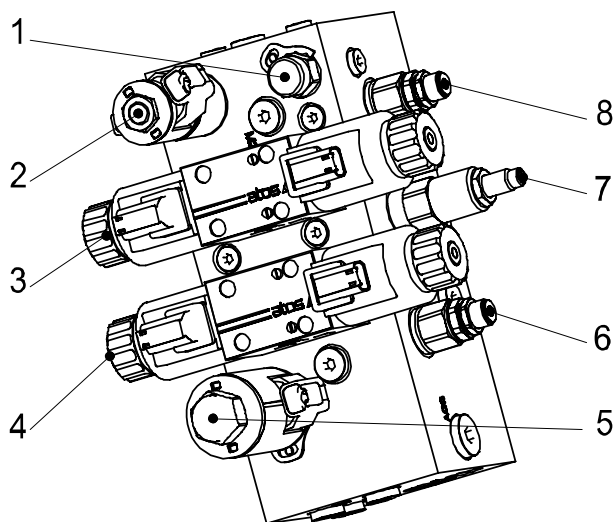


Figure 5-9 Lift, steer and outrigger control valves

Table5-1 Lift, steer and outrigger control valves

No.	Item	Function	Torque
1	Flow valve	Stable flow	27.1 Nm/20 ftlb
2	Solenoid coil	Control steering	27.1 Nm/20 ftlb
3	Solenoid coil	Control outrigger extending	8 Nm/6 ftlb
4	Solenoid coil	Control platform lifting	8 Nm/6 ftlb
5	Flow valve	Proportional flow control	27.1 Nm/20 ftlb
6	Overflow valve	Highest pressure of limit system	60 Nm/44 ftlb
7	Pressure reducing valve	Reduce pressure	34 Nm/25 ftlb
8	Overflow valve	Limit emergency unit pressure	60 Nm/44 ftlb

b) Travelling diverter valve.

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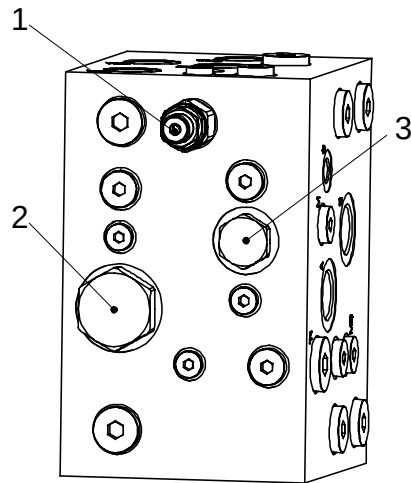


Figure 5-10 Traveling diverter valves

Table 5-2 Travel diverter valves

No.	Item	Function	Torque
1	Overflow valve	Pressure limit/overflow	43 Nm/31 ftlb
2	Flow distributing and collecting valve	Distribute flow	135 Nm/99 ftlb
3	Flush valve	Oil extraction	34 Nm/25 ftlb

c) Float balance valves.

起重機說明

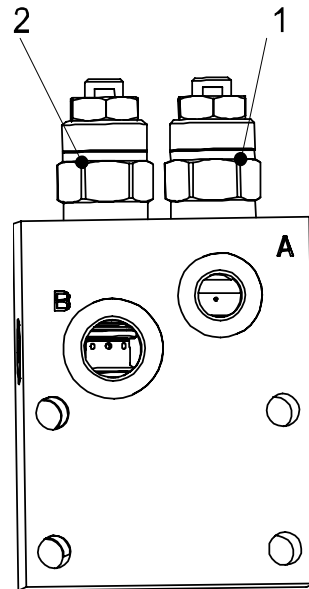


Figure 5-11 Float balance valves

Table 5-3 Float balance valves

No.	Item	Function	Torque
1	Balance valve	Lock float cylinder	30 Nm/22 ftlb
2	Balance valve	Lock float cylinder	30 Nm/22 ftlb

d) Upper lift balance valve.

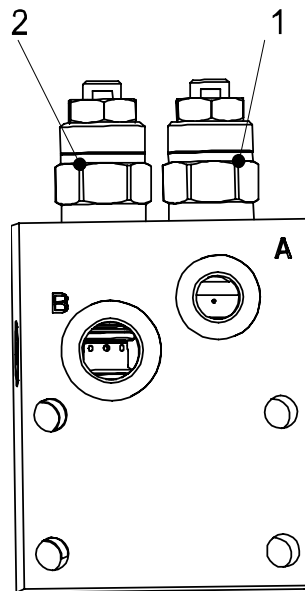


Figure 5-12 Upper lift balance valve

Table 5-4 Upper lift balance valve

No.	Item	Function	Torque
1	Plug	Block off oil port	34 Nm/25 ftlb
2	Balance valve	Lock float cylinder	73 Nm/54 ftlb

e) Upper lift balance valve.

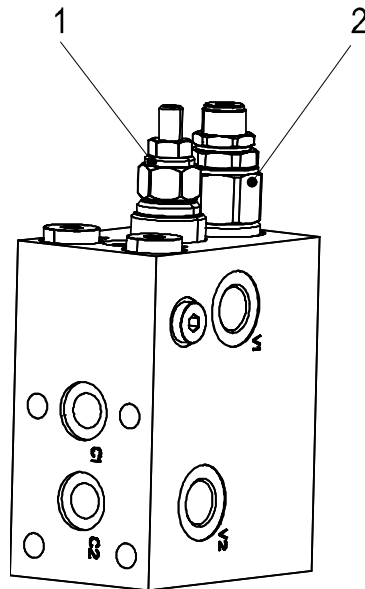


Figure 5-13 Lower lift balance valve

Table 5-5 Lower lift balance valve

No.	Item	Function	Torque
1	Balance valve	Lock float cylinder	73 Nm/54 ftlb
2	Overflow valve	Limit pressure	60 Nm/44 ftlb

f) Two-speed brake floating valve.

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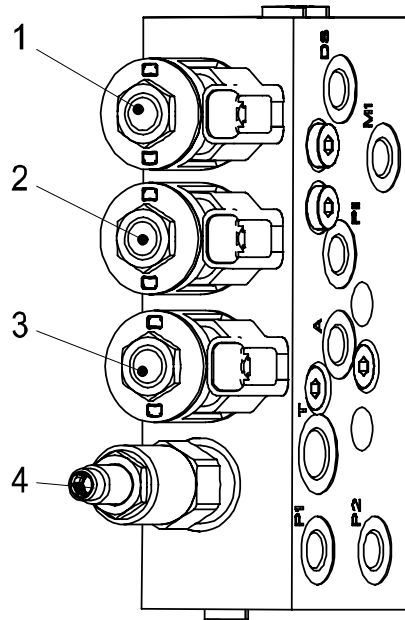


Figure 5-14 Two-speed brake floating valve

Table 5-6 Two-speed brake floating valve

No.	Item	Function	Torque
1	Solenoid valve	Switch two-speed	27.1 Nm/20 ftlb
2	Solenoid valve	Control motor start	27.1 Nm/20 ftlb
3	Solenoid valve	Control float balance valve start	27.1 Nm/20 ftlb
4	Solenoid valve	Reduce pressure	34 Nm/25 ftlb

g) Outrigger solenoid valve.

起重机说明

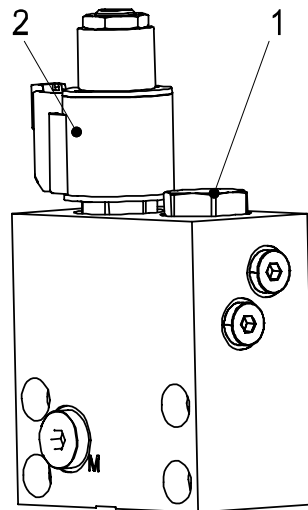


Figure 5-15 Outrigger solenoid valve

Table 5-7 Outrigger solenoid valve

No.	Item	Function	Torque
1	Check valve	Lock outrigger	34 Nm/25 ftlb
2	Solenoid valve	Outrigger extend	27.1 Nm/20 ftlb

5.1.9 Hydraulic schematics

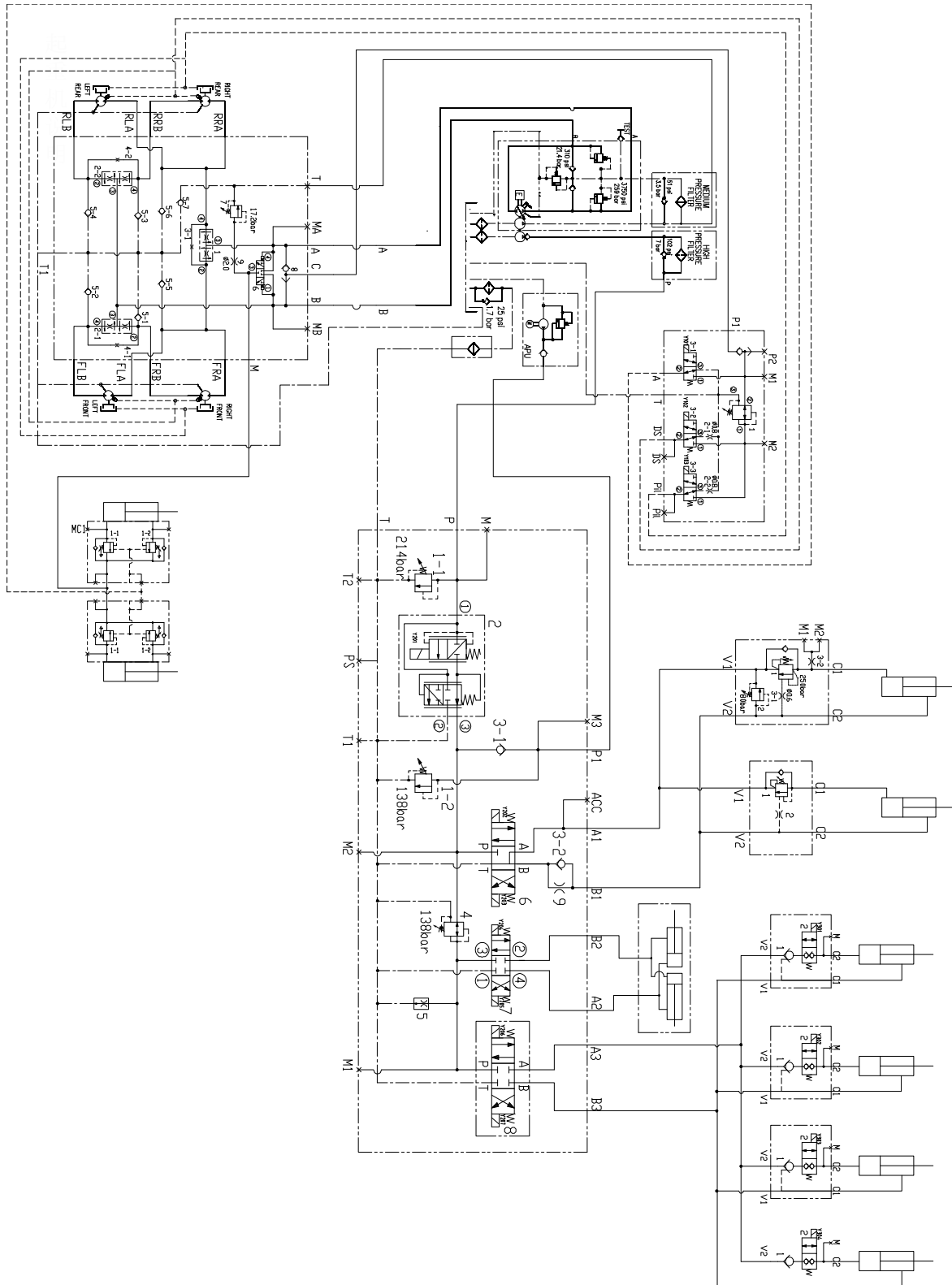


Fig. 5-16 ZS1623RT Hydraulic Schematics

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Service and Maintenance Manual

Section 6 Common Faults Analysis



SECTION 6 COMMON FAULTS ANALYSIS

When the work platform is in use, it is necessary to inspect it in time and to repair it when necessary. The purpose of maintenance is as follows:

- a) Ensuring the reliability of operations.
- b) Maintaining the efficiency of the work platform.
- c) Prevent downtime.
- d) Maintain the value of the work platform.
- e) Reduced maintenance costs.

6.1 Electrical System Fault

Table 6-1 Electrical System Fault List

No.	Fault phenomenon	Cause	Solution
1	Fault of angle sensor	1.Plug and connection of the angle sensor are loose. 2.Shift of installation position. 3.Damaged sensor.	1.Restore plug and connection. 2.Re-fixing of angle sensor. 3.Replacement of sensor.
2	Fault of pressure sensor	1.Plug and connection of the pressure sensor are loose. 2.Damaged sensor.	1.Restore plug and connection. 2.Replacement of sensor.
3	Fault of tilt sensor	1.Plug and connection of the tilt sensor are loose. 2.Shift of installation position. 3.Damaged sensor.	1.Restore plug and connection. 2.Re-fixing of angle sensor, and move the machine to the horizontal ground for zero calibration. 3.Replace sensor.
4	The work platform is elevated to the highest position and cannot be limited	1.Loose connection of upper limit switch. 2.The position of upper limit switch is shifted and cannot be triggered properly. 3.Shift of upper limit switch trigger metal plate position. 4.Upper limit switch fault.	1.Check and restore upper limit switch connection. 2.Recalibration and re-fixing installation position of upper limit switch. 3.Recalibration and re-fixing installation position of upper limit switch trigger metal plate. 4.Replace upper limit switch.
5	Safe height limit anomaly or position shifting	1.Lower limit switch connection is loose. 2.The lower limit switch position is shifted and cannot be triggered properly. 3.Lower limit switch trigger metal plate is shifted. 4.Fault of lower limit switch.	1.Check and restore the lower limit switch connection. 2.Recalibration and re-fixing the lower limit switch installation position. 3.Recalibration and re-fixing trigger the installation position metal plate of the lower limit switch. 4.Replace the lower limit switch.

Table 6-1 Electrical System Fault List

No.	Fault phenomenon	Cause	Solution
6	System communication error	1.Fault of communication lines between platform controller and ground controller. 2.Fault of work platform controller. 3.Fault of ground controller.	1.Whether CAN_H1 and CAN_L2 line on the platform and ground controller are properly connected. 2.Or replacement of the platform controller.※ 3.Or replacement of the ground controller.※
7	UP and DOWN control can't start normally.	1.300A main fuse burned down. 2.10A breaker tripping. 3.Abnormal cable connection between platform and ground controller. 4.Fault of platform controller. 5.Fault of ground controller.	1.Replacement of the 300A main fuse. 2.Press 10Acircuit breaker to restore connection. 3.Replace connection cable or plug-in of platform and ground controller. 4.Replacement of platform controller.※ 5.Replacement of ground controller.※

⚠ CAUTION

Do not disassemble or adjust when components with ※ break down. Contact the manufacturer.

Self-Propelled Rough-Terrain Scissor Lifts

Service and Maintenance Manual

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