



# HELI Reach Stacker Operation & Maintenance Manual

# FORWARD

This instruction manual mainly contains the contents of the relevant safety, performance, structure, operation and maintenance etc of the RSH4528-Vo, RSH4532-Vo, RSH4536-Vo container reach stacker in order that the operator can make proper use and maintenance.

The operators concerned and equipment management personnel of the users in the course of operation must fully read and understand this instruction manual, perform operation and maintenance according to the relevant requirements and stipulations in it so as to always keep the reach stacker of the container in good operation state.

Please note that our relevant commitments will be invalid if the requirements and stipulations in the instruction manual have failed to be followed.

Since the products and components are under constant improvement, the relevant contents of this manual are subject to any change without prior notice, please understand.

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## **I. Safety Matters Needing Attention for Operation of Container Reach Stacker**

The driver and manager of the container reach stacker must keep firmly in mind “Safety First” and operate it safely and normally according to the Users’ Operation and Maintenance Instruction for the container reach stacker.

### **1. Use of the Container Reach Stacker**

It is specially used for stacking the full-loaded containers to a stipulated height and handling within its reach. The equipment is forbidden to use beyond its purpose.

### **2. Site and Working Environment for Use of the Container Reach Stack**

#### **(1) Ground requirement**

The site where the reach stacker is applied should be with flat and solid road pavement or ground. It cannot be driven on the uneven, muddy or spongy ground.

#### **WARNING:**

**If need be, the driver should be very careful in driving the reach stacker on a slope or rough ground.**

Keep off rocks or rough and uneven road surface. Reduce the speed and try not to damage the chassis if such road surface is unavoidable.

Use the skid chain when driving the equipment on icy and snowy surface. Avoid sudden acceleration, stoppage and turn, and control the travel speed by pedal accelerator.

(2) The engine will discharge many kinds of harmful gases, which may accumulate in an enclosed environment and do harm to health and even endanger life, so the driver should pay attention to the safety and avoid working long in such environment.

### **3. Transportation of the Container Reach Stacker**

Pay attention to following matters in loading and transporting of container reach stacker:

(1) Spreader and telescopic arm should be dismantled and transported separately for long-distance delivery.

(2) For chassis transport, parking braking should be conducted to fix the vehicle, with the front and rear tyres being firmly wedged in place.

(3) All parts that possibly move in the course of transportation need to be fixed or held.

(4) Perform lifting operation according to the position indicated by the lifting sign. The removable parts of reach stacker include counterweight, telescopic arm assembly and spreader and their external dimensions and weights are listed in the table as follows.

	Outline dimension (mm)	Weight (kg)	Remarks
Upper counter weight	3200×2470×950	14000	RSH4528
Upper counter weight	3200×2470×950	15000	RSH4532
Upper counter weight	3200×2470×950	16000	RSH4536
Lower counter weight	1620×1270×622	4400	
Spreader	6060×1080×2200	9000	
Telescopic arm assembly	8530×1820×600	3700	

#### **4. Storing of the Container Reach Stacker**

(1) Placing of static fuel.

(2) Unpainted surface is coated with rust preventive oil, and the part between telescopic arm and slider coated with lubricating grease.

(3) The piston rod exposed out of hydraulic cylinder is coated with rust preventive oil.

(4) Telescopic arm is set at the lowest position.

(5) Parking brake is applied.

(6) The front and rear tyres are well wedged.

## **5. Preparations Before Use**

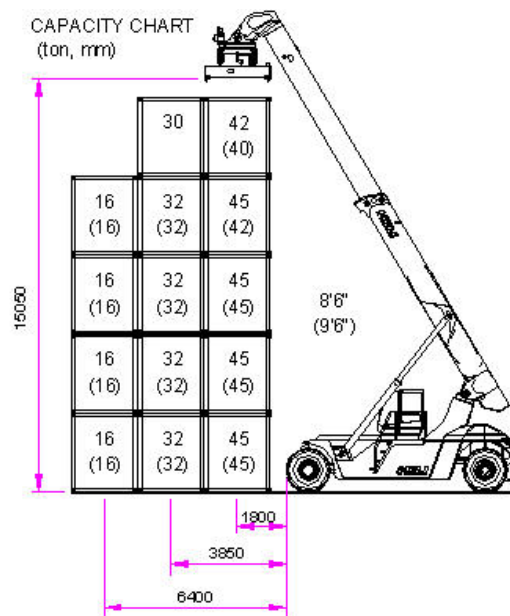
- (1) Do not check fuel, oil leak, oil level and electrical meters in presence of open fire, not fill fuel while the machinery is in operation.
- (2) No smoking at the time of fuel system being in operation and checking storage battery.
- (3) Check hydraulic oil volume, hydraulic braking system oil volume, throttle oil-can level.
- (4) Check tyre pressure.
- (5) Check piping, joints, pumps, valves for leakage or damage.
- (6) Check forward and reverse gear handle to see if they are in the middle position or not (neutral gear).
- (7) Check instruments, lighting, switches and wiring to see if they work well or not.
- (8) Check the movement of spreader, working indicator of the device and mechanical twist lock sign.
- (9) Check each handle and the pedal.
- (10) Make preparations before startup.
- (11) Loosen the parking brake.
- (12) Check the service brake.
- (13) Check the action of telescopic arm, forward and backward tilting, turning and braking of variable-amplitude oil cylinder, and the performance of spreader.
- (14) Frequently check the degree of pollution of the hydraulic oil.
- (15) Check the load sensor before lifting container and the figure indicated by the load sensor should not exceed the maximum allowable load.

## **6. Safe Operation Regulations for the Container Reach Stacker**

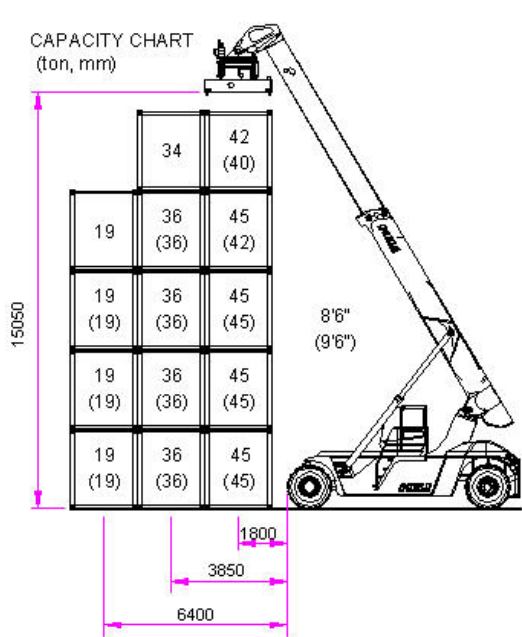
- (1) The container reach stacker driver must accept training and acquire driving license

before taking the job.

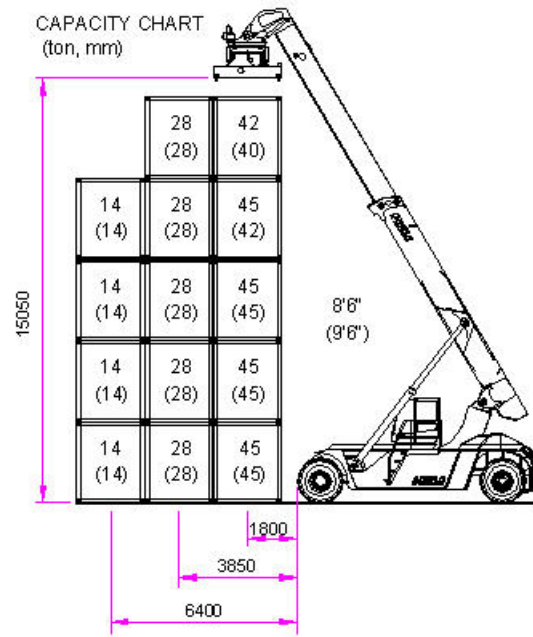
- (2) Vehicle is forbidden to use in the presence of force-6 gale and above.
- (3) The driver should put on protective shoes, cap, garments and gloves during operation.
- (4) Up/down stairs and platform to walk on should be firmly secured.
- (5) Check each controller and alarm and remove any trouble such as damage or defect, if any, before driving. The vehicle is forbidden to use in case the safety protective units of the vehicle and spreader are not in effect.
- (6) Perform loading and unloading strictly according to relevant requirements for the spreader and the vehicle as a whole. The weight to be lifted should be under strict control according to the vehicle load chart.



**RSH4532**



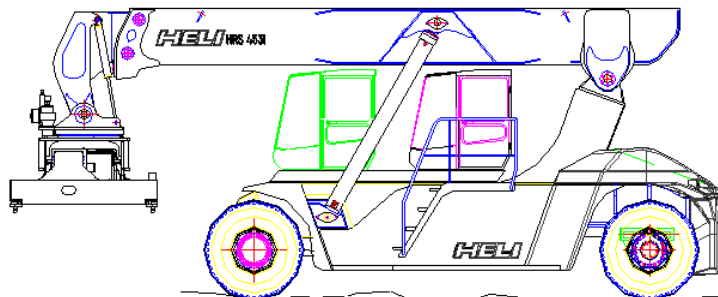
**RSH 4536**



**RSH 4528**

(7) Lifting, lowering and running are forbidden when the lifted container deviates from the central line. Lateral movement and turning by spreader are allowed only at standstill of the vehicle. Prevent the container and telescopic arm from colliding with the vehicle body or other objects when turning the spreader.

(8) Do the best to make the vehicle's action smooth and avoid sudden motion at the time of startup, loading and unloading, turning, traveling, braking and parking. Reduce the speed when running on the moist and slippery road. Forbid driving the vehicle on the bumpy and loose road.



(9) Pay close attention to the working state indicator of spreader and the handling operation signal prompt by mechanical twist lock sign. Forbid forcing to lock

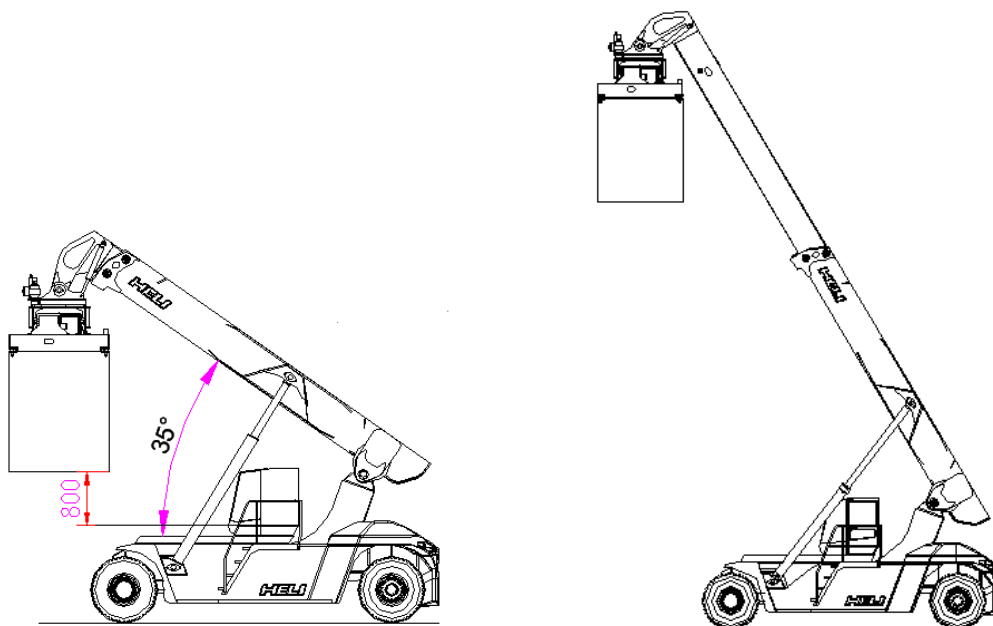


container with the twist lock of spreader. Forbid moving the container before the twist lock locks it.

(10) The spreader override switch can only be used in case that the safety unit sensor of the spreader fails and the spreader cannot lift weight and the twist lock cannot open and close. For the convenience of maintenance, it can only serve as a provisional operation. Forbid handling container in the state of safety override of the spreader. Immediately repair the spreader or the whole vehicle after application of the safety override switch due to breakdown.

(11) After the spreader safety override switch is employed in the emergency, owing to failure of all safety units, the operator must visually check the twist lock to ensure it in normal position before handling container, otherwise serious accidents may occur, such as breakage of the twist lock or fall of the container.

(12) It is better to keep an angle of 35 degrees between the telescopic arm and the ground or the lowest point of the container 800mm above the seat when traveling with container. Lifting, lowering and swaying the object are forbidden when traveling. The vehicle is forbidden to move when it lifts an object at high level.

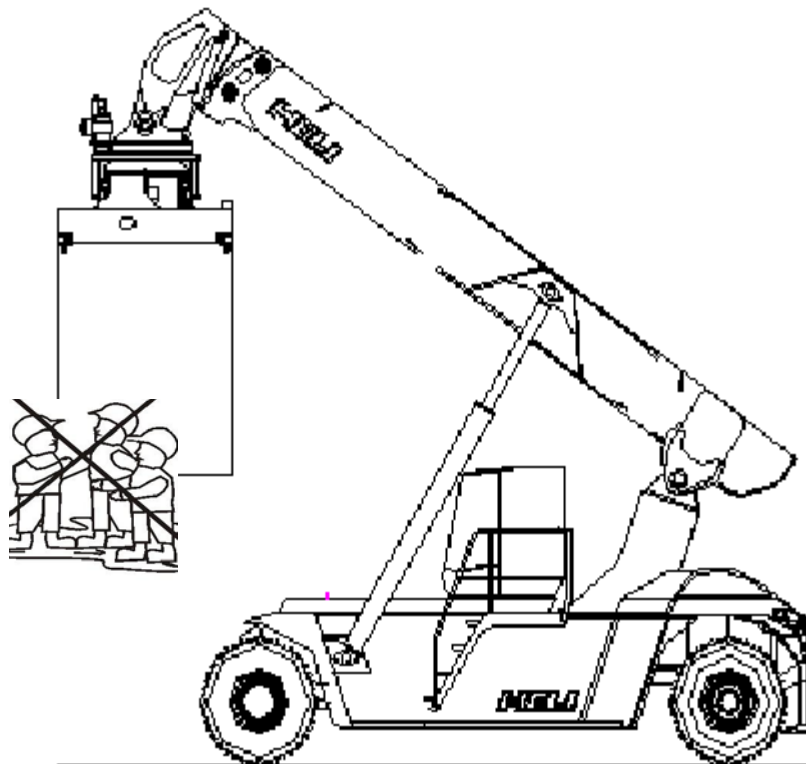


(13) Be careful when traveling on a slope. Move forward when climbing and backward when descending on a slope of above 1/10. Do not swerve when climbing and descending on a slope to prevent overturning. No handling operation when climbing on a slope.

(14) Reduce the speed, be careful in driving and pay attention to the overhead space and the distance away from surrounding people and objects when approaching a turn, slope, moving down a slope or in case of poor visibility.

(15) Neutral-gear gliding is forbidden when moving down a slope or traveling, otherwise the gearbox and torque converter may be damaged seriously.

(16) It is forbidden that anyone stands over and below the spreader and lifted container, walks below them and stands at any part around the vehicle when it works.



(17) Forbid operating the vehicle and spreader out of the seat of driver. In normal cases, forbid tilting forward the gantry at the time of full load and at the utmost height.

- (18) Slow down and be doubly careful in driving at a harbor or on a provisional board pavement.
- (19) The driver should leave and stall the vehicle when refueling. Do not switch on the ignition when checking storage battery or oil tank level.
- (20) Tilt and fully lower the gantry, make the spreader touch the ground, put the handle in the neutral gear position, stall the engine and switch off power source when leaving the vehicle, moreover, apply parking brake when parking the vehicle on a slope.
- (21) Be careful in reversing to avoid hitting any person or object.
- (22) Do not open the water tank cover when the engine is very hot.
- (23) Multi-port valve and safety valve pressures have been properly adjusted before the container reach stacker leaves factory. Do not try changing them willfully during use to avoid raising the pressure and damaging the whole hydraulic system and elements.
- (24) Strictly forbid adjusting the vehicle parts or performing overhaul and maintenance when loading and unloading.
- (25) Forbid sudden turn in direction at high speed when the container reach stacker travels.
- (26) Fill the tyres according to the pressure specified by the “Tyre Pressure” sign. Let off the air in a tyre when changing it.
- (27) When performing welding for the vehicle, the operator should cut off the power source and electric control CPU, protect the inflammable parts of the vehicle with fire preventive material.
- (28) Frequently check the piping of hydraulic system and braking system, and timely change it if damages are found.
- (29) Ensure no pressure inside the piping when performing maintenance and overhaul

for the hydraulic and braking systems.

(30) Regularly check all moving parts of the vehicle (such as frame, telescopic arm, front axle and rear axle joints, connecting parts of variable-amplitude cylinder with telescopic arm and frame, driveshaft, all sliders, moving parts of spreader, etc.) to ensure that all pin shafts stay in normal position and bolts are well connected and not worn.

(31) Regularly check (once every 50 hours) the installation of counterweight, front axle, rear axle and bolt connections.

(32) This vehicle is provided with fire extinguisher, installed inside the driver's room. Ensure the fire extinguisher under the custody of qualified personnel and subject to periodical inspection.

(33) Before towing the vehicle, cut off the drive shaft between the driver and gearbox, otherwise the gearbox and torque converter may be severely damaged.

(34) During maintenance and repair, discharge of various waste oils and electrolyte of storage battery should comply with national environmental protection treatment requirements.

(35) Fuel must be let out of the tank if the equipment is set aside for a long time. Take out the storage batteries and put them in a place with good ventilation and fire-prevention conditions, put on handbrake and wedge the wheels.

(36) Maintenance at higher elevation must be in conformity with norms for steeplejack. Forbid work performed against regulation. Follow the rule Safety First for everything to be done.

(37) The braking system of this equipment is furnished with accumulator whose pressure is as high as 25MPa. To prevent any accident that may occur, when repairing the braking unit, the operator must release the accumulator pressure with pressure-relief valve before removing any parts.

(38) The equipment maintenance and repair men must be subject to training, qualification examination and acquire Qualification Certificate or approval by relevant department before taking their jobs.

(39) Ensure stalling the engine, lowering the spreader, full withdrawal of telescopic arm and putting on parking brake before performing repair and check for the vehicle.

(40) Maintain the maximum traveling speed of the full-loaded vehicle no more than 15km/h.

## **7. Parts and Fittings**

(1) Use of parts and fittings that are not specially provided by our company may undermine the product safety.

(2) Propose using authentic HELI parts provided by our agents and repair service when changing any part.

(3) HELI will not be responsible for any breakdown due to use of non-authentic HELI parts in the period of the equipment under guaranty.

## **8. Signs**

Signs stuck on the vehicle are used for telling how to use the vehicle and what matters need attention, which are good to both the operator and the vehicle. If a sign falls off, please stick it on again immediately, and you can contact our salesmen if any sign is damaged and unable to use any longer.

(1) Safety sign

(2) Instructions sign

(3) Reach stacker sign

(4) Lubricating system sign

(5) Load chart sign

(6) Key points for check before startup sign

(7) Filling hydraulic oil sign

(8) Refueling sign

(9) Filling antifreeze fluid sign

(10) Tyre safety sign (air-filled)

(11) Tyre pressure sign (air-filled)

(12) Lifting sign

(13) Caution against hurting hand sign

(14) Sign for forbidding entry into space behind gantry

(15) Fan safety sign

### **9. Driver's Room**

This equipment has a driver's room with one door on the left and one on the right. The door handle is fitted with a key lock for locking the door outside the room. Press down the button to open the door.

Keep the inside of driver's room clean. Please do not operate the vehicle with wet or oily hands. Regularly clean and lubricate the door key lock.

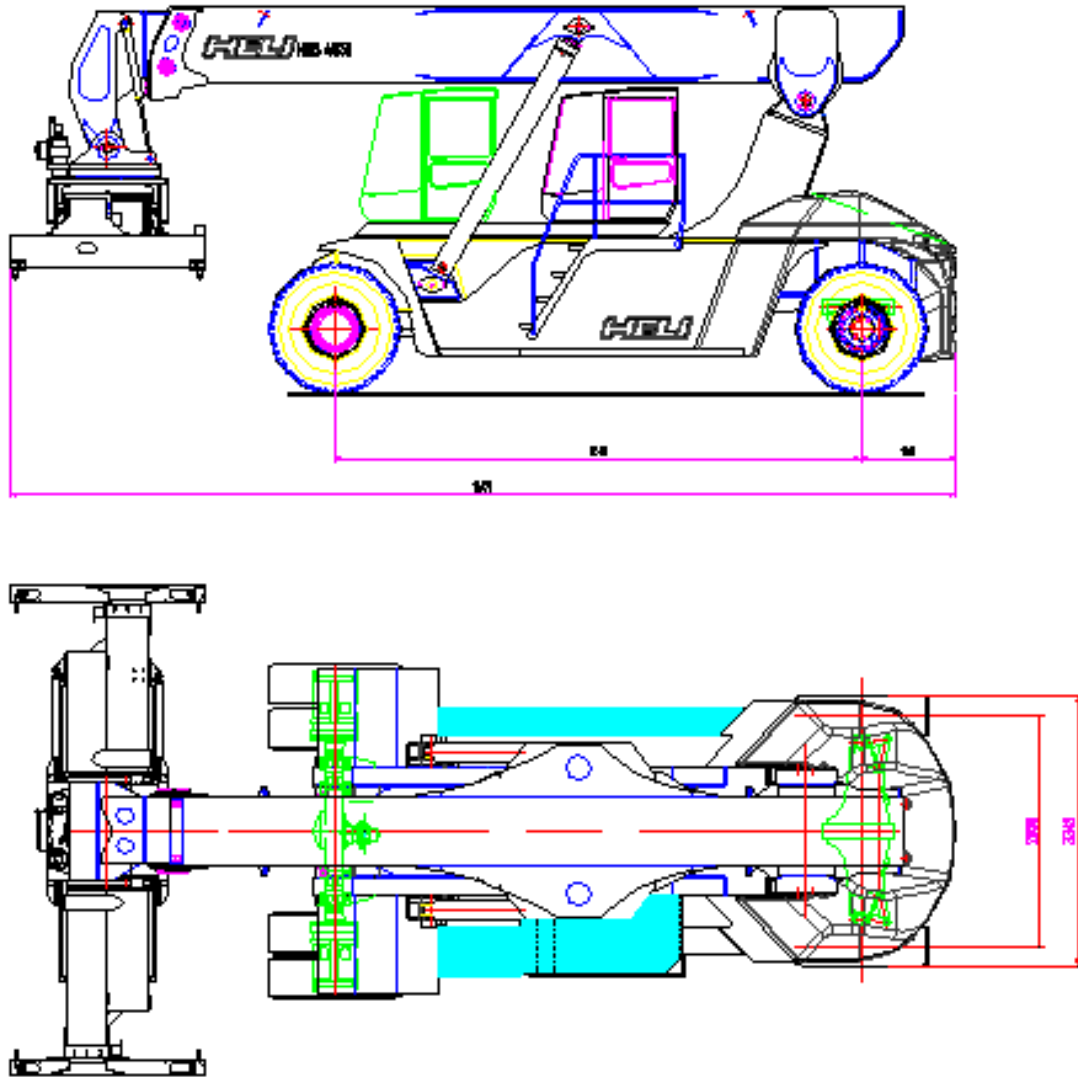


## II. Main Components and Technical Parameters of the Container Reach Stacker

### 1. The Container Reach Stacker Mainly Consists of Such Parts as Listed Below

No.	Part	Contents
1	Engine installation	Engine, air filter, water tank, intake and exhaust system, etc.
2	Main drive system	Torque converter, gearbox assembly, drive shaft, drive axle, etc.
3	Braking system	Liquid-filling valve, braking pedal valve, parking brake valve, accumulator, etc.
4	Steering axle	Steering axle body, steering knuckle assembly, hub, connecting rod assembly, steering cylinder, etc.
5	Steering system	Fully hydraulic steering gear, traversing unit, etc.
6	Wheel	Front wheel tyre, and rim, rear wheel tyre and rim.
7	Lifting system	Fixed arm and telescopic arm assembly, telescopic cylinder, slider and towing chain, etc.
8	Spreader	
9	Variable-amplitude cylinder	Cylinder body, piston rod assembly, cylinder head, etc.
10	Hydraulic system	Oil pump, pressure-gradient control valve, multi-port valve, control valve, etc.
11	Electric system	CAN-BUS system, air conditioner, combination instrument, light, storage battery

## 2. Technical Parameters of the Container Reach Stacker





Main parameters of HELI reach stacker

Type			RSH4528-Vo	RSH4532-Vo	RSH4536-Vo
Lifting capacity	Line1/	kg	45000/	45000/	45000/
	line2/		28000/	32000/	36000/
	line 3		14000	16000	19000
Load centre	Line1/	mm	1800/	1800/	1800/
	line2/		3850/	3850/	3850/
	line 3		6400	6400	6400
Max traveling speed (no load/full load)		km/h	28/24	28/24	28/24
Lifting speed (no load/full load)		mm/s	420/280	420/280	420/280
Descending speed (no load/full load)		mm/s	350/350	350/350	350/350
Grade ability (full load)		%	36	34	32
Max lifting height (line 1)		mm	15050	15050	15050
Sway		mm	+800~-800	+800~-800	+800~-800
Rotation		°	-95~+185	-95~+185	-95~+185
Min turning radius		mm	8590	8590	8590
Min space above ground		mm	320	320	320
Max tilting angle of spreader		°	59	59	59
Wheel base		mm	6500	6500	6500
Rear suspension		mm	1160	1160	1160
Front/rear tread		mm	3030/2838	3030/2838	3030/2838
Length		mm	11670	11670	11670
Width		mm	4060	4060	4060
Seat height		mm	2605	2605	2605
Min height of spreader		mm	4754	4754	4754
Traction		kN	365	365	365
Dead weight of the vehicle		kg	69000	73000	76800
Hydraulic system pressure		MPa	30	30	30
Tyre	Specification		18.00-25-40PR	18.00-25-40PR	18.00-25-40PR
	Number		Front 4/rear 2	Front 4/rear 2	Front 4/rear 2
	Pressure	kPa	1000	1000	1000
Engine	Producer		VOLVO	VOLVO	VOLVO
	Rated power	kW/rpm	250/2000	250/2000	250/2000
	Max torque	Nm/rpm	1631/1400	1631/1400	1631/1400
Gearbox (front/rear gear)			DANA (CLARK)4/4	DANA (CLARK)4/4	DANA (CLARK)4/4
Drive axle			Kessler wet brake	Kessler wet brake	kessler wet brake

### **III. Startup, Moving and Operation of the Container Reach Stacker**

#### **1. Running-in Period**

We propose at least 200-hour running-in period for a new container reach stacker.

Pay attention to following matters in the running-in period:

- (1) Fully warm the engine each time after its startup and avoid high-speed running immediately after it is started up.
- (2) The vehicle is not allowed to travel at maximum speed.
- (3) Frequently check each system of the whole vehicle.

#### **2. Startup and Stalling of Engine**

##### **(1) Inspection before startup of engine**

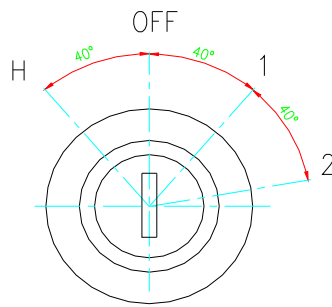
- a) Hydraulic oil volume: oil level should stay in the middle of oil meter scale;
- b) Braking hydraulic oil volume: oil level should stay in the middle of oil meter scale;
- c) Check piping, joints, pumps and valves for leaks or damages;
- d) Check service brake;
- e) Check parking brake;
- f) Check instruments, lighting, switches and wiring to see if they work well or not;
- g) Check the action, working state indicator of spreader and mechanic twist lock sign to see if they work well or not.

##### **(2) Engine startup**

###### **CAUTION:**

**Switch on the main switch before engine startup and check if the gearbox handle stays in neutral position, otherwise the engine cannot be started up.**

Startup switch position is shown in following diagram.



Engine startup steps are as follows:

- a) Sit on the driver's seat;
  - b) Switch on the main switch;
  - c) Insert the ignition key into the ignition lock hole and turn it clockwise to gear 1 (switch-on gear) and the instrument system is wired up.
  - d) Turn the ignition key clockwise to gear 2 (startup gear) to start up the engine. The startup time cannot exceed 5 seconds. After the engine is started up, immediately loosen the ignition key and return it to gear 1. If the engine refuses to be ignited after 3 times (the interval must be over 20 seconds), the operator must find out the reason and eliminate the trouble before another try of ignition.
  - e) The operator can use the startup preheating system after step (b) in case of low temperature. Turn the ignition key anticlockwise to gear H (preheating gear). The indicator lights, stays for 50 seconds and then goes out. Immediately go to step (c) and the intake of engine is warmed up, facilitating startup.
  - f) Check the engine oil pressure to see if it stays in normal range.
  - g) Keep the engine idle-running for over 10 seconds and then maintain it running at low speed and with low load for adequate warming.
- (3) Stalling of engine

Steps of stalling the engine are as follows:

- a) Keep the engine idle-running for 2-3 minutes making it cool down gradually and evenly.

- b) Turn the ignition key to the position “off” to cut off the power making the engine stop running and then take out the key.

### **3. Startup, Running and Stoppage of Reach Stacker**

#### **(1) Startup and running of reach stacker**

Procedures for startup and running of reach stacker are as follows:

- a) Press down parking brake button to free parking brake;
- b) Step on the service brake pedal;
- c) Choose suitable speed gear, loosen the service brake pedal and slowly step on the accelerator pedal.

#### **(2) Stopping reach stacker: Steps for stopping reach stacker are as follows:**

- a) Loosen the accelerator pedal;
- b) Slowly step on the service brake pedal;
- c) When the reach stacker almost stops, switch the gearbox handle to neutral. Loosen the service brake pedal after full stoppage of the vehicle;
- d) If needed, the operator can stall the engine, put on parking brake and switch off the main switch.

### **4. Acceleration, Deceleration and Gear Changing of rReach Stacker**

#### **(1) Acceleration and deceleration of reach stacker**

When gearbox stays in automatic operation state, step on the acceleration pedal for speeding up, the more you step on the pedal, the more the speed will be raised. Loosen the accelerator pedal for deceleration. The more you loosen the pedal, the more the speed will be reduced.

When the gearbox stays in manual operation state:

- a) If the gear-changing handle stays in a gear position, step on the acceleration pedal for speeding up, the more you step on the pedal, the more the speed will be raised. Loosen the accelerator pedal for deceleration. The more you loosen the pedal, the more the speed will be reduced.

b) Choose a suitable gear position for acceleration and deceleration according to load and road surface conditions.

**CAUTION:**

**The action must be smooth for acceleration and deceleration of the engine.**

**WARNING:**

**When the reach stacker moves with load, the telescopic arm maintains an angle of 35 degrees with horizon, the spreader stays in the middle position and the lower edge of container is proposed 800mm above the seat level. Forbid lifting, lowering and swaying the load during traveling. Forbid traveling when the vehicle is lifting a weight at high elevation.**

(2) Gear changing of reach stacker

a) The gear changing handle of reach stacker is situated at the left of steering column;

b) The gear changing handle has three positions:

Handle pushed forward: the gearbox stays in the forward gear position and gives gear 1, gear 2, gear 3 and gear 4 choices; handle maintained in middle: the gearbox stays in neutral position. The engine can only be started up at neutral position. Handle pull backward: the gearbox stays in reverse gear position and gives gear 1, gear 2, gear 3 and gear 4 choices. The reversing buzzer works at this moment.

c) When the gear changing handle stays in the forward or reverse gear position, the operator can choose gear 1, gear 2 and gear 3 by rotating the handle to and fro.

d) Gear position state of gearbox is shown in the APC200 display of central console.

e) The “gearbox manual/automatic rocker switch” of central console can achieve manual/automatic state switch, during which all vehicle actions must be at pause and the gear changing handle in neutral position.

**CAUTION:**

- a) **Gear changing is only allowed at low engine speed;**
- b) **Gear changing is not allowed at high traveling speed of the vehicle and not at the time of acceleration;**
- c) **Reverse gear can only be used at low engine speed or stalling;**
- d) **In automatic operation state with the gear changing handle in high gear position, the operator can press controller program buttons according to running conditions, thus achieving automatic switch between high and low gear position for the vehicle.**
- e) **In the manual operation state of gearbox, the driver should normalize his or her operations, for wrongdoings may be destructive to the gearbox.**

**5. Turning of Reach Stacker**

Turning of reach stacker is controlled by wheel, which turns in the same direction with the vehicle. The turning angle of wheel decides that of steering wheel.

**WARNING:**

**Sudden turning is not allowed at high vehicle speed and in case of spreader at high elevation, otherwise the vehicle may roll over.**

**6. Monitoring of the State of Reach Stacker**

(1) In normal traveling state, none of alarming indicators of reach stacker lights. An indicator will light in case of alarming. At this moment the driver must stop the vehicle to eliminate any trouble.

(2) Pay attention to display of each instrument during traveling of reach stacker

- a) Oil meter of engine: normal reading of 3-5 bar;
- b) Water temperature of engine: banned to reach the red area;
- c) Engine tachometer: rotation speed is not allowed to exceed the engine maximum;
- d) Oil temperature meter of torque converter: the service oil temperature of gearbox lies in the range of 80-110°C (120°C temporarily allowable). If the temperature

approaches 120°C and the red area of the meter, suspend use of the vehicle, put the gear changing handle in neutral position allowing the engine to run at low speed until the temperature decreases to the normal range. If rapid drop in temperature fails, stop the vehicle to locate the reason;

e) Fuel meter: Do not use up all the fuel to avoid air entry into the fuel pipe

## **7. Parking Brake and Service Brake**

(1) Parking brake: Applied at the time of the vehicle out of service.

Parking brake switch is fixed on the central console. Press down the switch for parking braking and the indicator of parking brake meter lights as a prompt. Press it again, it springs up and the parking brake is free.

### **WARNING:**

**a) When reach stacker stops for a short or long time, parking brake must be put on;**

**b) When service brake does not work, parking brake can be used for emergency braking.**

(2) Service brake: It is used for speed control and braking during running of the vehicle.

The more you step on the brake pedal, the bigger the braking force will be and the better the braking effect.

### **WARNING:**

**The action of service braking should be gentle. Sudden braking will affect the stability of vehicle, very easily causing it to overturn, especially when it travels with load at high speed.**

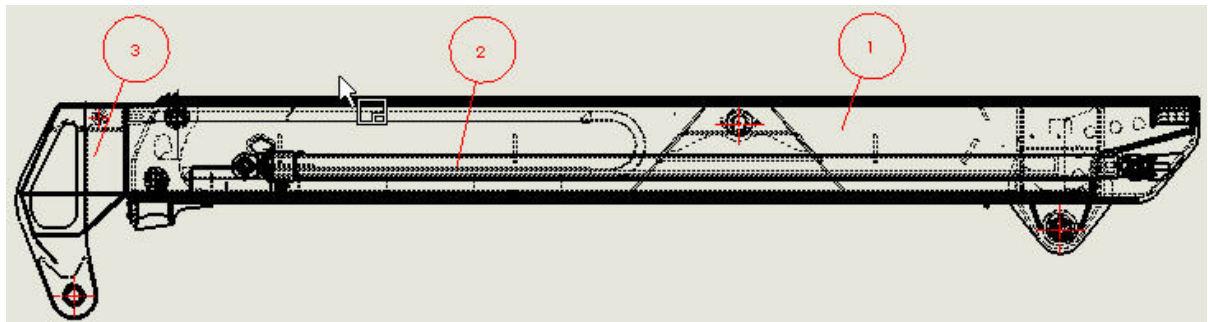
## **8. Arm and Spreader**

(1) Arm

a) Structure and working mechanism

RSH4532 As one of the two major working parts of the whole vehicle, the lifting

arm of RSH4532 container reach stacker mainly consists of fixed arm, telescopic arm, telescopic cylinder and slider. Telescopic arm is fitted inside the fixed arm. Anti-wearing high-performance engineering plastic sliders are provided between the two arms. One end of the telescopic cylinder is fitted on the fixed arm and the other end on telescopic arm. The action of cylinder drives the telescopic arm to glide inside the fixed arm, thus adjusting the length of the whole lifting arm to reach container stack.



1. Fixed arm      2. Telescopic cylinder      3. Telescopic arm

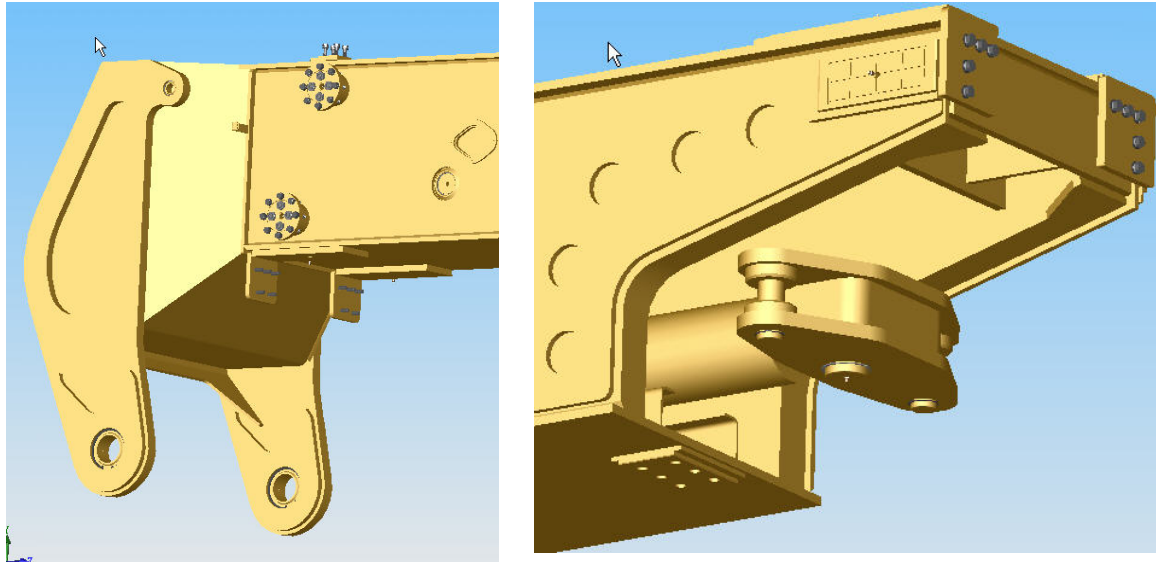
b) Assembly adjustment and maintenance

To ensure normal working of the whole vehicle, the lifting arm should be tested and maintained strictly according to regulation. Lubricating spots on sliders and lifting arm should be checked, cleaned and lubricated once every 50 hours. The fissure between slider and fixed arm should be adjusted along with actual wear conditions of the slider according to following standard: the space cannot exceed 1.5mm between the sliders on both sides behind the lifting arm and the fixed arm; not more than 5mm between the rear bottom sliders and the fixed arm; 0mm contact of the sliders on the frontal two sides, lower part and rear upper part of the telescopic arm with the inside of fixed arm. The method of adjustment is: the frontal circular sliders are adjusted by bolt tuning, other sliders are provided with suitable spacers according to the thickness as required.

Check the wear of slider when maintaining it. The thickness cannot be less than 20mm for sliders on the rear two sides, upper and lower parts and frontal lower part of



the telescopic arm. Sliders at this limit must be changed. Frontal circular sliders cannot be less than 32mm in thickness and must be changed at this limit. The difference of each slider cannot be over 2mm in the back-front thickness and upper-lower height. The oversized should be trimmed or changed.



c) Operation of telescopic arm

The telescopic arm has two functional actions: extension and withdrawal, which are achieved with pilot operational handle.

Single action:

a) Extension of telescopic arm: safety button is triggered and pilot operational handle turns to right and the turning angle size decides the valve opening. Return the handle to stop extension.

b) Withdrawal of telescopic arm: safety button is triggered and pilot operational handle turns to left and the turning angle size decides the valve opening. Return the handle to stop withdrawal.

Combined actions:

a) Extension of telescopic cylinder and uplift of variable amplitude cylinder: safety butt is triggered and integrated operational handle moves backward turning 45° to right. The angle size decides the opening of proportioning

valve. Reset the safety button for sudden stoppage and uplift.

b) Extension of telescopic cylinder and decline of variable amplitude cylinder: safety button is triggered and integrated operational handle moves forward turning 45° to right. The angle size decides the opening of proportioning valve. Reset the safety button for sudden stoppage and uplift.

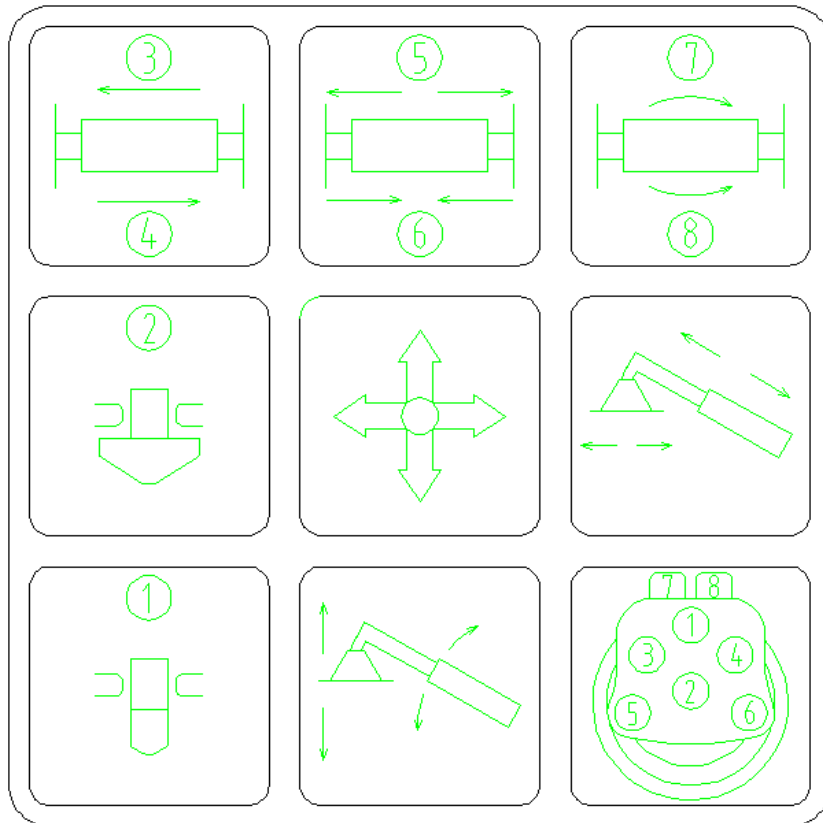
c) Withdrawal of telescopic cylinder and uplift of variable amplitude cylinder: safety button is triggered and integrated operational handle moves backward turning 45° to left. The angle size decides the opening of proportioning valve. Reset the safety button for sudden stoppage and uplift.

d) Withdrawal of telescopic cylinder and decline of variable amplitude cylinder: safety button is triggered and integrated operational handle moves forward turning 45° to left. The angle size decides the opening of proportioning valve. Reset the safety button for sudden stoppage and uplift.

**CAUTION:**

**a) Energy regeneration function is only used in case of no load for improving working efficiency;**

**b) When big arm extends and pitches to a certain angle, the integrated operational handle will be useless. It can be restored to safe state using unloading switch.**



## (2) Operation of spreader

Spreader has 8 functional actions: twist lock opening, twist lock locking, left sway, right sway, extension, withdrawal, clockwise rotation and anticlockwise rotation, which are all controlled by 8 buttons fitted on the integrated operational handle.

- a) Twist lock opening: controlled by No.1 button shown in the diagram
- b) Twist lock locking: controlled by No.2 button shown in the diagram.
- c) Left sway: controlled by No.3 button shown in the diagram.
- d) Right sway: controlled by No.4 button shown in the diagram.
- e) Extension: controlled by No.5 button shown in the diagram.
- f) Withdrawal: controlled by No.6 button shown in the diagram..
- g) Clockwise rotation: controlled by No.7 button shown in the diagram.
- h) Anticlockwise rotation: controlled by No.8 button shown in the diagram.

Spreader safety override switch:

Spreader safety override switch is controlled by the key switch as shown in the diagram. When the spreader safety unit sensor fails and the actions of sway, twist lock opening and closing and rotation cannot be performed for the spreader, for the convenience of repair, spreader safety override function can be used for provisional emergency operation.

**CAUTION:**

**Spreader safety override switch key must be kept by senior equipment manager.**

**WARNING:**

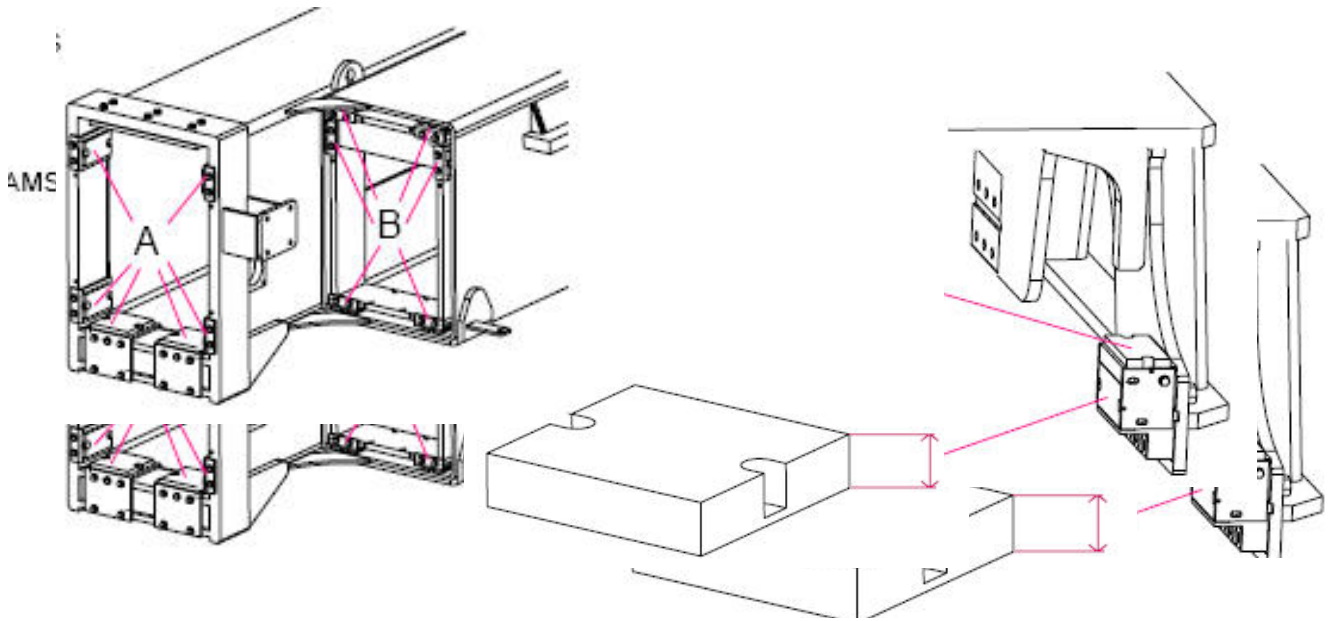
**When spreader safety override function is effectuated, all safety units will not work, the operator must visually check the spreader twist lock to ensure the lock in normal position before handling containers, otherwise serious accidents may be caused, such as breakage of twist lock or fall of container.**

Maintenance of spreader:

a) Maintenance of slider

Main sliders include: fix arm and telescopic arm sliders: A. Telescopic cylinder course slider; B. Sway slider. Check the movement performance (wear and lubrication) of slider once every 50 hours. Please add lubricating grease in case of poor lubrication.

Slider must be changed timely when it is worn to the minimum 18mm in thickness.



b) Maintenance of moving parts

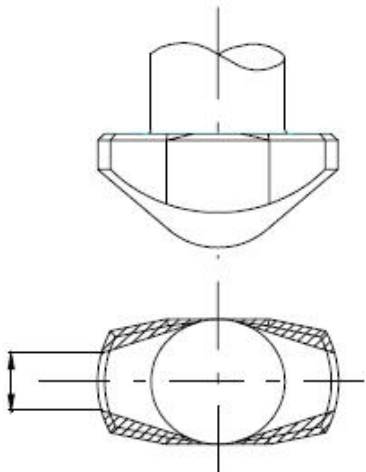
Main moving parts include damping cylinder part, twist lock, rotary bearing, knuckle bearing part of sway cylinder, gear reducer, etc. It is better to check and lubricate these parts once every 100 hours.

c) Maintenance of gear reducer

Change the oil 50 hours after its service for the first time. Afterwards, change it once every 2000 hours or annually.

d) Maintenance of twist lock

Twist lock is the main wear part. Our suggestion is to check the wear and lubrication of the lock once a month and to change it after its service of 5000 hours.



As shown in the diagram, if the dimension shown is less than 25mm, you need to change the twist lock. The diagram shows the wear status of twist lock head. When the worn part exceeds 1/4 area of the twist lock end, it needs to be changed timely.

## **9. Loading and Unloading Operation Process**

### (1) lifting of container

Steps for lifting container are as follows:

- a) Park the reach stacker approximately where the driver can face the container stack or at the central position of containers placed on the transport vehicle where the integrated operational handle can be perpendicular to or reach the container stack or container transport vehicle.
- b) Extend and adjust the spreader breadth according to the width of container to be lifted. Manipulate the integrated operational handle to lower the spreader to a height fit for lifting container by variable-amplitude telescopic of the big arm, swaying of spreader and rotating to central position.
- c) Ensure the spreader twist lock being located just above the corner lock hole of container;
- d) Lower the big arm to descend the spreader allowing 4 twist locks of spreader to enter corner into lock holes of container;
- e) Check the working state indicator of spreader and mechanical twist lock sign to see if the 4 twist locks have entered into the lock holes of container. If yes, go to next step, otherwise restart from step (3) by hoisting spreader.
- f) Manipulate the twist lock locking button on the integrated operational handle and check the working state indicator of spreader and mechanical twist lock sign to see if the container has been locked or not. If not, restart from step (3) by hoisting spreader.
- g) After confirming that the container has been properly locked, the operator can hoist container until the spreader landing indicator goes out.
- h) Lower the container being lifted to the normal working position of vehicle. The spreader must be put as low as possible without affecting the line of sight and goods placed around.

i) Reverse the vehicle only when no traffic is found behind.

**CAUTION:**

**a) Be sure to manipulate the integrated operational handle steadily and avoid transient violent operation;**

**b) When controller alarms, forbid use of big arm and any operation of spreader. Drive safely according to rule.**

**WARNING:**

**When traveling with load, the operator must be careful in driving and avoid any sudden braking or sudden turning, for any violent action may overturn the vehicle.**

(2) Stacking of containers

a) Slow down ahead of time when reach stacker approaches containers stack or containers transport vehicle.

b) Hoist big arm allowing spreader to rise to a height fit for stacking containers when approaching containers stack or containers transport vehicle.

c) Put the containers at the stacking place or just above the transport vehicle by swaying, rotating and telescopic actions, making sure that the lower 4 corner lock holes of container align with those of container already placed below or with 4 twist locks on the chassis of containers transport vehicle.

d) Lower big arm and descend spreader ensuring that the 4 lock holes of container to be placed can accurately find their given positions, otherwise restart from step (c) by hoisting spreader.

e) After ensuring accurate and steady landing of container, manipulate the twist lock opening button on pilot operational handle allowing the 4 twist locks of spreader to open fully (spreader landing indicator and twist lock opening indicator light). If one or 4 twist locks of the spreader have not been opened (relevant indicators have not lighted), manipulate the twist lock locking button on the

operational handle to relock, restart from step (d) by hoisting spreader and container.

f) After confirming that the 4 twist locks of spreader have been fully opened, be careful to hoist the spreader allowing the twist locks to withdraw from the corner lock holes completely (spreader landing indicator dies out and twist lock opening indicator lights). If one or 4 twist locks of the spreader have not withdrawn from the lock holes of container, restart from step (e) by lowering spreader.

g) Reverse the vehicle slowly in a straight line after no traffic is found behind. Be careful in driving and avoid violent operation.

h) Withdraw big arm and lower spreader to normal working position of vehicle.

**WARNING:**

**Over-tilting, thrusting and rapid descending of container are not allowed in operation, otherwise the container to be placed and spreader will do damage to the container already landed below and the chassis of vehicle.**



## IV. About Main Parts of Container Reach Stacker and Maintenance

### 1. Power System

Power system includes engine installation, intake system, cooling system, discharge system, etc. The engine is integrated with transmission unit and its bracket is connected with vehicle frame by buffering rubber spacer to reduce vibration. The power of engine is transmitted to main drive system through torque converter.

Normalized configuration for reach stacker power system covers TAD952VE diesel engine made by VOLVO, imported top-class attachments as air filter, muffler, etc, which can ensure normal service and life extension of engine.

Refer to the operation and maintenance manual of the engine for the details.

#### (1) Main parameters of engine

	TAD952VE
Type	In-line six-cylinder supercharging (air-air) intercooler
No. of cylinders-cylinder bore/stroke	6-120/138
Total displacement	9.36
Rated power/rotation	252kW/2000rpm
Rated torque/rotation	1634Nm/1400rpm
Min. fuel consumption rate	205g/kW.h

#### (2) Matters needing attention for cooling system

- a) Coolant used for reach stacker radiator is long-term anti-rust and antifreeze fluid (FD-2, -35 degrees). The antifreeze is applied in both summer and winter and needs no changing. Generally, it should be let out, filtered and purified after one-year service and then put to use again.
- b) Regularly check the seal of cooling system and level of coolant. Eliminate any trouble with respect to seal of the system as soon as possible.
- c) In case of antifreeze used for coolant, forbid adding water and different types of

antifreeze willfully. Supplement same type of antifreeze timely after it leaks or evaporates.

d) In case of water used for coolant, it may freeze in cold weather as the vehicle is parked, so the water in radiator should be let out. After radiator works for some time, it should be dismantled and put in boiling soda solution for washing, thus removing the scale or deposit formed on the inside of radiator.

e) When reach stacker is being used, if radiator “boils over” or coolant temperature is over high, do not uncover the radiator immediately. Check the liquid level for locating the reason of “boil-over”. Reduce the engine speed to a medium range, slowly loosen the radiator cap and remove it after a moment to avoid the coolant splashing out scalding operators. When tightening the radiator cap, it must be tightened in place, otherwise the system may not be fully sealed and the system pressure cannot be reached as required.

f) In light of different working conditions, the operator should remove the outer surface dirt of radiator periodically using detergent or compressed air or high-pressure water (not over  $4\text{kg/cm}^2$ ) for flushing.

## **2. Main Drive System**

The main drive system of this equipment includes gearbox, propeller shaft, drive axle, etc. The gearbox is of TE27 series of DANA Company, composed of hydraulic torque converter, power shift gearbox, hydraulic system and electric system. The drive axle comes from Kessler Company and consists of differential, wheel reducer, wet service brake, caliper disc parking brake, etc.

### **(1) Gearbox**

Refer to relevant manual for maintenance in detail.

Oil volume in gearbox is very important to the service life and function of gearbox, for the oil plays the role of cooling, lubrication and transmission. If the oil level is over low, gearbox and clutch cannot be lubricated, as a result, the gearbox will

be damaged and its performance undermined. If the oil level is over high, the oil foam will make gearbox over hot.

Check the oil level of gearbox once every 200 hours according to methods listed below:

- a) Start reach stacker making the gearbox oil temperature rise to normal working temperature ( 80~110° )
- b) Make all clutches and oil pipe inside gearbox be fully filled with oil by gear changing;
- c) Park the vehicle on level road surface and put on parking brake with the gearbox staying in neutral gear position (Attention: Allow the gearbox to be at idle);check oil level until oil volume reaches the upper limit on oil scale.

Change gearbox oil once every 1000 hours.

**CAUTION:**

**Change it at the time of engine stoppage and gearbox still being warm.**

First, fully let out oil from gearbox by handling the drain plug, cut off oil cooler and piping of torque converter to exhaust oil, tighten the drain plug again, attach piping and oil cooler of torque converter and fill oil through fill plug. After filling oil, check oil level of gearbox according to the method mentioned above.

**WARNING:**

**For a new gearbox, the oil and filter element need to be changed after its service for the first 100 hours.**

**CAUTION:**

**The method for changing gearbox oil and filter element mentioned above applies to usual climate and working environment. Under high-temperature, overtime and full-of-dust working conditions, the oil will be easily contaminated and the quality of lubricating oil deteriorated, so the time interval for changing gearbox oil and filter element must be shortened.**

## (2) Propeller shaft

Once every 100 hours: Use manual grease gun (never high-pressure grease gun) to feed oil to universal joint through the fill plug. Overflow indicates fullness.

Once every 400 hours: Check the looseness of torque of securing bolt of propeller shaft.

### **WARNING:**

**Make first check after its service for the first 200 hours.**

## (3) Drive axle

Refer to relevant manual for details on maintenance of drive axle.

Check drive axle for the main drive, wheel reducer and oil level of brake cylinder once every 100 hours, and feed same type of gear oil if need be; check working conditions of ventilation plug and clean it when necessary;

Check the tightness of connecting bolt of drive axle once every 50 hours and secure torque to tighten bolt in case of looseness;

Change the oil of main drive, wheel reducer and oil level of brake cylinder once every 1000 hours, feed the oil as required and check the two parts to see if there are any metal and other impurities inside.

## **3. Hydraulic System**

### Technical parameters

System pressure	bar	300
Hydraulic oil feed (including 3% additive in WDB unit)	liter	800
Oil filter precision	u	10
Uplifting rate (no load—rated load)	mm/s	420/280
Descending rate (no load—rated load)	mm/s	350/350
Hydraulic oil	Use of famous brand oil	
Electric hydraulic servo device		

Servo pressure	bar	35
WDB brake unit		
Service brake pressure	bar	138
Parking brake release pressure	bar	100
Steering unit		
Max. pressure	bar	220
Overload valve pressure	bar	241

### (1) Introduction

It is powered by variable plunger pump fixed on gearbox and a group of distribution valves control the telescoping of lifting arm and rotary oil channel.

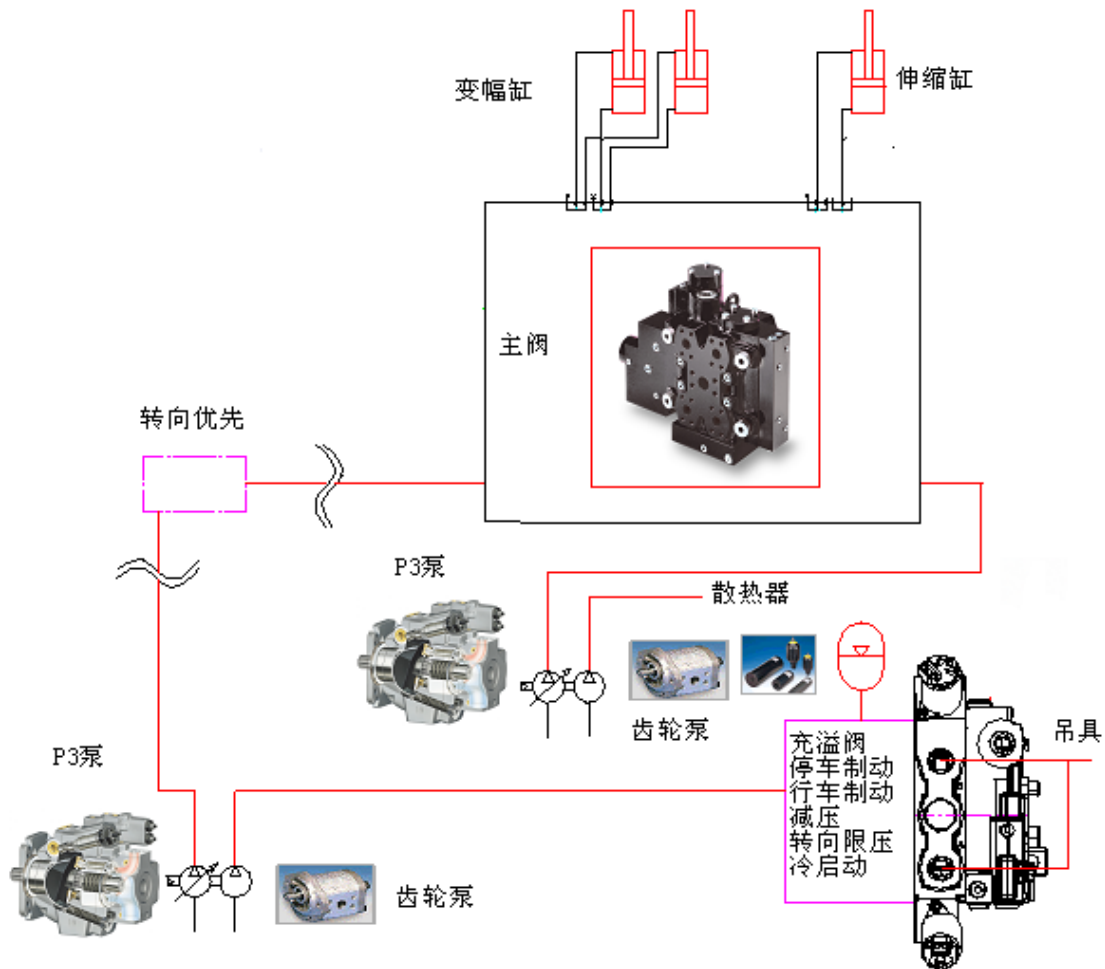
Another group of distribution valves control other operations of spreader (rotation, sway, 20'-40' conversion). Main control of arm and spreader is integrated on a multi-function operational handle. Hydraulic oil channel has a radiator system, which includes an oil/air heat exchanger powered by a hydraulic motor.

Hydraulic system consists of some sub-systems as follows: main oil channel feed; servo system to feed electric hydraulic unit; arm telescopic; variable amplitude of arm; spreader turning; adjustment of spreader—length; sway and twist lock looseness; service brake unit—WDB hydraulic brake oil-soaked disc brake unit; parking brake unit—consisting of disc brake installed in input shaft of front axle, spring-loaded hydraulic release; steering system

### (2) Main oil channel feed

Main oil channel of reach stacker is fed by two plunger pumps. One directly feeds main valve and provides variable amplitude and telescoping, the other feeds combination valves. This channel supplies oil to brake system (service and parking brakes) and also to steering system by way of pressure-gradient control valve and pressure-regulating valve. The pressure-gradient control valve can ensure the system giving priority to supplying oil to steering system, and then to piloting control system,

with the excessive oil going into main valve.



Main valve and combination valve are linked up in parallel, thus ensuring the speed requirement of variable amplitude and telescoping, also giving a full play to oil pump capacity and improving the performance of the whole vehicle.

(3) Servo system—servo system is integrated in combination valve and oil supply is controlled by operational handle.

(4) Variable amplitude and telescopic of arm—Variable amplitude and telescopic cylinder is a dual-role pistol cylinder. Fixed at oil inlet of rod-less chamber of cylinder is a function valve block, which can improve working efficiency of the vehicle and also plays the safeguarding role.

(5) Hydraulic oil—Hydraulic oil cylinder is located at the right of reach stacker. Observe the hydraulic oil level when the cylinder pistol stays at the bottom. Feed

famous brand hydraulic oil as required if need be. In addition, this reach stacker is fitted with oil-soaked disc brake unit, so 3%-6% Lubrizol additive must be added to hydraulic oil to ensure good braking effect and eliminate braking screech.

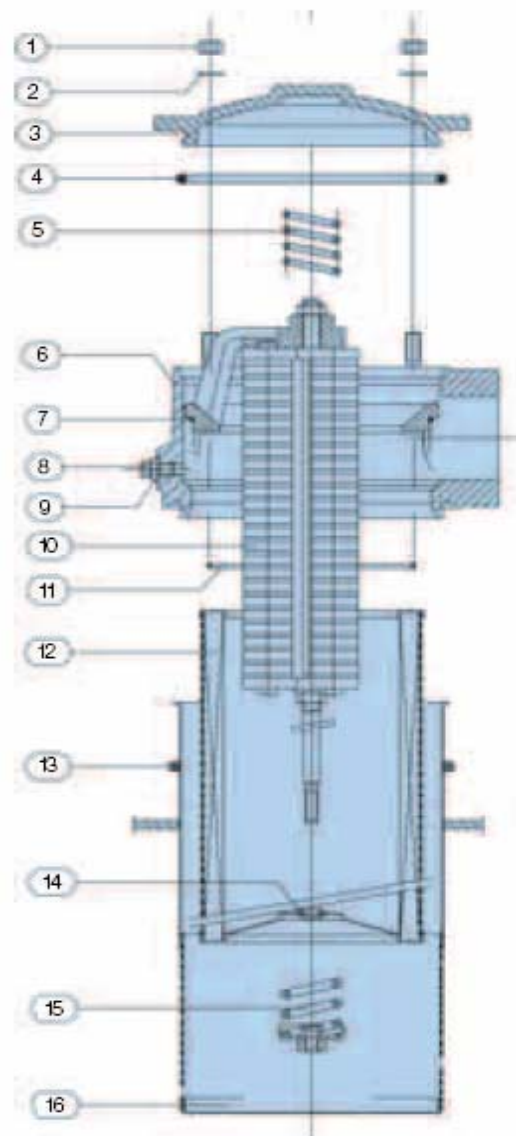
**WARNING:**

**Additive will not be consumed during normal working, so it needs only be replenished at the time of changing or adding oil. What needs attention is that Lubrizol additive-bearing hydraulic oil is corrosive to human skin.**

(6) Hydraulic oil filter

The vehicle is fitted with primary oil return filter, as shown in the diagram:

Hydraulic system must be changed when being repaired. Steps to change it are as follows: Clean filter surface and its surroundings, remove filter bowl with spanner, take out filter element and install a new one while changing sealing element. Restore the filter bowl and impose torque to tighten it. Start up engine and remove air in the system and ensure the filter without leakage.



- 1 Nut 2 Spacer 3 Cap 4 Seal 5,15 Spring 6 Shell 7 Sealing element  
8 Plug 9 Spacer 10 Insert 11,13,14 "O" ring 12 Filter element 16 Diffuser

Note: These must be changed after working 1000 hours.

#### (7) Hydraulic oil cylinder

Hydraulic oil cylinder is situated at right of reach stacker.

Hydraulic oil in the cylinder is supplied to the hydraulic system for arm uplift and telescoping, spreader, steering and braking system.

Every day: Park the vehicle on level surface, put on parking brake, lower and withdraw arm, check liquid level through relevant window and fill up with oil through fill plug if need be. Change filter element in case of jamming alarm lighting on panel. Change it if it is damaged.

#### **WARNING:**

**Ensure no pressure on the system before changing filter element.**

Change hydraulic oil after first 600 hours.

Change hydraulic oil once every 2800 hours according to following steps: stop engine, fully withdraw and lower telescopic arm, remove plug and impose pressure inside, loosen oil discharge valve and drain the cylinder oil. Attention: To discharge oil from system, remove oil drain plug on the brake of front drive axle (See drive axle), check the cylinder to see if it is clean inside, if not, clean it, reinstall oil drain plug and drive axle brake plug. Fill fresh oil through fill plug, start up engine, and allow the arm to perform telescopic and lifting actions, allow the pump to send oil to every corner of the system for circulation, keep the arm in non-working position, and check oil level and fill up if need be.

#### (8) Air filter

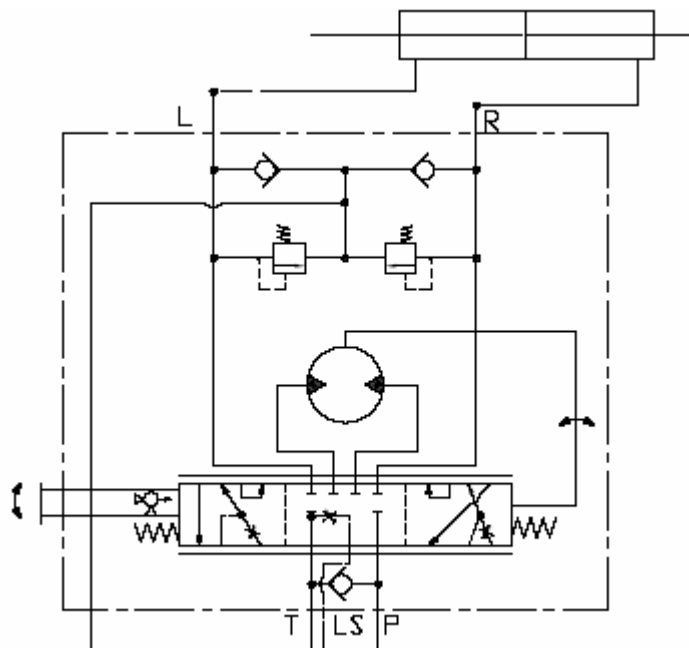
Filter element must be changed once every 1200 working hours, and 1000 hours if it is employed in dusty working environment. Air filter is the lung of oil cylinder, which ensures pressure balance between inside and outside of the cylinder. Plugging will cause cavitation damage to oil pump and greatly reduce its life of service.





### (9) Steering system

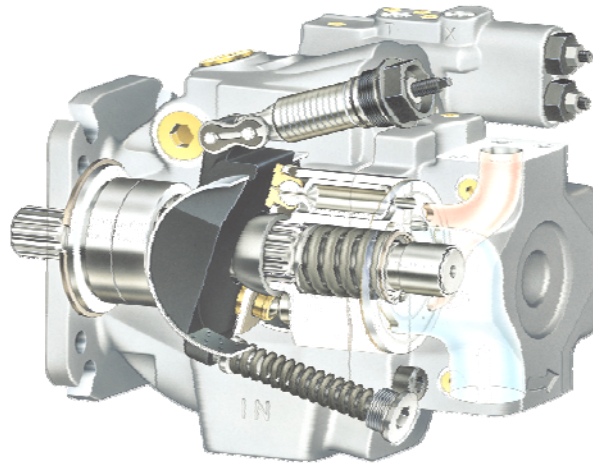
Hydraulic oil volume supplied to steering system depends on the speed of wheel movement. LS signal emitted by steering valve makes the pressure-gradient control valve of valve block constantly provide adequate oil for steering system. Buffer valve is added to steering system for improving driver's comfort and reducing driver's fatigue.



### (10) Plunger pump

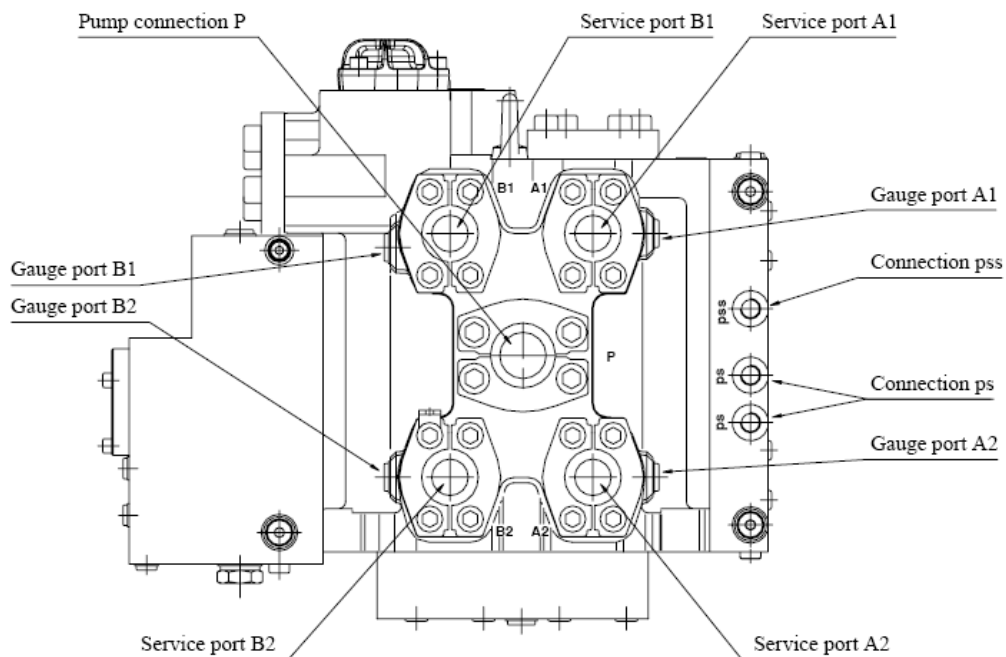
Plunger pump installed on this vehicle has many advantages. It is less noisy, capably bears high pressure and high rotation and is also well self-priming.

**Note: The parameters of plunger pump are well set upon leaving factory and users are forbidden to adjust them without permission.**



(11) Main valve

As an integrated multiport valve this valve is of a load transducer design used for variable capacity pump. It has long service life, has no leakage, is fast in opening and closing, ensures cavitation-free work, is preventive against unnecessary system loading shock, thus extending the time of components and sealing elements.



Test of oil pressure of main valve:

There are test ports for the working pressure of luffing cylinder and telescopic cylinder on the main valve. The test connections are installed on the main valve as standard test ports. Their positions are shown on the above diagram.

Gauge port A2: testing large chamber pressure of luffing cylinder.

Gauge port B2: testing the small chamber pressure.

Gauge port A1: testing large chamber pressure of telescopic cylinder.

Gauge port B1: testing the small chamber pressure.

#### (12) Maintenance of Main Valve

The main valve is a precision hydraulic element. The maintenance will be done carefully to ensure its excellent performances. Following stipulations must be followed during the maintenance:

The hoist of the valve body will be done through specified hoist holes to prevent the deformation of valve element and other parts. The slide valve end and body will be prevented from any impact. Otherwise it will result in the deformation of the slide valve and jamming of the valve element. Moist and dust should be prevented from entering into the main valve, especially the dust should be prevented from entering into each connecting hole. All holes and their contact surface will be protected from dust to avoid scratches and impact. When installing the oil connections, attention must be paid to the cleanness and prevention of over-tightening.

#### **WARNING:**

**The hydraulic cartridges on the valve are forbidden to be dismantled without permission.**

### **4. Braking System**

#### (1) Brief description

A multi-disc braking assembly is installed on the each hub of the driving wheel

of the reacher stacker. There is an independent cooling system for the oil circulation in the axle. The advantage of the braking form is that it is not necessary to make any adjustment, the braking force will not decrease and there is no abrasion. And as the friction discs and other parts are sealed in the axle, water, soil and debris can not get in.

There are three independent oil circuits in the unit: i.e service braking oil circuit, cooling oil circuit and parking braking oil circuit. The safety of the service braking is thus ensured.

(2) Cooling oil circuit: The cooling oil circulation pump draws oil directly from the oil tank and sends it to the front axle after cooling through the cooler to ensure the heat balance of the system. The oil is filtered and cleaned at same time.

(3) Main parts of the braking system:

Braking pump: it is a gear pump in series with variable plunger pump. The power is sent out through PTO port of the transmission.

Combination valve: The valve is made of screwed cartridge inserted valve and can realize many functions: overflow valve, pressure-gradient control valve, system safety valve and parking brake valve, etc.

Accumulators: For the storage of the energy.

Left braking pedal: It has micro-motion function in addition to the normal braking function.

Right braking pedal: it is a braking pedal.

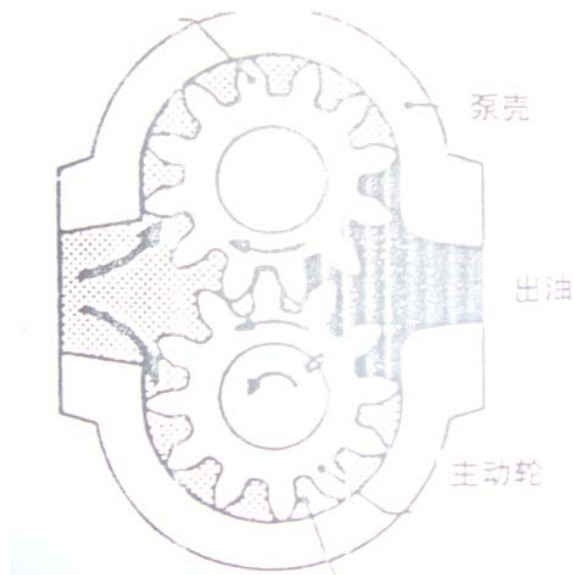
Parking brake: It is spring-loaded and hydraulic pressure released.

Gear pump: outside meshing gear pump in series with variable plunger pump.

The power is sent out through PTO port of the transmission.

**Note: It is not allowed to dismantle the pump body as that will affect its efficiency.**

Radiator: it is a suction type aluminum radiator driven by hydraulic motor.



Filters: To ensure the cleanness of the system.

Temperature control sensors: To monitor the function of the system.

#### (4) Combination valve

Its main functions: overflow valve for the accumulator, pressure control valve for the steering system, differential pressure valve, pressure-gradient control valve for steering oil circuit, pilot relief valve and release valve for cooling oil circuit, etc.

In this valve, following pressures can be detected:

Pump feedback pressure: LSPM port.

Pump outlet pressure: PM port.

Parking brake accumulator pressure: ACC1M port.

Service brake accumulator pressure: QCC2 port.

All these above are marked on the valve.

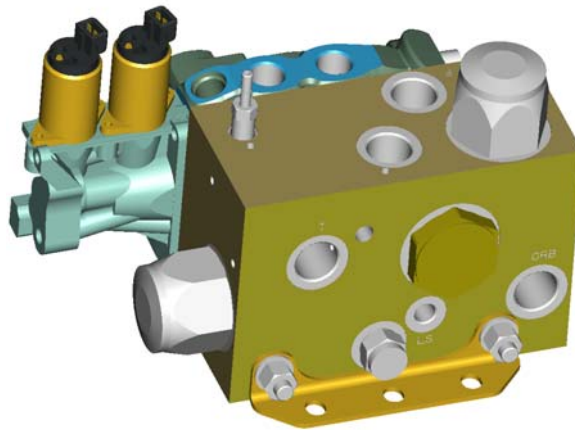
The valve is a precision hydraulic element. The maintenance will be done carefully to ensure its excellent performances. Following stipulations must be followed during the maintenance:

The hoist of the valve body will be done through specified hoist holes to prevent the deformation of valve element and other parts. The slide valve end and body will be prevented from any impact. Otherwise it will result in the deformation of the slide

valve and jamming of the valve element. Prevent moist and dust from entering into the main valve. All ports and their contact surface will be protected from dust to avoid scratches and impact. When installing the oil connections, attention must be paid to the cleanness and prevention of over-tightening.

**WARNING:**

**It is forbidden to dismantle relevant parts of the valve.**



(5) Accumulator

Three accumulators are installed in the braking system to ensure the power storage of the system. They are important safety parts. There are inlet connectors on the upper covers and filling and draining connectors on the lower covers.

Maintenance of the accumulators:

Leakage check: check the pressure of air chamber once every month after its installation. Check once every half year later.

Checking method: Install a stop valve on the circuit connecting oil tank for the accumulators and install a pressure gauge before the stop valve. Open the stop valve slowly to enable the pressure oil to return to the tank and pay attention to the pressure gauge at the same time. The needle of the pressure gauge drops slowly at first and drops to zero quickly after it reaches certain pressure. The value at which the speed of the needle movement changed is the charged pressure. In addition, the charged pressure can be checked directly with the charging tool. But some air will be released

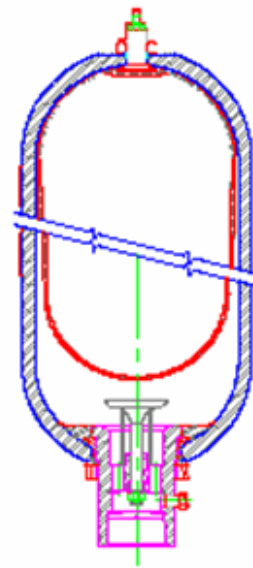
during each check.

When the air bag is damaged, pressure oil must be drained before the dismantling the accumulators and other parts.

**CAUTION:**

**Refer to attached hydraulic system schemes.**

**Note: Make sure that the system is not under pressure before undertaking the above-mentioned adjustment.**



(6) Braking pedal

The hydraulic braking pedal consists of a direct action three-way relief valve which is used to produce the continuously changed mechanical actions.

The braking force is decided by the force exerted by the operator.

The pedal can be adjusted according to the operator's habit and for the comfort of the operator.



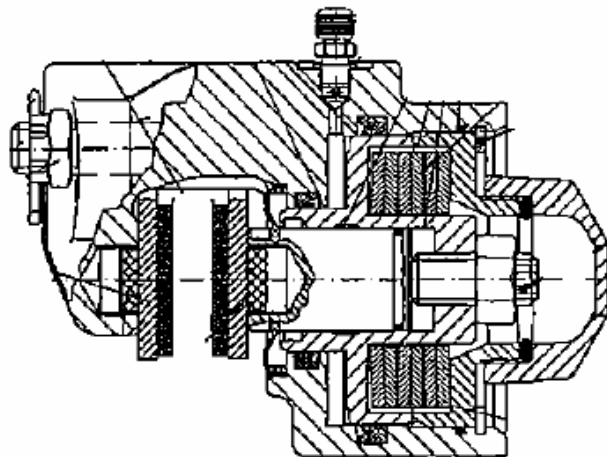
### (7) Parking Brake

The parking brake is a clamping mechanical system on the flange discs of the front axle.

The parking brake can be used as emergency brake. But the braking gaskets will wear seriously. Therefore the braking gaskets will be changed after the brake is used as emergency brake twice.

When the parking warning signal is lit up on the instrument panel, the vehicle should stop for checking and trouble-shooting.

**Note: It is forbidden for the user to make adjustment.**



### (8) Air cooling oil radiator

It can effectively remove the heat produced in the system. The specially designed radiator has excellent heat dissipating effect.

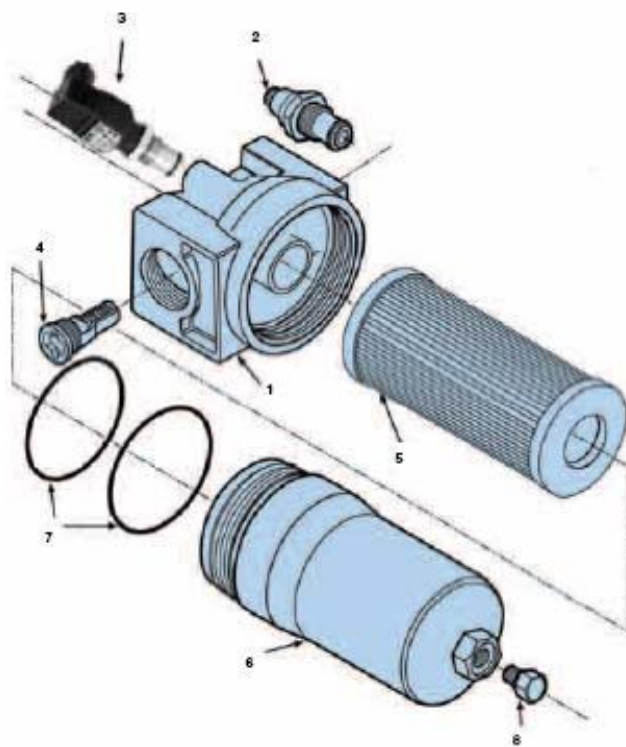
Maintenance: Once every week. Check if there is any plugging of the radiator. Make sure that there is no dust, tree leaves and other debris on surface of the air inlet. Clean with pressure air or water if necessary.

**Note: Corresponding safety measures should all be taken during cleaning.**





Maintenance of filter: The motor oil filter element will be changed every 400 hours or if there is an alarm.



1. Cover 2. Indicator 3. Electrical socket 4. By-pass valve 5. Filter element  
6. Shell 7. O-ring 8. Drain

**Note: Make sure the system is not under pressure before changing the filter element. If the liquid in the system will be drained, the engine must be stopped**

**first and then return and lower the hoist arm.**

Change the output oil filter element of the braking system every 400 hours or when the dual indicators are in the red zone.

**Note: After the filter element has been changed, check the oil level again.**

**Note: Make sure the system is not under pressure before changing the filter element. If the liquid in the system will be drained, the engine must be stopped first and then return and lower the hoist arm.**



## 5. Steering System

### (1) Brief description

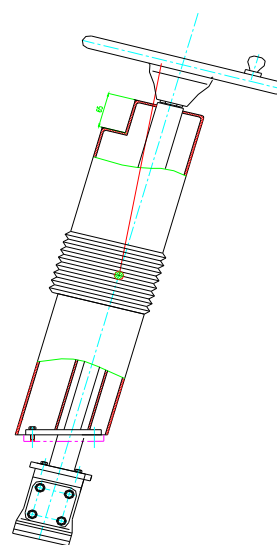
The steering system consists of low-torque load sensor all hydraulic steering gear and traversing unit assembly. The steering wheel can be adjusted up and down, forward and back to suite the need of the operator. The low-torque load sensor all hydraulic steering gear has excellent pressure compensation to the change of the steering load. The steering circuit will not affect other operation circuits. The main flow serves the steering circuit first. The steering is reliable, the system energy-saving.

### (2) Application requirements of the all hydraulic steering gear

#### a) Installation

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

In pipe line installation, the connection marked “In”(进) on the steering gear will connect with the pipe of oil pump, the connection marked “Return”(回) will connect with oil reservoir. The connections marked “Left”(左) and “Right”(右) will be connected with the left and right chambers respectively. The flow rate allowable in the suction pipe is 1—1.5m/s, pressure oil pipe and return oil pipe 4—5m/s. The test pressure of the high pressure tube will be at least 3 times that of the maximum operating pressure.



b) Oil temperature range:  $-20^{\circ}\text{C}$ -- $+80^{\circ}\text{C}$

Normal oil temperatures:  $+30^{\circ}\text{C}$ -- $+60^{\circ}\text{C}$

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

d) Filtering: The filtering fineness for the oil to the steering gear is  $30\mu\text{m}$ . A back pressure of 0.2—0.3Mpa will be ensured for the return oil of the steering gear to prevent the oil returning to the reservoir during manual steering.

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

Tighten all screw connections. Check if the steering system works normally under all working conditions. If the steering is heavy or out of order, do not turn

the steering wheel forcefully or dismantle the steering gear to prevent damages of the steering gear parts.

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

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

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

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

Do not dismantle steering gear rashly during system check. When the steering gear is confirmed to have problems, proceed according to the relevant procedures.

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

### (3) Trouble shooting of the steering system

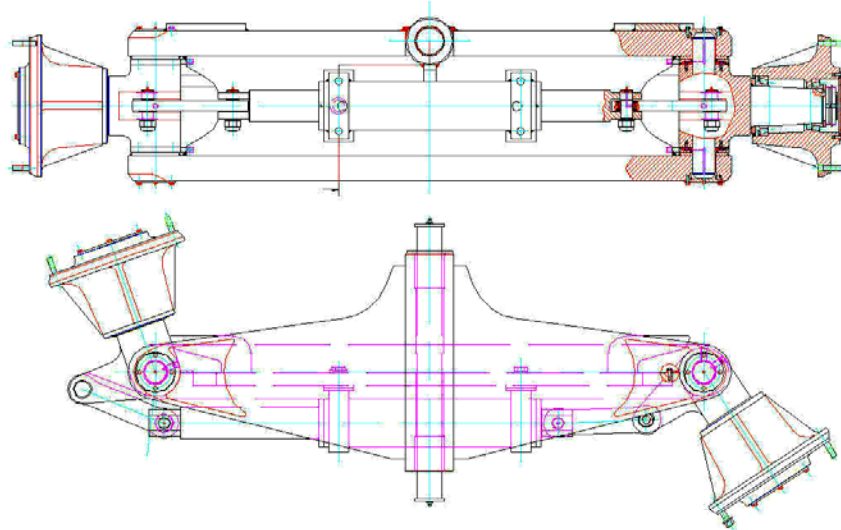
Fault	Cause of the Fault	Remedy
Steering wheel can not be turned	Damage or problem with oil pump.	Change
	Split-flow valve plugged or damaged	Clean or change
	Plastic tube or connections damaged or pipes blocked	Clean or change
Steering operation is difficult	Pressure of split-valve is too low.	Pressure adjustment
	Air in oil circuit of the steering system.	Air removal.
	Steering gear fails to return to the position. Positioning spring strip is broken or without enough elasticity.	Change spring strips
	Leakage inside steering cylinder is too big.	Check piston seal
	Oil reservoir level is too low.	Add oil
Forklift hunting or swaying	Steering flow rate is too big.	Adjust flow rate of split- valve
Abnormal noises	Oil level in reservoir is too low.	Add oil.
	Suction pipe or filter is blocked.	Clean or change

## 6. Steering Axle

### (1) Brief description

The cross section of steering axle is a frame welding structure (refer to diagrams below). It consists of steering axle body, steering oil cylinder, connecting rod and steering wheel. The steering trapezium uses crank slide structure. The piston rod of the oil cylinder pushes gimbals to turn through the connecting rod. It results in the deflection of deflection wheel and steering is thus realized. The steering axle is connected on the tail frame of the vehicle by integral pins so that the axle can sway

around the pins. There is a left and right steering knuckle on the left and right of the steering axle respectively. The wheels are fixed on the hubs through wheel rims. There are oil seals inside the bearings to make lube grease stay in the wheel hubs and steering knuckles.



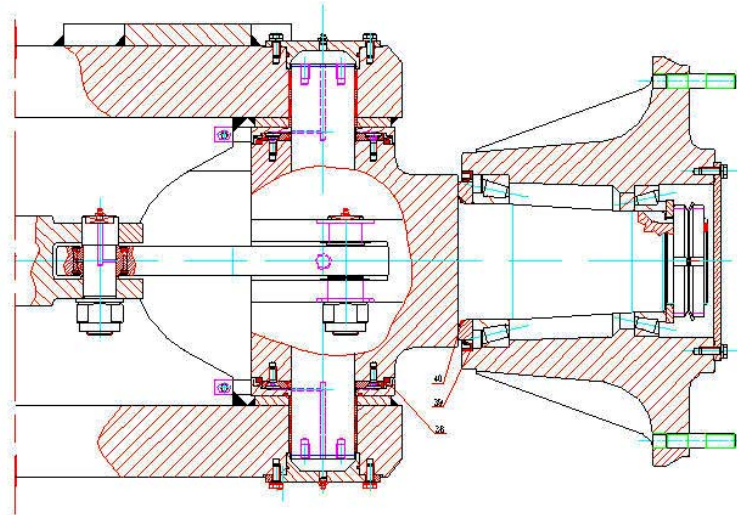
## (2) Steering knuckle and swivel pins of steering knuckle

The steering knuckle is fixed between upper and lower shaft sleeves at the two ends of steering axle with swivel pins, thrust bearings and adjusting gaskets. The center of the swivel pin is fixed on the steering knuckle with clamp pins. The two ends of the swivel pin are supported on self-lube bearings. There are oil seals at the two ends of the bearing. There is grease tap on the upper end of the swivel pin for periodical greasing.

## (3) Adjustment of pre-tightening load of steering wheel bearing

- a) Grease wheel hub, conical roller bearings, the inside of hub cover and oil sealing lips.
- b) Fix the outer ring of the bearing on the hub and install the hub on the shaft of the steering knuckle.
- c) Put on flat gasket, tighten the internal nut and back up 1/3 circle. The turning force under tightening condition is 150--180N. Tighten the internal nut and back up 1/3 circle. The turning force under tightening condition is 180--250N.

d) Knock the hub lightly with a wooden hammer. Turn the hub 3-4 circles to make sure that it has not been loosened.



## 7. Electrical System

### 7.1 A brief introduction of the electrical system

The electrical system of Heli RSH4532-V0 Reach Stacker uses modular design, CAN-BUS structure and the computer control system (WIZ) specially designed for reach stackers by 3B 6 company to integrate engine, transmission, braking, hydraulics and spreader systems into a complete control system for the unified and coordinated control of the vehicle. In addition, with large color LCD CAN-BUS interactive instruments, it has convenient on-line monitoring, display, setting up and inquiry functions and very reliable auto-diagnosis, auto-warning and auto-protection functions.

A brief introduction of major control units of the electrical system:

#### 7.1.1 Engine system

VOLVO TAD952VE engine from Sweden is a high performance engine using electronic accelerator pedal input and electric spray control and has automatic control, monitoring, diagnosis and protection functions.

TAD952VE engine uses EMS2 (engine management system) and CIU (interface

control unit) to control the engine and connects to WIZ system by CAN-BUS.

The working conditions automatically monitored and protected by the engine electrical system are: engine inlet air pressure and temperature, cooling water temperature and water level, engine oil temperature and pressure, fuel level, pressure, temperature and sediments, electronic control injection valve condition, piston cooling, crank case pressure, crank, cam and shaft speed and battery voltage, etc.

#### 7.1.2 Transmission system

American DANA TE27 transmission uses APE 200 transmission control (TCU) which has manual and auto control modes. It has complete input and output condition measurement and automatic control, diagnosis and protection functions. It connects to WIZ system by CAN-BUS.

The working conditions automatically monitored and protected by the transmission electrical system are: neutral start protection, forward/reverse directional change protection, forward/reverse gear shifting protection, input/turbo/shift/output speed measurement, gear shifting solenoid valve condition, transmission oil temperature, transmission oil filter and out of gear protection in emergency situation.

#### 7.1.3 WIZ system

WIZ system is a computer control system designed by 3B6 Company of Italy especially for reach stackers. The system includes controls for the electrical systems of braking, hydraulics and spreader and the safety and coordination control for engine and transmission systems.

The core part of WIZ system consists of HEAD and ARM controllers. The information interaction is done through CAN-BUS.

In WIZ system, the operation of the arm and spreader is controlled by a multi-function integrated joystick. It can realize the functions of arm's luff and flex, spreader's switch lock, side movement and rotation and 20" and 40" containers switching, etc. There is a safety button (DM) on the lever. When the operator's



hand is away from the joystick, the arm's luff and flex functions are automatically out of service. So it has an excellent safety feature.

WIZ system has following functions:

a) The measurement, warning and automatic safety protection for braking oil pressure and filter, hydraulic oil temperature and filter.

b) The indication of the spreader's switch lock, seating, swivel locking and opening positions.

c) Solenoid valve control of spreader's side movement, flexing and rotation actions.

d) Control of the spreader's vertical hoist and preset operation height (optional).

e) Measurement and display of hoisting container's weight, arm's length and angle. Record of hoisting work volume.

f) Stop spreader's side movement and rotation when the unbalance of the spreader's left and right load surpasses 80%.

g) When the spin lock of spreader malfunctions, the controller's alarm is on and spreader arm and various actions stop.

h) When the spin lock of spreader malfunctions, a key switch can be used to open "spin lock bypass" function for temporary operation.

i) Arm's luffing, control of proportion valve of the flexing oil cylinder and oil cylinder limit buffing functions.

j) When the load is above 90%, warning alarm is on and spreader's function and the arm's extension function stop.

k) When the hoisting container is overweight, a key switch can be used to open "overweight bypass" function for temporary operation.

l) When the load stability surpasses 65% or hoisting height is more than 8m, arm's extension surpasses 4m or overload bypass is used, there will be travel speed limit function to control high speed travel.

## 7.2 Parts description of electrical system

### WARNING:

- a) **When taking maintenance procedures on the vehicle, disconnect red main power switch on the side of electric box.**
- b) **Before using welding apparatus, disconnect red main power switch on the side of electric box.**

### 7.2.1 Battery

Type: 6-QA-180Ah (two)

Position: Battery compartment under the left body of vehicle.

For every 200 hours:

- Clean carefully battery, wires and battery box. Remove oxides and corrosiveness that may cause electric leakage.
- Observe the semi-transparent battery shell to see if the electrolyte level is at the normal level between min. and max. If the liquid level is below the min. mark, stop work and wait till battery is cool. Then add distilled water. Do not use the battery until the liquid is homogeneous (static).

Electrolyte Concentration when Battery is fully Charged	
Temperature	Electrolyte Concentration(g/cm <sup>3</sup> )
+40°C	1.265
+20°C	1.285
0°C	1.300
-20°C	1.365

7.2.2 Engine (Refer to original English version of Volvo Engine Operation Manual for details)

#### (1) Generator

Routine maintenance: Check if the connections are alright.

For every 1600 hours, carefully clean slip ring and check the wear and

connection condition of the carbon brush. If necessary, change carbon brush handles with same type as the original.

## (2) Starting motor

Routine maintenance: Check if the connection wires are ok.

For every 1600 hours, carefully clean the rectifier and check the wear and connection condition of the carbon brush. If necessary, change carbon brush handles with same type as the original.

## (3) Engine controller (EMS2+CIU)

### **WARNING:**

**Before doing any welding work, disconnect the connector assembly of EMS2 control module, cut off main power circuit of the engine and separate the jacketed cable from the control module. Reconnect EMS2 connector assembly when welding is finished.**

**During engine's test and operation, pay close attention to moving parts. If one has to approach it during operation, remember that loose clothing and long hair may be rolled in and cause serious injuries.**

**No work can be done on the engine during hoisting.**

**The engine can not operate in places with explosive source any gas storage.**

**The engine will be started in a well ventilated area. If the engine operates in a narrow area, ensure the ventilation of crank case and discharge of exhaust gas from working area.**

**The battery poles will not be in open air or places with sparks, nor close to smoking. The hydrogen produced during battery charging is flammable and highly explosive when mixed with air. A spark resulted from incorrect connection may produce a catastrophic explosion. So when starting the engine do not change the battery's connections and make it incline in any direction.**

**Make sure that the positive and negative cables are correctly and rightly**

**connected on the battery poles. Incorrect battery connection may result in serious damage of electrical equipment. Please refer to the connection scheme of the engine system.**

**Normally one will wear goggles in handling batteries. Battery electrolyte contains highly corrosive sulfuric acid. If your skin is in contact with the acid, wash with large amount of soapy water and then seek medical attention. If the acid gets into eyes, flush eyes with large amount of clear water and then seek medical attention immediately.**

Trouble Shooting: Following table lists symptoms that may cause engine faults. If the problems can be solved, please contact the manufacturer.

Symptoms and Possible Causes

Engine Symptoms	Consulting “Diagnosis”
Engine does not stop.	2, 5
Starter does not work.	1, 2, 3, 4, 5, 6, 7, 24
Starter motor running slowly.	1, 2
Engine does not start while starter working normally.	8, 9, 10, 11
Engine stops after starting.	8, 9, 10, 11, 13
Engine does not have enough speed even when accelerator is down to the bottom.	9, 10, 11, 12, 13, 21, 25, 26
Engine is not running smoothly.	10, 11
High fuel assumption.	12, 13, 15, 25
Black exhaust.	12, 13
Blue or white exhaust.	14, 15, 22
Low lubrication oil pressure.	16
High cooling water temperature.	17, 18, 19, 20
Low cooling water temperature	20
No indication or no charging.	2, 23

### **Diagnosis:**

1. Low battery.
2. Open circuit or poor contact.
3. Main switch is cut off.
4. Fuse out.
5. Starting switch fault.
6. Main relay fault.
7. Starter or starter coils fault.
8. No fuel (empty fuel tank or wrong fuel pipe connection).
9. Fuel filter blocked (caused by pollution or waxy materials in fuel in low temperature).
10. Air in fuel system.
11. High water content in fuel.
12. Injection pump fault.
13. Insufficient air intake of the engine.
  - Air filter blocked.
  - Leakage in turbo-charger and engine intake connections.
  - The compressor in turbo-charger is dirty.
  - Turbo-charger fault.
  - Insufficient ventilation space for the engine.
14. High coolant temperature.
15. Low coolant temperature.
16. Low engine oil level.
17. Low coolant level.
18. Air in cooling system.
19. Pump circulation fault.
20. Thermostat short coming.

21. Air blocking in cooler.
22. Engine oil level is too high.
23. Generator belt is loose.
24. Water in engine.
25. High discharge pressure.
26. “+” end cable of accelerator pedal is breaking off.

**Diagnosis Function:**

a) The diagnosis function monitors and checks various functional modules of EMS2 system.

It has following tasks:

- Discover and confirm the fault’s position.
- Inform faults being found.
- Make suggestions for the trouble shooting.

b) Fault code

The fault found by fault diagnosis in EMS2 system will be reported in fault code. Whether the faults solved or unsolved will be stored in the controller.

All fault codes and fault information are in the fault code list. They will be eliminated according to the causes, responses and measures described by the information.

c) Fault display

When a fault is discovered by the system, CIU diagnosis lamp will flash. Push and release the diagnosis button on the control panel in the operator cab, a fault code will come out.

For example, the flashing pattern of CIU diagnosis lamp is (\*\* \*\*\*\*) , the fault code is (2.4).

d) Fault ends

When the flashing pattern of CIU diagnosis lamp returns to (\* , \* ) , that means

there is no fault (1.1).

e) Effect on the engine

The effect on the engine differs as the seriousness of the fault discovered by the diagnosis function is different:

- Engine is not affected.
- Engine in idle speed.
- Engine torque is limited.
- Engine stops.

When a fault is discovered by diagnosis function, a fault code will always be produced.

f) Operation

When a fault happens and the diagnosis has produced one or several fault codes, please refer to “Fault code” in reading these codes.

Switch the engine to idle speed or shut off the engine.

As to CIU, push down diagnosis button and read the fault code appeared.

Find corresponding code in the fault code list and repair in accordance with the measures recommended.

g) Fault code

**CAUTION:**

**Read following fault codes.**

For example, Code 2.1, PID 97: in which 2.1 is fault code, PID97 is information read by VODIA tool.

**CAUTION:**

**Please check the wire number tube on “CIU and DCU Wiring” and confirm the electrical connection to the engine control equipment.**

Fault Codes					
Code	VODIA	Fault description	Cause	Response	Measures
1.1	-	Fult-free	-	-	-
2.1	PID/SPN 97	Oil-water separator	Water entering into fuel	Easy to stall.	Drain out the water accumulated in the oil-water separator.
2.2	PID/SPN 111	Level of cooling fluid	Lower cooling fluid level	Alarm indicates. The control module of engine reduces the power output.	Check the level of cooling fluid. Check the function of cooling fluid monitor.
2.3	PID/SPN 111	Cooling fluid level sensor	Short circuit of power supply of sensor Fault of sensor	No response.	Check if the wiring of level sensor of cooling fluid is damaged. Check the function of level sensor.
2.4	SID21/SPN 637	Fly-wheel speed sensor	No signal Abnormal frequency Intermittent sensor signal Fault of sensor	Engine is difficult to start up. The start-up operation is not smooth.	Check if the plug-in unit of sensor is installed correctly. Check if the circuit of sensor is damaged. Check if the sensor is correctly mounted on the flywheel shell. Check the function of sensor.
2.5	SID21/SPN 636	Driving cam speed sensor	No signal Abnormal frequency Fault of sensor	The starting time of engine is longer than that of normal. The operation is normal.	Check if the plug-in unit of sensor is correctly mounted. Check if the sensor is damaged. Check the installation of sensor on the upper timing gear cover end. Check the function of sensor.
2.6	PID/SPN 190	Rotary speed of engine	Too high the rotary speed of engine	No response	Stop and find out the cause of high rotary speed.
2.8	PPID132/SPN 608	Connection of accelerator pedal with CIU	Short circuit of power supply of sensor Fault of sensor	Engine is idle. If release first , then step on , the engine can be forced to make idle operation.	Check if the connection of accelerator is correct. Check if the wiring that connects the accelerator is damaged. Check the function of potential meter of accelerator.



Code	VODIA	Fault description	Cause	Response	Measures
2.9	PID/SPN 97	Alarm of oil-water separator	Short circuit Open circuit Fault of indicator	No response	Check if the circuit of indicator is damaged and the function of indicator and change it when needed.
3.1	PID/SPN 100	Oil pressure sensor	Short circuit of the power supply of sensor Open circuit	No response	Check if the circuit of indicator is damaged. Check if the connection of oil pressure sensor is correct.
3.2	PID/SPN 105	Temperature sensor of inlet air	Short circuit of power supply of sensor Open circuit	No response	Check if the installation of plu-in unit of sensor is correct. Check if the line of sensor is damaged. Check the installation correctness of sensor and function of air inlet temperature sensor.
3.3	PID/SPN 110	Temperature sensor of cooler	Short circuit of power supply of sensor Open circuit	It is activated when engine become heated.	Check if the connector and plug-in unit of sensor are correctly mounted. Check if the circuit of sensor is damaged. Check if the installation of sensor is correct. Check the function of cooling temperature sensor.
3.4	PID/SPN106/102	Load pressure sensor	Short circuit of power supply of sensor Open circuit	The smoke during acceleration or loading is much more than that under the normal condition.	Check if the connector and plug-in unit of sensor are correctly mounted. Check if the circuit of sensor is damaged. Check if the sensor is correctly mounted and the function of the load sensor.
3.5	PID/SPN 106/102	Load pressure	The load pressure is too high.	The control module of engine decreases the power of engine.	Check the turbocharger. Check the load pressure sensor. Check the fuel consumption and fuel nozzle.

Code	VODIA	Fault description	Cause	Response	Measures
3.6	PID / SPN 94	Pressure sensor of fuel	Short circuit of power supply of sensor, open circuit	No response	Check if the plug-in unit of sensor is correctly mounted. Check if the line of sensors damaged. Check the mounting correctness of sensor and the function of fuel pressure sensor.
3.7	PID / SPN 175	Oil temperature sensor	Short circuit of power supply of sensor Damage	No response	Check if the circuit of sensor is damaged. Check if the sensor is correctly mounted.
3.8	PID / SPN 94	Fuel pressure	The fuel pressure is low.	No response	Check if the pressure established by hand oil pump is enough. Check the fuel filter and fuel coarse filter.
3.9	PID/SPN 158	Voltage of battery	Fault of power generator Fault of battery or connection cable	No response	Check the voltage from controller.
4.8	PPID6/SPN 520195	EMS stop input	Short circuit with negative pole Open circuit	It can only be stopped with the help of auxiliary stop function.	Check if the connection line of starter and switch are damaged.
5.2	PPID4/SPN 520195	CIU start input	Short circuit with negative pole The start-up time is too long.	The engine can not start up. The engine starts immediately when the ignition switch is turn on.	Check if the connection line of ignition key switch is damaged. Check if there is an damaged from cable to ignition switch.
5.3	PPID6/SPN 970	CIU stop input	Short circuit with negative pole Open circuit The activation time is too long.	It can only be stopped through auxiliary stop function. The engine stops.-A fault code indicates for about 40s and the engine can not be started up at this time. When the fault code is activated, the engine can be started up, but can not stop.	Check if the switch connection line of starter is damaged and if the cable of ignition switch is damaged.

Code	VODIA	Fault description	Cause	Response	Measures
5.4	PID45/SPN 626	Pre-heat relay	Short circuit with positive or negative pole Open circuit	The preheat can not be activated. Always preheat	Check if the input line of relay is damaged and check the function of relay.
5.7	PID/SPN 98	Machine oil level	The level of machine oils too low	The oil level is too low and the alarm gives indication.	Check the level of machine oil.
5.8	PID / SPN 175	Temperature of machine oil	The temperature of machine oil is too high.	The alarm indicates The control module of engine limits the output. (except that protection is closed with VODIA tool)	Check the oil level Check oil temperature and the function of sensor.
5.9	PID / SPN 98	Level sensor of machine oil	Short circuit of positive or negative Damage	No response	Check if the cable of oil level sensor is damaged. Check the function of oil level sensor. Check the function of oil level sensor
6.1	PID / SPN 110	Temperature of cooling fluid	The temperature of cooling fluid is too high.	The control module of engine reduces the power of engine. ( Except that the closing protection is used with VODIA tool.)	Check the cooling fluid level. Check the cleanness of coolant. Check if air has entered into cooling system Check the pressure cap of expansion tank. Check the function of temperature sensor of cooler. Check the function of thermostat
6.2	PID / SPN 105	Air inlet temperature	Air inlet temperature is too high.	The control module of engine reduces the power of engine. (Except the closing protection with VODIA tool is used)	Check the level of cooling fluid. Check the cleanness of cooling fluid. Check the function of air inlet temperature sensor. Check the function of thermostat.

Code	VODIA	Fault description	Cause	Response	Measures
6.3	PPID3/SID 39/SPN677	EMS start –up signal outputs Starter relay	Short circuit with positive or negative pole The activation time is too long.	The engine can't start. When the ignition switch is used, the engine starts at once.	Check the line of ignition switch. Check the line from cable to key switch.
6.4	PPID231/SPN639	CAN connection	CAN communication fault	Instrument and alarm stop working.	Check if the 8-pin plug-in unit is damaged. Check if the CIU and EMS cables are damaged.
6.5	PID231/SPN639	EMS2 telecommunication connection	Internal fault of control module	The engine can't operate. The engine can't start up. Operation of engine : The engine become idle and can only be stopped with the help of auxiliary stop function.	Check if the 8-pin plug-in unit is damaged. Check if CIU and EMS cables are damaged. Check if the CIU – 11,12 pins are damaged.
6.6	PID / SPN 100	Pressure of machine oil	The pressure of machine oil is low.	The control module of engine reduces the power of engine ( Except that the closing protection with VODIA tool is used.)	Check the level of machine oil. Check if the air filter is obstructed. Check the pressure valve and safety valve inside the system and check the function of oil pressure sensor.
6.7	PID8/SPN 520192	The cooling pressure of piston	The cooling pressure of piston is too low.	Engine stops. The fault code is released when the rotary speed of engine is lower than 1000 rpm.	Check the pressure of machine oil when engine exceeds 175kPa.
6.8	PID8/SPN 520192	Cooling pressure sensor of piston	Short circuit with positive or negative pole Damage	No response	Check if the plug-in unit of sensor is correctly mounted. Check if the wiring from cable to sensor is damaged. Check the function of cooling pressure sensor of piston.

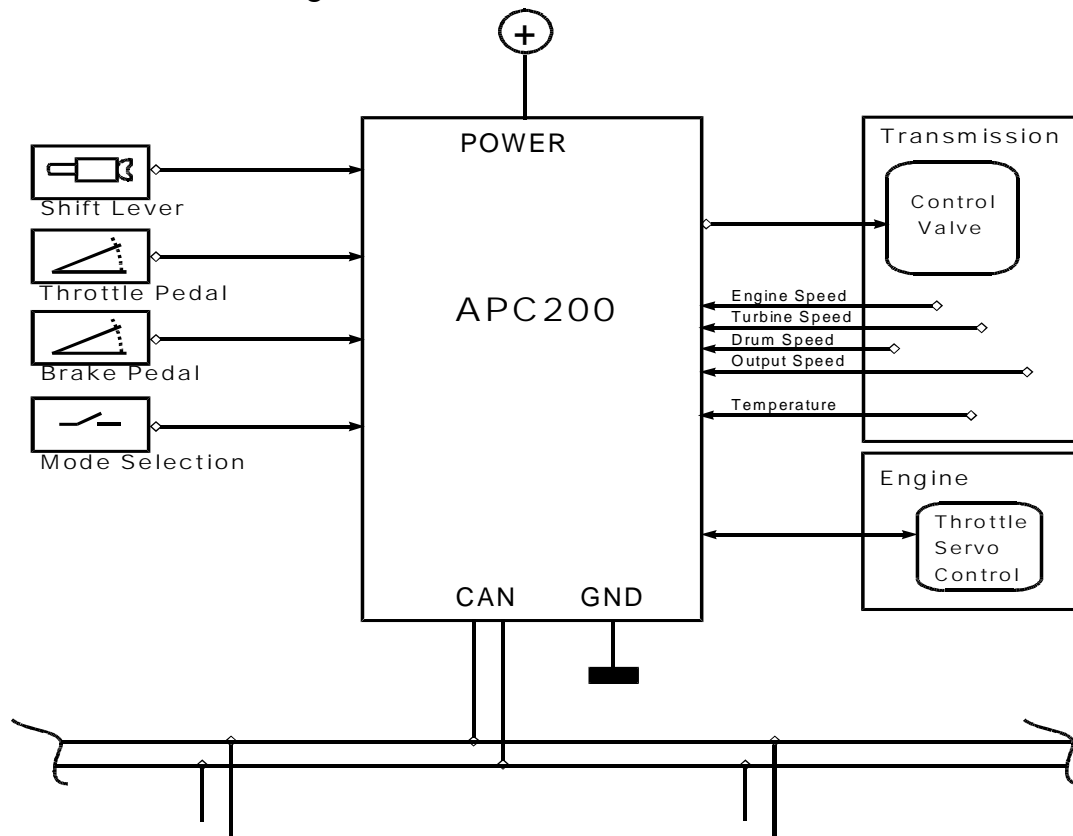
Code	VODIA	Fault description	Cause	Response	Measures
6.9	PID / SPN 158	Voltage of battery	Short circuit of negative pole Fault of motor Fault of battery and cable	There exists the problem on the start-up of engine.	Check the voltage from controller Check the battery Check the power generator. Check 8-pin plug-in unit.
7.1	SID 1 / SPN 651	Injection pump, No.1 cylinder1	Electric fault , fault of injection pump or compression	The engine operates at other 5 cylinders. Abnormal noise Weakened performance	Check if the cable of injection pump is damaged. Check if the connection of injection pump is damaged. Check the fuel supply pressure and the clearance of valve. Check make a compression test and check No.1 cylinder.
7.2	SID 2 / SPN 652	Injection pump ,No.2 cylinder	Electric fault Faults of injection pump or compression	The engine operates at other 5 cylinders. Abnormal noise Weakened performance	Check if the cable of injection pump is damaged. Check if the connection of injection pump is damaged. Check the fuel supply pressure and the clearance of valve. Make a compression test and check No.2 cylinder.
7.3	SID 3 / SPN 653	Injection pump ,No.3 cylinder	Electric fault Faults of injection pump or compression	The engine operates at other 5 cylinders. Abnormal noise Weakened performance	Check if the cable of injection pump is damaged. Check if the connection of injection pump is damaged. Check the fuel supply pressure and the clearance of valve. Make a compression test and check No.3 cylinder.

Code	VODIA	Fault description	Cause	Response	Measures
7.4	SID 4 / SPN 654	Injection pump, No.4 cylinder	Electric fault Faults of injection pump or compression	The engine operates at other 5 cylinders. Abnormal noise Weakened performance	Check if the cable of injection pump is damaged. Check if the connection of injection pump is damaged. Check the fuel supply pressure and the clearance of valve. Make a compression test and check No.4 cylinder.
7.5	SID 5 / SPN 655	Injection pump, No.5 cylinder	Electric fault Faults of injection pump or compression	The engine operates at other 5 cylinders. Abnormal noise Weakened performance	Check if the cable of injection pump is damaged. Check if the connection of injection pump is damaged. Check the fuel supply pressure and the clearance of valve. Make a compression test and check No.5 cylinder.
7.6	SID 6 / SPN 656	Injection pump, No.6 cylinder	Electric fault Faults of injection pump or compression	The engine operates at other 5 cylinders. Abnormal noise Performance reduced	Check if the cable of injection pump is damaged. Check if the connection of injection pump is damaged. Check the fuel supply pressure. Check the clearance of valve, make a compression test and check No.6 cylinder.
7.7	PID / SPN 153 (only for TAD950-952VE)	Air pressure of crankcase	The air pressure of crankcase is too high.	The engine stalls (in case of not passing closing protection of VODIA tool)	Check if the crankcase is sealed off. Check if the cylinder body, piston or piston lever are worn or damaged.
7.8	PID / SPN 153	Air pressure sensor of crankcase	Short circuit with positive or negative pole Damage of sensor	No response	Check if the sensor is correctly mounted. Check if the line of sensor is damaged and check the function of sensor.

Code	VODIA	Fault description	Cause	Response	Measures
9.2	SID 250 / SPN 608	Data connection fault	Fault of data connection	No response	Check if 8-pin plug-in unit is damaged. Check the cable of CIU and EMS is damaged.
9.3	SID 232 / SPN 620	Power provided to sensor	Short circuit, fault of sensor	Fault of oil pressure and air inlet sensor Fault code of oil pressure and air inlet sensor The output of engine is low. The instrument indicates zero pressure or the pressure rises rapidly.	Check if the cable to oil pressure and air inlet sensor is damaged. Check oil pressure and air inlet sensor.
9.8	SID 253 / SPN 630	CIU EEPROM	Internal fault of control module Fault of program design	The engine can not start up.	Reprogram the control module, if the fault still exists, change the control module.
9.8	PID 254 / SPN 629	Fault of CIU controller	Fault of CIU EEPROM Fault of flash memory Fault of CIU control module	CIU returns to the enactory setting Engine becomes idle and can not start up.	Reprogram the controller
9.9	SID 240 / SPN 639	Error of memory	Fault of EMS internal memory of engine	The engine can not start up	Reprogram the controller Change the controller of engine (EMS)
9.9	SID 253 / SPN 630	EMS EEPROM	Internal fault of control module Program fault	The engine can not start up.	Reprogram the control module, if the fault still exists, change the control module
9.9	SID 254 / SPN 629	EMS control module	Internal fault of control module	The engine does not ignite. The engine can not start up.	Change the controller of engine.
\	PID 19 / SPN 2791	Internal EGR	Cable fault IEGR mechanical fault	The control module of engine reduces the power of engine.	Check the cable Check IEGR

7.2.3 Transmission (Please refer to the original English version of “DANA Transmission Operation Manual” for details)

TE27 Transmission of American DANA Company used by Heli Reach Stacker utilizes APC200 Transmission Control Unit (TCU). It has manual and automatic control modes with complete input and output measurement and automatic control, diagnosis and protection functions. It is connected to WIZ system through CAN-BUS. Following is the control sketch.



In addition to simple operation, APC200 provides good protection function for the transmission and has high gear shifting quality and reliability. It also has auto test and measurement and trouble shooting functions and can solve the problems quickly. The wiring of the transmission is comparatively simple. It mainly includes connections among gear shifting lever, APC200 controller and transmission valve, etc.



► Description of main parts:

(1) Gear shifting lever

The lever selects the gear of the transmission. Its output signal is input signal for APC200.

APC200 supports remote control through CAN bus

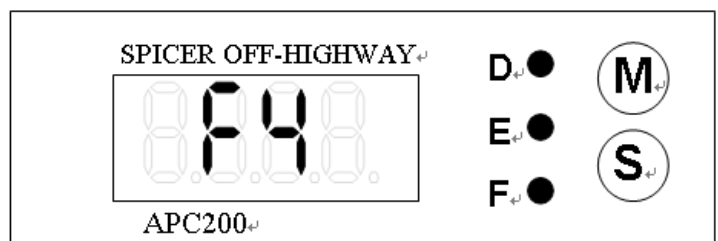
(2) Transmission control unit (TCU)

APC200 TCU is mounted on the operation panel in operator cab. On the TCU display, there are (refer to following scheme):

4 red 7parts LED digital displays

3 LED indicators

2 mode selection button



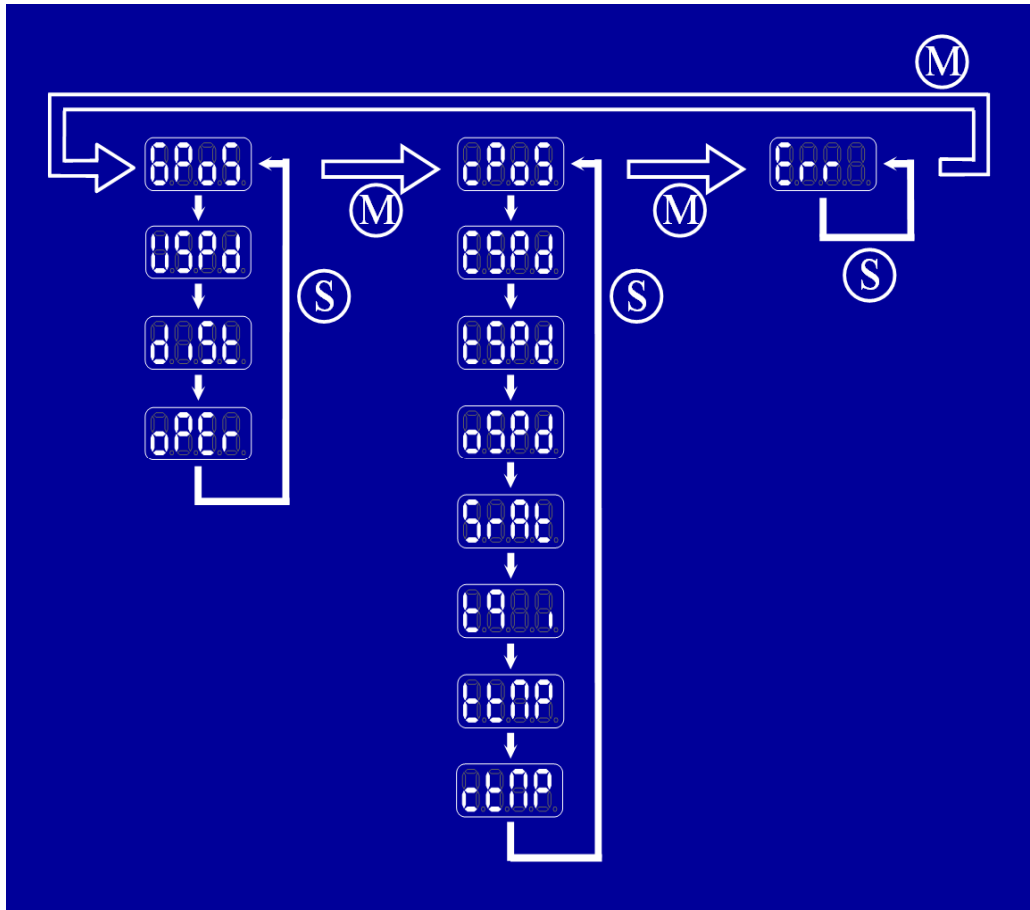
APC200 front panel display

Yellow indicator D shows auto test mode; Yellow indicator E shows fault mode; Red indicator lamp shows the interchange between fault indication and relief under reset condition of APC200.

After power is on, the display will enter into the last display mode by default (if there is no fault). Normally it is a gear shifting mode. In this mode, the figure on the center left is actual travel direction, the figure on the center right shows present gear.

Pressing M button changes display information. If pressing S button at same time, you can choose sub-mode of present mode.

Pressing M button continuously (release after about 5 seconds) shows present selected mode.



- There are three indication groups: most frequently used gear selection display, vehicle speed display and travel distance display.

Display Code	Remarks
GPOS	Shows present vehicle travel direction and gear used.
VSPD	Shows vehicle speed in km/h or MPH (parameter setting). The initial value of speed display is 0.1 km/h or 0.1 MPH.
DIST	Shows travel mileage in km or miles. Initial value of display is 0.1 km or 0.1 mile. Press S button continuously for 3 seconds, distance counter will reset.
OPER	Shows total operation time of the vehicle (engine operation time). Operation time display begins with 1h till 49999h. When figures display time, the decimal between the two figures shows that the time has passed 10000h, the figure before the first decimal will be taken as the first figure of the time. For example: 1 2 3 4 = 1234 hours 1 2.3.4. = 31234 hours
CPOS	Shows present direction and gear of the lever.
ESPD	Shows engine speed (RPM)
TSPD	Shows turbine speed (RPM)
OSPD	Shows output speed(RPM)
SRAT	Shows transmission rate calculated as TSPD/ESPD (turbine speed/engine speed). It is an important parameter in auto gear shift.
TQI	Turbine torque measured at output end.
TTMP	Shows transmission oil temperature °C
TCMP	Shows cooler input temperature °C

When the controller has found a fault, indicator lamp E will flash. The cause of the fault and the solution can be found according to the fault display code.

### (3) Manual/auto selection switch

The switch sends manual/auto selection signal to APC200.

If manual/auto selection switch is not used, the auto mode will be taken as normal mode by default.

### (4) Parking brake switch:

When the parking brake switch signal is putting in APC200 controller, transmission will be in neutral gear.

Once the parking brake input is forced in neutral gear, there will be following two methods to return the gear shifting lever to neutral gear whether parking brake is closed again or not:

- Unconditional: Once the parking brake is closed, the gear shifting lever will immediately stop transmission from direction selection.

- Reset neutral gear: if parking brake is closed, shifting lever will recycle through neutral gear before APC200 identifying lever direction again.

There are following ways for the connection between the parking brake and APC200:

- Use one digital input. If requested, the digital input logic will be reversed.

- Use CAN information to transmit parking brake switch signals.

### (5) Digital input for clutch out-of-gear:

Activate clutch separation by braking pedal position signals. It can be done by one figure signal.

The digital input is not at all controlled by braking pedal analog signals. So the two options can be activated at same time.

Clutch separation digital input can only use one digit input to connect with APC200. If requested, the digital input logic will be reversed.

(6) First and second gear start selection switch:

The transmission starting gear can select this input signal. This will overrule the selection standard of starting gear. It is favorable for different transmission operations requested by the operators in accordance with available operation conditions.

1/2 gear start selection switch can be connected with APC200 through following ways:

- Use one digital input. If requested, the digital input logic will be reversed.
- Use CAN information to transmit 1/2 gear start selection signals. Refer to

1.1 section of Chapter 3

APC200 has following major functions:

- Reversing protection.
- Downshift protection.
- Excessive speed protection control.
- Automatic shifting.
- Automatic neutral shifting.
- Clutch out of gear
- Electronic micro drive (decided by configuration, optional).
- Engine control (decided by configuration, optional).
- Pedal braking (decided by configuration, optional).

► Diagnosis and maintenance:

APC200 does not need any special apparatus in the process of diagnosis and maintenance. It has already pooled several automatic test and measurement functions for these operations.

But multi-meter and some other simple tools are needed in checking the causes of faults.

## (1) Auto-testing function

APC200 has a special circuit to check if it is working normally. 6 auto-testing modes have been written in the control programs of APC200.

Displaying testing and measurement and versions;

Digital input testing and measurement;

Analog input testing and measurement;

Speed sensor testing and measurement;

Output testing and measurement;

Voltage testing and measurement;

When APC200 is in auto-testing mode operation, indicator lamp “D” is on.

### **CAUTION:**

**If fault is found during auto-testing mode operation, indicator lamp “E” will flash to show outstanding fault.**

**In this case, press S button and hold on for a movement. The fault code will not be displayed anymore.**

## (2) Auto-testing operation

After APC200 is on, press down the button on the controller, auto-testing function is activated.

When power is cut off, APC200 will quit its auto-testing function.

Normally, in all testing and measurement module conditions, a visual mode is preset for every module’s turning-on display.

For example: when turning on input display mode, an electrical level will be displayed for every input. The speed sensor testing mode will display the frequency of each sensor signal.

Press “M” button to select next group of orders menu.

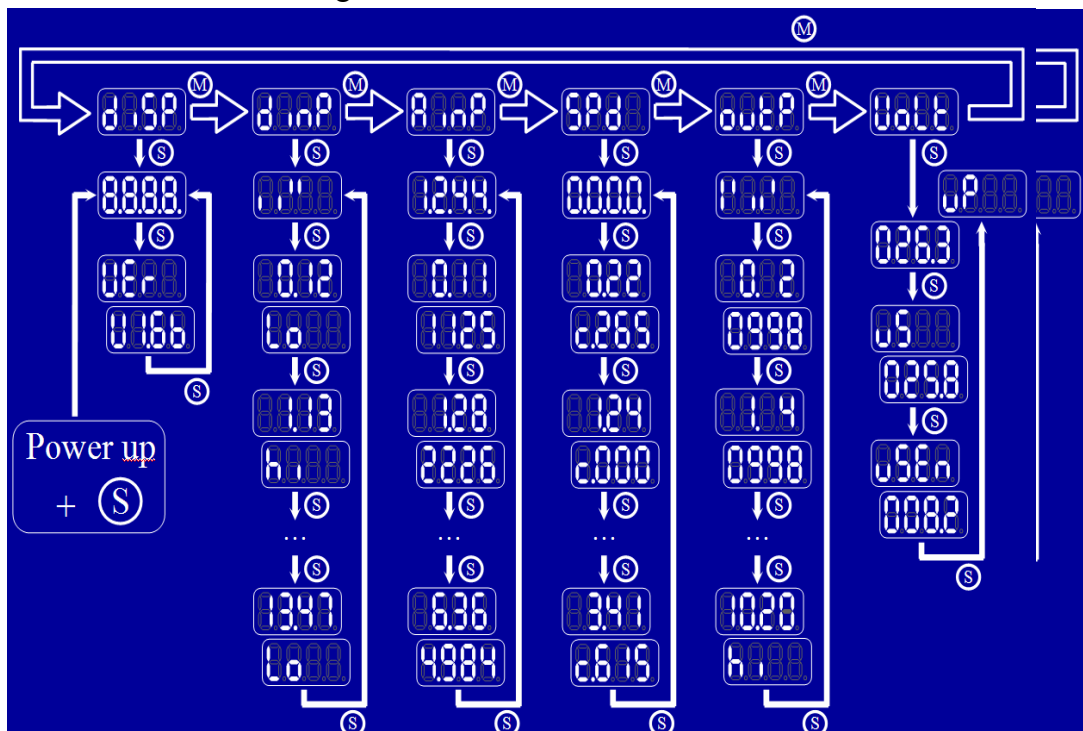
By pressing “S” button at the same time, you can view all detailed command information of the selected group.

The display will normally return to display window when you select a new function group by pressing “M” button.

Pressing “M” or “S” button for a short time can reselect current configuration or mode.

The useful configurations in all diagnosis groups will display that the testing mode is activated when power is on.

Preview of the testing mode:



Display testing and measurement and version:

When selecting this group mode, it is shown on display:



When pressing down “S” button, the display is changed as:



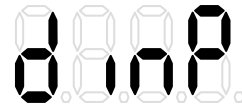
Pressing “S” button continuously, the display switch will return to testing and measurement mode and display:



After relief of S button, all digital part will be lit up on the display.

a) Digital input testing mode

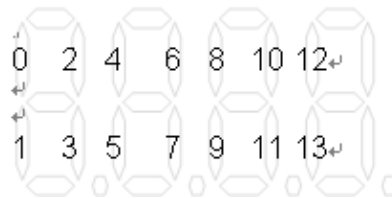
When this mode is selected, it will show on the display:



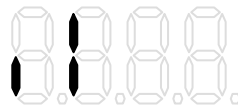
The display shows that the input is activated. Each digital part on the display shows a specific logic input. If different inputs are activated at the same time, the different digital parts can be turned on or off at the same time. Of all 14 inputs, 10 are digital inputs, 4 are analog inputs.

The digital input will display figures 0—9 as shown on schemes of following specification.

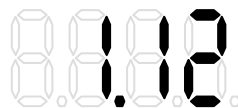
The analog input will display 0—3 on 10—13 of the digital parts as shown on following schemes.



The following is on display of input 1,4 and 5, other digital parts are close.



Press S button repeatedly, each independent input will be displayed in detail. Pressing down S button continuously, input wire number matching the logic input will be displayed.



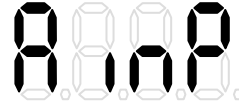
Release the button. Input conditions (high electrical level or low electrical level) will be displayed.

Press down “S” button after last simulation input. The next display window will be shown on the display.

b) Analog input testing mode

There are 4 analog impedance inputs in APC200. They are used for individually measuring the impedance between connection sensor input and grounding B18.

When this mode is selected, it will display:



After the button is released, the visual signals of 4 analog inputs will be displayed. The value figures, with k as their unit, are separated by decimals.



The above first digital input shows 1k, the second shows input 2k. The last two digits show 0k.

These values can be found precisely at any time when these inputs are displayed.

When pressing down the switch, similar digital input is displayed. The left shows the group input of current testing. The right end shows matching wire number.

It displays impedance value with k as unit after “S” button is released.

c) Speed sensor testing mode

When this mode is selected, the display shows:



When releasing “M” button, a view appears again on the display.

With KHz as unit, the four figures are separated by decimals. Speed is displayed at 0—1000Hz.

With S button, more detailed information concerning speed can be viewed. If the button is released, the left figure shows what kind of speed sensor the current channel is connected:

1	C	Electric current sensor (magnetic impedance sensor)
2	i	Inductive speed sensor

Other three figures and decimals show the matching speed value in KHZ.

For example, in following display, the left group shows the corresponding



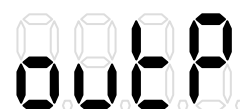
frequency of a current speed sensor is 933Hz. The right group shows the corresponding frequency of the inductive current sensor is 1330 Hz.



When last channel is displayed, you may reselect speed sensor contents by pressing down S button.

#### d) Output testing mode

When this mode is selected, the display shows:



The display shows activated output. Similar digital input testing also shows on the display. Every display digital part shows a special input.

If different outputs are activated at the same time, the different digital part will not open at the same time.



If an output digital part is flashing, it means a fault.

There are 11 channels of outputs in all:

0—6 are analog output.

7—9 are STP digital quantity output.

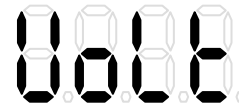
10 is STG digital quantity output.

In operating all these different modes, very detailed information can be found. When pressing down the switch, the left digital part shows the input information of current testing channels and the right digital part shows matching wire number. When the button is released, the current electric current or logic output condition (high electrical level or low level) in mA will be displayed.

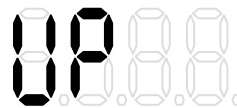
If there is fault in one group of output, the corresponding digital parts will flash slowly. There will be detailed output quantities on display. The display will alternatively shows current output conditions and types of faults.

e) Voltage testing mode

When this mode is selected, the display shows:



When the button is released, the display shows permanent voltage value measured at A01 wire.



The other two modes in this group are switch electrical level (Vs) and sensor voltage (Vsen) which can be expressed in Volts.

Measure Vs at wire B12: The input power supply provided by this circuit is used for the control of power decreasing process. It is allowed to be stored in the flash memory before actual shut-down.

Vsen is used to divide internal voltage generating regulator. It is close to 8V and can be measured at any load discharging simulation quantity output end. Vsen voltage is used for reference to simulation input quantity.

► Service request

If there is a request to have exchange with service engineer, A code in the range of 90.00—99.99 will be produced.

If such a fault is produced, the fault code and the word “code” will be continuously displayed. There will be no special indication when the fault is read out through CAN-bus.

If this situation happens, it is suggested that the fault code be recorded in detail and contact manufacturer for solution.

► Fault indication

When fault happens, “E” lamp begins to flash.

To make sure if the fault really exists, refer to APC200 display fault code menu described in 1.3.2 section of Chapter 1.

Furthermore, fault information can be collected by CAN. The detailed information for this collection is described in section 1.3.5 and section 2.2.3 of Chapter 3.

Following are two possible methods of using APC200 display:

For finding what kind of fault is, press “S” button for one second and the fault area is displayed. When pressing another button for about two seconds, the fault quantity happened in the past (since last cleaning of the fault record) is displayed. When “S” button is released, total fault codes will display.

If several faults happen at the same time press down “S” button and select another fault display before the restart of normal display.

The faults will be displayed in the order of their seriousness. After last fault display, if “——” appears on the display, it means no more fault is discovered.

► Transmission fault code:

Refer to transmission manufacturer’s manual.

#### 7.2.4 Braking and hydraulic systems

Braking system: The system is divided into service braking and parking braking.

Service braking is hydraulic power braking. Left and right foot pedals are service brakes. During service braking, if braking pressure is larger than 158Bar, the transmission will automatically be out of gear. The electrical system can automatically test and measure braking oil pressure, oil temperature and oil filter condition and display on the instruments.

Parking brake is caliper disc brake. There is a parking brake switch on the control console. When the braking system pressure is low, parking braking will start

automatically, the transmission is out of gear, the vehicle will stop and parking braking alarm is on.

Hydraulic system: The system uses WIZ reach stacker computer control system of Italian 3B6 Company for control.

► WIZ reach stacker computer control system specifications:

System description:

WIZ system of 3B6 Company is a computer control system used for reach stackers. It has load indication and safety monitoring functions and is a advanced vehicle management system.

The color LED display of WIZ system can show complete information of vehicle's condition.

WIZ system has intelligent soft wares for self-calibrations, automatic measurement of container weight and self-diagnosis of faults.

WIZ system is perfectly designed and suitable for container operation. Its compact parts and mechanical strength can guarantee the job completion even under most demanding conditions.

System composition:

HEAD-CS Main controller

ARM2 Secondary controller

ACT11CS100R Length and angle sensor

HTD65 color display

Y11 4745-350 Pressure sensor (3)

JOYSTICK Integrated control lever (two shafts, 8 buttons and one safety button)

(1) HEAD-CS is core controller of WIZ system

HEAD-CS main controller is connected with ARM2 secondary controller, HTD65 display and vehicle's engine, transmission and spreader, etc through

CANBUS. It is also connected with the testing and measurement sensors outside the braking and hydraulic systems and can timely, on-line and continuously monitor the working conditions of the vehicle.



(2) ARM2 is a secondary controller for the control of arm's movement.



(3) ACT11CS100R is a length and angle sensor. It is installed on the arm for the measurement of arm's extensions and elevation angles.



(4) HTD65 display is installed on an adjustable base for the convenience of adjustment.



HTD65 color LED display uses TFT technology to ensure its fine visibility.

HTD65 display can show vehicle's information under all conditions. There are 10 functional keys on the two sides of the display for man-machine interactions. It is connected to WIZ system through CANBUS.

(5) Y11 4745-350 pressure sensor is situated on the left and right luffing cylinder and is used for measuring the load of the arm.

WIZ system will calculate the load, by triangle calculation method, with the

parameters of hoisting cylinder pressure, angle and arm's length, etc measured by the system and judge whether it is safe.

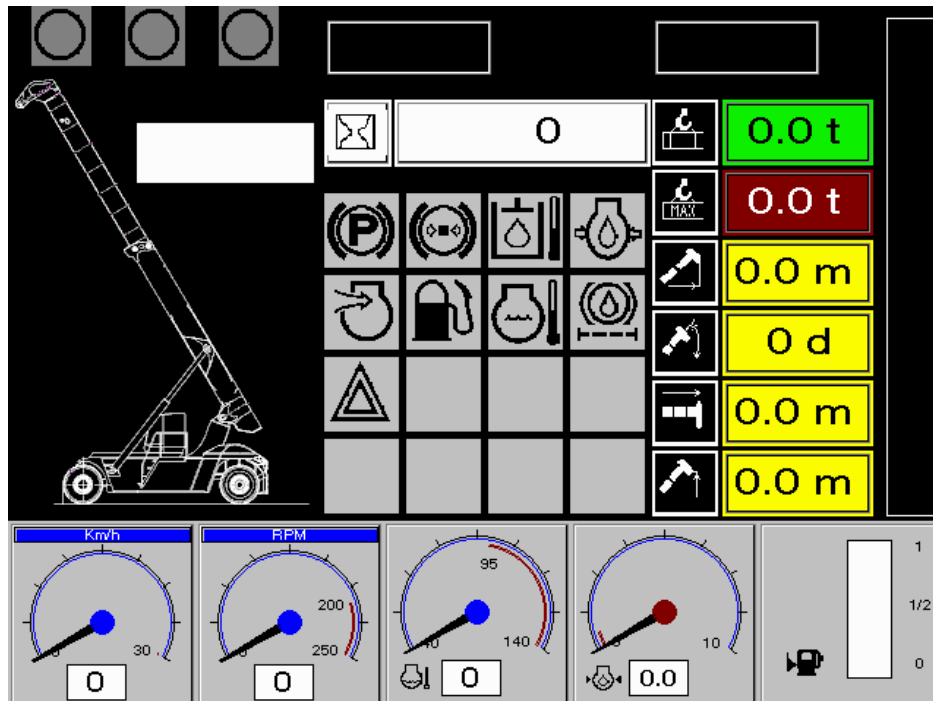


(6) JOYSTICK is an integrated control lever with two shafts, 8 buttons and on safety button. It is connected with WIZ through CANBUS.



### LMI Home Page

HTD65 display has a 6.5" color screen and can show all conditions of the vehicle and LMI functions (see following illustration). There are 10 functional keys on the two sides of screen for switching of different functions.



Description of functional keys:

F1: Enter into controller port statepage.

F2: Enter into checking and maintenance page.

F3: Enter in password and enter into calibration procedures

F5: Enter into additional information page.

F9: Return to LMI home page.

Information displayed on LMI home page:

- a) Shows proportion of actual load and max. load
- b) Actual load: actual load detected by the system
- c) Max. load: max. load allowed by the system
- d) Radius: the distance from the front end to the center of spreader
- e) Angle: arm's angle
- f) Extension: arm's length
- g) Height: the distance between the bottom of spreader and the ground
- h) Warning frame: showing warning code
- i) Alarm frame: showing fault code
- j) Machine scheme: showing machine's name and outside look
- k) Time-meter: showing machine's service time
- l) Spreader indicator lamps: 3 condition lamps of the spreader
- m) Engine torque percentage
- n) Engine's speed
- o) Engine water temperature indicator
- p) Engine oil pressure gauge
- q) Fuel oil gauge
- r) Parking braking indicator
- s) Low braking oil pressure indicator
- t) High fuel oil temperature indicator
- u) Low engine oil pressure indicator
- v) Air filter blockage indicator

- w) Fuel oil low indicator
- x) High engine water temperature indicator
- y) Braking oil filter
- z) Emergency button pushing down indicator
- a) Alarm reminder
- b) Warning reminder

► **Enter into controller port conditions page (press F1 to enter)**

HEAD controller diagnosis page

Press F1 to enter, press F9 to return to LMI home page. This page shows the input conditions of HEAD controller ports.

HE07 0	HE18 0	HE29 0	HE40 0
HE08 0	HE19 0	HE30 0	HE41 0
HE09 0	HE20 0	HE31 0	HE42 0
HE10 0	HE21 0	HE32 0	
HE11 0	HE22 0	HE33 0	
HE12 0	HE23 0	HE34 0	
HE13 0	HE24 0	HE35 0	
HE14 0	HE25 0	HE36 0	
HE15 0	HE26 0	HE37 0	
HE16 0	HE27 0	HE38 0	
HE17 0	HE28 0	HE39 0	

ARM controller diagnosis page

Press F1 to enter, press F9 to return to LMI home page. This page shows the input state of ARM controller ports.

AR01 0	AR19 0	AR42 0	
AR02 0	AR2 0	AR43 0	
AR03 0	AR23 0	AR44 0	
AR04 0	AR24 0	AR45 0	
AR05 0	AR25 0	AR46 0	
AR06 0	AR29 0	AR47 0	
AR14 0	AR30 0	AR50 0	
AR15 0	AR31 0	AR51 0	
AR16 0	AR32 0	AR52 0	
AR17 0	AR33 0	AR53 0	
AR18 0	AR34 0		



► **Enter into check and maintenance page (press F2 to enter)**

Press F7 to set password. High-grade password is able to clear 4 time-counters and container counters. Clearing function is as follows:

Press F1: the first counter is cleared;

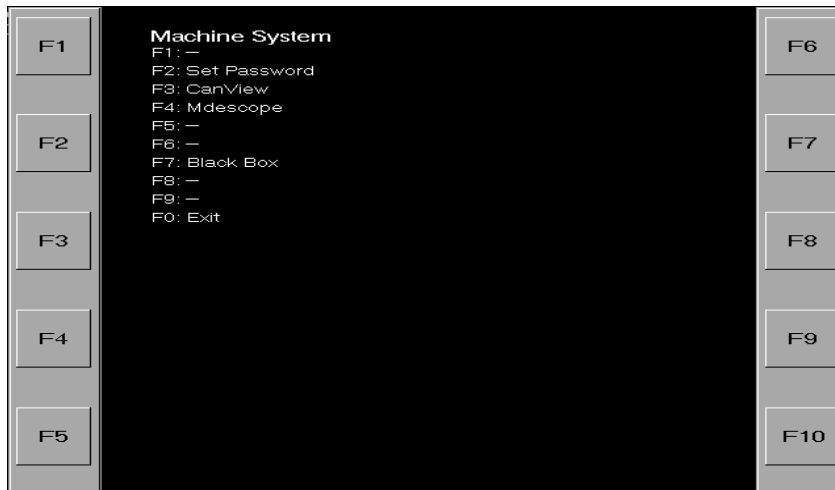
Press F2: the second counter is cleared;

Press F3: the third counter is cleared;

Press F4: the fourth counter is cleared;

Press F6: the container counter is cleared.

Other diagnosis information and black box functions:



Press F2: Set Password;

Press F3: use CanView function (shows canbus information);

Press F4: use MDSECOPE function (system diagnosis function);

Press F7: check black box;

Press 10: return to LMI home page

**Password**

It is necessary to have password in certain operations, for example, changing parameters or deleting black box in MDESCOPE page.



Press F8: move the cursor to the left;

Press F9: move the cursor to the right;

Press F6: enlarge the selected numerical value;

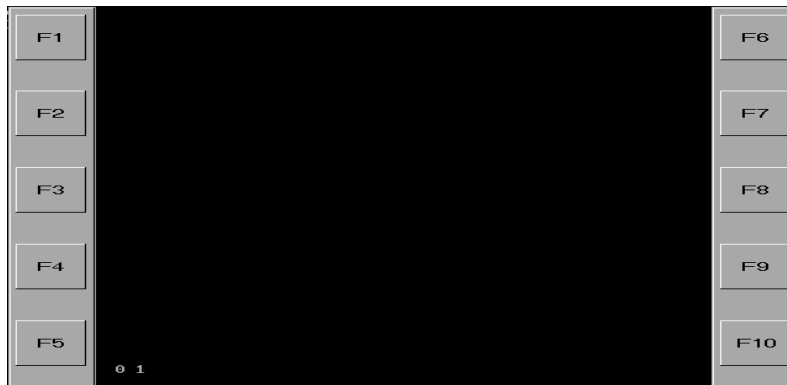
Press F7: decrease the selected numerical value;

Press F10: confirm the input numerical value;

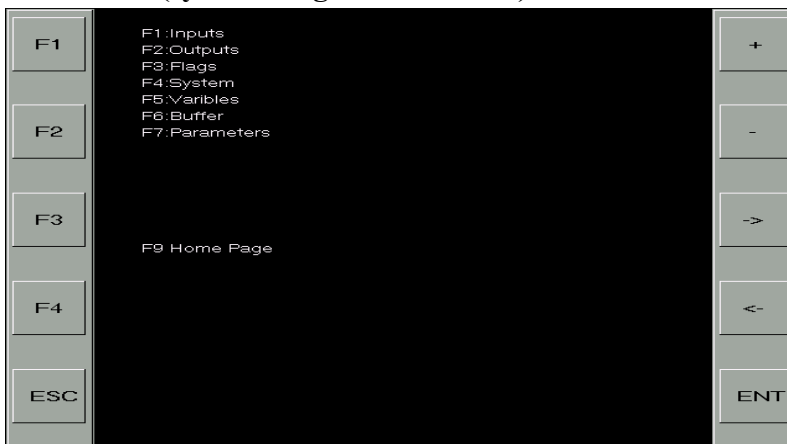
Press F5: exit and do not confirm the input value.

### CanView functions

In this page, the system will show canbus information. Press F9 to return to former page.



### MDESCOPE function (system diagnosis function)



MDESCOPE function of HTD display is the soft ware used in common PC.

Press F1: enter into input page;

Press F2: enter into output page;

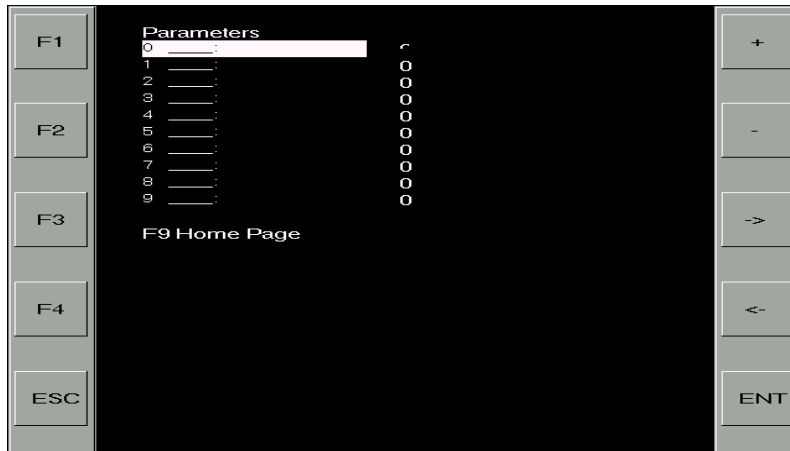
Press F3: enter into direction flag page;

Press F4: enter into system variable page;

Press F5: Enter into variable page;

Press F6: enter into buffer memory page;

Press F7: enter into parameter page. See following illustration: the value of 10 items can be checked in each page.



Press F1: entering 10 items of next page;

Press F2: entering 10 items of former page;

Press F7: go to next page;

Press F6: go to former page;

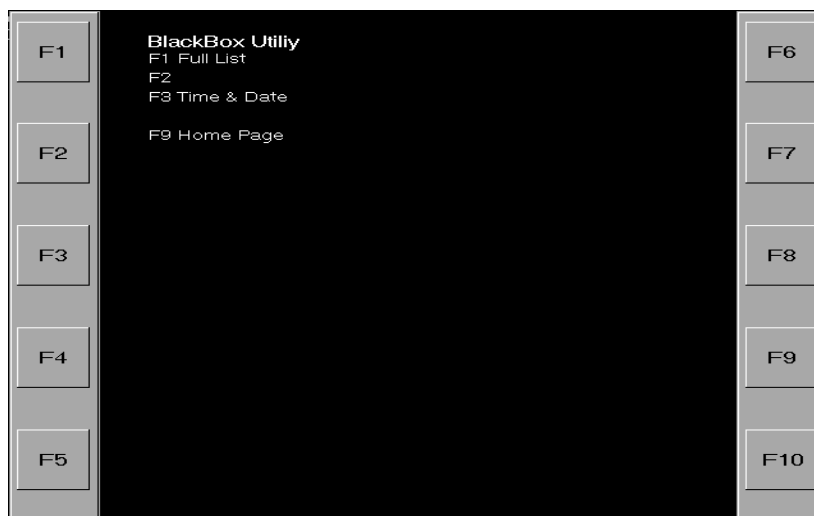
Press F10: enter in numerical values (numerical value setting);

Press F9: return to MDESCOPE home page.

**CAUTION:**

**The parameters will be changed only by entering high-grade password.**

**Black box**



Black box can be seen on this page.

Press F1: See list of all alarms. Each alarm shows its code, time and date.

Press F2: clear the record of black box;

Press F3: set time and date.

Press f9: return to home page.

**CAUTION:**

**The record of black box can be cleared only by entering high-grade password.**

**► The home page shows fault alarms and warning information lists:**

<b>ALARM LIST</b>		
CODE	FAULT DESCRIPTION	SUGGESTED CORRECTIVE ACTION
1	EEPROM ALARM EEPROM Data error inside the HEAD board HEAD	If the alarm persists, please, contact Technical Assistance
2	PRESSURE TRANSDUCER LOW CHAMBER BOOM (Min) Open Circuit	Verify that the wiring is not open circuited. Verify the pressure transducer integrity.
3	PRESSURE TRANSDUCER LOW CHAMBER BOOM (Max) Short circuit	Verify that the wiring is not short circuited. Verify the pressure transducer integrity.
4	PRESSURE TRANSDUCER HIGH CHAMBER BOOM (Min) Open Circuit	Verify that the wiring is not open circuited. Verify the pressure transducer integrity.
06	PRESSURE TRANSDUCER LOW Open Circuit	Verify that the wiring is not open circuited. Verify the pressure transducer integrity.
07	PRESSURE TRANSDUCER LOW Short circuit	Verify that the wiring is not short circuited. Verify the pressure transducer integrity.
10	ARM CANBUS ERROR (1) Timeout (1) of the canbus transmission	Verify the connection of the ARM. Verify the canbus connection.
11	ARM CANBUS ERROR (2) Timeout (2) of the canbus transmission	Verify the connection of the ARM. Verify the canbus connection.
12	ARM CANBUS ERROR (3) Timeout (3) of the canbus transmission	Verify the connection of the ARM. Verify the canbus connection.
13	ARM CANBUS ERROR (4) Timeout (4) of the canbus transmission	Verify the connection of the ARM. Verify the canbus connection.
14	ARM CANBUS ERROR (5) Timeout (5) of the canbus transmission	Verify the connection of the ARM. Verify the canbus connection.
15	ARM CANBUS ERROR (6) Timeout (6) of the canbus transmission	Verify the connection of the ARM. Verify the canbus connection.
16	WDO ARM Missing re-reading of the WatchDog output from the ARM	Verify the connection of the ARM. If the alarm persists, please contact Technical Assistance

CODE	FAULT DESCRIPTION	SUGGESTED CORRECTIVE ACTION
17	ACT ARM CANBUS ERROR Timeout of the canbus transmission	Verify the connection of the ACT. Verify the canbus connection.
18	JOYSTICK CANBUS ERROR Timeout of the canbus transmission	Verify the connection of the JOYSTICK. Verify the canbus connection.
20	ACT ARM FAULT ERROR Error from ACT of the main arm	Verify the connection of the ACT. Verify the canbus connection.
21	ANGLE MAIN ARM (Min) Signal from Angle sensor lower than the minimum value	Verify the angle sensor integrity. If the alarm persists, please contact Technical Assistance.
22	ANGLE MAIN ARM (Max) Signal from Angle sensor higher than the maximum value	Verify the angle sensor integrity. If the alarm persists, please contact Technical Assistance.
23	LENGTH MAIN ARM (Min) Signal from Length sensor lower than the minimum value	Verify the length sensor integrity. If the alarm persists, please contact Technical Assistance.
24	LENGTH MAIN ARM (Max) Signal from Length sensor higher than the maximum value	Verify the length sensor integrity. If the alarm persists, please contact Technical Assistance.
25	BIG DIFFERENCE PRESSURE BETWEEN TWO LOW CHAMBERS	If the alarm persists, please contact Technical Assistance.
30	OVERLOAD	Lifted weight more than maximum weight admitted.
31	ALARM DUTY (1) No machine selected	Verify the machine selection.
32	ALARM DUTY (2) More than 1 machine selected	Verify the machine selection.
33	BYPASS LMI	BYPASS LMI switch ON.
34	BYPASS SPREADER	BYPASS SPREADER switch ON
40	FUEL LEVEL TRANSDUCER LOW(Min) Open Circuit	Verify that the wiring is not open circuited. Verify the fuel level transducer integrity.
41	FUEL LEVEL TRANSDUCER High Short circuit	Verify that the wiring is not short circuited. Verify the fuel level transducer integrity.
42	ALARM MAINTENANCE TIME 1 End of timer of the 1st maintenance time	Verify the timer alarm.
43	ALARM MAINTENANCE TIME 2 End of timer of the 2nd maintenance time	Verify the timer alarm.
44	ALARM MAINTENANCE TIME 3 End of timer of the 3rd maintenance time	Verify the timer alarm.
45	ALARM MAINTENANCE TIME 4 End of timer of the 4th maintenance time	Verify the timer alarm.

WARNING LIST	
CODE	FAULT DESCRIPTION
1	Movement slow close to the overload
2	Movement stop by LMI alarm
3	Movement stop by max angle switch
4	Movement stop by spreader seated
5	Movement stop by twist lock signal
6	Movement slow close to max angle
7	Movement slow close to min angle
8	Movement slow close to max length
9	Movement slow close to min length
10	Movement stop by twist signal
11	Movement stop by spreader seated
12	Movement stop by spreader not seated
13	Missing dead man button
14	Movement stop by overload condition
15	Movement (lifting) stop by minimum radius condition
30	Reduction of the boom speed with RPM
31	Reduction of the boom speed with a double movement

#### 7.2.5 Lighting and signal system

##### **CAUTION:**

**Before using reach stacker, make sure whole lighting system is working normally.**

Regularly clean front combination headlamps, rear combination lights, warning lights, Service lights, etc. Make sure that horns and back-up buzz are working normally.

##### **WARNING:**

**The bulbs of halogen lamps can be installed directly by hand or their function will be affected.**

(1) The front combination headlights include:

Dipped headlamp/ Headlamp: bulb specification: 13620, double filaments, 24V, 50W/55W;

Width lamp: bulb specification: R523T, 24V, 5W;

Direction indicator: bulb specification: 13496, 24V, 21W;

(2) Rear combination lights include:

Width/braking lamp: bulb specification: 13499, double filaments, 24V, 5W/21W;

Direction indicator: bulb specification: 13498, 24V, 21W;

Backing lamp: bulb specification: 13498, 24V, 21W.

(3) Warning lights: electronic flashing type, has to be changed wholly if breaking down.

(4) Service lights: front lighting working lamp, bulb specification: H3 (halogen bulb), 24V, 70W; working lamp in electrical compartment, bulb specification: 2427, 24V, 35W.

(5) Other lights, rear service lights, fog-lights, etc.

Note: optional, bulb specification: H3, 24V, 70W.

(6) Signal system

Horns: double snail type (sound level  $\geq 100$ dB); Back-up buzz (sound level  $\geq 100$ dB); Spreader indicator: bulb specification: 13498, 24V, 21W.

(7) Fuses: The fuses protecting parts in electrical system are located in the electrical compartment of the vehicle.

**CAUTION:**

**If a fuse is broken more than once, please check the cause in the electrical system.**

### 7.2.6 Air Conditioning

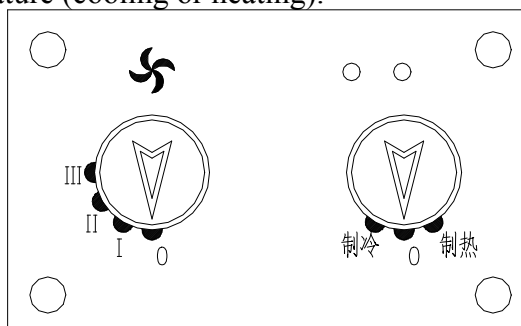
Air conditioning can be used only after the engine is working. There are 4 air inlets in the operator cab, located separately on the left and right of the instrument console. The air conditioner can be turned on or adjusted with the air conditioning control panel on the operation console at the right side of the cab.

(1) Control

A—On/Off and vent control

O—Off; I—On-low speed; II—On-medium speed; III—On-high speed;

B—Temperature adjustment control; Use temperature adjustment control knobs to choose suitable temperature (cooling or heating).



**CAUTION:**

If coolant temperature is low, the air temperature sent to the cab will not change even the temperature adjusting knob is turned to the max.

**CAUTION:**

If you want to remove fog of the glass quickly, please turn the wind speed selection to high speed and turn the wind duct to the glass.

-- Make sure all vent holes and windows are closed.

-- If the vehicle is used after parking in the sunshine for a long time, turn the wind speed knob to III position and open windows to speed up the cooling of the cab.

-- Do not let the wind blow on the people directly.

-- It is not good for health if the air temperature is too low. Optimum temperature in the cab is the temperature 5-6 degrees lower than the outside temperature.

-- There is temperature sensor in the air conditioner to keep the inside temperature at preset temperature.

-- The water dripping from normal cooling is produced from the moisture removal of the air conditioning system.

**Reminder:** Even in cold season, make sure the air conditioner is turned on for 5 minutes each week at least to ensure good lubrication inside the compressor



**and optimal operation of the air conditioner.**

Every week: Check belt tightening of the compressor; Check and clean inside and outside machines and air filters.

Every year: Check and add refrigerant R134 (1kg), add compressor oil PAG SP10 (1 ounce when empty).

**Reminder: To ensure reliability and smooth operation of the air conditioner, the maintenance will be carried out by professional institutions.**

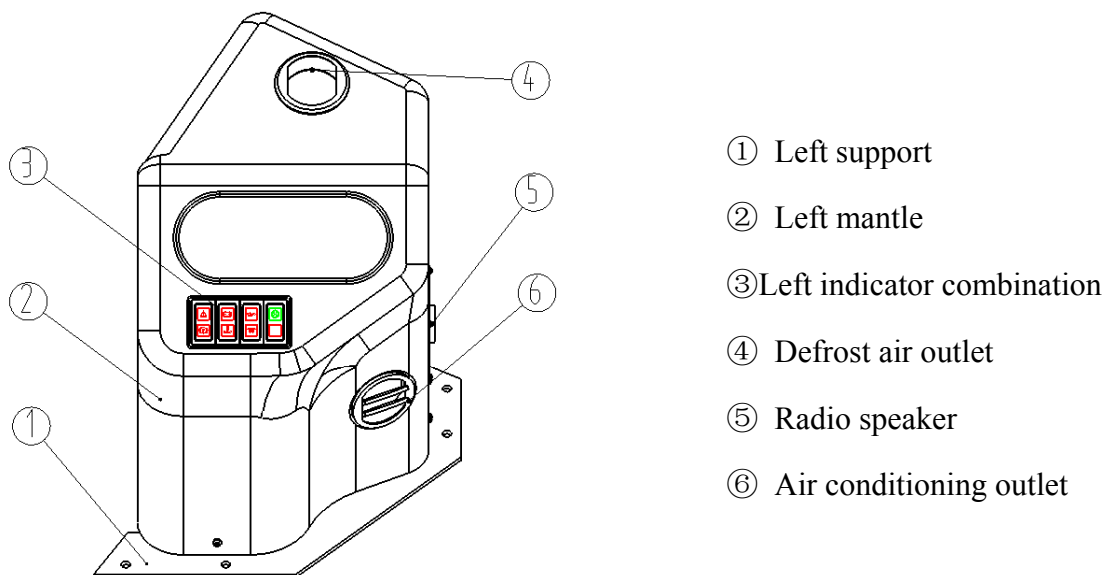
7.2.7 Description of Instruments and Operation Console

(1) General description

The instrument console assembly of reach stacker used by Heli includes: Left instrument console, right instrument console and operation console. With integral structure and streamline shell design, the function zones are rationally laid out so there are easy to read and comfortable in operation.

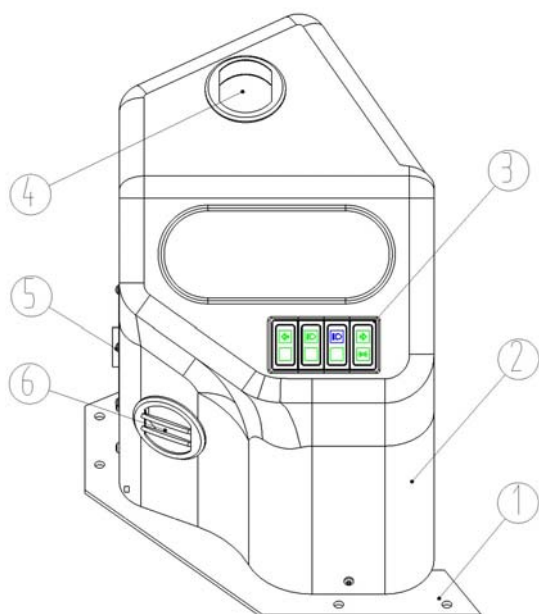
(2) Description of functional indication

a) Left instrument console



符号	标志意义	颜色
	控制器故障	红
	停车制动	红
	充电指示	红
	发动机水温高	红
	发动机油压低	红
	预热指示	红
	空滤器堵塞	绿
空白	--	红

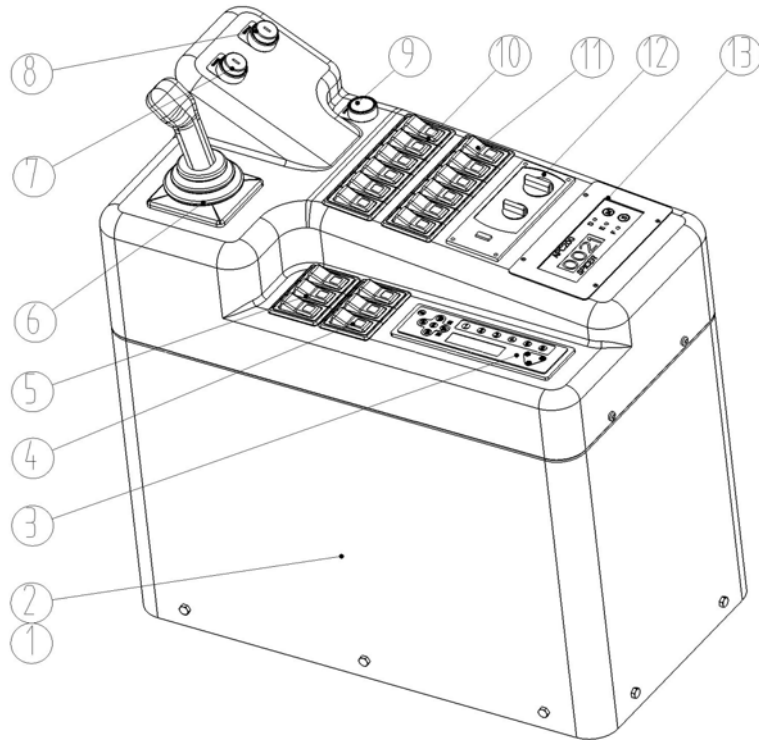
b) Right instrument console



- ① Right support
- ② Right mantle
- ③ Right indicator combination
- ④ Defrost air outlet
- ⑤ Radio speaker
- ⑥ Air conditioning outlet

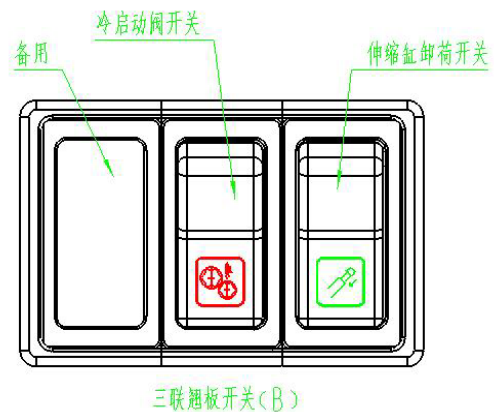
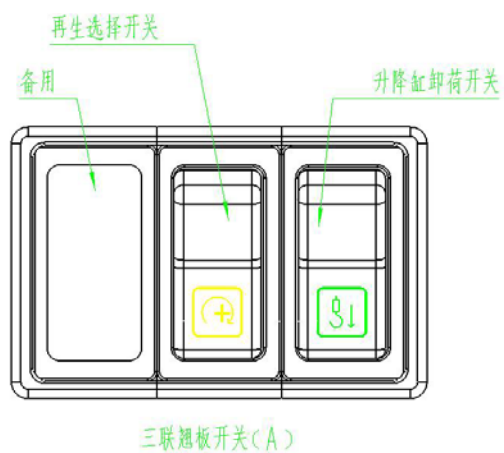
符号	标志意义	颜色
	左转向灯	绿
空白	--	绿
	近光	绿
空白	--	绿
	远光	蓝
空白	--	绿
	右转向灯	绿
	示廓灯	绿

c) Operation console

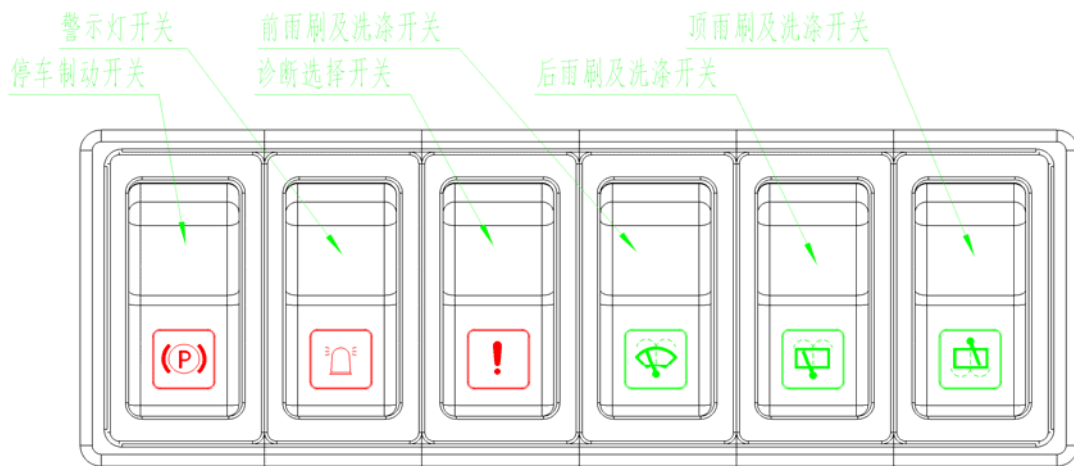


- ① Operation console support    ② Operation console mantle    ③ Radio
- ④ Triple rocker switch (A)    ⑤ Triple rocker switch(B)    ⑥ Integrated control lever
- ⑦ Overload relief key switch    ⑧ Twist lock bypass key switch
- ⑨ Engine stop button    ⑩ Sextuple rocker switch (A)    ⑪ Sextuple rocker switch (B)
- ⑫ Air conditioning control panel    ⑬ APC200 controller

Rocker switch group definition: Triple rocker switch (A/B)



Sextuple rocker switch (A):



Sextuple rocker switch (B):

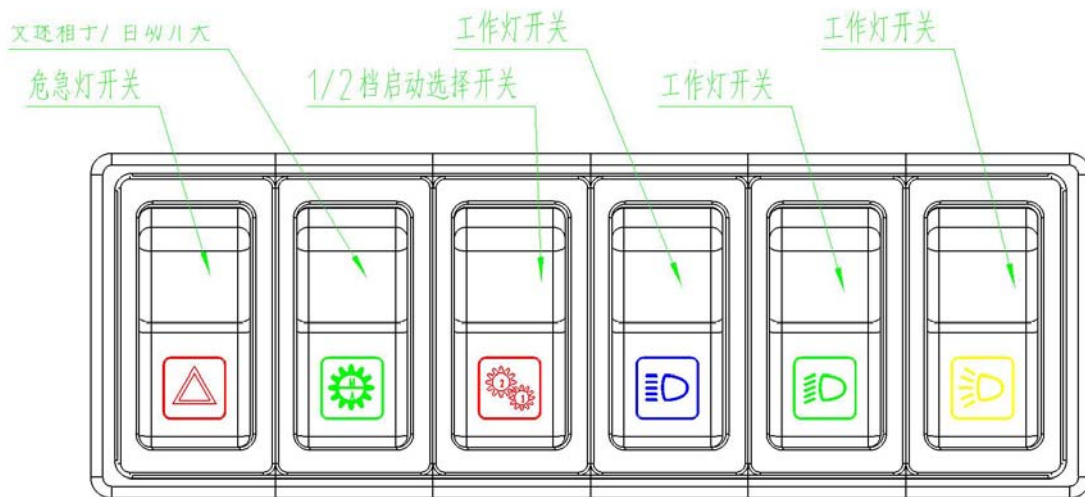
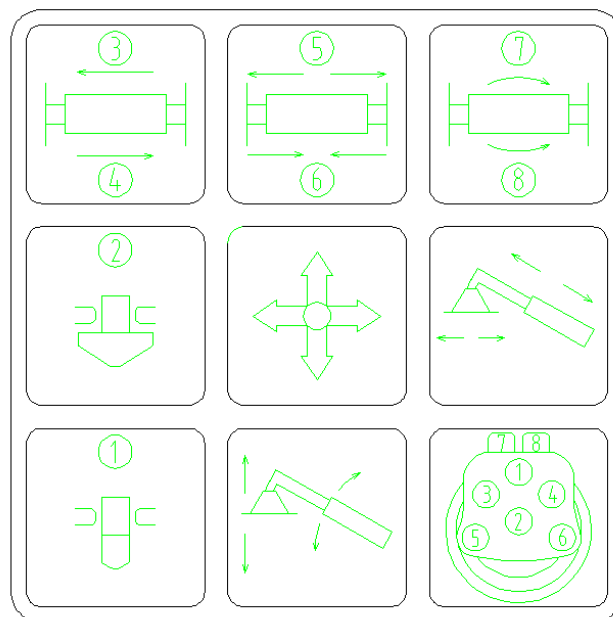
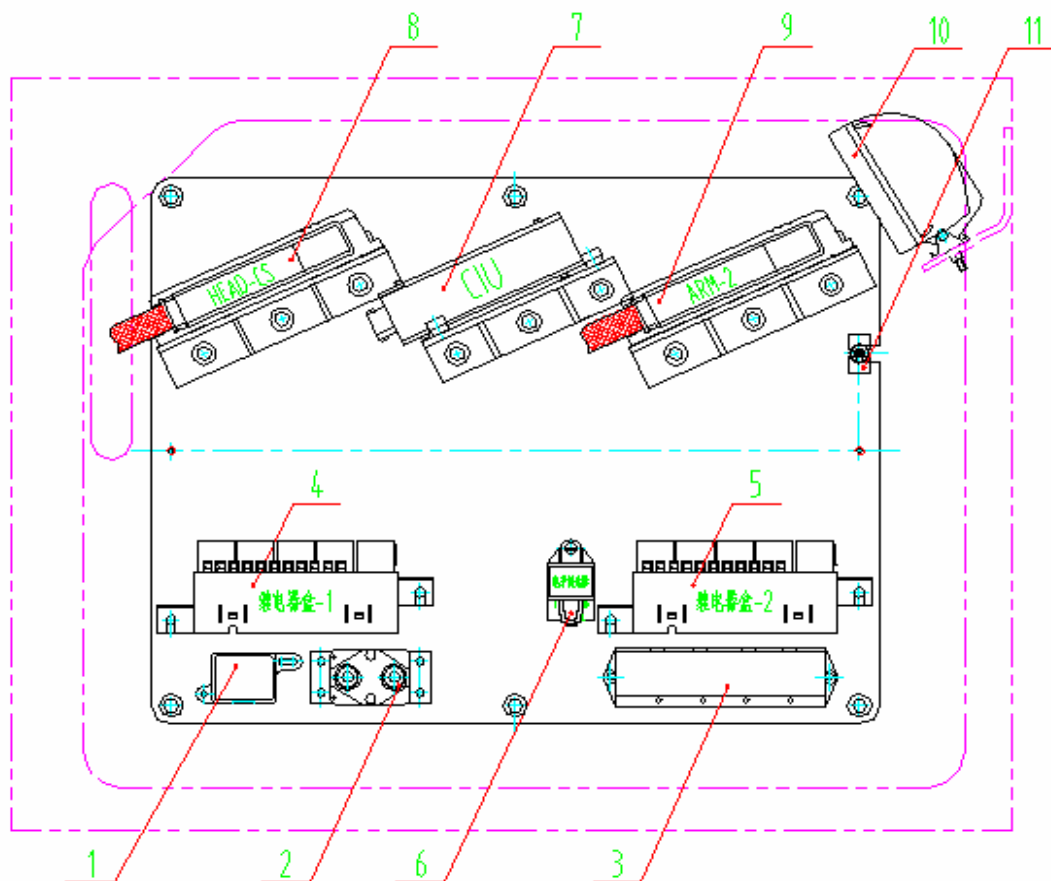


Illustration of integrated control lever functions:



## 7.2.8 Component and part description of electrical compartment



1. Fuse box; 2. Control power contactor; 3. Multiple fuse box; 4. Relay box 1  
 5. Relay box 2; 6. Flash apparatus; 7. Engine CIU controller;  
 8. Main controller of hydraulic system; 9. Arm controller; 10. lights;  
 11. lighting switch

Introduction of parts functions:

### (1) Fuse box

Vehicle control power input fuse, FU1-80A/strip type

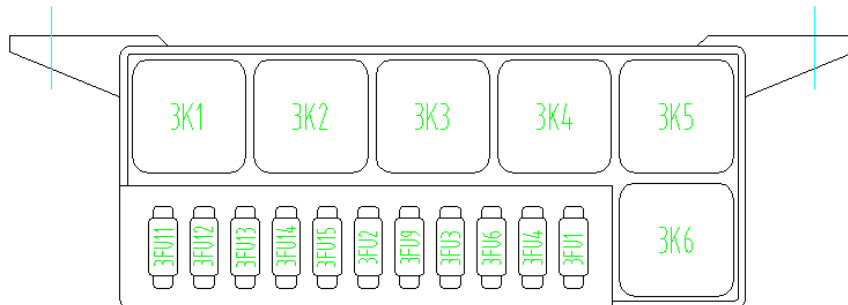
### (2) Control power contactor:

It is controlled by ignition key switch. When the ignition key switch is turned to first gear, the contactor connects the control circuit.

(3) Multiple fuse box:

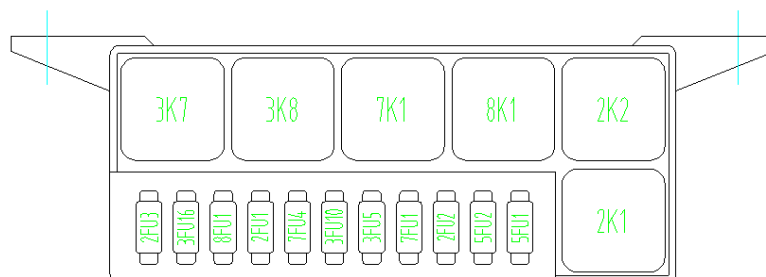
15 Circuits Fuse Box	
4FU1, 4FU2, 4FU3	Power fuses for front, rear and top wipers of cab and washer.
4FU4	Fuse for cab overhead lamp and fan power.
4FU5	Fuse for air conditioning power.
7FU2	Fuse for outside equipment power of main controller.
7FU3	Fuse for main controller power.
8FU2	Fuse for arm controller power.
8FU3	Fuse for outside equipment power of arm controller.
8FU4	Fuse for display power.
7FU5	Fuse for lift cylinder pressure sensor power.
3FU7, 3FU8	Fuses for front and rear fog-lamps power.
—	Two spare fuses.

(4) Relay box 1



Relay Box 1			
3K1	Light relay, width lamp control	3K4	Light relay, braking light control
3K2	Light relay, dipped headlight control	3K5	Light relay, front working light control
3K3	Light relay, headlight control	3K6	Light relay, rear working light control
3FU11	Width lamp fuse	3FU9	Braking lamp fuse
3FU12	Dipped headlight fuse	3FU3	Braking lamp relay fuse
3FU13	Headlight fuse	3FU6	Warning light switch fuse
3FU14	Front working light fuse	3FU4	Switch/indicator fuse
3FU15	Rear working light fuse	3FU1	Combination lights switch fuse
3FU2	Flasher fuse(cornering lamp)		

(5) Relay box 2



Relay Box 2			
3K7	Parking braking relay, parking braking valve control	8K1	Arm controller power relay
3K8	Horn relay	2K2	Reverse gear relay, reverse reminder
7K1	Main controller power relay	2K1	Neutral gear relay, neutral start control
2FU3	Backing lamp & buzz fuse	3FU5	Horn relay fuse
3FU16	Parking brake valve fuse	7FU1	Unloading valve fuse
8FU1	Arm controller power fuse	2FU2	Transmission power fuse(behind key switch)
2FU1	Transmission power relay (before key switch)	5FU2	Spreader working lamp fuse
7FU4	Rear working light fuse	5FU1	Spreader power fuse
3FU10	Horn fuse		

(6) Flash apparatus: cornering lamp flash controller

(7) Engine CIU controller: the controller connects input and out control equipment of the engine

(8) Hydraulic system main controller

(9) Arm controller: controller of 3B6 hydraulic control system

(10) Lights

(11) Light switch: lighting instruments in electrical compartment

#### 7.2.9 The other important notes for the electrical system

(1) Precautions for mounting electronic control elements

Prevent that the forklift is improperly operated. The mistaken operation might damage the sensitive electronic control elements on it, so we suggest the following precautions will be taken:

- For the work relating to the welding on the chassis, disconnect the connector of the electronic control elements. If the welding must be made besides the electronic components, the electronic components must be removed first.

- After the maintenance procedures needed for disconnecting battery are finished and when reconnection will be made, pay attention to the safe connection of terminal of the battery with clamp.

- The battery charger is not allowed to be used to start up the engine.
- When the battery is charged, disconnect the connection between battery and electrical system on the forklift. vehicle. When the engine is running or the electronic element is energized, the connectors of the electronic control elements are not allowed to be connected or disconnected.

- When the engine is running, the battery is not allowed to be disconnected.
- When the temperature produced exceeds 80 degree centigrade , remove the electronic control elements.

**Note: The electronic control elements include the devices and apparatus inside the electrical control compartment, the cockpit and spreader control cabinet.**

#### 7.2.10 Safety prompt for use of spreader

- The operators must be trained and read carefully the instruction and make sure that you are familiar with its operation method before getting on it.

- The safety of you and the people nearby all depend on the your correct operation of the spreader.

- Trial-use the spreader on the open space before it is used.

- All the control units and work lamps should be carefully checked before the vehicle and spreader are used.

- The limit of the spreader must be known and it can be completely controlled at any cases. It should not be operated too much and too fast.

- If the function fails or the part loses, the vehicle must be stopped immediately and necessary maintenance made ,otherwise the accident will produce.

- No body is allowed to enter into operation scope of the vehicle and spreader.

- Failure to correctly connect or disconnect the electric parts according to the electric circuit diagram will result in injury or damage.

- Do not force the lock knob of the spreader to lock the container and the



container can not be moved before the lock knob is locked.

- The descended spreader should be placed at a proper position on the container or moved to the front of container. Do not use too much force since the self weight of spreader is enough to drive the spin lock into the lock hole of the container.

- Mixing actions are not allowed while the containers are piled.

- The indication lamp of the spreader in case of failure must be immediately repaired.

- When the spreader locks the container, the telescopic arm is not allowed to be stretch out and draw back..

- When the spreader locks the container, the spreader is not allowed to be laterally moved.

- The vehicle should be checked and see if all the safety devices work normally when it is not used for a long time.

- If the spin lock can not lock the container, check if the container is deformed.

- When the spreader is loaded, the radical movements such as sharp turn, fierce braking and high speed driving should be avoided.

- With the increase of working radius, the lifting ability reduces. When the reach stacker goes down the slope, the radius will increase.

- The vehicle if stored in open air for a long time should be greased on the surface of the hydraulic cylinder lever to prevent the rust.

- Observe the indication lamp before lifting to ensure that the spin lock firmly locks the container.

- The spreader can only be operated by the qualified personnel.

Check every week the connection, cable, switch and inductor and check if any parts are stuck or deformed. If needed, change the damaged parts. For the electric circuit diagram of the spreader, refer to the principle diagram for electric system attached.

## 7.3 Basic instruction for operation

### 7.3.1 Running-in period

For a new vehicle, we suggest the running-in period should at least be 200 hours and attention should be paid to the following matters within the running-in period:

- (1) Every time when the engine is started, first fully preheat the engine and avoid its high-speed driving soon after it is started.
- (2) The vehicle is not allowed to drive at the top speed.
- (3) Each system of the whole vehicle should be frequently checked.

### 7.3.2 Start-up and stalling of engine

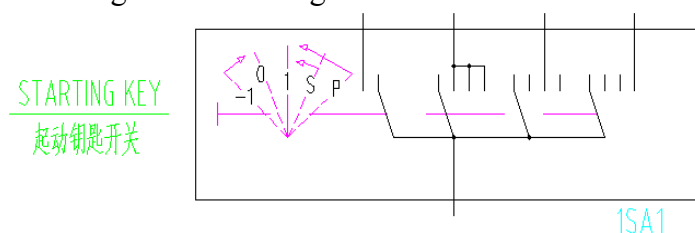
The following checks should be made before the engine of the reach stacker is started up:

- (1) Oil volume of hydraulic oil: The oil level should be at the middle position of upper and down scale of oil gauge;
- (2) Check if the pipelines, connectors, pump and valves are leaked or damaged;
- (3) Check the service braking;
- (4) Check the parking brake;
- (5) Check if the instrument, lighting, switch and electric line work normally;
- (6) Check if the action, work-state indicator of spreader and the indication board of mechanical twistlock are normal.

The start-up of engine:

**Note: Connect the general switch of power supply and check if the change gear shift handle is at zero gear before the engine is started up, otherwise the engine can't be started up.**

The schematic diagram for starting switch is shown as follows:



The procedures for starting up the engine are as follows:

- (1) Seat on the driving chair;
- (2) Connect the general switch of power supply;
- (3) Check the change-gear shift handle to ensure it is in neutral gear (N gear);
- (4) Plug the ignition key into the lock hole (0 gear), turn it clockwise to (gear 1) vehicle control and the power supply of the vehicle is connected;
- (5) Turn the ignition key clockwise to gear 2 (start preheating gear), start up the engine with the starting time less than 5 s, release the ignition key so that it returns to gear 1 soon after engine is started. If the engine can not be started up after starting for 3 times (15~ 20 seconds each time), the cause must be found out and the engine will be started up again after the fault is eliminated;
- (6) Check if the machine oil pressure of engine is within the normal scope;
- (7) Idly run the engine for over 10 seconds before work begins.

The stalling procedures of engine are as follows:

- (1) Run the engine at idle speed for 2- 3 minutes so that the engine is gradually and evenly cooled;
- (2) Turn the ignition key counter clockwise to (-1 gear) through (0 gear), then release it and make it return to (0 gear), the engine stalls and turn off the power supply of the vehicle at the same time. Pull off the ignition key before leaving;
- (3) The “stalling switch” on the console can also stall the engine. Then turn the ignition key to 0 gear, turn off the control power supply and pull off the ignition key before leaving.

### 7.3.3 Initial starting up and stopping of reach stacker

The reach stacker will be started up according to the following procedures:

- (1) Press the parking brake button to release the parking brake; (The park brake lamp of the instrument goes out.)
- (2) Step on the service brake pedal;

(3) Choose a proper change-gear shift, release the service brake pedal and slowly step on the accelerator pedal.

The reach stacker will be stopped according to the following procedures:

- (1) Release the accelerator pedal;
- (2) Slowly step on the service brake pedal;
- (3) When the reach stacker is close to stop, turn the handle at change-gear shift to the zero one and release the brake pedal after the vehicle is completely stopped;
- (4) When necessary, the engine can be stalled, the parking brake used and the general switch of the power supply disconnected.

#### 7.3.4 Acceleration, deceleration and change gear shift of reach stacker

##### (1) Acceleration and deceleration of reach stacker

When the gearbox is in the automatic operation state: Step on the accelerator pedal when the reach stacker needs to be accelerated. The larger the angle you step on, the more the increased speed. Deceleration of the reach stacker only needs release upward the accelerator pedal, the larger the angle you release, the more the decreased speed.

When the gearbox is in the manual operation state:

- a) When the change-gear shift handle is in a certain gear,, step on the acceleration pedal for speeding up, the larger the angle you step on, the more the speed will be raised. Release the accelerator pedal for deceleration. The large the angle you release, the more the speed will be reduced.
- b) For the acceleration and deceleration of the reach stacker , the proper gearbox gear should be chosen according to the load and road surface state.

Note: Acceleration and deceleration of the engine must be smooth.

#### **WARNING:**

**When the reach stacker operates with load, the spreader should be placed as lower as possible and the lower edge of the container is suggested to be kept at**

**about 0.8~1m higher than the chair face. The object lifted is forbidden to be ascended, descended and laterally removed. in the course of driving. The vehicle is forbidden to drive when it lifts the weight at high position.**

(2) Change-gear shift of reach stacker

a) The Change-gear shift handle of reach stacker is located at the left side of the steering wheel column.

b) There are three positions for the change-gear shift handle:

The handle forward—the gearbox is in the forward speed position, you can choose gears 1、 2、 3 and 4.

The handle at middle—the gearbox is in the 0 gear position, the engine can only be started up when the gearbox is in the 0 gear position.

Handle backward – the gearbox is in the backing gear position, you can choose 1,2,3 and 4 gear for backing. At this time, the reverse buzzer sounds and gives warning.

c) When the Change-gear shift handle is in the forward speed and backing gear position, you can rotate the handle forward and backward and choose gear 1,2 and 3 respectively.

d) The gear status of the gearbox is shown on the APC200 display of central control console.

e) The switchover of manual/ automatic state can be realized through the “manual/automatic switch on the console. At this moment, all the actions of the vehicles must be stopped and the change-gear handle in the 0 gear position. When it operates in the automatic mode, the gear ((1、 2、 3、 4) chosen by the driver on the shift handle is the upper limit of the actual speed limiting gear.

**Note:**

**a) The speed change is only allowed when the engine is at the lower speed.**

**b) The speed change is forbidden when the vehicle runs at high speed and**

during acceleration.

c) **The backing gear can only be chosen when the engine runs at lower speed or stopped.**

d) **In case of the automatic operation state of the vehicle, when the chang-gear handle is at higher gear, the high and lower gears of vehicle can be automatically switched over according to the driving condition.**

e) **When the gearbox is under the manual operation state, the driver should operate according to the stipulations and the wrong operation can result in the damage of the gearbox.**

**Suggestion: The “automatic” “mode used for normal operation is better for protection of the gearbox.**

**Reminder: When the manual/automatic switch on the console is backward pressed and indicating lamp of switch is on, it is a “manual mode”.**

#### 7.3.5 Turning of the reach stacker

The turning of the reach stacker is controlled by the steering wheel and the rotary direction of the steering wheel is the same with that of reach stacker. The greater the angle that steering wheel turns, the larger the turning angle of turning wheel.

#### **WARNING:**

**The sharp turn is forbidden when the vehicle runs at high speed and the position of the spreader is higher, because the sharp turn at his moment would cause the side overturning of the vehicle.**

#### 7.3.6 The status monitoring of the reach stacker

Under the normal running state, all the warning lamps of the reach stackers are off. If an alarm lights up, the vehicle must be stopped for trouble shooting.

Pay attention to the indication of each instrument in the driving course of the reach stacker.

a) **Manometer of machine oil of the engine: The normal value is 3~5 bar.**

- b) Water temperature meter of engine: it is not allowed to reach the red zone.
- c) Tachometer of engine: The rotary speed can not exceed the maximum rotary speed of engine.
- d) Oil temperature meter of torque converter: The application scope of oil temperature of the gearbox is 80~110°C (reaching 120°C for short time). If the temperature is close to 120°C and reaches the red zone of the oil temperature meter, stop using the vehicle, put the change-gear shift handle at 0 gear so that the engine runs at lower speed and the work can only begin after the temperature drops to within the normal scope. If the temperature has not rapidly decreased, stop the vehicle to find out the cause.
- e) Fuel oil meter: Take care not to use up all the oil stored and avoid that the air enters into the fuel pipe.

### 7.3.7 Parking and service brake

Parking brake: It will be used when the vehicle is stopped and not used.

The parking brake switch is on the central console, when it is pushed down, the lamp of the instrument of parking brake is on at the same time.

Hints: When it is pushed up, the parking brake is released.

#### **WARNING:**

**a) When the reach stacker stops for a short or long time, the parking brake must be used.**

**b) In case of failure of service brake, the parking brake can be used as an emergency brake.**

Service brake: The speed control and brake in the driving course of the vehicle. The greater the step-on angle of service brake pedal, the larger the braking force and the more obvious the braking effect.

#### **WARNING:**

**The operation of service brake should be gentle and slow and the urgent**

step-on should be avoided. The emergent brake will affect the stability of the vehicle, especially when the loaded vehicle runs at high speed, the overturning of the vehicle will be very easily caused.

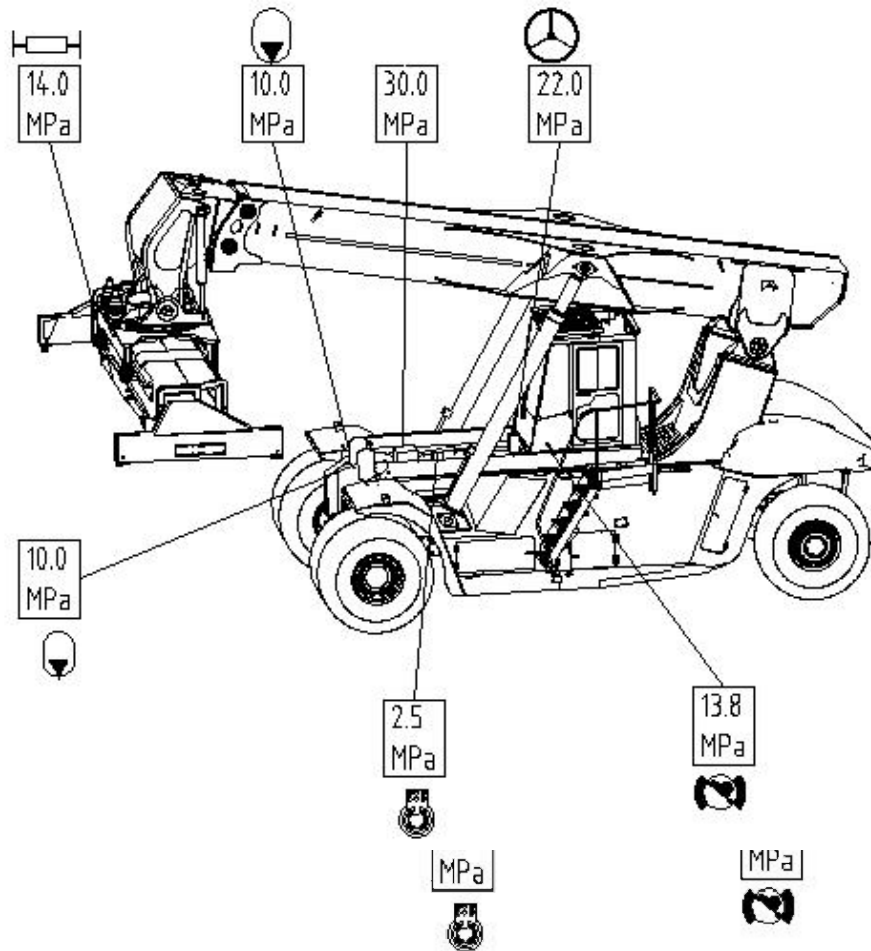
#### 7.4 Routine Electrical Inspection and Maintenance Table

Routine electrical inspection and maintenance table							
Item	Content	Every day (8h)	Every week (40h)	Every month (200h)	3 month (600h)	6 month (1200h)	Every year (2400h)
Battery	Check the level and specific gravity of electrolyte			○	○	○	○
	Check connection and clean surface		○	○	○	○	○
Electric cabinet	Inside and outside cleaning				○	○	○
	Connection reliability of circuit board and fuse holder		○	○	○	○	○
Engine Gearbox Spreader	Refer to the relevant contents in the operation and maintenance instruction of manufacturer	○	○	○	○	○	○
Air conditioner	Check and adjust the belt of compressor			○	○	○	○
	The fixture and damage of pipelines			○	○	○	○
Instrument and indication lamp	Work and installation state	○	○	○	○	○	○
Lamp fitting and bulb	Work and installation state	○	○	○	○	○	○
Horn Braking buzzer	Work and installation state	○	○	○	○	○	○
Rearview mirror	Dirt, damage state	○	○	○	○	○	○
	Rearview mirror state	○	○	○	○	○	○
Wiring	The fixing , damage state of wiring	○	○	○	○	○	○
	Reliability of connection				○	○	○



## V. Product Label and Oil Consumption Table

### 1. General Map of the Pressure of the Main Components



### 2. Oil Consumption Table

The oil consumption for each system of container reach stacker is shown in the following table.

Name	Brand No. (Code)	Recommended Brand	Capacity
Fuel (Diesel oil)	In summer 0#, in winter-10#		
Gear lubricating oil of drive axle	Titan Gear LS90 (85W-90)	FUCHS	
Driving oil of gearbox	Donax TC 30	SHELL	
Lubricating oil of engine	SG/CF-4 15W-40	FUCHS	
Lubrication oil for brake and hydraulic fittings	L-HM46+anti-wear agent LZ9990A	FUCHS	
Grease	Drip-point of 3# lithium grease 170		

### 3. Periodic maintenance timetable

This timetable is made based on the standard work time and working conditions.  
If the reach stacker works under the fiercer conditions, please make maintenance ahead of time (“●” means change)

#### (1) Engine

No.	Checking content		Each 200 hours	1000 hours	Each 2000 hours
1	Visual check the running state and sound of engine and see if there is any oil leakage.	Check everyday			
2	Change the machine oil of engine and filter element of machine oil	100 hours for the first time	●		
3	Check fan and tension of belt and see if they are damaged		○		
4	Change the filter of fuel		●		
5	Clean oil-water separator	Each 100hours			
6	Clean fuel tank				○
7	Check the oil volume and cleanness of engine		○		
8	Clean or change filter element of air filter		○		
9	Check if the filter of fuel is plugged.	Each 100 hours			
10	Check the volume of fuel and cooling liquid	Check everyday			

#### (2) Driving and braking system

No.	Checking content		Each 200 hours	600 hours	1000 hours	2000 hours
1	Check the leakage of the gearbox	Check everyday				
2	Check the oil volume of gearbox		○			
3	Change the oil filter of gearbox	100 hours for the first time ( change oil and oil filter at the same time )			●	
4	Change the oil of the gearbox	100 hour for the first time			●	
5	Check the pressure of clutch of gearbox	100 hours for the first time Normal pressure value 1.6~2MPa	○			
6	Check if the drive axle is leaked.	Check everyday	○			

No.	Checking content		Each 200 hours	600 hours	1000 hours	2000 hours
7	Check if the hub bolt of drive axle is loosened.		○			
8	Change the gear oil of drive axle				●	
9	Pneumatic pressure of tyre				○	○
10	Check the wearing state of tyre				○	
11	Change the filter element of brake oil filter	Every 400 hours or when alarm is given : change the fuel return filter element of motor				
12	Check if there is air in braking pipelines.		○			
13	Check the pressure of braking system	Check once every month				
14	Check the leakage of accumulator	Check pressure of air pocket every month in the first half a year			○	
15	Cleaning of steering axle and lubrication point of lubrication pin roll	Each 50 hours				

### (3) Telescopic arm system and spreader system

No.	Checking content	Each 50 hours	Each 500 hours	Each 1000 hours
1	Clean and lubricate the slider and lubrication point on the telescopic arm	○		
2	Check if the clearance between slider and fixed arm is normal.		○	

### (4) Hydraulic system

No.	Checking content		Each 50 hours	Each 400 hours	Each 2000 hours
1	Change the filter element of hydraulic and braking oil filter	The 1 <sup>st</sup> 100 hours		●	
2	Change the hydraulic oil	The 1 <sup>st</sup> 600 hours			●
3	Check the pressure of accumulator	Each 200 hours			