# CHAPTER 6 PLANNED MAINTENANCE

## 1. INTRODUCTION

Periodic maintenance shall be performed by the trained and authorized personnel. HYUNDAI dealers are prepared to help customers to perform inspection and maintenance of the lift trucks according to applicable safety regulations.

**⚠ Safety accidents may occur if maintenance is neglected.**

As mentioned in 「CHAPTER 4 OPERATOR'S MAINTENANCE AND CARE」, the operator must perform safety inspection before operating the truck. The purpose of this daily examination is to check for any obvious damage and maintenance problems, and to have minor adjustments and repairs made to correct any unsafe condition.

In addition, HYUNDAI recommends to perform periodic maintenance and inspection. Performed on a regular basis by trained personnel, the program provides through truck. The PM identifies needed adjustments, repairs, or replacements so they can be made before failure occurs. The specific schedule (frequency) for the PM inspections depends on the particular application and lift truck usage.

This chapter recommends typical planned maintenance and lubrication schedules for items essential to the safety, life, and performance of the truck. It also outlines safe maintenance practices and gives brief procedures for inspections, operational checks, cleaning, lubrication, and minor adjustments.

Specifications for selected components, fuel, lubricants, critical bolt torques, refill, and settings for the truck are found in Chapter 7.

Please inquire to the HYUNDAI dealer for detailed infromation on the maintenance.

## 2. SAFE MAINTENANCE PRACTICES

The following instructions have been prepared from current industry and government safety standards applicable to industrial truck operation and maintenance.
For safe maintenance work, the following recommended procedures indicate the necessary conditions for safe maintenance of the lift truck, method and accommodation procedures, etc. for reference by all workers. Carefully read and understand these instructions and the specific maintenance procedures before attempting to do any repair work. When in doubt of any, please contact your local HYUNDAI dealer.

1) Powered industrial trucks can become hazardous if maintenance is neglected. Therefore, suitable maintenance facilities and trained personnel and procedures shall be provided.

2) Maintenance and inspection of all lift trucks shall be performed in conformance with the manufacturer's recommendations.

3) Follow a scheduled planned maintenance, lubrication, and inspection system.

4) Only trained and authorized personnel are permitted to maintain, repair, adjust, and inspect trucks and must do so in accordance with the manufacturer's specifications.

5) Always wear safety glasses. Wear a safety (hard) hat in industrial plants and in special work areas where protection is necessary and required.

6) Properly ventilate work area, vent exhaust fumes, and keep shop clean and floors dry.

7) Avoid fire hazards and have fire protection equipment present in the work area. Do not use open flame such as lighter, etc. to inspect the parts with oil leakage and risk of fire, etc.

**BEFORE STARTING WORK ON TRUCK**

(1) Lift the driving wheels to use the support or other device to fix the lift truck.

(2) Remove all jewelry (watches, rings, bracelets, etc.).

(3) Put oak blocks under the load engaging means, inner masts, or chassis before working on them.

(4) Separate the battery grounding cable (-) before working on the electrical system.

**⚠ Performance inspection shall be performed on the safe and clean location.**

**Before starting to operate the truck**

(1) Put the direction control lever in the NEUTRAL position

(2) Start the truck.

(3) Check functioning of lift and tilt systems, direction and speed controls, steering, brakes, warning devices, and load handling attachments.

11) **BEFORE LEAVING THE TRUCK.**

(1) Return the forward and reverse levers to the neutral position.

(2) Release the foot from the brake pedal to stop the truck.

(3) Lower the attachments (mast, carriage, fork or attachments) completely on the floor.

(4) Turn the to the OFF position.

(5) Put blocks at the wheels if the truck must be left on an incline.

12) Brakes, steering mechanisms, control mechanisms, warning devices, lights, lift, tilting device, reach device, driving unit, backrest, overhead guard and frame must be carefully inspected in detail, and maintained in a safe operating condition.

13) Special trucks or devices designed and approved for hazardous area operation must receive special attention for maintenance.

14) Hydraulic system must be performed with periodic inspection and maintenance.
Tilt, lift cylinder and valve system may have risk of oil leakage, and detailed inspection must be performed.

15) When working on the hydraulic system, be sure the engine is turned off, mast is in the fully-lowered position, and hydraulic pressure is relieved in hoses and tubing.

⚠ **When working with the mast lifted, block must be place below the carriage and mast rail at all times to prepare for unexpected lowering.**

16) The nameplate, operation and maintenance indicating sign and label of the lift truck must maintain the normal state.

17) Batteries, limit switches, protective devices, electrical conductors, and connections must be maintained in conformance with good practice. Special attention must be paid to the condition of electrical insulation.

18) To avoid injury to personnel or damage to the equipment, consult the manufacturer's procedures in replacing contacts on any battery connection.

19) Fire can be prevented by maintaining the cleanliness of the truck, and part loosening and damage can be identified more easily.

20) Modifications and additions that affect capacity and safe truck operation must not be done without the manufacturer's prior written approval. Specification, work, maintenance indicator sign and label, etc. must be changed according to the relevant procedure, and relevant nameplate, etc. must be changed after the modification.

21) All consumables must be used with the same part as used when the truck is released, or the equivalent or higher grade of parts, and if possible, use genuine parts approved according to the quality control procedures by the manufacturer for replacement.

22) Tire is performed with detailed inspection before removal when near the exchange period. During the installation, skid or safety device is used for safe exchange.

23) Use special care when removing heavy components, such as mast, etc.

## 3. INSPECTION INTERVAL AND OPERATING CONDITION

### 1) INSPECTION AND MAINTENANCE INTERVAL

(1) You may inspect and service the truck by the period as described at based on service meter of LCD on the truck. Work hour indicator and truck use period are almost the same, so the schedule may be established to perform the inspection and maintenance based on this.

(2) The inspection and maintenance check is in the standard of general working environment, so the inspection and maintenance interval must be reduced and performed in the bad working condition or with high amount of dust and humidity.

(3) Practice the entire related details at the same time when the service interval is doubled.
Ex) For 250 hours of inspection interval, [Every 250 hours and 100 hours, and daily inspection] items are performed simultaneously.

**※ The inspection interval is difference according to the operating condition of the truck.**
**Operation in the area with high amount of sand or dust has shorter inspection interval compared to the operation in the clean warehouse. Contents related to the inspection interval indicated without detailed description specifies the truck use in the general workplace. Definition of the operating condition is as follows.**

**· Normal operation**

Eight hour material handling, mostly in buildings or in clean, open air on clean paved surfaces.

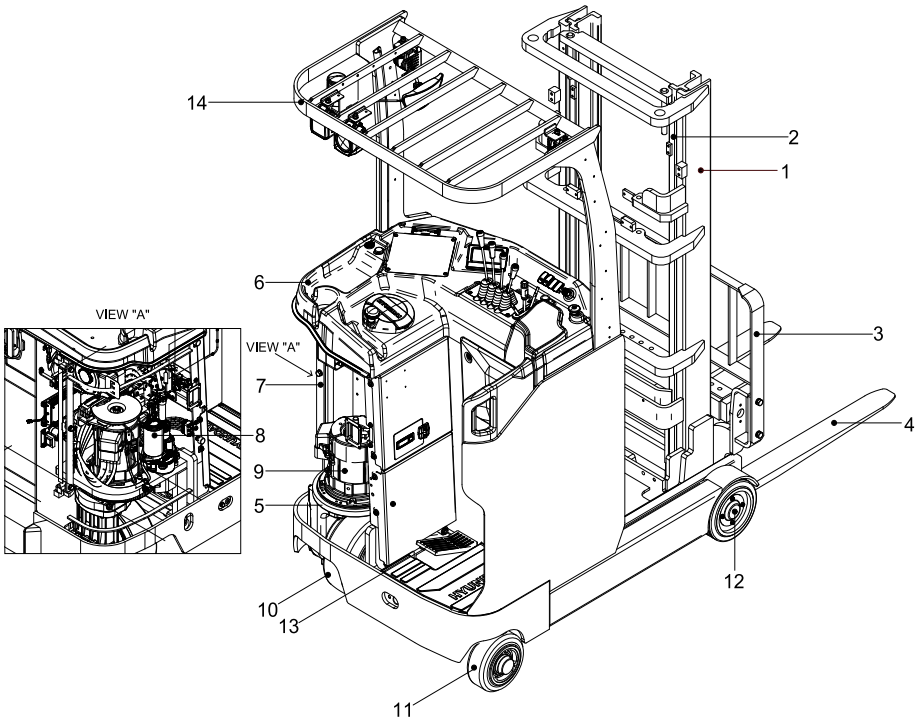
**· Harsh operation**

- Continuous heavy load operation
- High or low temperature working environment
- Working environment with sharp change in temperature
- Dusty or sandy working environment
- Highly corrosive chemical working environment
- Working environment with high humidity level
- Overall workplace with harsh environment compared to the general workplace

**※ Since the operating environment of lift trucks varies widely, the above descriptions are highly generalized and should be applied as actual conditions dictate.**

## 4. MAJOR COMPONENT LOCATIONS

The locations of each functional parts for maintenance during the periodic inspection are as follows.

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| | | | | | |
|---|---|---|---|---|---|
| 1 | Mast | 6 | Cluster | 11 | Caster wheel |
| 2 | Lift cylinder | 7 | Frame | 12 | Road wheel |
| 3 | Carriage and backrest | 8 | EPS motor | 13 | Brake pedal |
| 4 | Forks | 9 | Driving motor | 14 | Overhead guard |
| 5 | Driving unit | 10 | Driving wheel | | |

## 5. DAILY MAINTENANCE CHECKLIST

Service intervals are based on the hourmeter reading.

| DAILY (OR EVERY 8 HOURS) CHECK LIST | |
|---|---|
| 1 | Damage of truck and oil leak |
| 2 | Cleanness of battery connector |
| 3 | Battery electrolyte level |
| 4 | Capacity, warming plate and label |
| 5 | Check tire and wheel condition, removal of foreign substances and tire pressure check |
| 6 | Wheel lug nut loosening and detachment checking |
| 7 | Oil amount check on the hydraulic tank |
| 8 | Inspection of the gauge and indicator lamp |
| 9 | Warning lamp and hourmeter check |
| 10 | Overhead guard conditions, and bolts |
| 11 | Horn operation and other alarming devices |
| 12 | Check steering device operation |
| 13 | Check service brake operation |
| 14 | Gear selector, and speed adjustment |
| 15 | Check lift, tilt and reach operation |
| 16 | Mast, lift chain fastening torque |
| 17 | Check carriage, or attachment and forks |
| 18 | Check additional safety devices (horn, and alarm lamp) |

## 6. PERIODICAL CHECKLIST

Service intervals are based on the hourmeter reading.

| | Inspection item | | Oil symbol | Service interval hours | | | | | | | | Initial hours | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 50 | 250 | 500 | 1000 | 1500 | 2000 | 3000 | 4000 | 50i | 100i | 250i |
| 1 | Tightening | Tilt cylinder, pin, rod eye | | | | T | | | | | | | | T |
| 2 | | Hydraulic pump | | | | | | | T | | | | | T |
| 3 | | Main control valve | | | | | | | T | | | | | T |
| 4 | | Lift, tilt, attachment cylinder | | | | | | | T | | | | | T |
| 5 | | Mast | | | | T | | | | | | | | |
| 6 | | Drive motor and unit | | | | T | | | | | | | | |
| 7 | | Drive and steering wheel | | T | | | | | | | | | | |
| 8 | | Overhead guard | | T | | | | | | | | | | |
| 9 | Lubrication | Mast roller | G | | | L | | | | | | | | L |
| 10 | | Lift chain | GO, G | | | | | | | | | | | L |
| 11 | | Free bar sliding part (V MAST) | G | | L | | | | | | | | | |
| 12 | | Attachment cylinder rod & tube connector | | | L | | | | | | | | | |
| 13 | | Steering U-JOINT | G | | | L | | | | | | | | |
| 14 | | Driving motor and unit connector | G | | | L*1 | L*2 | | | | | | | |
| 15 | | Pump motor and pump connector | G | | | L*1 | L*2 | | | | | | | |
| 16 | | Tilt cylinder and rod connector | G | | L*1 | L*2 | | | | | | | | |
| 17 | | Manual lever, hinge - Bushing | G | | | | | | L | | | | | |
| 18 | | Under carriage mounting part | G | | L | | | | | | | | | |
| 19 | Oil leakage | Hydraulic tank | | | | I | | | | | | | | I |
| 20 | | Main control valve | | | | I | | | | | | | | I |
| 21 | | Pump | | | | I | | | | | | | | I |
| 22 | | Lift, tilt, attachment cylinder | | | I (harsh) | I (normal) | | | | | | | | I |
| 23 | Operation test | Steering wheel | | | | I | | | | | | | | I |
| 24 | | Manual lever | | | | I | | | | | | | | |
| 25 | | Natural lowering and front deflection of the fork | | | | | | | I | | | | | |
| 26 | | Mast angle | | | | | | | M | | | | | |
| 27 | | Weight measurement sensor (option) | | | | | | | I | | | | | |
| 28 | Periodical replacement parts | Drive axle air vent | | | | | | | | | | | | |
| 29 | | Drive axle oil | | | | | | | | | | | | |
| 30 | | Hydraulic tank air breather element | | | | | R | | | | | | | |
| 31 | | Hydraulic oil return filter | | | | | | | | | | | | |
| 32 | | Hydraulic oil absorption strainer | | | | | | | clean | | | | | |
| 33 | | Hydraulic oil | HO | | A | | | | R*3 | | R*4 | | | |

*1 Harsh condition *2 Normal condition *3 Conventional hydraulic oil *4 Hyundai genuine long life hydraulic oil

A : Add C: Checking L: Lubrication R: Replacement T0: Retightening

I : Visual inspection (repair or replace if required) M : Measurement (repair or adjust if required)

※ **Oil symbols**

G : Grease GO : Gear oil HO : Hydraulic oil MO : Transmission oil

## 7. VISUAL INSPECTION

First, perform a visual inspection of the lift truck and its functional parts.

· Walk around the truck and take note of any obvious parts damage or maintenance problems.
· Check various capacity and safety·warning signs.

**※ Nameplates and labels : Nameplates and labels are recorded with important instructions. Do not operated when the nameplates and labels are damaged or detached, and replace immediately.**

To check the leakage of water and oil such as the driving unit and hydraulic oil, etc., inspect the oil leakage before and after starting the truck, and loosening of the fittings.

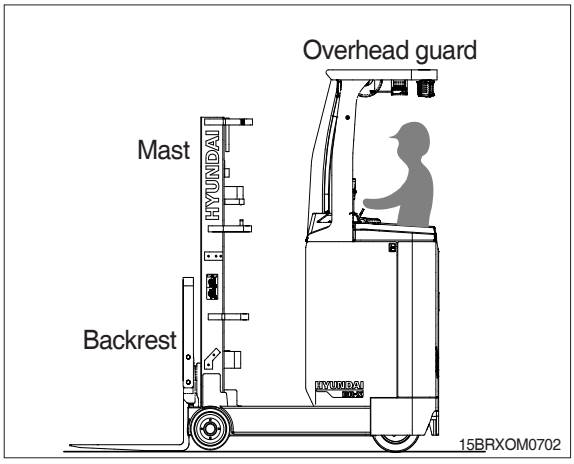
**⚠ Oil pressure and temperature : Do not use bare hands when checking the oil leakage. High temperature and pressure oil can penetrate your skin and cause serious injury.**

### 1) OVERHEAD GUARD

Check whether the overhead guard and safety devices are not damaged and mounted safely in the original position.

### 2) ATTACHMENT COMPONENTS

Mast, backrest, rail, lift roller, lift chain, lift cylinder and tilt cylinder must be inspected. Look for obvious wear and maintenance problems and damaged or missing parts. Loose parts, leakage, damage or loose roller and rail abrasion must be inspected.




Carefully check the lift chain for wear, rust, corrosion, bending or broken parts, and scratched parts, etc.

Check whether the lift chain and the carriage chain are adjusted with the same tension. Check whether the lift chain and the fixtures are set firmly in the original position. Check for oil leakage on all parts connected with the hydraulic oil.

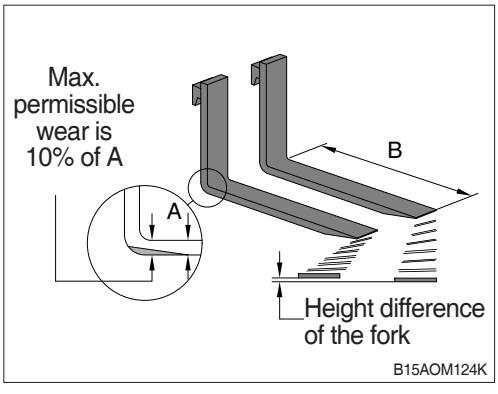
**⚠ Special caution and maintenance are required on the mast and lift chain for safe operation. For details, refer to 「Lift chain maintenance」.**

### 3) FORKS

Inspect the load forks for cracks, breaks, bending, and wear.

The fork top surfaces should be level and even with each other. The height difference between both fork tips refer to below table.

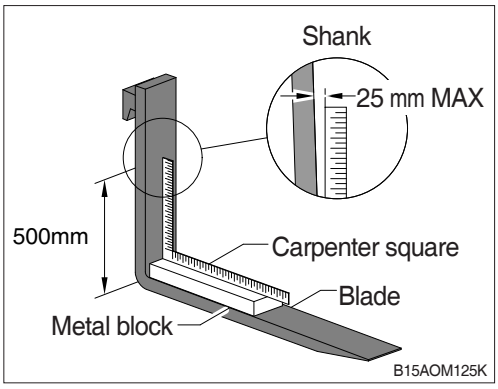
| Applicable model | Fork length (mm) | Height difference (mm) |
|---|---|---|
| All Model | 1500 or lower | 3 |
| | More than 1500 | 4 |



⚠ **When the fork blade is worn out of 10% or more, reduce the load amount and replace the fork.**

Fork bending or distortion must be inspected.
Place the metal bar of 100 mm in width, 600 mm in length and 50 mm in thickness on top of the fork, and check that in the 500 mm position of the square, it is not bent more than maximum of 25 mm or more.

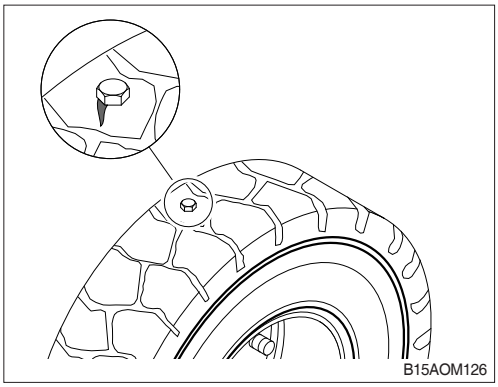
If the fork blades are obviously bent or damaged, have them inspected by a trained maintenance person before operating the truck. Inspect the fork locking pins for cracks or damage. Inspect for appropriate installation.




**4) WHEEL AND TIRES**

Check the condition of the wheels and tires before operation. Remove objects that are embedded in the tread.
Inspect the tire wear, crack or attachment of foreign substances.

Check all wheel lug nuts or bolts to be sure none are loose or missing. Replace missing bolts or lug nuts.
Loose or replaced parts must be installed with proper torque according to the specification.



## 8. HOW TO PERFORM PLANNED MAINTENANCE

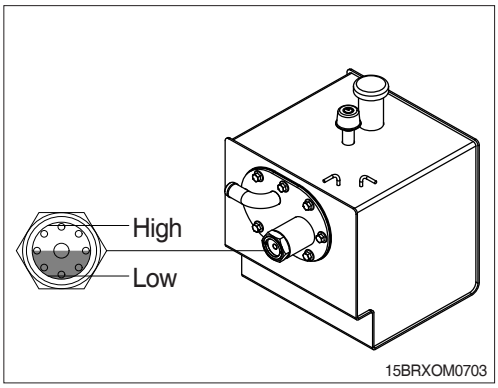
### 1) SUPPLEMENTATION OF HYDRAULIC OIL

Check the oil amount in the hydraulic tank. There must be proper amount of oil to operate the hydraulic system. Low oil amount can result in damage to the pump, and excessive oil can cause oil leakage and fault in lift truck operation.

Oil is expanded when the temperature increased, and it is appropriate to inspect the oil amount in appropriate temperature (45 degrees).

To check the oil amount, park the lift truck first on the flat surface, and lower the fork completely to the floor to be horizontal to the ground.

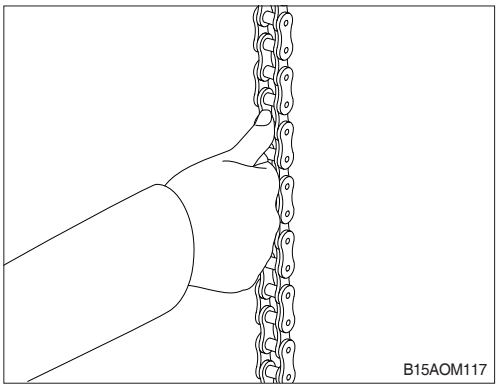
Check the oil amount through the gauge outside the tank. Add oil to have appropriate amount of oil filled above the "LOW" mark. Do not add oil excessively.




### 2) CHECKING AND ADJUSTING LIFT CHAIN TENSION

Stop the truck at level ground, lift forks kept horizontal 20-30 cm above the ground, and push the chain with the both hands.

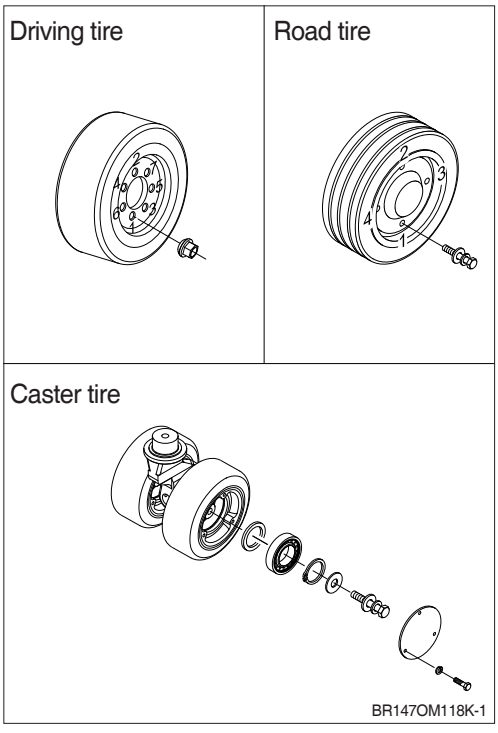
If any side of the chain shows excessively high or low tension, adjust the chain with the anchor bolt.




### 3) CHECKING HUB NUT

Tightening the hub nut firmly.

Tighten the hub nut in alternate directions for even tightening.



### 4) GREASE REFUELING ON EACH PARTS

Clean and wipe the parts for refueling.

(1) Lift chain : Apply the grease after wiping with the oil of SAE 30~40.

(2) Working surface of mast guide rail roller : Apply grease.

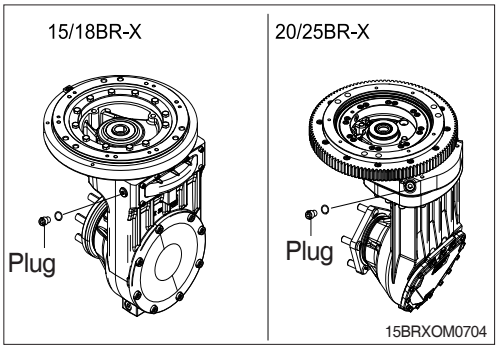
(3) Slide guide and slide rail : Apply grease evenly.

(4) Sliding section between inner and outer masts : Apply grease evenly.

(5) Sliding section between the fork and finger bar : Apply grease.

### 5) OIL CHECK ON THE DRIVING GEAR CASE

Remove the plug on the front of the driving gear case to check the oil level.

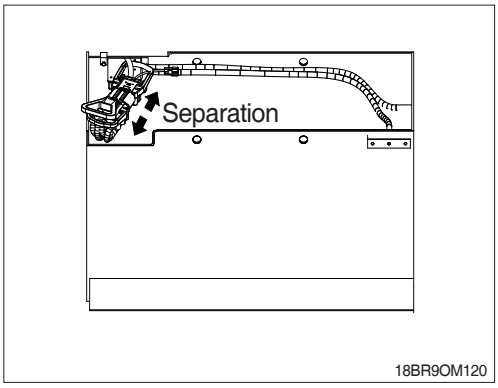


### 6) TRUCK BODY INSPECTION

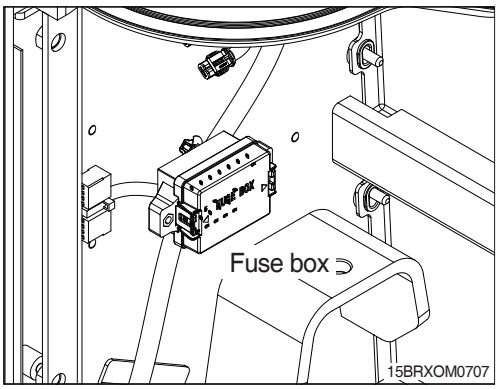
Inspect the truck body, and immediately consult with the shop for any defects, if any.

### 7) FUSE EXCHANGE

(1) Separate the battery connector.




(2) Remove the existing fuse, and install new fuse.

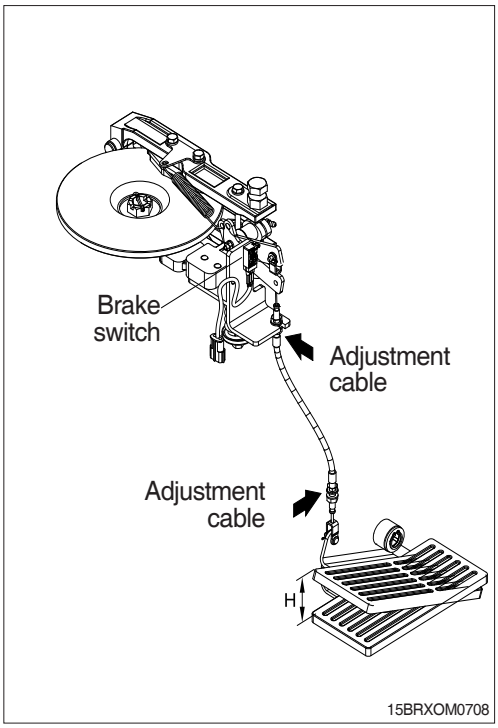



※ **Product with the same capacity must be used when exchanging the existing fuse. Request inspection to the designated repair shop when the fuse is disconnected frequently. Use of conductors such as the copper wire, etc. instead of the fuse are prohibited.**

## 8) INSPECTION AND ADJUSTMENT OF THE SERVICE BRAKE SYSTEM

(1) Check the pedal height (H), and adjust the cable adjustment nut when the height is too high or low.
· Adjustment range (H) : 64 $^{+5}_{0}$ mm

(2) While the pedal pressure is released, check the normal state of the brake switch.



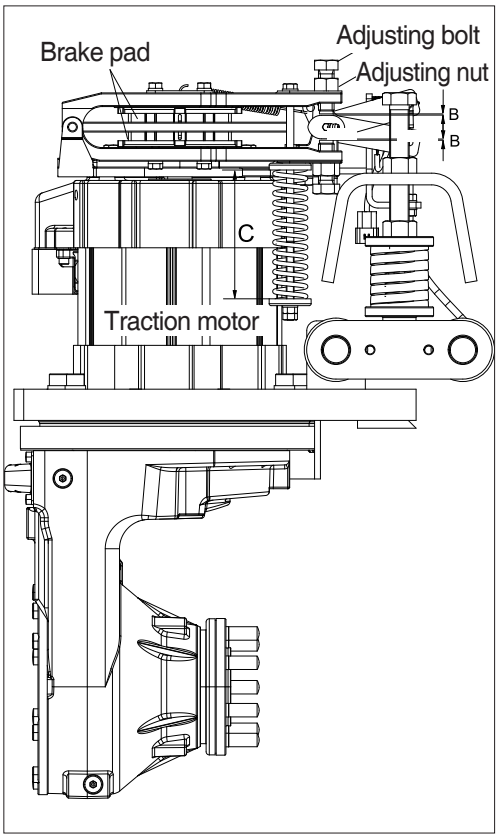

(3) Check the clearance between the brake cam and adjusting bolt (B).
· B : 0.1~0.5 mm
Adjust the adjusting bolt when the clearance is too big or small.
· Adjusting nut tightening torque :
11.4~12.6 kgf·m
Check the operation of the cam and bolt, and lubricate with grease.

(4) Check the abrasion or damage on the brake pad. When the brake pad is slanted to one side or when the thickness is 4.5 mm or less, the brake pad must be replaced.
· Brake pad bolt tightening torque : 1.8~2.7 kgf·m

(5) Check the height (C) of the brake spring, and adjust the spring.

| Model | Height(mm) |
|---|---|
| 15/18BR-X | 118±1.0 |
| 20/25BR-X | 104±1.0 |

· Spring nut tightening torque : 1.8~2.7 kgf·m



### 9) LIFT CHAIN MAINTENANCE

The chain system on the mast was designed for safe, efficient, and reliable transmission of lifting force from hydraulic cylinder to the forks. Safe use of your truck with minimum down time depends on the correct care and maintenance of the lift chains. Most of the issues related to the chain operation are result of inappropriate maintenance. Periodic inspection is essential to long use of the chain.

**⚠ When the chain is worn out and damaged, the chain must be replaced instead of repairing. The chain must not be connected together for use.**

#### (1) Inspection and measurement of lift chain

Perform inspection and lubrication on the lift chain during the periodic inspection (every 500 hours) period. When operating in corrosive environments, inspect the chains in shorter period.

During inspection, check for the following conditions.

① Rust and corrosion, cracked plates, raised or turned pins, excessively tight joints, wear and worn pins or holes.

② When the pins or holes become worn, the chain becomes longer.
When a section of chain is 3% longer than a section of new chain, the chain is worn and must be discarded.

③ Chain wear can be measured by using a chain scale or a steel tape measure. When checking chains, be sure to measure a segment of chain that moves over a sheave. Do not repair chains by cutting out the worn section and joining in a new piece. If part of a chain is worn, replace all the chains of both sides on a truck.

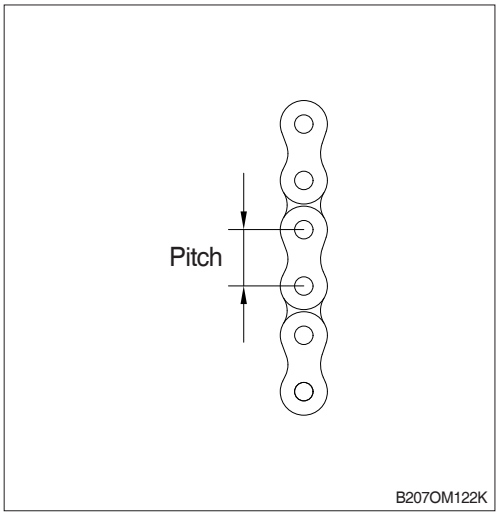
#### (2) Lift chain lubrication

Lift chain lubrication is a very important part of your maintenance program. The lift chains operate more safely and have longer life if they are regularly and correctly lubricated. HYUNDAI genuine chain lubricant is recommended; it is easily sprayed on and provides superior lubrication. Heavy motor oil may also be used as a lubricant and corrosion inhibitor.

#### (3) Lift chain wear and replacement criteria

Degree of wear on the chain can be identified through the distance from the center of one pin to the center of the next pin.
For the length, when the distance from the center of one pin to the center of the next pin is worn out 3% or more, or when damages are discovered during the inspection, replace all chains.

Follow the instructions from the local HYUNDAI dealer for replacement of the chain. Do not remove factory lubrication or paint new chains. Replace anchor pins and worn or broken anchors when installing new chains. Adjust tension on new chains.
Lubrication is required when installing the chain to the mast.



## 10) CHANGE OF HYDRAULIC OIL AND CONSUMABLES

### (1) Change the hydraulic oil

① Battery reach-out is performed to secure the drain space.

② Perform reach-out of the mast as much as possible to the front, and lower the fork to the ground.

③ Prepare a suitable drain pan (40L or more) and loosen the drain plug.

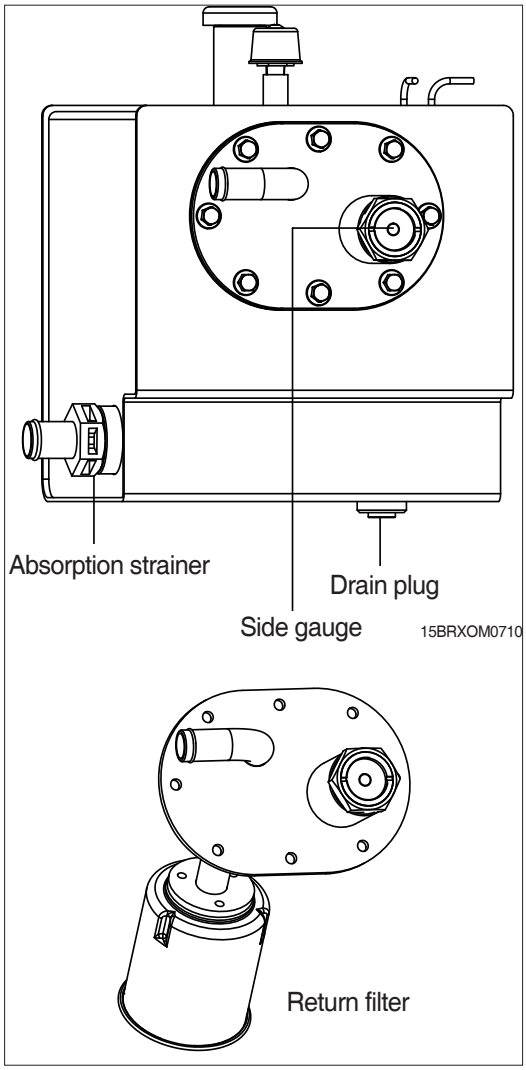
④ After draining oil, tighten the drain plug.
- Tightening torque : 5 kgf.m

⑤ Remove the absorption strainer for cleaning, and mount the strainer again.

⑥ Refer to the defined oil refueling amount for add the oil.

⑦ Turn the engine on, and operate the operating lever completely to performing bleeding.

※ **The oil must be free of bubbles. When there are bubbles in the oil, air may penetrate into the hydraulic system. Check for damage on the suction hose and clamp, and for any oil leakage.**




### (2) Hydraulic return filter exchanging

① Procedure for oil exchange is performed to remove the oil inside the tank.

② Remove the flange on the front of the tank.
- Tightening torque : 4kgf.m

③ Remove the return filter tightening bolt, and exchange and mount with new product
- Tightening torque : 1.05 kgf.m

④ Remove any foreign substances inside the tank, and perform re-assembly.

## 9. BOLT TIGHTENING TORQUE INSPECTION

Truck may occur with faults or accidents when the parts receiving the load is loosened, and damage can be caused to the parts.
All parts applied with the load must maintain the accurate torque for safety and to prevent truck damage.

Critical items include the following.

Steering axle mounting
- Drive axle mounting
- Overhead guard
- Tilt cylinder mounting and yokes
- Mast mounting and components

See 「**CHAPTER 8 SPECIFICATIONS**」 for tightening torque.

## 10. AIR CLEANING

Always maintain a lift truck in a clean condition. Prevent foreign substances, dust or other pollutants from building up on top of the truck. Leakage of oil or grease from the truck must be prevented. Wipe up all oil spills. The control device and operating room floor must be maintained safely in a clean and dry condition. A clean truck makes it easier to see leakage and loose, missing, or damaged parts, and helps prevent fires. Operating environment of the lift truck is the standard for determining the maintenance interval and range.
For example, the truck performing work in the place with high amount of dust or pollutants in the air, floor or ground must be cleaned more frequently. If the compressed air cannot remove the grease and oil, etc. use steam or liquid spray cleaner for removal.

**※ Perform air cleaning on each periodic inspection, and more frequently cleaning is performed depending on the truck condition.**

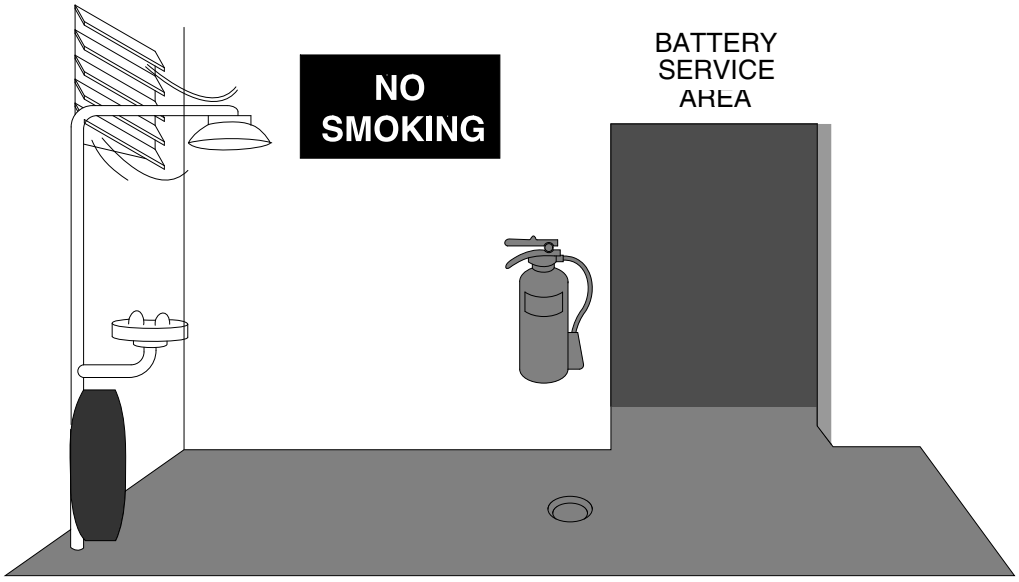
Use special connecting strand control valve and nozzle, etc. on the air hose to perform air cleaning more efficiently. Use clean, dry and low-pressure compressed air. Air pressure is limited up to 2 $kgf/cm^2$.

**⚠ Wear proper safety glasses and protective clothing during the air cleaning. Take caution on not pointing the air nozzle on others.**

Air cleaning must be performed on the overall parts of the truck including the mast, driving unit, battery accessories, driving line and related parts, sterring axle and cylinder, etc.

## 11. BATTERY MAINTENANCE

### 1) GENERAL




B15AOM128

Battery charging, replacement and removing should be performed at designated battery shop only. The shop should be free of inflammable materials or combustibles.

Facilities mandatory for the shop :

- Electrolyte cleaning facility
- Fire preventing and fire-fighting facility
- Facility protecting battery from systems
- Ventilation facility for gas from battery

Protection goggles should be worn when handling strong-acid solution of concentration of of 50% or higher, and washing bowl should be provided for emergency.

Transportation facilities such as conveyor and crane should be provided for handling the batteries.

**⚠ Battery of the lift truck is very heavy and dangerous when handling, so special caution is required. The battery is filled with toxic chemical solutions and hydrogen and oxygen are generated during charging. These gases may be mixed and explodes. Read and understand the manual before removing, servicing or installing batteries, and comply with the cautions.**

## 2) BATTERY HANDLING

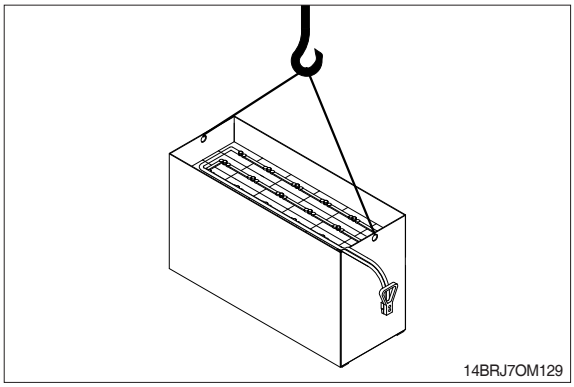
(1) Battery charging, replacement and removing should be performed at designated battery shop only.

(2) The battery shop should operate electrolyte cleaning facility, battery gas ventilation facility, and fire-preventing and fire-fighting facilities.

(3) Transportation facilities such as conveyor or crane should provided at the shop for removing and installing batteries. Lifting hook with safety locking device should be used.

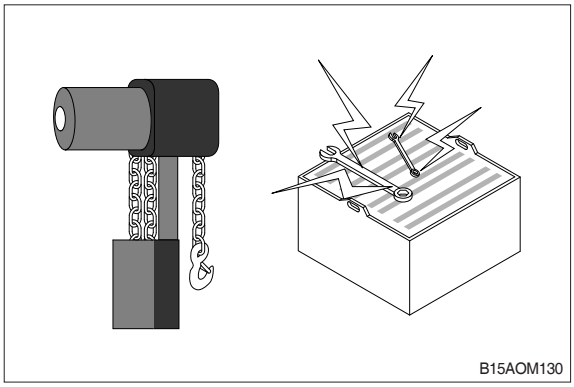
(4) Always use specific lifting tools including insulated cable for lifting batteries. Lifting hook of insulated cable should be compatible with lifting hook of battery to prevent damage to batteries. Battery can be damaged when the lifting cable is slanted to one side, so the lifting hook must be adjusted appropriately to maintain the balance.

(5) If there is no battery cover, or terminal or connector is exposed, cover the battery with wooden sheet or thick cardboard to make insulation.



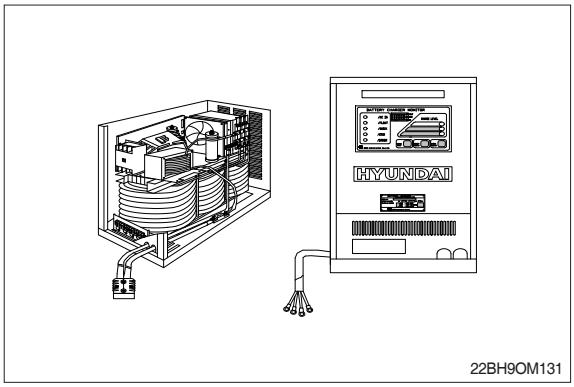

(6) Chain container should be mounted on chain crane or motor-driven crane for accommodating excessive length of chain.

(7) Any tool or other metal object should not make contact with terminal.



### 3) BATTERY CHARGING

This charger uses automatic method, and continuous observation is not required after connecting the plug.




#### (1) How to use charger

① Connecting the plug and the battery connector lights up the input power lamp, and the normal charging indicator lamp, and charging starts few seconds later.
**Once charging is complete, power is automatically shut down.**

② **Functions of indicator lamps and switches**

- **Input power indicator lamp** : Lighted when the power plug of the charger is connected. If the lamp is not lighting up, check the plug or the input power.
- **Battery connection indicator lamp** : Lighted when the battery is connected to the charger. If not lighting up, check the connector.
- **75% charging indicator lamp** : Green lamp is lighted when the current charging state is 75%.
- **Charging complete indicator lamp** : Lighted when the charging is complete.
- **Input power shutoff indicator lamp** : Lighted when the power input connection is blocked. When lighting up, check input power.
- **Overvoltage indicator lamp** : Lighted when the manual stop button is pressed, or when the charging voltage is 66V or higher. In such a case, remove the battery from the charger cable.
- **Overcurrent indicator lamp** : Lighted when the current is flowing excessively. In such a case, shut power down, open the charger door and press temperature relay button of the electromagnetic switch plug. If this lamp lights up five minutes later again, contact the charger service center.
- **Normal/Equal charging conversion switch** : In normal charging, the switch is operated to the left, and the switch is operated to the right during equal charging.
- **Manual stop button** : Pressing this button during charging stops charging.
- **Release switch** : Pressing Recovery button after stopping charging manually or pressing manual switch resumes charging.
- **Voltage/Current check button** : Battery voltage is displayed at all times, and current is indicated when the button is pressed.

### (2) Installation of charger

① Installation place
The charger should be installed at a place of well ventilation, low temperature/humidity, and free from dusts.

② Before using the charger, adjust to the voltage appropriate for the service area.

③ Check grounding line of the charging cable for well grounding of the grounding line.

### (3) Normal charging

① The charging procedures are as follows:
- Connect the charger input power.
- Be sure the switch is in the normal charge position.
- Connect the battery connector to the charge connector.
- Make sure that the indicator lamps normally light up.

② The procedures after charging are as follows.
- Make sure that CHARGE COMPLETE indicator lamp lights up.
- Remove the battery connector from the charger connector.

③ The procedures of stopping during charging are as follows.
- Press the manual switch during charging.
- Remove the battery connector from the charger connector.

### (4) Equal charging

① Repeated normal charging causes difference of capacity among cells. In such a case over-charging is often performed to keep capacities of cells uniform; this is called equal charging.
Equal charging should be performed in any of the cases listed below.
- When battery charging and discharging are repeated every day, equal charging should be performed once a month:
- Battery discharged below specified capacity;
- Recharging not performed after discharging; and
- Equal charging method is same as normal charging. All you have to do is press EVEN switch when starting charging.

**⚠ Excessive equal charging may reduce service life of the battery.**

### (5) Makeup charging

If daily charged capacity is not sufficient for a day's work, normal charging should be performed during idling time.

### (6) PRECAUTION

① Check input power when installing the charger, and use the charger compatible with the voltage of region.

② Charge the battery immediately after exhaustively using it. Charge the battery once a month when the battery is kept in standby mode for an extended period of time.

③ Prevent drop of density of the battery, particularly, in winter.

④ Immediately stop charging the battery if temperature of electrolyte exceeds 50˚C during charging.

⑤ Combustible gases are generated from the battery during charging. Pay special attention to fire prevention, and ventilation.

## 4) BATTERY REMOVAL AND MOUNTING

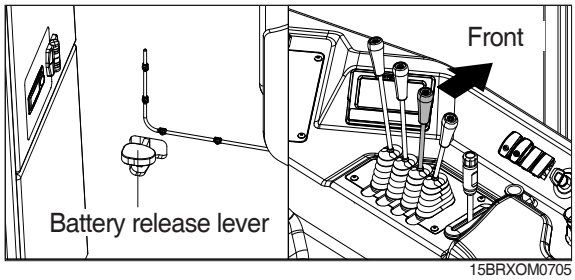
### (1) Battery removal

When spare battery is used for continuous work, or when inspecting the battery and the motor, etc., remove the battery in the following order.

① Switch ON the starting key.

② Press the battery release lever to release the fixing device.

③ Push the reach lever forward until the battery is removed from the frame.



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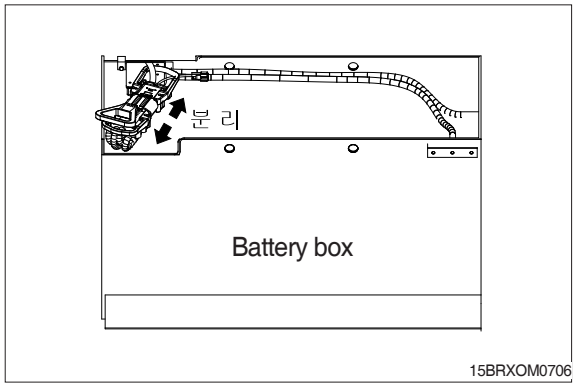
④ Switch OFF the starting key.

⑤ Separate the battery connector.



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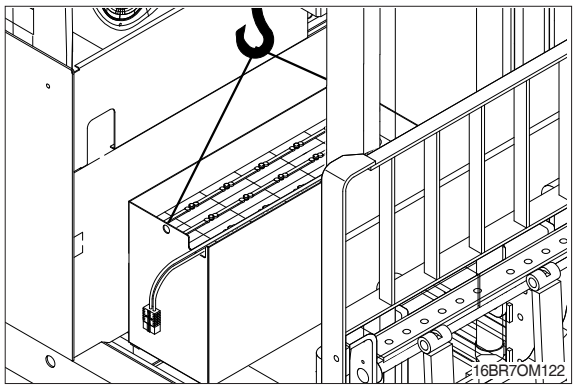
⑥ Use the battery lifting device to lift the battery carefully.

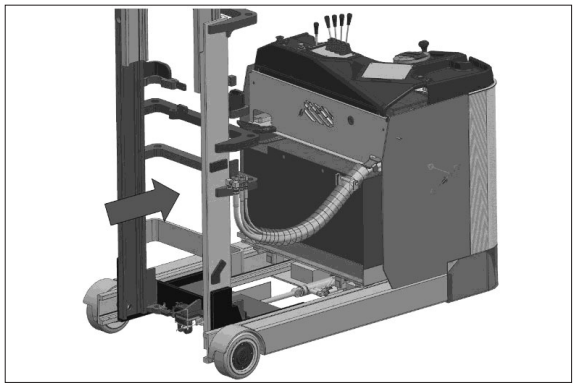

16BR7OM122

### (2) Battery mounting

**※ Battery mounting is performed in the reverse order of battery removal. Caution is taken for safety to perform the procedure slowly.**

Among the movement of pulling the reach lever to fix the battery, when the hose bundle connected to the mast is deviating from the guide roller, stop the operation to move the hose to the guide roller. Afterwards, insert the battery again into the truck.

**※ Take caution from others touching the operating lever while touching the hose.**

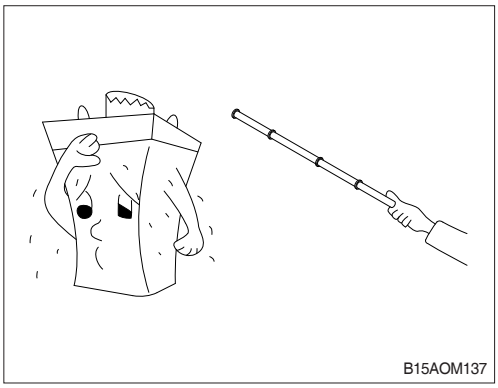


## 5) BATTERY MAINTENANCE

### (1) Prohibition of over-discharge

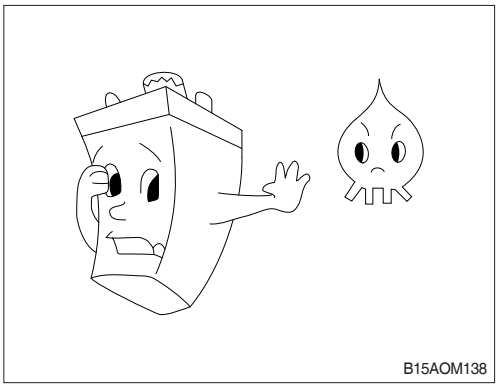
If the battery is so exhaustively consumed that the truck can not move anymore, the service life of the battery is reduced.

When turning the starting switch to ON position, and the battery charging indicator bar blinks, immediately charge the battery.


B15AOM137

### (2) Strict prevention of open flame

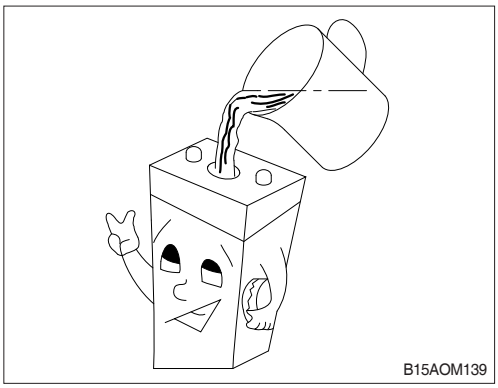
The battery contains inflammable gas. Never let open fame get near the battery.


B15AOM138

### (3) Makeup with distilled water

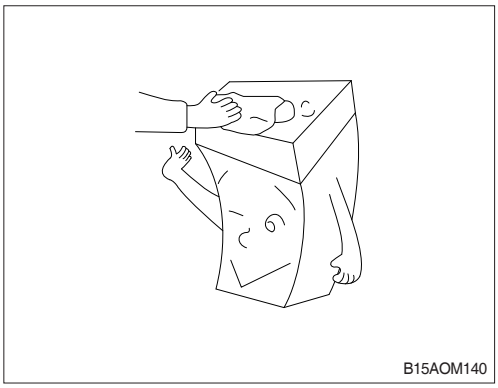
Electrolyte is reduced from decomposition and natural evaporation while charging, and after the charging is complete, distilled water is added to enable the electrolyte to be up to the defined level.

It is not required to make up with thin sulfuric acid except overflow of electrolyte.


B15AOM139

### (4) Keeping battery clean

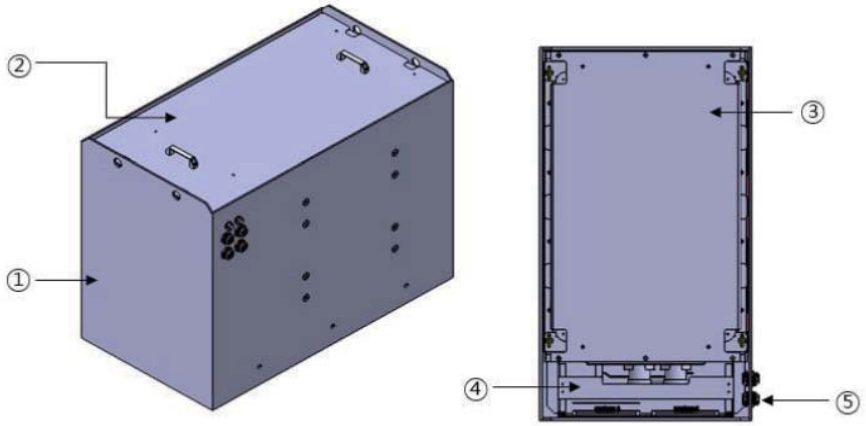
Keep the top of the battery clean and dry. Securely tighten the stopper of the solution port.


B15AOM140

## 12. LITHIUM ION BATTERY (OPT)

### 1) STRUCTURE

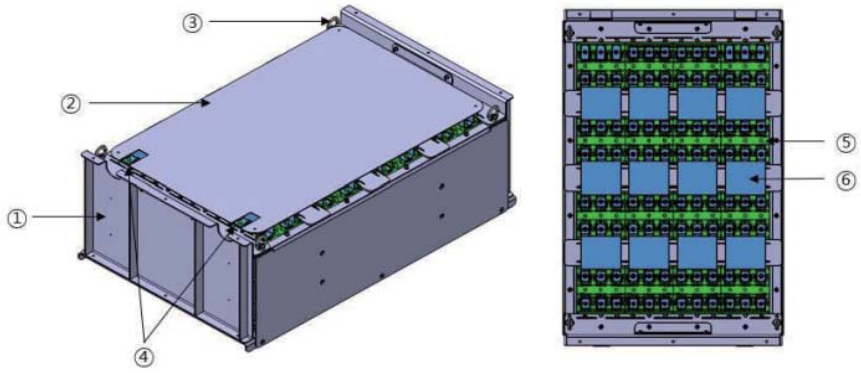
#### (1) Battery pack




25BX7PM14

| | | | | | |
|---|---|---|---|---|---|
| 1 | Housing | 3 | Module | 5 | Cable |
| 2 | Top case | 4 | BPU | | |

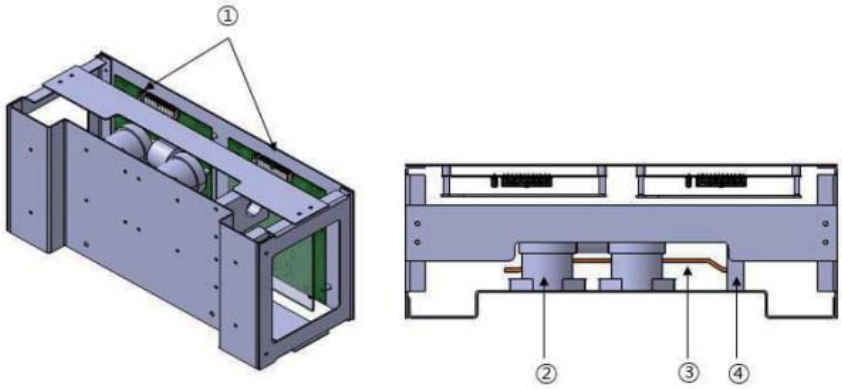
#### (2) Battery module




25BX7PM15

| | | | | | |
|---|---|---|---|---|---|
| 1 | Module frame | 3 | Eye-cut | 5 | Cell |
| 2 | PC cover | 4 | +: Anode terminal, -: Cathode terminal | 6 | Module bus bar |

### (3) BMS and BPU




25BX7PM16

1 BMS 3 Grounding bus bar 4 Current sensor
2 Relay

## 2) INSPECTION PROCEDURE

### (1) Daily inspection before starting

- Make sure that the battery pack charging terminal (DIN320 connector) is disconnected on the charge.
- Check the battery pack charging terminal for fixed state.
- Check the battery pack charging terminal for damage.
- Check the battery pack charging terminal and system load for fixed state.

### (2) Measures for abnormality before starting

① Voltage on charging and discharging terminals of battery pack
- Servicing is required for troubleshooting of failure by molten relay, short on both ends of relay.
- Servicing is required in cases of function failure of BMS, or power supply to BMS.

② Measures for poor stationary conditions of charging and discharging terminals of battery pack
- Check tightening status of bolts of charging/discharging terminals.
- Fasten the bolt at specified torque.

③ Damage of battery pack charging terminal
- Replace with specified connector (DIN320).

### (3) Inspection for defects after start stopping

- Check if starting is stopped before connecting charging terminal on battery pack charging terminal.
- Check if voltage is detected before connecting charging terminal on battery pack charging terminal.
- Check the battery pack charging terminal for damage.

### (4) Measure for defects after start stopping

① When starting is not stopped
- Starting should be stopped.

② Voltage detected on the charger terminal
- Make sure that starting is stopped. If so, take servicing action.
- Failure by molten relay is suspected. Take servicing action.

③ Charging terminal of charger or battery pack damaged
- Replace with specified connector (DIN320).

## 13. LITHIUM ION BATTERY CHARGER (OPTION)

**※ Please read and familiarize yourself with the following instructions before connecting the battery charger to the power and battery.**

### 1) USE AND OPERATION

1) When using battery charger, safety requirements should be satisfied pursuant to the local laws and regulations, and regulations stipulated by local authorities.
2) The user must use the charger according to the regulation. Actions that may threaten the lives and health of the user and others must be avoided, and property damage must be prevented.

CHARGER2

### 2) WARNING ON INSTALLATION AND SAFETY

(1) Read and understand the following instructions before connecting battery charger to power source and battery.

① For proper function and efficient use, position the battery charger in the proper direction on the wall, and fix with the plug through the slot. Take caution on not blocking the ventilation slot hole.

② Authorized skilled experts are only allowed of opening battery charger.

③ Vent insulation sections of power cable and battery connector before operating the battery charger.

④ Skilled engineers are only allowed of performing works on electric apparatus.

⑤ Shut power off before connecting or disconnecting the battery.

⑥ The battery under charging generates explosive gases. Do not smoke in the vicinity of the truck. Avoid open flame and spark, and prevent access of other truck that may cause risky situations on human beings and properties.

⑦ The battery charger contains electric components generating electric arc and spark, and should be positioned on place adequate for functions of the charger when using it in confined space. Every standard battery charger should be used on hard and flat floor in contained space of well ventilation and free from rainwater and/or water splash. In particular, place of dusty environment, or with water or heat source, or high humidity should be avoided. Do not place the battery charger on floor or shelf made of wooden material or other inflammable materials, or do not stack objects around the charger. Never put solution container on the lid of the charger.
The battery charger should be connected to grounded receptacle/socket for preventing shock.

⑧ In addition, receptacle/socket for connecting with the battery charger should compliant with the charger capacity, and should be protected by proper electric devices pursuant to the standards (e.g., fuse and auto switch). Protection system should have calibration margin of 10% or higher based on current absorption ratio of the truck for sufficient selectivity.

⑨ Always use special bipolar connector (DIN 320 REMA).

⑩ Do not extent existing power connection with additional cable.

⑪ The charger is free from maintenance except routine cleaning. Cleaning should be performed regularly dependent upon working environments. Disconnect power cable and battery connection cable from power source before cleaning the charger.

### 3) POWER CONNECTION

The battery charger should be connected to power receptacle compatible with capacity of installed battery charger. Correctly connect the charger to grounding line. It is desirable to verify that main power of 3-phase is supplied on place for operating the battery charger while installing the charger (or moving the batteries).

| Battery voltage (V) | Charger current (A) | Module power (kw) | Active input power (kw) | Input LAC norm (A) | Fuse AC (A) | DC fuse code |
|---|---|---|---|---|---|---|
| 48 | 200 | 12 | 12.26 | 19.98 | 25 | LMT250 |
| 48 | 250 | 16 | 15.32 | 24.97 | 32 | LMT315 |

### 4) BATTERY CONNECTION

It is recommended to use bipolar connector compliant with the specification pursuant to the standards to prevent inverse connection of the polarity of the battery. Check the cable connection of the connector contact. This work must be performed by a skilled engineer.

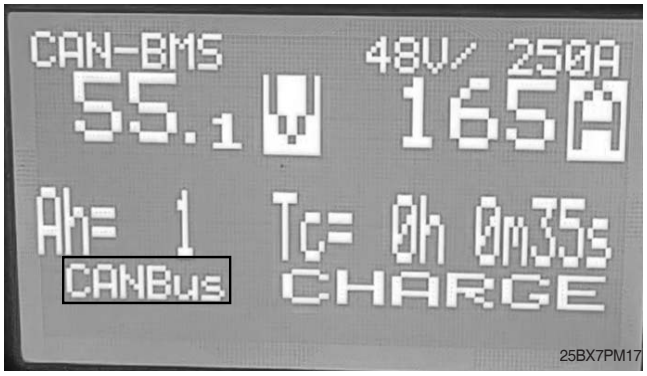
**※ USB port should only be used for programming charging variables, and downloading history data and graphs. To prevent the EMI noise from causing interference to the charging process to have unexpected result on the battery charger and battery, separate the USB cable from the charger while charging.**

### 5) PRECAUTION DURING CHARGING

Shut down starting switch, and emergency stop switch of the truck before battery charging.

Completely connect the battery charger to the battery connector for charging. Check texts of CAMBus on the bottom left of the charger monitor after beginning charging.

Do not disconnect the connector during charging. (Never forget to press the ON/OFF switch of the charger to stop operation of the charger before disconnecting the connector.)



## 14. STORAGE

### ※ CAUTIONS

Improper storage of the truck may cause damage and corrosion of major functional parts, or damage and discharging of the battery. The battery of the lift truck should be stored in indoor environment to prevent damage by rainfall.

### 1) DAILY STORAGE

Follow the instructions below when storing the lift truck in a warehouse.

(1) Place the lift truck in dry and clean environment of well ventilation, and free from frost.
(2) Make sure parking brake is applied.
(3) Make sure that the forks have been lowered on the floor, and the mast vertically inclined.
(4) Turn both of the starting switch and the emergency stop switch to OFF position to shut off power to the battery.

### 2) LONG-TERM STORAGE

(1) Caution on storage
① Clean the truck clear.
② Check the functions of the brake, the mast, motor starting, steering, horn, and electric parts.
③ Check the hydraulic oil level, and makeup the oil, if required (See Table Recommended Lubricants).
④ Apply thin film of oil or grease on all of surfaces not coated with paint.
⑤ Supply grease to the lift truck at injection points specified in 'Regular Checklist.'
⑥ Coat all of exposed electric connections with adequate spray.l
⑦ Disconnect the battery cable, and then clean the battery. When the lift truck is to stored for a month or longer, remove the battery from the truck, and store it in indoor place.
- Refer to 'Battery Maintenance' on Page 7-22 for further information of maintenance of the battery.

### 3) CAUTION DURING STORAGE

(1) Move short distance and operate the attachments.
(2) Check exposed parts for rust once a month.
(3) Check voltage of the battery once a month, and recharge the battery, if required.

### 4) CAUTION AFTER STORAGE

(1) Clean the lift truck clear.
(2) Reconnect the battery cable, and check the battery voltage.
- Recharge the battery, if required, and then check specific gravity of electrolyte.
(3) Lubricate the lift truck with grease at injection points specified in 'Regular Checklist.'
(4) Check whether condensed water is included in the hydraulic oil, gear oil, brake oil, drive axle oil and driving device oil,
(5) and (if required), drain the water or exchange the oil.
(6) Start the truck, and check for all of functions and oil leak.
To operate the attachments, operate in ultra-low speed for 10 or more times until the final cylinder stroke to remove air from the tank.
- Points and electric parts of operation, steering, and noise
- Leak from cylinder, MCV,pump, powertrain part, tube and hose

## 15. OIL

### 1) NEW TRUCK

The following oil is used when releasing the new truck.

| Item | Spec. |
|---|---|
| Gear oil | SAE 80W-90 |
| Hydraulic oil | ISO VG32, VG46, VG68, Hyundai long life hydraulic oil, ISO VG15★ |
| Grease | NLGI No.2 |

· API : American Petroleum Institute
· SAE : Society of Automotive Engineers
· ISO : International Organization for Standardization
· NLGI : National Lubricating Grease Institute
★ : Cold area (Russia, Mongolia, CIS)

### 2) RECOMMENDED LUBRICANT

| Item | Lubricant Type | Capacity l | | Outdoor temperature˚C |
|---|---|---|---|---|
| | | 15/18BR-X | 20/25BR-X | -50 -30 -20 -10 0 10 20 30 40 |
| Driving unit | Gear oil | 3.5 | 4 | SAE 80W-90 |
| Hydraulic oil tank | Hydraulic oil | 18 | 24 | ISO VG 15★<br>ISO VG 32<br>ISO VG 46<br>ISO VG 68 |
| Grease feeding unit | Grease | 0.1 | 0.1 | NLGI No.1<br>NLGI No.2 |

★ : Cold area (Russia, Mongolia, CIS)