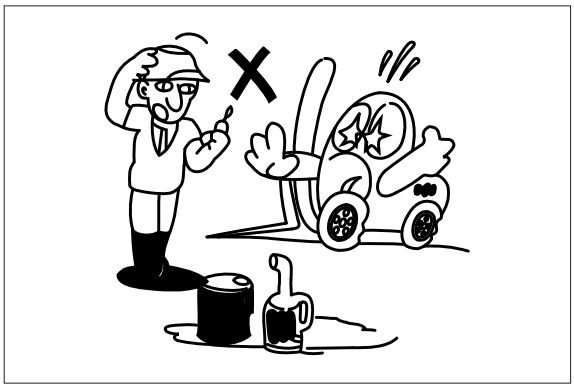
# CONTENTS

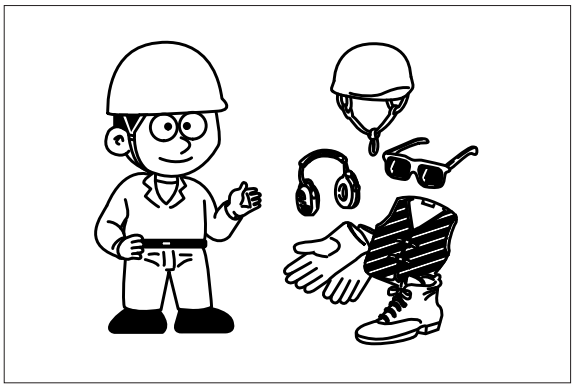
# GROUP 1 SAFETY HINTS

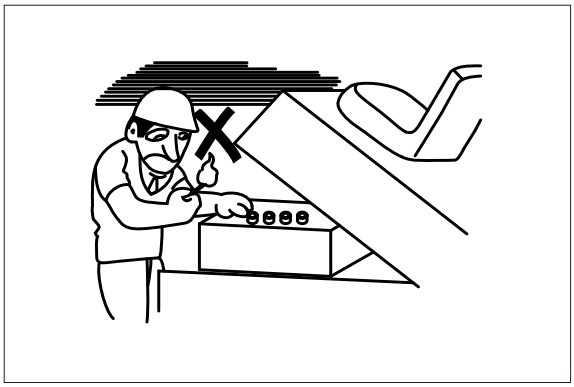
Careless performing of the easy work may cause injuries.
Take care to always perform work safely, at least observing the following.

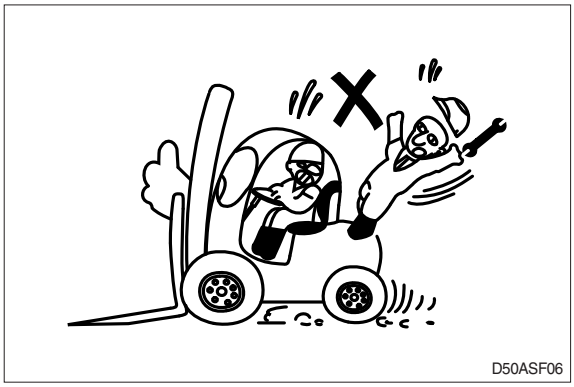
- Oil is a dangerous substance. Never handle oil, grease or oily clothes in places where there is any fire of flame.
  As preparation in case of fire, always know the location and directions for use of fire extinguishers and other fire fighting equipment.



- Wear well-fitting helmet, safety shoes and working clothes. When drilling, grinding or hammering, always wear protective goggles.
  Always do up safety clothes properly so that they do not catch on protruding parts of machines. Do not wear oily clothes.
  When checking, always release battery plug.







D50ASF06

## 4. TIGHTENING TORQUE FOR MAJOR COMPONENTS

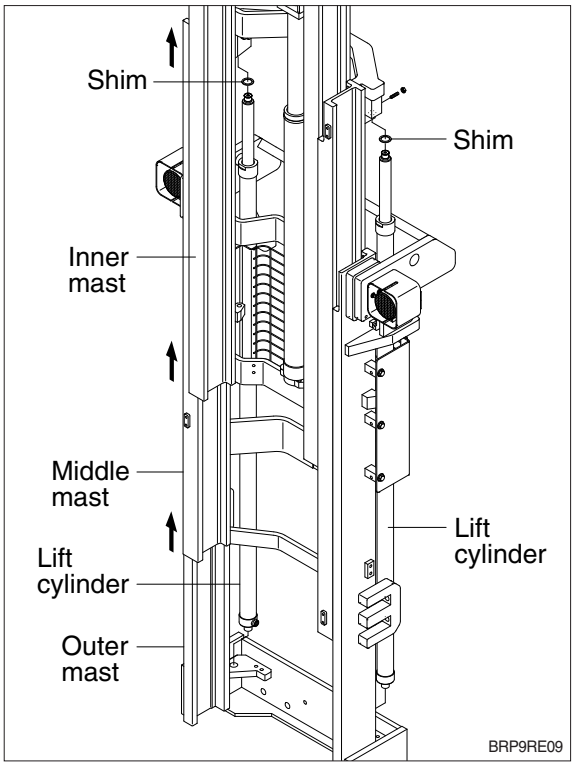
| NO | Items | | Size | kgf·m | lbf·ft |
|---|---|---|---|---|---|
| 1 | Electric system | Hyd pump motor mounting bolt | M10×1.5 | 6.9±1.4 | 50±10 |
| 2 | | Traction motor mounting bolt | M 8×1.25 | 7.0±1.0 | 50.6±7.2 |
| 3 | | EPS motor mounting bolt | M10×1.5 | 3.05±0.5 | 22.1±3.6 |
| 4 | | Electric brake mounting bolt | M 8×1.25 | 4.0±0.8 | 28.9±5.8 |
| 5 | Hydraulic system | Hydraulic pump mounting bolt | M10×1.5 | 5±1 | 36±7.2 |
| 6 | | MCV mounting bolt, nut | M 8×1.25 | 2.5±0.5 | 18.1±3.6 |
| 7 | | Hydraulic oil tank mounting bolt | M 8×1.25 | 2.5±0.5 | 18.1±3.6 |
| 8 | Power train system | Drive unit mounting bolt | M12×1.75 | 14.3±1.0 | 103±7 |
| 9 | | Load wheels mounting bolt | M12×1.75 | 14.0±1.0 | 101±7 |
| 10 | | Drive wheel mounting nut | M14×1.5 | 14.5±1.0 | 105±7 |
| 11 | Other | Seat mounting bolt | M 8×1.25 | 2.5±0.5 | 18.1±3.6 |
| 12 | | Head guard mounting bolt | M12×1.75 | 12.8±3.0 | 93±22 |
| 13 | | | M16×2 | 29±4 | 210±29.0 |
| 14 | | Mast mounting bolt, nut | M20×1.5 | 62.8±9 | 455±65.2 |
| 15 | | | M22×1.5 | 83.2±12.5 | 603±90.6 |
| 16 | | Outrigger mounting bolt | M27×3 | 120±12 | 868±87 |

### (5) Lift cylinder

① Loosen hexagonal bolts and remove washers securing the lift cylinders to inner mast.
② Bind the lift cylinder with overhead hoist rope and pull up so that the rope has no slack or binding.

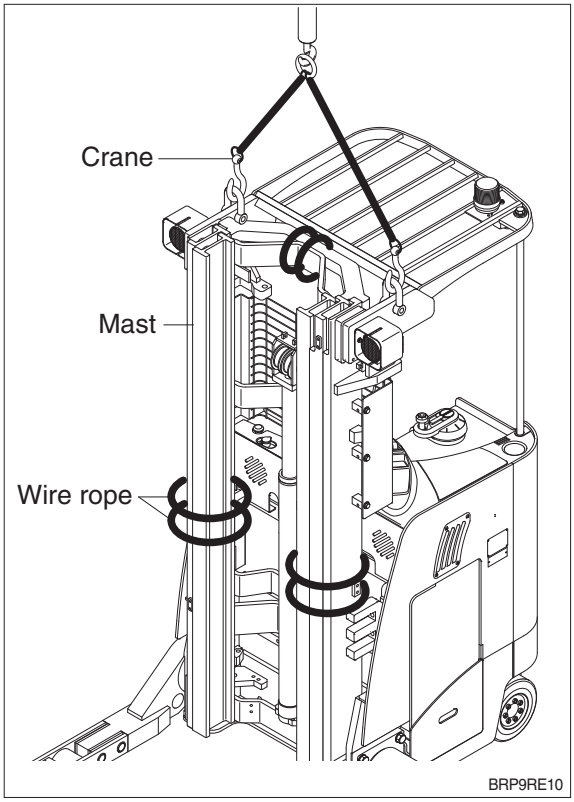
**⚠ Make sure that the lift cylinder be tightened firmly for safety.**

③ Loosen and remove hexagon nuts and cylinder band securing cylinder to outer mast.
④ Using an overhead hoist, slowly raise the inner mast high enough to clear lift cylinder.
⑤ Using an overhead hoist, draw out lift cylinder carefully and put down on the work floor.




### (6) Mast removal

① Pass wire rope around the inner and outer masts to allow lifting them out with a hoist.
② Remove the stopper pin at the end of reach cylinder and then remove the stopper bolt at the end of guide rail.
③ Draw out the mast from the guide rail with lifting up.
④ Lower the mast and place it on stand.



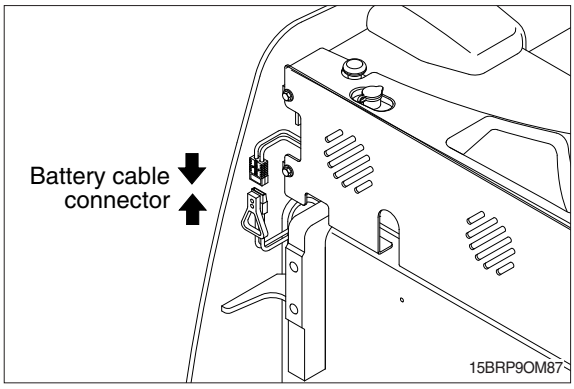
### (4) BATTERY REMOVAL

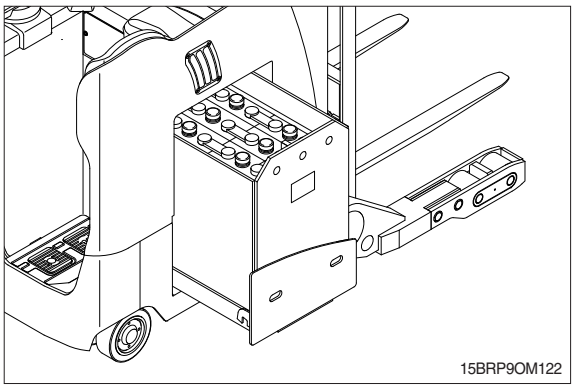
① Turn off the key.

② Release the lock screw of side support in frame.

③ Disconnect the battery connector.

④ Pull out the battery and using a battery hanger, carefully raise the battery assembly.



# GROUP 3 DISASSEMBLY AND ASSEMBLY

## 1. INSTRUCTION

1) Pay attention to cleanliness and expert like manner for all work to be carried out. Transmission removed from the vehicle has therefore to be cleaned prior to opening. Both utmost care and cleanliness are essential conditions for a correct disassembly and reassembly of the transmission as well as for the installation of each spare part. A fault during installation can result in an early wear and chips or other foreign particles in the transmission can cause fatal damages.

2) Prior to assembly all parts must be cleaned and inspected for wear and other defects.

3) If it is found that removed parts are damaged or worn, do not reinstall but replace them by new ones.

4) If not separately indicated, the housing and cover faces forming an oiltight connection are to be provided with the corresponding sealing compound during assembly.

5) Special devices and special tools are necessary besides the standard tools. Their use is unavoidable for a technically adequate dis- and reassembly. The application of devices, special tools and other fixtures are to be adapted to circumstances of the respective users.

6) Commercial tools and fixtures belonging to the basic equipment are assumed to be available.

7) If not otherwise indicated all pressing operations are made by means of the hand lever press.

8) All screws and threads in this transmission have metric dimensions. Only spanners and socket spanners with metric sizes are allowed to be used.

9) For reassembly all of the indicated setting values, test data and tightening torques must be observed.

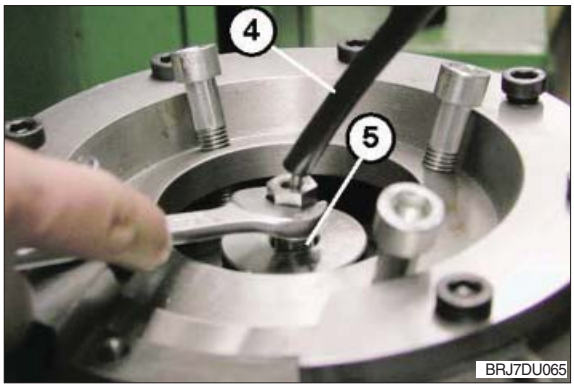
10) Observe the described sequence of the working steps.

11) All pictures serve the illustration and are not obliging for this execution.

④ Connect the flexible high-pressure pipe (item 4) from the pressure oil device into the connecting bore provided in the wheel shaft (item 5).

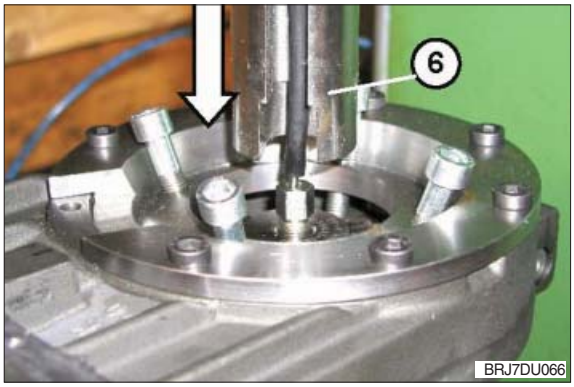
Fixedly tighten the connecting nipple with an openjaw spanner.

**⚠ Pay attention for pressing-off that there is sufficient clearance in pressing-off direction avoiding that the wheel shaft is bottoming. Do not jam the wheel shaft at the pressing-off procedure.**

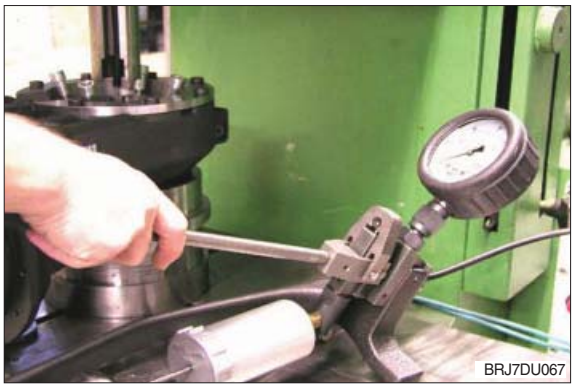



⑤ Mount the stamp (item 6) from the holding fixture (see Figure 64) into the press.

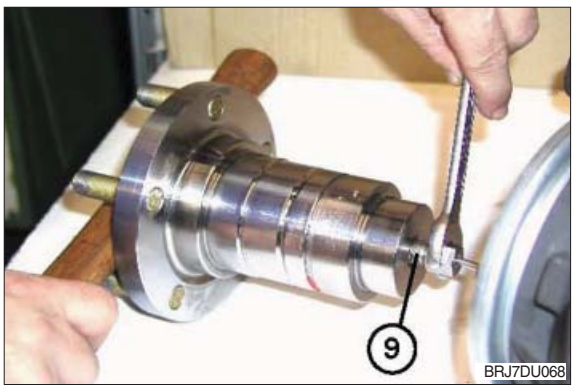
Adjust a pressing-off force from approx. 80 ... max.
120 KN on the press.




⑥ At the same time also use fixture 62222 to produce the necessary pressure until the wheel shaft is pressed out from the crown gear.




⑦ Remove and handle the wheel shaft in such a way that the flexible high-pressure pipe can be unscrewed from the connecting bore of the wheel shaft (item 9), removed and put aside.



## 6) DETERMINATION OF BASIC INSTALLATION DIMENSIONS

### (1) Determination of the necessary shim thickness for the exact installation dimension setting of the bevel pinion shaft

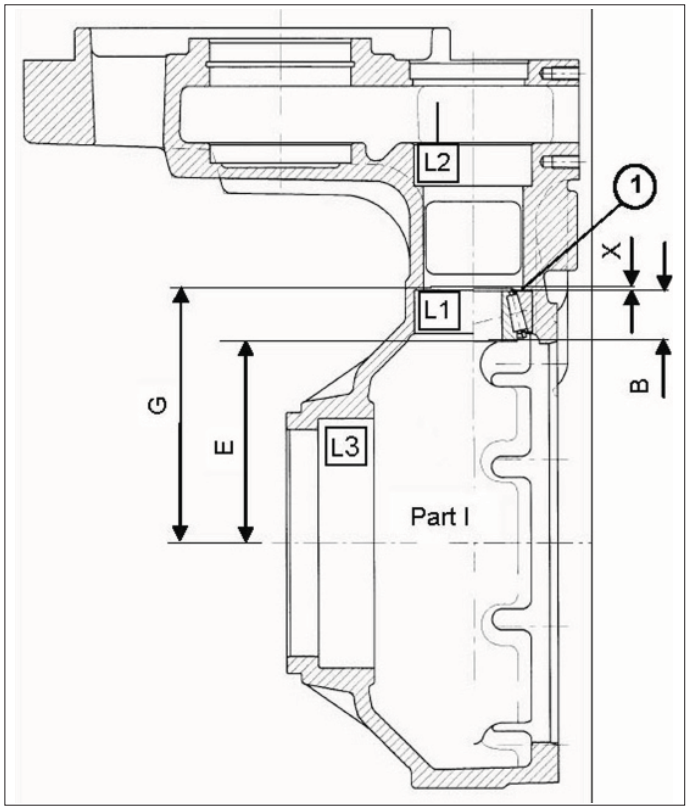
The correct position of the bevel pinion shaft is required for an optimum service life of the transmission.

Thickness of the shim (Item 1) and the correct setting of the bevel pinion shaft respectively will be determined acc. to the following method:

① Put measuring fixture I Part Ⅰ(see figure 95) into the housing bearing bore L1 until contact is obtained.

② Put measuring fixture I Part Ⅱ(see figure 96) into the housing bearing bore L2 until contact is obtained and fasten it hand-tight with measuring fixture I Part Ⅰ.

③ Put measuring fixture part Ⅰ to zero.
(S) Measuring fixture I 62828

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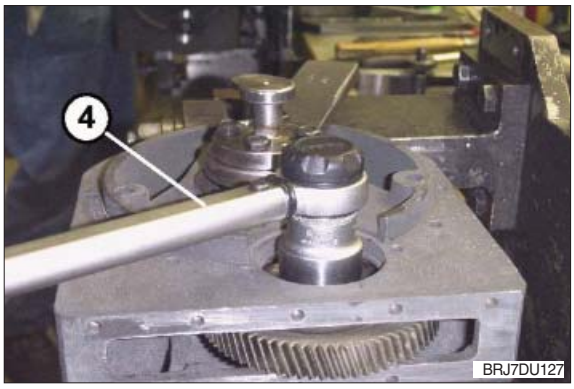
⑧ Place the hexagon nut and M20×1.5 onto the bevel pinion shaft and tighten it with a torque spanner (item 4).

Tightening torque : 150 Nm




⚠ **Do not yet peen the hexagon nut with the bevel pinion shaft! The hexagon nut must only be peened after setting and checking of the bearing preload! Use the hexagon nut only once.**

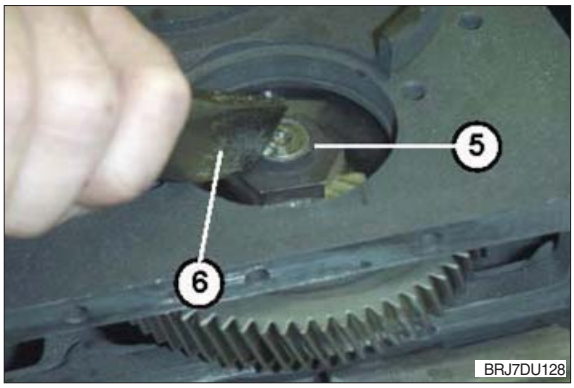
⑨ Turn the bevel pinion shaft and the helical gear respectively by hand several times, that the taper rollers can align in the bearing rings.

⑩ Check the bearing preload by means of a drag torque spanner with dial gauge.
The bearing preload is adjusted correctly, when a bearing friction torque of

0.5 ... 1.0 Nm

is reached on the bevel pinion shaft.
If this value deviates the procedure must be repeated.

⑪ Drive the collar of the hexagon nut (item 5) by means of a chisel (item 6, edge of the chisel must be a radius of approx. 2.0 mm) into the recesses of the bevel pinion shaft. Lock the hexagon nut by peening!



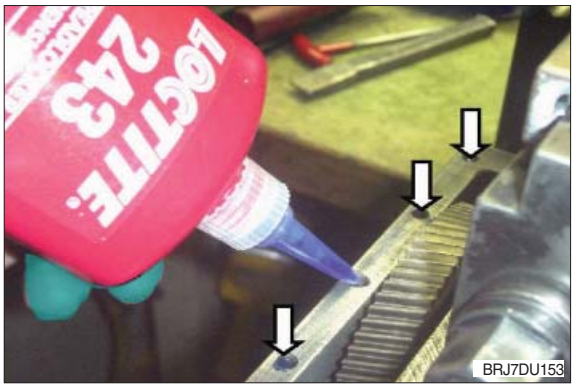
### (7) Installation of side cover

Prior to the installation of the side cover clean the sealing surface on the housing and remove the oil residues. The sealing surface must not be damaged.

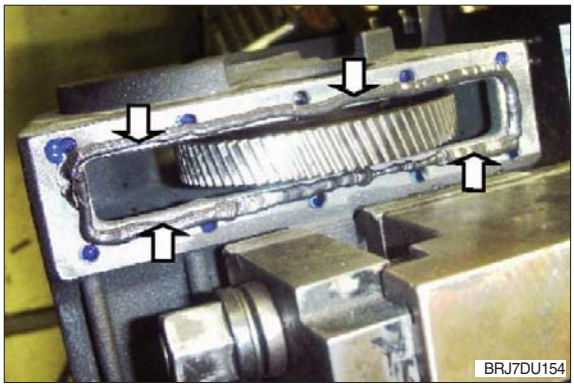
**⚠ Wear safety gloves for working with adhesives and observe the LOCTITE instructions.**

**⚠ The following step must be carried out within 10 minutes since the LOCTITE hardens.**

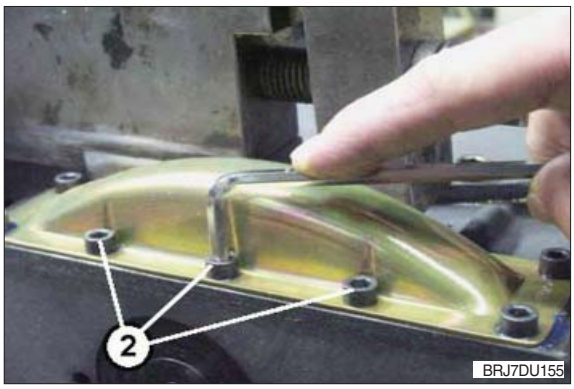
① For sealing of the through holes as well as of the area around the screw the following sealing application is required:
LOCTITE 243 : Product application into the threaded blind holes M6 as sealing function by excess product.




② Sealing of the cover:
LOCTITE 5910: Product application as uniform adhesive application onto the sealing surface at the housing as sealing function.



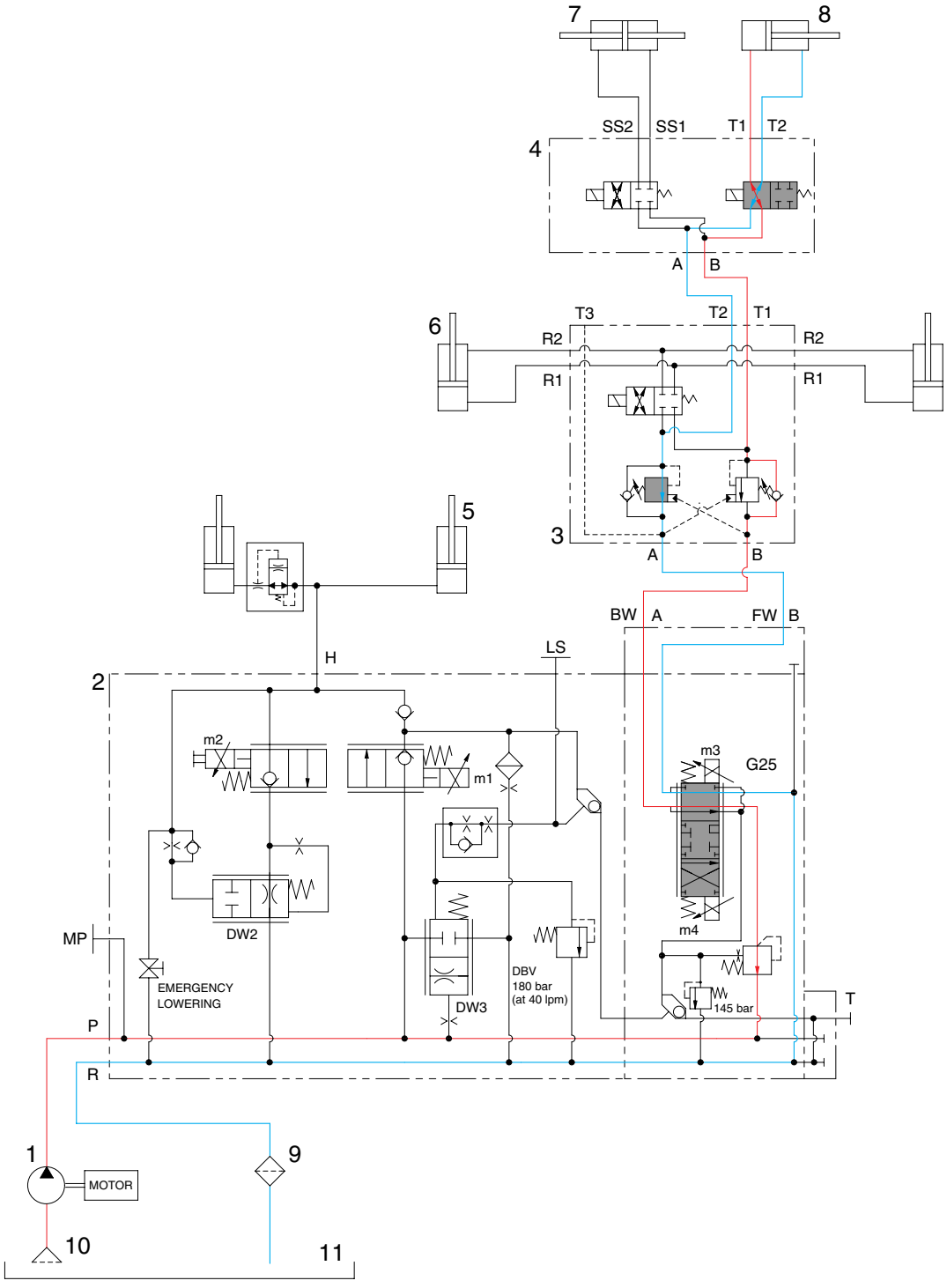

③ Put on the side cover (sheet cover) and fasten it hand-tight with 10 cap screws M6 × 10 (item 2) onto the housing.



## 7. TROUBLESHOOTING AND FAULT ELIMINATION

| Fault | Cause | Remedy |
|---|---|---|
| **Brake does not release** | · Power supply is too low<br>· Power supply is interrupted<br>· Airgap too large<br>· Worn disc<br>· Coil is damaged<br>· Airgap too small | · Adjust power supply<br>· Reconnect power supply<br>· Re-adjust the airgap<br>· Change disc and readjust the airgap (PK 60)<br>· Replace the brake<br>· Re-adjust the airgap |
| **Brake does not brake** | · Voltage present at switch off position<br>· Grease on friction faces | · Check the customer's power supply<br>· Change the disc and re-adjust the airgap |
| **Nuisance braking** | · Power supply is too low | · Adjust power supply |

## 5) WHEN THE JOYSTICK IS IN THE BACKWARD TILT POSITION



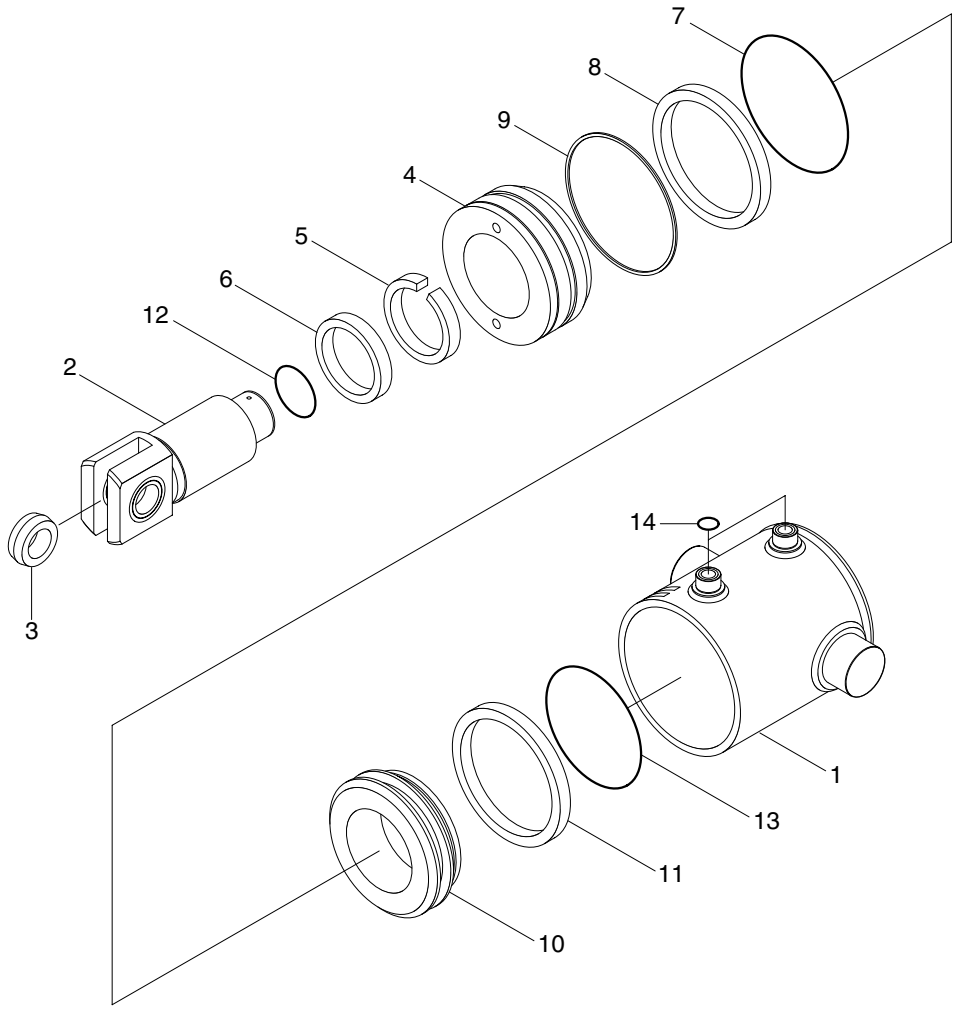

BRP7HS06

When the joystick is pulled during pressing the tilt button, the spool in the tilt block is moved to tilt backward position.

The oil from hydraulic gear pump (1) flows into main control valve (2) and then goes to the large chamber of tilt cylinder (8).

The oil at the small chamber of tilt cylinder (8) returns to hydraulic oil tank (11) at the same time.

## 6. TILT CYLINDER

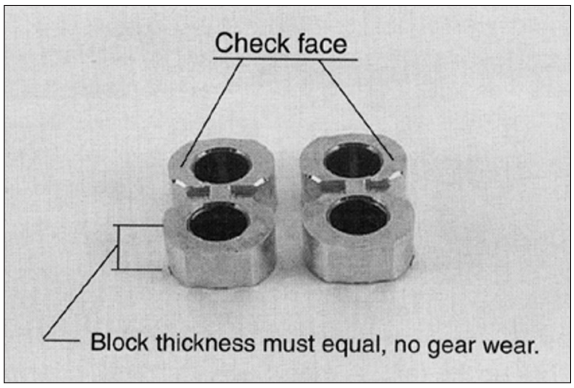



BRP7HS25

| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 6 | Dust wiper | 11 | Piston seal |
| 2 | Rod | 7 | O-ring | 12 | O-ring |
| 3 | Bushing | 8 | Back up ring | 13 | Locking ring |
| 4 | Rod cover | 9 | Locking wire | 14 | O-ring |
| 5 | U-packing | 10 | Piston | | |

(5) Inspect bearing blocks for excessive wear or scoring on the surfaces which are in contact with the gears. Also inspect the bearings for excessive wear or scoring.

(6) Inspect the area inside the gear housing. It is normal for the surface inside the gear housing to show a clean "wipe" on the inside surface on the intake side. There should not be excessive wear or deep scratches and gouges.



PUMP 14

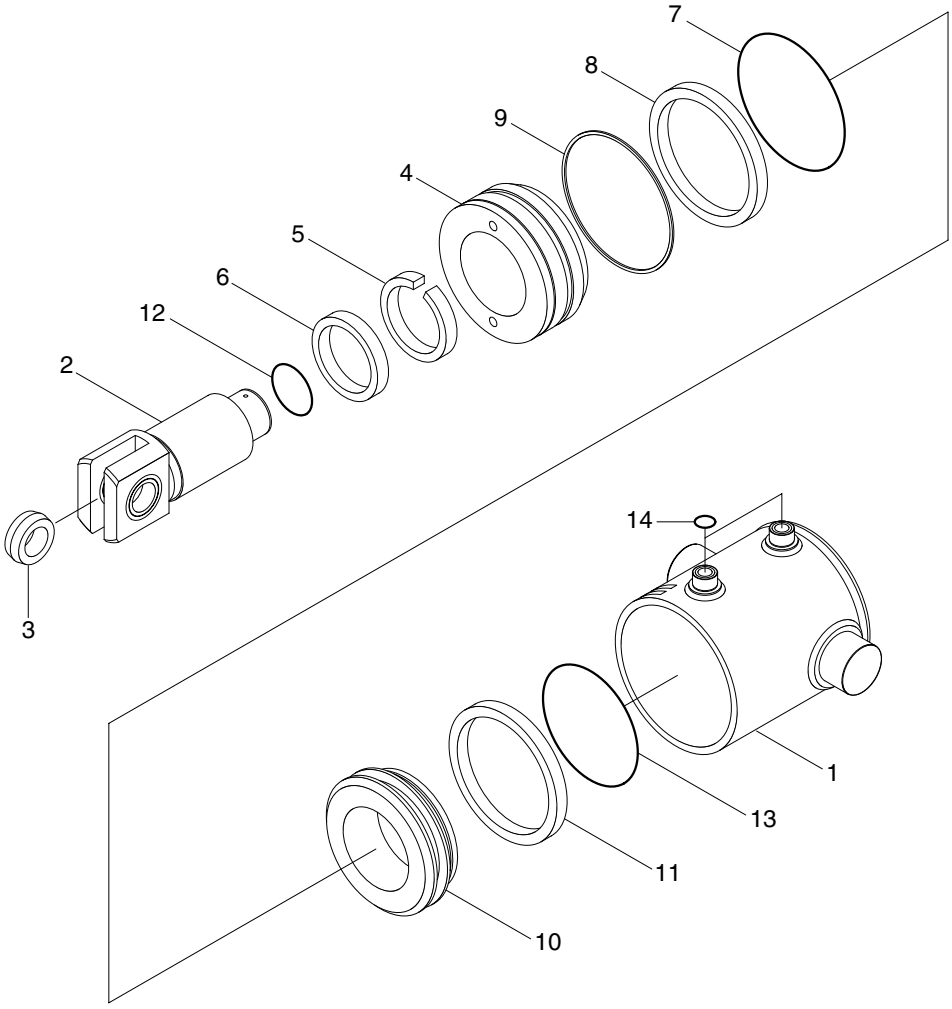
※ **General information**

It is important that the relationship of the mounting flange, bearing blocks and gear housing is correct. Failure to properly assemble this pump will result with little or no flow at rated pressure.

※ **This pump is not bi-rotational.**

## 4. TILT CYLINDER

### 1) STRUCTURE




BRP7HS25

| | | | | | |
|---|---|---|---|---|---|
| 1 | Tube assy | 6 | Nylon nut | 11 | O-ring |
| 2 | Rod | 7 | Gland | 12 | O-ring |
| 3 | O-ring | 8 | DU bushing | 13 | O-ring |
| 4 | Piston | 9 | Rod seal | | |
| 5 | Piston seal | 10 | Dust wiper | | |

## 4) SAFETY PRECAUTIONS

### (1) When a sulfuric acid contact with skin

For acid contact with skin, eye or clothing, flush with water immediately. If swallowed, drink a large amount of water or milk. Seek medical attention immediately. When handling acid, always wear eye goggles or a face shield and rubber gloves.

### (2) Strict prohibition of fire and ventilation

Since batteries generate explosive hydrogen gas, no fire should be drawn near. Before the battery charging, keep the battery cover open and check the ventilation status. Charging in an enclosed space can cause a explosion.

### (3) Never place metallic articles on the batteries

If done so, it may cause “short circuit” accidents (dangerous especially while charging).
Sparks will be generated which is equally dangerous as open fires.

### (4) Handling of charger

When connecting or disconnecting a battery from a charger or attempting maintenance, make sure switches are all off. Ensure that the charger and the battery are matched. If a 300Ah battery is used with a charger designed to charge a 500Ah battery, it will severely overcharge the battery.

## 5) OPERATION PRECAUTIONS

### (1) Avoid over-discharge

If over-discharged, it will be difficult to restore the batteries to the original state by recharge. In order to maintain the batteries in use for long period of time, it is recommended to use the batteries with discharge amount not exceeding 80% of the rated capacity. Further care should be taken for preventing the unit cell voltage from falling below 1.5V.

### (2) Avoid over-charge

If overcharged, the rise in battery temperature will become excessive, resulting in deterioration of plates and other parts and markedly shortening of battery life.

### (3) Avoid excessive elevation of temperature

Be sure to open the cover of battery housing tray before charging. If there is a possibility of temperature to exceed 55°C, discontinue the charge operation temporarily, or reduce the charge current.

## 6) INSTRUCTION

### (1) Unpacking

Electric traction storage batteries (herein after refer to as “batteries”) are delivered to customers in dry-charged condition. At unpacking, check whether the batteries and accessories have been damaged. If there are observed defects, you should notify the condition to our branch office or agent. Never remove the sealing plug until the battery is put into service.

## 3) MAINTENANCE INSTRUCTION

### (1) Inspection

#### ① Rotor assembly inspection

Rotor should always be cleaned with compressed air.

If the dirt will not come off lightly wipe off with piece of cotton or soft cloth wetted with gasoline.

Rotor out diameter : ø 123.1 ± 0.05

Tool : Vernier calipers and standard tool

18BR9EL41

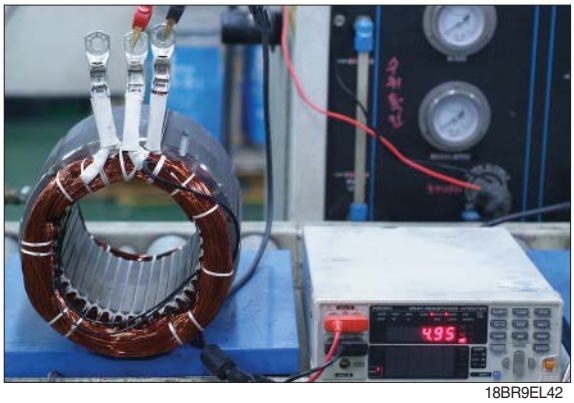
#### ② Stator assembly inspection

Stator should always be cleaned with compressed air.

If the dirt will not come off lightly wipe off with piece of cotton or soft cloth wetted with gasoline, using care not to damage the coil insulation.

Use mmΩ tester and check for two power line of stator repeatedly (U-V, V-W, W-U).

At that time resistance is around 3.3 mmΩ.

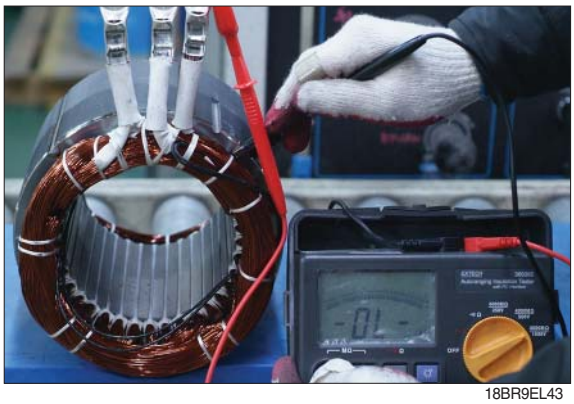


18BR9EL42

Insulation test

Use insulation tester (1000 Vac, Min. 10 MΩ) and measure as a picture.

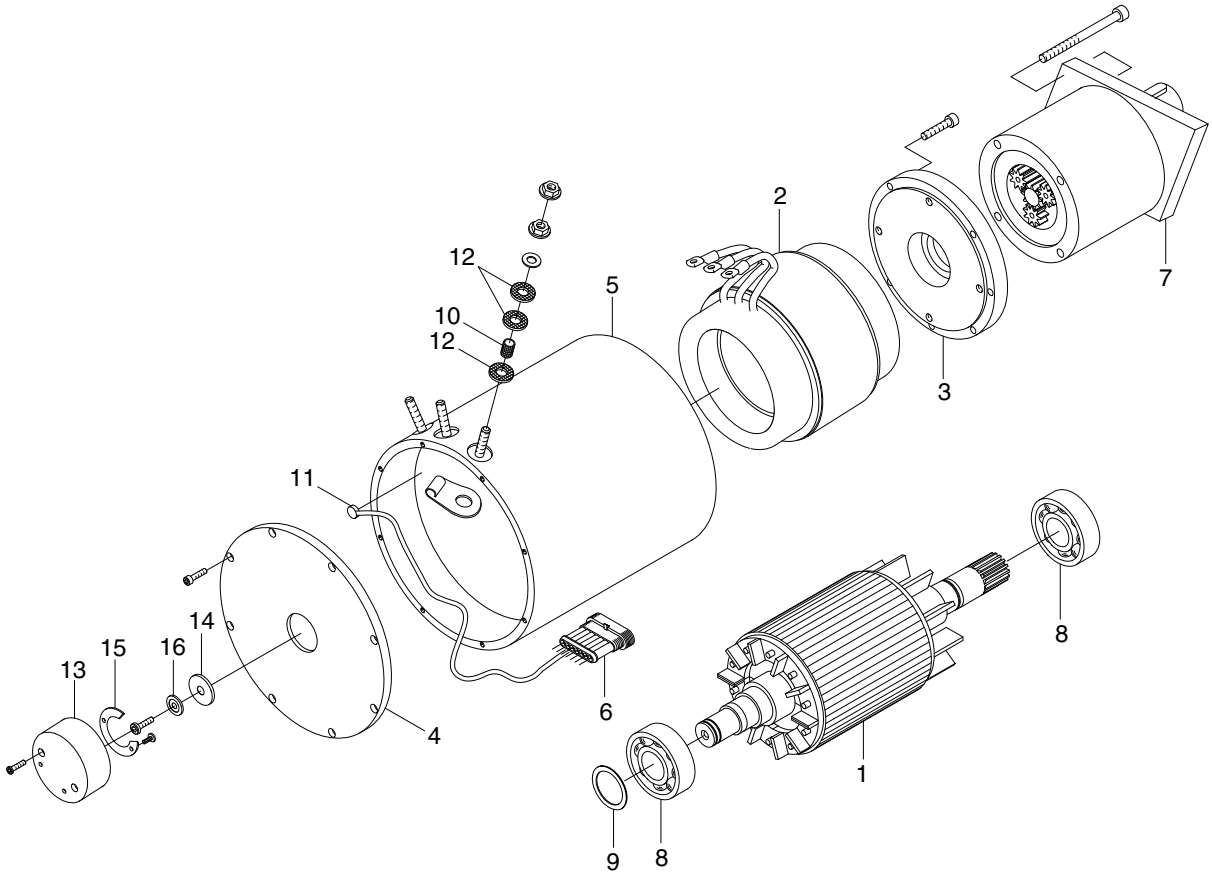
If the insulation is defective, replace with new parts.



18BR9EL43

## 5. EPS MOTOR

### 1) STRUCTURE




BRJ7EL08

| | | | | | |
|---|---|---|---|---|---|
| 1 | Rotor | 9 | Screw | 17 | Screw |
| 2 | Stator | 10 | Screw | 18 | Washer |
| 3 | Flange | 11 | Thickness ring | 19 | Bakelite washer |
| 4 | Flange | 12 | Flange nut | 20 | Sensor support |
| 5 | Casing | 13 | Bakelite pipe | 21 | Magnet |
| 6 | Super seal | 14 | Thermal | 22 | Screw |
| 7 | Gear | 15 | Screw | 23 | Sensor card |
| 8 | Bearing | 16 | Grower | 24 | Magnet support |

⑧ **Set temperature**

- DIGITAL : A digital (ON/OFF) motor thermal sensor is connected to F6 (F12) input.
- ANALOG : An analog motor thermal sensor is connected to F6 (F12) (the curve can be customized on a customer request).
- NONE : No motor thermal sensor switch is connected.

⑨ **EPS**

- ON : If this option is set to ON, electric power steering function is used.
- OFF : If this option is set to OFF, electric power steering function isn't used.

⑩ **Display**

If this option is set to on the communication with the graphic display is enabled.

⑪ **S.R.O.**

If this option is set to on the static return to off is requested for starting the truck.
The required sequence is :
Foot switch - Brake switch - Joystick acceleration
If this option is set to off the required sequence to start the truck is :
Brake switch - Joystick Acceleration

⑫ **Pedal type (not being used)**

- OPTION #1 : The pedal position is sent to the display for graphic indication.
- OPTION #2 : The speed set-point is sent to the display for graphic indication.

⑬ **Pedal brake stop**

If set to on the truck is stopped when the pedal brake is pressed.
If set to off the traction current is reduced to the half of the maximum current.

⑭ **Model selection**

There are 3 options, 15/20/23.
In case of BRP-9 truck, it has to be selected 15, 20, 23 (15BRP-9 → 15, 18/20BRP-9 → 20, 23BRP-9 → 23).

⑮ **BRP 9**

- ON : Entire parameters of the controller is adjusted to be used on BRP-9 trucks.
- ON : Entire parameters of the controller is adjusted to be used on BRP-7 trucks.

※ Adjusted parameters are supposed to be effective after recycle of key.

⑯ **Lift limit**

If the mast is lifted higher than free cylinder phase, traction speed reduction is working depends on the setting status of this function.

- ON : If set to on this function, traction speed control is performed.
- OFF : If set to off this function, traction speed control isn't performed.

※ Input of lift limit is E13 of pump controller.
※ To set the traction speed of lift limit, read
Traction → Parameter change → Lift limit CTB

### (2) Submenu "ADJUSTMENTS"

① **Set battery type**

It selects the nominal battery voltage. (nominal voltage of BRP-9 is 36V)

② **Adjust battery**

Fine adjustment of the battery voltage measured by the controller.
Please increase or decrease the value 1 by 1 and check the voltage.

### (3) Description of ALARMS menu (in display, Truck menu → Alarm history)

The microprocessor in the controller records the last five alarms that have occurred. Items remembered relative to each alarm are: the code of the alarm, the number of times the particular Alarm occurred, the hour meter count, and the inverter temperature.
This function permits a deeper diagnosis of problems as the recent history can now be accessed.
Flow chart showing how to use the ALARMS function via the digital console.
(Alarm history is also available in display → Truck menu)

Opening Zapi display.

Press ENTER to go into the general menu.

The display will show:

Press ROLL UP or ROLL DOWN button until PARAMETER CHANGE. appear on the display.

The display shows:

Press ENTER to go into the ALARMS function.

The display will show the most recent alarm.

Each press of the ROLL UP button brings up following alarms. Pressing ROLL DOWN returns to the most recent.

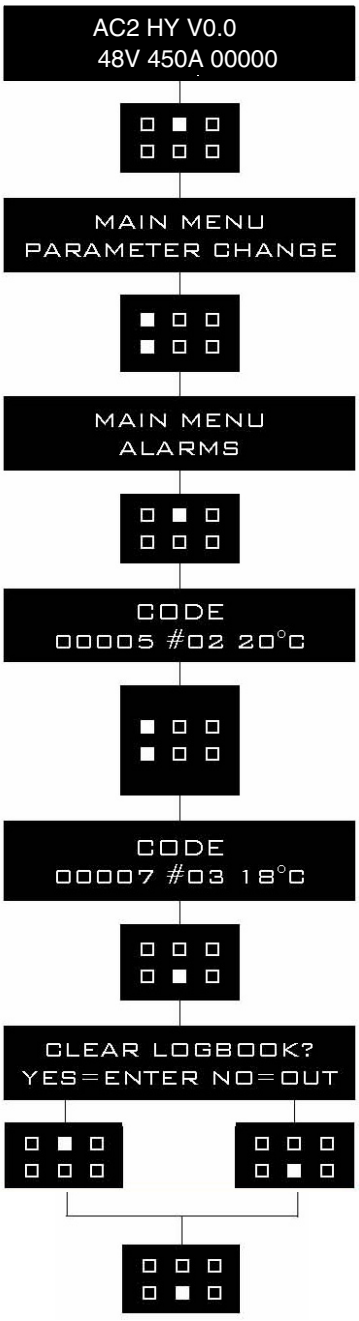
If an alarm has not occurred, the display will show: ALARM NULL.

When you have finished looking at the alarms, press OUT to exit the ALARMS menu.

The display will ask "CLEAR LOGBOOK?".

Press ENTER for yes, or OUT for NO.

Press OUT to return to the opening Zapi display.



## 4) FUNCTION CONFIGURATION

Using the config menu of the programming console (or using a display), the service engineer can configure the following functions.

### (1) Submenu "SET OPTIONS"

① **MICRO CHECK** (not to recommend to change)

This option is useful to support debug and troubleshooting. It makes possible to inhibit the supervisor (slave uC) operations and allows the system to run with just the main uC. When entering this operating mode the safety contacts stay open. Therefore, traction shall be disabled.

It can be set one of two:

PRESENT: Default setting: enable the operations of the supervisor (slave uC).

ABSENT: Disable the operations of the supervisor (slave uC). The safety contacts stay opened.

② **AUTOCENTERING** (not to recommend to change)

This option makes the automatic centering (AUTC) operation available. When it is set on, an automatic alignment of the steered wheel on the straight ahead toggle switch is always performed at key-on. When it is set off, the AUTC at key-on is still performed for any configuration but for the open loop (stepper motor at the steering wheel) without angle limitation. In this latest case, the centering must be manually executed. Besides, this option enables the AUTC on demand.

A centering request is required in this case to get the AUTC on-demand really performed.

③ **RECOVERY AT REST** (not to recommend to change)

(Stepper motor version only).This option enables the function "alignment at the rest position"

It consists of the following steps:

- When releasing the stepper motor, the SW records the steered wheel angle.
- Then it is expected the steered wheel angle does not change meanwhile travelling with a released stepper motor.
- If the steered wheel angle changes more than 8 degrees, the system automatically turns back to the recorded position If the driver moves the stepper motor meanwhile an alignment at the rest position is in progress, the alignment will be aborted.

④ **DIAG MOTOR TEMP** (not to recommend to change)

This option enables the diagnosis of the motor temperature. When it is set on and the motor temperature overtakes 150° , a MOTOR TEMPERAT alarm occurs.

The KTY84-130 motor thermal sensor must be connected between CNB#3 and a minus battery (CNA#13).

⑤ **TRUCK TYPE**

This option sets the truck type.

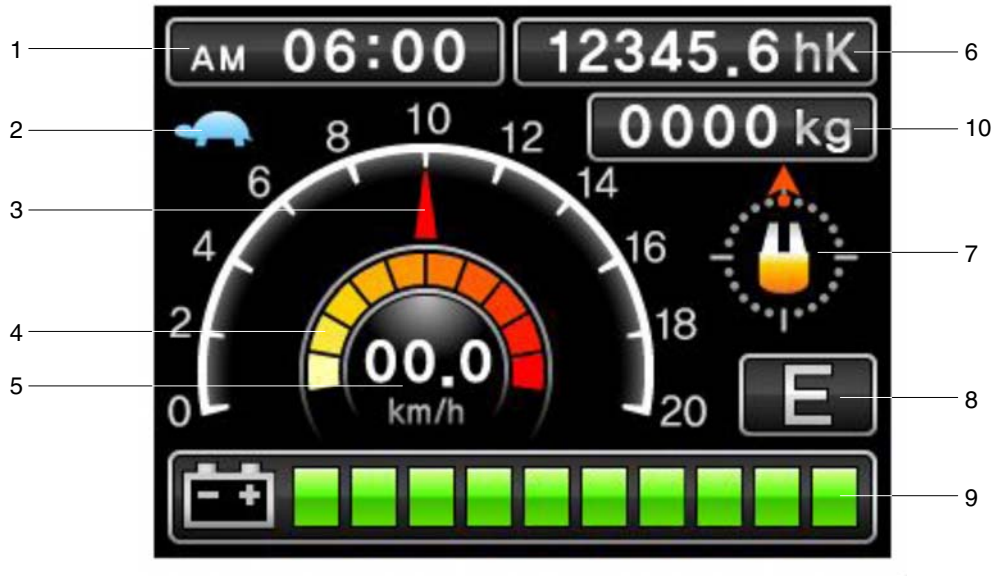
- Option #1 : 14/16/20/25BRJ-7
- Option #2 : 10/13BOP-7
- Option #3 : 15/18/20/23BRP-7
- Option #4 : 14/16/20/25BRJ-9
- Option #5 : 15/18/20/23BRP-9

This parameter is supposed to be "Option #5" in BRP-9 trucks always if you replace the EPS controller, first thing the service engineer has to is setting this parameter correctly, then recycling the key twice.

### 4) Description of connectors

| No. of pin | Function | Description |
|---|---|---|
| A1 | PCLRXD | Serial communication interface |
| A2 | NCLRXD | Serial communication interface |
| A3 | PCLTXD | Serial communication interface |
| A4 | NCLTXD | Serial communication interface |
| A5 | GND | Negative supply. |
| A6 | +12 | +12V supply. |
| A7 | - | |
| A8 | - | |
| B1 | +KEY | Mhyrio CB positive power supply |
| B2 | PAUX | Input of valves positive power supply |
| B3 | -BATT | Mhyrio CB negative supply |
| B4 | CAN_L | CAN low signal in |
| B9 | CAN_T | CAN termination : connect to CANH_OUT (B14) to insert a 120 ohm termination resistance |
| B10 | PPO_S | Positive supply of analog devices (+12 V) (Joystick, CAN encoder) |
| B13 | CAN_H | Can high signal in |
| B14 | CANH_OUT | Can high signal out (should be connected to B9) |
| C1 | NEVP1 | Negative of the proportional electro valve lift up. |
| C2 | PEVP1/2 | Positive of the proportional electro valves lowering. |
| C3 | NEVP2 | Negative of the proportional electro valve lift up. |
| C4 | NEVP3 | Negative of the proportional electro valve attach-B. (common proportional valve-B for reach out, tilt down, side shift left) |
| C5 | PEVP3/4 | Positive of the proportional electro valves attach-A, attach-B |
| C6 | NEVP4 | Negative of the proportional electro valve attach-A. (common propotional valve-A for reach in, tilt up, side shift right) |
| C9 | NEV1 | Negative of reach ON/OFF valve. |
| C10 | NEV2 | Negative of tilt ON/OFF valve. |
| C11 | NEV3 | Negative of side shift ON/OFF valve. |
| C12 | NEVP7 | Negative of the fan relay. |
| C13 | PEVP7/8 | Positive of the fan relay. |
| C16 | PEV1 | Positive of reach ON/OFF valve. |
| C17 | PEV2 | Positive of tilt ON/OFF valve. |
| C18 | PEV3 | Positive of side shift ON/OFF valve. |
| C23 | -BATT | Mhyrio CB negative supply |

4) LCD FUNCTION

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| | | | |
|---|---|---|---|
| 1 | Current time | 6 | Hour meter |
| 2 | Turtle mode | 7 | Wheel position and running direction |
| 3 | Truck speed pointer | 8 | Power mode |
| 4 | Speed level | 9 | BDI (Battery Discharge Indicator) |
| 5 | Truck speed | 10 | Load weight (option) |

(1) Current time

The number shows the current time according to the setting, which can be changed by display setting at page 7-78.

(2) Turtle mode

The turtle symbol is normally off. When this symbol appears, the turtle mode is activated regardless of the power mode of the truck to reduce the maximum speed to the set-point. This mode can be activated by pressing the button.

(3) Truck speed pointer

The speed of the truck is indicated with a pointer.

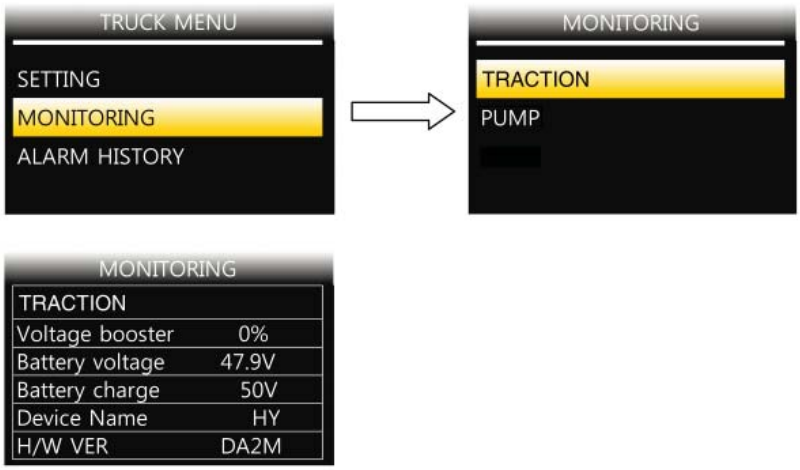
(4) Speed level

It indicates the speed level by 2 km.

(5) Truck speed

The truck speed is shown in number. The unit can be km/h or mph according to the display setting (see 7-78 page).

### (2) Monitoring




20BC9EL43

**In MONITORING MENU, service man can check various stats of trucks.**

① TRACTION

Refer to 6-6)-(1) “Traction controller” (page 7-47)

② PUMP

Refer to 6-6)-(2) “Pump controller” (page 7-48)

③ EPS

Refer to 7-6) “EPS controller” (page 7-61)

④ FINGER TIP

Refer to 8-7) “FINGER TIP controller” (page 7-71)

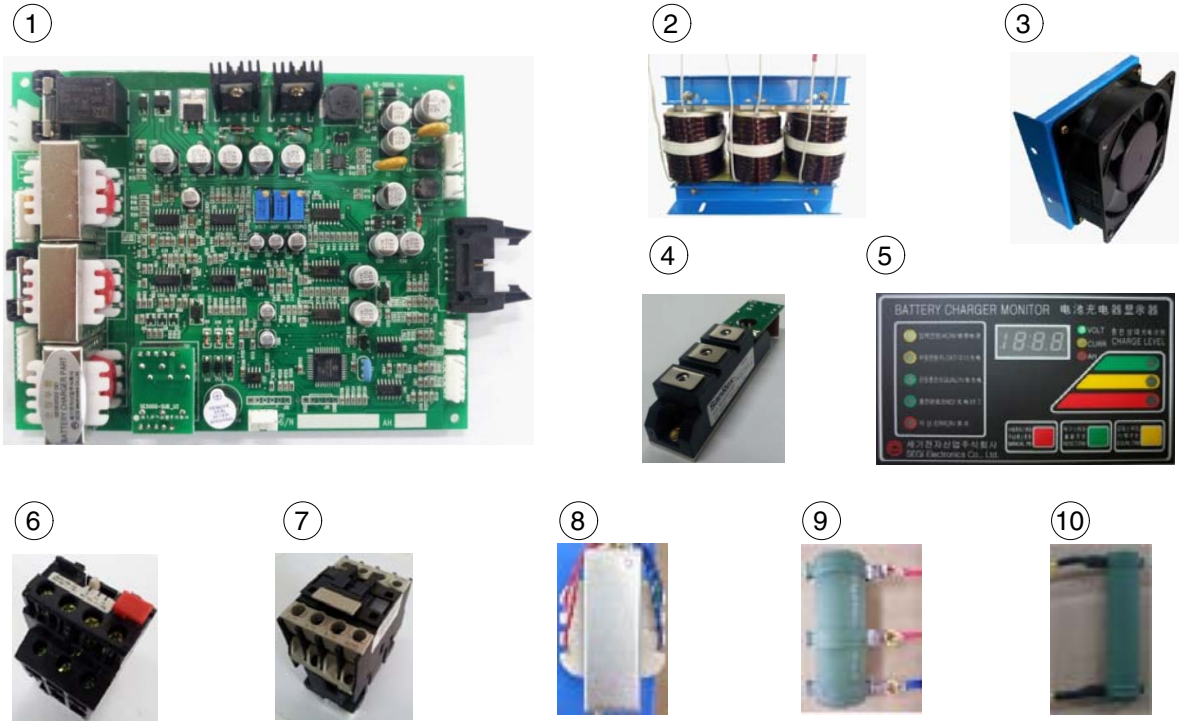
### (3) Alarm history

Refer to 9-7) “ALARM & ALARM HISTORY” (page 7-82)

| Code | Hex | Alarm | Traction (T) | Pump (P) | Mhyrio (V) | EPS (E) | Description |
|---|---|---|---|---|---|---|---|
| 71 | 47 | POWER FAILURE #3 | | | | ○ | This alarm occurs when the current in the phase V of the motor is zero and the motor is commanded for moving.<br>Check the power fuse is OK. Check the battery positive arrives to the controller. Check the continuity of the wire in the phase V of the motor. Otherwise it is necessary to replace the controller. |
| 72 | 48 | POWER FAILURE #2 | | | | ○ | This alarm occurs when the current in the phase U of the motor is zero and the motor is commanded for moving.<br>Check the power fuse is OK. Check the battery positive arrives to the controller. Check the continuity of the wire in the phase U of the motor. Otherwise it is necessary to replace the controller. |
| 73 | 49 | POWER FAILURE #1 | | | | ○ | This alarm occurs when the current in the phase W of the motor is zero and the motor is commanded for moving. Check the power fuse is OK. Check the battery positive arrives to the controller. Check the continuity of the wire in the phase W of the motor. Otherwise it is necessary to replace the controller. |
| 74 | 4A | DRIVER SHORTED | ○ | ○ | | | When the key is switched ON, the uP checks that the MC coil driver is not shorted; if it is, this alarm is signalled; replace the logic board.<br>1) Check the components & wires & connectors attached to PWM output of the controller.<br>Traction<br>F2-F8 : Main contactor & diode<br>F3-F9 : Electrical parking coil<br>Pump<br>F2-F8 : Back buzzer relay<br>F3-F9 : Horn relay<br>2) If they are all fine, replace the controller. |
| 75 | 4B | CONTACTOR DRIVER | ○ | ○ | | | When the initial diagnosis is finished, the traction logic closes the MC and checks the voltage on the drain of the driver. If this is not low, an alarm is signalled. Replace the logic.<br>1) Check the components & wires & connectors attached to PWM output the controller.<br>Traction<br>F2-F8 : Main contactor & diode<br>F3-F9 : Electrical parking coil<br>Pump<br>F2-F8 : Back buzzer relay<br>F3-F9 : Horn relay<br>2) If they are all fine, replace the controller. |

| Code | Hex | Alarm | Traction (T) | Pump (P) | Mhyrio (V) | EPS (E) | Description |
|---|---|---|---|---|---|---|---|
| 241 | F1 | DATA ACQUISITION | ○ | ○ | | | This alarm is signalled in the current gain acquisition phase.<br>Wait the end of the acquisition activity. |
| | | CAN BUS KO | | | ○ | | There is a problem related to the CAN-BUS line.<br>The error is signalled if the MHYRIO controller does not receive any message from the CAN-BUS line.<br>First of all, check the wiring. If it is ok, the problem is on the logic board, which must be replaced.<br><br>Difference between CAN BUS KO & No CAN MSG N<br>* CAN BUS KO : a specific controller can not receive any message from CAN BUS line, which means entier CAN BUS line is out of functions, unless the controller's internal circuits related to CAN BUS line is out of control.<br>1) Check the entire CAN BUS line is fine (measeure the can resistance of 60 ohm between CAN High & Low lines while it is properly connected to controllers, simply by stripping little bit on surface of wires).<br>2) If CAN lines & connections are fine, replace the controller. (you can always check the soundness of each controller's CAN communication, simply by checking each controller's "SW Ver" & varing values (attached to the controller), as you operate any devices attached to the controller, in display's monitoring menu).<br><br>* No CAN MSG : a controller receive can massages well from other controller except a specific controller which is probably a cause of problem.<br>The specific troubled controller can be found easily in monitoring menu.<br>(you can always check the soundness of each controller's CAN communication, simply by checking each controller's "SW Ver" & varing values (attached to the controller), as you operate any devices attached to the controller, in display's monitoring menu).<br>1) Find a troubled controller in monitoring (tester) Menu.<br>2) Check the entire CAN BUS Line connected to the troubled controller.<br>3) Check if there is any alarm in the troubled controller (sometimes when a seriou alarm happens, CAN communication is not working).<br>4) If any wires or connections are fine, replace the controller. |
| | | ENCODER ERROR | | | | ○ | It occurs when encoder control is set ON and the real frequency does not pursuit the commanded frequency. This condition is several times due to either, a mismatching between the encoder resolution used in the SW and the real encoder resolution, or a wrong connection between the two encoder channels. In this latest case swap the channels of the encoder (CNB#8 with CNB#7). |

## (3) Names of each part (independent items)

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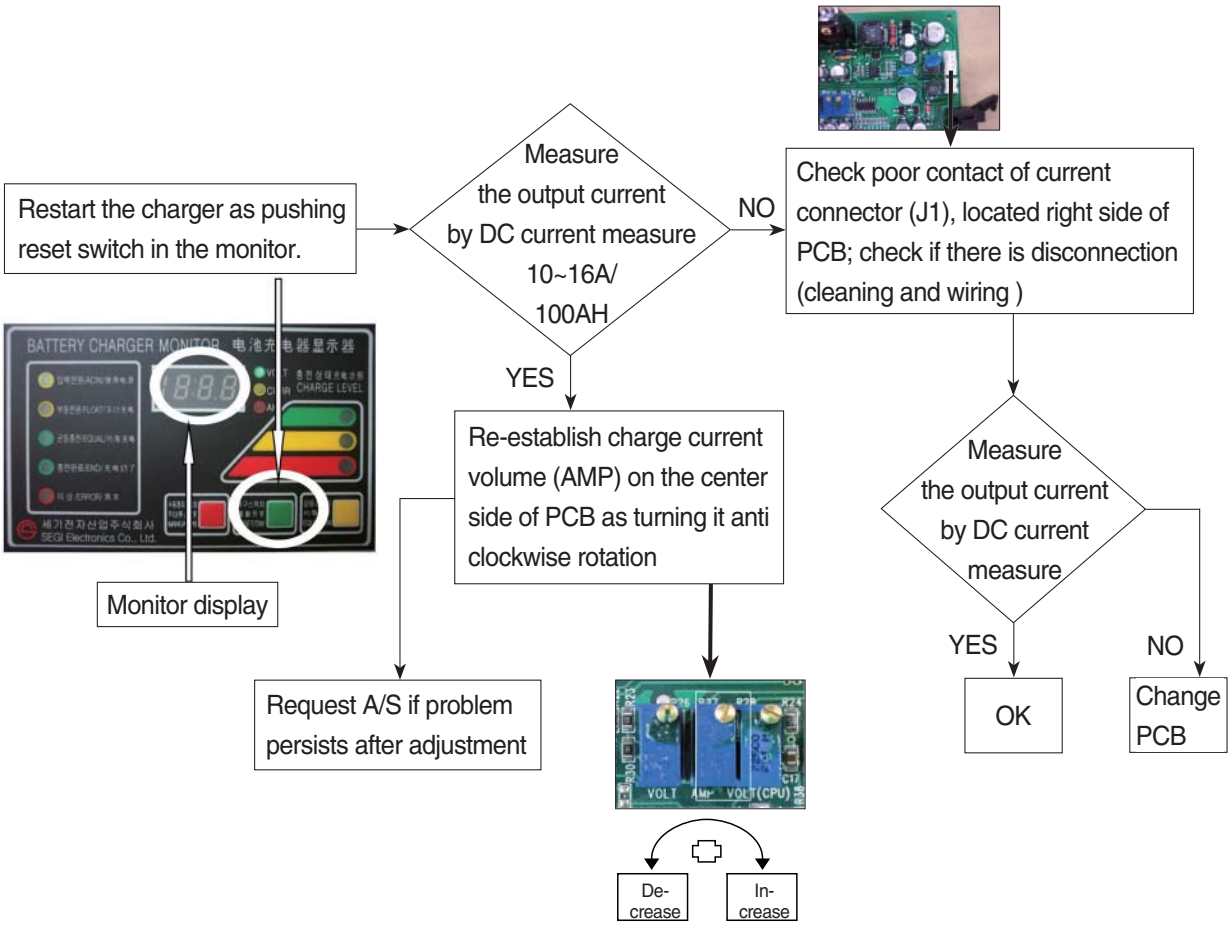
| | | | | | |
|---|---|---|---|---|---|
| 1 | Main PCB board | 5 | Monitor PCB | 9 | Resistance (RD) |
| 2 | Main trans (Class H) | 6 | Overload | 10 | Resistance (DR) |
| 3 | Cooling fan | 7 | MG S/W | | |
| 4 | SCR module | 8 | Assistant trans | | |

④ Charger TRIP is occurred after abnormality lamp is on.
After opening the cover which is located on the front bottom side of the charger.
In case error code is "O.C" → Output over current, established as 110~120% of the rated current.



# GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

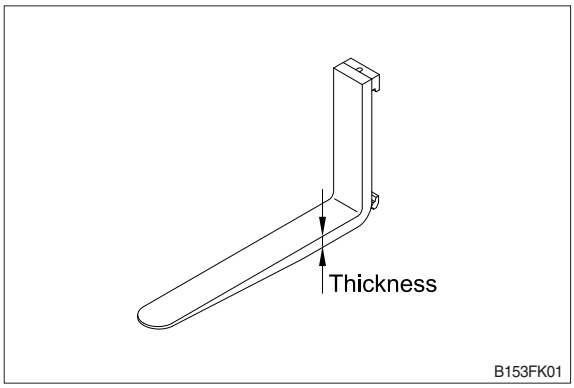
## 1. OPERATIONAL CHECKS

### 1) FORKS

(1) Measure thickness of root of forks and check that it is more than specified value.
EX : $l$ =1050 mm (41.3 in)

mm (in)

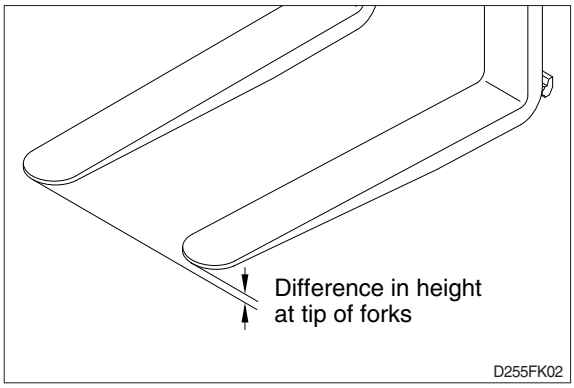
| STD Fork assy | Applicable model | Standard | Limit |
|---|---|---|---|
| 64HM-11060 | 15/18BRP-9 | 40 (1.6) | 36 (1.4) |
| 64HN-21040 | 20/23BRP-9 | 45 (1.8) | 40 (1.6) |




(2) Set forks in middle and measure difference in height at tip of forks.

mm

| Model | Fork length | Height difference |
|---|---|---|
| 15/18/20/23BRP-9 | equal or below 1500 | 3 |
| | above 1500 | 4 |




(3) Most force is concentrated at root of fork and at hook, so use crack detection method to check cracks.

## 2. MAST

1) Check for cracks at mast stay, tilt cylinder bracket, guide bar, fork carriage and roller shaft weld. Check visually or use crack detection method. Repair any abnormality.
2) Set mast vertical, raise forks about 10 cm from ground and check front-to-rear clearance and left-to-right clearance between inner mast and fork carriage, and between outer mast and inner mast. Use these figures to judge if there is any play at roller or rail.
   - Front-to-rear clearance : Within 2.0 mm (0.08 in)
   - Left-to-right clearance : Within 2.5 mm (0.10 in)
3) Check that there is an oil groove in bushing at mast support.
4) Set mast vertical, raise forks about 10 cm from ground, and push center of lift chain with finger to check for difference in tension.
   If there is any difference in tension, adjust chain stopper bolt.
5) Check visually for abnormalities at thread of chain anchor bolt, and at contact surface between chain wheel and chain.
   Rotate chain wheel by hand and check for any play of bearing.

② Rust and corrosion

Chains used on lift trucks are highly stressed precision components. It is very important that the "as-manufactured" ultimate strength and fatigue strength be maintained throughout the chain service life. Corrosion will cause a major reduction in the load-carrying capacity of lift chain or roller chain because corrosion causes side plate cracking.

③ Cracked plate

The most common cause of plate cracking is fatigue failure. Fatigue is a penomenon that affects most metals and many plastics. After many repeated heavy loads, the plates may crack and the chains will eventually break. Fatigue cracks are almost always found through the pitch holes perpendicular to the pitch line. Contrast this failure mode to the random failures caused by stress-corrosion cracking. If cracks are present, replace all the chain on the truck. Noise in the chain indicates that the plate is on the verge of cracking and will be failed before long.

④ Tight joints

All joints in lift chain should flex freely. Tight joints resist flexure, increase internal friction, thus increasing chain tension required to lift a given load. Increased tension accelerates wear and fatigue problems.

Tight joints in lift chains can be caused by :

- Bent pins or plates.
- Rusty joints.
- Peened plate edges.

Oil rusty chains and replace chains with bent or peened components.

⑤ Protruding or turned pins

Heavily loaded chains operating with lube generate tremendous friction between pins and plates. In extreme cases, the frictional torque in the joint can actually turn pins in the press-fit outside plates. If chain is allowed to operate in this condition, the pins slowly work out of the chain causing chain failure. Turned pins can be quickly spotted because the flats on the V heads are no longer in line. Chains with turned or protruding pins should be replaced immediately. Do not attempt to repair the chain by driving pins back into the chain.

⑥ Chain side wear

A wear pattern on pin heads and outside plates indicates misalignment. This condition damages chain and sheaves as well as increasing internal friction in the chain system.

⑦ Chain anchors and chain wheel bearings

An inspection of the chain system includes a close examination of chain anchors and chain wheel bearings. Check chain anchors for wear, breakage and misalignment.

Anchors with worn or broken fingers should be replaced. Anchors should be adjusted to eliminate twisting or other misalignment in the chain. When chain is misaligned, load is not distributed uniformly between the plates. Prolonged operation will result in premature fatigue failure. Chain wheel bearings with badly worn flanges and outside diameter should be replaced. Heavy flange wear indicates chain misalignment.

## APPENDIX #3 : DESCRITION AND SETTING FOR THE AUSTRALIA OPTION

### 1. DESCRITION

This option limits the travel speed to 3 km/h when the mast is risen above the operation range of the free cylinder.

### 2. COMPONENTS INSTALLATION

Refer to the page A-25 for the components installation.

### 3. PARAMETER SETTING

1) Display the lift limit parameter of the traction controller as below.
   Truck Menu -> Settings -> Traction -> Set Options -> Lift Limit : Off -> ON
2) Adjust the speed to the lift limit CTB (default 33 Hz) if the speed reduction is above or below 3 km/h.
   Truck Menu -> Settings -> Traction -> Parameter Change -> Lift Limit CTB
3) If this function is not operated normally, check the limit switch operation by below parameter.
   Truck Menu -> Monitoring -> Pump -> Cutback Switch (reduction : ON)

## 4. 15BRP-9 D TYPE BATTERY

### · 34 inch outrigger

| Mast | Load capacity (kg) | Warning weight (kg, 110%) |
|---|---|---|
| TF500 | 1361 | 1497 |
| TF530 | 1361 | 1497 |
| TF610 | 1361 | 1497 |
| TF685 | 1361 | 1497 |
| TF760 | 1111 | 1222 |
| TF815 | 612 | 673 |

### · 36 inch outrigger

| Mast | Load capacity (kg) | Warning weight (kg, 110%) |
|---|---|---|
| TF500 | 1361 | 1497 |
| TF530 | 1361 | 1497 |
| TF610 | 1361 | 1497 |
| TF685 | 1361 | 1497 |
| TF760 | 1315 | 1447 |
| TF815 | 748 | 823 |

### · 38 inch outrigger

| Mast | Load capacity (kg) | Warning weight (kg, 110%) |
|---|---|---|
| TF500 | 1361 | 1497 |
| TF530 | 1361 | 1497 |
| TF610 | 1361 | 1497 |
| TF685 | 1361 | 1497 |
| TF760 | 1361 | 1497 |
| TF815 | 907 | 998 |

### · 40 inch outrigger

| Mast | Load capacity (kg) | Warning weight (kg, 110%) |
|---|---|---|
| TF500 | 1361 | 1497 |
| TF530 | 1361 | 1497 |
| TF610 | 1361 | 1497 |
| TF685 | 1361 | 1497 |
| TF760 | 1361 | 1497 |
| TF815 | 1111 | 1222 |
| TF865 | 839 | 923 |

### · 42 inch outrigger

| Mast | Load capacity (kg) | Warning weight (kg, 110%) |
|---|---|---|
| TF500 | 1361 | 1497 |
| TF530 | 1361 | 1497 |
| TF610 | 1361 | 1497 |
| TF685 | 1361 | 1497 |
| TF760 | 1361 | 1497 |
| TF815 | 1315 | 1447 |
| TF865 | 998 | 1098 |
| TF930 | 590 | 649 |

### · 44 inch outrigger

| Mast | Load capacity (kg) | Warning weight (kg, 110%) |
|---|---|---|
| TF500 | 1361 | 1497 |
| TF530 | 1361 | 1497 |
| TF610 | 1361 | 1497 |
| TF685 | 1361 | 1497 |
| TF760 | 1361 | 1497 |
| TF815 | 1361 | 1497 |
| TF865 | 1202 | 1322 |
| TF930 | 748 | 823 |
| TF1010 | 340 | 374 |

### · 46 inch outrigger

| Mast | Load capacity (kg) | Warning weight (kg, 110%) |
|---|---|---|
| TF500 | 1361 | 1497 |
| TF530 | 1361 | 1497 |
| TF610 | 1361 | 1497 |
| TF685 | 1361 | 1497 |
| TF760 | 1361 | 1497 |
| TF815 | 1361 | 1497 |
| TF865 | 1361 | 1497 |
| TF930 | 907 | 998 |
| TF1010 | 476 | 524 |

### · 48 inch outrigger

| Mast | Load capacity (kg) | Warning weight (kg, 110%) |
|---|---|---|
| TF500 | 1361 | 1497 |
| TF530 | 1361 | 1497 |
| TF610 | 1361 | 1497 |
| TF685 | 1361 | 1497 |
| TF760 | 1361 | 1497 |
| TF815 | 1361 | 1497 |
| TF865 | 1361 | 1497 |
| TF930 | 1066 | 1173 |
| TF1010 | 590 | 649 |

### · 50 inch outrigger

| Mast | Load capacity (kg) | Warning weight (kg, 110%) |
|---|---|---|
| TF500 | 1361 | 1497 |
| TF530 | 1361 | 1497 |
| TF610 | 1361 | 1497 |
| TF685 | 1361 | 1497 |
| TF760 | 1361 | 1497 |
| TF815 | 1361 | 1497 |
| TF865 | 1361 | 1497 |
| TF930 | 1293 | 1422 |
| TF1010 | 726 | 799 |