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MEGA-LHY

Instruction book

674426-GB-98/5



EU Declaration of Conformity

Manufacturer,

HARDI INTERNATIONAL A/S
Helgeshøj Allé
DK 2630 Taastrup
DENMARK

Importer,

declare that the following product;

.....
.....

Adhere extra shipping package labels to inside cover.

A. was manufactured in conformity with the provisions in the COUNCIL DIRECTIVE of 14 June 1989 on mutual approximation of the laws of the Member States on the safety of machines (89/392/EEC as amended by directives 91/368/EEC and 93/368/EEC) with special reference to Annex 1 of the Directive on essential safety and health requirements in relation to the construction and manufacture of machines.

B. was manufactured in conformity with the standards current at that time that implements a harmonised standard in accordance with Article 5 (2) and other relevant standards.

Taastrup 25.5.98

Erik Holst
Managing Director
HARDI INTERNATIONAL A/S

Operator safety

Watch for this symbol . It means WARNING, CAUTION, NOTE. Your safety is involved so be alert!

Note the following recommended precautions and safe operating practices.

-  Read and understand this instruction book before using the equipment. It is equally important that other operators of this equipment read and understand this book.
-  Local law may demand that the operator be certified to use spray equipment. Adhere to the law.
-  Pressure test with clean water prior to filling with chemicals.
-  Wear protective clothing.
-  Rinse and wash equipment after use and before servicing.
-  Depressurize equipment after use and before servicing.
-  Never service or repair the equipment whilst it is operating.
-  Disconnect electrical power before servicing.
-  Always replace all safety devices or shields immediately after servicing.
-  If an arc welder is used on the equipment or anything connected to the equipment, disconnect power leads before welding. Remove all inflammable or explosive material from the area.
-  Do not eat, drink or smoke whilst spraying or working with contaminated equipment.
-  Wash and change clothes after spraying.
-  Wash tools if they have become contaminated.
-  In case of poisoning, seek doctor or ambulance. Remember to identify chemicals used.
-  Keep children away from the equipment.
-  Do not attempt to enter the tank.
-  Do not go under any part of the sprayer unless it is secured. The boom is secure when placed in the transport brackets.
-  Do not use the step unless the sprayer is connected to the tractor or the sprayer is correctly placed on a hard, flat surface.
-  If any portion of this instruction book remains unclear after reading it, contact your HARDI dealer for further explanation before using the equipment.





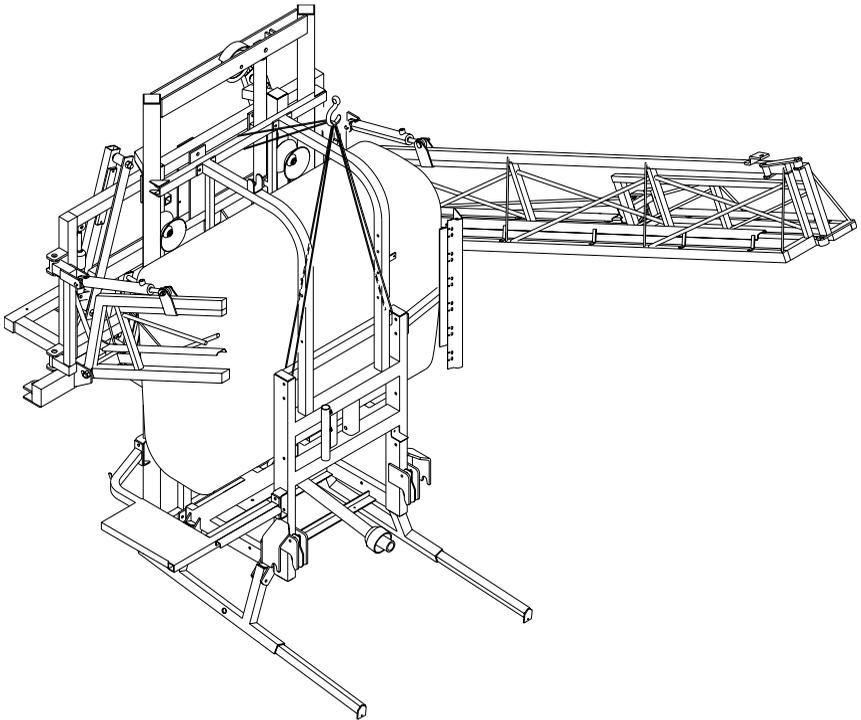
We congratulate you for choosing a HARDI plant protection product. The reliability and efficiency of this product depend on your care. The first step is to carefully **read and pay attention** to this instruction book. It contains essential information for the efficient use and long life of this quality product.

As the instruction book covers all MEGA models with hydraulic LHY booms (ME-LHY), please pay attention to the paragraphs dealing with precisely your model. This book is to be read in conjunction with the "Spray Technique" book.



Lifting points

When loading or unloading the sprayer from a truck or lorry with a crane, use the lifting points as shown.



Description

The HARDI MEGA (ME-LHY) sprayers are for the application of crop protection chemicals and liquid fertilizers. They consist of a pump, ME type frame with tank of 800, 1000 or 1200 litre capacity, BK or EC operating unit, Self-Cleaning Filter, transmission shaft and LHY type boom. Options include the HARDI MANIFOLD SYSTEM valves, Rinsing tanks and In-Line Filters.

The design of the diaphragm pump is simple, with easily accessible diaphragms and valves that ensures liquid does not contact the vital parts of the pump.

The tank, made of impact-proof and chemical resistant polyethylene, has a purposeful design with no sharp corners, for easy cleaning. A large, easy to read tank contents indicator is placed in front of the tank. The filling hole is placed at the right hand side of the sprayer for easy access.

The BK operating unit consists of; pressure agitator valve, safety valve, main ON/OFF valve, pressure filter with pressure gauge, distribution valves with pressure equalization and HARDI-MATIC pressure control valve.

The BK/EC and EC (Electric Control) operating unit consists of; pressure agitator valve, main ON/OFF valve, pressure control valve with HARDI-MATIC, pressure gauge, distribution valves with pressure equalization and control box.

HARDI-MATIC ensures a constant volume per hectare of the liquid (l/ha) at varying speed in the same gear when the number of P.T.O. revolutions are between 300-600 r/min.

The left hand side of the sprayer is equipped with the basic connections for the HARDI MANIFOLD SYSTEM. It is wise to utilize the MANIFOLD SYSTEM in combination with a number of optional extras as this makes the operation of the sprayer more safe and simple.

With the Self-Cleaning Filter the impurities that exist in the spray liquid will by-pass the filter and be recirculated back to the tank via the return flow.

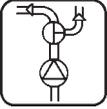
The LHY spray boom is equipped with 4 hydraulic rams. The raising/lowering and folding/unfolding functions are done via the tractor hydraulics. The frame and boom are connected by a spring suspended trapeze suspension which stabilizes boom when driving on uneven ground. The outer sections incorporate a double-action breakaway.





Identification plates

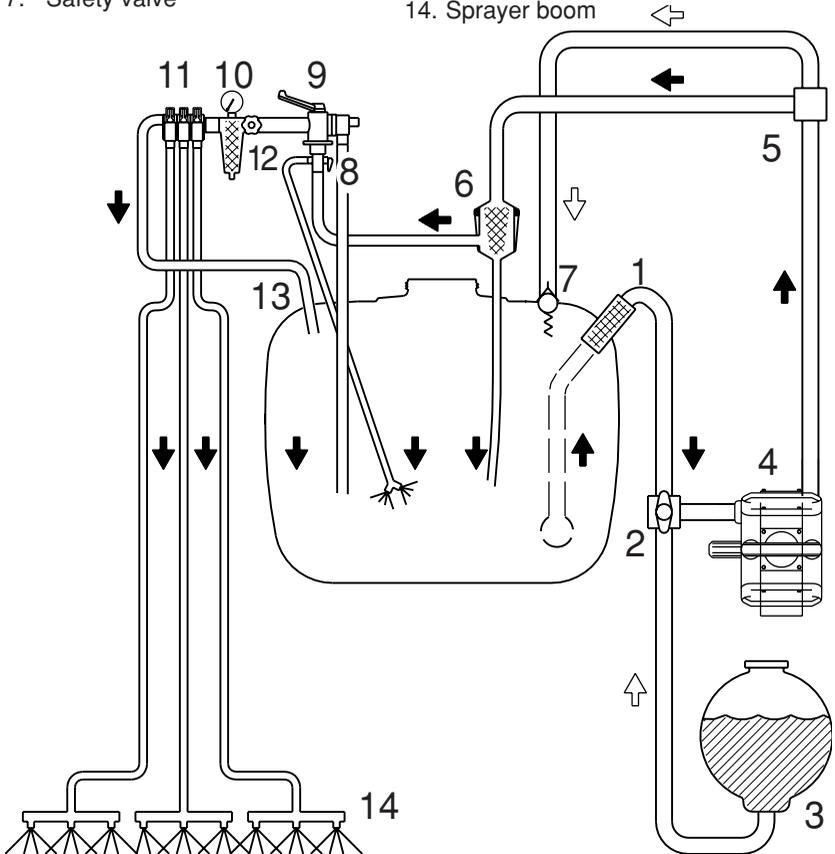
An identification plate fitted on the frame and pump is to indicate model, serial number and country of origin. Boom centre frame, and inner/outer sections also have identification plates indicating boom type and part no. of steel parts. If ordering spare parts, inform your dealer of these so the right model and version are described.



Function diagram

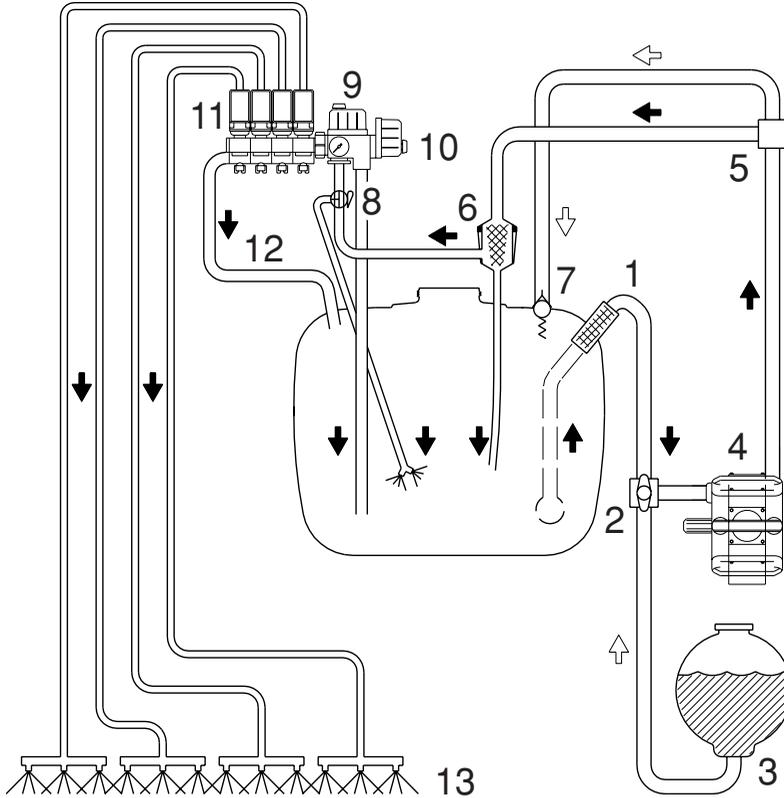
BK operating unit

1. Suction filter
2. Suction manifold
3. Rinsing tank (if fitted)
4. Pump
5. Pressure manifold
6. Self-Cleaning Filter
7. Safety valve
8. Pressure agitator valve
9. Main ON/OFF valve
10. Pressure filter with pressure gauge
11. Distribution valves with pressure equalization
12. Pressure control valve with HARDI-MATIC
13. Return to tank
14. Sprayer boom



EC operating unit

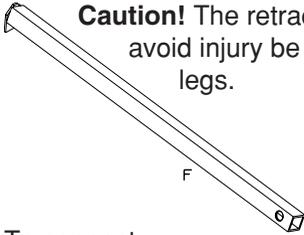
1. Suction filter
2. Suction manifold
3. Rinsing tank (if fitted)
4. Pump
5. Pressure manifold
6. Self-Cleaning Filter
7. Safety valve
8. Pressure agitator valve
9. Main ON/OFF valve with pressure gauge
10. Pressure control valve with HARDI-MATIC
11. Distribution valves with pressure equalization
12. Return to tank
13. Sprayer boom



Connecting the sprayer

The sprayer is designed for three point suspension and is equipped with semi automatic hitch for the tractor lift arms (28 mm pivots, cat. II). The frame has retractable support legs that can be folded up to minimize crop damage.

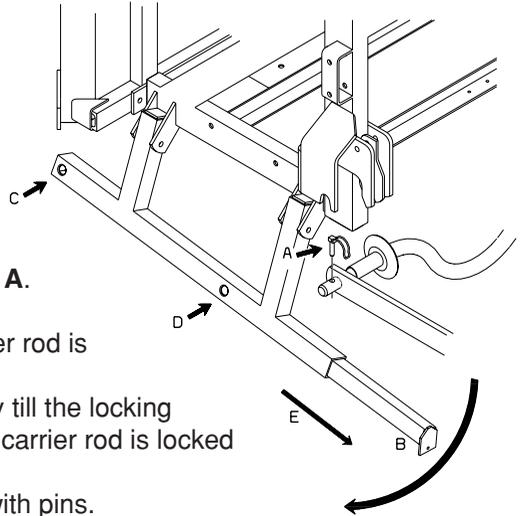




Caution! The retractable support legs are spring-loaded - to avoid injury be careful during folding/unfolding of the support legs.

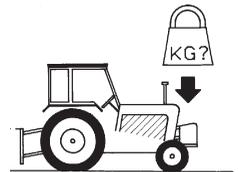
To connect the sprayer proceed as follows:

1. Fit carrier rod in tractor lift arms and secure with 10 mm pins **A**.
2. Lower tractor lift arms
3. Reverse tractor till carrier rod is under the sprayer hitch.
4. Lift the lift arms carefully till the locking devices “clicks” and the carrier rod is locked to the sprayer frame.
5. Fit the top bar, secure with pins.
6. Lift the sprayer, retract the support legs, and fold them up.
7. Position the tractor lift so the boom can be lowered to 45-50 cm in lowest position, and adjust top bar until the gantry is perpendicular to the ground.



WARNING: Note the weight of the sprayer. General recommendations are as follows:

- Add ballast to front of tractor.
- Increase tyre pressure (see tractor instruction book).
- Be careful when filling/lifting the sprayer for the first time.
- Ensure the operating unit and tractor do not touch.
- Travel at slower speeds when driving with a full tank. (The tractor braking effect will be reduced.)



Disconnecting the sprayer.

To disconnect the sprayer, proceed as follows:

The retractable support legs must be folded down and extended before lowering and disconnecting the sprayer. Proceed as follows:

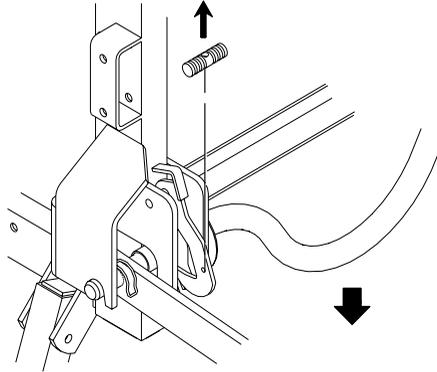
1. Swing support legs down.
2. Push the black button **C** in.
3. Extend the legs **B** until the black button clicks out in location hole **D**.

WARNING! Note correct location of support leg extensions!

When the boom is folded in **transport position** the support leg extensions must be placed and extended at the **front** of the sprayer **B**.

When the boom is unfolded in **working position** the support leg extensions must be placed and extended at the **back** of the sprayer **F**.

4. Lower the sprayer
5. Disconnect top bar, stop engine and disconnect PTO-shaft, hydraulics and electric cables.
6. Pull the string to disengage the semi automatic hitch locking devices and lower the lift arms fully.



Transmission shaft

Operator safety

To avoid accidents and personal injuries, note the following recommended precautions and safe operation practices.

Always STOP ENGINE before attaching the transmission shaft to tractor P.T.O. - most tractor P.T.O. shafts can be rotated by hand to facilitate spline alignment, when engine is stopped.

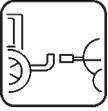
When attaching the shaft, make sure that the snap lock is FULLY ENGAGED - push and pull shaft until it locks.

WARNING: ROTATING TRANSMISSION SHAFTS WITHOUT PROTECTION GUARDS ARE FATAL.

Always keep protection guards and chains intact and make sure that it covers all rotating parts, including CV-joints at each end of the shaft. Do not use without protection guard.

Do not touch or stand on the transmission shaft when it is rotating - safety distance: 1.5 meter.





Prevent protection guards from rotating by attaching the chains allowing sufficient slack for turns.

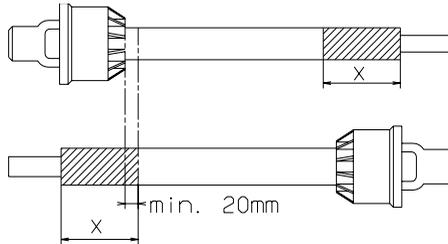
Make sure that protection guards around tractor P.T.O. and implement shaft is intact.

Always STOP ENGINE and remove the ignition key before carrying out maintenance or repairs to the transmission shaft or implement.

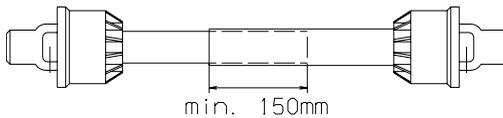
Installation of transmission shaft

Initial installation of the shaft is done as follows:

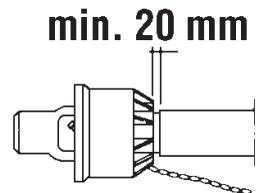
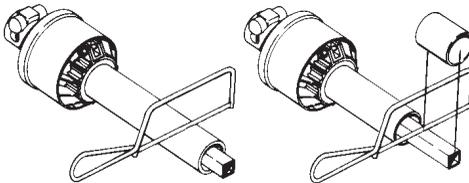
1. Attach sprayer to tractor and set sprayer in the position with **shortest** distance between the tractor and sprayer pump P.T.O. shafts.
2. Stop engine and remove ignition key.
3. If transmission shaft must be shortened, the shaft is pulled apart. Fit the two shaft parts at tractor and sprayer pump and measure how much it is necessary to shorten the shaft. Mark the protection guards.



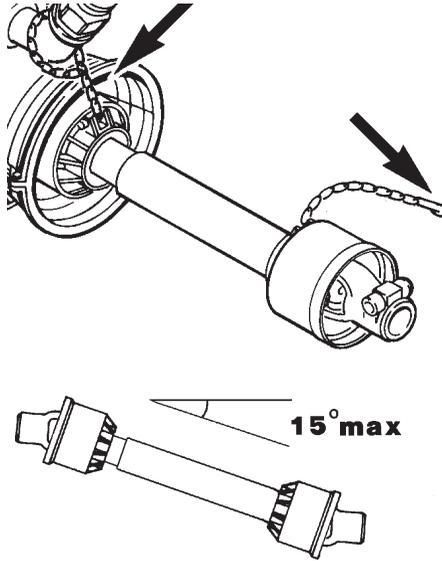
NOTE: The shaft must always have a minimum overlap 150 mm.



4. The two parts are shortened equally. Use a saw, and file the profiles afterwards to remove burrs.
5. Grease the profiles, and assemble male and female parts again.



6. Fit the shaft to tractor and sprayer pump.
NOTE: Female part towards tractor.
Fit the chains to prevent the protection guards to rotate with the shaft.
7. To ensure long life of the transmission shaft, try to avoid working angles greater than 15° .
8. Transmission shafts with cone must be fitted by tightening the Allen screw to a torque of 40 Nm.
Check again after 2 minutes use.



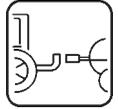
Hydraulics

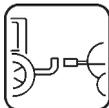
Connection requirements for ME-LHY are;

- single outlet to raise or lower the boom,
- double outlet to fold or unfold the boom,
- double outlet for Hydraulic Slanting Control (if fitted).

Ensure the snap couplers are clean before connection.

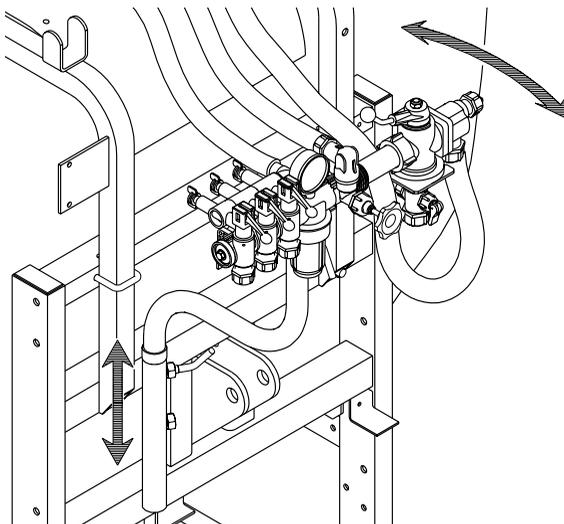
NOTE: The hydraulic system requires a minimum oil pressure of 130 bar, max. oil pressure of 160 bar and an oil capacity of approx. 5 litres. After having operated the boom and the system has been filled with oil, check tractor's hydraulic oil level and top up if necessary.





BK operating unit

The position of the operating unit can be adjusted forward or backward and up or down. Position it so it can be operated from the tractor without risk of damage to the sprayer or tractor.

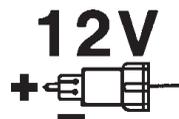


BK/EC and EC operating unit control box

The control box is fitted at a convenient place in the tractor cabin. The control box has 4 screw holes in the back cover. Mount it on a flat surface.

Power requirement is 12 V DC.

Note polarity. Brown pos. (+), Blue neg. (-).



Rear lights (if fitted)

Connect plug for rear lights to the tractors 7-poled socket and check that rear lights, stop lights and direction indicators work properly before driving anywhere.

The wiring is in ISO accordance. See section on Technical specifications.

Roadworthiness

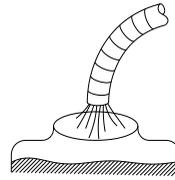
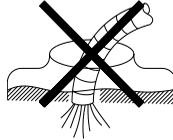
When driving on public roads and other areas where the highway code applies, or areas where there are special rules and regulations for marking and lights on implements, you should observe these and equip implements accordingly.

Operating instructions

Filling the main tank

Water is filled into the tank by removing the tank lid located at right hand side of sprayer tank. It is recommended to use as clean water as possible for spraying purposes. Always fill water through the strainer basket to prevent foreign particles from entering the tank. An overhead tank can be used in order to obtain high filling capacity.

WARNING: Do not let the filling hose enter the tank. Keep it outside the tank, pointing towards the filling hole. If the hose is lead into the tank and the water pressure drops at the water supply plant, chemicals may be syphoned back and contaminate the water supply lines, plant and well.



Filling the Rinsing tank (if fitted)

Remove the tank lid and fill with clean water and replace lid.

Operating the boom

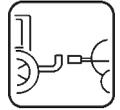
Operating the boom

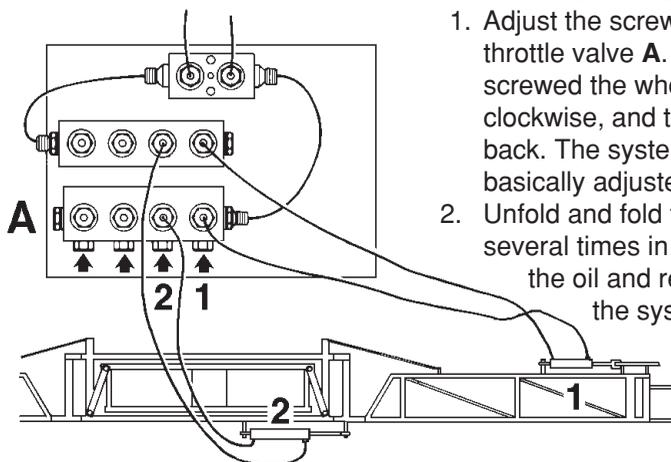
WARNING: Before unfolding the boom it is important to connect the tractor to prevent overbalancing of the sprayer.

WARNING: Testing of the hydraulic system should be done very cautiously. There may be air in the system and this may cause violent movements of the boom. Therefore take care that no persons or objects are hurt or damaged in the process of testing.

Speed regulation of the hydraulic boom movements

Adjustable restrictors for regulation of boom unfolding speed is located on the lower hydraulic distribution block (fitted at the boom centre frame). It is important to adjust the valves so that the boom operates smoothly.





Proceed as follows:

1. Adjust the screws (↑) of the throttle valve **A**. They are screwed the whole way in clockwise, and then 1 turn back. The system is now basically adjusted.
2. Unfold and fold the boom several times in order to heat the oil and remove air from the system.

3. Set the adjustment screws on the throttle valve until the individual rams run with the speed wanted (clockwise = less speed).

Unfolding and folding the LHY



IMPORTANT! To avoid damages the boom must only be unfolded and folded when the tractor is NOT moving!

Unfolding and folding of the LHY boom is carried out by means of the tractor remote control valves.

To unfold proceed as follows:

1. Lift boom clear of transport brackets
2. Unfold boom wings completely
3. Lower boom lift to correct working height (approx. 50 cm above ground or crop).

To fold proceed as follows:

1. Lift the boom.
2. Fold the boom completely.
3. Lower the boom until it rests in the transport brackets.

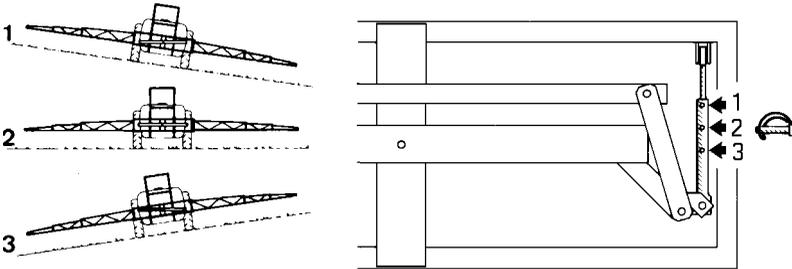


Caution! When driving on public roads the tractor hydraulic remote control levers should be locked to avoid unintended unfolding of the boom!

Operating of the trapeze

The trapeze suspension of the boom to be correctly adjusted and regularly lubricated, if it is going to operate satisfactorily. See section on re-adjustment of the boom.

The primary function of the suspension is to protect the boom against vibrations and shocks and to keep it in a uniform height above the target.

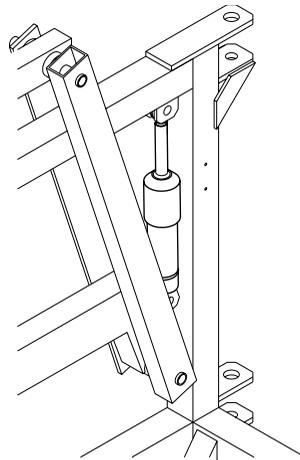


When driving on slopes the boom can be slanted in order to keep the trapeze effect. At delivery the boom is locked in pos. **2** which is used when driving on horizontal grounds. Hydraulic slanting equipment can be supplied as optional extra.

Hydraulic Slanting Control (if fitted).

The Hydraulic Slanting Control enables slanting of the entire boom hydraulically. This is advantageous when the spraying along hillsides.

Reset position to neutral (midway) before folding the boom.

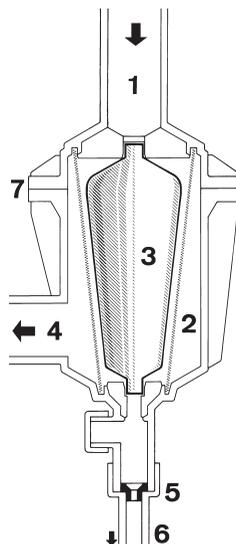




Self-Cleaning Filter

Function diagram

1. From pump
2. Filter screen
3. Guide cone
4. To operating unit
5. 3, 4, 5 or 6 mm restrictor
6. Return to tank
7. Ring nut



Choice of restrictor

It is important to have a large flow through the filter. This is achieved by choosing the restrictor size in relation to the liquid consumption of the spray boom.

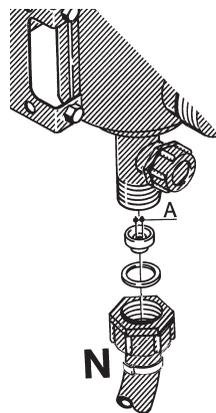
4 restrictors are supplied. Use the green one (largest **A** orifice first).

Hose **N** is unscrewed from the filter. Be careful not to loose the seal. The restrictor is placed in the hose and the hose is mounted again.

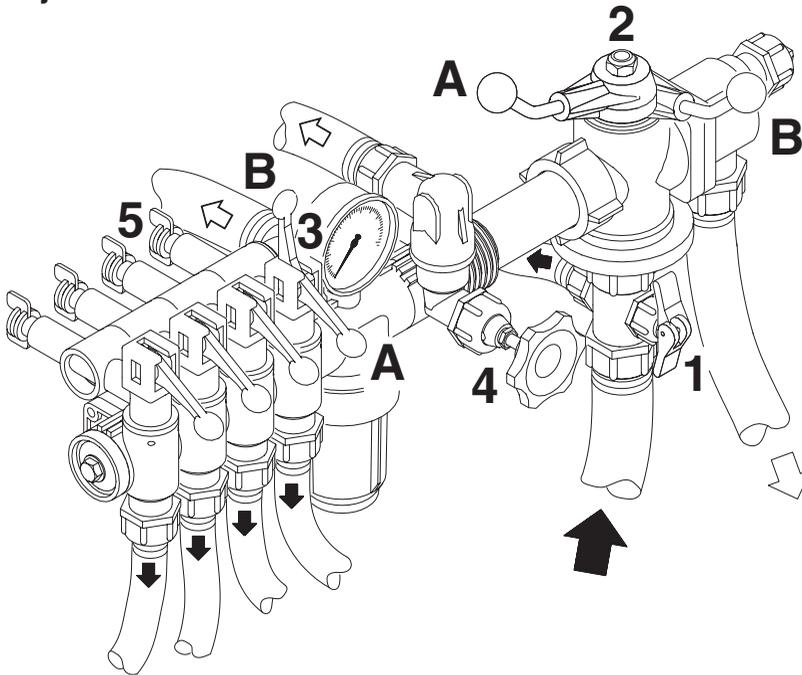
If the required working pressure cannot be obtained, the restrictor is too large. Choose a smaller restrictor. Start with a black one, then a white and finally a red one.

When cleaning the filter remove hose **N** and the hose at the safety valve and check there are no residues.

Standard filter size is 80 mesh. Filters of 50 and 100 mesh are available. To remove filter mesh undo the large ring nut. Check condition and placement of O-rings before reassembly.



Adjustment of the BK controls



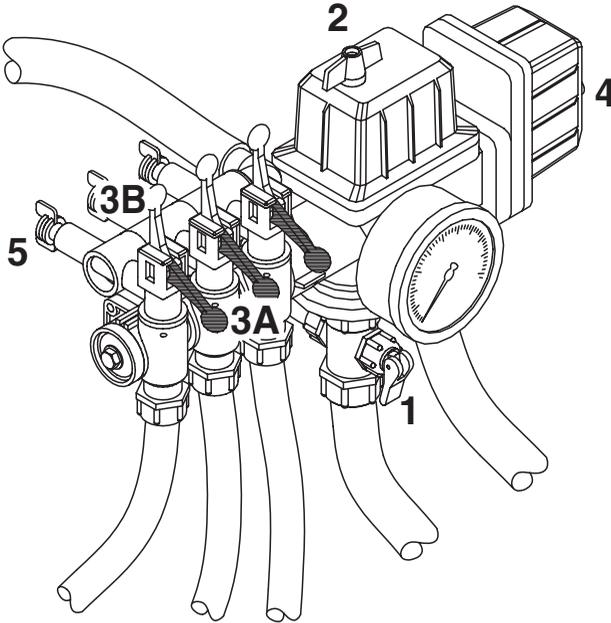
1. Choose the correct nozzle. TRIPLET nozzle turrets are turned to the suitable nozzle for the spray purpose. Make sure that all nozzles are the same type and capacity. See "Spray Technique" book.
2. Open or close lever **1** depending on whether pressure agitation is required. (Remember pressure agitation takes 5% to 10% of pump output).
3. Turn main ON/OFF handle **2** to ON position **A**.
4. Set all hand levers **3** on the distribution valve to ON position **A**.
5. Turn the HARDI-MATIC valve **4** anti-clockwise to its extreme position.
6. Put the tractor in neutral and adjust the P.T.O. thereby the number of revolutions of the pump corresponding to the intended travelling speed.
NOTE: The P.T.O. revolutions must be kept between 300-600 r/min.
7. Adjust the HARDI-MATIC valve **4** so that the pressure gauge indicates the recommended pressure.



ADJUSTMENT OF PRESSURE EQUALIZATION:

8. Place the first lever **3** on the distribution valve in OFF position **B**.
9. Turn the adjusting screw **5** until the pressure gauge again shows the same pressure.
10. Adjust the other sections of the distribution valve in the same way.
Hereafter adjustment of pressure equalization will only be needed if you change to nozzles of other capacities.
11. Operating the control unit while driving:
To stop the liquid flow to the boom turn the ON/OFF handle **2** to OFF position **B**. This returns the pump output to the tank through the return system. The diaphragm anti-drip valves ensure instantaneous closing of all nozzles.
To stop the liquid flow to one or more boom sections, turn lever **3** of the distribution valve to OFF position **B** for the section to be closed. The pressure equalization ensures that the pressure does not rise in the sections which are to remain open.

Adjustment of the BK/EC controls



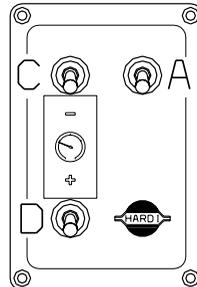
BK/EC operating unit

1. Pressure agitation valve
2. Main ON/OFF valve
3. Distribution valve
4. Pressure control valve
5. Adjustment screw for pressure equalization

BK/EC Remote control box

- A. Operating switch for main ON/OFF valve
- C. Pressure control switch (to lower)
- D. Pressure control switch (to raise)

1. Choose the correct nozzle. TRIPLET nozzle turrets are turned to the suitable nozzle for the spray purpose. Make sure that all nozzles are the same type and capacity. See "Spray Technique" book.
2. Open or close lever 1 depending on whether pressure agitation is required. (Remember pressure agitation takes 5% to 10% of pump output).





3. Main ON/OFF switch **A** is set to ON.
4. Set all hand levers **3** on the distribution valve to ON position **A**.
5. Pressure control switch **C** is activated until emergency handle **4**, stops rotating (minimum pressure).
6. Put the tractor in neutral and adjust the P.T.O. thereby the number of revolutions of the pump corresponding to the intended travelling speed.
NOTE: The P.T.O. revolutions must be kept between 300-600 r/min.
7. Pressure control switch **D** is activated till the recommended pressure is shown on the pressure gauge.

ADJUSTMENT OF PRESSURE EQUALIZATION:

8. Place the first lever **3** on the distribution valve in OFF position **B**.
9. Turn the adjusting screw **5** until the pressure gauge again shows the same pressure.
10. Adjust the other sections of the distribution valve in the same way. Hereafter adjustment of pressure equalization will only be needed if you change to nozzles of other capacities.

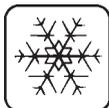
11. Operating the control unit while driving:

To stop the liquid flow to the boom switch ON/OFF **A** to OFF position. This returns the pump output to the tank through the return system. The diaphragm anti-drip valves ensure instantaneous closing of all nozzles.

To stop the liquid flow to one or more boom sections, turn lever **3** of the distribution valve to OFF position **B** for the section to be closed. The pressure equalization ensures that the pressure does not rise in the sections which are to remain open.



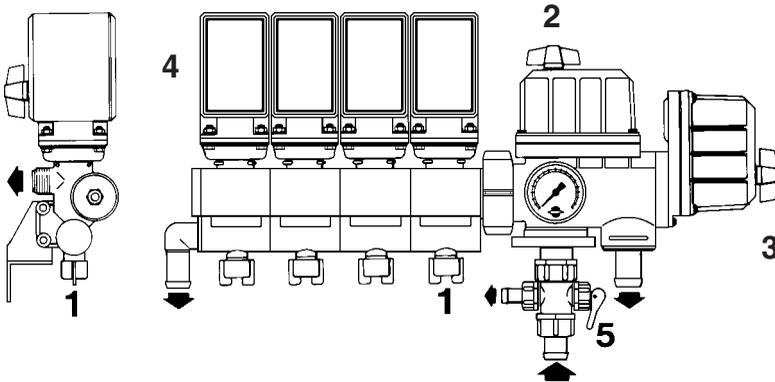
In case of power failure it is possible to activate the functions of the operating unit. To operate manually, disconnect the multiplug first.



When the sprayer is put aside, the control box and the multiplug must be protected against moisture and dirt. A plastic bag may be used to protect the multiplug.

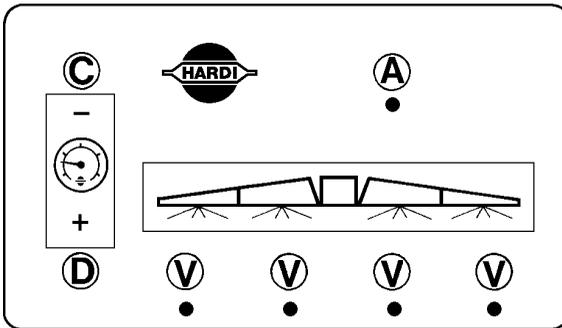
Adjustment of the EC controls

EC operating unit



1. Adjustment screw for pressure equalization
2. Main ON/OFF valve
3. Pressure control valve
4. Distribution valve
5. Pressure agitation valve

EC Remote control box



- A. Operating switch for main ON/OFF valve
- V. Operating switch for distribution valves
- C. Pressure control switch (to lower)
- D. Pressure control switch (to raise)

1. Choose the correct nozzle. TRIPLET nozzle turrets are turned to the suitable nozzle for the spray purpose. Make sure that all nozzles are the same type and capacity. See "Spray Technique" book.





2. Open or close lever **5** depending on whether pressure agitation is required. (Remember pressure agitation takes 5% to 10% of pump output).
3. Main ON/OFF switch **A** is set towards green.
4. All distribution valves switches **V** are set towards green.
5. Pressure control switch **C** is activated until emergency handle **3**, stops rotating (minimum pressure).
6. Put the tractor in neutral and adjust the P.T.O. and thereby the number of revolutions of the pump corresponding to the intended travelling speed.



- NOTE:** The P.T.O. revolutions must be kept between 300-600 r/min.
7. Pressure control switch **D** is activated till the recommended pressure is shown on the pressure gauge.

ADJUSTMENT OF PRESSURE EQUALIZATION:

8. Close the first distribution valve switch **V**.
9. Turn the adjusting screw **1** until the pressure gauge again shows the same pressure.
10. Adjust the other sections of the distribution valve in the same way. Hereafter adjustment of pressure equalization will only be needed if you change to nozzles of other capacities.

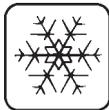
11. Operating the control unit while driving:

To stop the liquid flow to the boom switch ON/OFF **A** to OFF position. This returns the pump output to the tank through the return system. The diaphragm anti-drip valves ensure instantaneous closing of all nozzles.

To stop the liquid flow to one or more boom sections, switch the relevant distribution valve **V** to OFF position. The pressure equalization ensures that the pressure does not rise in the sections which are to remain open.



In case of power failure it is possible to activate all functions of the operating unit. To operate manually, disconnect the multiplug first.



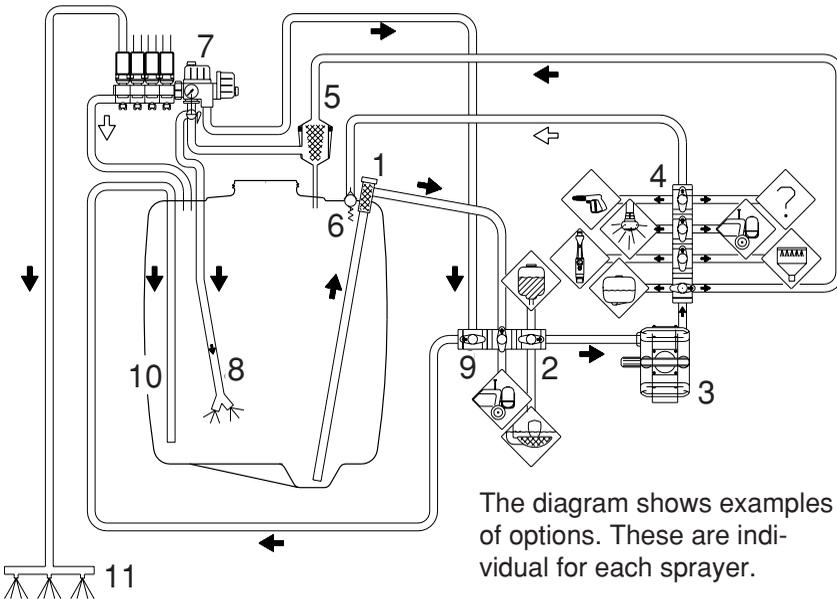
When the sprayer is put aside, the control box and the multiplug must be protected against moisture and dirt. A plastic bag may be used to protect the multiplug.

Adjustment of MANIFOLD SYSTEM (if fitted)

The MANIFOLD SYSTEM is located at the left side of the sprayer and permits operation of all HARDI optional extras from this one position. The modular system facilitates the addition of up to three optional extras on the suction side and five extras on the pressure side. Furthermore the suction manifold can be fitted with a return valve which ensures better draining of the sprayer before cleaning.

Function diagram

- | | |
|--|-------------------------|
| 1. Suction filter | 5. Self-Cleaning Filter |
| 2. Suction manifold BLACK with 2 valves | 6. Safety valve |
| 3. Pump | 7. Operating unit |
| 4. Pressure manifold GREEN with 3 valves | 8. Pressure agitator |
| | 9. Return valve BLUE |
| | 10. Return to tank |
| | 11. Sprayer boom |



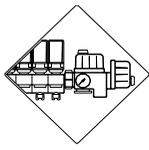


Symbols

The pressure, suction and return valves are distinguished by coloured identification discs on the 3-way valves. Symbols corresponding to the optional extras are located on the discs for easy identification and operation.



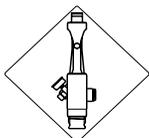
Green disc = Pressure valve



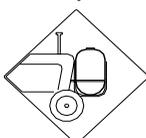
To Self-Cleaning
Filter/operating
unit



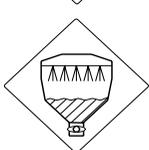
To Hose reel/spray gun



To Fast Filler



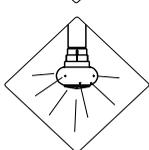
To Front Tank



To HARDI
FILLER



To main tank



To Tank Flush-
ing Nozzle



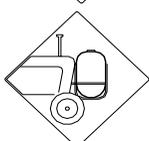
Black = Suction valve



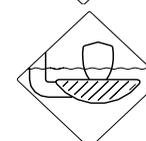
From main tank
(suction filter)



From Rinsing Tank



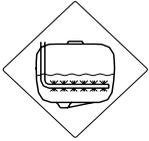
From Front Tank
(suction filter)



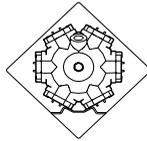
From Filling Device



Blue = Return valve



Return from
operating unit



Pump

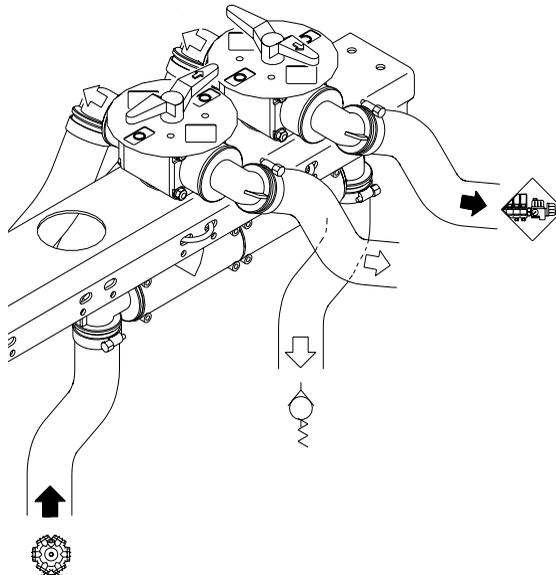
Operating instructions

The green pressure valves and the black suction valves have 4 positions. Two positions are for options. The other two are marked “O” indicating the valve is closed. The blue return valve only has 2 positions. The arrow on the handle indicates which position is selected.

Green pressure valves

To select the optional equipment, the handle is turned so the arrow and thereby liquid is directed to the optional extra instead of the Self-Cleaning Filter/operating unit. When spraying is to resume, turn the handle so the Self-Cleaning Filter/operating unit is selected.

If 2 or more valves are fitted, the arrow must point towards the optional extra you select. Remaining handles are turned to “O” (closed). When spraying is to resume, select the Self-Cleaning Filter/operating unit. The other handles are turned to “O”.



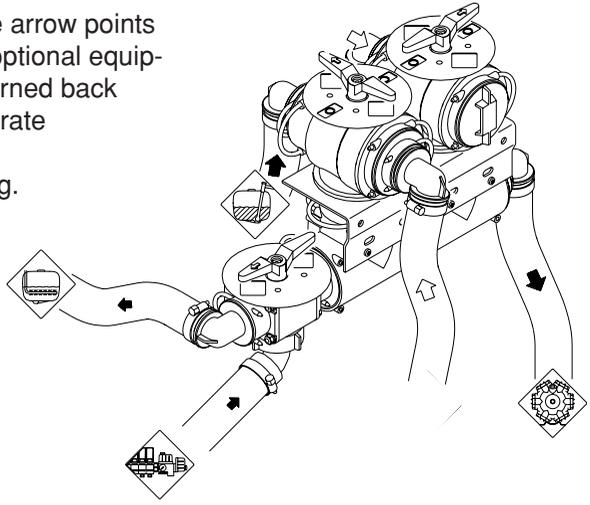
If all the green pressure valves are closed the safety valve will open inside the tank.



Black suction valves

Turn the handle so the arrow points towards the selected optional equipment. The handle is turned back when you want to aspirate from the main tank.

If 2 valves are fitted, eg. Front Tank and Rinsing Tank, select optional extra and turn the other valve to "O" (closed). To resume aspiration from the main tank, the arrow must point towards the main tank. Remaining valve must be closed.

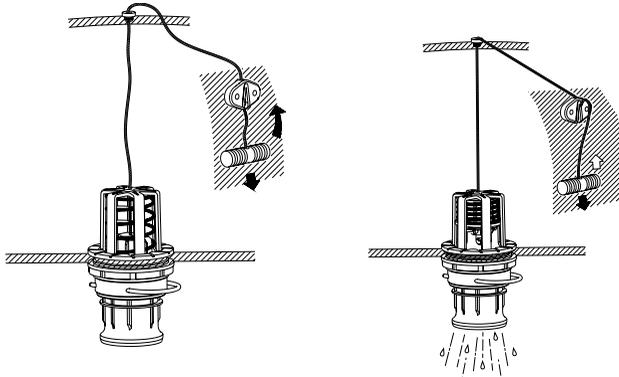


Blue return valve

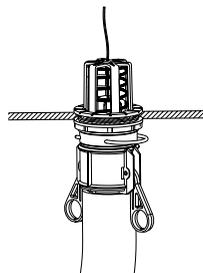
Normally the liquid is directed to the tank return. When the tank is nearly empty, the handle is turned so the liquid is directed to the suction side of the pump instead of the tank return.

Operation of the tank drain valve

Pull the red handle on the side of the tank to open the drain valve. The valve is spring-loaded, but can be kept open by pulling the string out and upwards in the V-shaped slit. To release, pull the string downward and the valve will close automatically.



If draining residues, e.g. liquid fertilizer into a reservoir, a snap-coupler with hose can rapidly be connected to the drain valve and the liquid safely drained.



Spray Technique - see separate book.
Optional Extras - see separate books.

Maintenance

In order to derive full benefit from the sprayer for many years the following few but important rules should be kept:

Cleaning the sprayer

Guidelines

Read the whole label of the chemical. Take note of any particular instructions regarding recommended protective clothing, deactivating agents, etc. Read the detergent and deactivating agent labels. If cleaning procedures are given, follow them closely.

Be familiar with local legislation regarding disposal of pesticides washings, mandatory decontamination methods, etc. Contact the appropriate body, eg. Dept of Agriculture.

Pesticide washings can usually be sprayed out on a soakaway. This is an area of ground that is not used for cropping. You must avoid seepage or run-off of residues into streams, water courses, ditches, wells, springs, etc. The washings from the cleaning area must not enter sewers. Drainage must lead to a soakaway.

Cleaning starts with the calibration, as a well calibrated sprayer will ensure the minimal amount of remaining spray liquid. It is good practice to clean the sprayer immediately after use thereby rendering the sprayer safe and ready for the next pesticide application. This also prolongs the life of the components.

It is sometimes necessary to leave spray liquid in the tank for short periods, eg. overnight, or until the weather becomes suitable for spraying again. Unauthorized persons and animals must not have access to the sprayer under these circumstances.





If the product applied is corrosive, it is recommended to coat all metal parts of the sprayer before and after use with a suitable rust inhibitor.

Remember: Clean sprayers are safe sprayers.
Clean sprayers are ready for action.
Clean sprayers can not be damaged by pesticides and their solvents.

Cleaning

1. Dilute remaining spray liquid in the tank with at least 10 parts water and spray the liquid out in the field you have just sprayed.

NOTE: It is advisable to increase the forward speed (double if possible) and reduce the pressure. For S4110 nozzles, pressure may be reduced to 1.5 bar.

2. Select and use the appropriate protective clothing. Select detergent suitable for cleaning and suitable deactivating agents if necessary.
3. Rinse and clean sprayer and tractor externally. Use detergent if necessary.

4. Remove tank and suction filters and clean. Be careful not to damage the mesh. Replace suction filter top. Replace filters when the sprayer is completely clean.

5. With the pump running, rinse the inside of the tank. Remember the tank roof. Rinse and operate all components and any equipment that has been in contact with the chemical.

Before opening the distribution valves and spraying the liquid out, decide whether this should be done in the field again or on the soakaway.

6. After spraying the liquid out, stop the pump and fill at least 1/5 of the tank with clean water. Note that some chemicals require the tank to be completely filled. Add appropriate detergent and/or deactivating agent, eg. Washing soda or Triple ammonia.

NOTE: If a cleaning procedure is given on the chemical label, follow it closely.

7. Start the pump and operate all controls enabling the liquid to come in contact with all the components. Leave the distribution valves until last. Some detergents and deactivating agents work best if left in the tank for a short period. Check the label.

The Self-Cleaning Filter can be flushed by removing the bypass hose from the bottom of the filter. Stop the pump and remove the hose. Start the pump for a few seconds to flush filter. Be careful not to lose the restrictor nozzle.



8. Drain the tank and let pump run dry. Rinse inside of tank, again letting the pump run dry.
 9. Stop the pump. If the pesticides used have a tendency to block nozzles and filters, remove and clean them now. Check also for sediment on the pressure side of the safety valve for the Self-Cleaning Filter.
 10. Replace all the filters and nozzles and store the sprayer. If, from previous experiences, it is noted that the solvents in the pesticide are particularly aggressive, store the sprayer with the tank lid open.
- NOTE:** If the sprayer is cleaned with a high pressure cleaner we recommend lubrication of the entire machine.



Filters

Clean filters ensure :

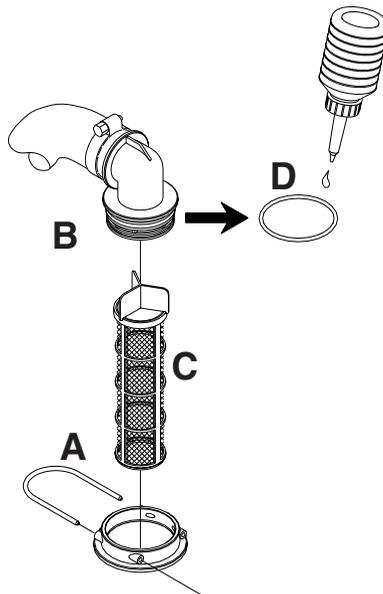
- Sprayer components such as valves, diaphragms and operating unit are not hindered or damaged during operation.
- Nozzle blockages do not occur whilst spraying.
- Long life of pump. A blocked suction filter will result in pump cavitation.

Suction filter

The main filter protecting sprayer components is the suction filter at the top of the tank. Check it regularly.

To service the suction filter:

1. Pull the steel clip **A** out.
2. Lift the suction hose fitting **B** from housing.
3. Filter guide and filter **C** can now be removed.



To reassemble:

4. Press the guide onto filter end.
5. Place the filter into housing with guide facing up.
6. Ensure the O-ring **D** on the hose fitting is in good condition and lubricated.
7. Refit the suction hose **B** and steel clip **A**.



BK Pressure filter / In Line Filters (if fitted)

The BK operating unit has a built in pressure filter. Unscrew the filter bowl to inspect and clean the filter.

The boom may be equipped with In Line Filters. Unscrew the filter bowl to inspect and clean the filter.

Alternative filters are available. See section on Technical specifications - Filters and nozzles.



Lubrication

Recommended lubrication is shown in following tables. Use ball bearing grease (lithium grease NLGI No. 2).



NOTE: If the sprayer is cleaned with a high pressure cleaner or fertilizer has been used, we recommend lubrication of all sections.

POS. Position on sprayer



Oil



Grease



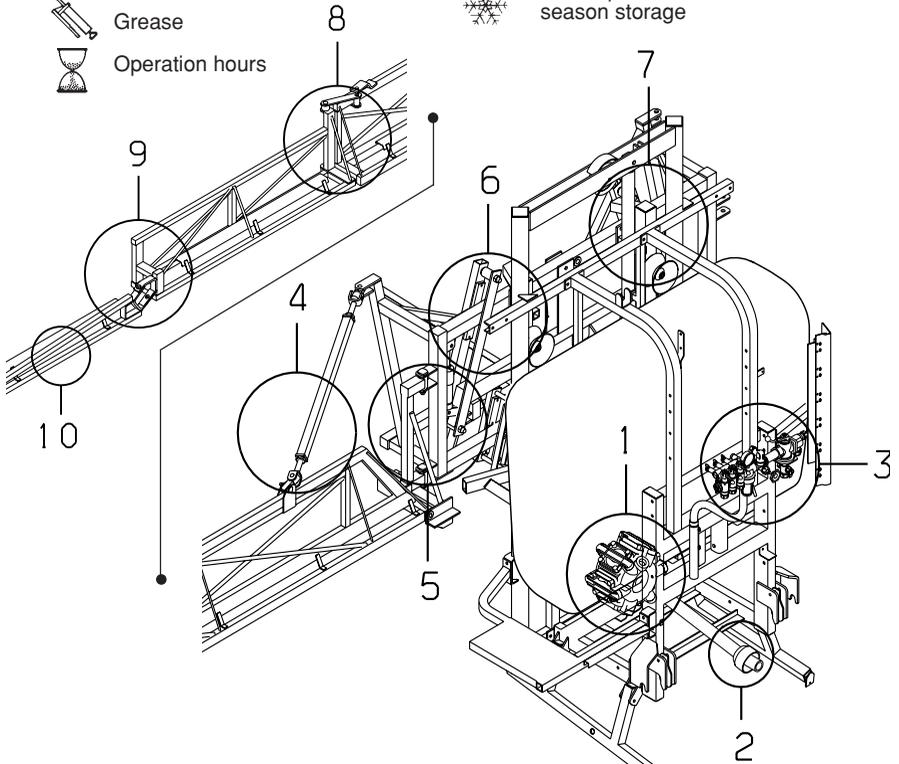
Operation hours

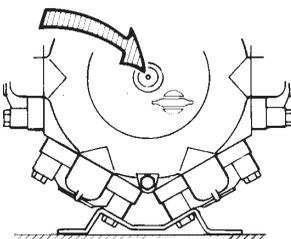
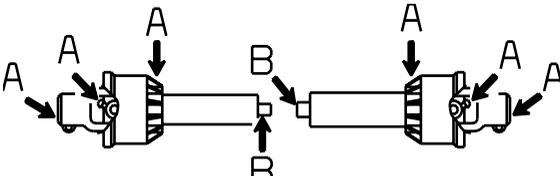
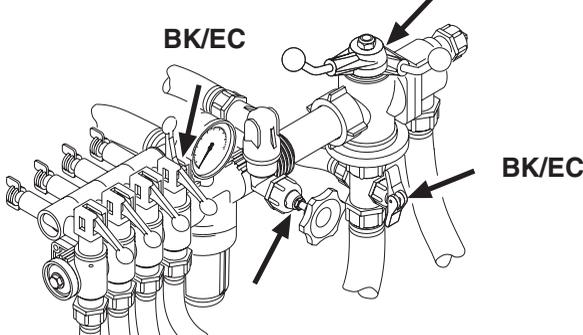
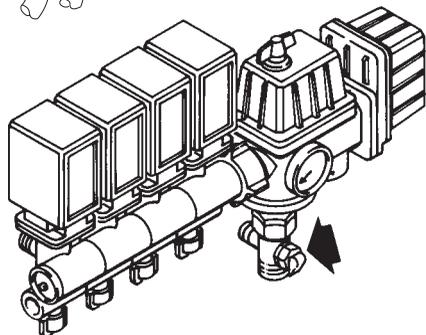


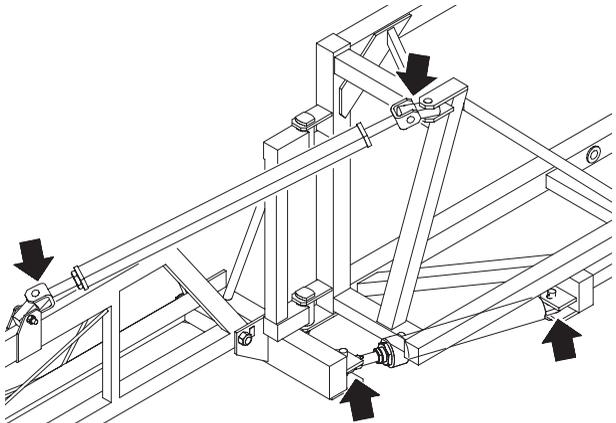
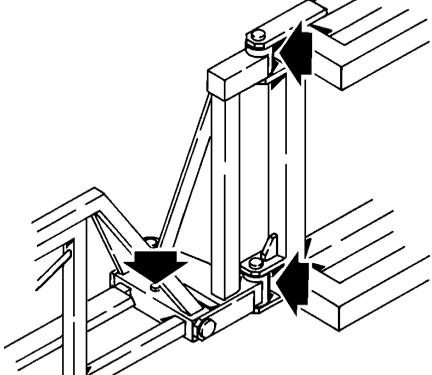
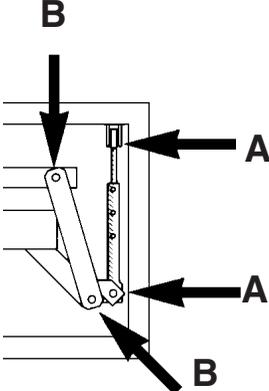
Page to find more information

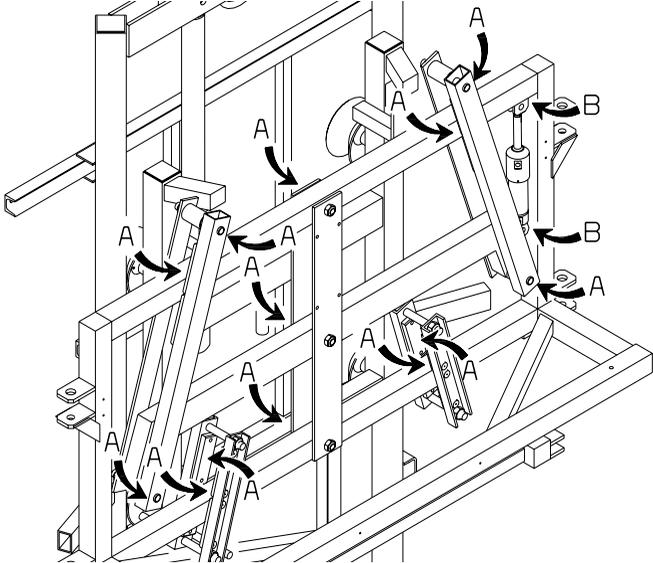
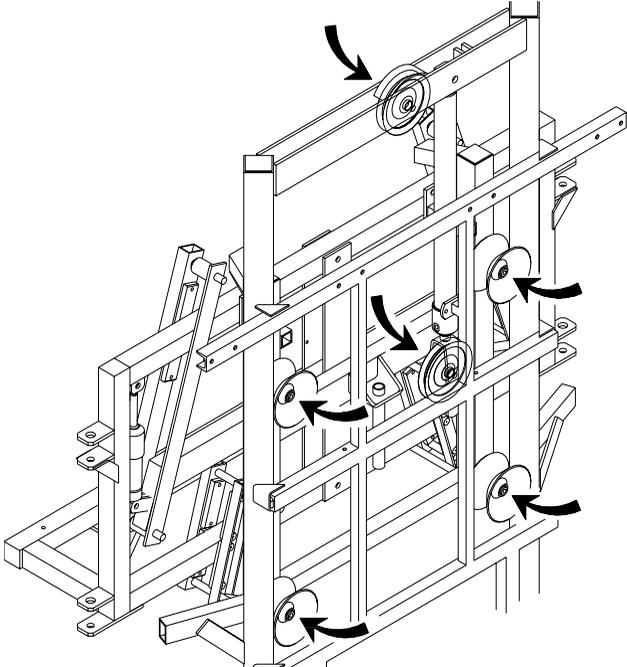


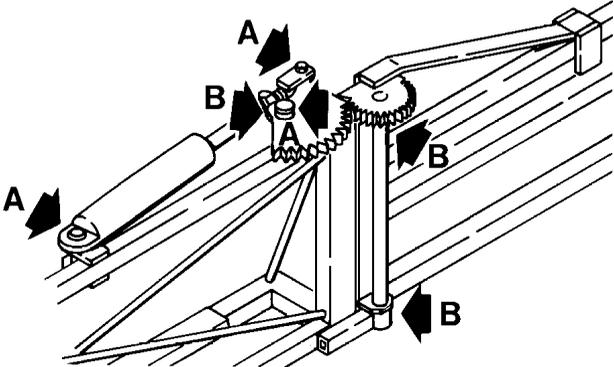
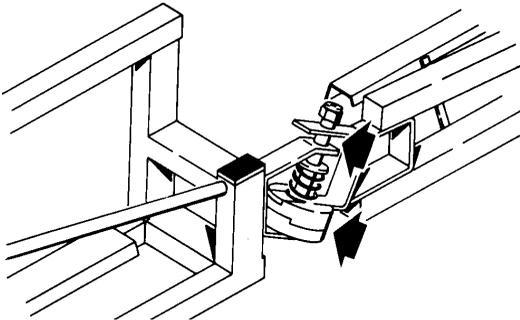
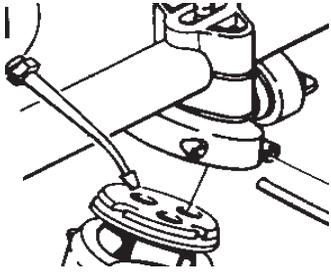
Winter protection or off-season storage



POS.					
1		X	40		38 39 45 48 49
2 A B		X X	8 40		9 10 11 42 44
3	X		20		6 17 18
					7 21 22 41 47 48 51

POS.					
4	X		40		13 14 35 36
5		X	40		
5 A B	X	X	40 40		15

POS.					
6 A B	X	X	40 40		15 37
7	X	X	40		39 40

POS.					
8 A B	X	X	40 40		38
9		X	40		
10	X				

Re-adjustment of the Boom

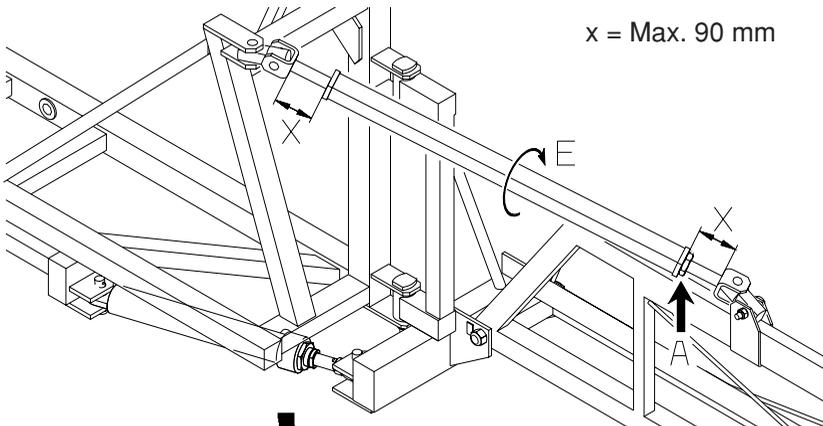
After having used the sprayer for some days the boom should be adjusted according to the following instructions:

Before adjusting, ensure the spray boom is in the working position with trapeze unlocked, on level ground and lubricated.

Adjustment of hydraulic cylinders is done without pressure in the hydraulic system.

WARNING! NOBODY MUST BE UNDER THE BOOM WHILST ADJUSTMENT IS CARRIED OUT.

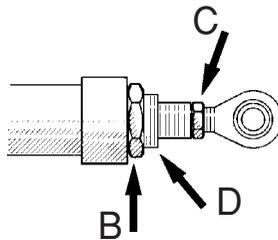
Re-adjustment of the LHY boom Horizontal adjustment



1. Fold out the boom.

NOTE: Adjustment of hydraulic cylinders is done without pressure in the hydraulic system.

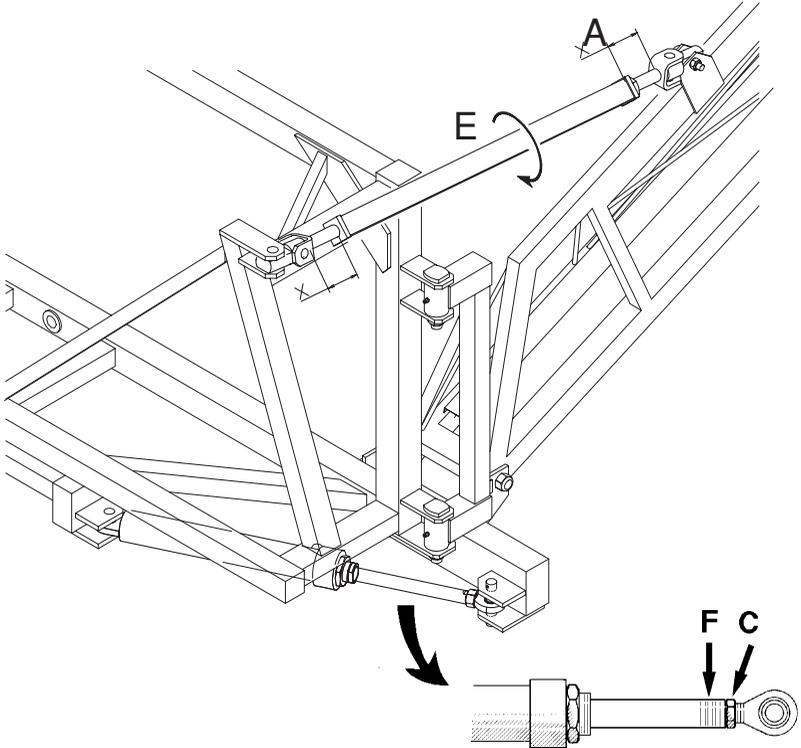
2. Loosen lock nuts **A**, **B** and **C**.
3. Adjust on the threaded bushing **D** which sets the bottom stop position of the cylinder. When the cylinder stop is screwed outwards, the boom will point forwards, and if the cylinder stop is screwed inwards, the boom will point backwards. The boom must be in alignment with the central section but may point a bit forwards.





- Adjust on rod **E** until the boom is horizontal.
Important! The fork bolt on each end of rod **E** must not exceed 90 mm as show.
- When the boom is adjusted, tighten nut **B**.

Transport position

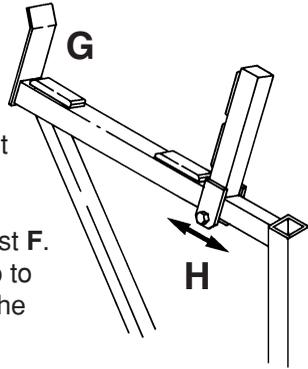


The boom is to be adjusted so that boom movement is not possible during transport.

- Fold the outer sections and then the inner sections until the folding rams have minimum length and carefully place the boom in the transport brackets.
NOTE: The following is best done without pressure in the hydraulic rams.
- Loosen the counter nut **C** and adjust the length of the rod **F** until the boom rests against **G** at the transport bracket.
- Retighten counter nut **C**.

Transport position - STOP

1. The boom is folded onto the transport brackets.
2. The folding cylinder is adjusted so the boom fits against the outer stop **G**. Adjust on the cylinder rod **F**, the length of the stroke on the rod. When the boom fits against **G**, the lock nut **C** is tighten against **F**.
3. The adjustable boom stop **H** is placed up to the boom, so the boom is supported on the inner side. Tighten the bolt.



Boom lift

The boom lift does not require any adjustments. Only lubrication - see lubrication chart.

Boom lift steel cable

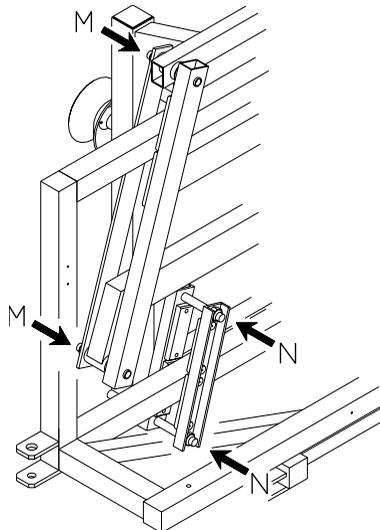
The boom lift steel cable must be inspected for wear and damages with regular intervals.

By first sign of wear, broken threads etc. the steel cable is replaced instantly. The steel cable is lubricated with oil or grease - see lubrication chart.

Trapeze suspension

1. Check the tension on nuts **M**. They must not be overtightened.
2. The trapeze function is adjusted by tightening or loosening the 4 nuts **N**.
3. It is important that the friction pads are lubricated.

Minor adjustments in the field may be necessary.

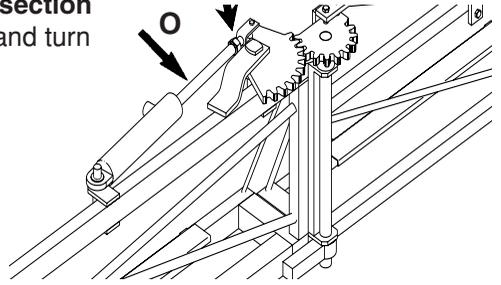




Linear adjustment of outer section

To adjust, loosen lock nut **O** and turn cylinder rod.

CHECK ALL LOCK NUTS ARE TIGHT AFTER ADJUSTMENT.

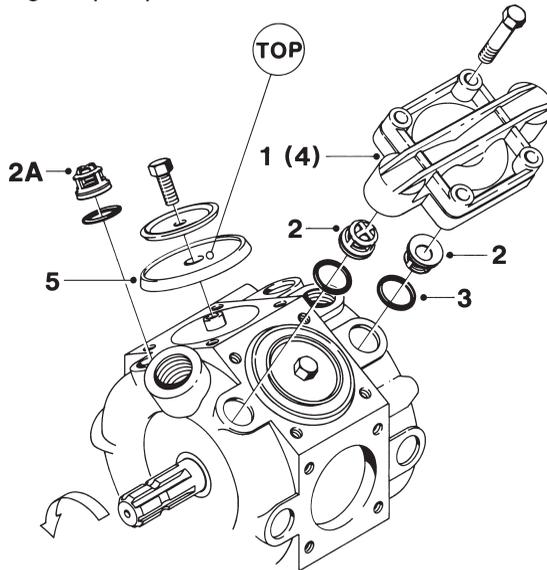


Changing of valves and diaphragms

Access to the pump is best from the rear of the sprayer.



WARNING! To avoid personal injury the booms must always be in transport position so the boom is secured and can not be lowered before servicing the pump.



Valves

Remove valve cover **1**. Before changing the valves **2** note their orientation so they are replaced correctly.

NOTE: One special valve with white flap **2A** is used on model 361. It has to be placed in the valve opening shown. It is recommended to use new gaskets **3** when changing or checking the valves.

Diaphragms

Remove the diaphragm cover **4**. The diaphragm **5** may then be changed. If fluids have reached the crankcase, re-grease the pump thoroughly. Check also the drain hole at the bottom of the pump is not blocked. Reassemble with the following torque setting.



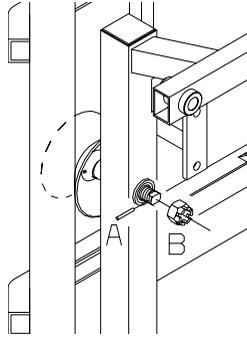
Pump Model	Valve cover Nm	Diaphragm cover Nm	Diaphragm bolt Nm
361	70		60

1 Nm = 0.74 ft-lb

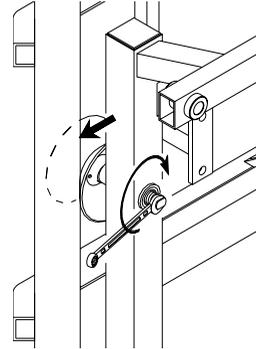


Adjustment of lift wagon wheels

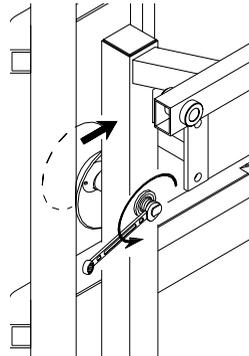
1. Remove cotter pin **A** and loosen castelated nut **B**.



2. Turning the eccentric axle clockwise will decrease the gap between the wheel and the lift. Use a spanner.



3. Turning the eccentric axle counter clockwise will increase the gap between the wheel and the lift. Use a spanner.



4. Make sure that the contact surface between the eccentric axle and liftwagon is free of grease and paint.
5. After adjustment retighten castelated nut **B** and secure with new cotter pin. Torque wrench setting 200 Nm.

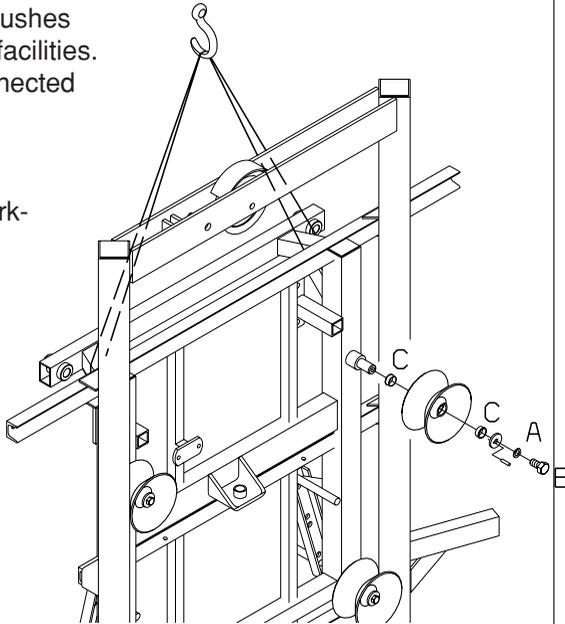
Changing of bushes in lift wagon wheels

Periodically check the wear bushes in the boom lift wheels and replace if worn.

NOTE! Replacement of bushes requires a crane or lift facilities. The sprayer must be connected to the tractor first.

Proceed as follows:

1. Unfold the boom to working position.
2. Attach a rope as shown and keep the centre section in position by the crane. To avoid boom tilt, the bushes are replaced one side at a time.
3. Loosen nuts **B** on the RH side and pull the boom wagon carefully off the wheels.
4. Replace worn bushes **C**, refit the wheels and tighten nuts **B**.
5. Repeat step 3 and 4 on LH wheels.
6. Lower boom and remove rope.
7. Grease through grease nipples.

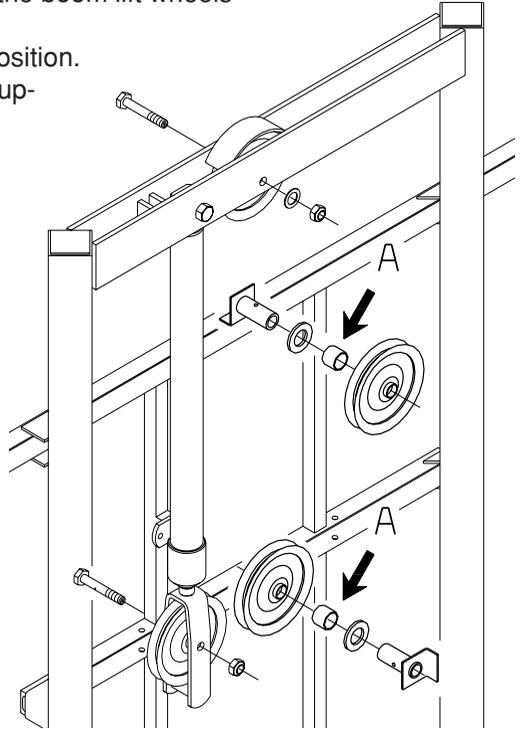




Change of wear bushes in boom lift wheels.

To remove wear bushes in the boom lift wheels proceed as follows:

1. Fold boom in transport position.
Make sure the boom is supported in front and rear transport brackets.
2. Remove pressure in boom lift ram by setting the tractor spool valve in position "lower".
3. Dismantle the wheel assembly and replace the two wear bushes **A** in both wheels.
4. Reassemble wheel assembly.
5. Grease wheels through grease nipples.



Changing of boom lift steel cable

The steel cable is holding the entire boom, and its proper condition is essential. The cable is replaced by first sign of wear. Proceed as follows:

The sprayer must be connected to the tractor first.

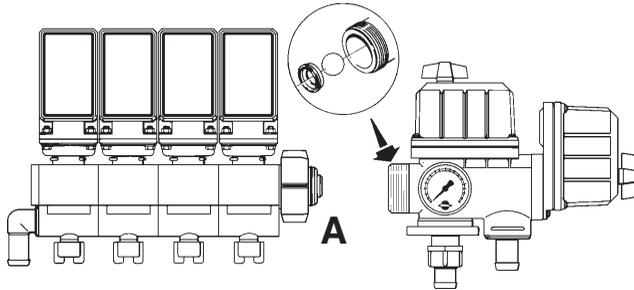
1. Fold boom in transport position, and lower until it rests in the front and rear transport brackets.
2. Set hydraulic remote control valve in position "lower" so the cable can be removed.
4. Fit new cable, and secure with split pins. Grease cable - see lubrication chart.

Changing the ball seat in BK, BK/EC and EC

If the main ON/OFF valve does not seal properly (dripping nozzles when main ON/OFF valve is closed), the ball and seat should be checked.



Remove the 2 bolts fixing the main ON/OFF-pressure valve unit to the bracket, unscrew the union nut **A** and pull the valve away from the distribution valves.



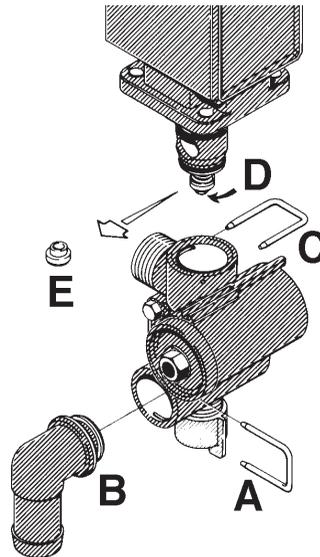
Check the ball for sharp edges and scratches, and check the ball seat for cracks and wear - replace if necessary.

Checking the valve cone - EC only

Periodically check the distribution valves for proper sealing. Do this by running the sprayer with clean water and open on/off valve and all distribution valves.

Cautiously remove the clip **A** and pull out the hose **B** for the pressure equalization device. When the housing is drained, there should be no liquid flow through the pressure equalization device. If there is any leakage, the valve cone **E** must be changed.

Remove the clip **C** and lift the EC-motor housing off the valve housing. Then unscrew the screw **D** and replace the valve cone **E**. Reassemble in opposite sequence.



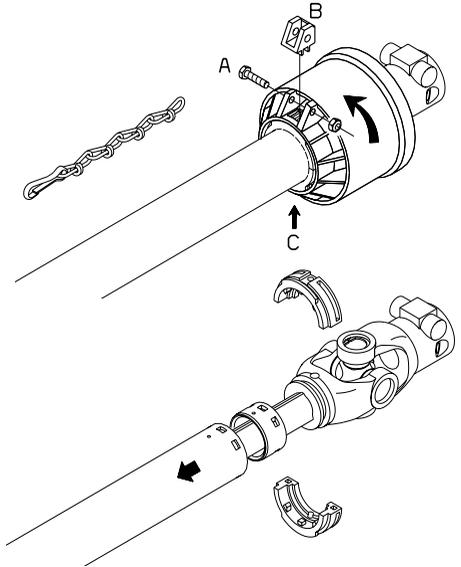


Replacement of transmission shaft protection guards

The replacement of defective protection guards is easy to do.

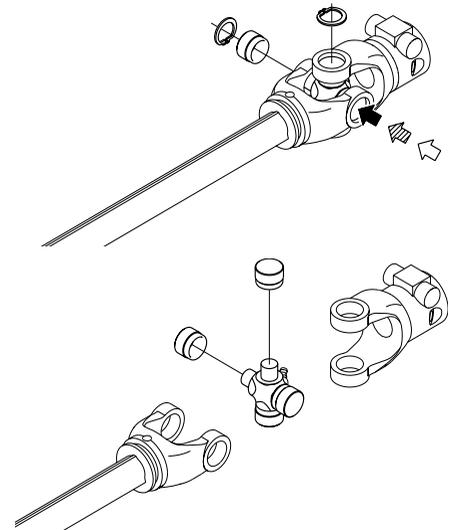
1. Remove bolt **A**, lock **B** and grease nipple **C**. Twist uni CV-joint cover 1/4 turn and pull it backwards.
2. Remove the synthetic bearings and protection tube.
- 2a. Remove inner bush from protection tube.
3. Assemble again in reverse order, using new parts where necessary. Remember to fit chains again.
4. Grease bearings.

Use only genuine HARDI spare parts to service the transmission shaft.



Replacement of transmission shaft cross journals.

1. Remove protection guard as described previously.
2. Remove Seeger circlip rings
3. Press the cross journal sideways - use hammer and mandrel if necessary.
4. Remove needle bearing cups and cross journal can now be removed.
5. Carefully remove needle bearing cups from new cross journal and install it in reverse order. Before fitting the needle bearing cups again, check that needles is placed correctly. Avoid dust and dirt in the new bearings.

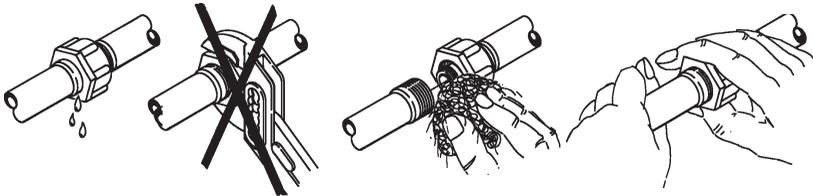


Nozzle tubes and fittings

Poor seals are usually caused by;

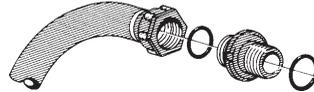
- missing O-rings or gaskets
- damaged or incorrectly seated O-rings
- dry or deformed O-rings or gaskets
- foreign bodies

Therefore, in case of leaks: **DO NOT** overtighten. Disassemble, check condition and position of O ring or gasket, clean, lubricate and reassemble. The O-ring is lubricated **ALL THE WAY ROUND** before fitting on to the nozzle tube. Use non-mineral lubricant.



For **radial** connections only hand tighten them.

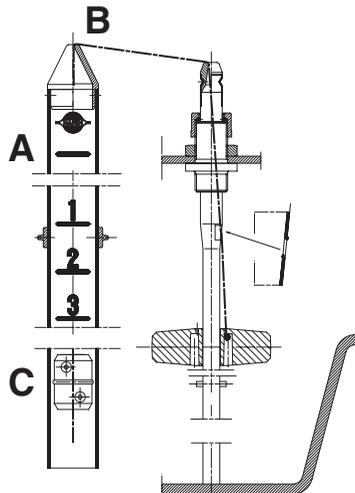
For **axial** connections, a little mechanical leverage may be used.



Level indicator

The level indicator should be checked regularly. When the tank is empty, the floater should rest on the stop pin on the rod and the O-ring at the indicator should be positioned at the top position line **A**.

If any deviation is found, pull out the plug **B**, loosen the screws **C** and adjust the length of the cord.





Off-season storage

When the spraying season is over you should devote some extra time to the sprayer before it is stored.

Hoses

Check that none of the hoses are caught or have sharp bends. A leaky hose can give an annoying delay in the middle of the spraying job. Therefore check all the hoses and change if there is any doubt about the durability.

Paint

Some chemicals are very rough on paints. It is therefore well advised to remove rust, if any, and then touch up the paint.

Tank

Check that no chemical residues are left from the last spraying. Chemical residues must not be left in the tank for a long time. It will reduce the life of the tank. See section on Cleaning the sprayer.

BK/EC and EC operating unit

When the sprayer is put away the control box and the multiplug must be protected against moisture and dirt. Possibly use a plastic bag.

Transmission shaft

It is important that the push pins are clean and well lubricated, to ensure safe function.

Every 40 hours: Inspection of protection guards, function and condition. Replace possible damaged parts.

Every 1000 hours: Check condition of protection guards and replace nylon bearings.

Check general condition of cross journals and push-pin/quick release - replace if necessary.

Anti-freeze precaution

If the sprayer is not stored in a frost free place you should take the following precautions: Put at least 10 litres of 33% anti-freeze mixture in the tank and let the pump run a few minutes so that the entire system including spray hose are filled. The anti-freeze solution also hinders the O-rings and gaskets from drying out.

Remove the glycerine filled pressure gauge and store it frost free in vertical position.

Operational problems

In cases where breakdowns have occurred the same factors always seem to come into play:

- Minor leaks on the suction side of the pump will reduce the pump capacity or stop the suction completely.
- A clogged suction filter will hinder or prevent suction so that the pump does not operate satisfactorily.
- Clogged up pressure filters will result in increasing pressure at the pressure gauge but lower pressure at the nozzles.
- Foreign bodies stuck in the pump valves with the result that these cannot close tightly against the valve seat. This reduces pump efficiency.
- Poorly reassembled pumps, especially diaphragm covers will allow the pump to suck air resulting in reduced or no capacity.
- Electrical and hydraulic components that are contaminated will result in poor connections and rapid wear to the hydraulic system.

Therefore ALWAYS check:

1. Suction, Self-Cleaning, pressure and nozzle filters are clean.
2. Hoses for leaks and cracks, paying particular attention to suction hoses.
3. Gaskets and O-rings are present and in good condition.
4. Pressure gauge is in good working order. Correct dosage depends on it.
5. Operating unit functions properly. Use clean water to check.
6. Electrical and hydraulic components are maintained clean.





Fault	Probable cause	Control / remedy	
Liquid system			
No spray from boom when turned on.	Air leak on suction.	Check if suction filter O-ring is sealing. <hr/> Check suction tube and fittings. <hr/> Check tightness of pump diaphragm and valve covers.	
	Air in system.	Fill suction hose with water for initial prime.	
	Suction/pressure filters clogged.	Clean filters. <hr/> Check yellow suction pipe is not obstructed or placed too near the tank bottom.	
Lack of pressure.	Incorrect assembly.	Agitation nozzles not fitted. <hr/> Restrictor nozzle in Self-Cleaning Filter not fitted. <hr/> Safety valve spring for Self-Cleaning Filter not tight. <hr/> Too little distance between yellow suction pipe and tank bottom.	
		Pump valves blocked or worn.	Check for obstructions and wear.
		Defect pressure gauge.	Check for dirt at inlet of gauge.
		Pressure dropping.	Filters clogging.
Nozzles worn.	Check flow rate and replace nozzles if it exceeds 10%.		
Tank is airtight.	Check vent is clear.		
Sucking air towards end of tank load.	Excessive agitation, turn off. <hr/> Returns inside tank need relocation.		



Fault	Probable cause	Control / remedy
Pressure increasing	Pressure filters beginning to clog.	Clean all filters.
	Agitation nozzles clogged.	Check by turning agitation off and on.
Formation of foam.	Air is being sucked into system.	Check tightness / gaskets / O-rings of all fittings on suction side.
	Excessive liquid agitation.	Turn agitation off. Reduce pump r/min.
		Check safety valve for Self-Cleaning Filter is tight.
		Ensure returns inside tank are present.
		Use foam damping additive.
Liquid leaks from bottom of pump.	Damaged diaphragm.	Replace. See Changing of valves and diaphragms.

Operating unit BK/EC and EC

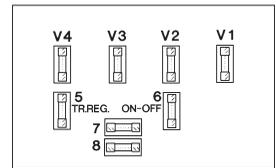
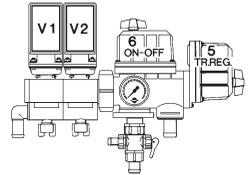
Operating unit not functioning	Blown fuse(s).	Check mechanical function of microswitches. Use cleaning/ lubricating agent if the switch does not operate freely. Check motor. 450-500 milli-Amperes max. Change motor, if over.
	Wrong polarity.	Brown - pos. (+). Blue - neg. (-).
	Valves not closing properly.	Check valve seals for obstructions. Check microswitch plate position. Loosen screws holding plate a 1/2 turn.
	No power.	Wrong polarity. Check that brown is pos. (+), Blue is neg. (-). Check print plate for dry solders or loose connections. Check fuse holder are tight around fuse.



Fault	Probable cause	Control / remedy
Hydraulic system		
Boom slow/eradic.	Air in system.	Loosen ram connection and activate hydraulics until oil flow has no air in it (not whitish).
	Regulation valve incorrectly set	Open or close until desired speed is achieved (clockwise = less speed). Remember oil must be at operating temperature.
	Insufficient hydraulic pressure.	Check output pressure of tractor hydraulics. Minimum for sprayer is 130 bar.
	Insufficient amount of oil in tractor reservoir.	Check and top up if needed.
Ram not functioning.	Restrictor or regulation valve blocked.	Secure boom with "S" hook. Dismantle and clean.

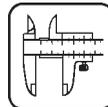
Emergency operation of BK/EC and EC

In case of power failure it is possible to operate all functions of the operating unit manually. First disconnect the multiplug from the control box. Now manually turn the emergency control knobs. The problem may be due to a blown fuse. The fuses are placed in the control box and are marked according to functions. Fuses 7 and 8 are spare fuses.
 Fuse type T 500 mA HARDI ref. no. 261125



Technical specifications

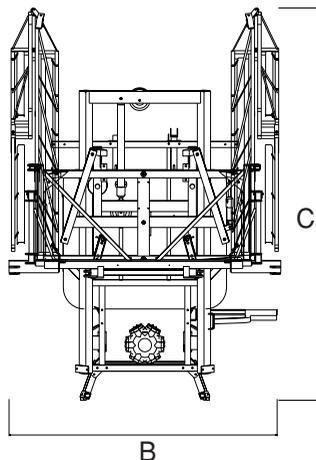
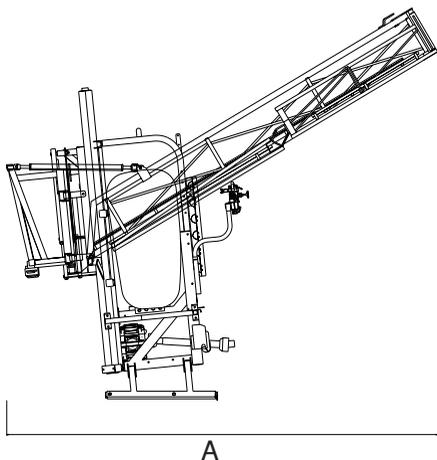
Pump power consumption and capacity

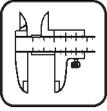


361/9.5	r/min									
	300		400		500		540		600	
bar	l/min	kW	l/min	kW	l/min	kW	l/min	kW	l/min	kW
0	95	0,92	127	1,33	158	1,56	171	1,69	189	1,85
5	92	1,49	123	1,93	151	2,38	165	2,63	183	2,98
10	91	2,22	120	2,89	148	3,69	163	4,02	180	4,74
15	89	3,03	119	3,92	148	4,90	160	5,40	177	6,15
Rotation per min.	r/min	Capacity				l/min	Suction height			0,0 m
Power consumption	kW	Max. pressure				15bar	Weight			54,0 kg

Measure and weight

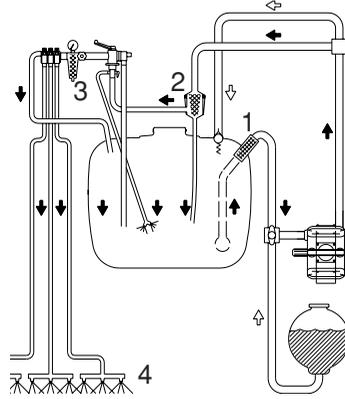
Tank size l	Spray width	Pump model	Pump capacity	Measure L x W x H cm	Weight kg
800	12	361	171	280 x 245 x 295	912
	15	361	171	380 x 245 x 330	936
	16	361	171	380 x 245 x 330	966
	18	361	171	400 x 245 x 350	976
1000	12	361	171	280 x 245 x 295	919
	15	361	171	380 x 245 x 330	943
	16	361	171	380 x 245 x 330	973
	18	361	171	400 x 245 x 350	983
	20	361	171	420 x 245 x 370	1036
1200	21	361	171	420 x 245 x 370	1046
	12	361	171	280 x 245 x 290	945
	15	361	171	380 x 245 x 325	969
	16	361	171	380 x 245 x 325	999
	18	361	171	400 x 245 x 345	1009
	20	361	171	420 x 245 x 365	1062
	21	361	171	420 x 245 x 365	1072





Filters and nozzles

Pos.	Mesh/ colour	Description/ nozzle
1	30 green	Suction filter
2	80 red	Self-Cleaning Filter (if fitted)
3	50 blue	Pressure filter
4	50 blue	Nozzle S4110-14 Nozzle S4110-16 Nozzle S4110-20



Temperature and pressure ranges

Operating temperature range: 2° to 40° C.

Operating pressure for safety valve: 15 bar

Max. pressure on the pressure manifold: 20 bar

Max. pressure on the suction manifold: 7 bar

Electrical connections

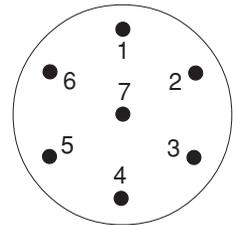
Rear lights

Position

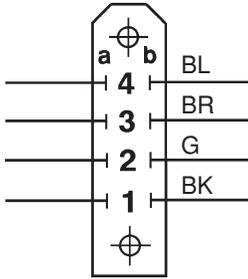
Wire colour

1. LH direction indicator
2. Free
3. Frame
4. RH direction indicator
5. RH rear position lamp
6. Stop lamps
7. LH rear position lamp

- Yellow
Blue
White
Green
Brown
Red
Black



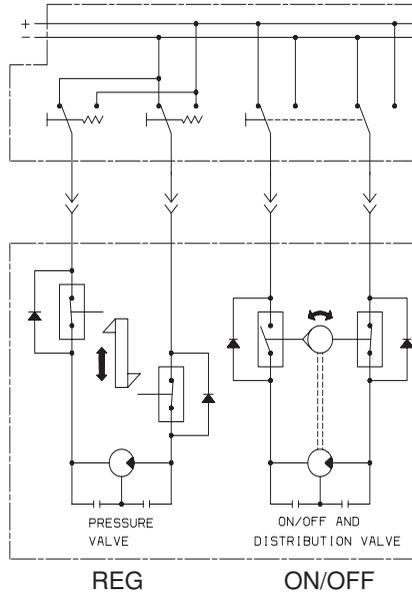
BK/EC



REG		ON/OFF	
BR	BL	BL	BR
BK	G	BR	BL
1	2	3	4

BL = Blue
 BR = Brown
 G = Gray
 BK = Black

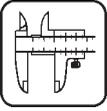
BK/EC and EC



EC

	Number of distribution valves		
	2 / 3 / 4	5 / 6	7
Valve	Wire number or colour code		
V1	1-2	1-2	1-11
V2	3-4	3-4	2-12
V3	5-6	5-6	3-13
V4	7-8	7-8	4-14
V5		9-10	5-15
V6		11-12	6-16
V7			7-17
REG	9-10	13-14	9-10
ON/OFF	11-G/Y	15-G/Y	8-G/Y

G/Y = green/yellow



Materials and recycling

Tank: HDPE
Hoses: PVC
Valves: mainly glass-filled PA.
Fittings: PA

Disposal of the sprayer

When the equipment has completed its working life, it must be thoroughly cleaned. The tank, hose and synthetic fittings can be incinerated at an authorized disposal plant. The metallic parts can be scrapped. Always follow local legislation regarding disposal.



Pictorial symbols



Description



Service/adjustment



Winter storage



Function



Liquid flow



Operational problems



Connection



Pressure



Technical specifications



Warning



Cleaning



EU Declaration of Conformity



Operating



Lubrication

