

MASTER TWIN STREAM

Instruction book

679042-GB-2003/02



We congratulate you for choosing a HARDI plant protection product. The reliability and efficiency of this product depend upon 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 this instruction book covers all MASTER models with VHY or VHZ boom, and all models with either BK or EVC operating unit, please pay attention to the paragraphs dealing with precisely your model.

This book is to be read in conjunction with the “Spray Technique” book.

Illustrations, technical information and data in this book are to the best of our belief correct at the time of printing. As it is HARDI INTERNATIONAL A/S policy permanently to improve our products, we reserve the right to make changes in design, features, accessories, specifications and maintenance instructions at any time and without notice.

HARDI INTERNATIONAL A/S is without any obligation in relation to implements purchased before or after such changes.

HARDI INTERNATIONAL A/S cannot undertake any responsibility for possible omissions or inaccuracies in this publication, although everything possible has been done to make it complete and correct.

As this instruction book covers more models and features or equipment, which are available in certain countries only, please pay attention to paragraphs dealing with precisely your model.

Published and printed by HARDI INTERNATIONAL A/S

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CE Declaration



Declaration of Conformity

Manufacturer,

HARDI INTERNATIONAL A/S
Helgeshøj Allé 38
DK 2630 Taastrup
DENMARK

Importer,

declare that the following product;

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 current standards implementing harmonised standards in accordance with Article 5 (2) and other relevant standards.

Taastrup, March 2002

Lars Bentsen
Product Development Manager
HARDI INTERNATIONAL A/S

Adhere extra shipping package labels in the  *Product Identification Certificate.*

Important safety notes

Operator's 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 is 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 while 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 while spraying or working with contaminated equipment.



Wash and change clothes after spraying.



Wash tools if they have become contaminated.



In case of poisoning, immediately seek medical advice. 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.



If any portion of this instruction book remains unclear after reading it, contact your HARDI dealer for further explanation before using the equipment.

Safety precautions - crop protection chemicals



Always be careful when working with crop protection chemicals!

Personal protection

Depending on chemical type, protective gear /equipment should be worn to avoid contact with the chemicals, e.g.:

- Gloves
- Waterproof boots
- Headgear
- Respirator
- Safety goggles
- Chemical resistant overall



Protective clothing/equipment should be used when preparing the spray liquid, during the spray job and when cleaning the sprayer. Follow the chemical manufacturer's instructions given on the chemical label.



It is always advisable to have clean water available, especially when filling the sprayer with the chemical.



Always clean the sprayer carefully and immediately after use.



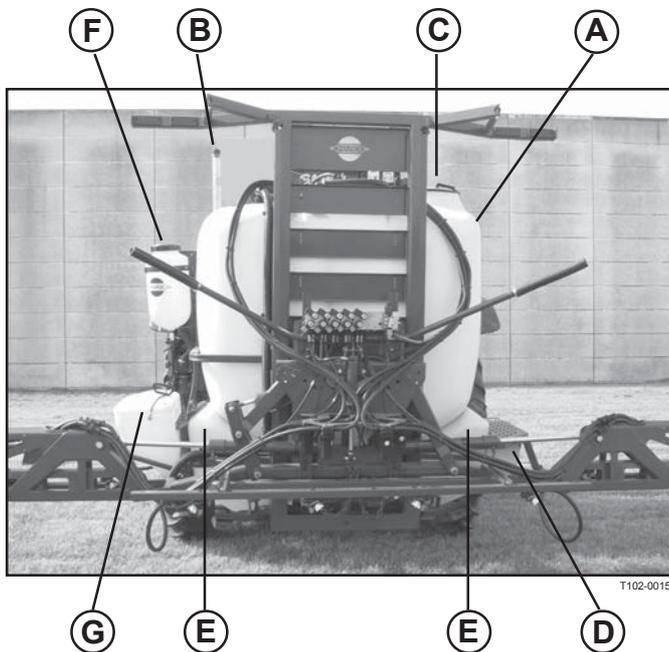
Only mix chemicals in the tank according to directions given by the chemical manufacturer.



Always clean the sprayer before changing to another chemical.

Description

Description and review of the MASTER sprayer



Tank

The tank (A), made of impact-proof and chemical resistant polyethylene, has a purposeful design with no sharp corners for easy cleaning. Nominal contents: 800, 1000 or 1200 litres.

A large, easy to read tank contents indicator (B) is placed in front of the tank.

The filling hole (C) and a footboard (D) is placed at the right hand side of the sprayer. This ensures an easy access for the filling of sprays, cleaning of the tank, etc.

Rinsing tank(s) (E) are optional equipment.

Clean water tank (F) is optional equipment.

HARDI-FILLER (G) is optional equipment.

Frame

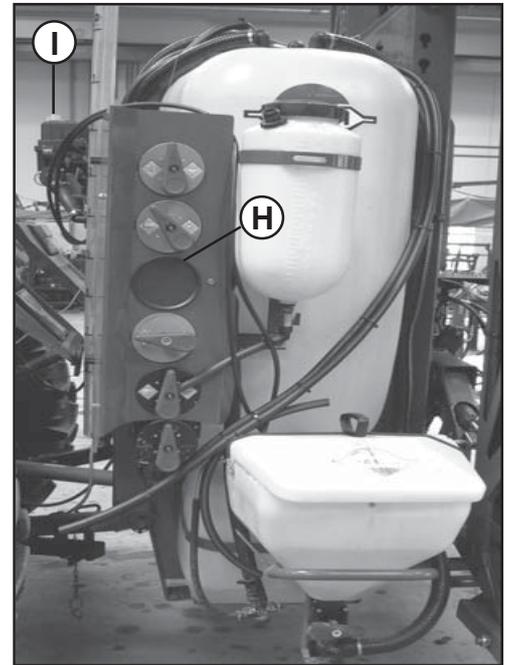
Very strong and compact frame which also has a strong chemical and weather resistant electrostatic lacquer coat. Screws, nuts, etc. have been DELTA-MAGNI treated to be resistant to corrosion.

Pump

Diaphragm pump model 1302 or 363. The design of the diaphragm pump is simple, with easily accessible diaphragms and valves which ensures liquid does not contact the vital parts of the pump.

MANIFOLD system

The functions of the spray circuits are operated via the centrally situated MANIFOLD valves with colour coded plates and pictorial symbols for easy operation (H).



Operating unit

The sprayer is equipped with either a BK operating unit or an EVC unit (I).

BK operating unit

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.

EVC unit

EVC - Electrical Valve Control. The ON/OFF is linked to the section valves, which results in a very quick response to ON/OFF. The operating unit is constructed of modules and is electrically controlled via a remote control box. The unit is fit with built-in HARDI-MATIC.

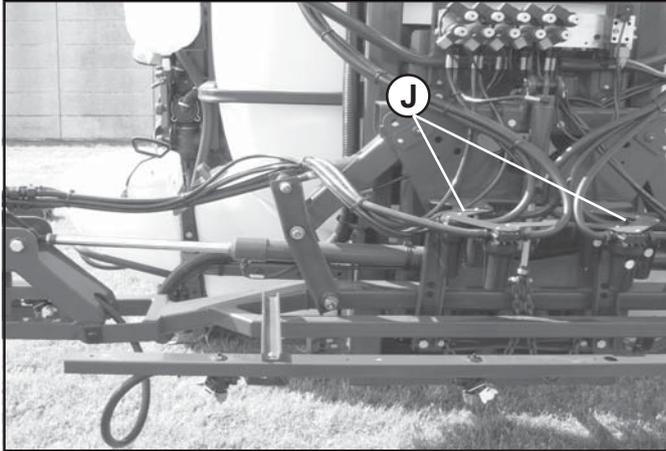
HARDI-MATIC ensures a constant volume per hectare of the liquid (l/ha) at varying forward speed within the same gear when the number of P.T.O. revolutions are between 300-600 r/min.

Description

Filters (optional equipment)

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.

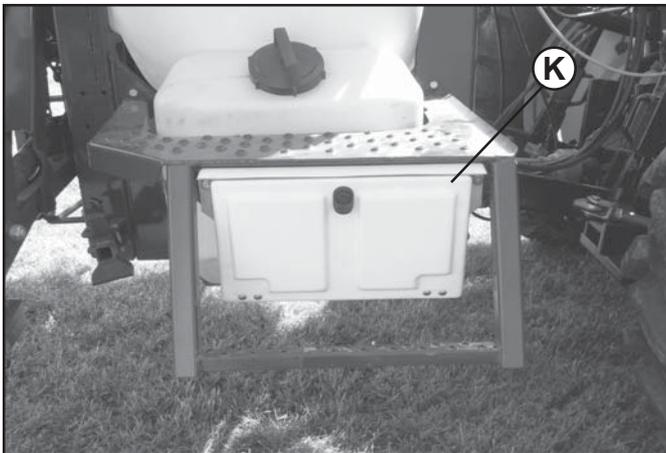
Also suction filter and nozzle filters are standard. In-line pressure filters can be fitted as option (J).



T102-0017

Safety locker (optional equipment)

A safety locker (K) can be mounted underneath the footboard for the storage of safety gear.



T102-0018

Boom

The sprayer is fitted with TWIN STREAM (MA-HAL) boom. The boom are supported by a trapeze which is fitted to the tank frame.

The trapeze helps the boom to stay horizontal when unfolded and it protects the boom against vibrations and shocks when driving on uneven ground. This ensures longer boom life and improves boom stability for better spray distribution.

Booms are available in 12 and 15 m working width for the TWIN STREAM model. All booms are provided with spring loaded breakaway.

Identification plates

An identification plate fitted on the frame indicates producer name, model, own weight, max height, max pressure of the hydraulic system and max pressure of the spray liquid system. Frame, boom centre frame and inner/outer sections also have identification plates indicating boom type and part number. If ordering spare parts, inform your dealer of these numbers.

Sprayer use

The HARDI MASTER sprayer is for the application of crop protection chemicals and liquid fertilisers.

The equipment must only be used for this purpose. It is not allowable to use the sprayer for other purposes.

If no local law demands that the operator must be certified to use spray equipment, it is strongly recommended to be trained in correct plant protection and in safe handling of plant protection chemicals to avoid unnecessary risk for persons and the environment when doing your spray job.

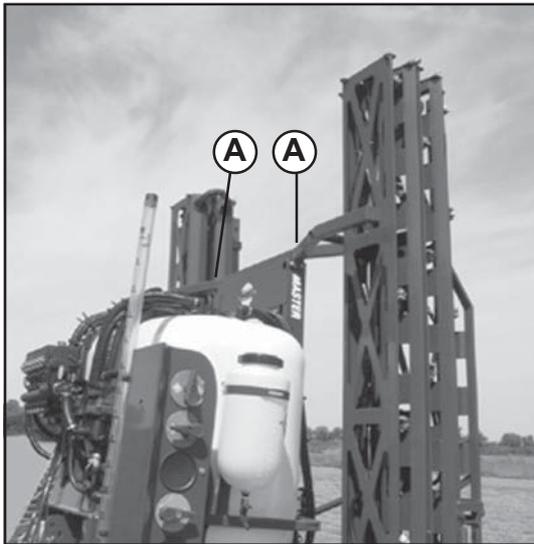
Description

Unloading the sprayer from the truck

Lifting points

For the unloading of the sprayer, you need a crane or a fork lift.

When unloading with a crane please observe the two lifting points (A) as shown on the picture below, and make sure that the straps or belts used for lifting are strong enough.



Before putting the sprayer into operation

Although the sprayer has been applied with a strong and protective surface treatment on steel parts, bolts etc. in the factories, it is recommended to apply a film of anticorrosion oil (e.g. CASTROL RUSTILLO or SHELL ENSIS FLUID) on all metal parts in order to avoid chemicals and fertilisers discoloring the enamel.

If this is done before the sprayer is put into operation for the first time, it will always be easy to clean the sprayer and keep the enamel shiny for many years.

This treatment should be carried out every time the protection film is washed off.

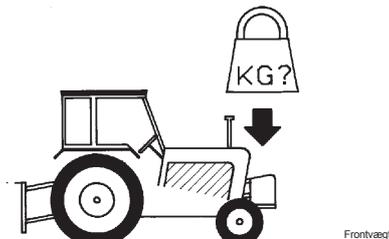
Sprayer setup

Connecting/disconnecting the sprayer

Safety information



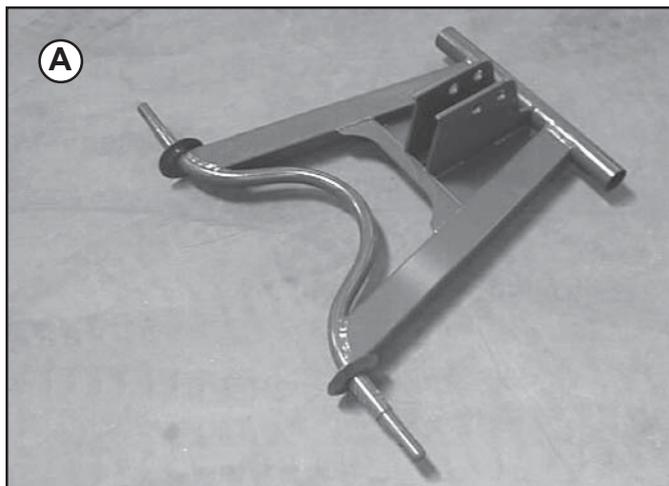
WARNING! Note the weight of the sprayer. General recommendations are as follows:



1. Add ballast to front of tractor, if necessary.
2. Check tyre pressure (see tractor's instruction book).
3. Be careful when filling/lifting the sprayer for the first time.
4. Ensure the operating unit and tractor do not touch.
5. Travel at slower speeds when driving with a full tank, as the tractor braking effect will be reduced.

Quick hitch

The sprayer is designed for three point suspension (cat. II). A quick hitch (A) is supplied with the sprayer. Fit the quick hitch to the tractor for easy hook-up of the sprayer.



T102-0019

Support legs

The frame has two retractable support legs that can be turned in to minimise crop damage.

NOTE! The support legs must be unfolded before lowering and disconnecting the sprayer.

How to unfold support legs

1. Lift spring-loaded catch (B) from the front hole (spraying position).
2. Swing support legs (C) backwards.
3. Fit catch (B) in the back hole (storage position).

Support legs are turned in in reverse order.

Picture B shows support legs in spraying position. Picture C shows support legs in storage position.



T102-0020



T102-0021

Storage wheels

The sprayer can be equipped with nylon tires for support of the sprayer during storage. Storage wheels are fitted to the support legs.

NOTE! Tank must be empty when using storage wheels. Max weight: 250 kg/tyre

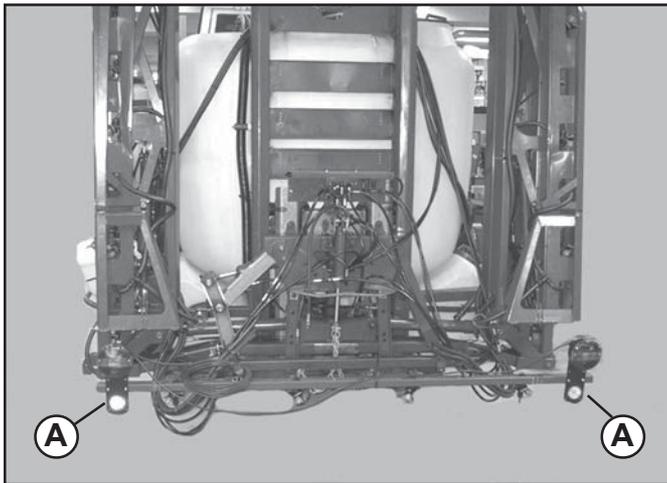
Sprayer setup

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.

Rear lights (optional equipment)

The sprayer can be equipped with rear lights (A).



T250-0002

Connect plug for rear lights to the tractor's 7-pin socket and check the functions of rear lights, stop lights and direction indicators on both sides of the sprayer before driving.

The wiring is in accordance with ISO 1724. (See section on Technical Specifications).

Sprayer setup

Transmission shaft

Operator safety

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

1. 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.
2. 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.

3. 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.
4. Do not touch or stand on the transmission shaft when it is rotating - safety distance: 1.5 meter.
5. Prevent protection guards from rotating by attaching the chains allowing sufficient slack for turns.
6. Make sure that protection guards around tractor P.T.O. and implement shaft are intact.
7. Always STOP ENGINE and remove the ignition key before carrying out maintenance or repairs to the transmission shaft or implement.

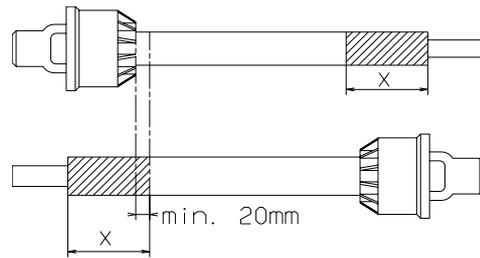
Installation of transmission shaft

First installation of the transmission shaft is done in the following way:

1. Attach sprayer to tractor and set sprayer height 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.

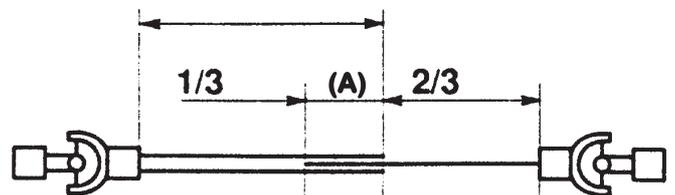


T259-0004

NOTE! The shaft must always have a minimum overlap. The size of this overlap depends on the pump model:

Pump with 6 splines/540 r.p.m.

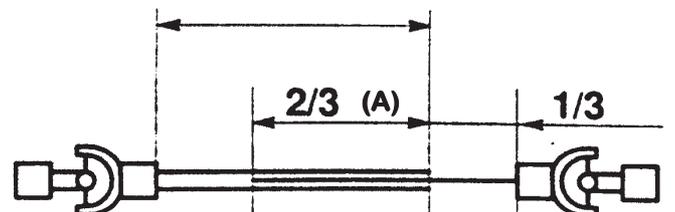
The shaft must always have an overlap (A) of minimum 1/3 of the length.



T259-0011

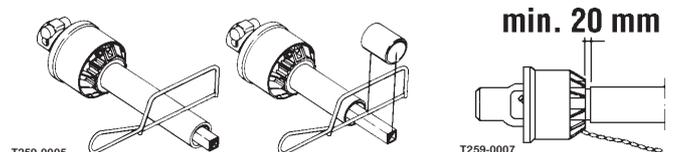
Pump with 21 splines/1000 r.p.m.

The shaft must always have an overlap (A) of minimum 2/3 of the length.



T259-0011

4. The two parts are shortened equally. Use a saw, and file the profiles afterwards to remove burrs.

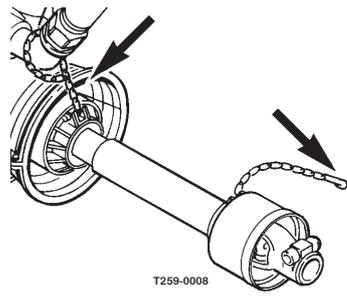


5. Grease the profiles and assemble male and female parts again.
6. Fit the shaft to tractor P.T.O. and sprayer pump shaft.

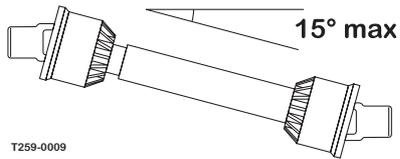
NOTE! Female part marked with a tractor towards tractor!

Sprayer setup

7. Fit the chains to prevent the protection guards from rotating with the shaft.



8. To ensure long life of the transmission shaft, try to avoid working angles greater than 15°.



Sprayer setup

Hydraulics

Requirements - tractor

Connection requirements are

- single outlet to raise or lower the boom,
- double outlet to fold/unfold the boom and angle the outlet,
- single return drain line to the tractor.

The hydraulic hose with the red arrow indicates direction of oil flow to unfold the boom and turn the fan. Maximum permissible oil pressure is 180 bar. See also section on Technical specifications.

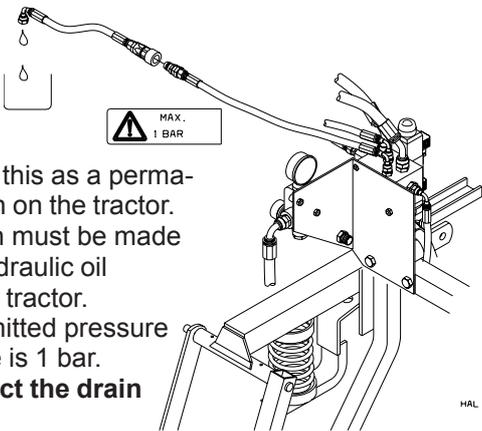


CAUTION! All hoses **MUST** be connected. Ensure the snap couplers are thoroughly clean before connection. Failure to do so will cause premature wear to the blower hydraulics.

Drain line

The sprayer is supplied with a short hydraulic hose with coupler and fittings. Fit this as a permanent installation on the tractor. The connection must be made direct to the hydraulic oil reservoir of the tractor. Maximum permitted pressure in the drain line is 1 bar.

Always connect the drain line.



NOTE! Pressures over 1 bar or failure to connect the drain line will damage the hydraulic motor seal.

Oil purity

Oil from the tractor to the sprayer must as minimum have been filtered according to ISO 4406 20/14. Particles measured over 25 micron Absolute must be filtered from the oil (Filtration quotient β_{25-75} , ISO 4572-81 Multipass test).

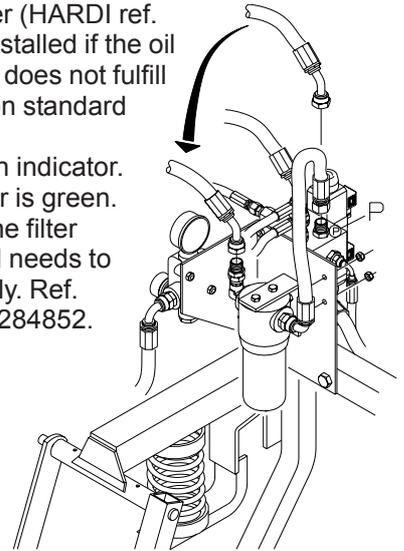
Follow the tractor oil change schedule as directed. Choose hydraulic oil with anti-foam and anti-oxidant additives.

Be especially cautious where the tractor transmission oil is also the oil used for the implement hydraulics. Consult the tractor dealer if in doubt.

Oil pressure line filter (if fitted)

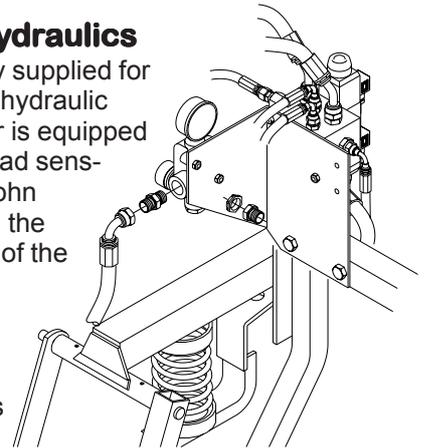
An oil pressure line filter (HARDI ref. no. 729555) must be installed if the oil supplied to the sprayer does not fulfill the minimum oil filtration standard ISO 4406 20/14.

The HARDI filter has an indicator. Check that the indicator is green. If the indicator is red, the filter element is clogged and needs to be changed immediately. Ref. no. for filter element is 284852.



Closed centre hydraulics

The sprayer is factory supplied for use with open centre hydraulic systems. If the tractor is equipped with closed centre (load sensing) hydraulics e.g. John Deere, the bypass on the hydraulic valve block of the sprayer needs to be blocked off. The sprayer is supplied with an extra 1/2" nipple made of brass with no perforation.



To convert sprayer for closed centre hydraulics:

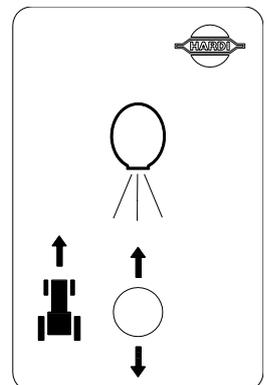
1. Disconnect hydraulic hose **A**.
2. Swap standard black 1/2" nipple **B** with brass nipple **C**.
3. Connect hydraulic hose **A**.

Electric remote for air stream angle

The control box is fitted at a convenient location in the tractor cabin.

Power requirement is 12 V DC. Note polarity. Brown pos. (+), Blue neg. (-).

Use the HARDI Electric Distribution Box ref. no. 817925 if the tractor has a doubtful power supply.



Sprayer setup

General information

Ensure that snap couplers are clean before connection!



NOTE! The hydraulic system requires a minimum oil pressure of 100 bar and an oil capacity of approx. 2 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.

Safety information



WARNING! Test of the hydraulic system should be done very cautiously. There may be air trapped in the system which can cause violent movements of the boom.



WARNING! Hydraulic leaks. Never use your fingers to locate a leakage in any part of the hydraulic system. Due to high pressure, hydraulic oil may penetrate the skin.

Control boxes and power supply

Control boxes

Control boxes are fitted in the tractor cabin at a convenient place. Tapping screws can be used for mounting.



T102-0022

Power supply

Power requirement is 12V DC. Note polarity!

The wires must have a cross sectional area of at least 4.0 mm to ensure a sufficient power supply. For the EVC operating unit the tractor circuit should have an 8 Amp fuse

Control box	Polarity (wire colour)		Fuse (Amp)
	Positive +	Negative -	
EVC control unit	Brown	Blue	8

Operation

Operating the boom

Safety information



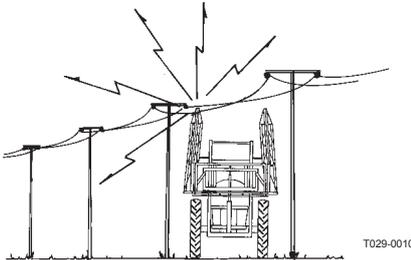
WARNING! Before unfolding the boom it is important to connect the sprayer to the tractor to prevent overbalancing of the sprayer.



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.



DANGER! When folding or unfolding the boom, make sure that no persons or objects are in the operating area of the boom.



DANGER! Always follow the guidelines listed below when driving in areas with overhead power lines:

- Never use the folding/unfolding functions in areas with overhead power lines.
- Unintended boom movements can cause contact with overhead power lines.

NOTE! A label (ref. no. 978448) follows the sprayer. This label must be placed in the cabin at a place visible from the operator's seat.

General information

Following operations are carried out by the tractor's hydraulic control lever(s)

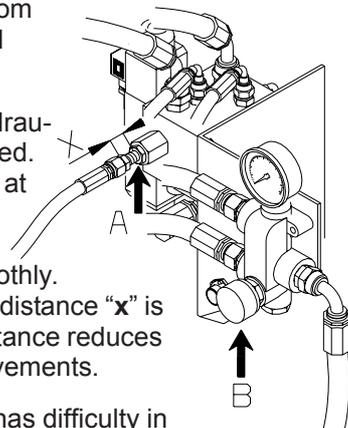
- Raising/lowering of the boom
- Folding/unfolding the boom
- Slanting control (optional equipment)

Speed regulation of the hydraulic movements can be altered.

A restrictor valve is located at the hydraulic block on the blower. It must be adjusted so the boom operates smoothly. Nut **A** is loosened, and the distance "x" is adjusted. Reducing the distance reduces the speed of the boom movements.



NOTE! If the boom has difficulty in unfolding, increase the oil flow to the blower by turning valve **B** on the blower.



HAL 6

How to unfold the boom

1. Activate hydraulic control lever
2. Raise boom until it is clear of the transport brackets.
3. Turn blower on to prevent boom hydraulics by-passing through the blower.
4. Activate double-acting hydraulic control lever to unfold the boom.
5. When boom wings are completely unfolded, activate lever to unlock trapeze.
6. Lower boom to desired working height.

How to fold the boom

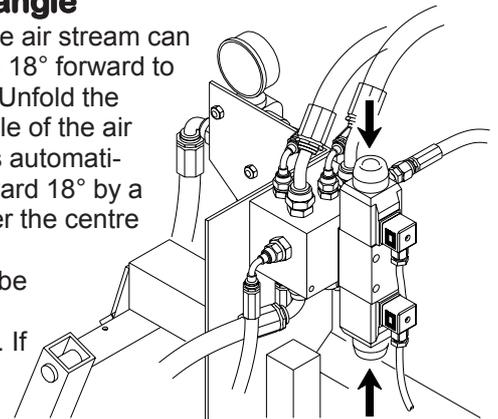
1. Activate hydraulic control lever.
2. Set slanting position at midway (if fitted).
3. Activate lever to lock trapeze.
4. Raise boom half-way to the top (minimum).
5. Activate double-acting hydraulic control lever to fold boom.
6. Lower the boom completely so it is secure in the transport brackets.

Air stream angle

The angle of the air stream can be altered from 18° forward to 18° backward. Unfold the boom. The angle of the air stream outlet is automatically set backward 18° by a small ram under the centre section.

The angle can be altered via the electric remote. If the electric power should fail, it is possible

to manually change the angle by pushing the buttons on the solenoid valve on the blower.



Blower

Unfold the boom and lock the tractor double activating hydraulic lever to open position and increase engine revolutions to correspond with forward speed.

To increase or decrease the fan revolutions and thereby air volume, adjust valve **B** on the hydraulic block.



CAUTION! For the safety of the operator, no other persons may carry out adjustments.

After the oil has driven the hydraulic motor, it then passes through a cooler before returning to the tractor. This ensures the hydraulic oil does not overheat.



NOTE! For maximum performance from the blower, the tractor hydraulic system must meet the following demands.

Operation

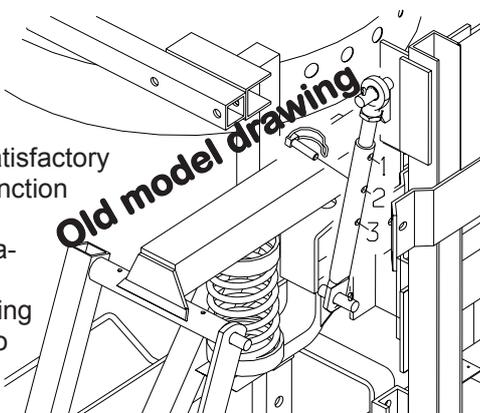
Boom size	Minimum oil flow l/min	Minimum pressure bar
12 m	38	180
15 m	44	165

The above table includes 25 bar back pressure on the tractor hydraulic system. See also section on Technical specifications. With load sensing or constant pressure systems, back pressure may be higher. If in doubt, contact your tractor dealer.

After initial operation of the boom and blower, check the hydraulic oil level of the tractor and top up if necessary.

Trapeze

The trapeze suspension needs to be correctly adjusted and lubricated for satisfactory operation. Its function is to protect the boom from vibration and shock thereby prolonging boom life. It also helps to keep the boom a uniform height from the target. See also sections Lubrication and Re-adjustment of the boom.



At delivery the boom is locked in pos. **2** which is used when driving on horizontal grounds. When driving on slopes the boom can be slanted in pos. **1** or **3** in order to keep the trapeze effect. Hydraulic slanting can be supplied as optional extra.

If Hydraulic Slanting Control is fitted, another double acting outlet is required. Note that whilst activating this function, fan output may be reduced.

Operation - liquid system

MANIFOLD system

Review - MANIFOLD system

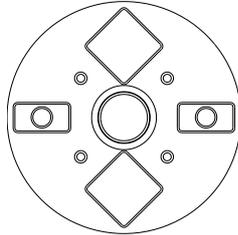
The MANIFOLD system is located at the left side of the sprayer and permits operation of the liquid from one position. The modular MANIFOLD system facilitates the addition of optional extras on both pressure side and suction side. Furthermore the suction manifold can be fitted with a return valve which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

Symbols

The 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.

A function is activated/opened by turning the handle towards the desired function.

IMPORTANT! Only the functions in use should be open - always close remaining valves.



Symbols - Green disc = Pressure valve

To Self-Cleaning Filter/operating unit	
To Fast Filling Device	
To HARDI FILLER	
To Tank Flushing Nozzle	
To main tank	
To front tank	

Symbols - Black disc = Suction valve

From main tank (suction filter)	
From Rinsing Tank	
From Filling Device	
From front tank (suction filter)	

Symbols - Blue disc = Return valve

Return from operating unit - used for agitation (Spraying position)	
Return from operating unit to suction side of pump (Used for fully emptying main tank)	

Electrically operated MANIFOLD valves (optional equipment)

One or more MANIFOLD valve(s) can be electrically operated via a control box in the tractor cabin. These can only be operated manually if the power to the valve motor is disconnected.

Adjustment of 3-way valve

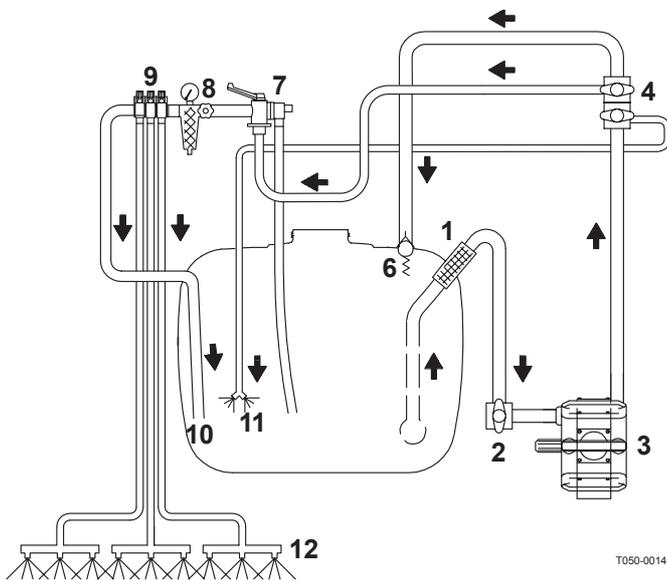
NOTE! If a MANIFOLD valve is too tense to operate - or too loose (= liquid leakage) - the 3-way valve needs to be serviced. Please see the section 'Maintenance' for further information.

Operation - liquid system

Function diagrams

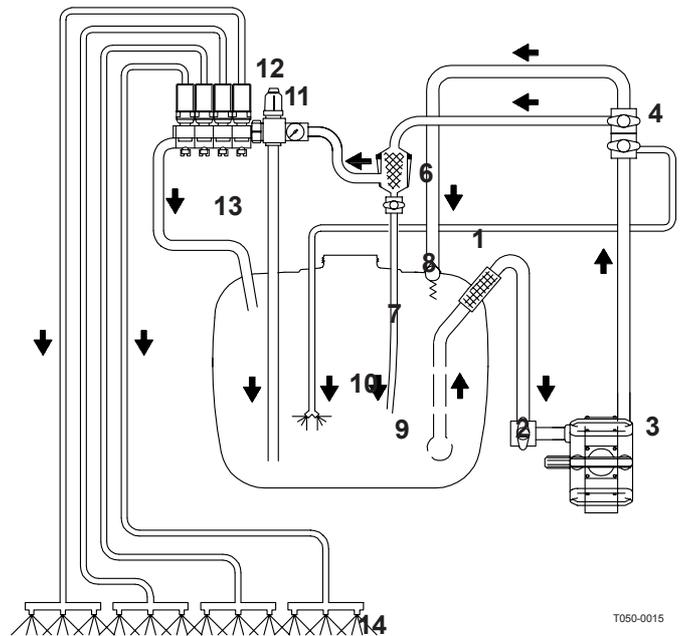
BK operating unit

1. Suction filter
2. Suction MANIFOLD
3. Pump
4. Pressure MANIFOLD
- 5.
6. Safety valve
7. Operating unit ON/OFF
8. Pressure regulation
9. Distribution valves
10. Return to tank from pressure equalization
11. Agitation
12. Distribution boom



EVC operating unit

1. Suction filter
2. Suction MANIFOLD
3. Pump
4. Pressure manifold
- 5.
6. Self-cleaning filter
7. Return line (self-cleaning filter)
8. Safety valve
9. Agitation
10. Pressure agitation
11. Pressure regulation
12. Distribution valves
13. Return from pressure equalization
14. Distribution boom



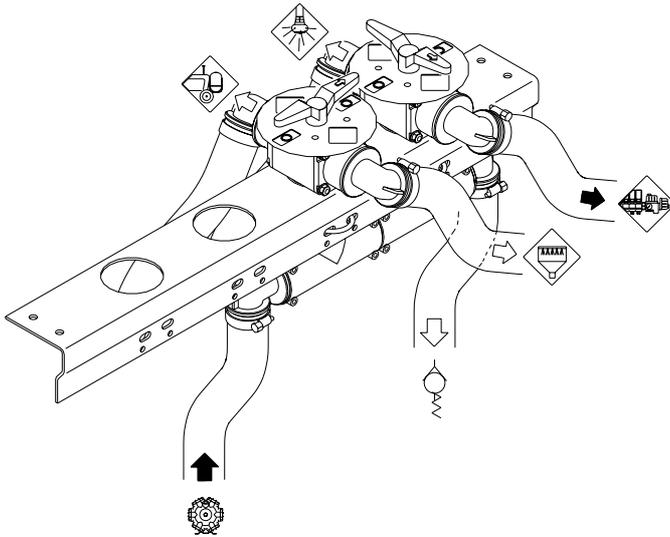
Operation - liquid system

Operating instructions - valves

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

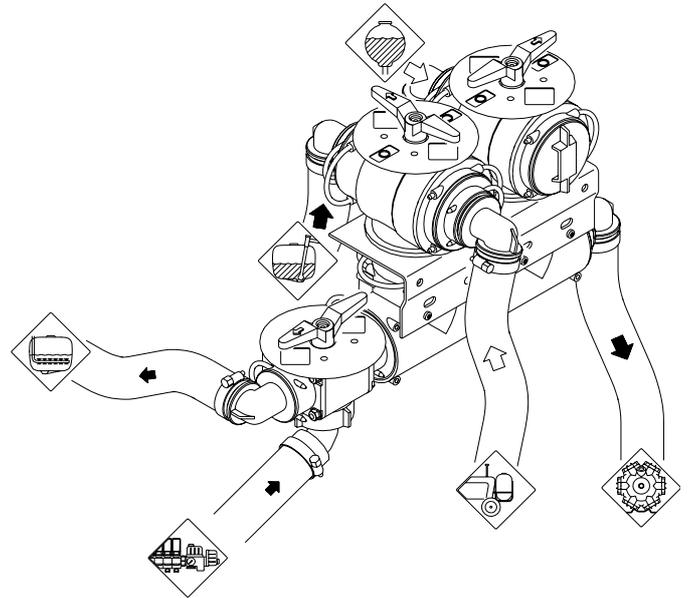


To select the optional equipment, the handle is turned so the arrow and thereby liquid is directed to the optional extra instead of to the self-cleaning filter/operating unit. When spraying is to resume, turn the handle so the self-cleaning filter/operating unit is selected.

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, e.g. 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 to the tank return.

Operation - liquid system

Filling of water

Filling of main tank

Water can be filled into the main tank as follows:

1. **Filling through tank lid.**
2. **Suction filling device (optional equipment)**
3. **Fast filling device (optional equipment).**

Tank should normally be filled 1/3 with water before adding chemicals. Always follow instructions given on the chemical container!

IMPORTANT! If the sprayer is put aside with liquid in the main tank all MANIFOLD valves must be closed.

1. Filling through tank lid

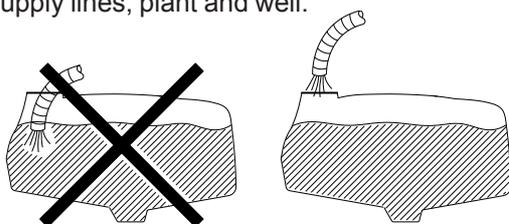
Water is filled into the tank by removing the tank lid located at right hand side of sprayer tank. It is recommended to use as clean water as possible for spraying purposes.

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.



T021-0012

2. Suction filling device (optional equipment)



WARNING! Avoid contamination or personal injury. Do not open suction valve towards Suction Filling Device unless pump is running and filling hose is connected. If this valve is opened without pump running, liquid will stream out of the MANIFOLD.

The Suction Filling Device is operated as follows:

1. Remove cover and connect suction hose to Suction Manifold.
2. Engage diaphragm pump and set P.T.O. revolutions at 540 r/min.

3. Turn handle on Suction Manifold towards Filling Device.
4. The tank is now filled with water. Keep an eye on the liquid level indicator.
5. Turn handle on Suction Manifold away from Filling Device to discontinue filling process. Then disengage pump.
6. Disconnect suction tube and replace cover.

NOTE! Observe local legislation regarding use of Filling Device. In some areas it is prohibited to fill from open water reservoirs (lakes, rivers etc.). It is recommended only to fill from closed reservoirs (mobile water tanks etc.) to avoid contamination.

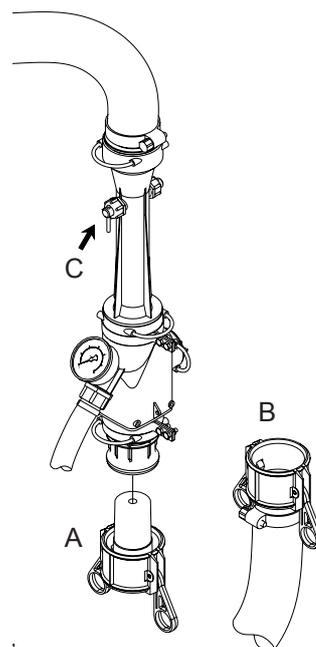


WARNING! If suction hose/filter is carried on the sprayer during spraying, it can be contaminated by spray drift which will be transferred to lake/river when filling!

3. Fast Filling Device (optional equipment)

The Fast Filling Device is operated as follows:

1. Ensure spray liquid tank contains at least 50 litres of water.
2. Remove cover (A) and connect suction hose (B).
3. Turn handle on Pressure Manifold towards Fast Filler. With the P.T.O. at 540 r/min the pressure gauge should indicate about 10 bar.
4. If water is not seen in the transfer tube, prime by turning valve (C).
5. Keep an eye on the liquid level indicator.
6. Turn handle on Pressure Manifold away from Fast Filler to discontinue filling process.



T041-0002

Operation - liquid system

NOTE! Turn handle towards operating unit **before** turning away from Fast Filler in order to avoid peak pressure blowing the safety valve!

7. Disconnect suction tube (B) and replace cover.



WARNING! Do not leave the sprayer whilst filling the tank and keep an eye on the level indicator in order NOT to overfill the tank.

NOTE! Observe local legislation regarding use of filling device. In some areas it is prohibited to fill from open water reservoirs (lakes, rivers etc.). It is recommended only to fill from closed reservoirs (mobile water tanks etc.) to avoid contamination

Filling of rinsing tank (optional equipment)

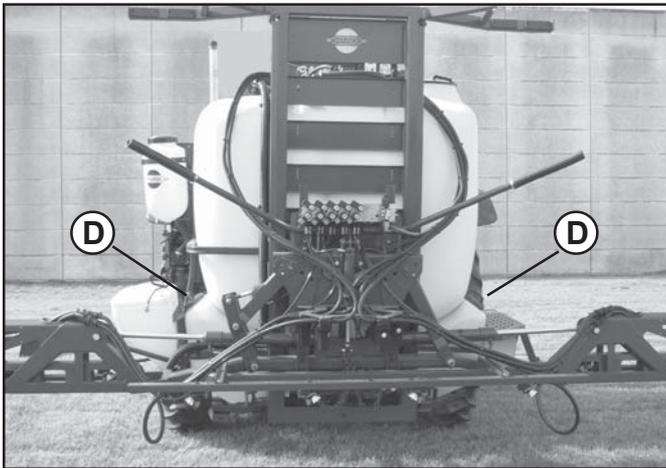
One or two rinsing tanks (depending on main tank size) can be mounted underneath the main tank.

Remove tank lid, fill with clean water and reposition tank lid.

Capacity: 80 litres per tank.

Picture below shows MASTER equipped with two rinsing tanks (D).

Only fill rinsing tank with clean water!



T102-0015

To avoid algae developing in the rinsing tank always drain the rinsing tank if the sprayer is not in use for a longer period.

Filling of clean water tank (optional equipment)

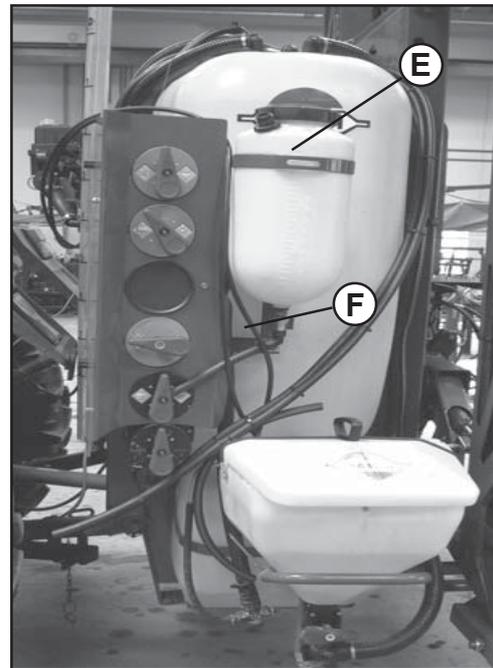
A clean water tank (E) can be fitted next to the MANI-FOLD system.

Remove tank lid, fill with clean water and reposition tank lid. Turn the ball valve (F) to open tap.

Capacity: 15 litres.

The water from this tank is for hand washing, cleaning of clogged nozzles etc.

Only fill the clean water tank with clean water from the well.



T102-0016



WARNING! although the clean water tank is only filled with clean water, this water must never be used for drinking.

Operation - liquid system

Filling of chemicals

Chemicals can be filled in the tank in two ways:

1. Through tank lid.
2. HARDI FILLER chemical filling device.



WARNING! Always wear correct protective clothing before handling chemicals!

1. Filling through tank lid

The chemicals are filled through the tank lid - Note instructions on the chemical container!

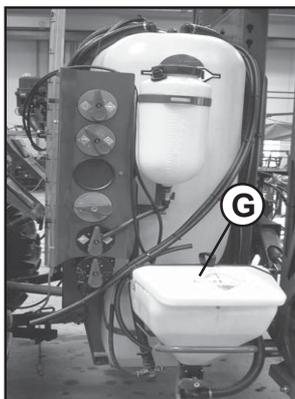


WARNING! Be careful not to slip or splash chemicals when carrying chemicals up to the tank lid!

1. Make sure the EVC is switched off.
2. Set the MANIFOLD valves to correct position. Black valve "Suction from main tank", green valve towards "Agitation"
3. Engage the pump and set P.T.O. revolutions to 540 r/min.
4. Add the chemicals through the main tank hole.
5. When the spray liquid is well mixed, turn handle on the Pressure Manifold towards "Spraying" position. Keep P.T.O. engaged so the spray liquid is continuously agitated until it has been sprayed on the crop.

2. HARDI FILLER chemical inductor (optional equipment)

HARDI FILLER (G)



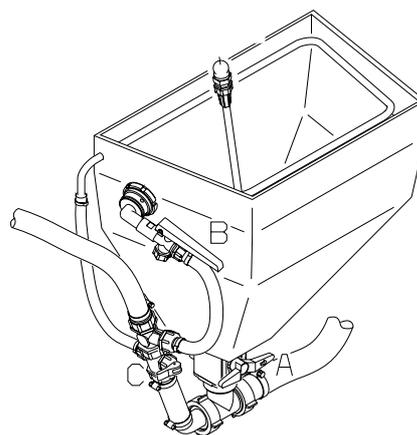
T102-0016

Filling of Liquid chemicals

1. Fill the main tank at least $\frac{1}{3}$ with water (unless something else is stated on the chemical container label). See section "Filling of water".
2. Turn the handle at the Suction Manifold towards "Main tank". Turn blue valve towards "Agitation and

green valve towards "HARDI FILLER". Close remaining valves.

3. Check that bottom valve **A** at the FILLER is closed.
4. Engage the pump and set P.T.O. speed at 540 r/min.
5. Open FILLER lid.
6. Measure the correct quantity of chemical and fill it into the hopper.



NOTE! The scale in the hopper can only be used if the sprayer is parked at level ground! It is recommended to use a measuring jug for best accuracy.

7. Open the bottom valve **A** and the chemical is transferred to the main tank.
8. If the chemical container is empty it can be rinsed by the container rinsing device (if fitted). Place the container over the multi-hole nozzle and press the lever **B**.



WARNING! Do not press lever **B** unless the multi-hole nozzle is covered by a container to avoid spray liquid hitting the operator.

IMPORTANT! Rinsing device uses spray liquid to rinse containers for concentrated chemicals. Always rinse the chemical containers with clean water several times until they are clean before disposal.

9. Engage the hopper rinsing device by opening valve **C**.
10. Close valve **C** again when the hopper is rinsed.

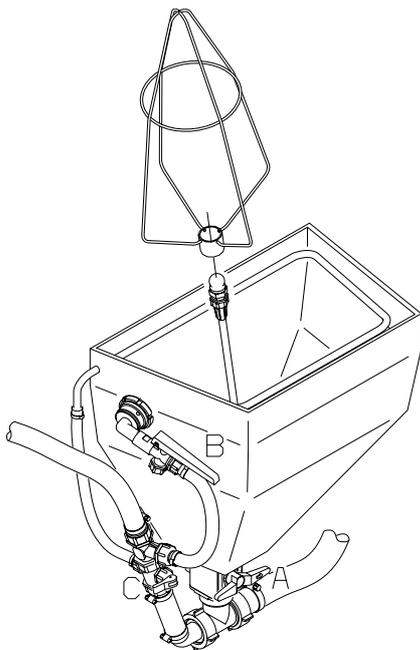
IMPORTANT! The hopper rinsing device is using spray liquid for rinsing the hopper for concentrated chemical! The FILLER must always be cleaned together with the rest of the sprayer when the spray job is done.

11. Close valve **A** and the FILLER lid again.
12. When the spray liquid is well mixed, turn handle on the Pressure Manifold towards "Spraying" position. Keep P.T.O. engaged so the spray liquid is continuously agitated until it has been sprayed on the crop.

Operation - liquid system

Filling of Powder chemicals

1. Fill the main tank at least $\frac{1}{2}$ with water (unless something else is stated on the chemical container label). See section "Filling of water".
2. Turn the handle at the Suction Manifold towards "Main tank" and blue valve towards "Agitation". Turn the green handle at the Pressure Manifold towards "HARDI FILLER". Close remaining valves.
3. Engage the pump and increase P.T.O. speed to 540 r/min.
4. Open the bottom valve **A** at the FILLER. Open FILLER lid.
5. Engage the hopper rinsing device by opening valve **C**.
6. Measure the correct quantity of chemical and sprinkle it into the hopper as fast as the rinsing device can flush it down.
7. If the chemical container is empty it can be rinsed by the container rinsing device (if fitted). Fit the bag bracket and place the powder bag over the multi-hole nozzle and press the lever **B**.



T042-0002



WARNING! Do not press lever **B** unless the multi-hole nozzle is covered by a container to avoid spray liquid hitting the operator.

IMPORTANT! Rinsing device uses spray liquid to rinse containers for concentrated chemicals. Always rinse the chemical containers with clean water several times until they are clean before disposal.

9. Close valve **C** again when the hopper is rinsed.

IMPORTANT! The hopper rinsing device is using spray liquid to rinse the hopper for concentrated chemical. The FILLER must always be cleaned together with the rest of the sprayer when the spray job is done.

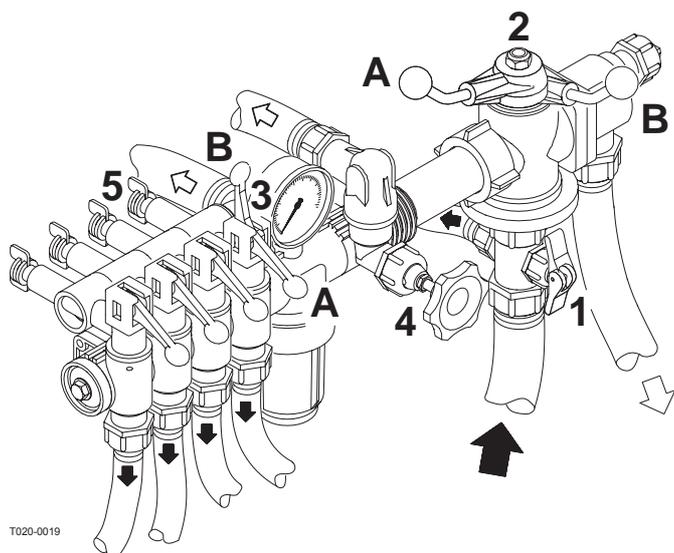
10. Close valve **A** and the FILLER lid again.
11. When the spray liquid is well mixed, turn handle on the Pressure Manifold towards "Spraying" position. Keep P.T.O. engaged so the spray liquid is continuously agitated until it has been sprayed on the crop.

Operation - liquid system

Adjustment of the operating unit

Adjustment of BK operating unit

1. Choose the correct nozzle. 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).



T020-0019

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.

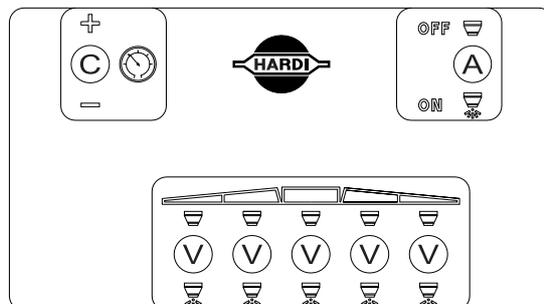
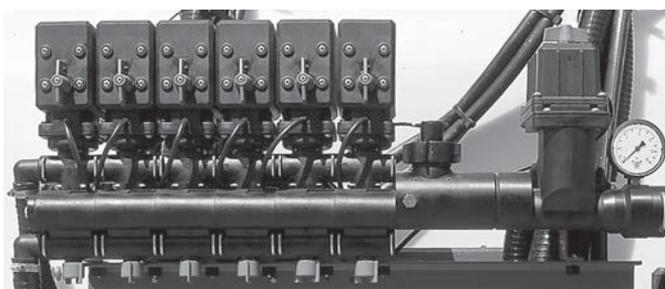
7. Adjust the HARDI-MATIC valve **4** so that the pressure gauge indicates the recommended pressure.

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 EVC operating unit



T020-0044

Before spraying, the EVC operating unit is adjusted using clean water (without chemicals).

1. Choose the correct nozzle for the spray job by turning the TRIPLET nozzle bodies. Make sure that all nozzles are the same type and capacity. See the "Spray Technique" book.
2. On-off switch **A** is activated against green.
3. All distribution valve switches **V** are activated against green.
4. Pressure regulation switch **C** is activated until emergency handle stops rotating (minimum pressure).
5. 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. Remember the number of revolutions on the P.T.O. must be kept between 300-600 rpm (pump 540 r/min) or 650-1100 rpm (pump 1000 r/min).
6. Pressure regulation switch **C** is activated until the required pressure is shown on the pressure gauge.

Adjustment of pressure equalisation

1. Close the first distribution valve switch **V**.
2. Turn the adjusting screw(s) until the pressure gauge again shows the same pressure.
3. Adjust the other sections of the distribution valve in the same way.

Operation - liquid system

NOTE! HEREAFTER ADJUSTMENT OF PRESSURE EQUALISATION WILL ONLY BE NEEDED WHEN:

1. YOU CHANGE TO NOZZLES WITH OTHER CAPACITIES
2. THE NOZZLE OUTPUT INCREASES AS THE NOZZLES WEAR

Operating the control unit while spraying

In order to close the entire boom, switch ON/OFF **A** to off position. This returns the pump output to the tank through the return system.

The diaphragm Non-drip valves ensure instantaneous closing of all nozzles.

In order to close one or more sections of the boom, switch the relevant distribution valve **V** to off position. The pressure equalisation ensures that the pressure does not rise in the sections which are to remain open.

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

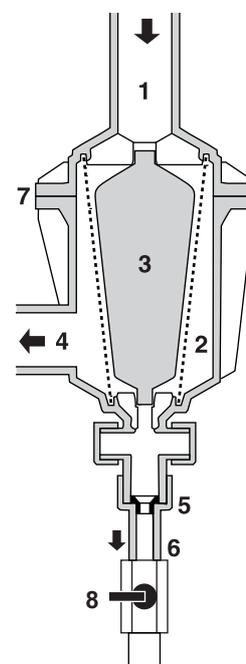
Filters

All filters should always be in use and their function checked regularly. Pay attention to the correct combination of filter and mesh size. The mesh size should always be less than the flow average of the nozzles in use.

Self-cleaning filter

Function diagram

1. From pump
2. Double filter screen
3. Guide cone
4. To operating unit
5. Exchangeable restrictor
6. Return to tank
7. Screw joint
8. Ball check valve



Ball check valve (8) should normally be open, but can be closed in situations where return flow is to be avoided.

NOTE! If ball check valve is closed the self-cleaning filter is inoperative!

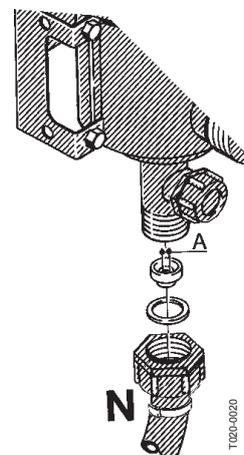
Choice of restrictor

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 orifice **A** first).

Hose **N** is removed from the filter. Be careful not to lose 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.

Operation - liquid system

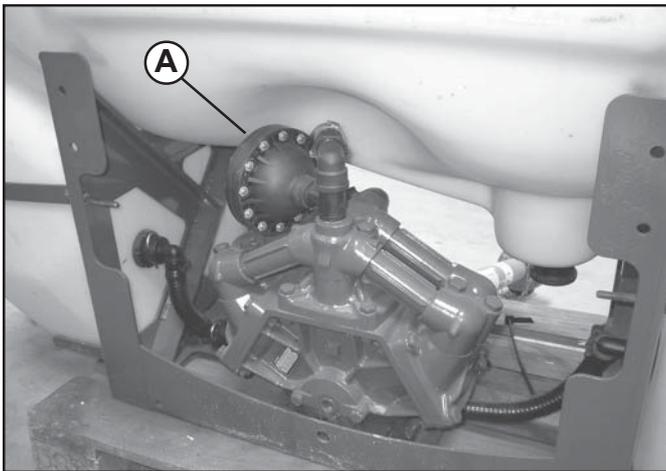
Standard filter size is 80 mesh. Filters of 50 and 100 mesh are available and can be changed by opening the filter top. Check condition of O-rings before reassembly and replace if damaged.

Pulsation damper (if fitted)

The air pressure in the pulsation damper **A** is factory preset at 2 bar to cover spray working pressures between 3 and 15 bar.

When using spray pressures outside this range, the air pressure should be adjusted as shown in the diagram. The diagram is also embossed on the damper.

bar	bar
1.5 - 3	0 - 1
3 - 15	1 - 3
15-25	3 - 4

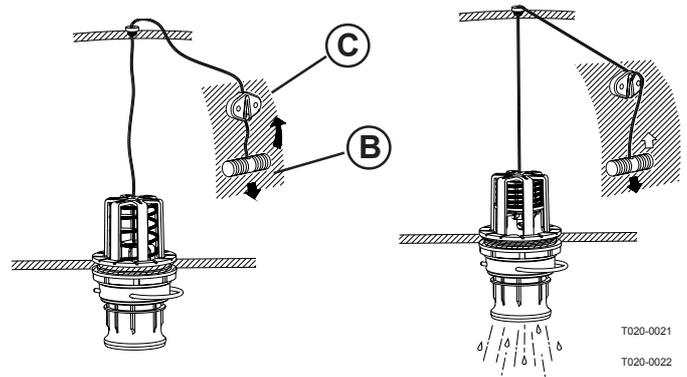


T102-0014

Tank drain valve

How to operate

Pull the string (B) 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 (C). To release, pull the string downward and the valve will close automatically.

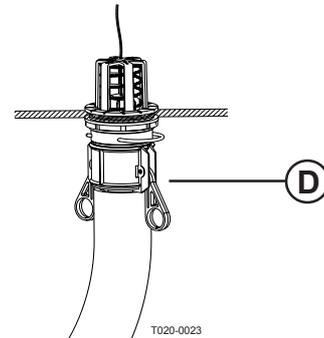


T020-0021

T020-0022

Draining a residue

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



T020-0023

Spray Technique - see separate book.

Optional extras - see separate books.

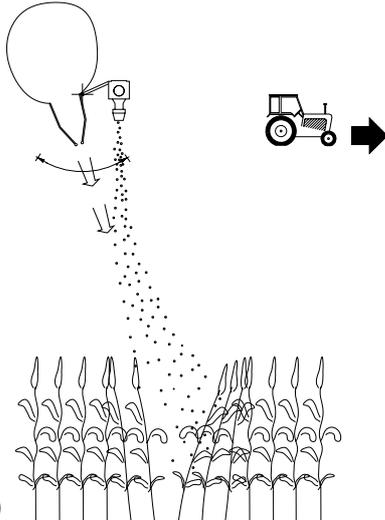
Air Technique

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

Air technique

With TWIN air assistance energy is added to the spray droplets to improve control with the spray liquid . This way TWIN makes it possible to:

- carry the spray droplets safely to the target and increase plant deposit
- minimize off-target deposit due to wind drift or loss on the ground
- open the crop and obtain good penetration even with a low volume rate
- ensure a high coverage.



The principles

The angle between nozzles and air slot is fixed. The system can be angled hydraulically ranging from 18° forwards to 18° backwards. (0° = air vertical down)

Air speed / Air volume

The fan speed is infinitely variable and can produce from 0 to 35 m/s (78 mph) air speed at the air outlet. This equals from 0 to 2000 m³ air/m boom/hour (3.872 CFM/A boom/hour). The air speed must be adjusted to the spray job

Adjustment of air outlet and nozzles.

The fan air speed is adjusted either at the blower or it can be set from the tractor cabin via a remote control (optional extra).

A guiding air speed can be read via the oil pressure gauge at the blower:

	Air speed	low (L)	medium (M)	high (H)
	m/s	5-10	10-20	20-30
	Oil pressure at blower (bar)*			
	12 m boom	60-80	80-120	120-180
	15 m boom	40-60	60-100	100-160
	Blower r/min	470-930	930-1870	1870-2800

* Based on 25 bar back pressure.
 Back pressure depends on tractor manufacture and series, and it may well be below 25 bar, which means that the blower r/min. and air speed could be higher than listed.



NOTE! Necessary oil flow: see Technical specifications.

Spraying instructions - TWIN STREAM.

Instruction for angling of air and liquid.

The angle should be used for adjusting the liquid/air flow towards the wind direction.

- When driving with head-winds, adjust the slot forwards.
- When driving with down-winds, adjust the slot backwards.
- When driving with side-winds, the slot should be adjusted as follows:

1) Forward speed:

- When the speed exceeds 8 km/h the slot should be angled forwards (the faster the speed, the larger the angle).

2) Crop density and height:

- When spraying low crops e.g. weed spraying in beets or spraying bare soil a backwards angle is used. With this adjustment reflection of the spray liquid can be minimized as the air curtain works as a "shield" on top of the spray liquid.
- When spraying high and dense covering crops (e.g. potatoes) it would be an advantage to use the same adjustment because of the good penetration ability.
- When spraying medium to high cereal crops efforts are made - considering the forward speed - to obtain a spray angle which penetrates the crop directly. The crop should not be deflected so much during the air influence that further droplet transport towards the lower parts of the crop is blocked. When driving at generally recommended speeds and under neutral wind conditions the best adjustment will often be slightly forwards.
- It is recommended to check the spraying quality (deposit and penetration) with spray test paper.

Adjusting the air assistance

The air speed and angling must always be adjusted individually for each spray job and the given weather conditions.

It is always a good idea to get used to a new sprayer out in a field with only water in the tank, on this occasion the following routine for air adjustment should be practised:

1. Start with the air vertical
2. Set the air speed **A**
3. Find the best angling **B**
4. Readjust the air **A**

IMPORTANT! Fine turning of air speed and angling will often be necessary all through the spraying job.

It is easiest to find the best air setting to reduce drift when the sun is low and behind the boom (backlight). These conditions make the drift more visible.

Air Technique

A Setting of air speed, rules of thumb

Step 1: Find the range of air speeds that can control drift:

1. Start with the air setting at zero and keep increasing the air speed just to the point where you can see that the drift cloud is minimised - note minimum setting.
2. Then increase the air speed until you see drift again - note maximum setting.
3. Now you know the range of air speeds that can be used with minimum drift.

Bare ground / low crop

The range of air speeds is usually very small.

Taller crop

The taller the crop the wider the range of air speeds that can reduce drift.

At higher wind speeds

More air is needed on the sprayer and it is advisable to drive more slowly and use minimum boom height (40 cm)/(16 in).

NOTE! Too high air speed over bare ground/low crop can cause reflection of the spray liquid and leave dust on the leaves, which can again reduce the effect of the plant protection product.

Step 2: Set the optimal air speed within possible the range mentions above.

<u>Conditions</u>	<u>Air speed recommendations</u>
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Bare ground / low crop:	Use maximum air within the possible range
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Taller crop:	Deeper crop penetration requires more air on the sprayer (if you are in doubt check with water sensitive paper).
---------------------	--

Forward speed:	Higher forward speeds require more air on the sprayer.
-----------------------	--

Volume rate:	Lower volume rates require more air assistance to avoid drift.
---------------------	--

B Angling of air and liquid, rules of thumb

To control wind drift the influence of wind speed and wind direction as well as the horizontal air current around the boom due to forward speed must be minimised. Because it is a sum of two forces with variable direction and size that we have to counteract for, the following can only be very rough guidelines.

NOTE! Often it will be necessary to drive with two different anglings, so the angling is changed when changing driving direction after turning at the headland.

<u>Wind direction</u>	<u>Angle / air speed</u>
-----------------------	--------------------------

Head wind:	Angle forward
-------------------	---------------

Down wind:	Angle back (if the forward speed is higher than the wind speed: angle forward).
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Side wind / No wind:	Angle vertical or back. Only high forward speeds may require forward angling.
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<u>Crop condition</u>	<u>Angle / air speed</u>
-----------------------	--------------------------

Bare ground/ low vegetation:	Low air speed and angling back will often be the best setting to avoid reflection of spray liquid.
-------------------------------------	--

Dense crop:	The angling feature is ideal to help opening the canopy and improve penetration. If you follow the crop movement as you are varying the angling you will find that at certain settings the crop will open more for penetration.
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If wind speed, wind direction or for some reason forward speed changes during spraying the optimum angling is likely to change too. Be aware that with certain combinations of air speed and angling you can “close” or flatten the crop and make penetration impossible - follow the crop movement intensively especially when setting the air assistance and keep an eye on the crop all through the application.

NOTE!

- It is most important that the sprayer operator is familiar with the above rules of thumb before using the TWIN sprayer
- All volume rates, pressures and air adjustments stated in the following tables are, of course, guiding. Special conditions regarding climate, crop quality, spraying time and applied chemical can change the procedure. The tables are showing practice in northern Europe, and conditions may be very different in other countries. If you want some local advice you are very welcome to contact the TWIN application expert at the HARDI importer or daughter company in your country
- The volume rate can generally be reduced to half of what is applied with a conventional sprayer, but with a minimum of 50-60 l/ha at 7-8 km/h (5.5-6.5 GPA at 4.5-5 mph. Exceptions are of course liquid fertiliser and herbicides whose selectivity is based large droplets that will only stick to the weeds

Air Technique

- Low drift nozzles can also be fitted on a TWIN sprayer and help reduce drift even further
- If there is a detailed spraying instruction on the chemical label regarding drop size, spray pressure, spray volume rate etc. this should be followed. Enclose 1 bag of water sensitive paper and instruction of how to use with all TWIN sprayers.

Water sensitive paper

USE WATER SENSITIVE PAPER TO HELP FIND THE BEST AIR SETTING.

Some time spent in different types of crops with clean water in the tank and some water sensitive paper will be valuable experience for the future work with your TWIN sprayer. The paper can be cut into smaller pieces (to simulate the target) and fixed with double sided tape at relevant places in the crop. Then spray with pure water and check the blue spots (droplets) on the paper. This way you can test different spraying techniques. Water sensitive paper is available at your local HARDI dealer, part No. 893211

Spring Barley - Tractor speed 8 km/h					
Spray task	Growth stage Feekes scale	Volume rate l/ha	Nozzle ISO	Pressure bar	Air setting
Herb. spraying	2-4	75	F-015-110	2.1	L/M
Wild oat spraying	3-5	100	F-015-110	3.6	M
1. Fungicide spraying	5-7	50	F-01-110	2.1	M
Aphids spraying	7-10.1	100	F015-110	3.6	H
Growth regulation	8-10.1	50	F-01-110	2.1	H
2. Fungicide spraying	9-10.1	100	F-015-110	3.6	H
Herb. spraying Couch grass	Latest 10 days before harvest	50	F-01-110	2.1	M/H

009

Potatoes - Tractor speed 6 km/h					
Spray task	Growth stage	Volume rate l/ha	Nozzle ISO	Pressure bar	Air setting
Herb. spraying	Pre-emergence	75	F-01-110	2.7	L
Herb. spraying	Post-emergence	75	F-01-110	2.7	L/M*
Herb. spraying	Haulm 15 cm high	75	F-01-110	2.7	M
Diseases (potatoe blight)	1. spraying latest July 1	150	F-02-110	2.6	H(VH)
Same treatment to be repeated with 10 days interval until 2 weeks before harvest					
Desiccation	When the tubers have the size required	200	F-03-110	2.1	H(VH)

011

NOTE! All volume rates, pressures and air suggestions indicated in these tables are only guiding. Special conditions regarding climate, quality of the crop, spraying time and chemicals applied (burning) may partially change the procedure.

* NOTE! If dust is deposited on leaves the air speed must be reduced.

Air Technique

Winter Wheat - Tractor speed 8 km/h					
Spray task	Growth Feekes scale	Volume rate l/ha	Nozzle ISO	Pressure bar	Air setting
Herb. spraying pre-emergence	0	75	F-015-110	2.1	L
Herb. spraying post-emergence	1-2	100	F-015-110	3.6	L/M*
Fungicide autumn	2-3	75	F-015-110	2.1	M
Herb. spraying spring	4	75	F-015-110	2.1	M
Growth regulation	4	75	F-015-110	2.1	M
Eyespot	5-6	75	F-015-110	2.1	M
1. fungicide, leaf disease	7	75	F-015-110	2.1	M
Growth regulation	8-9	75	F-015-110	2.1	M/H
1. aphids spraying	8-9	75	F-015-110	2.1	M/H
2. fungicide, leaf disease	9-10	75	F-015-110	2.1	M/H
2. aphids spraying	10-10.5	50	F-01-110	2.1	L
Fungicide, ear diseases	10-11	50	F-01-110	2.1	L
Herb. spraying Couch grass	Latest 10 days before harvest	50	F-01-110	2.1	M/H

010

Rye - Tractor speed 8 km/h					
Spray task	Growth stage Feekes scale	Volume rate l/ha	Nozzle ISO	Pressure bar	Air setting
Herb. spraying, residual type	0	75	F-015-110	2.1	L
Herb. spraying, post-emergence	1-2	100	F-015-110	3.6	L/M*
Autumn fungicide	2-3	75	F-015-110	2.1	M
Herb. spraying, spring	4	75	F-015-110	2.1	M
Growth regulation	5-6	100	F-015-110	3.6	M
Fungicide, eyespot	5-6	100	F-015-110	3.6	M/H
Fungicide, leaf disease	7-8	100	F-015-110	3.6	M/H
Growth regulation	8-9	75	F-015-110	2.1	M
Insecticide spraying	10-10.5	75	F-015-110	2.1	M
Herb. spraying					
Couch grass	10 days before harvest	75	F-015-110	2.1	M/H

012

NOTE! All volume rates, pressures and air suggestions indicated in these tables are only guiding. Special conditions regarding climate, quality of the crop, spraying time and chemicals applied (burning) may partially change the procedure.

* NOTE! If dust is deposited on leaves the air speed must be reduced.

Air Technique

Winter Rape - Tractor speed 8 km/h					
Spray task	Growth stage Feekes scale	Volume rate l/ha	Nozzle ISO	Pressure bar	Air setting
Herb. spraying	Pre-drilling	75	F-015-110	2.1	L
Herb. spraying	Post-drilling	100	F-015-110	3.6	L*
Volunteer cereal	Pre-emergence	100	F-015-110	3.6	L
Pests	At emergence	75	F-015-110	2.1	L/M*
Volunteer cereal	4 leaf stage	100	F-015-110	3.6	M
Pests	2-3 beetles/plant when in bud	75	F-015-110	2.1	M
Pests, brassica pod midge and cabbage seed weevil	Beginning of flowering	100	F-015-110	3.6	M/H
Pests	Full flowering	100	F-015-110	3.6	H
Fungicide	Full flowering and until ceasing	100	F-015-110	3.6	H/VH
Herb. spraying, couch grass + desiccation	2 weeks before harvest	100	F-02-110	2.1	H/VH

013

Peas (yellow) - Tractor speed 8 km/h					
Spray task	Growth stage Feekes scale	Volume rate l/ha	Nozzle ISO	Pressure bar	Air setting
Herb. spraying	Pre-emergence	75	F-015-110	2.1	L
Pests (pea and bean weevil + thrips)	Post-emergence	100	F-02-110	2.1	L
Herb. spraying	2-5 cm high	100	F-02-110	2.1	M
Fungicide spraying (grey mould + leaf and stem pod spot and pea weevil)	Prior to flowering	100	F-02-110	2.1	M/H
Fungicide spraying (grey mould + pea weevil)	14 days later	100	F-02-110	2.1	H
Aphids spraying	At flowering until ceasing	100	F-02-110	2.1	M
Herb. spraying, couch grass+ desiccation by systemic herbicide	2-4 weeks before harvest	100	F-015-110	3.6	H
Withering by contact herbicide	2-4 weeks before harvest	150	F-02-110	4.6	H

014

NOTE! All volume rates, pressures and air suggestions indicated in these tables are only guiding. Special conditions regarding climate, quality of the crop, spraying time and chemicals applied (burning) may partially change the procedure.

* NOTE! If dust is deposited on leaves the air speed must be reduced.

Air Technique

Spring Rape - Tractor speed 8 km/h					
Spray task	Growth stage Feekes scale	Volume rate l/ha	Nozzle ISO	Pressure bar	Air setting
Herb. spraying	Pre-drilling	75	F-015-110	2.1	L
Herb. spraying	Post-drilling	75	F-015-110	2.1	L
Pests	At emergence	75	F-015-110	2.1	L*
Herb. spraying broad-leaf-species	3-4 true leaves	100 ¹	F-02-110	2.1	L/M
Herb. spraying monocotyledonous species	4 true leaves	100	F-015-110	3.6	M
Pests, blossom beetle	1 beetle/plant when in bud	75	F-015-110	2.1	M
Pests, brassica pod midge and cabbage seed weevil	Beginning flowering	75	F-015-110	2.1	M/H
Pests, brassica pod midge and cabbage seed weevil	At full flowering	75	F-015-110	3.6	H
Fungicide	At end of flowering	100	F-015-110	3.6	H/H
Herb. spraying, couch grass + desiccation	2 weeks before harvest	100	F-015-110	3.6	H/H
¹ If applying full dose rate Benasalox (Benazolin - ethyl + Clopyralid) and Bladex (Cyanazin) in a tank mix, use water rate 150 l/ha					

014

NOTE! All volume rates, pressures and air suggestions indicated in these tables are only guiding. Special conditions regarding climate, quality of the crop, spraying time and chemicals applied (burning) may partially change the procedure.

* NOTE! If dust is deposited on leaves the air speed must be reduced.

Maintenance

Maintenance - rules of thumb

In order to derive full benefit from the sprayer for many years the following service and maintenance program should be followed.

IMPORTANT! Always read the individual paragraphs. Read instructions for service/maintenance jobs carefully before starting on the job. If any portion remains unclear or requires facilities which are not available, then for safety reasons please leave the job to your HARDI dealer's workshop.

Cleaning the sprayer

Guidelines

1. Read the whole chemical label. 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.
2. Be familiar with local legislation regarding disposal of pesticides washings, mandatory decontamination methods, etc. Contact the appropriate department, e.g. Dept. of Agriculture.
3. 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 runoff of residue into streams, water courses, ditches, wells, springs, etc. The washings from the cleaning area must not enter sewers. Drainage must lead to an approved soakaway.
4. Cleaning starts with the calibration, as a well calibrated sprayer will ensure the minimal amount of remaining spray liquid.
5. It is good practice to clean the sprayer immediately after use and thereby rendering the sprayer safe and ready for the next pesticide application. This also prolongs the life of the components.
6. It is sometimes necessary to leave spray liquid in the tank for short periods, e.g. overnight, or until the weather becomes suitable for spraying again. Unauthorised persons and animals must not have access to the sprayer under these circumstances.
7. 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 cannot be damaged by pesticides and their solvents.**

Cleaning the tank

1. Dilute remaining spray liquid in the tank with at least 10 parts of 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 to 1.5 bar (20 psi).
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 $\frac{1}{5}$ of the tank with clean water. Note that some chemicals require the tank to be completely filled. Add appropriate detergent and/or deactivating agent, e.g. 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 the pump run dry. Rinse inside of the 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 immediately. Also check for sediment on the pressure side of the safety valve for the Self-Cleaning Filter.

Maintenance

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 lubrication of the entire machine is recommended.

Cleaning and maintenance of 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 the pump. A blocked suction filter will result in pump cavitation.

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

Maintenance

Lubrication

Following recommended lubricants are to be used.

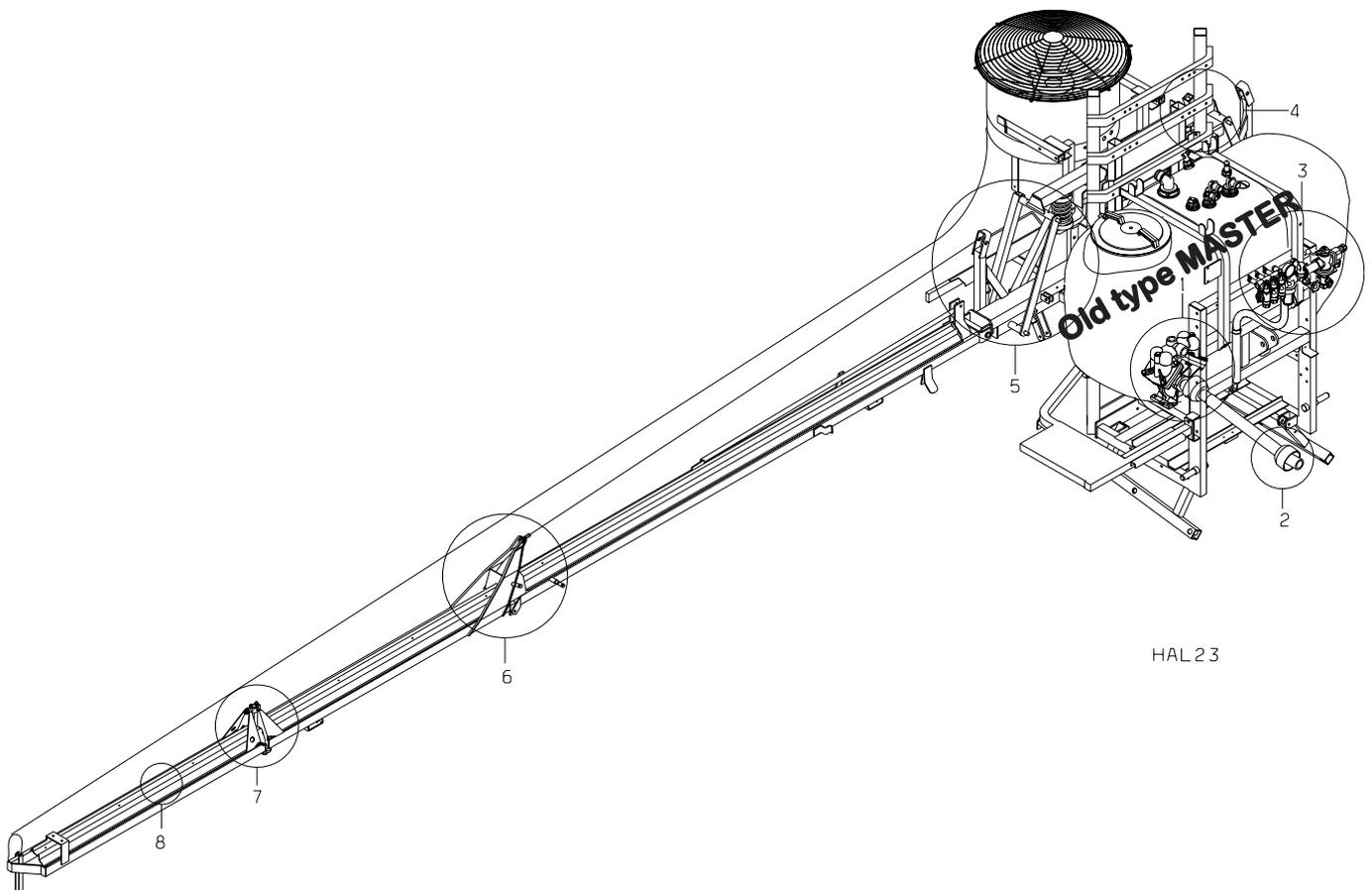
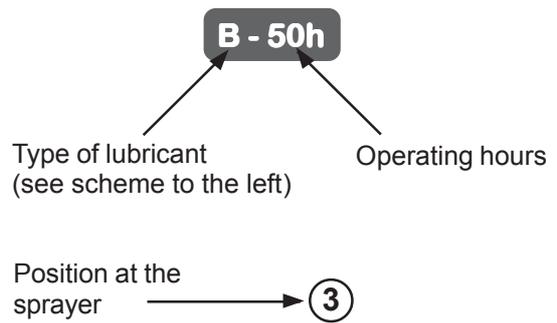
Lubricating points		Lubricant
Ball bearings	 A	Universal Lithium grease, NLGI No. 2 SHELL RETINAX EP2 CASTROL LMX GREASE
Slide bearings	 B	Lithium grease with Molybdenumdisulphide or graphite SHELL RETINAX HDM2 CASTROL MOLYMAX
Oil lub. points	 C	TOTAL Transmission TM SAE 80W/90 Castrol EPX 80W/90 SHELL Spirax 80W/90 Mobil Mobilube 80W/90
Glide shoes	D	Use stearin or a non-greasy type of wax

Always store lubricants clean, dry and cool - preferably at a constant temperature - to avoid contamination from dirt and condensed water.

Keep oil filling jugs, hoppers and grease guns clean, and clean the lubricating points thoroughly before lubricating.

Avoid skin contact with oil products for longer periods.

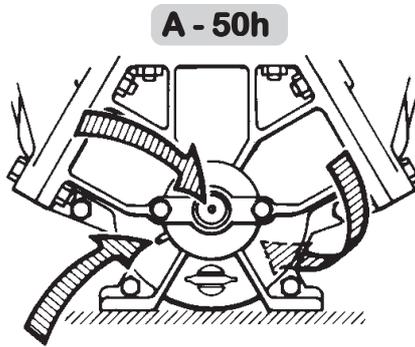
NOTE! If the sprayer is cleaned with a high pressure cleaner or fertiliser has been used, lubrication of all sections is recommended.



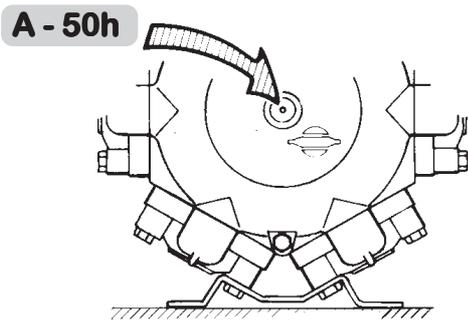
HAL 23

Maintenance

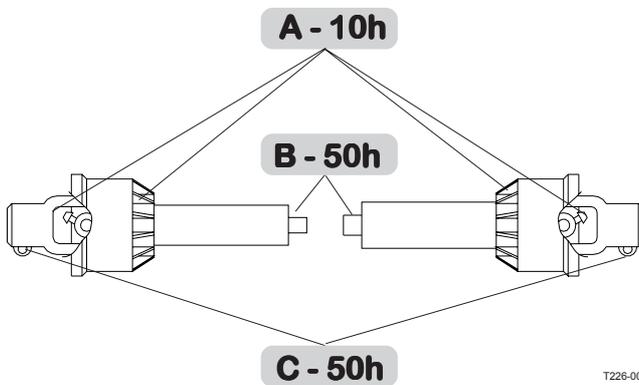
①



①

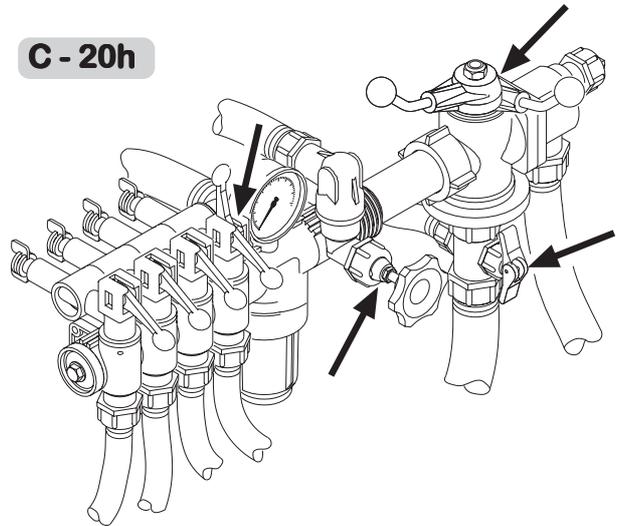


②



T226-0001

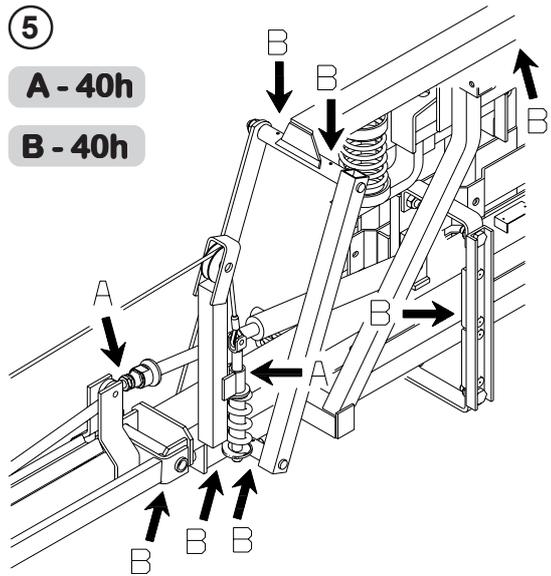
③ Models with BK control unit only



⑤

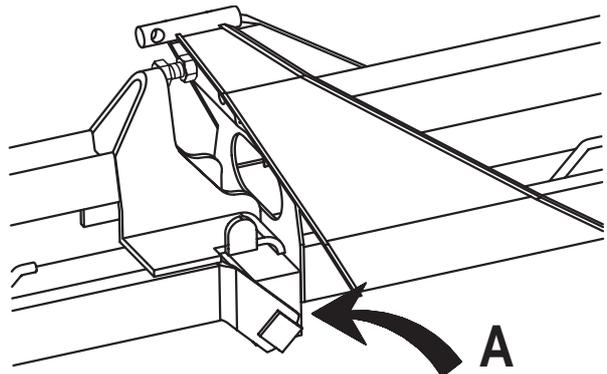
A - 40h

B - 40h



⑥

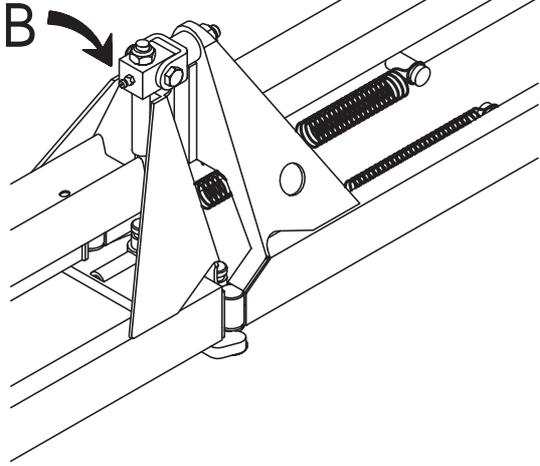
A - 40h



Maintenance

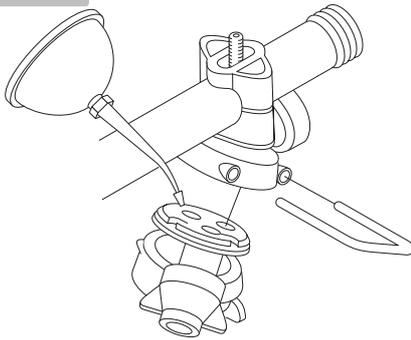
⑦

B - 40h



⑧

C - 500 h



T219-0003

Maintenance

10 hours service

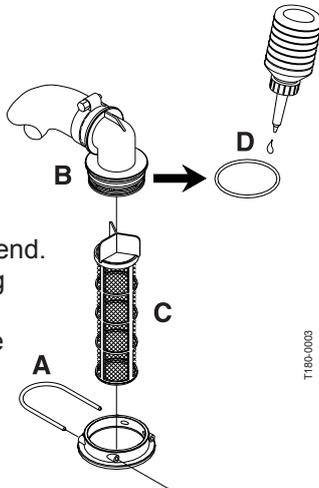
1. Suction filter

To service the suction filter:

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

To reassemble:

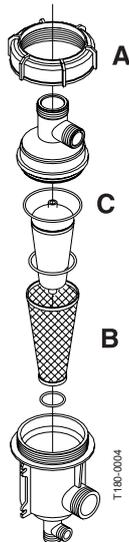
4. Press the guide onto filter end.
5. Place the filter into housing with guide facing up.
6. Ensure the O-ring **D** on the hose fitting is in good condition and lubricated.
7. Refit the suction hose **B** and steel clip **A**.



T180-0003

2. Self-Cleaning Filter

1. Unscrew nut **A** and open filter.
2. Check filter gauze **B**, clean if necessary
3. Lubricate O-ring **C**
4. Assemble filter again.

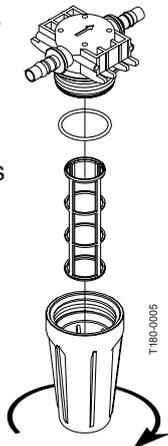


T180-0004

3. In-Line filter (if fitted)

If the boom is 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.



T180-0005

4. Nozzle filters

Check and clean.



T180-0006

5. Spraying circuit

Fill with clean water, operate all functions and check for leaks using higher spray pressure than normal. Check nozzle spray patterns visually using clean water.

Maintenance

50 hours service

1. Transmission shaft

Check function and condition of the transmission shaft protection guard. Replace possible damaged parts.

250 hours service

1. Readjustment of the boom

See section 'Basic adjustment of the boom'.

2. Hydraulic circuit

Check the hydraulic circuit for leaks and repair if any.

3. Hoses and tubes

Check all hoses and tubes for possible damages and proper attachment. Renew damaged hoses or tubes.

1000 hours service

1. Transmission shaft

Change the protection tube nylon bearings as described under 'Replacement of transmission shaft protection guards'.

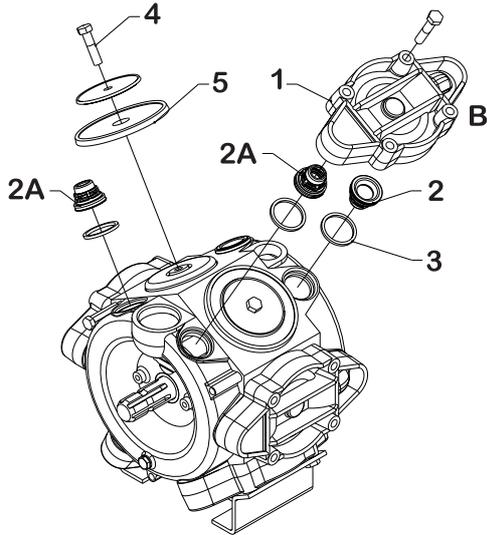
Maintenance

Occasional maintenance

The maintenance and renewal intervals for the following will depend very much on the conditions under which the sprayer will be operated and are therefore impossible to specify.

Pump valves and diaphragms renewal

Model 363



T261-0001

Diaphragm pump overhaul kit (valves, seals, diaphragms etc.)

Pump model	HARDI part No.
363	750342

Valves

Remove valve cover 1 before changing the valves 2 - note their orientation so they are replaced correctly!

NOTE! A special valve with white flap 2A is used at the two upperside inlets. It has to be placed in the valve openings as shown. All others are the type with black flap.

It is recommended to use new gaskets 3 when changing or checking the valves.

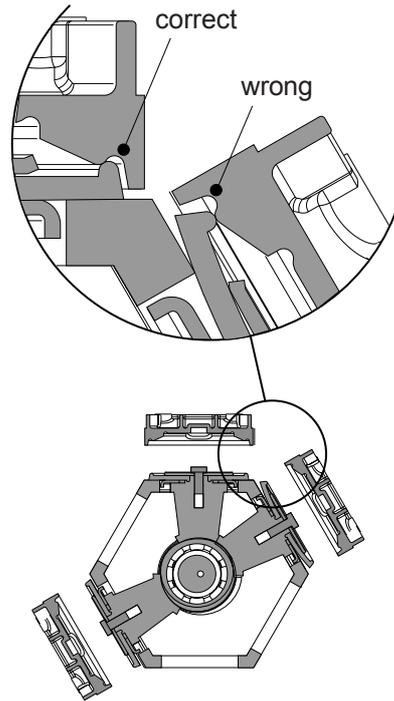
Diaphragms

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

Pump model	Diaphragm cover Nm	Diaphragm bolt Nm
363	90	90

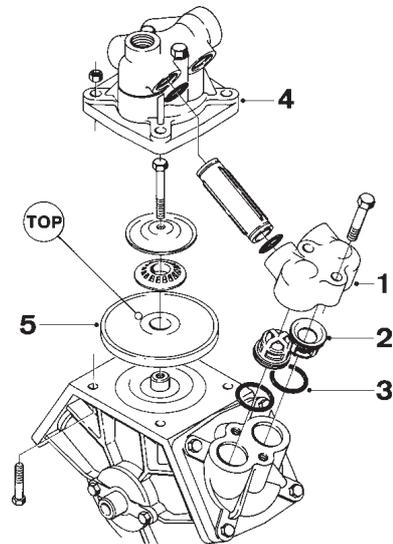
1 Nm = 0.74 lbft

IMPORTANT! Before tightening the 4 bolts for the diaphragm cover B the diaphragm must be positioned between centre and top to ensure correct sealing between diaphragm pumphousing and diaphragm cover. Turn crank shaft if necessary.



T192-0005

Model 1303



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
1303	60	70	60

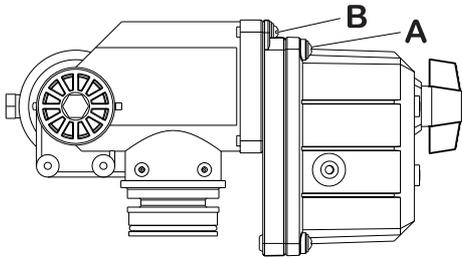
1 Nm = 0.74 ft-lb

Maintenance

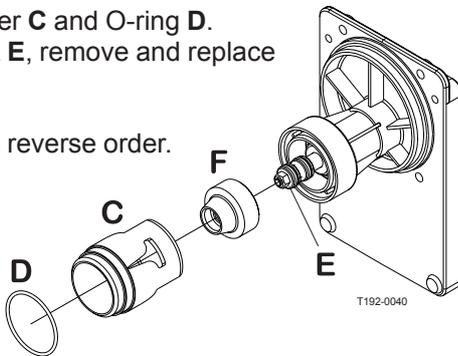
Cone check/renewal EVC operating unit

If it becomes difficult to build up sufficient pressure or if pressure fluctuations occur, it may be necessary to renew cone and cylinder. A HARDI kit is available for this purpose. Ref. no. 741293.

1. Remove 4 x screws **A** and remove the housing.
2. Remove 4 x screws **B**.



3. Replace cylinder **C** and O-ring **D**.
4. Loosen the nut **E**, remove and replace the cone **F**.
5. Reassemble in reverse order.



T192-0039

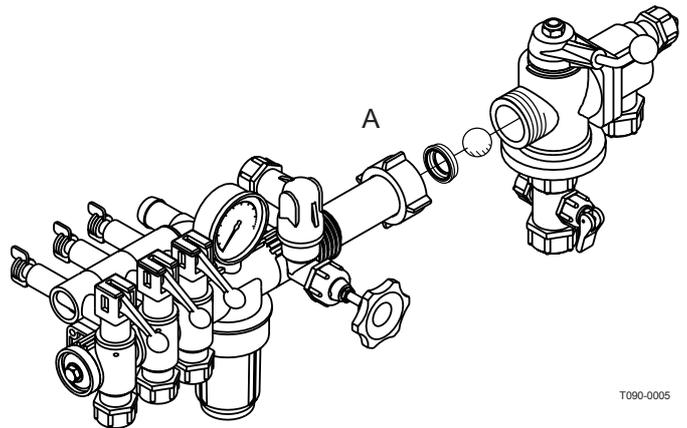
T192-0040

Changing the ball seat in BK operating unit

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.



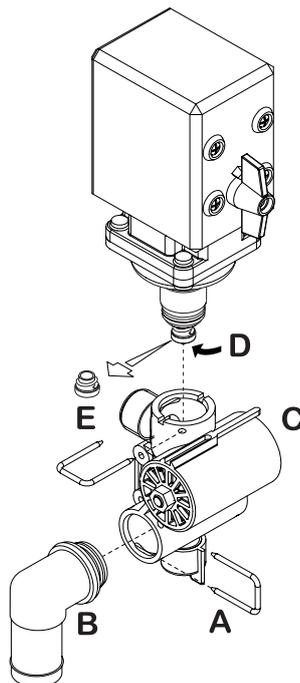
T090-0005

Cone check/renewal, EVC distribution valve

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

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

Remove the clip **C** and lift the motor housing off the valve housing. Then unscrew the screw **D** and replace the valve cone **E**. Reassemble in reverse order.



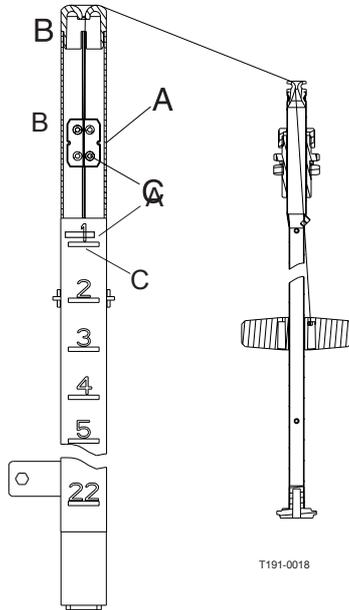
Maintenance

Level indicator adjustment

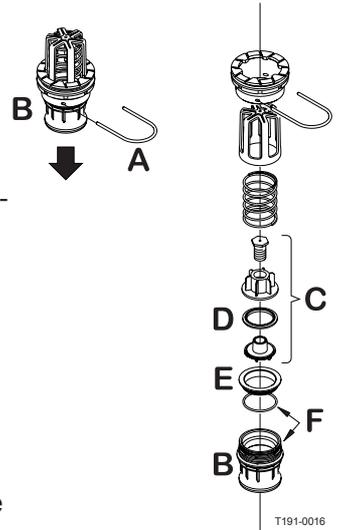
The level indicator reading should be checked regularly.

When the tank is empty, the float should lie on the stop pin, of the rod, and the O-ring on the indicator should be positioned at the top position line **A**.

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



3. Pull out the clip **A** and pull down connecting piece **B**. The entire valve assembly can now be pulled out.
4. Check cord and valve flap assembly **C** for wear, replace seal **D** and assemble again.
5. Assemble the valve assembly again using a new valve seat **E**. Lubricate O-rings **F** before assembly.
6. Fit clip **A** again.



NOTE! Check function of valve with clean water before filling chemicals into the tank.

Nozzle tubes and fittings

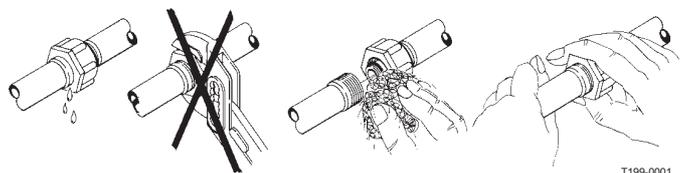
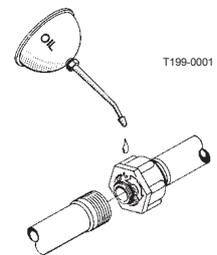
Poor seals are usually caused by:

- Missing O-rings or gaskets
- Damaged or incorrectly seated O-rings
- Dry or deformed O-rings or gaskets
- Foreign bodies

In case of leaks:

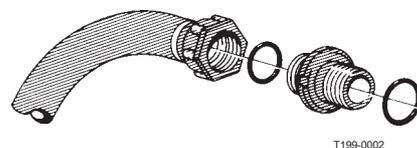
DO NOT overtighten. Disassemble, check condition and position of O-ring or gasket. Clean, lubricate and reassemble.

The O-ring must be 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.



Cord renewal, level indicator

If the cord on the level indicator has to be changed, the float guide pole is removed:

1. Remove the tank drain valve (see paragraph "Main tank drain valve") and loosen the fitting holding the pole in position.
2. Pull the pole down through the drain valve hole till it is free in the top of the tank.
3. The pole can now be taken out of the tank through the filling hole.



DANGER! Do not attempt to enter the tank - the float pole can be removed from outside the tank!

Seal renewal, drain valve

If the main tank drain valve leaks, the seal and seat can be changed the following way.



DANGER! Do not enter the inside of the tank - the parts can be changed from underneath the tank!



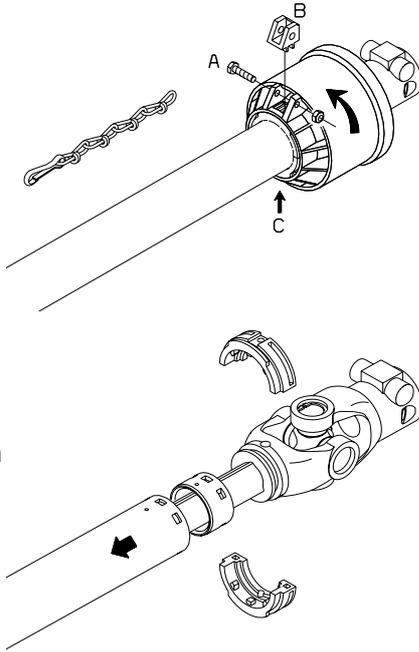
WARNING! Use eye / face protection mask when dismantling the tank drain valve!

1. Make sure the tank is empty and clean.
2. The valve must be closed and the string loose.

Maintenance

Replacement of transmission shaft protection guards

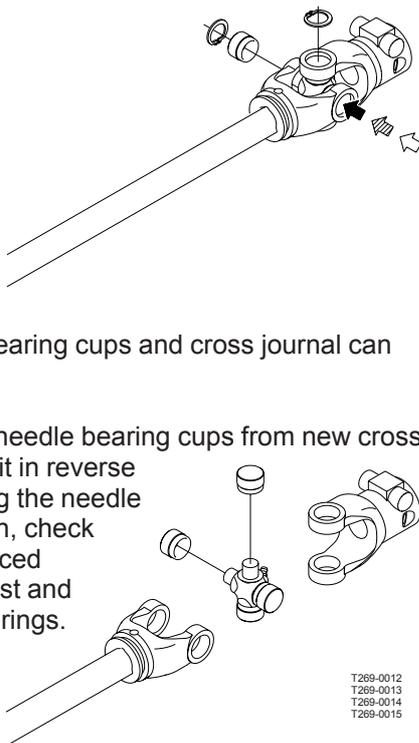
1. Remove bolt **A**, lock **B** and grease nipple **C**. Twist uni CV-joint cover 1/4 turn and pull it backwards.
2. Remove the synthetic bearings and protection tube.
- 2a. Remove inner bush from protection tube.
3. Assemble again in reverse order, using new parts where necessary. Remember to fit chains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



NOTE! Only use 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.



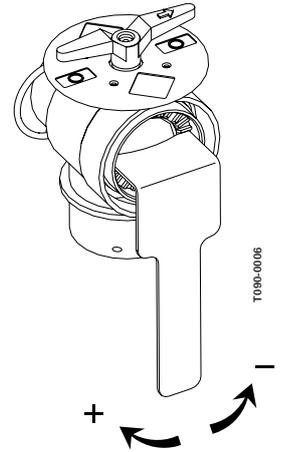
T269-0012
T269-0013
T269-0014
T269-0015

Adjustment of 3-way-valve

The MANIFOLD valve can be adjusted if it is too tight to operate - or if it is too loose (= liquid leakage).

Correct setting is when the valve can be operated smoothly by one hand

Use a suitable tool and adjust the toothed ring inside the valve as shown on the drawing.



T090-0008

Maintenance

Readjustments - boom and frame

Before commencing adjustment jobs please go through this check list.

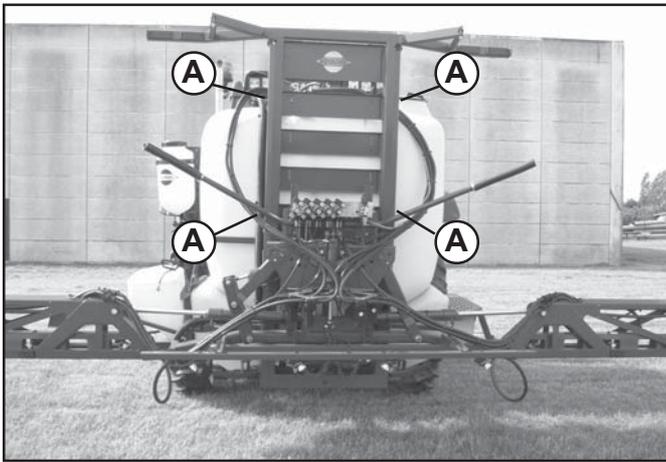
1. Connect the sprayer to the tractor.
2. Place tractor and sprayer on level ground (horizontal)



WARNING! Nobody is allowed to be under the boom whilst adjustment is carried out.

Centre part - wheel arrangements

If slack occurs (backwards and forwards movements of the boom) the 4 wheel arrangements (A) (see picture below) should be adjusted.

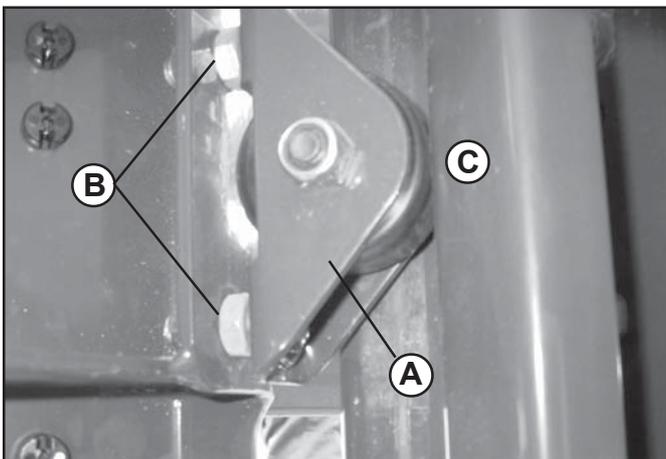


T102-0035

To simplify the job raise the boom to adjust the 2 wheel arrangements at the top and lower the boom to adjust the 2 wheel arrangements at the base.

Each wheel arrangement (A) is adjusted by means of two bolts (B). Bring the wheel itself into correct position by tightening (B) = wheel should only just touch the frame (C) - without being squeezed.

Please note that all 4 wheels should be uniformly tightened.



T102-0036

Re-adjustment of the boom

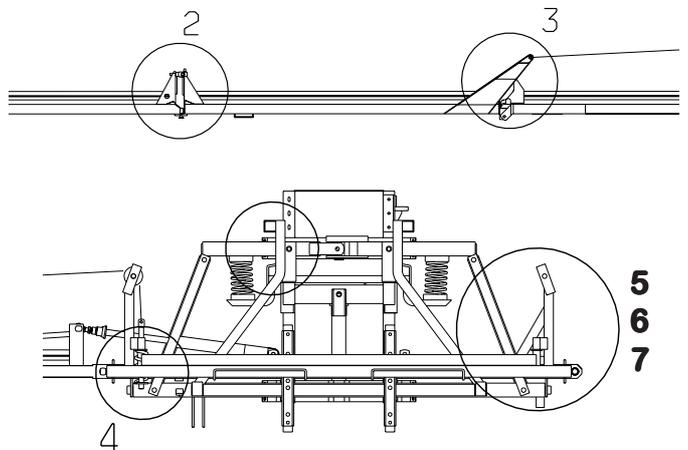
After having used the sprayer for some days the boom should be adjusted according to the following instructions:

NOTE! Tractor and sprayer must be on level ground with unfolded boom. Sprayer must be lubricated. See section on Lubrication.

Adjustment of hydraulic rams is done without pressure in the hydraulic system. Carry adjustments out in the following order. (2, 3, 4...) order.

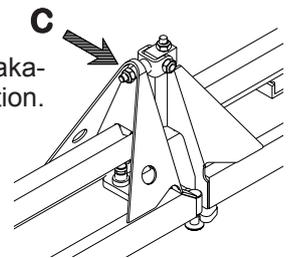


WARNING! NOBODY MUST BE UNDER THE BOOM WHILST ADJUSTMENT IS CARRIED OUT.



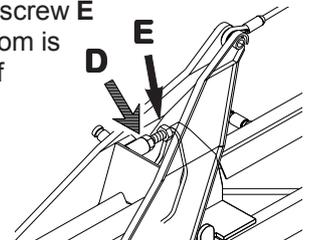
2. Breakaway

Adjust nut C at swivel so the breakaway is parallel with the outer section.



3. Parallel adjustment of outer section

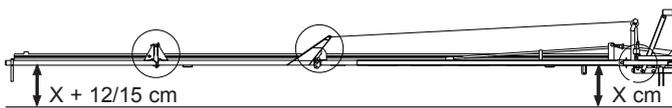
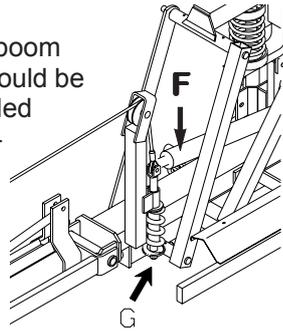
Loosen counter nut D and turn screw E until the outer section of the boom is parallel with the inner section of the same side.



Maintenance

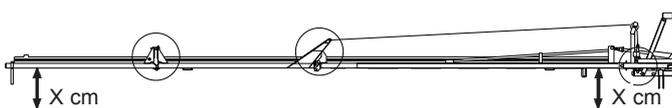
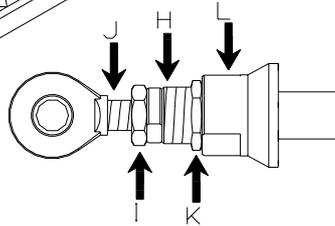
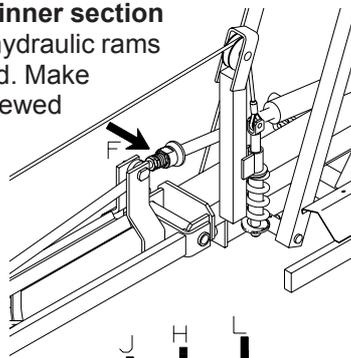
4. Wire

The wire function is to carry the boom wings. Adjustment of the wire should be undertaken with the boom unfolded and the hydraulic rams **F** disconnected from the boom wings. Tighten nut **G** so that the tip is raised 12 cm for the 12 m boom and 15 cm for the 15 m boom from the horizontal line of the centre section.



5. Parallel adjustment of inner section

1. Cautiously activate the hydraulic rams **F** so they are fully extended. Make sure the extension **H** is screwed in and tight.
2. Loosen counter nut **I** and adjust the ram eye **J** so that when connected, the boom wings are parallel with the centre section. The ram must force the boom tip down so distance "X" is equal.

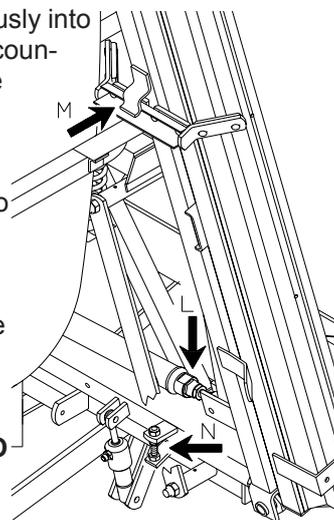


6. Adjustment for transport brackets and air stream angle

Fold boom and lower cautiously into transport brackets. Loosen counter nut **K** and adjust **L** so the boom rests in the middle of the brackets.

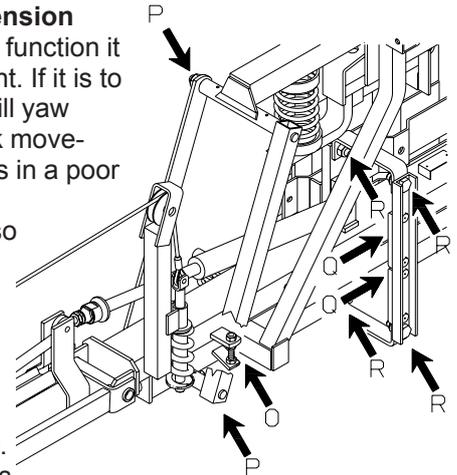
When the boom is lowered, it must be firmly hooked onto the transport bracket **M**.

Loosen counter nuts and adjust bolt **N** so that the boom hooks firmly into place without exerting excessive force on the boom wings. Unfold the boom. Loosen counter nut and screw bolt **O** in fully. Set air stream to angle forward so the ram is fully extended. Now adjust bolt **O** up to the stop and turn furthermore " a turn.



7. Trapeze suspension

For the trapeze to function it must not be too tight. If it is too loose the boom will yaw (forward and back movement). This results in a poor spray distribution. Adjust tension **P** so the boom is not too tight nor too loose. Minor adjustment in the field may be necessary. Check distance **Q**.



The synthetic pads should only just touch the centre beam. Relocate washers on each of the 4 bolts **R** if the distance is excessive.

IMPORTANT! Check all counter nuts are tight after adjustment.

Changing of valves and diaphragms

Access to the pump is best from the rear of the sprayer. A "S" shaped hook supplied with the sprayer is used to mechanically secure the boom from lowering whilst servicing the pump. Raise the boom with the hydraulic boom lift and use the hook as shown.

WARNING!
Always secure the boom before servicing the pump.

NOTE! For servicing model 361 pump, it is best to remove the lower anchor bolt of the lift ram and push the ram over to one side.

Maintenance

Repair of the bag

If the air bag is damaged it can be repaired by sewing or gluing a patch on it. A repair kit is available; HARDI ref. no. 728746.

Oil cooler

The cooler under the fan must be inspected externally at least yearly and cleaned if necessary. Remove the bag and check that the cooler ribs are clean. A pressure cleaner can be used to clean the ribs. When the bag is replaced, unfold the boom to check it is centred and angle the air outlet forward to check there is no slack in the bag.

Hydraulic transmission

If the hydraulic motor has been dismantled or replaced, the following start-up procedure has to be done:

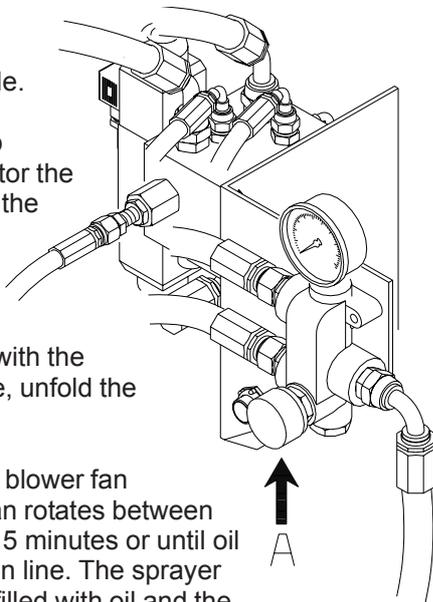
1. The boom needs to be unfolded so choose a location where this is possible.

2. Remove the snap coupler from hy. motor the drain line and place the hose in a small container. Set the valve for blower fan revolutions at or near minimum and with the tractor engine at idle, unfold the boom.

3. Adjust valve **A** for blower fan revolutions so the fan rotates between 300 to 500 r/min for 5 minutes or until oil comes from the drain line. The sprayer hydraulics are now filled with oil and the valve can be set to maximum and tractor r/min increased to check for possible leakage.

4. Check oil pressure filter (if fitted) indicates green (not clogged).

5. Replace the drain line snap coupler. Check the tractor hydraulic oil level and top up if needed.



Maintenance

Off-season storage

When the spraying season is over, you should devote some extra time to the sprayer.

If chemical residue is left over in the sprayer for longer periods, it can reduce the life of the individual components.

Off-season storage program

To preserve the sprayer intact and to protect the components, carry out following off-season storage program.

1. Clean the sprayer completely - inside and outside - as described under "Cleaning of the sprayer". Make sure that all valves, hoses and auxiliary equipment have been cleaned with detergent and flushed with clean water afterwards, so no chemical residue is left in the sprayer.
2. Renew possible damaged seals and repair possible leaks.
3. Empty the sprayer completely and let the pump work for a few minutes. Operate all valves and handles to drain as much water off the spraying circuit as possible. Let the pump run until air is coming out of all nozzles. Remember to drain the rinsing tank also.
4. Pour appr. 50 litre (11 Imp.gal) anti-freeze mixture consisting of 1/3 automotive anti-freeze and 2/3 water into the tank.
5. Engage the pump and operate all valves and functions on the MANIFOLD, operating unit, FILLER etc. allowing the anti-freeze mixture to be distributed around the entire circuit. Open the operating unit main on/off valve and distribution valves so the anti-freeze is sprayed through the nozzles as well. The anti-freeze will also prevent O-rings, seals, diaphragms etc. from drying out.
6. Lubricate all lubricating points according to the lubricating scheme - regardless of intervals stated.
7. When the sprayer is dry, remove rust from possible scratches or damages in the paint and touch up the paint.
8. Remove the glycerine-filled pressure gauges and store them frost free in vertical position.
9. Apply a thin layer of anti-corrosion oil (e.g. SHELL ENSIS FLUID, CASTROL RUSTILLO or similar) on all metal parts. Avoid oil on rubber parts, hoses.
10. Fold the boom in transport position and relieve pressure from all hydraulic functions.

11. All electric plugs and sockets are to be stored in a dry plastic bag to protect them against damp, dirt and corrosion.
12. Remove the control boxes and the HARDI PILOT control box + display from the tractor, and store them dry and clean (in-house).
13. Wipe hydraulic snap-couplers clean and fit the dust caps.
14. Apply grease on all hydraulic ram piston rods which are not fully retracted in the barrel to protect against corrosion.
15. To protect against dust the sprayer can be covered by a tarpaulin. Ensure ventilation to prevent condensation.

Preparing the sprayer for use after storage

After a storage period the sprayer should be prepared for the next season the following way:

1. Remove the cover
2. Wipe off the grease from hydraulic ram piston rods.
3. Fit the pressure gauges again. Seal with Teflon tape.
4. Connect the sprayer to the tractor including hydraulics and electric's.
5. Check all hydraulic and electric functions.
6. Empty the tank for remaining anti-freeze.
7. Rinse the entire liquid circuit on the sprayer with clean water.
8. Fill with clean water and check all functions.

Fault finding

Operational problems

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

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

Therefore ALWAYS check:

1. Suction, 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. Hydraulic components are maintained clean.

Hydraulic system

FAULT	PROBABLE CAUSE	CONTROL/REMEDY
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.
Boom will not unfold.	Oil bypassing rams.	Increase fan r/min at valve block.
Excessive noise from hydraulic motor.	Air in hydraulics.	Top tractor reservoir up. Use oil that does not foam.
Tractor hydraulics safety valve operating constantly (open centre).	Sprayer hydraulics set to closed centre hydraulics.	Swap nipple at valve block.

Fault finding

Liquid system

FAULT	PROBABLE CAUSE	CONTROL/REMEDY
No spray from boom when turned on.	Air leak on suction line.	Check if suction filter O-ring is sealing. Check suction tube and fittings. 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. Check yellow suction pipe is not obstructed or placed too near the tank bottom.
Lack of pressure.	Incorrect assembly.	Restrictor nozzle in Self-Cleaning Filter not fitted. Safety valve spring for Self-Cleaning Filter not tight. Too little distance between yellow suction pipe and tank bottom.
		Pump valves blocked or worn.
	Defect pressure gauge.	Check for dirt at inlet of gauge.
Pressure dropping.	Filters clogging.	Clean all filters. Fill with cleaner water. If using powders, make sure agitation is on.
	Nozzles worn.	Check flow rate and replace nozzles if it exceeds 10%.
	Tank is air tight.	Check vent is clear.
	Sucking air towards end of tank load.	Lower pump r.p.m.
Pressure increasing	Pressure filters beginning to clog.	Clean all filters.
Formation of foam.	Air is being sucked into system.	Check tightness / gaskets / O-rings of all fittings on suction side.
	Excessive liquid agitation.	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.

Fault finding

EVC Operating unit

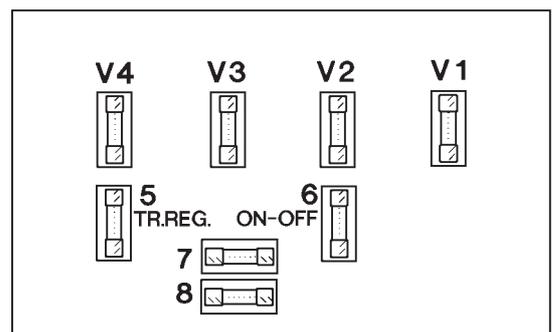
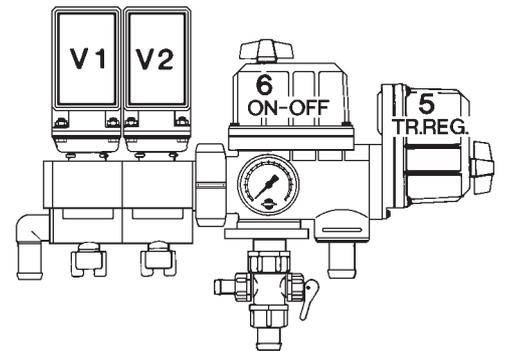
FAULT	PROBABLE CAUSE	CONTROL/REMEDY
Operating unit not functioning	Blown fuse(s).	Check mechanical function of microswitches. Use cleaning/lubricating agent if the switch does not operate freely. Check motor. 450-500 milli-Amperes max. Change motor, if over.
	Wrong polarity.	Brown - pos. (+). Blue - neg. (-).
	Valves not closing properly.	Check valve seals for obstructions. Check microswitch plate position. Loosen screws holding plate a $\frac{1}{2}$ 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.

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.

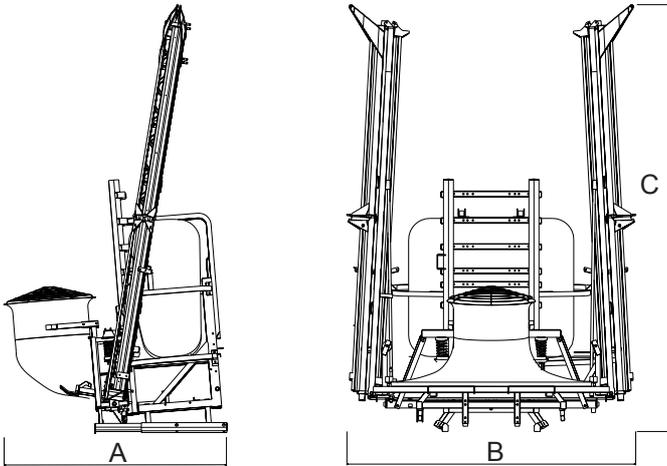
The problem may be due to a blown fuse. The fuses are placed in the control box and are marked according to functions. Fuses 7 and 8 are spare fuses.

Fuse type T 500 mA HARDI ref. no. 261125



Technical specifications

Dimensions



Tank size (litres)	Spraying width (m)	Measurement (mm) A x B x C
800	12	A x B x C
	12.5	A x B x C
	15	A x B x C
	16	A x B x C
	18	A x B x C
1000	12	A x B x C
	12.5	A x B x C
	15	A x B x C
	16	A x B x C
	18	A x B x C
1200	12	A x B x C
	12.5	A x B x C
	15	A x B x C
	16	A x B x C
	18	A x B x C

Weight

Tank size (litres)	Spraying width (m)	Weight (kg) incl. pump	
		1302 type	363 type
800	12	X	X
	12.5	X	X
	15	X	X
	16	X	X
	18	X	X
1000	12	X	X
	12.5	X	X
	15	X	X
	16	X	X
	18	X	X
1200	12	X	X
	12.5	X	X
	15	X	X
	16	X	X
	18	X	X

Pump capacity

1303/9.0

Rotation per min.	300		400		500		540		600	
bar	l/min	kW	l/min	kW	l/min	kW	l/min	kW	l/min	kW
0	63	0.90	84	1.19	103	1.51	114	1.61	125	1.80
5	58	0.94	79	1.29	96	1.61	105	1.75	116	1.93
10	56	1.30	76	1.80	94	2.30	101	2.48	111	2.72
15	55	1.80	74	2.22	93	2.92	99	3.18	109	3.54
Max. pressure: 15 bar			Weight: 35 kg				Suction height: 0.0 m			

chart 1302-9.0

363/10.0

Rotation per min.	200	300	400	500	540	600
bar	Capacity l/min					
0	73	107	141	178	194	211
2	72	105	140	175	189	207
4	71	103	139	172	186	205
6	70	102	138	169	184	203
10	68	100	135	166	182	200
15	66	98	132	164	178	197
Max. pressure: 15 bar		Weight: 52.5 kg			Suction height: 0.0 m	

chart 363-10.0

Technical specifications

Filters and nozzles

Filter gauze width

30 mesh: 0.58 mm	50 mesh: 0.30 mm
80 mesh: 0.18 mm	100 mesh: 0.15 mm

Temperature and pressure ranges

Operating temperature range:
2° to 40° C. (36°F to 104°F)

Operating pressure for safety valve:
15 bar (220 psi)

Max. pressure on the pressure manifold:
20 bar (290 psi)

Max. pressure on the suction manifold:
7 bar (100 psi)

Max. oil flow for hydraulics:
48 l/min

Max. pressure for the hydraulics:
180 bar

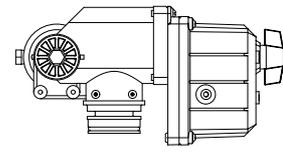
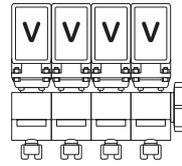
Oil specifications

Type	Hydraulic oil with anti-foam and anti-oxidant additives.
Purity	ISO 4406 20/14. Filtration quotient b25-75, ISO 4572-81
Multipass test.	25 micron Absolute.
Viscosity	10 mm ² /s (Cst) minimum 100 mm ² /s (Cst) maximum 15 - 35 mm ² /s (Cst) normal work

Blower specifications

Boom size	12 m	15 m
Minimum oil flow	38 l/min	44 l/min
Minimum pressure	180 bar	165 bar
Power consumption	10 kW	14 kW
Hydraulic motor make	HP Hydraulics	HP Hydraulics
Type	HP M4 MF13	HP M4 MF15
Blade angle	27.5°	30.0°
Max. fan revolutions	3,100 r/min	3,100 r/min

EVC



T192-0041

Number of distribution valves

2/3/4 5/6 7 8

Valve Wire number or color code

V1	1-2	1-2	1-11	1-11
V2	3-4	3-4	2-12	2-12
V3	5-6	5-6	3-13	3-13
V4	7-8	7-8	4-14	4-14
V5		9-10	5-15	5-15
V6		11-12	6-16	6-16
V7			7-17	7-17
REG	9-10	13-14	9-10	9-10
V8	?	?	?	8-G/Y

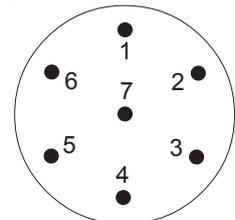
G/Y = Green/Yellow

The EVC operating unit fulfils the EC noise reduction standards.

Electrical connections

Rear lights

Position	Wire colour
1. LH direction indicator	Yellow
2. Free	Blue
3. Frame	White
4. RH direction indicator	Green
5. RH rear position lamp	Brown
6. Stop lamps	Red
7. LH rear position lamp	Black



The wiring is in accordance with ISO 1724.

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 authorised disposal plant. The metallic parts can be scrapped. Always follow local legislation regarding disposal.

Technical specifications

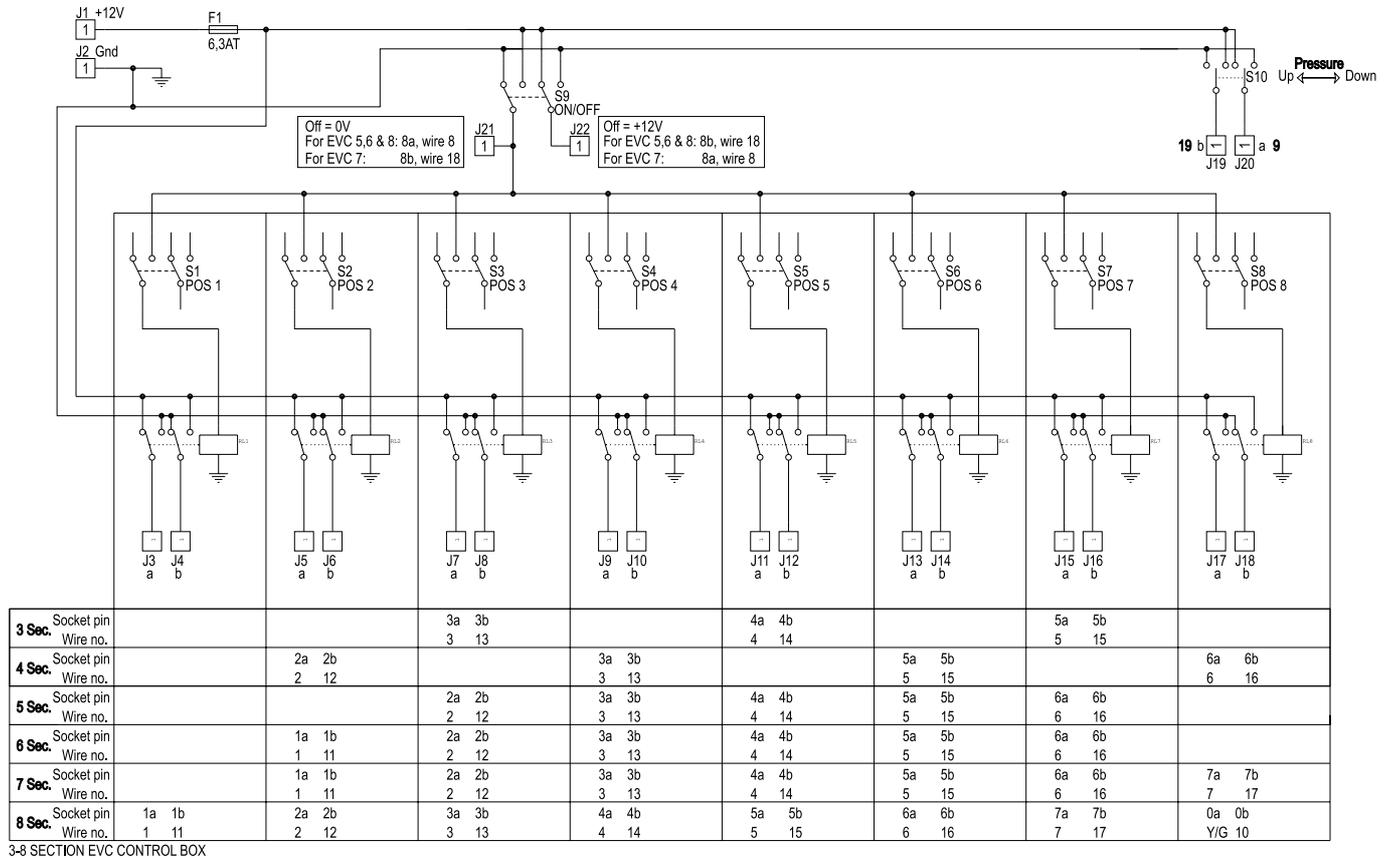
Electrical connections for EVC operating unit

20 poled plug with cable

Number of distribution valve											
8	7	6 & 5	4	3 & 2		2 & 3	4	5 & 6	7	8	
Wire number or colour code											
8										G/Y	
9	9	13	9	9		10	10	14	10	10	
	8	G/Y	G/Y	G/Y		11	11	15	G/Y		
7	7									17	17
6	6	1	1				2	2	16	16	16
5	5	3	3	1		2	4	4	15	15	15
4	4	5		3		4		6	14	14	14
3	3	7	5	5		6	6	8	13	13	13
2	2	9	7				8	10	12	12	12
1	1	11							12	11	11

G/Y = green/yellow

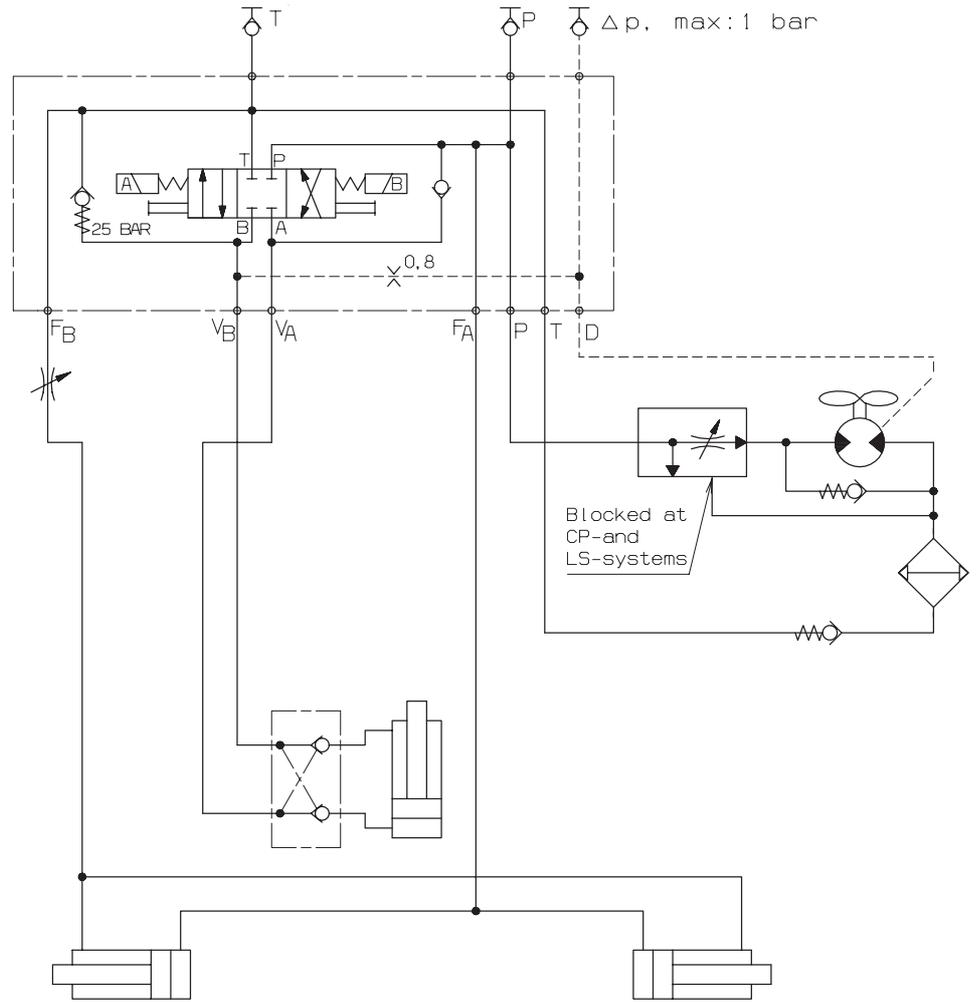
Electrical chart (EVC)



T192-0038

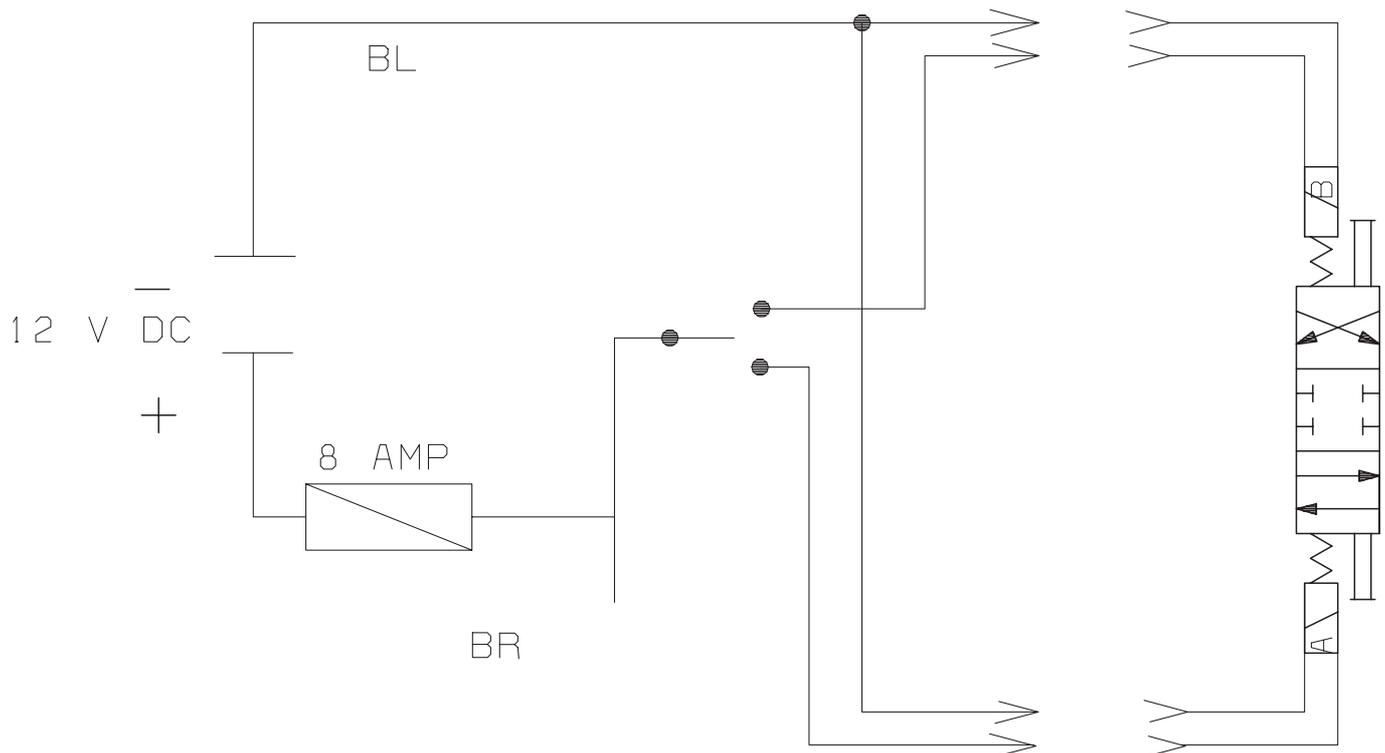
Technical specifications

Hydraulics diagram



Electrical connections

Air outlet controls



Technical specifications

Graphs

