MARRO TWIN FORCE

Instruction book

674156-GB-2001/04

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.

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.

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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, October 2000

_____ _____

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

Safety notes

Operator safety

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

Note the following recommended precautions and safe operating practices.

Read and understand this instruction book before using the equipment. It is equally important that other operators of this equipment read and understand this book.

Local law may demand that the operator 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.

Description

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

Front tank
UV-resistant Polyethylene in a suitable design with no sharp corners for easy agitation, emptying, and cleaning. Nominal contents: 1000 l or 1300 l.

Pump
Diaphragm pump with 6 diaphragms, model 463, with easily accessible valves and diaphragms. Standard = 540 r.p.m, optional = 1000 r.p.m.

MANIFOLD SYSTEM
All functions of the spray circuits are operated via the centrally situated MANIFOLD valves with colourcoded plates and pictorial symbols for easy operation.

Operating unit
The operating unit is constructed of modules and consists of main ON/OFF valve, pressure gauge, pressure regulation with built-in HARDI-MATIC and distribution valves with pressure equalization. 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 (for pump/540 r.p.m.) or 650-1100 r/min (for pump/1000 r.p.m.).

The operating unit is fully electrically controlled (EC) via remote control box.

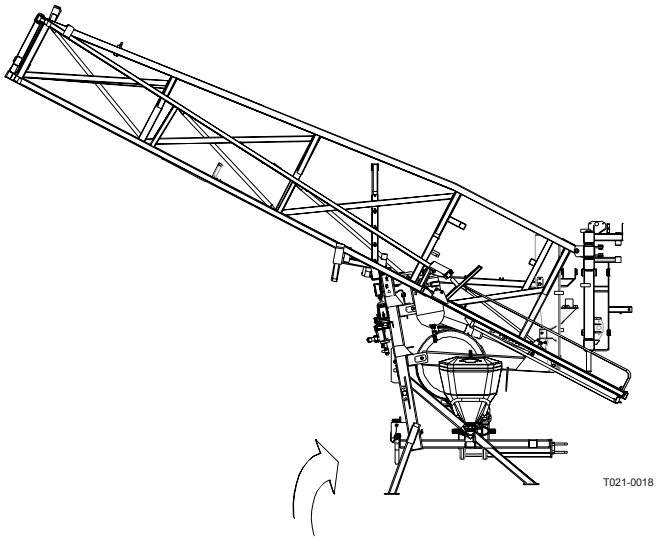
Filters
With the self-cleaning filter the impurities that exist in the spray liquid will by-pass the filter and be recirculated back to the tank via the return flow. Also suction filter and nozzle filters are standard. In-line pressure filters can be fitted as option.

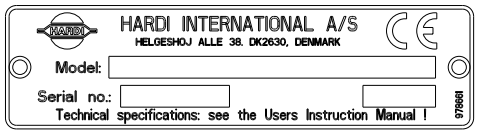
Boom
The sprayer is equipped with a HAZ boom, avaliable in 18, 20, 21 and 24 m working width. The boom is suspended in a strong, stable parallelogram boom lift and is fully hydraulically operated, including boom slanting control and air slot angling. The HAZ boom has Direct Acting Hydraulics (D.A.H) and individual boom tilt function as well.

All boom widths can spray 12 m with outer sections folded.

The TWIN blowers are driven by a built-in hydrostatic transmission, powered via the tractor P.T.O. Blower speed can be adjusted stepwise from the tractor cabin.

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





Sprayer use

The HARDI COMMANDER 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.

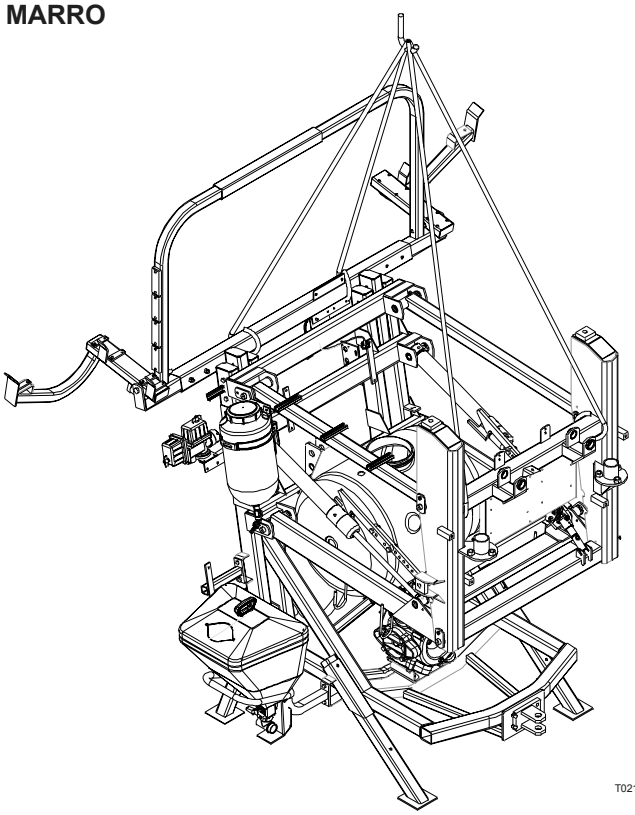
If no local law demands that the operator must be certified to usespray equipment, it is strongly recommended to be trained in correct plant protection and in safe handling of plant protection chemicals to avoid unnecessary risk for persons and the environment when doing your spray job.

Unloading the sprayer from the truck

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

When loading with a crane please observe the lifting points as shown on the sketches, and make sure that the straps or belts used for lifting are strong enough.

MARRO



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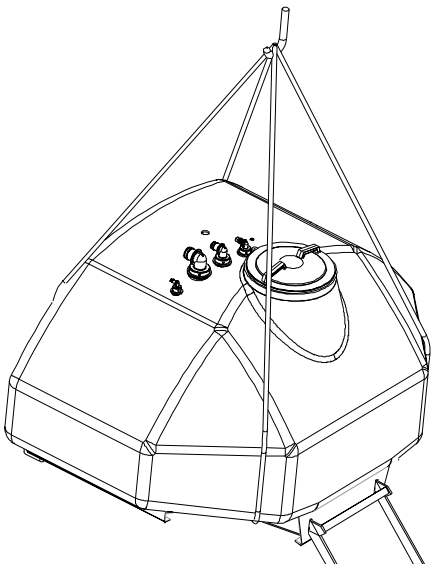
Front tank



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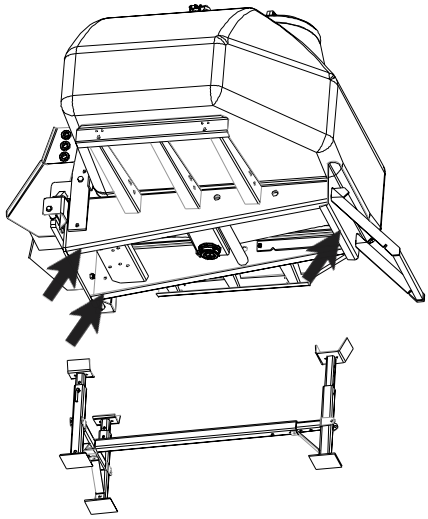
Parking stand for front tank (optional equipment)

A stand for parking the front tank when not used is available (ref 233269).



T021-0004x

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.

MARRO set-up

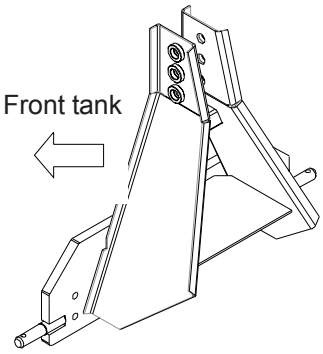
WARNING! Note these recommendations:

1. Add front tank to the tractor before mounting the MARRO lift.
2. Adjust tyre pressure (see tractor's instruction book)
3. Be careful when filling/lifting the sprayer for the first time
4. Ensure that the operating unit and the tractor do not touch

Connecting the front tank

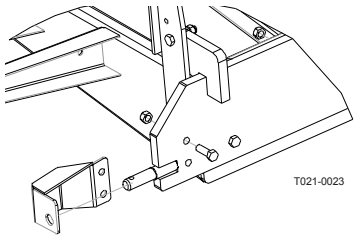
Tractor with front lift

Quick hitch 3-point linkage frame (ref. no. 732319) must be mounted to the front tank; fasten it by two bolts (M16 x 55).



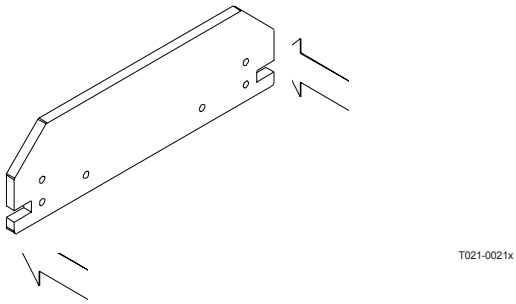
Standard = cat. II wide. If conversion to cat. III is necessary, please see the part "Connecting the MARRO lift" for further information.

Fit the two reinforcement mountings on the linkage frame as shown on the drawing. Fasten each with two bolts (M16 x 50).



Tractor without front lift

A base plate for hook-on attachment (ref. no. 161594) must be used as interface between tractor and front tank.



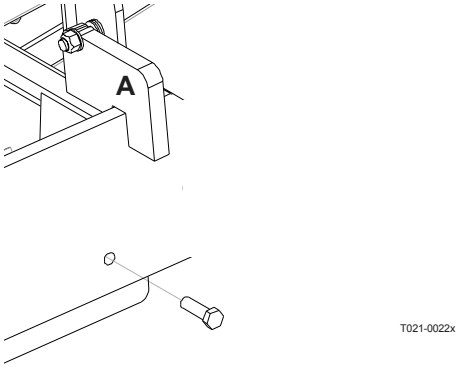
This plate needs to be welded to two longitudinal bearers, which subsequently can be bolted to each side of the tractor.

NOTE! The two longitudinal bearers should be extended as far as possible towards the rear axle of the tractor.

It is strongly recommended to leave this job to your tractor dealer, who is familiar with tractor manufacturing recommendations.

To connect the front tank:

1. Lift the front tank, e.g. by a small crane, and lower it onto the mounting, fastened on the tractor. The two jags A on the tank frame must catch hold on the mounting as shown on the drawing.

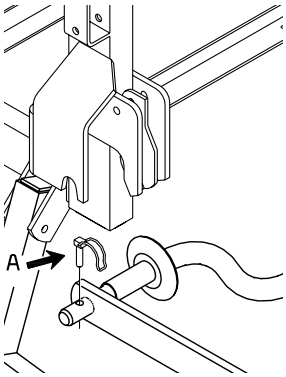


2. Secure the set up by two bolts (M16 x 55).

Connecting the MARRO lift

The MARRO is designed for three point suspension and is equipped with semi automatic hitch for the tractor lift arms (cat. II wide).

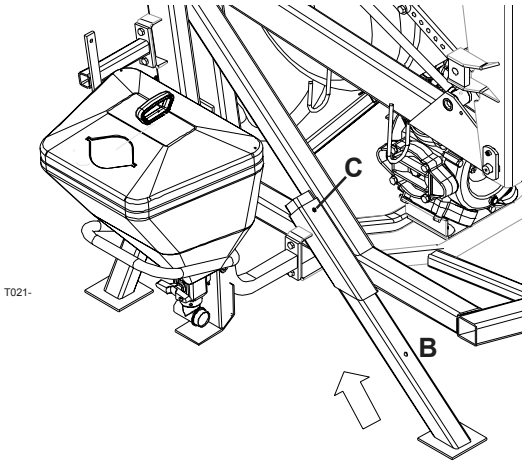
1. Fit the carrier rod in tractor lift arms and secure with 10 mm pins A.
2. Lower tractor lift arms
3. Reverse tractor till carrier rod is under the sprayer hitch
4. Lift the lift arms carefully till the locking devices “clicks” and the carrier rod is locked to the sprayer frame
5. Fit the top bar, secure with pins
6. Lift the sprayer
7. Retract each of the four support legs



støtteben mega

Retraction of support legs

1. Remove the lock pin.
2. Push up the support leg till the lower hole B in the inner profile matches the hole C in the outer profile.
3. Fasten this position by the pin A.
4. Position the tractor lift so the boom can be lowered to 45-50 cm in lowest position, and adjust top bar until the gantry is perpendicular to the ground.

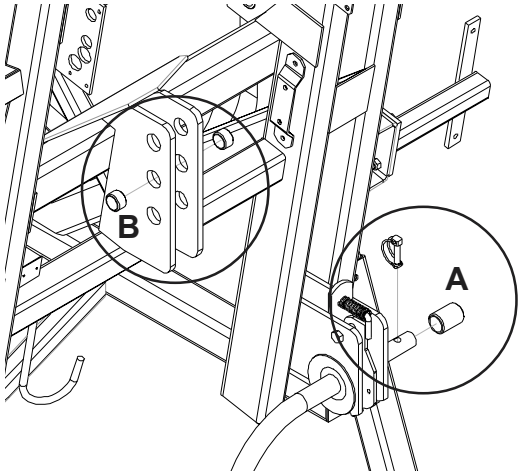


T021-

Conversion between cat. II and cat. III

Both the semi automatic hitch and the 3-point linkage frame for front tank are standard cat. II wide. For use with cat. III use bushes A (ref. no. 147575). Secure with lock pin.

The clevis for top bar is standard cat III. For use with cat. II use bushes B (ref. no. 147576).

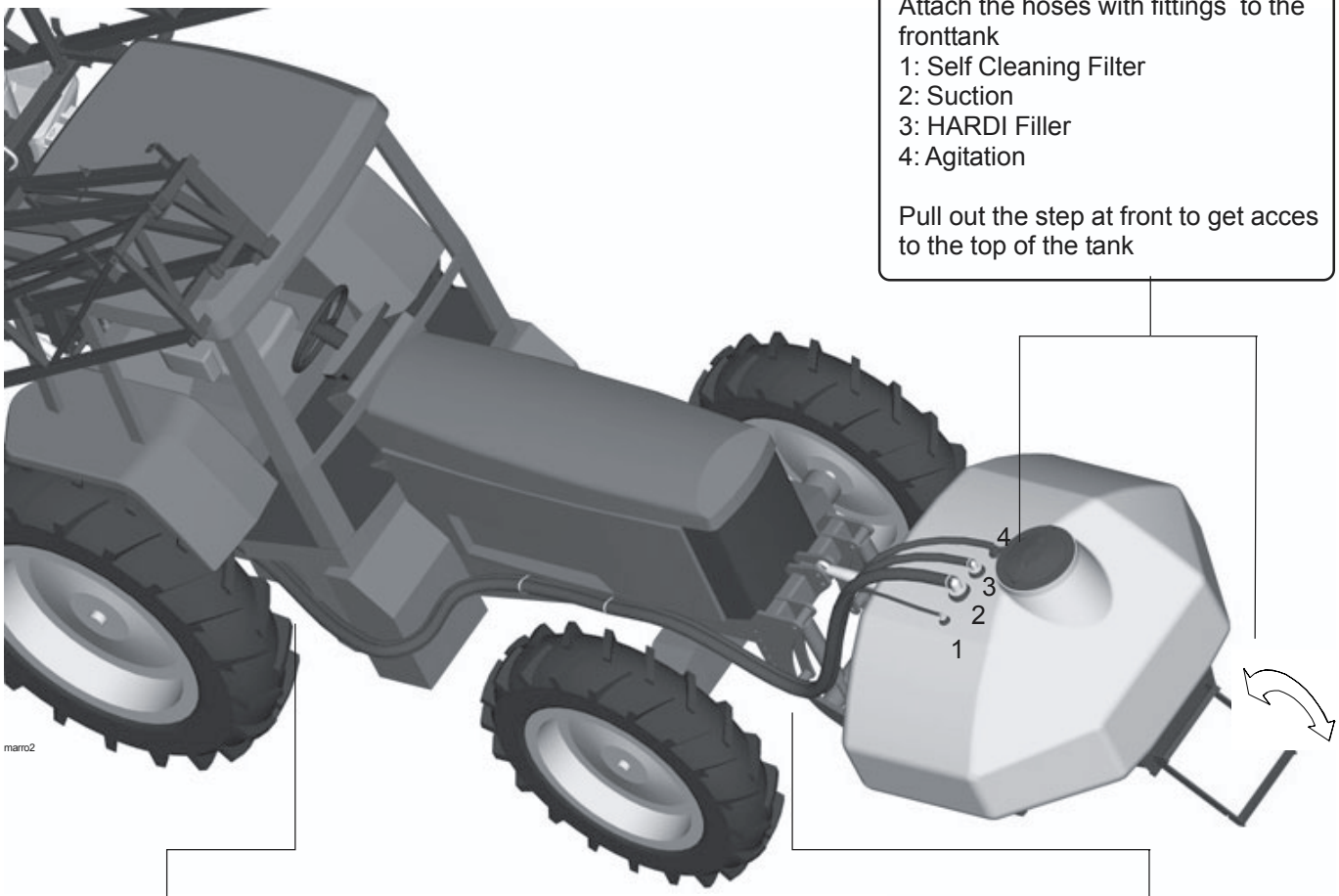


T021-023x

Set up - hoses

Attach the hoses with fittings to the fronttank
1: Self Cleaning Filter
2: Suction
3: HARDI Filler
4: Agitation

Pull out the step at front to get acces to the top of the tank



The hoses are led from the MANI-FOLD valves along the side of the tractor to the front tank as shown on the drawing. Routing of hoses will vary depending on tractor model.

Distance: 20 cm

The hoses must be secured with straps each 20 cm between MANI-FOLD valves and front tank

Transmission shaft

Operator safety

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

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

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

WARNING! ROTATING TRANSMISSION SHAFTS WITHOUT PROTECTION GUARDS ARE FATAL.

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

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

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

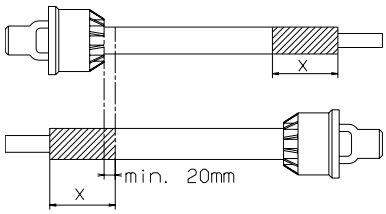
Make sure that protection guards around tractor P.T.O. and implement shaft are intact.

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

Transmission shaft installation

First installation of the transmission shaft is done 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.



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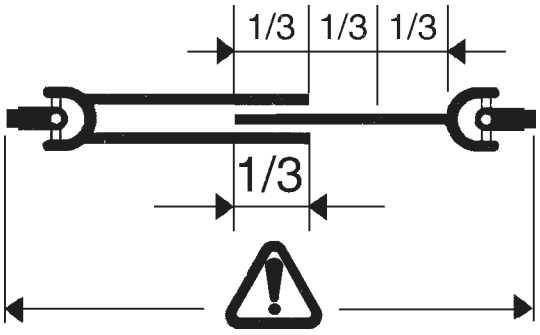
NOTE! The shaft must always have an overlap of minimum 1/3 of the length.



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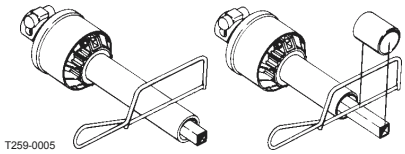
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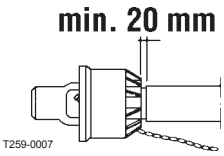
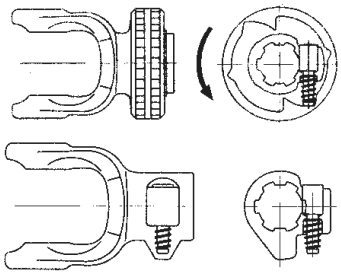
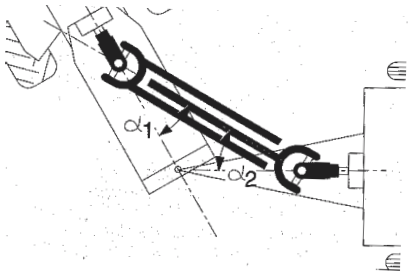


T259-0007

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. Grease the tractor P.T.O. and pump shafts.
7. Fit the shaft to tractor P.T.O. and sprayer pump shaft. **Note:** Female part marked with a tractor towards tractor! Twist the collar and slide the yoke onto the P.T.O. shaft. Make sure that the lock engages by pushing and pulling the shaft forwards and backwards. Fit the chains to prevent the protection guards from rotating with the shaft.


T259-0003

8. When operating, ensure that joint angles are equal. Disengage the P.T.O. when the angle of the joints exceeds 35°



T259-0010

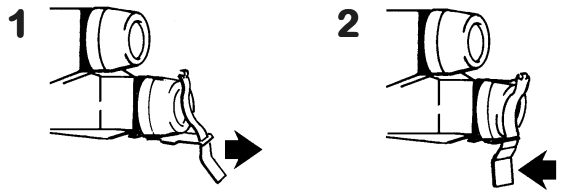
Hydraulic system

Direct Acting Hydraylics, D.A.H.

The D.A.H. system requires a double acting hydraulic outlet. The hydraulic hoses are marked with arrows to indicate direction of oil flow.

The D.A.H. system requires an oil flow between 10 and 90 l/min (19.8 Imp. gal/min.) and a min. pressure of 130 bar (1886 psi.). The system has a built-in flow regulator that maintains constant speed on hydraulic movements.

Before operating the hydraulics, the clip at the distribution valve (situated under the platform behind the pump) should be set for OPEN CENTRE or CLOSED CENTRE tractor hydraulics, depending on tractor model.



T020-0024

1. Unlocked = Open centre hydraulics (Constant Flow)

2. Locked = Constant Pressure (Closed Centre) and Load-Sensing hydraulics

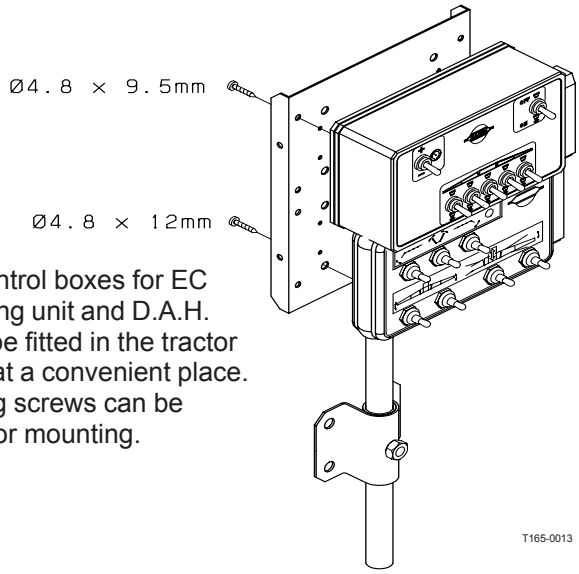
If you doubt which type of hydraulic system your tractor is equipped, ask your tractor dealer.

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

12V power sockets are required for the control boxes. Note polarity!

For EC: Brown pos. (+), Blue neg. (-)
For D.A.H.: White pos. (+), Black neg. (-)



T165-0013

The control boxes for EC operating unit and D.A.H. are to be fitted in the tractor cabin at a convenient place. Tapping screws can be used for mounting.

The wires must have a cross-sectional area of at least 4.0 mm2 (#10 awg) to ensure sufficient power supply. The boxes must be fused according to the table.

Control box for	Polarity (wire colour)		Required Fuse, Amp
	Positive (+)	Negative (-)	
EC operating unit	Brown	Blue	8
D.A.H. + Electric Air Slot angle and fan speed adjustment	White	Black	20
MANIFOLD valve	Brown	Blue	8

chart 005

Use the HARDI Electric distribution box (No. 817925) if the tractor has a doubtful power supply.

Transport position

The height and width of the transport brackets can be set in different positions. Choose a setting which gives sufficient clearance from the tractor cabin.

IMPORTANT! Make sure that max. transport height and width are not exceeded.

Height setting

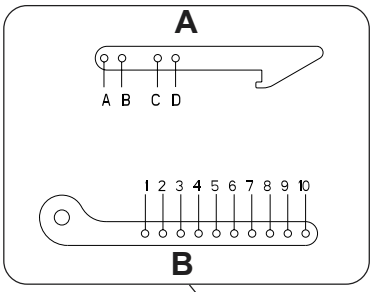
NOTE! The rear settings must correspond to the front settings so the boom is resting on the front as well as rear brackets.

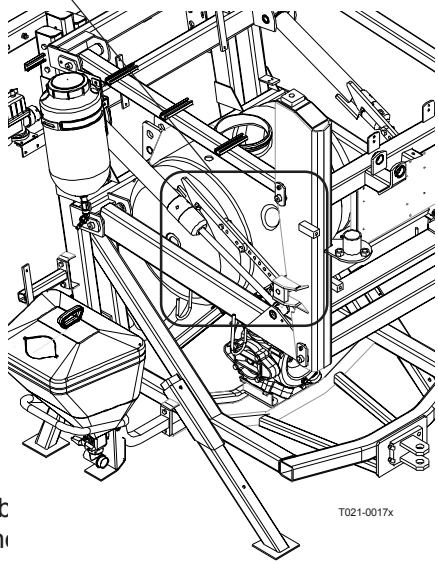
WARNING! The max. transport height must never exceed 4.0 m (13.1 ft) Always measure the actual total height, and choose settings not exceeding 4.0 metre.

Transport lock

The setting of the transport lock determines the bearing point of the boom when it rests in the transport brackets.

The setting is adjustet by means of the hole combination in the brackets A + B.



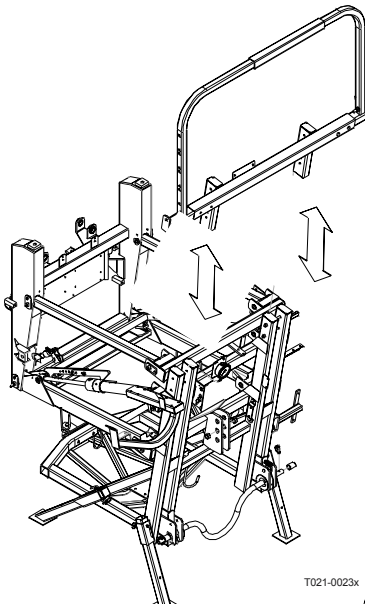


1. Lift and unfold inner sections till lock is disengaged.
2. Loosen and remove the two bolts, which keep the parts A and B assembled.
3. Reassemble A and B according to the desired hole combination.

NOTE! Always use b
bolts to assemble th

Transport brackets

The height of the transport brackets can be adjusted up and down as shown on
Simply loosen the bolts both sides, adjust the height of the brackets and fasten the bolts again according to new position.



Width setting

The width of the sprayer can be independently adjusted for each sid
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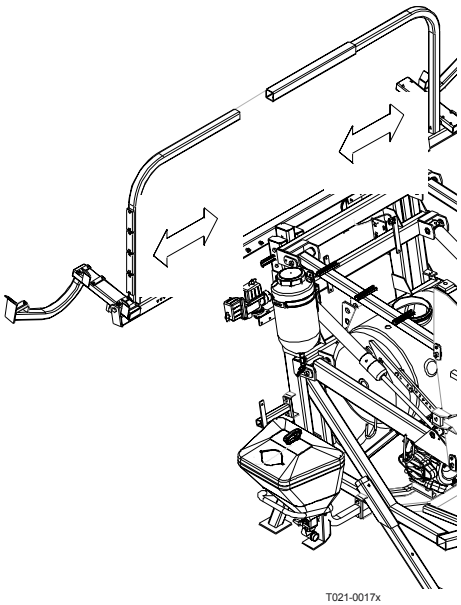
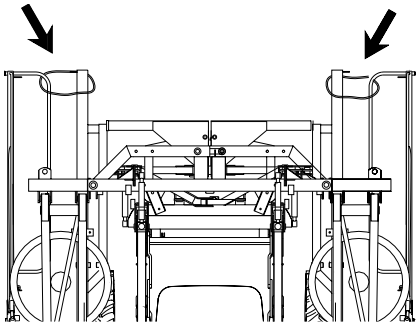


Boom transport safety chains (if fitted)

Fit the safety chains as shown before transport on public road.



Roadworthyness

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.

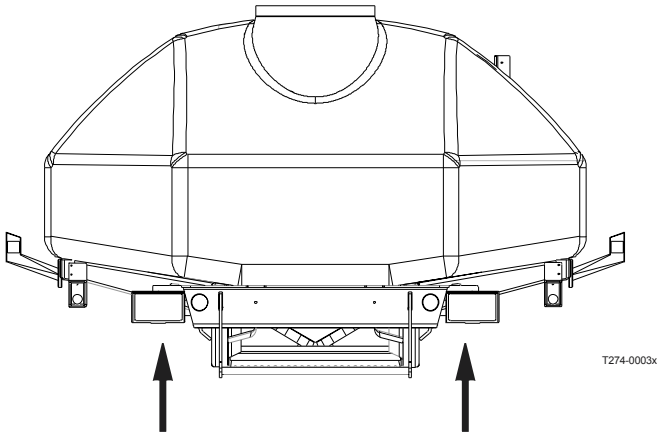
Rear lights

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 ot the sprayer before driving.

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

Head lamps (if fitted)

Head lamps can be mounted on the front tank. Please see the part "Occasional maintenance - Adjustment of head lamps" for the correct positioning of the lamps.

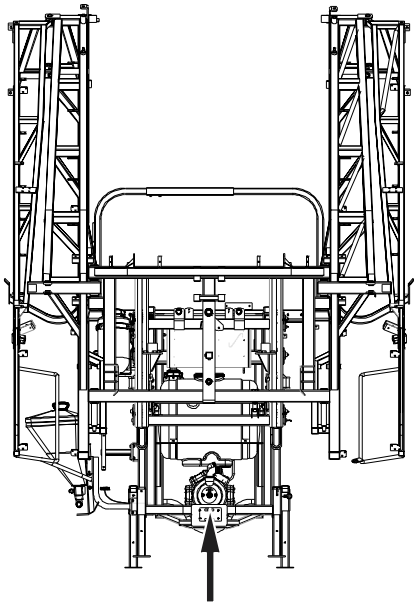


T274-0003x

Connecting a trailer

A coupling can be mounted on the MARRO lift for the purpose of connecting a trailer.

NOTE! Only connect 4-wheeled trailers.



T202-0010x

Load limits

Max horizontal load: → 1000 kg

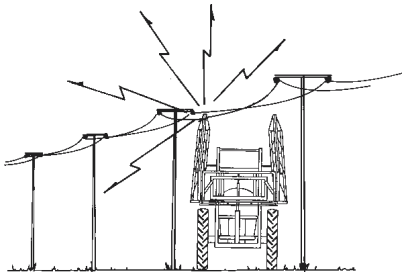
Max. vertical load: ↓ 50 kg

For further information, please refer to instructions given by the coupling manufacturer.

Operating the HAZ boom

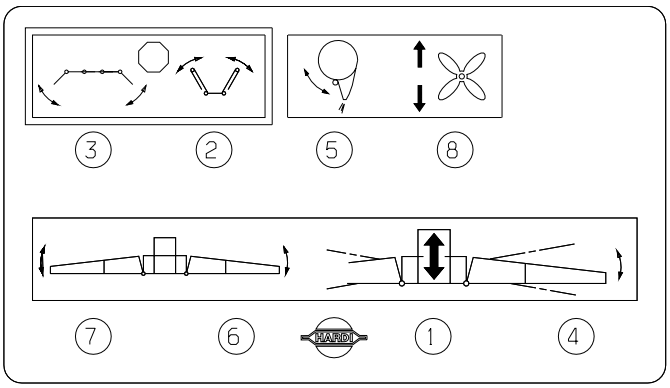
WARNING! Be cautious with initial use of the hydraulic systems. If there is air in the system, this may cause violent movements of the boom. Therefore, take care that no persons or objects are hurt or damaged in the process of testing.

DANGER!
When folding and unfolding the boom, be sure that no persons or objects are in the operating area of the boom, and that the boom cannot touch any electrical conductors!



T029-0010

Functions of the control box



T030-0003

1. Raising and lowering of boom
2. Unfolding/folding of inner sections
3. Unfolding/folding of outer sections
4. Slanting of boom
5. Angling of air slot/nozzle assembly
6. Boom tilt, RH
7. Boom tilt, LH
8. Fan speed adjustment

Unfolding the boom

NOTE! Ensure that the transport safety chains are removed and that the booms are clear from the transport brackets before unfolding.

1. Push switch **1** upwards to lift the boom clear of the transport brackets.
2. Push switch **2** upwards to unfold the inner sections. Rear transport hooks disengage automatically.
3. Push switches 6 and 7 downvards to lower individual tilt rams.
4. Push switch **3** upwards to unfold outer sections.
5. Push switch **4** to correct slant angle.
6. Push switch **1** downwards to lower the boom to correct height above crop or ground level.
7. In order to reduce wind drift and/or increase penetration of spray liquid in the crop, the slot angle can be changed backwards and forwards with switch **5**.

IMPORTANT! The two upper functions in the red rectangle with STOP signs must only be operated when sprayer is stationary! Failure to do so will damage the boom.

Folding the boom

1. Check that the slanting function is midway **4**.
2. Set slot angle at midway **5**.
3. Raise boom **1** to upper position.
4. Fold outer sections **3**
5. Lift individual boom tilt **6** and **7**
6. Fold inner sections **2**. Rear transport hooks engage automatically.
7. Lower boom **1** until boom rests on transport brackets.

Hydraulic slanting control

The hydraulic slanting control **4** enables slanting of the entire boom hydraulically. This is advantageous when spraying across hillsides.

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

Boom tilt function

The boom tilt function control **6** and **7** enables you to adjust the boom height individually in right and left-hand side.

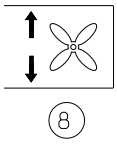
Air slot angling

The air slot and nozzle assembly can be angled approx. 40º forwards and 30° backwards compared to vertical position. Regarding adjustments - see section on “Air technique”.

Electric fan speed adjustment (if fitted)

Increasing of fan speed

Decreasing of fan speed



T030-0003

The max. revolutions for the fan are 3100 r.p.m., which will give full air speed of approx. 40 m/sec (90 mph).

The fan speed is indicated by the transmission working pressure by means of a pressure gauge. (Please see the part “Air Technique”).

Conversion table between pressure and fan speed - see the part “Air Technique”

IMPORTANT! To avoid shock starting the fans always set fan speed to 0 before engaging the P.T.O.

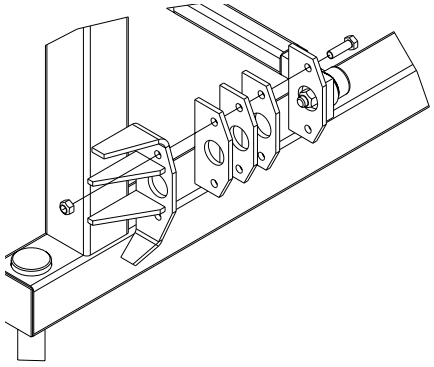
Boom support wheels
The boom is equipped with two support wheels. When spraying with low boom heights on bare ground or plants in the first growth stage it is recommended to fold down the support wheels. In later growth stages the wheels should remain folded up.

IMPORTANT! When driving on public roads the support wheels should be folded up and secured in order to keep the machine overall width according to the regulations!

Boom suspension sensitivity
The boom suspension would normally suit most conditions and would not require any adjustment. The suspension will keep the boom parallel to the ground and compensate for uneven ground.

However special conditions or situations can require the suspension to react less or more slowly.

When the RH and LH guide rods are parallel to each other (factory setting) the boom suspension will react immediately, and the boom will move independently of the trailer or tractor.



T030-0005

If the boom should follow the movements or inclinations of the trailer the guide rods should be inclined towards each other at the rear.

Add 1-4 pcs. of 10 mm spacers as shown at each rod until the decired function is reached.

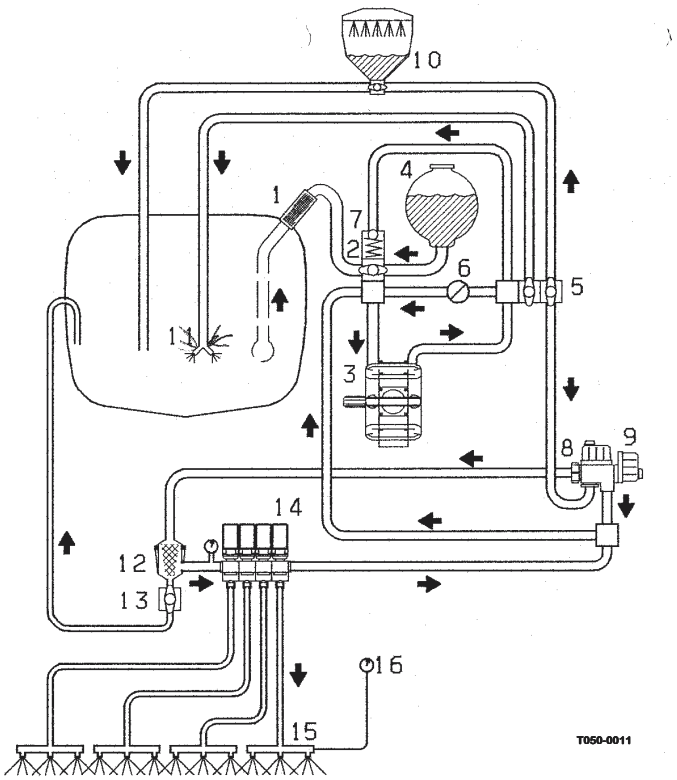
Operating instructions

MANIFOLD SYSTEM

The MANIFOLD SYSTEM is located at the right side of the sprayer and permits operation of all HARDI optional extras from one position. The modular system facilitates the addition of one optional extra (equal to two functions) on the suction side.

Function diagram

1. Suction filter
2. Suction MANIFOLD
3. Pump
4. Rinsing tank
5. Pressure MANIFOLD
6. By pass valve
7. Safety valve
8. On/off
9. HARDI-MATIC
10. HARDI Filler
11. Pressure agitator
12. Self-clellaning filter
13. Ball valve
14. Distribution valves
15. Sprayer boom
16. Pressure gauge

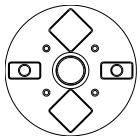


The diagram shows examples of options. These are individual for each sprayer.

Use of MANIFOLD valve system

The following pictograms and colours are used for visualizing the function of the MANIFOLD valves:

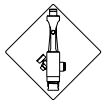
Green disc = Pressure valve
Black disc = Suction valve



Green disc = Pressure valve

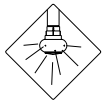
To Self-Cleaning Filter/operating unit

To Fast Filling Device



To HARDI FILLER

To Tank Flushing Nozzle



To main tank

Agitation

Black disc = Suction valve

From main tank (suction filter)

From Rinsing Tank

From Filling Device

To operate the spraying functions:

- Turn the handle on a green pressure valve towards the function desired
- Turn the handle on a black suction valve towards the desired function
- Close all remaining valves by setting the handle(s) on "**O**"

IMPORTANT! The valves and functions may vary from machine to machine depending on optional equipment fitted. Only the functions to be used must be open - Always close remaining valves.

Electric operated MANIFOLD valves (if fitted)
One or more MANIFOLD valves can be electrically operated via a control box in the tractor cab. These can only be operated manually when the power to the valve motor is disconnected first.

Filling of water

Water can be filled into the main tank in following ways:

1. Filled through tank lid.
2. Filled by diaphragm pump through a suction side fitted filling device (optional extra) using normal pump capacity directly to the tank.
3. Filled by diaphragm pump through a pressure side fitted injector/venturi type Fast Filling Device (optional extra) using up to 3 times normal pump capacity.
4. Combination of 2 and 3.

The tank should normally be filled 1/3 with water, before adding the chemicals.

Always read instruction on chemical container!

NOTE! Max. permitted tank contents:

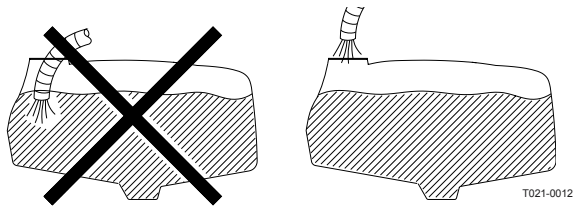
Model	Volume, water			Volume, liquid fertilisers*		
	Litre	Imp. gal	US gal	Litre	Imp. gal	US gal
1000 l	1000	220	264	770	169.4	203.3
1300 l	1300	286	343.2	1000	220	264
* Based on liquid fertilisers with specific gravity 1.3						

Filling through tank lid
Remove tank lid and fill water through strainer to prevent rust or other particles to enter the tank.

An overhead tank can be used in order to obtain high filling capacity.

It is recommended to use as clean water as possible for spraying purposes.

WARNING! DO NOT LET FILLING HOSE ETC. ENTER THE TANK. KEEP IT OUTSIDE THE TANK, POINTING TOWARDS THE FILLING HOLE.

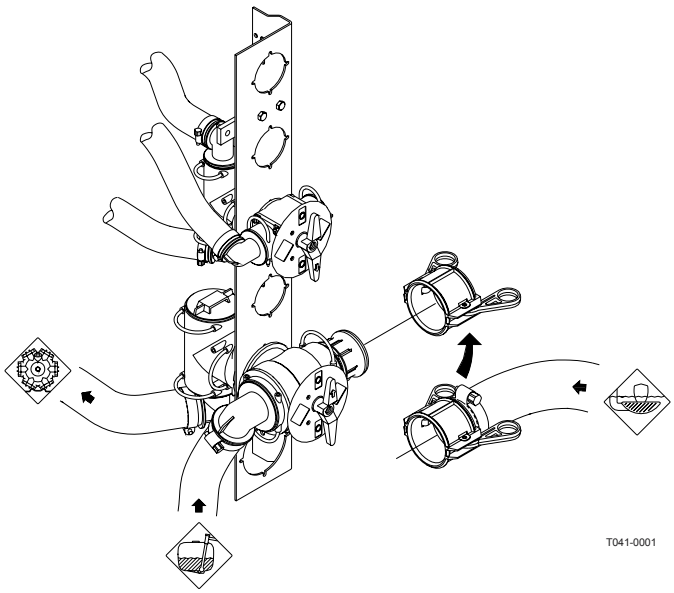


IF THE HOSE IS LEAD TO THE BOTTOM OF THE TANK, AND THE WATER PUMP AT THE WATER SUPPLY PLANT STOPS, CHEMICALS CAN BE SIPHONED BACK AND CONTAMINATE THE WATER SUPPLY LINES.

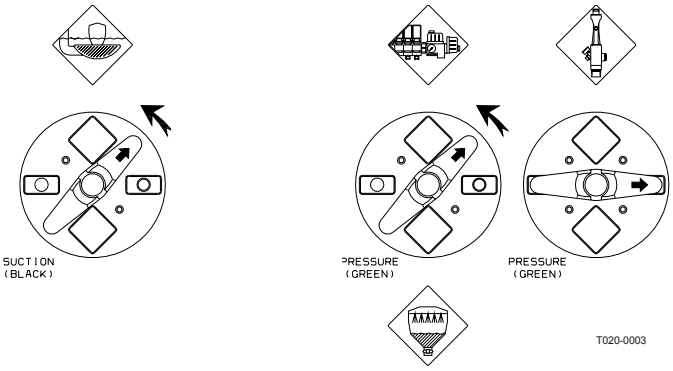
Suction Filling Device (if fitted)

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 **A**, and connect suction hose **B** to Suction Manifold.
2. Engage diaphragm pump and set P.T.O. revolutions at 540 r/min or 1000 r/min depending on pump model. Turn handle on Suction Manifold towards Filling Device.

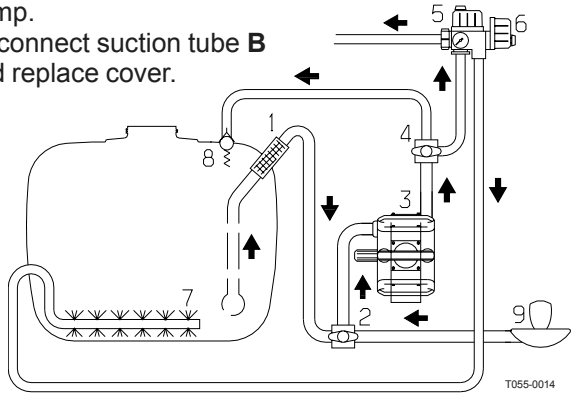


3. The tank is now filled with water. Keep an eye on liquid level indicator.
4. Turn handle on Suction Manifold away from Filling Device to discontinue filling process. Then disengage pump.
5. Disconnect suction tube **B** and replace cover.

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!

1. Remove cover **A**, and connect suction hose **B** to Suction Manifold.
2. Engage diaphragm pump and set P.T.O. revolutions at 540 r/min. Turn handle on Suction Manifold towards Filling Device.
3. The tank is now filled with water. Keep an eye on liquid level indicator.
4. Turn handle on Suction Manifold away from Filling Device to discontinue filling process. Then disengage pump.
5. Disconnect suction tube **B** and replace cover.



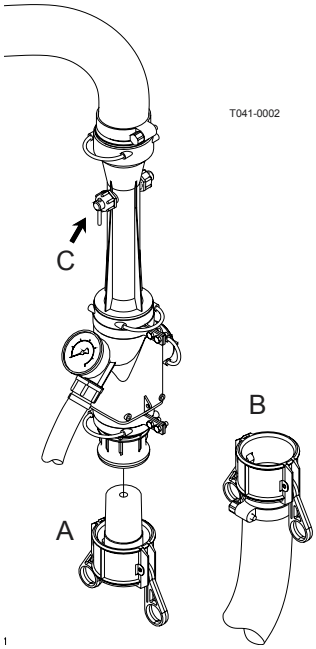
NOTE! Observe local legislation regarding use of Filling Device. In some areas it is prohibited to fill from open water reservoirs (lakes, rivers etc.). It is recommended only to fill from closed reservoirs (mobile water tanks etc.) to avoid contamination.

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!

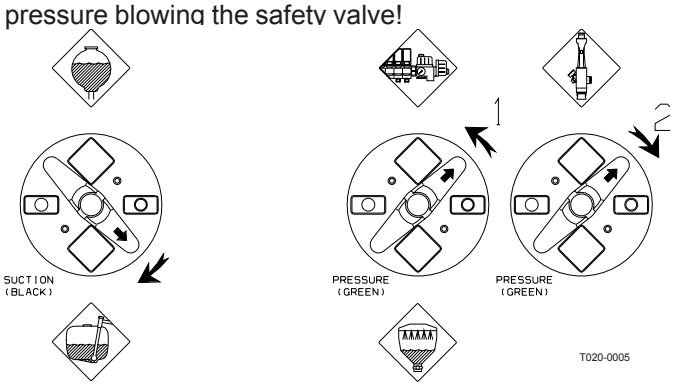
Fast Filling Device (if fitted)

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 transfer tube, prime by turning valve (**C**).
5. Keep eye on liquid level indicator.
6. Turn handle on Pressure Manifold away from Fast Filler to discontinue filling process.

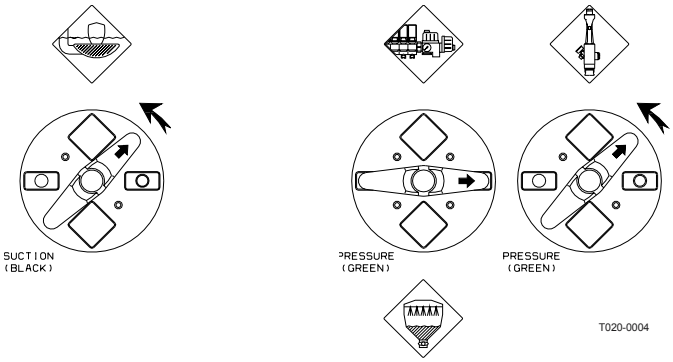


NOTE: Turn handle towards EC-operating unit **before** turning away from Fast Filler in order to avoid peak pressure blowing the safety valve!



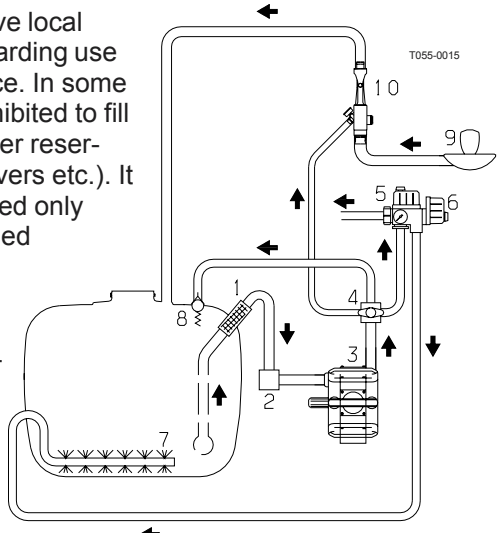
7. Disconnect suction tube (**B**) and replace cover.

The Filling Device and the Fast Filling Device can be used simultaneously - this gives even bigger filling capacity.



WARNING: Do not leave the sprayer whilst refilling the tank, and keep an eye on the level gauge 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.



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!

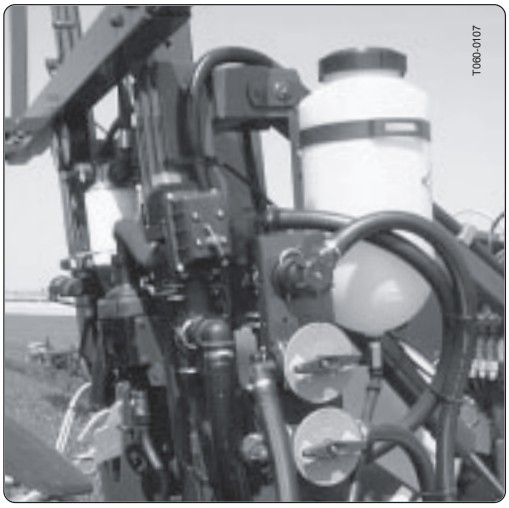
Filling of rinsing tank

The tank has a capacity of 200 l.The rinsing tank is situated just above the pump. Access to the tank is possible from the back of the MARRO lift. Only fill with clean water.

Filling of clean water tank (if fitted)

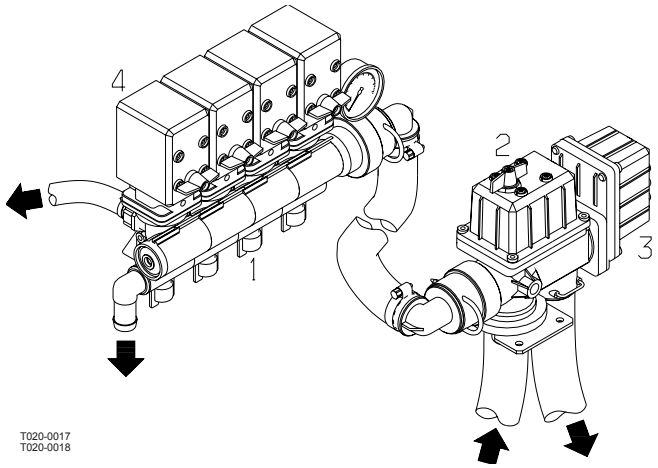
The clean water tank has a capacity of 15 l. The water from this tank is for hand washing, cleaning of clogged nozzles etc. Only fill this tank with clean water from the well.

The tank can be fitted on a mounting next to the MANIFOLD valves.

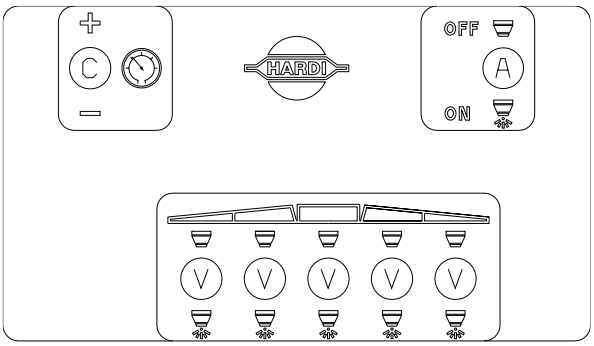


WARNING! Although the clean water tank is only filled with clean water, it must never be used for drinking.

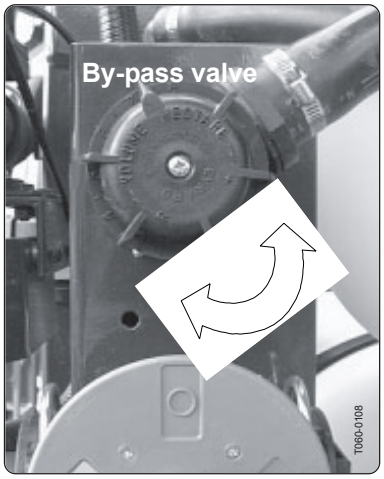
Adjustments of EC operating unit



T020-0017
T020-0018



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



T060-0108

1. Close the by-pass valve.
2. 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.
3. On-off switch **A** is activated against green.
4. All distribution valve switches **V** are activated against green.
5. Pressure regulation switch **C** is activated until emergency handle **3** stops rotating (minimum pressure).
6. Put the tractor in neutral and adjust the P.T.O. and thereby the number of revolutions of the pump corresponding to the intended travelling speed. Remember the number of revolutions on the P.T.O. must be kept between 300-600 rpm (pump 540 r/min) or 650-1100 r.p.m. (pump 1000 r/min)
7. Open the by-pass valve (can be adjusted from 0 to 8) till the pressure drops to 1-1.5 bar.
8. 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 **1** until the pressure gauge again shows the same pressure.
3. Adjust the other sections of the distribution valve in the same way.

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

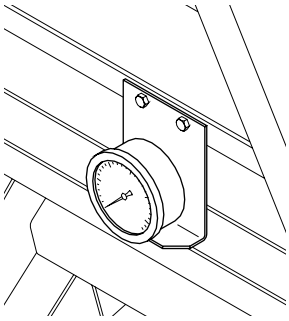
OPERATING THE CONTROL UNIT WHILE SPRAYING

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.

Remote pressure gauge

The remote pressure gauge messures the working pressure in the boom tubes as close to the nozzles as possible. This pressure reading will always be slightly lower than the reading at the operating unit pressure gauge.



T042-0006

The outputs stated in the nozzle charts are always based on the pressure measured at the nozzle.

Always adjust pressure when calibrating and spraying according to readings at the Remote pressure gauge.

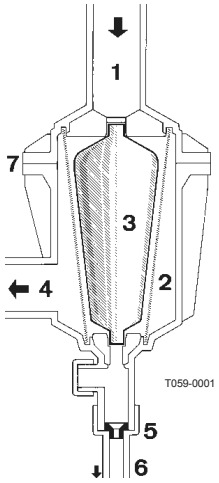
Filters

All filters should always be used, and their function checked regularly. The mesh size of the filter in use should always be smaller than the flow average of the nozzles used. Therefore, pay attention to the correct combination of filters, mesh size.

Self-cleaning filter

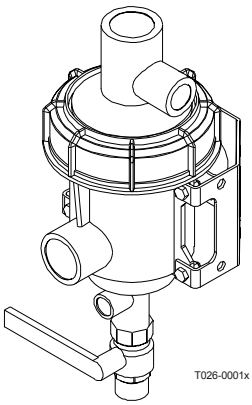
Operating diagram

1. From pump
2. Double filter screen
3. Guide cone
4. To operating unit
5. Replaceable restrictor
6. Return to tank
7. Screw-joint



IMPORTANT! The ball valve underneath the self-cleaning filter should normally be open, but must be closed in the following cases:

1. If rinsing with water from the rinsing tank and a quantity of spray liquid still remains in the main tank (otherwise the spray liquid will be diluted).
2. If opening the self-cleaning filter and a quantity of spray liquid still remains in the main tank (otherwise there is a risk that spray liquid will flow out).

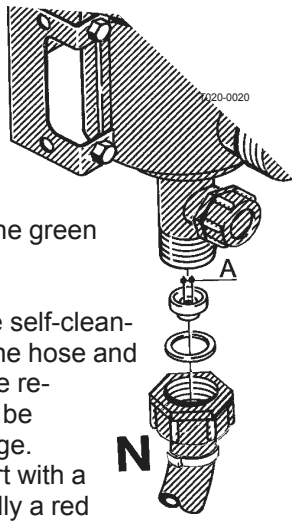


Choice of correct restrictor

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) first.

The hose **N** is demounted at the self-cleaning filter, the restrictor is put in the hose and the hose is mounted again. If the required working pressure cannot be obtained, the restrictor is too large. Choose a smaller restrictor. Start with a black one, then a white and finally a red one.



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

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

Filling of chemicals.

Chemicals can be filled in the tank in 2 ways:

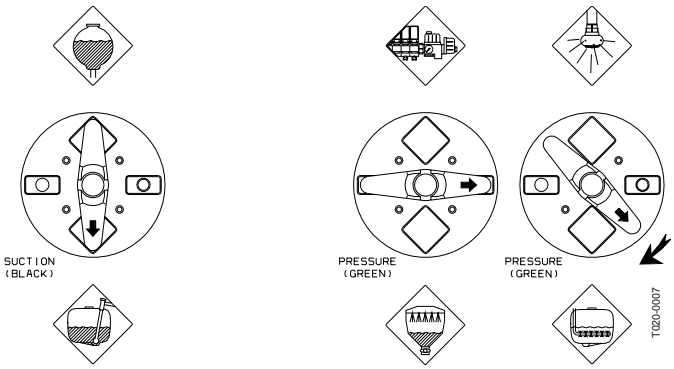
1. Through tank lid.
2. By means of HARDI FILLER chemical filling device.

Filling through tank lid

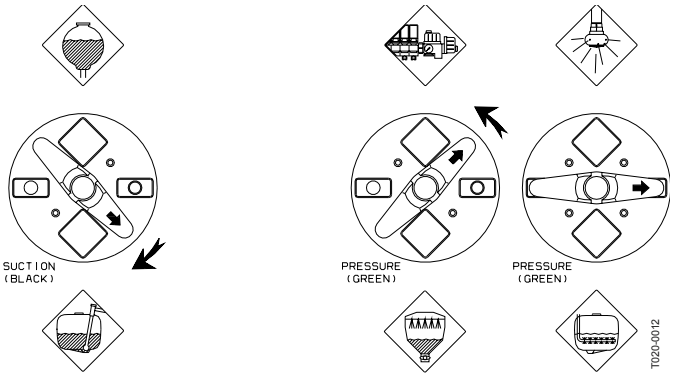
The chemicals are filled through the tank lid - Note instructions on the chemical container!

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

1.Make sure the EC on/off valve is switched off.
2.Set the MANIFOLD valves to correct position. Black valve “Suction from main tank”, green valve towards “Agitation”.

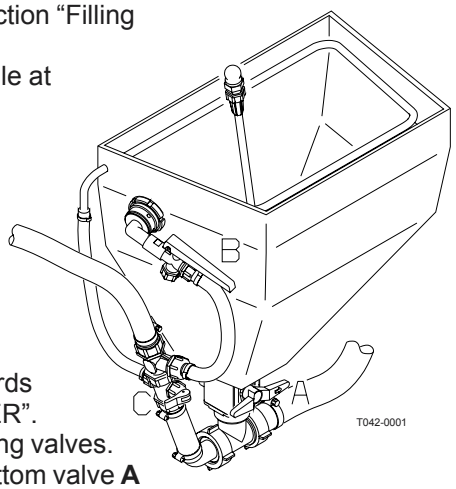


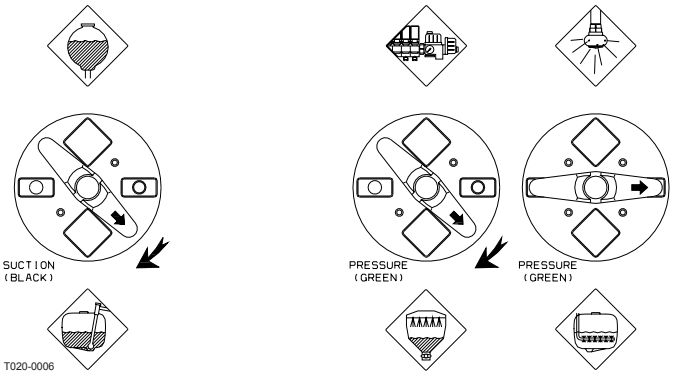
3.Engage the pump and set P.T.O. revs. to 540 r.p.m. or 1000 r.p.m. depending on pump model.
4.Add the chemicals through the main tank hole.
5.When the spray liquid is well mixed, turn handle on the Pressure Manifold towards “Spraying” position. Keep P.T.O. engaged so the spray liquid is continuously agitated until it has been sprayed on the crop.



Filling by HARDI FILLER chemical inductor
Liquid chemicals

1. Fill the main tank at least $^1/_3$ 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”. Close remaining valves.
3. Turn the handle at the Pressure Manifold towards “HARDI FILLER”. Close remaining valves. Check that bottom valve **A** at the FILLER is closed.





4. Engage the pump and set P.T.O. speed at 540 r.p.m. or 1000 r.p.m. depending on pump model.
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**.

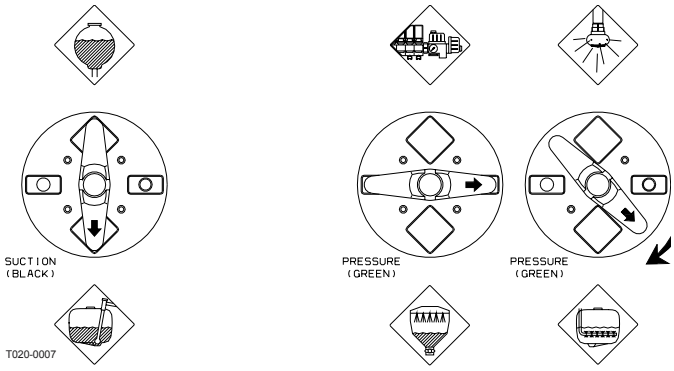
WARNING! Do not press lever **B** unless the multi-hole nozzle is covered by a container to avoid spray liquid hitting the operator.

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.

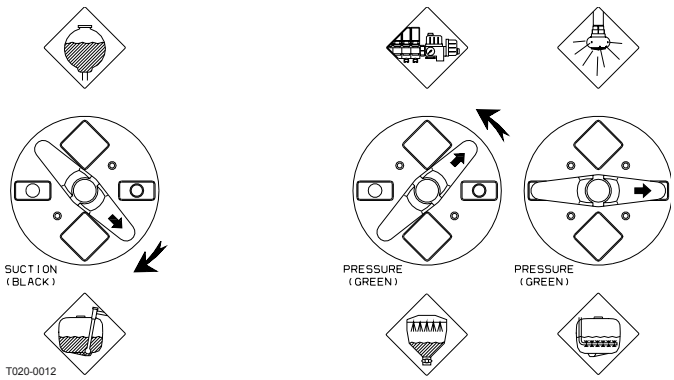
9.Engage the hopper rinsing device by opening valve **C**.
10.Close valve **C** again when the hopper is rinsed.

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.Turn handle at the Pressure Manifold towards “Intensive Agitation” and close remaining valves.



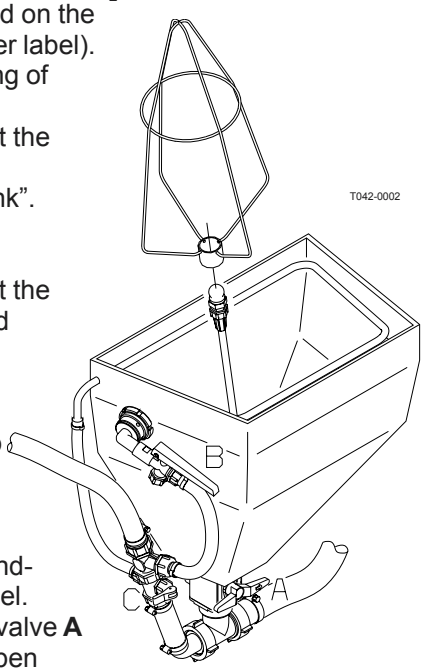
13.When the spray liquid is well mixed, turn handle on the Pressure Manifold towards “Spraying” position. Keep P.T.O. engaged so the spray liquid is continuously agitated until it has been sprayed on the crop.



Filling by HARDI FILLER chemical inductor
Powder chemicals

Filling of powder chemicals is done as follows:

1. Fill the main tank at least $^1/_2$ 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”. Close remaining valves.
3. Turn the handle at the Pressure Manifold towards “HARDI FILLER”. Close remaining valves.
4. Engage the pump and increase P.T.O. speed to 540 r.p.m. or 1000 r.p.m. depending on pump model.
5. Open the bottom valve **A** at the FILLER. Open FILLER lid.



6. Engage the hopper rinsing device by opening valve **C**.
7. Measure the correct quantity of chemical and sprinkle it into the hopper as fast as the rinsing device can flush it down.
8. 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**.

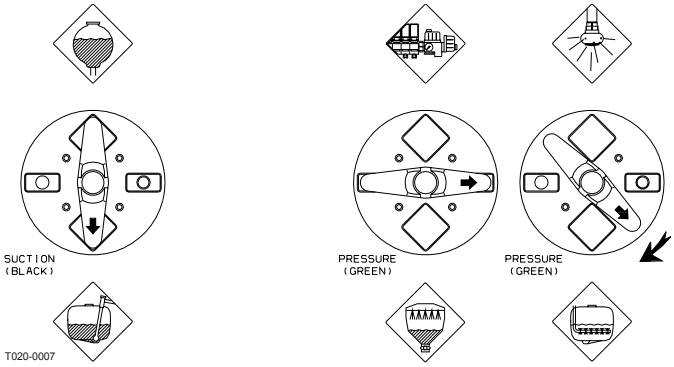
WARNING! Do not press lever **B** unless the multi-hole nozzle is covered by a container to avoid spray liquid hitting the operator.

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.

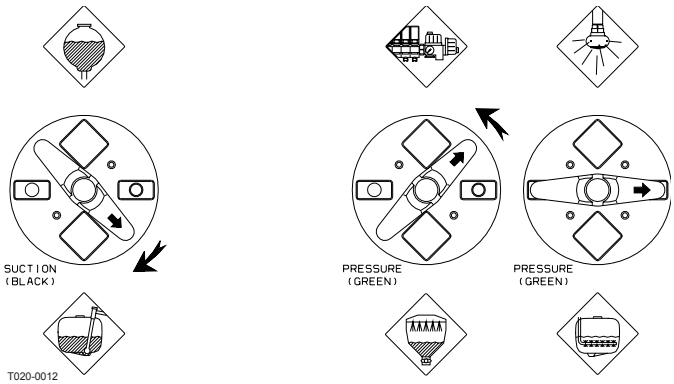
9. Close valve **C** again when the hopper is rinsed.

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. Turn handle at the Pressure Manifold towards “Intensive Agitation” and close remaining valves to mix the spray liquid.



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.

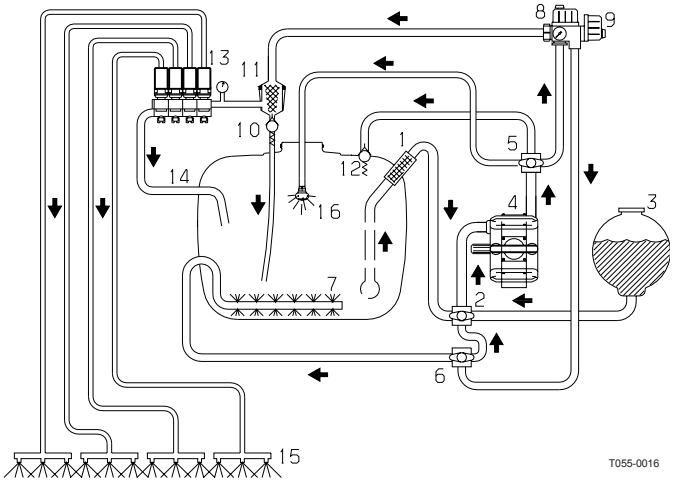


Spray Technique - see separate book

Use of rinsing tank and rinsing nozzles (if fitted)

The 200 l rinsing tank can be used for two different purposes.

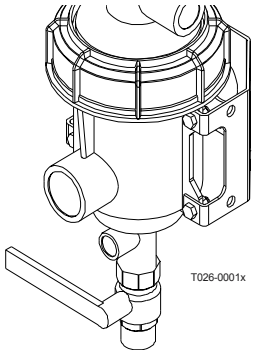
A. In-field diluting of remaining spray liquid residues in the spraying circuit for spraying the liquid in the field, before cleaning the sprayer.



1. Empty the sprayer as much as possible. Turn the blue valve **6** towards pump and spray till air comes out of all nozzles.
2. Remove the tank filter basket.
3. Turn suction valve **2** towards rinsing tank.
4. Turn pressure valves **5** towards rinsing nozzle (if fitted).
5. Engage and set the pump at appr. 300 r.p.m.
6. When rinsing water corresponding to appr. 10 times the spray liquid residue (see paragraph “Technical Residue”) is used, turn back suction valve towards suction from main tank and operate all valves, so all hoses and components are rinsed.
7. Turn pressure valve **5** back to EC operating unit and spray liquid in the field you have just sprayed.
8. Repeat point 3-7 until the rinsing tank is empty.

B. Rinsing the pump, operating unit, spray lines, etc. in case of stop in spraying before main tank is empty (e.g. beginning rain etc.).

1. Close ball valve underneath the self-cleaning filter.



2. Turn suction valve **2** towards rinsing tank.
3. Turn blue return valve **6** (if fitted) towards pump suction line.
4. Engage the pump and spray water from rinsing tank in the field until all nozzle tubes/nozzles are flushed with clean water.
5. Disengage pump again.
6. Open ball valve again.

WARNING! The rinsing nozzles cannot always guarantee a 100% cleaning of the tank. Always clean manually with a brush afterwards, especially if crops sensitive to the chemical just sprayed are going to be sprayed afterwards!

Technical Residue

Inevitably a quantity of spray liquid will remain in the system, which cannot be sprayed properly on the crop, as the pump takes in air when the tank is about to be empty.

This Technical Residue is defined as the remaining liquid qty. in the system as the first clear pressure drop on the pressure gauge is read.

Residue, litre		
	1000 l	1300l
Dilutable residue[1]	-	-
Total residue[2]	-	-

chart 016

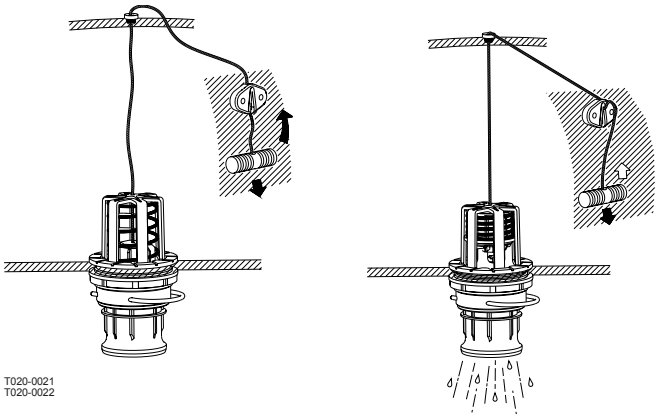
1) Residue in main tank, possible to dilute with water from rinsing tank

2) Total residue in tank and spraying circuit on standard sprayer. Variations due to different ground inclinations etc.

The dilutable residue must be diluted 10 times with clean water and sprayed to the crop just sprayed before cleaning the sprayer - See paragraph “Cleaning”.

Operation of the tank drain valve

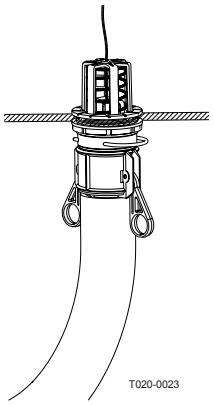
Pull the string at left hand side of the front tank to open the drain valve. The valve is spring-loaded but can be kept open by pulling the string out and upwards in the V-shaped slit.



T020-0021
T020-0022

To release and close the drain valve again pull the string downwards and the valve will close automatically.

If draining a residue, e.g. liquid fertilisers into a reservoir, a snap coupler with hose can rapidly be connected to the drain valve, and the liquid let safely out.



T020-0023

Rinsing tank drain valve

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

Safety precautions

Always be careful when working with crop protection chemicals!

Personal protection

Dependant on which type of chemical used, the following protective clothing/equipment should be used:

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

This equipment should be worn to avoid contact with the chemicals!

- Protective clothing/equipment should be used when preparing the spray liquid, during the spraying work and when cleaning the sprayer. Also follow the recommendations 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.

- Do not mix different chemicals in the tank.

- Always clean the sprayer before changing to another chemical.

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.

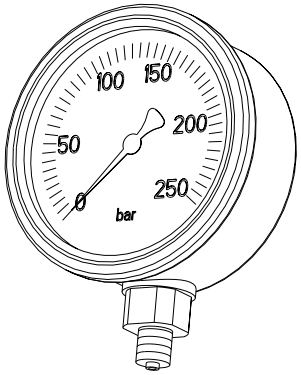
Air speed / Air volume

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 m^3 air/m boom/hour (3.872 CFM/A boom/hour).The air speed must be adjusted to the spray job

Blower adjustment

The oil flow determines the air speed from the blowers. The oil flow can be observed on the pressure gauge (0-250 bar).

The colour codes of the gauge refer to air speed produced at certain pressure ranges.



T140-0001r

Air assistance level	Low (L)	Medium (M)	High (H)	Very high (VH)
Air speed (m/s)	5-10	10-20	20-30	30-35
Fan r.p.m.	400-1000	1000-1900	1900-2700	2700-3100
Colour code	Blue	Green	Orange	Red
Boom 18 m	20-40	40-75	75-125	125-180
Boom 20-21 m	25-50	50-90	90-150	150-200
Boom 24-28 m	30-70	70-140	140-190	190-240

018

Pressure in bar

When booms are half-folded, reduce r.p.m. or pressure with 25% to obtain the same performance.

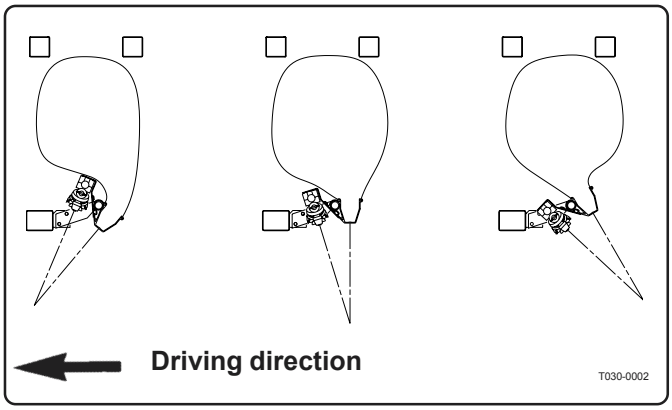
The following table gives a rough guideline of the air assistance needed for different crop conditions.

Spray job	Air assistance
Bare ground/low vegetation/ early stage row crop	Low/Medium
Spraying only the top of a crop e.g. ear spraying in wheat*	Low
Penetration in open crop*	Medium/High
Penetration in dense crop*	High/Very high
* Can be checked with water sensitive paper	

019

Angling of air and liquid.

The main purpose of the TWIN angling system is to counteract for the negative influence which wind direction and driving speed have on the quality of the spray job. Further the “co-angling” af air and liquid can help “opening” dense crops for better penetration
The TWIN FORCE air system can be set at any angle from 40° forward to 30° back (defined by the air stream).



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.

Conditions	Air speed recommendations
Bare ground / low crop:	Use maximum air within the possible range
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 avard 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.

Wind direction	Angle / air speed
Head wind:	Angle forward
Down wind:	Angle back (if the forward speed is higher than the wind speed: angle forward)
Side wind / No wind:	Angle vertical or back. Only high forward speeds may require forward angling.

Crop condition	Angle / air speed
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.

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

Air Technique

mph. Exceptions are of course liquid fertiliser and herbicides whose selectivity is based large droplets that will only stick to the weeds

• 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 herbacide	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.

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/VH
Herb. spraying, couch grass + desiccation	2 weeks before harvest	100	F-015-110	3.6	H/VH

[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.

Disconnecting the MARRO

Always clean the sprayer - inside and outside - before disconnecting and parking it.

WARNING! To prevent the sprayer from tipping over, do not disconnect the sprayer from the tractor with the booms unfolded unless the boom is supported!

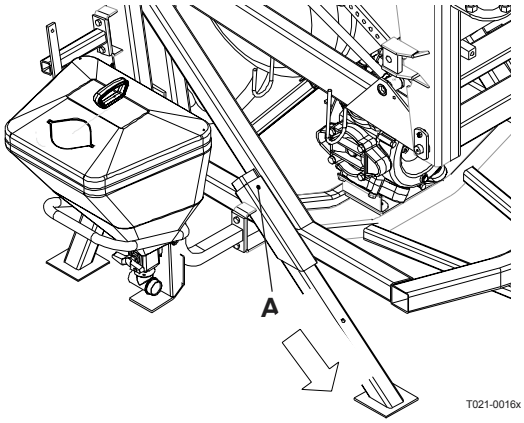
Remember to disconnect all hoses and cables from the tractor.

WARNING! If the sprayer is parked unattended avoid unauthorised persons, children or animals having access to the sprayer.

Disconnecting the MARRO lift

IMPORTANT! The MARRO lift must be placed on a level and hard foundation. Failure to do so may cause settling of support legs - and the sprayer will tip over. If necessary, place the sprayer on a bearing plate to prevent this.

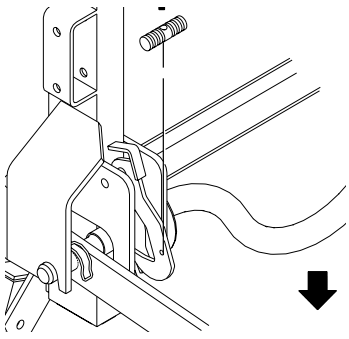
Max.ground inclination: 8.5°.



1. Remov
2. Pull dov
   till the
   profile r
   the outer profile.
3. Fasten this position by the pin.

NOTE! All of the 4 support legs must be pulled down before lowering and disconnecting the sprayer.

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

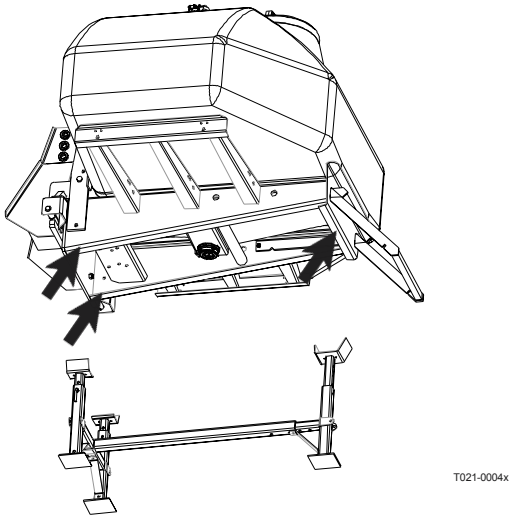


Disconnecting the front tank

Disconnect the hoses (please see next page) before disconnecting the front tank.

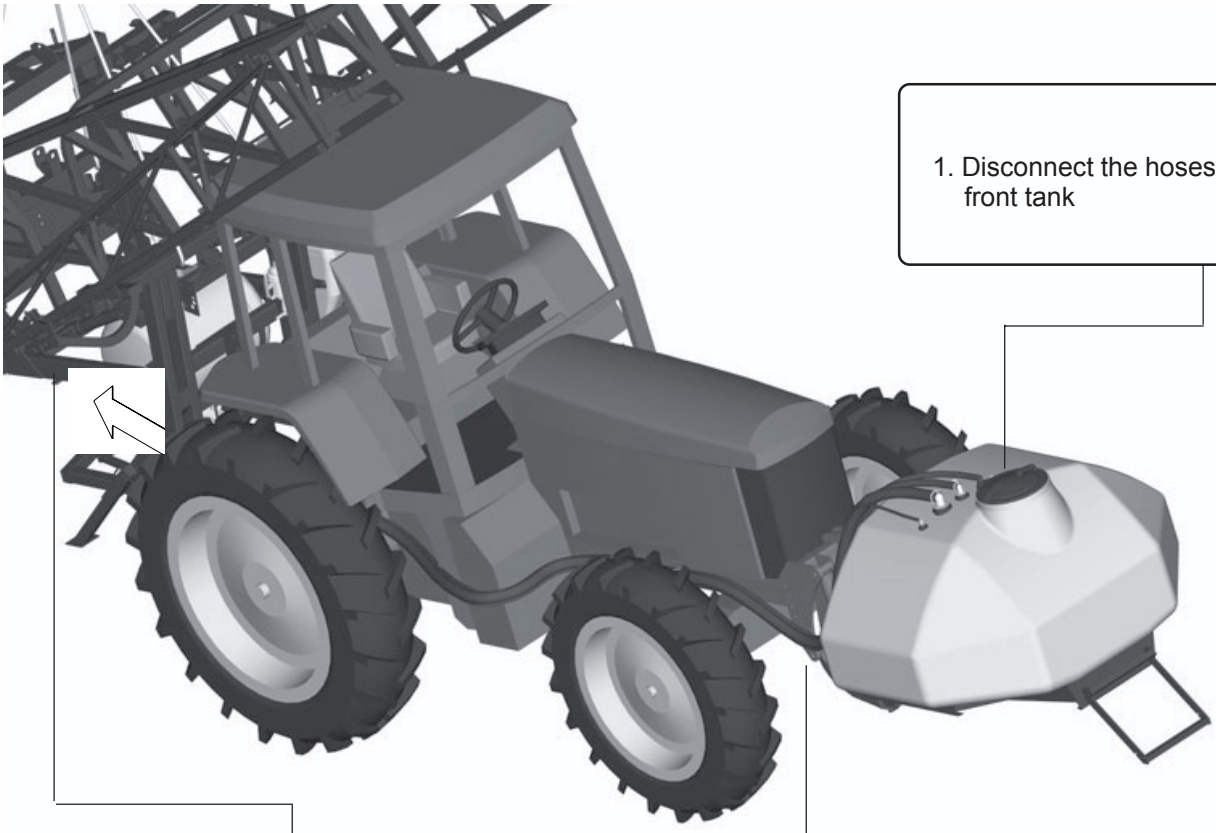
Parking stand for front tank (Optionmal equipment)

A parking stand (r ` 833269) can be used for parking the front ⁻t used.

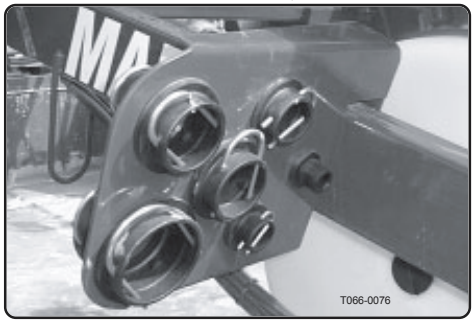


The height of the legs ca.

Disconnecting the hoses



1. Disconnect the hoses from the front tank



3. Fasten the fittings/hoses to the mounting on the MARRO.

2. Loosen the hoses if they have been fastened to the tractor - but retain the staps along the hoses to keep them gathered.

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 - See paragraph "Use of rinsing tank and rinsing nozzles".

   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 $^1/_5$ 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 by-pass 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 now. Also check for sediment on the pressure side of the safety valve for the Self-Cleaning Filter.

10. Replace all the filters and nozzles and store the sprayer. If, from previous experiences, it is noted that the solvents in the pesticide are particularly aggressive, store the sprayer with the tank lid open.

NOTE! If the sprayer is cleaned with a high pressure cleaner lubrication of the entire machine is recom mended.

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.

Lubrication

Recommended lubrication is shown in following table. Following 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 80/W90 SHELL SPIRAX 80W/90 MOBIL MOBILUBE 80W/90
Hydrostatic fan transmission			Hdraulic oil type ISO HV 68 SHELL TELLUS T 68[1] CASTROL HYSPIN AWH 68 TEXACO RANDO OIL 68
Gear box			Engine or universal oil SAE 15W40
[1] This quality is filled in the factory			

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

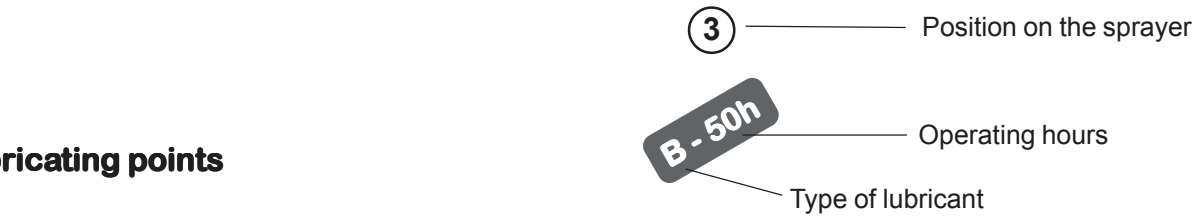
Keep oil filling jugs, hoppers and grease guns clean, and clean the lubricating points thoroughly before lubricating.

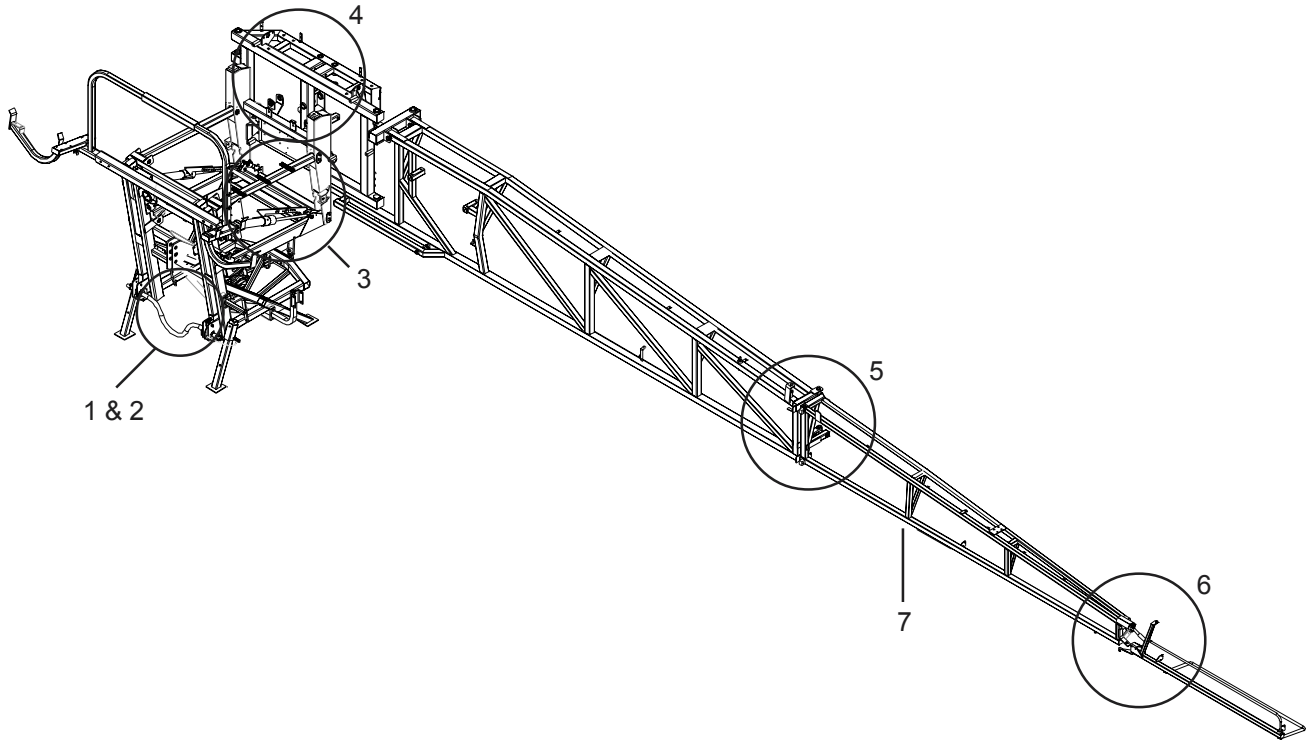
Avoid skin contact with oil products for longer periods.

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

chart 017

Lubricating points





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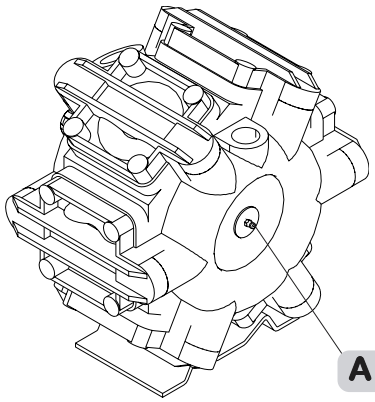

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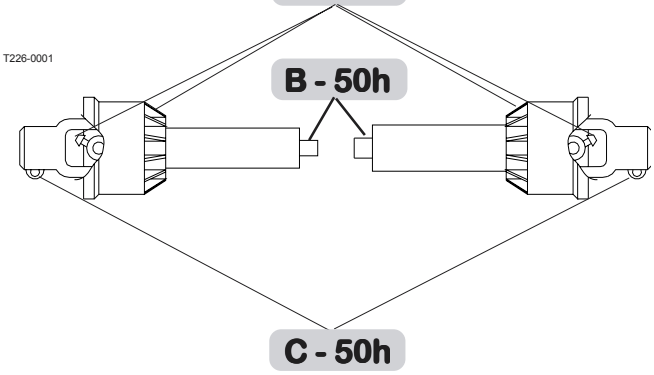

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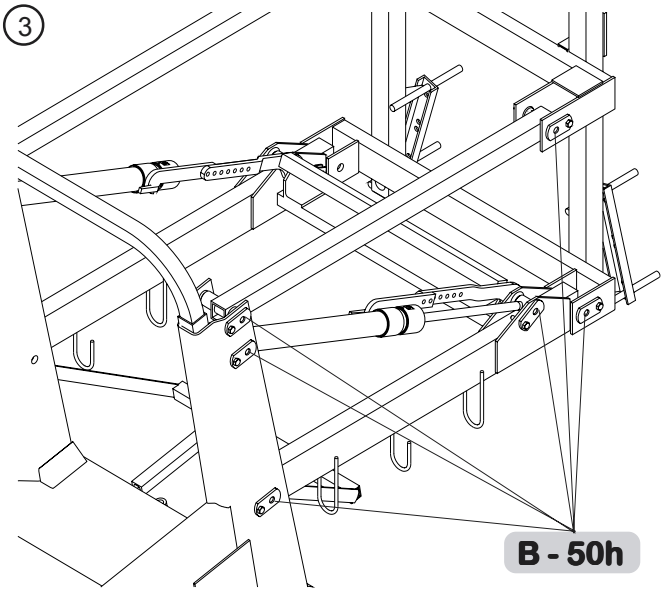

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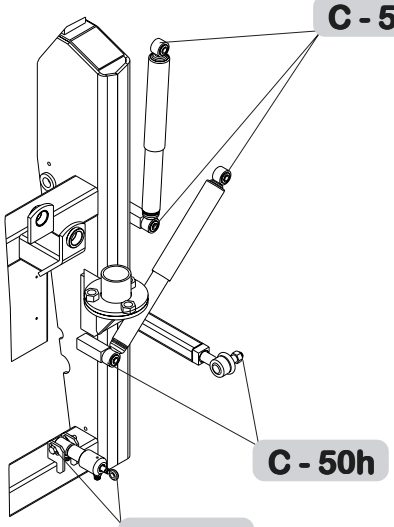

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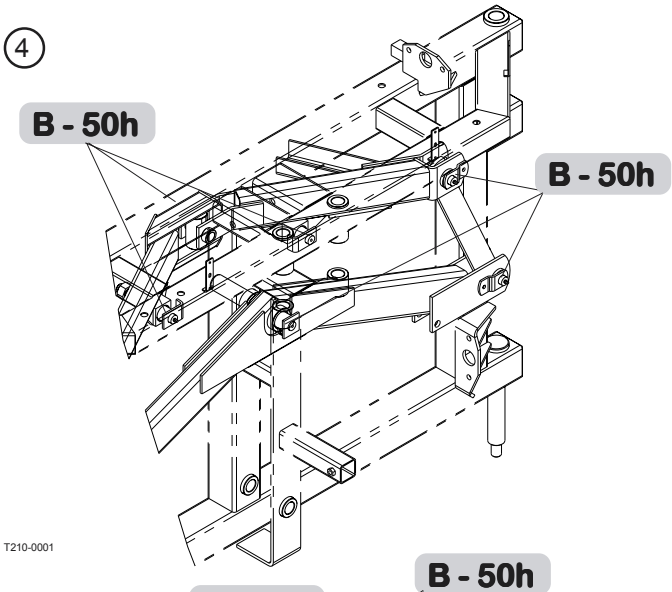

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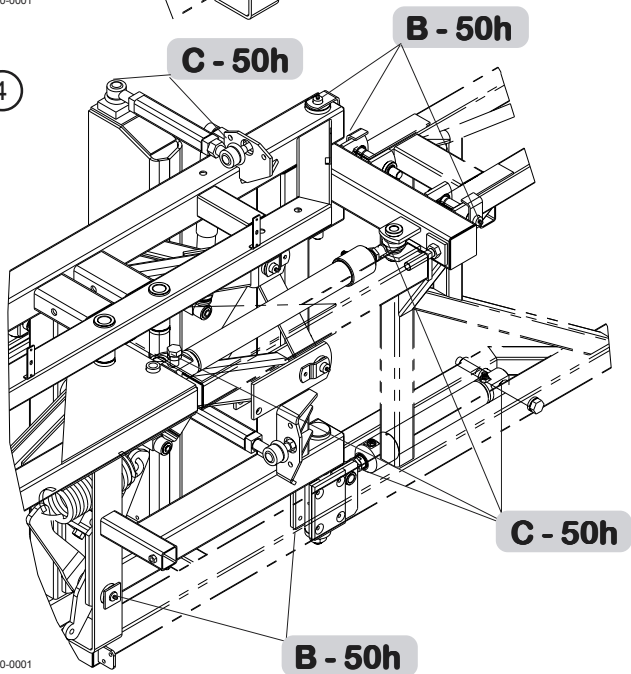

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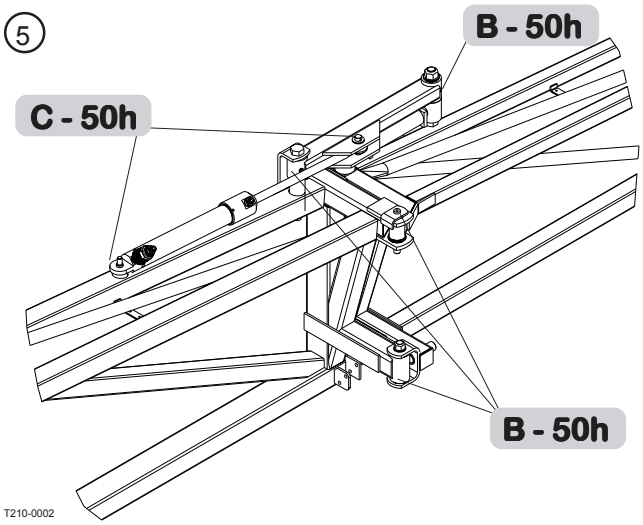

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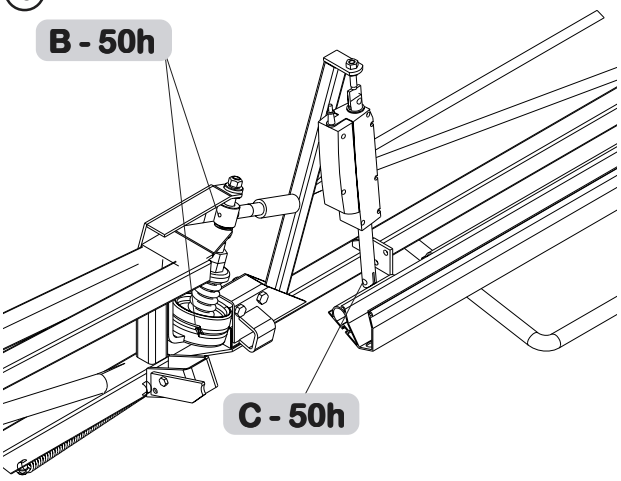

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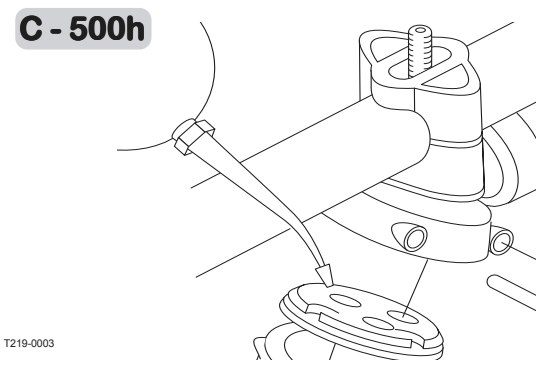


T219-0003

Service and Maintenance

10 hours service or daily (whichever comes first)

1. Suction filter, clean
2. Self-cleaning filter, check and clean gauze if necessary
3. In-line filters, clean
4. Nozzle filters, clean
5. Spraying circuit, check for leaks
6. Check hydraulic oil level
7. Check gear box oil level

50 hours service or weekly (whichever comes first)

Do all previous mentioned +

1. Check transmission shaft
2. Check gear box bolts

250 hours service or monthly (whichever comes first)

Do all previous mentioned +

1. Check hydraulic circuit
2. Check hoses and tubes
3. Readjustment of the boom

500 hours service or twice a year (whichever comes first)

Do all previous mentioned +

1. Check hydraulic oil filter

1000 hours service or yearly (whichever comes first)

Do all previous mentioned +

1. Transmission shaft
2. Hydraulic oil change
3. Gear box oil change
4. Hydraulic tank air filter

Occasional maintenance

Pump valves and diaphragms renewal
Ball seat check/renewal, EC on/off valve
Cone check/renewal, EC distribution valve
Wear bush renewal, boom lift and drawbar
Shield renewal, transmission shaft
Check shock absorbers
Level indicator adjustment
Cord renewal, level indicator
Seal renewal, drain valve
Air sleeve repair
Light equipment, bulb renewal
Fan speed adjustment
Fan transmission priming
Fan transmission pressure adjustment
Check nozzle tubes and fittings
Adjustment of head lamps
Adjustment of 3-way-valve

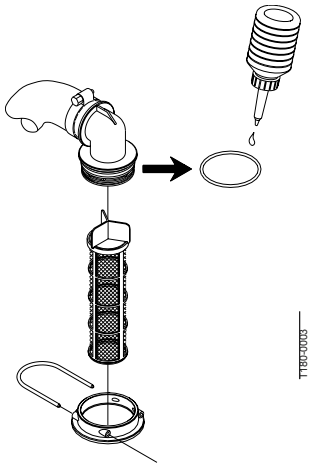
ALWAYS CHECK THAT ALL LOCK NUTS ARE TIGHT AFTER ADJUSTMENT!

10 hours service

1. Suction filter

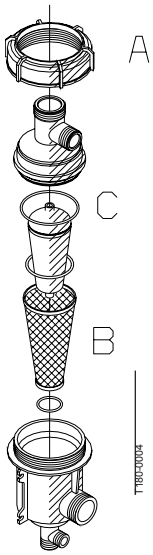
To service the suction filter:
1. Pull the steel clip **A** out.
2. Lift the suction hose fitting **B** from housing.
3. Filter guide and filter **C** can now be removed.

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



2. Self-Cleaning Filter

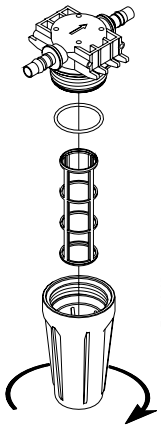
1. Unscrew nut **A** and open filter.
2. Check filter gauze **B**, clean if necessary
3. Lubricate O-ring **C**
4. Assemble filter again.



3. In-Line filter (if fitted)

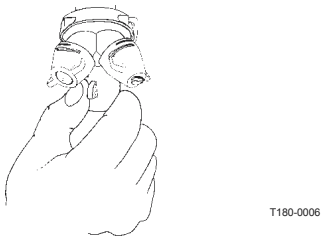
If the boom is equipped with In-Line Filters unscrew the filter bowl to inspect and clean the filter.

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



4. Nozzle filters

Check and clean.

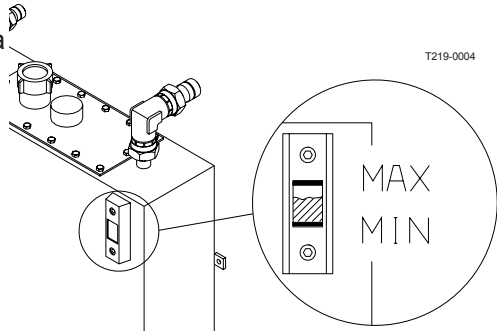


5. Spraying circuit

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

6. Hydraulic oil level

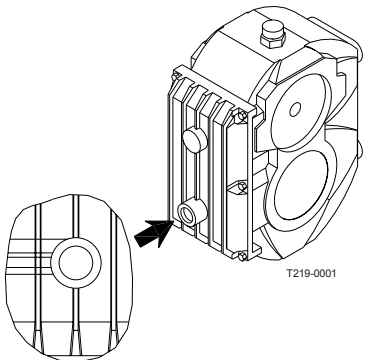
Check that the oil level is between min. and max. on the sight glass.
Clean the area areound the filling cap carefully and add fresh, clean oil if the level is low. Regarding oil quality - see section the section “Lubricants”.



7. Gear box oil level

Check the gear box oil level is reaching the sight glass.

Clean the area areound the filling plug and add fresh, clean oil if the level is low. Regarding oil quality - see the section “Lubricants”



50 hours service

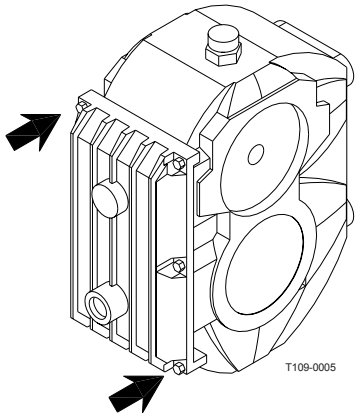
1. Transmission shaft

Check function and condition of the transmission shafts protection guards. Replace possible damaged parts

2. Gear box bolts

Check/retighten the gear box housing bolts to the specified torque.

70 Nm (51 lbft).



250 hours service

1. Hydraulic circuit

Check the hydraulic circuit for leaks and repair if any.

2. Hoses and tubes

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

3. Boom readjustment

Please see next page.

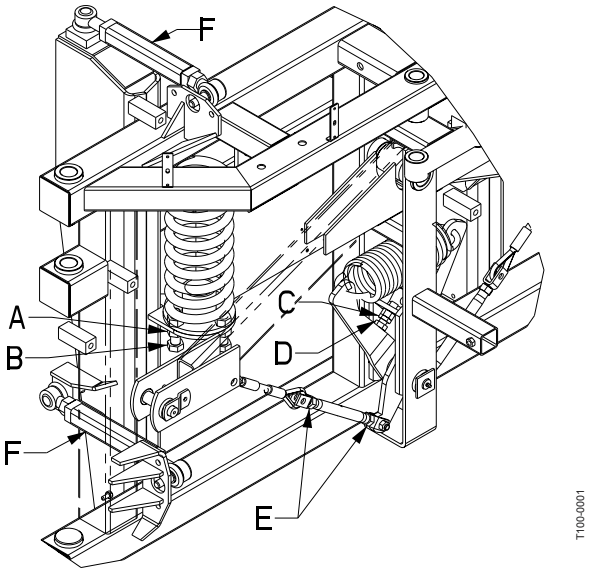
Boom readjustment

1.Park the sprayer on a level surface
2.Unfold the boom completely
3.Lower tilt rams completely
4.Set the slanting control midway (piston rod length is 60 mm)

Following adjustments can now be carried out:

Suspension spring tension

1.Loosen the counter nuts **A** in either side and adjust the tension of the vertical springs on the bolts **B** to suit the boom weight. The adjustment is correct when the guide rods are approximately level.
2.Tighten the counter nuts again.



Pendulum return spring and cables

1.Ensure that the slanting ram is set midway
2.Loosen the counter nuts **C** and adjust the stop screws **D** until the V-shaped mechanism is in symmetry.
3.Allowe max. 1 mm play between stop screw and arm.
4.Loosen the counter nuts **E** on the rigging screws, and adjust the length of the rigging screws until the boom is level. The correct adjustment is reached when the spring opens 1 mm between the threads
5.Tighten the counter nuts again.

Guide rods length adjustment

The guide rods length should normally not be necessary to adjust. If the suspension has been dismantled, the length must be checked or adjusted if necessary.

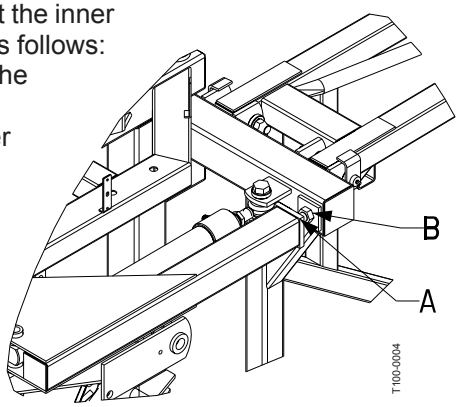
The trapeze and pendulum must hang freely. Adjust the length of the rods F accordingly.

Loosen the counter nuts and adjust the rods.

Inner section folding adjustment

The boom tip must point slightly forward. If necessary adjust the inner section folding as follows:

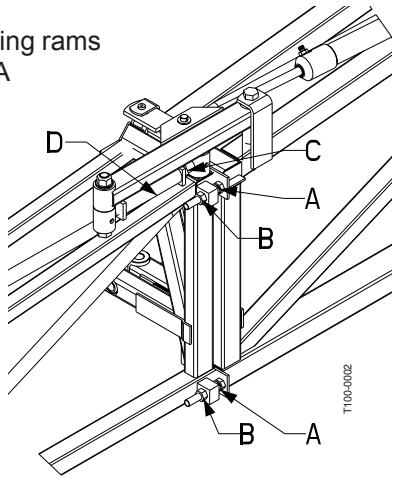
1.Depressurize the folding rams
2.Loosen counter nut **A**
3.Adjust stop screw **B** until the correct setting is reached.
4.Tighten counter nuts again



Outer section folding adjustment

The outer sections must be aligned with the inner sections. If necessary adjust the outer sections as follows:

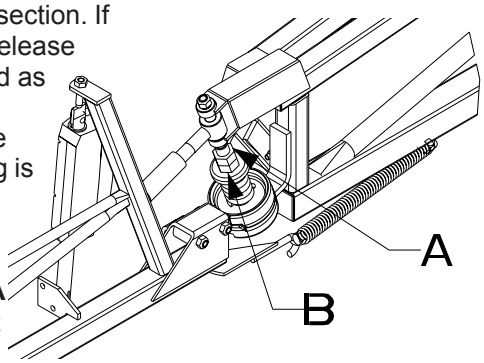
1.Depressurize the folding rams
2.Loosen counter nuts A and C.
3.Loosen the screws B.
4. Pressurize the folding ram until it is fully extended.
5.Adjust on the rigging screw D until the correct setting is reached.
6.Adjust the stop screws B up against the inner section.
7.Tighten counter nuts again



Breakaway section adjustment

The breakaway section must release when a force of approximately 150 N (34 lb) is applied to the extremity of the breakaway section. If necessary the release force is adjusted as follows:

1.Make sure the claw coupling is correctly lubricated.
2.Loosen the counter nut **A**
3.Adjust the nut **B** until the breakaway will release at a force of 150 N (34 lb) applied at the extremety of the section.
4.Tighten the counter nut again.

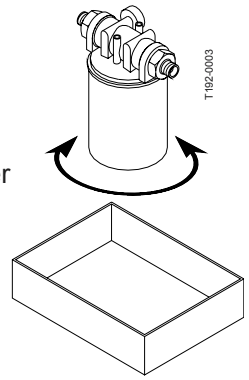


500 hours service

1. Hydraulic oil filter

Change the hydraulic oil filter after the **first 50 hours** and then every 500 hours or once a year - whichever comes first. Always change the oil filter if the vacummeter indicator is in the red area. Check when the oil has reached working temperature.

1. Place a drain pan under the filter to retain waste oil and unscrew the filter cartridge CCW.
2. The new filter cartridge is filled with fresh **clean** hydraulic oil. Apply a thin oil film to the cartridge seal.
3. Screw the filter cartridge on CW until the seal is lying against the flange.
4. Tighten the filter cartridge another 1/2 to 3/4 turn.
5. Check hydraulic oil level - top up with fresh clean hydraulic oil if necessary.
6. Set the blower in neutral, start the tractor P.T.O. and let it run idle for 5 min. to prime the system.
7. After 5 min. the blower r.p.m. can gradually be increased to full speed.



Disposal of used hydraulic filter cartridges must only take place in accordance with local legislation.

1000 hours service

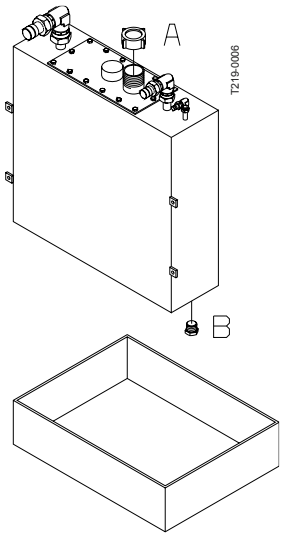
1. Transmission shaft

Change the protection tube nylon bearings as described under “Replacement of transmission shaft protection tubes”.

2. Hydraulic oil change

The hydraulic oil is changed every 1000 hours or once a year - whichever comes first. The hydraulic oil change is best done when the fan has been working for at least one hour so the oil has reached working temperature.

1. Clean the area around the oil filling cap **A** and the drain plug **B**. Unscrew the filling cap and drain plug, and drain the oil into an appropriate container.
2. When the oil is drained, fit and tighten the drain plug again.
3. Fill the tank with fresh, **clean** hydraulic oil until the level is between min. and max. on the level glass. The tank contains approx. 32 l (7.2 Imp.gal.) (8.5 US.gal.). Regarding oil specification - see section on “Lubricants”
4. Fit the filling cap again.

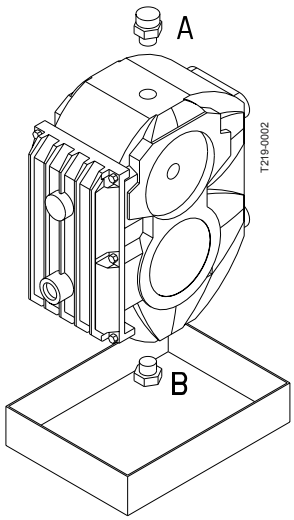


Note local legislation regarding disposal of waste oil.

4. Gear box oil change

The first gear box oil change must be done after 50 hours, then every 1000 hours or once a year - whichever comes first. The gear box oil change is best done when the machine has been working for at least one hour and the oil has reached working temperature.

1. Clean the area around filling plug/breather **A**, dip stick **B** and drain plug **C** thoroughly. (15 m and 16 m HAB has a sight glass - do not remove this).
2. Place a tray under the drain plug to retain the waste oil.
3. Unscrew the filling and drain plugs and drain the gear box oil.
4. Refit the drain plug using a new seal - retighten.
5. Fill with fresh, clean oil until the level reaches the sight glass.



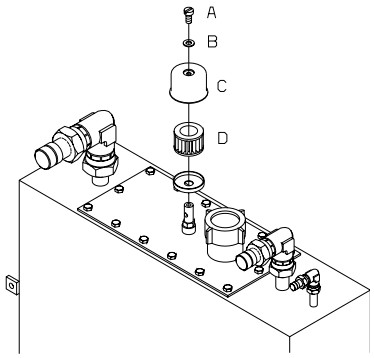
Approx. oil quantity: 1.0 l (35.2 fl.oz.)
Regarding oil quality, see section on “Lubricants”
6. Refit the dip stick and filling plug - retighten.

Disposal of waste oil must only be carried out in accordance with local legislation.

5. Hydraulic tank air filter

Change the hydraulic tank breathing filter.

1. Clean the area around the air filter thoroughly.
2. Remove screw **A**, washer **B** and cap **C**.
3. Renew the filter cartridge D.
4. Reassemble in reverse order.

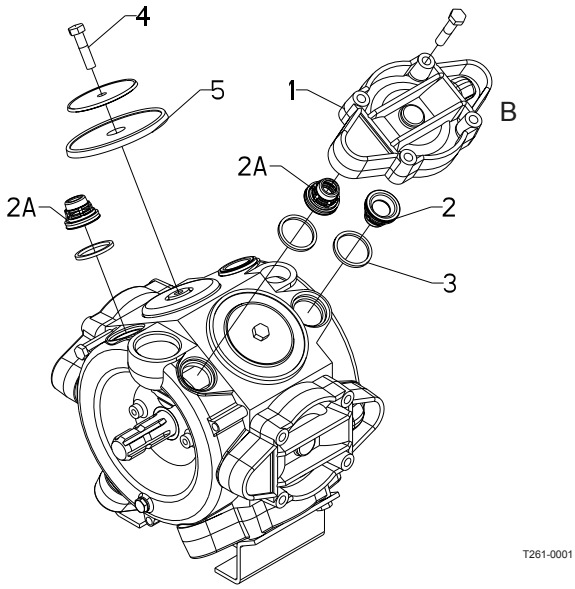


T191-0011

Occasional maintenance

The maintenance and renewal intervals for the next points will depend very much on the conditions under which the sprayer will operate, and are therefore impossible to specify.

Pump valves and diaphragms renewal



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

Pump model	HARDI part No.
463 (540 r.p.m.)	750343
463 (1000 r.p.m.)	750343

Valves

Remove valve cover **1**. Before changing the valves **2** note their orientation so they are replaced correctly.
NOTE: One special valve with white flap **2A** is used. It has to be placed in the valve opening shown.
It is recommended to use new gaskets **3** when changing or checking the valves.

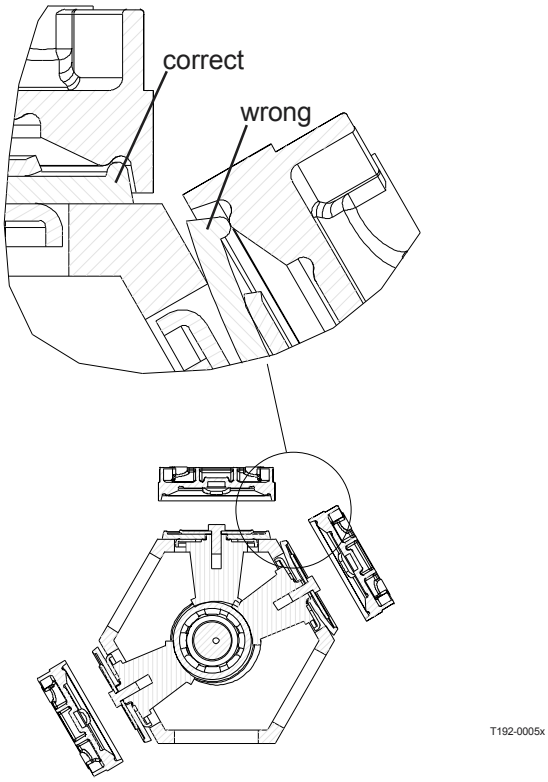
Diaphragms

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

Pump model	Diaphragm cover Nm	Diaphragm bolt Nm
463 (540 r.p.m.)	90	90
463 (1000 r.p.m.)	90	90

1 Nm = 0.74 lbft

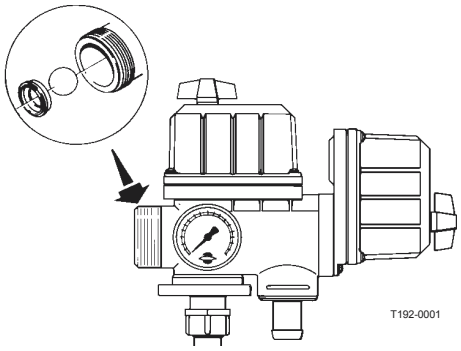
IMPORTANT! Before tightening the 4 bolts for the diaphragm cover B the diaphragm must be positioned between centre and top to ensure correct sealing between diaphragm pumphousing and diaphragm cover. Turn crank shaft if necessary.



Ball seat check/renewal, EC on/off valve

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 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.

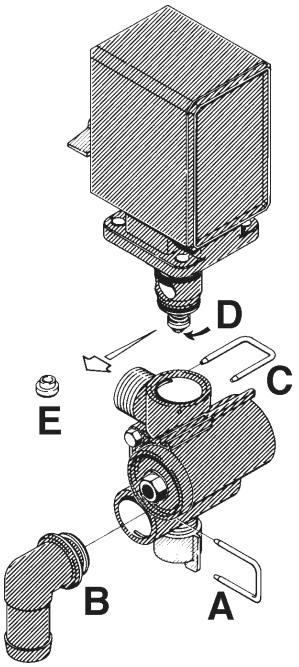
Cone check/renewal, EC distribution valve

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

Cautiously remove the clip **A** and pull out the hose **B** for the pressure equalisation device. When the housing is

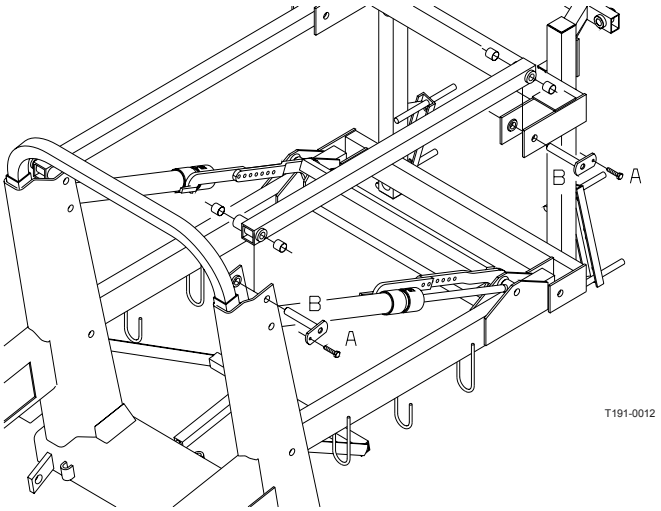
drained, there should be no liquid flow through the pressure equalisation device. If there is any leakage, the valve cone **E** must be changed.

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



Wear bush renewal, boom lift

The wear bushes are inspected and renewed before they are worn through.

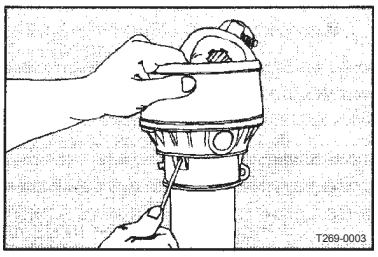


1. Connect the trailer to a tractor and unfold the booms to working position.
2. Lift the boom centre frame with a lifting device and support it until the load is taken off the parallelogram arms.
3. Remove the screws **A**, and pull out the pins **B** at one of the upper parallelogram arms and renew the wear bushes.
4. Refit the arm.
5. Repeat this on the other upper arm.
6. The lower arms must be disconnected simultaneously.
   Grease all grease nipples.
7. Remove the lifting gear again.

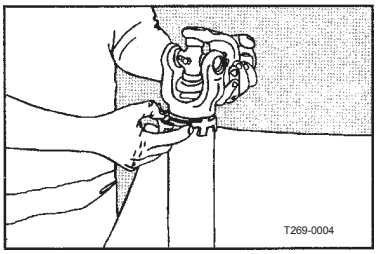
Transmission shaft, shield renewal

The replacement of defective shields is done as follows:

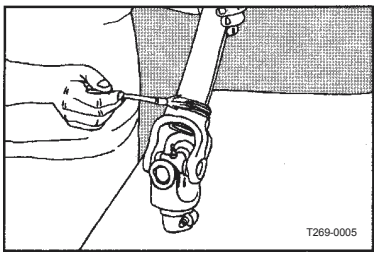
1. Push down on the universal cross cover and press in the tabs with a screwdriver. Maintain pressure until all three tabs are released.



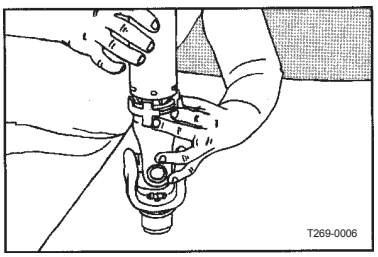
2. Remove the nylon bearing and pull off the protection tube.



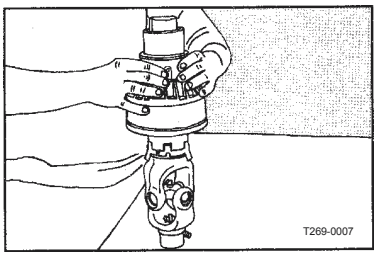
3. Grease protection tube bearing groove on the inner yoke.



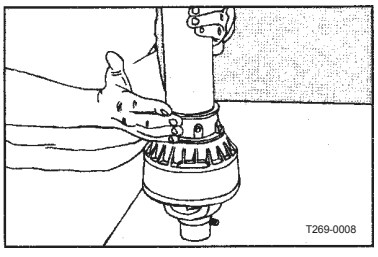
4. Slide on the shield tube and fit the bearings tabs into the slots.



5. Slide the universal cross cover over the protection tube and align the grease nipple with the grease channel on the bearing. Press the universal cross cover onto the tabs until they lock.



6. Check alignment and locking of the tabs by tapping the universal cross cover lightly.



Shock absorbers

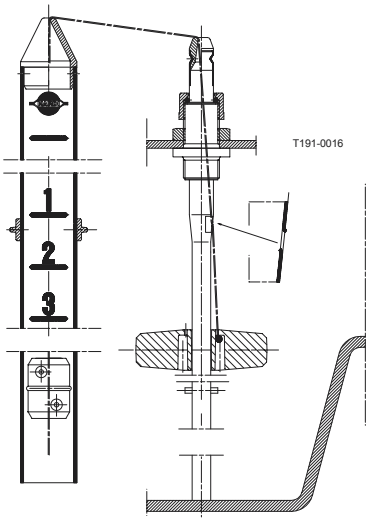
If the shock absorbers does looses their efficiency or starts leaking oil, they should be replaced.

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.



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

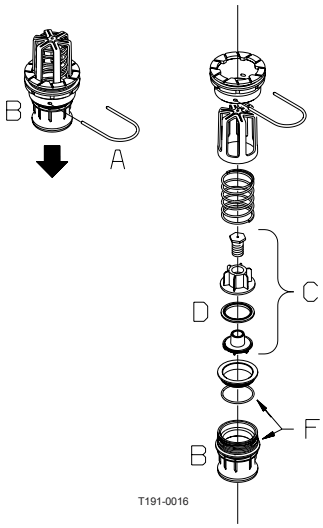
If the main tank drain valve leaks, the seal and seat can be changed the following way.

NOTE! 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.
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!



Air sleeve repair

If the boom air sleeve should be torn, it can be mended. Clean the bag with a suitable solvent and mend it using the mending kit, Part No. 728746, which include glue and cloth.

Light equipment, bulb renewal

Following bulb renewal procedures:

Rear combi lamp, HELLA		
Function	Bulb type (DIN)	Volt / Watt
Rear lamp	R5W	12V / 5W
Stop lamp	P21W	12V / 21W
Direction indicator	P21W	12V / 21W
Rear combi lamp, GEKA (with warning boards)		
Function	Bulb type (DIN)	Volt / Watt
Rear lamp	R5W	12V / 5W
Stop lamp	P21W	12V / 21W
Direction indicator	P21W	12V / 21W
Position lamp, front	(GEKA)	12V / 5W
Head lamps		
Function	Bulb type (DIN)	Volt / Watt
Low beam	H4	12V / 60/55W
Position lamp	-	12V / 4W
Side marking combi lamp		
Prise out the lens carefully from the rubber housing to remove the bulb.		
Function	Bulb type (DIN)	Volt / Watt
Side marking combi lamp white, red yellow	R5W	12V / 5W

chart 020

For wiring diagrams see section on technical specifications.

Fan speed adjustment

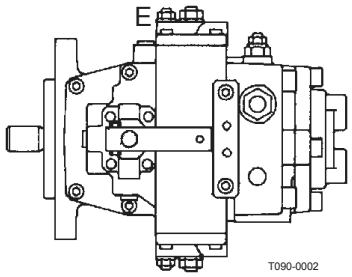
(Bowden cable adjusted pumps only). The boom fan speed base adjustments are carried out as follows.

A tachometer is required for this job.

1. Fit a piece of light-reflecting tape to the fan wing and to the tractor P.T.O.
2. Unfold the boom to working position.
3. Set tractor P.T.O. at 540 r.p.m. - check with the tachometer.
4. Set the fan speed control lever to max. speed.
5. Measure the fan speed with the tachometer. The fan speed must be 3100 r.p.m.

WARNING! Do not wear loose hanging clothes! Hold the tachometer firmly in your hands in order not to be sucked into the fan. DO NOT REMOVE THE PROTECTION GRID!

6. Turn the swash plate adjustment screw **E** CW to decrease or CCW to increase the blower r.p.m.. Remember to tighten the counter nut. Repeat 3. and 4. until the correct setting is obtained.

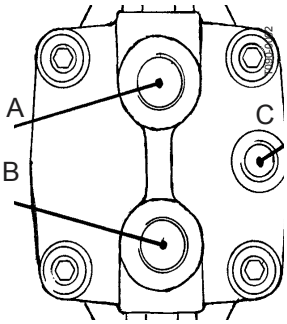


7. If the correct fan r.p.m. cannot be reached, the hydraulic transmission pressure settings must be checked - see section on “Fan transmission pressure adjustment”.

Fan transmission priming

If the hydraulic fan transmission has been dismantled, or pump or motor has been changed, the following priming procedure must be carried out before starting up the transmission:

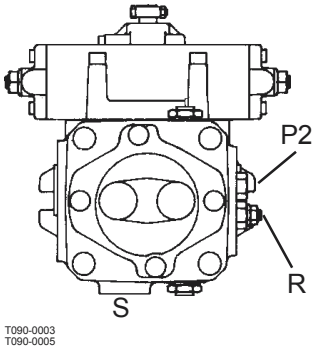
1. Fill the oil reservoir with fresh, clean oil to the top of the sight glass.
2. Fill the pump housing with oil through the drain pipe **D** which is dismantled at the tank connection. Reconnect and tighten.
3. Check the oil level in the gear box.

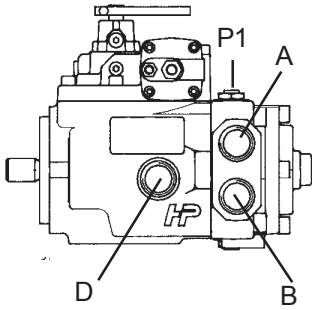


4. Remove the drain hose **D** from the motor outsidethe blower housing.
5. Set the fan r.p.m. at 0, engage the tractor P.T.O. with the engine running idle - wait a few minutes.
6. Set the fan speed at 200 r.p.m.
7. After a while the oil will start dripping constantly. Refit the drain hose and tighten.
8. With the tractor P.T.O. at 540 r.p.m. the fan should rotate at max. revolutions/min.

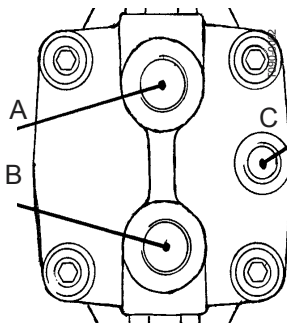
9.Recheck oil level at tank sight glass.
10.Check vacummeter at the suction filter.
11.Retighten hose connections and check for leaks.
12.Check fan speed and feed pressure adjustments - see sections on “Fan speed adjustment” and “Fan transmission pressure adjustment”.

Fan transmission pressure adjustment





A = Pressure port
B = Return port
D = Drain port
P1 = Connector for working pressure measurement
P2 = Connector for feed pressure
R = Adjustment Screw for fed pressure
S = Suction port



The transmission feed and working pressure are checked as follows:

1. Connect a 40 bar (580 p.s.i.) pressure gauge to the feed pressure connector **P2,** and a 400 bar (5800 p.s.i.) pressure gauge at the working pressure connector **P1**.
2. Set the tractor P.T.O. at 540 r.p.m. - check with tachometer.

3. Set the blower at max. speed.
4. Check the feed and working pressure:

Feed pressure, P2 15-20 bar (218-290 p.s.i.)
Working pressure, P1, approx.

18 m	180 bar (2610 p.s.i.)
20 m	190 bar (2755 p.s.i.)
21 m	200 bar (2900 p.s.i.)
24 m	240 bar (3045 p.s.i.)

Adjust feed pressure if necessary.

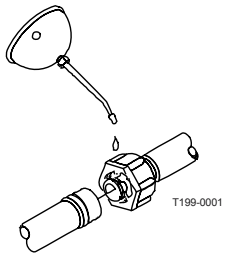
Failure to reach feed and working pressure indicates that the transmission needs overhauling.

Nozzle tubes and fittings

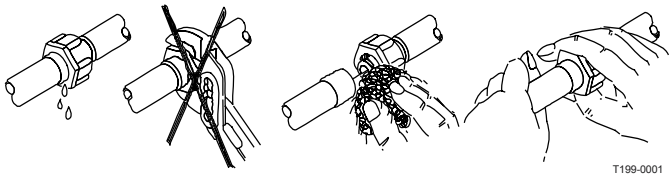
Poor seals are usually caused by:

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

Therefore, in case of leaks:
DO NOT overtigthen, disassemble, check condition and position of O-ring or gasket, clean, lubricate and reassemble.



For radial connections only hand tighten them.



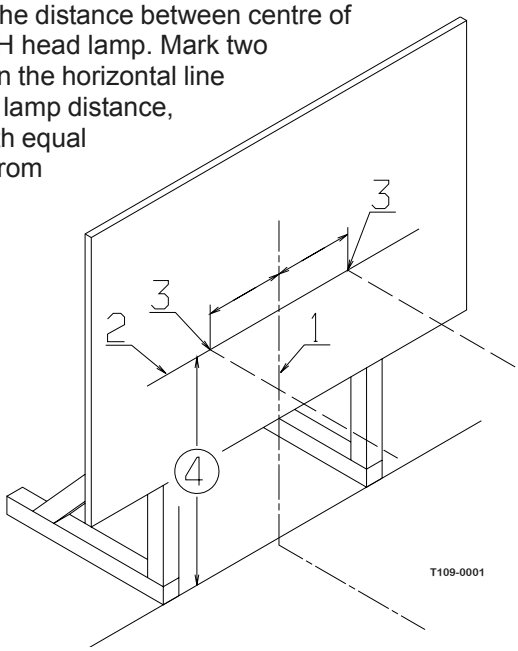
The O-rings must always be greased all the way round before refitting.

For face connections, a little mechanical leverage may be used.

Adjustment of head lamps

Adjust the head lamps the following way:

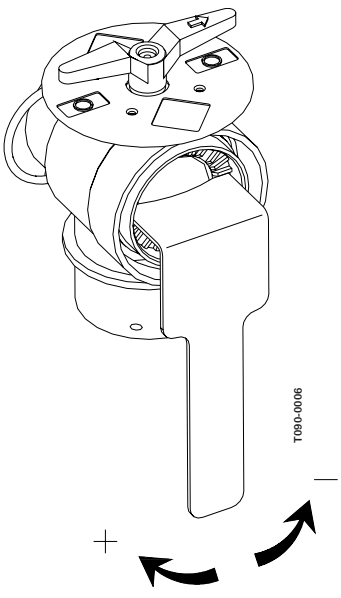
1. Position the sprayer facing a wall or screen with a distance between wall and head lamps of 2 metres.
2. Mark a point on the wall or screen by sighting down the hood centre line.
3. Draw a vertical line **1** through the point.
4. Measure the head lamp height, and draw a horizontal line **2** through the vertical line **1** at head lamp height **4**.
5. Measure the distance between centre of RH and LH head lamp. Mark two points **3** on the horizontal line with head lamp distance, placed with equal distance from the vertical line **1**.
6. Switch on the main beam, and cover off LH head lamp.
7. Adjust RH head lamp so the point **3** is in the centre of the beam.
8. Cover RH head lamp and repeat point 7 on LH head lamp.



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).

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



Off-season storage

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

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

To preserve the sprayer intact and 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 has been cleaned with detergent and flushed with clean water afterwards, so no chemical residues 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 and 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.

Preparation after off-season storage

After a storage period the sprayer should be prepared for the next season in 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 electrics.
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.

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.	Check for obstructions and wear.
	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 begining 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.

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.

EC Operating unit

FAULT	PROBABLE CAUSE	CONTROL/REMEDY
Operating unit not functioning	Blown fuse(s).	Check mechanical function of micro-switches. 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 micro-switch plate position. Loosen screws holding plate a $^{1}/_{2}$ turn.
	No power.	Wrong polarity. Check that brown is pos. (+), Blue is neg. (-). Check print plate for dry solders or loose connections. Check fuse holder are tight around fuse.

D.A.H. Hydraulic system

FAULT	PROBABLE CAUSE	CONTROL/REMEDY
No boom movements when activated	nsufficient oil pressure	Check oil pressure - min. 130 bar, max. 160 bar. Check tractor hydraulic oil level
	Insufficient oil supply.	Oil flow must be min. 10 l/min. and max. 90 l/ min. Check tractor hydraulic oil level.
	Blown fuse.	Check / replace fuse in junction box.
	Bad / corroded electrical connections	Check / clean connections, multi plugs etc.
	Insufficient power supply.	Voltage on activated solenoid valve must be more than 8 Volts. Use wires of at least 4 mm^2 for power supply.
	Defect relay / diodes in junction box.	Check relays, diodes and soldering at PCB in junction box
	Clogged restrictors **B** or **C** in by-pass block.	Remove and clean restrictors **B** and **C** in by-pass block (See hydraulic diagram) Change hydraulic oil + filter
	Wrong polarity.	Check polarity. White pos. (**+**) Blue neg. (**-**).
Boom lift raises to max. pos. when tractor hydraulics are engaged	Wrong oil inlet to by-pass block.	Connect hydraulic snap couplers opposite in tractor outlets, or engage spool valve lever in opposite direction
	Back pressure in return line exceeds 20 bar	Connect the return line with free flow to hydraulic oil reservoir. Divide return line in two and lead return oil back to reservoir via two spool valves.
Oil heats up in Closed Centre systems	By-pass valve **0** does not close properly	Check / replace locking clip on by-pass valve **0**.
	Internal leaks in flow regulator	Replace flow regulator O-rings and back-up rings. Replace flow regulator.
Individual ram does not move	Clogged restrictor	Dismantle and clean restrictor

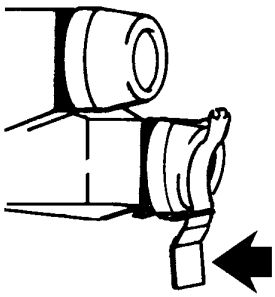
Hydraulic fan transmission

FAULT	PROBABLE CAUSE	CONTROL/REMEDY
Max. revolutions cannot be obtained	Tractor P.T.O. speed is lower than 540 r.p.m. (reading failure on tractometer)	Check tractor's P.T.O. r.p.m. Check tractometer
	Feed pressure is too low	Adjust feed pressure to correct setting
	Max. fan r.p.m. is not adjusted correctly (models with bowden cable adjustment only)	Adjust the max. fan r.p.m.
	Pump/motor is worn	Get transmission checked by your HARDI dealer
Noisy fan transmission	Wrong oil quality (foam)	Change oil to correct quality
	Feed pressure too low	Adjust feed pressure
	Oil filter clogged (vacummeter indicator in red area)	Change oil filter
Formation of foam in oil tank	Pump/motor is worn	Get the fan transmission checked by your HARDI dealer
	Wrong oil quality	Change the oil to correct quality
	Mixture of hydraulic oil and other quality (e.g. universal oil)	Change the oil to correct quality
	Oil change interval not kept	Change the oil to fresh, clean oil of correct quality
	Leak on the pump suction line	Check hydraulic pump suction line for leaks
Fan speed will not stay at adjusted level	No signal from speed sensor at the fan	Check the wire connection between sensor and actuator for damages
	Bad connections	Check the wire connection between sensor and actuator for damages
Fan r.p.m. control does not start up	Fuse blown	Check power supply and fuse
Oil leaks from pump/motor shaft seal (seal pressed out)	Drain hoses from motor/pump housing is blocked	Check the drain hose(s) for bendings, damages, and proper attachment
	Too much pressure in pump/motor housing (pump/motor worn)	Get the transmission checked by your HARDI dealer

Emergency operation of the sprayer

The boom

In case of power failure, the boom can be operated manually by pressing the individual buttons on the solenoid valves. This is done by locking the by-pass valve, as is done when using tractors with closed centre hydraulics.

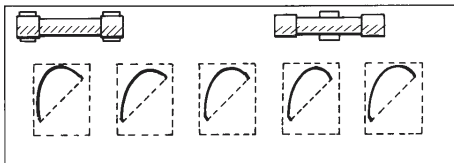


T020-0024

Remove the protection box of the solenoid valves at the boom. The boom can now be operated by pressing the individual buttons on the solenoid valves.

Remember to reset the system to Open Centre hydraulic, if the tractor has an Open Centre (Constant Flow) hydraulic system.

The problem may be due to a blown fuse. One spare fuse is located inside the junction box.



T199-0003

Fuse type: T10 A 250 V

HARDI ref. no. 261272

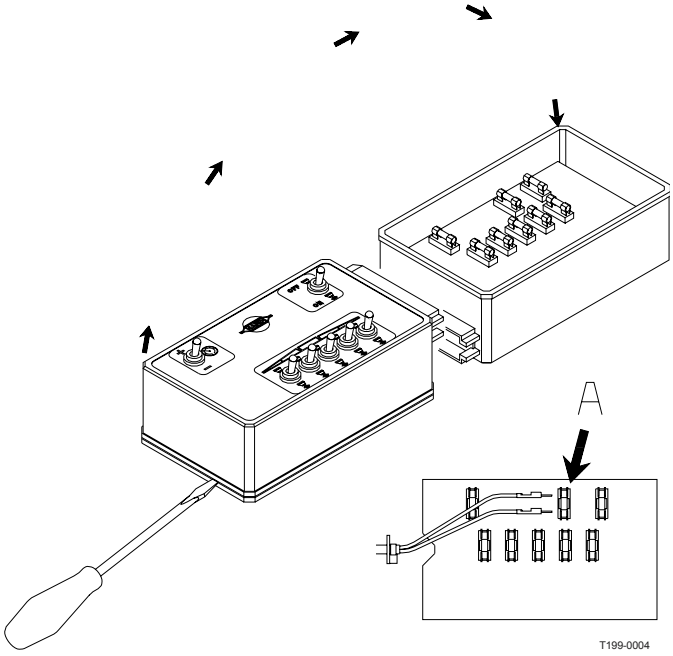
EC operating unit

In case of power failure it is possible to operate all functions of the operating unit manually. First disconnect the multi plug 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
T 1.25 A

HARDI ref. no. 261125

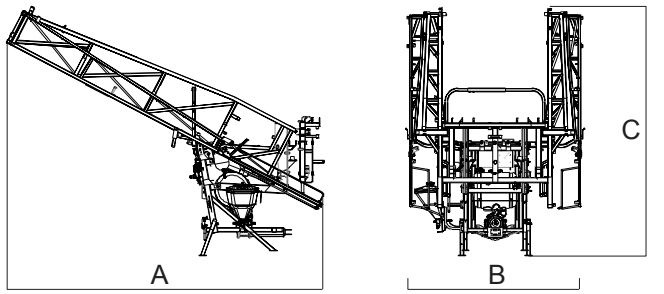


T199-0004

Technical specifications

Measure and weight

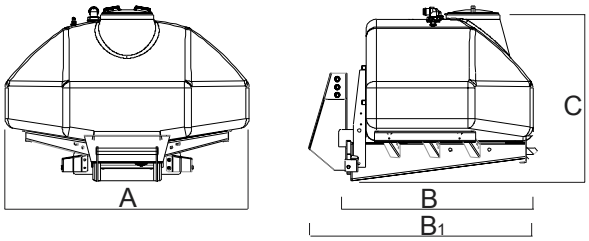
Overall dimensions



T021-0018x T202-0010x

Boom width (m)	A (mm)	B (mm)	C (mm)
18 - HAZ	5950	2980	3900
20 - HAZ	5950	2980	3900
21 - HAZ	5950	2980	3900
24 - HAZ	5950	2980	3900

chart 01 02 01



T021-0025x

Tank size	A (mm)	B (mm)	B_1 (mm)	C (mm)
1000 l	1860	1450	-	1222
1300 l	1860	1450	-	1240

chart 01 02 02

Weight

MARRO with HAZ boom	
Boom width	**kg**
18 m	1830*
20 m	1860*
21 m	1870*
24 m	1910*
Front tank	
1000 l	195
1300 l	210
* Weights are based on maschines with empty rinsing tank and full hydraulic oil tank	

chart 01 03 01

Pump capacity

Pump 463/10.0 (540 r/min)

Rotation per min.	200	300	400	500	540	600
bar	Capacity l/min					
0	109	156	207	257	276	305
2	103	152	202	252	270	299
4	101	149	198	246	265	295
6	99	146	195	242	263	289
10	94	142	192	236	256	282
15	91	136	184	230	248	276
Max. pressure: 15 bar		Weight: 66.5 kg		Suction height: 0.0 m		

Pump 463/5.5 (1000 r/min)

Rotation per min.	200	300	400	500	600	700	800	900	1000
bar	Capacity l/min								
0	61	89	119	148	178	206	233	273	305
2	56	84	113	140	168	197	222	252	278
4	54	82	108	137	162	190	216	244	273
6	52	78	105	131	158	185	211	239	269
10	49	74	100	126	151	178	202	229	257
15	46	70	95	120	145	171	195	219	246
Max. pressure: 15 bar			Weight: 66.5 kg			Suction height: 0.0 m			

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)

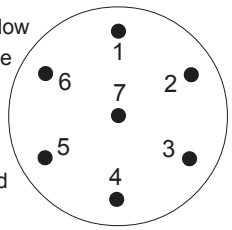
Max. pressure on the pressure manifold:
20 bar (290 psi)

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

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

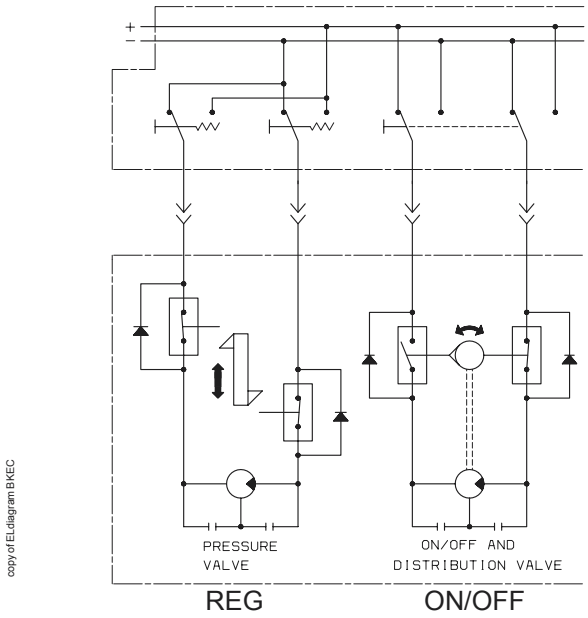
When the equipment has completed its working life, it must be thoroughly cleaned. The tank, hose and synthetic fittings can be incinerated at an authorised disposal plant. The metallic parts can be scrapped. Always follow local legislation regarding disposal.

Conversion factors, SI to Imperial units

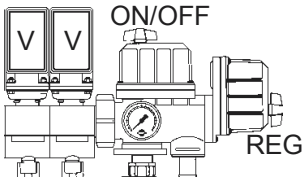
All units used in this manual are SI units. In some occasions Imperial units are used. Use following factors to convert SI units to Imperial units:

	SI unit	Imperial unit	Factor
Weight	kg	lb.	x 2.205
Surface area	ha	acres	x 2.471
Length	cm	in	x 0.394
	m	ft	x 3.281
	m	yd	x 1.094
	km	mile	x 0.621
Velocity	km/h	mile/h	x 0.621
	km/h	m/s	x 0.277
Quantities/area	l/ha	gal (Imp.) /acre	x 0.089
Volume	ml	fl. oz (Imp.)	x 0.0352
	l	Imp. pt.	x 0.568
	l	gal (Imp.)	x 0.22
Pressure	bar	lb./in^2 (p.s.i.)	x 14.504
Temperature	°C	°F	(°C x 1.8) + 32
Power	kW	hp	x 1.341
Torque	Nm	lbft	x 0.74

EC



copy of EL diagram BKEC



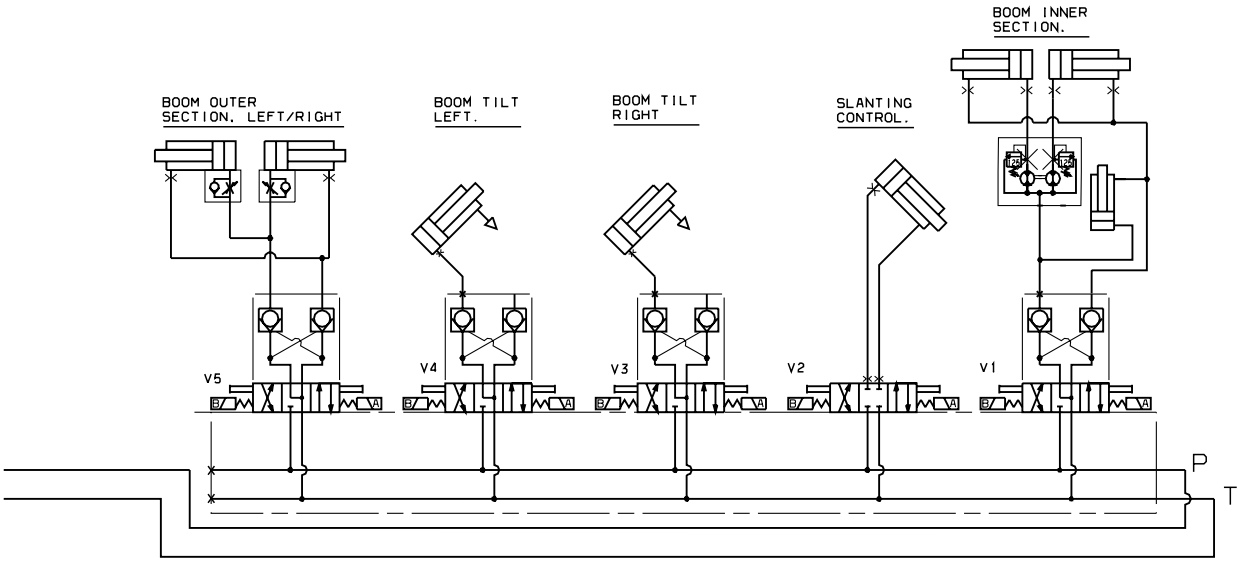
armatur EC 2B(L)

Number of distribution valves

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

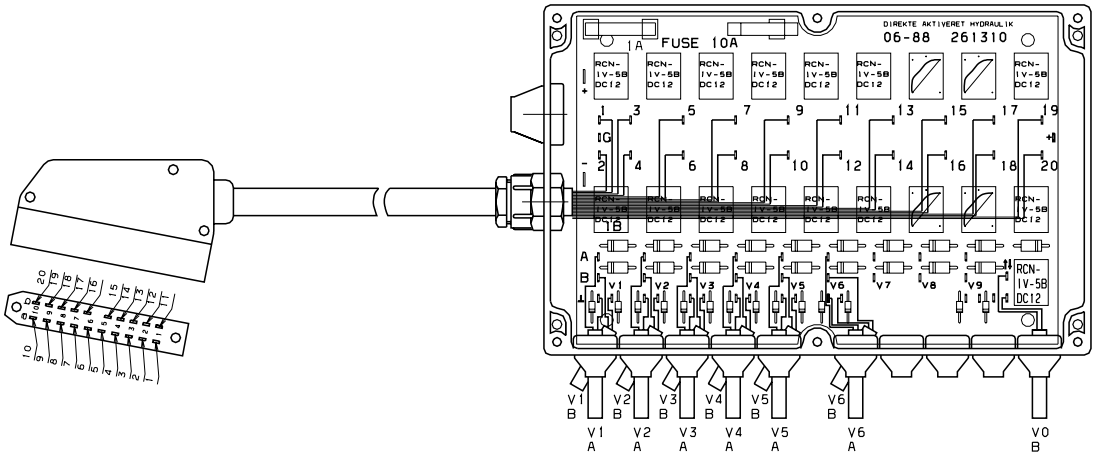
The EC operating unit fulfils the EC noise reduction standards.

Boom hydraulic HAZ



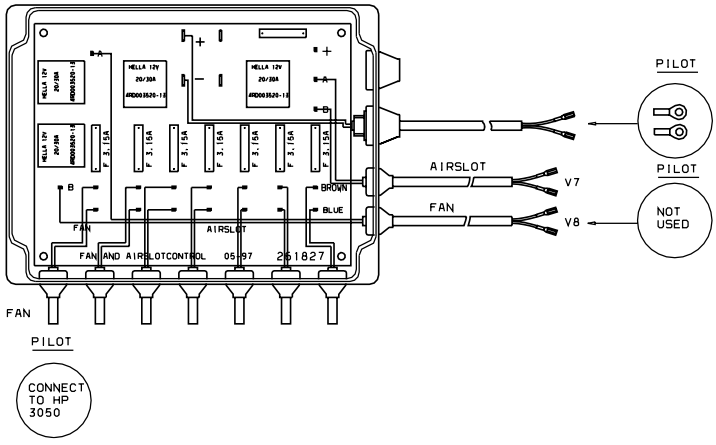
T054-0057

Electric chart HAZ



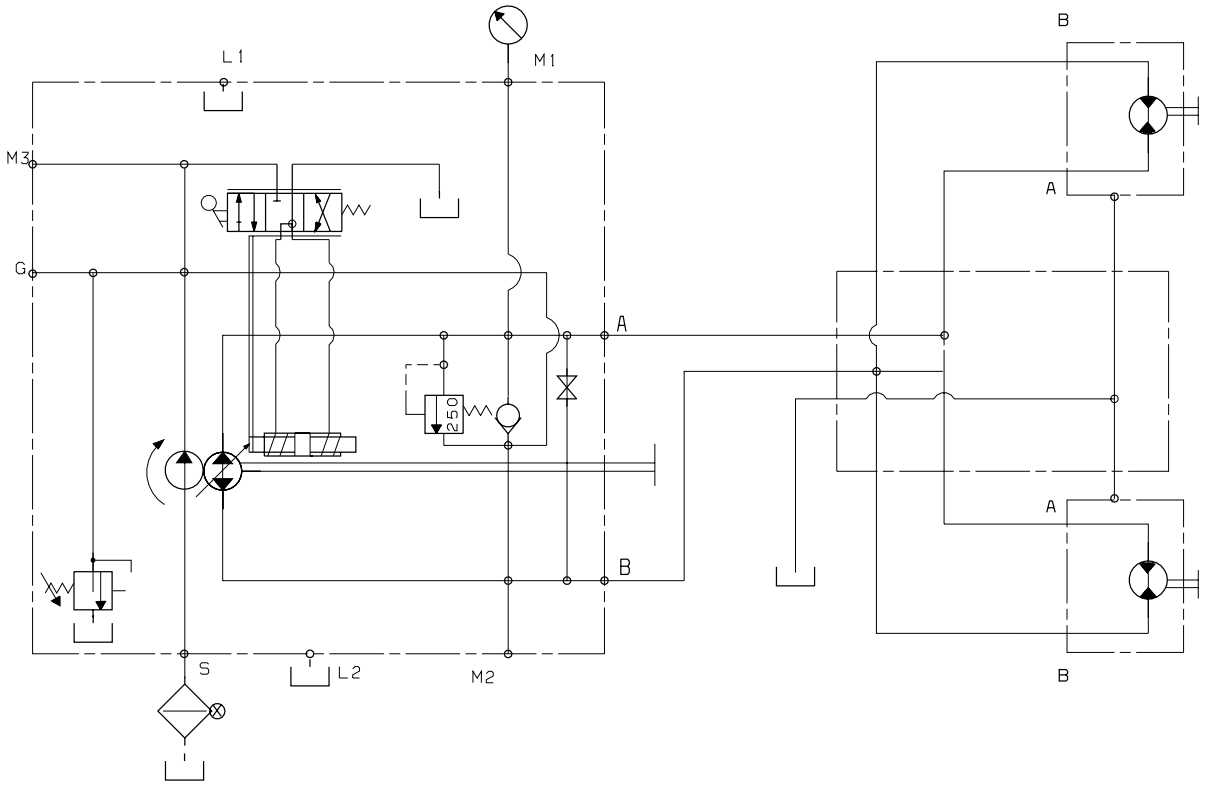
T053-0014

Junction box HAZ



T053-0012

Transmissions HAZ



T054-0068

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