

# New **COMMANDER**

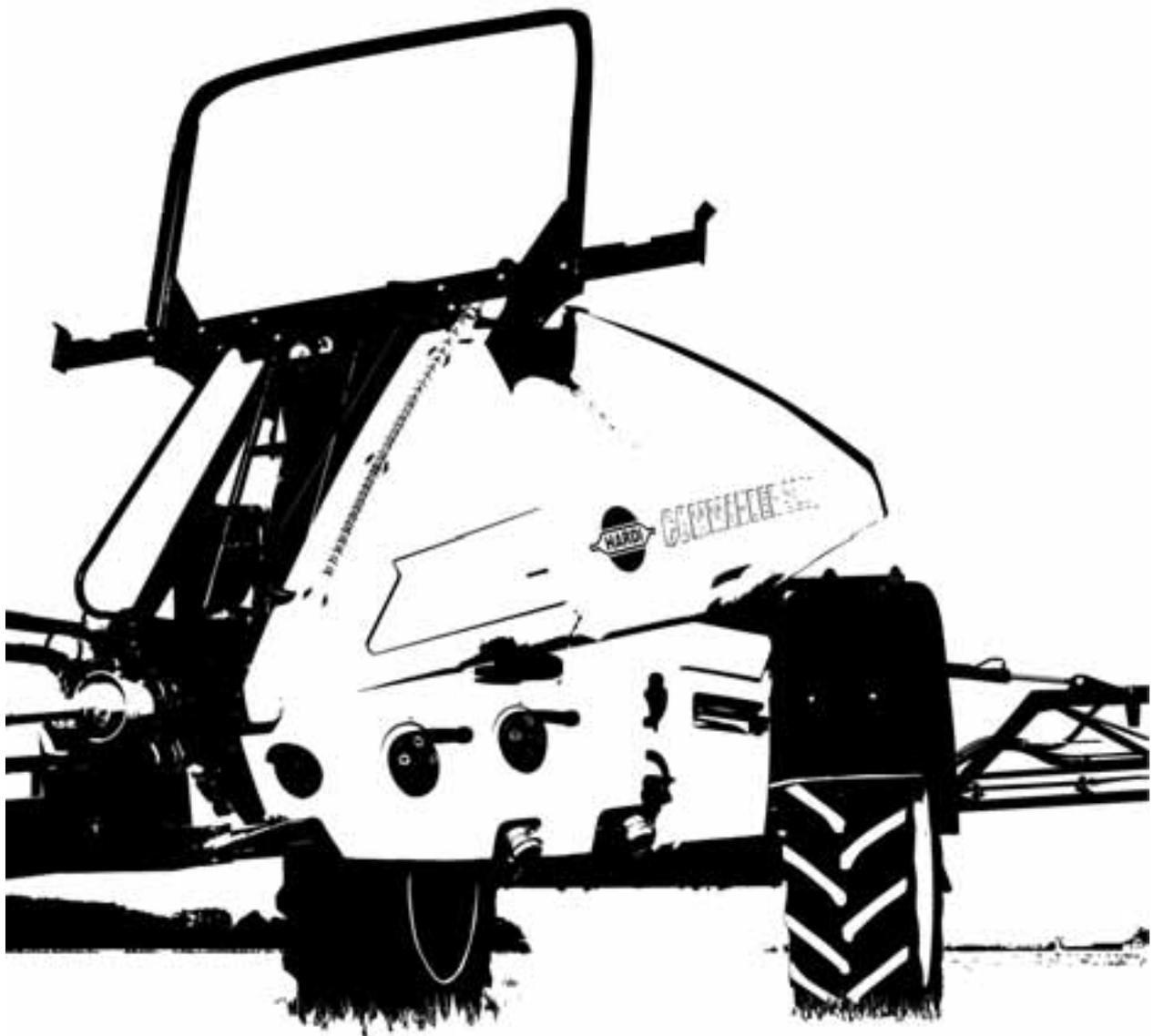
## **Operators Instruction Book**



P/N: 67026304 - HAU - 09/2006

**HARDI Australia**

ABN: 74 076 150 617



[www.hardi.com.au](http://www.hardi.com.au)

# NEW COMMANDER

## Operators Instruction Manual

67026304 - Version 1.01

HAU - 09/2006



**HARDI Australia**

Cross Keys Road Cavan  
South Australia

### To our valued customer:

Congratulations on your purchase and thank you for choosing the HARDI "NEW COMMANDER" Series Sprayer. This "Operators Instruction Manual" covers the Safety, Operation and Maintenance procedures for the 5000, 7000, and 9000 Litre models, and is to be read in conjunction with the "Boom" and "Spray Controller" manuals supplied with your sprayer.



**Warning:** Any persons intending to use this equipment, or any of it's parts or systems must read and understand these publications (plus any related material) paying close attention to the Safety warnings prior to operation.

In addition, all operators must be of a suitable age, have undergone appropriate training and hold correct licenses where applicable, as required by state and federal law. The safety sections and warnings in this publication and all related material must be thoroughly read and understood before attempting to operate this equipment.



**Danger:** Failure to comply with the above may result in personal injury, death or damage to the equipment, property, crops or the environment.



**Attention:** The technical data contained herein is to the best knowledge of HARDI Australia Pty Ltd correct at the time of publishing. HARDI Australia Pty Ltd reserves the right to make changes in design, features, accessories, specifications and instructions at any time without prior notice and is without obligation in relation to products purchased before or after such changes and assumes no responsibility for any errors, inaccuracies or omissions.

Please visit our web site at: **[www.hardi.com.au](http://www.hardi.com.au)** for more information about research and development, our product range, spraying techniques and crop protection. For sales, service and spare parts information contact your local HARDI dealer.

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### Operator safety

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#### Introduction

This manual contains safety information which could prevent crop damage, personal injury or death. It is compulsory that *all* operators intending to use this equipment read and understand this manual *and related literature*. Safety information in each section must be read carefully, and if any doubt remains contact your HARDI dealer for further information.

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#### Safety alert icons

Safety information in this manual is highlighted by the following icons according to the level of potential risk:



**Danger:** This indicates the highest level of hazard alert. Failure to comply with the information contained here could result in personal injury or death.



**Warning:** This indicates that mandatory action is required. Failure to comply with the information contained here could result in damage to crops, the equipment and / or the environment.



**Attention:** This indicates practical information regarding safe and effective use of the equipment and its systems.

---

#### Chemical safety



**Danger:** Avoid risk of chemical contamination. Always read chemical labels and pressure test the equipment with clean water prior to filling. Never eat, drink or smoke when spraying or working with contaminated equipment. *Never drink water from any of the sprayer's tanks.* Never assume that the contents of the 'clean water' tank is safe to drink.

Remove and store safety wear and clothing after spraying to prevent contamination of the tractor cab. Dispose of, or clean appropriately. If poisoning occurs identify the chemicals and seek medical advice urgently. (for more info see "Chemical Safety" pg. 2.3).

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#### Mechanical safety



**Danger:** Never operate any part of the equipment if any of its components or safety shields are damaged. Never service or repair the equipment while it's operating and replace all safety devices and shields after service procedures.

Always de-pressurise the equipment and disconnect the power after each use and before servicing. Ensure all hydraulics are in the recommended position. Do not walk under any part of the sprayer or the boom unless it is properly secured.

When using an arc welder disconnect any power leads to the sprayer prior to welding and remove any flammable or explosive material from the area.



**Danger:** Never attempt to enter a tank or allow some one else to do so for any reason.



**Attention:** The tractor's drivers seat is the only intended working place during operation.



**Danger:** No persons are allowed in the operations area of the sprayer. Keep unauthorised persons and children away from the equipment at all times. Do not allow any one to ride on the equipment while it is operating.



**Danger:** Do not exceed the max. recommended RPM for any part of this equipment.



**Danger:** Local laws may require operators to be certified before using spray equipment and some chemicals. Consult your local authorities before commencing operation.



**Warning:** Although every effort has been made to include as much safety information as practical, it is impossible to anticipate every hazardous scenario. It is therefore the responsibility of the operator to exercise safe operating practices.



**Warning:** This equipment is intended for the application of crop protection chemicals and liquid fertilisers only. HARDI Australia does not authorise or endorse its use for any other purpose.

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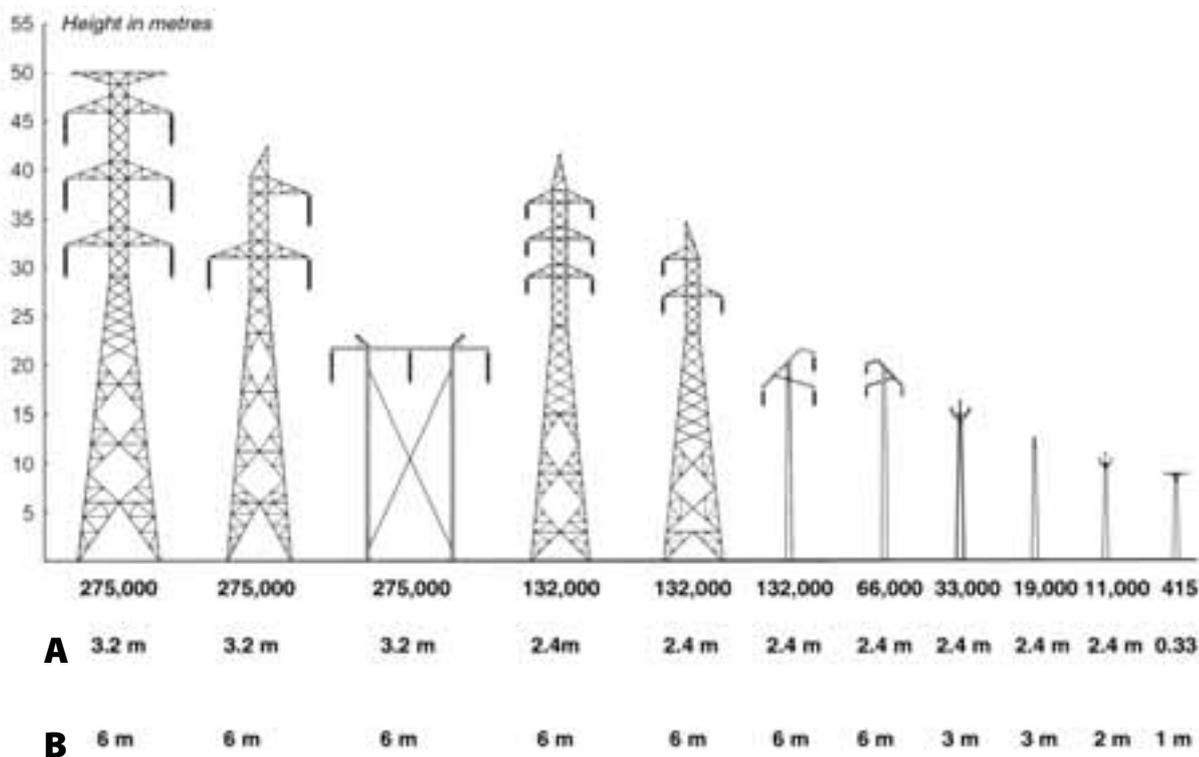
## 2 - Safety notes continued

Beware of overhead power lines!



**Danger:** Operating agricultural machinery near power-lines presents a potentially fatal hazard. It is the responsibility of the operator to ensure that minimum safe clearances are strictly observed, in particular when transporting the implement, spraying, raising, tilting or lowering the boom. Also be aware that during hot or windy weather sagging or swaying of power lines can reduce safe working clearances.

The illustration below is a guide to typical power-line structures for South Australia (guide only and subject to change without notice). power line structures and voltages can vary in different regions of Australia, so it is vitally important to consult your local Electricity Supply Authority for details of minimum safe clearances in your area before proceeding.



A: Minimum safe clearance from conductor for vehicles and implements.

B: Minimum safe clearance from conductor for persons and livestock.

### Spray Drift



**Warning** Serious crop damage can occur as a result of spray drift. Certain climatic conditions can increase the risk of spray drift onto neighbouring crops.

Although calibration information is provided in the Spraying Techniques Manual it is vitally important that you read the chemical manufacturer's recommendations for the correct use of their product.

The manufacturers label will also state the products limitations and warnings.

Wind speed, temperature, humidity and chemical properties should all be considered when determining if conditions are suitable for spraying. Contact your local Department of Primary Industries for details of relevant publications explaining the risks and how best to minimise them. It is the responsibility of the sprayer operator to ensure that the spraying conditions are suitable for the application of the chemical to be used.



**Warning:** After changing chemicals or crops it is essential that the entire sprayer be flushed. This includes disconnecting hoses from the filters and pressure relief valve and cleaning residue and sediment in the hoses, valves and filters. Failure to do so may potentially lead to serious crop damage.

### Chemical Safety



**Danger:** Chemical contamination poses a serious health risk. It is the responsibility of the operator to ensure safe work practice is observed and correct safety equipment and clothing is used.

#### Safety equipment

Depending on the type of chemical used, some or all of the following protective clothing and equipment will be required (see diagram to right).

- 1: Headgear, 2: Safety goggles or face shield, 3: Respirator,  
4: Chemical resistant coveralls, 5: Chemical resistant gloves,  
6: Chemical resistant boots.

#### Contaminated clothing and equipment

Contaminated clothing should be carefully removed, safely isolated and then appropriately laundered or disposed of, taking care not to contaminate the inside of the tractor cab. Tools and equipment used must also be safely isolated and carefully washed and decontaminated.

#### Australian Safety Standards

Protective clothing and equipment must conform to Australian Safety Standards and must always be used when handling chemicals, operating the sprayer and during the cleaning and decontamination process.

#### Chemical Information

Always read the chemical manufacturer's labels as they contain critical information about your safety and the environment. Always consider the environment when disposing of chemical residue (see section on decontamination). Chemical labels are registered by the National Registration Authority. Laws vary from state to state regarding the purpose for which a chemical may be used so consult your local authorities.



**Danger:** Agricultural chemicals can be dangerous. Always read chemical labels and carefully follow safety recommendations to the letter.



**Attention:** Please refer to the chapter on "Cleaning and De-contamination" in the Operation section of this manual for further information.

### Disposal of chemical containers

Please note that in addition to normal safe operating practices, and in the interests of a cleaner and safer environment HARDI Australia supports the "drumMUSTER" chemical drum recycling program:

- Rinse empty drums immediately after use.
- Puncture metal drums through the base from the inside.
- Remove lids to allow drums to dry completely.
- Recycle with "drumMUSTER"

**Please Note:** You will find a "drumMUSTER" Drum Disposal Instruction sticker supplied with your sprayer's documentation. Attach it to a surface close to your chemical drum handling area where it may be clearly seen and make others aware. Please visit [www.drummuster.com.au](http://www.drummuster.com.au) or call 1800 008 707 for further details.

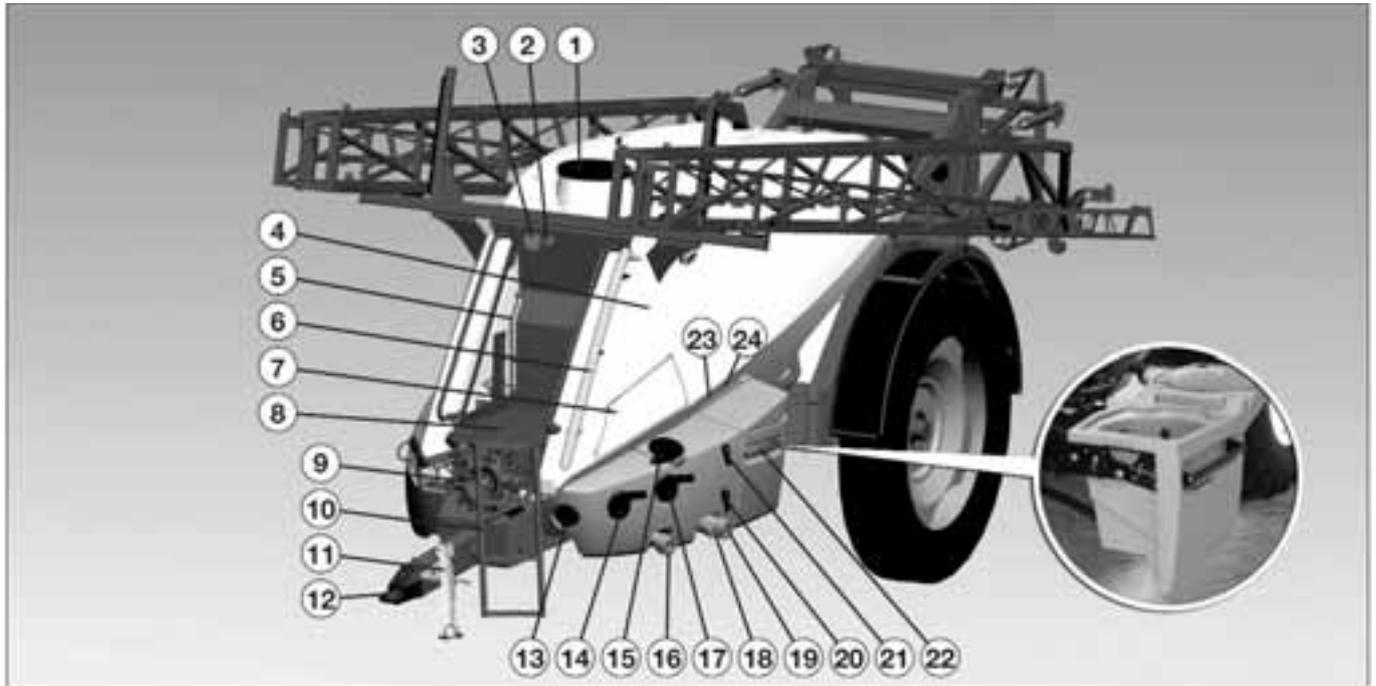


**Warning:** Used chemical containers pose a severe threat to persons, animals and the environment. Before disposal, contact the Environmental Protection Authority or the Department of Primary Industries in your area for more information.

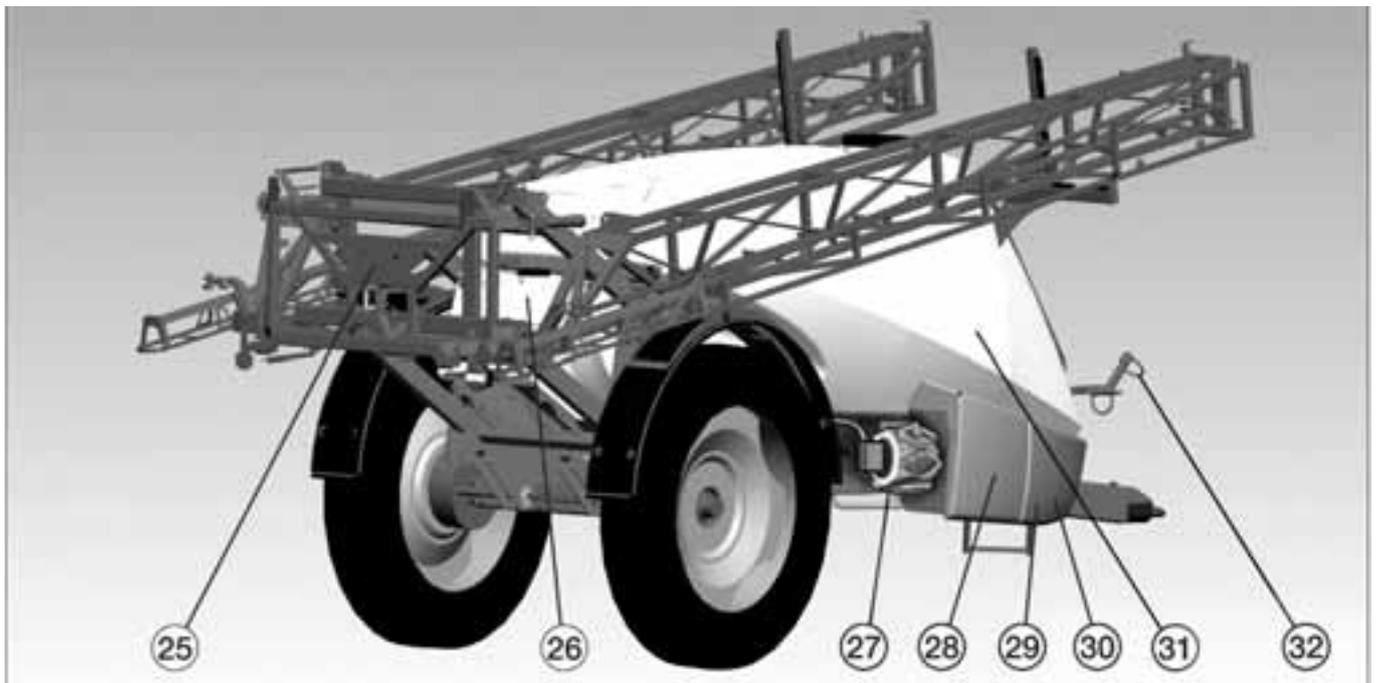
# 3 - Description

## General info

View 1



- |  |  |  |
|--|--|--|
| 1. Main tank lid                                     | 9. Pump                                      | 17. Pressure SmartValve                              |
| 2. EasyClean clogging indicator                      | 10. Ladder                                   | 18. Rinsing tank coupler                             |
| 3. Spray pressure gauge                              | 11. Support leg (5000 model shown)           | 19. External FastFiller coupler                      |
| 4. Clean water tank                                  | 12. Drawbar                                  | 20. External FastFiller ON/OFF valve                 |
| 5. Rinsing tank level indicator (5000 and 7000 only) | 13. Agitation/External Cleaning Device valve | 21. ChemFiller suction ON/OFF valve                  |
| 6. Main tank level indicator                         | 14. Suction SmartValve                       | 22. ChemFiller                                       |
| 7. SafetyLocker                                      | 15. EasyClean filter                         | 23. Valve to operate chemical container rinse nozzle |
| 8. Platform  | 16. Pressure empty coupler                   | 24. ChemFiller Vortex nozzle valve                   |



## View 2 continued

25. Distribution valves	28. ChemLocker or FoamMarker tank	30. CycloneFilter
26. Rinsing tank	29. Hose reel for External Cleaning Device	31. Main Tank
27. FlexCapacity Pump		32. Hose Bundle Support

## Sprayer use

The NEW COMMANDER sprayer is designed and built in Australia solely for the purpose of applying crop protection chemicals and liquid fertilisers. HARDI Australia does not authorise or endorse the sprayer's use for any other purpose. Please note that some local authorities require by law that operators be certified to use spray equipment. In any case it is strongly recommended that they undergo training in spray techniques and safe handling of plant protection chemicals to avoid unnecessary risk to persons, animals and the environment.

## Roadworthiness

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



**Attention!** Max. recommended driving speed is 25 km/h for models without brakes and 40 km/h for models with brakes.

## Identification Plates

Your equipment is fitted with an identification plate located at the front of the chassis on the right hand side of the sprayer. The reference number on the plate will help you and your HARDI Dealer to clearly identify your machine and assist in the correct supply of spare parts and service information.

Please record your sprayer's details here:

Model.....  
Reference number.....  
Date of delivery.....  
Dealer.....

**HARDI INTERNATIONAL A/S**

REFERENCE:

## Further documents

Upon delivery please make sure your sprayer's documentation is complete. Your HARDI Dealer will spend time to check your new equipment with you and give a detailed explanation of the sprayer's systems and functions. Please take the time also to fill out your warranty form and return it to HARDI Australia within fourteen days of delivery.

## Chassis

Strong and compact chassis with chemical and weather resistant powder coat finish. Screws, nuts and bolts (etc) are Stainless Steel or DELTA-MAGNI treated to resist corrosion.

## Tanks

The NEW COMMANDER is equipped with 3 tanks:

1. Main Fluid Tank
2. Flush tank
3. Clean Water Tank

The tanks are made of UV, chemical and impact resistant polyethylene. The main tank is designed for easy cleaning with an access hole next to the work platform and rounded corners to prevent chemical being trapped in tight spots.

1. The main tank has a large capacity of either 5000, 7000 or 9000 Litres (nominal contents) and also features a large fluid level indicator, easily visible from the tractor's cab.
2. The Flush tanks have a nominal contents of 450 Litres for 5000 and 7000 models and 740 Litres for 9000 Litre models.
3. The "clean water" tank is intended for hand washing etc. only and is *not to be used for drinking*. Nominal contents: 20 Litres

## 3 - Description

### Main tank level indicator

The fluid level in the main tank is displayed by a simple float and counter weight device. As the fluid level in the tank changes, a float inside the tank pulls a piece of nylon string and operates the indicator inside the sight gauge on the front left corner of the sprayer. The tank contents are displayed in Litres.



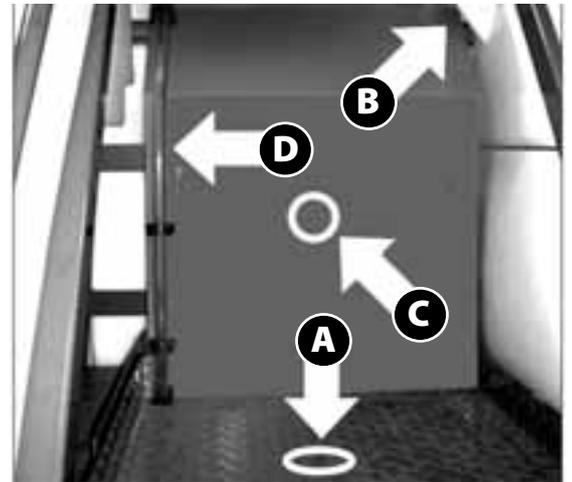
### Working Platform

The working platform provides access to the clean water tank and the main tank lid.

To access the working platform pull the step ladder down from its folded position. When you have finished using the step ladder, return it to its transport position and secure it in place with the rubber strap.

The floor of the platform (A) doubles as a cover for hydraulic, electric and valve manifold components. Lift the platform (A) for access to this area. The clean water tank (B) is also located to the side of the platform.

Electric's and the fast filler are located behind the rear cover (C) and the pressure gauge and rinse tank level indicator (D) are also accessible.



### Remote pressure gauge

The remote pressure gauge is integrated in the top of the platform. This gauge measures the working pressure in the boom tubes as close to the nozzles as possible.

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.



### Steering hydraulics (optional)

The steering hydraulic control block operates the safe track steering system, and is located on the inside of the chassis, under the main fluid tank and just forward of the Paralift hydraulic block.



### Paralift hydraulics

The paralift hydraulic control block manages hydraulic pressure for the paralift and boom functions and is located on the inside of the chassis, under the main fluid tank and just rear of the Steering hydraulics.



### Safety Locker

The safety locker is incorporated into the clean water tank. Located just above the SmartValves work area, it is intended for storing non-contaminated gear such as clean protective equipment and clothing, soap for hand washing etc. There are two compartments so that one may be used for isolating items such as clothing which may have been exposed.



**WARNING!** Although this locker is meant for storing non-toxic items, it must never be used for storing items intended for consumption.



### LookAhead Liquid system

#### Pump

A HARDI 540 RPM (6 spline) 463 positive displacement 6x diaphragm pump, with easy access to service parts.

**Standard** = 540 r.p.m. (6 splines)

**Optional** = 1000 r.p.m. (21 splines).

#### Pump drive

The sprayer's main fluid pump is powered by a conventional PTO shaft (see "Set-up" section for more details). Alternatively a hydraulic powered drive motor may be fitted as optional equipment (please note that the optional hydraulic drive is not available on 1000 RPM pumps or Twin Force boom models. Please see set-up section for more details).

#### LookAhead pressure control unit

Combined with the HARDI HC 5500 Controller the LookAhead pressure control system calculates the correct valve positions when spraying, thus ensuring the programmed chemical application rate is quickly reached and maintained (for example when driving into and out of headlands). Faster response means fewer fluctuations in system pressure, resulting in a better spray job.

The built-in HARDI-MATIC ensures a constant volume of liquid is discharged per hectare (l/ha) at varying forward speeds within the same gear when the number of P.T.O. revolutions are between 300-600 r.p.m. for 540 r.p.m Pumps and 650-1100 r.p.m. for 1000 r.p.m. Pumps.



**Attention:** The LookAhead pressure control system is only active when the spray control box is switched on.

#### Section valves

A central component of the sprayer's fluid system is the group of electrically controlled 'Section valves' located on the boom centre at the rear of the machine (A).

The section valves control one section of the boom each (up to 13 sections) and are able to be switched on or off individually or as a group remotely from the tractor's cab. Direct switching via the Spray control box ensures fast response rates providing precision and economy.



#### Smart Valves and symbols

All functions of the spray circuits are operated by *Smart Valves* located in the "Work zone" (left hand side towards the front) and are identified with colour coded pictorial symbols for easy operation.

Symbols corresponding to every possible function are located on the valve discs for easy identification and operation. Functions are selected by turning the handle towards the desired function symbol.



**Attention:** Machines equipped with HC 6500 with Intelligent features have electrically operated Smart Valves.



**Attention:** Only the functions in use should be open - always close remaining valves.

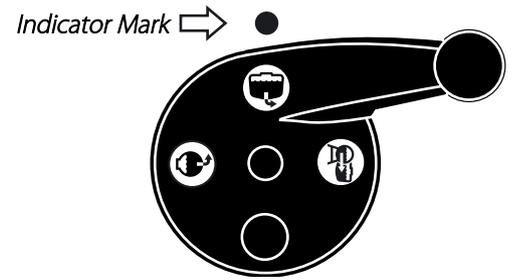
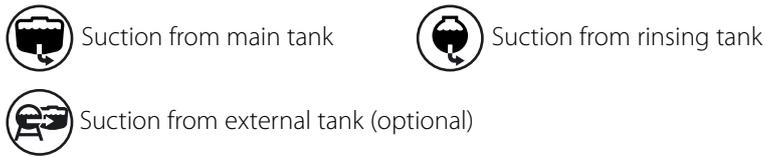


**Attention:** If a Smart valve is too tight to operate easily by hand - or too loose (ie: fluid leaks) the valve needs to be serviced. Please see the 'Maintenance' section of this manual for further information.

### 3 - Description

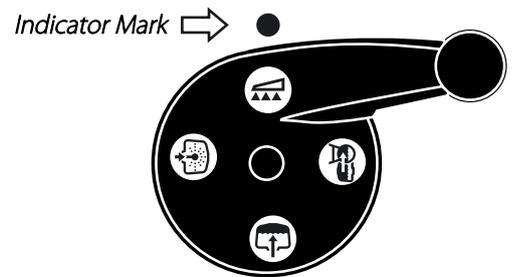
#### Suction valve = Blue symbols

An indicator mark above each valve shows the active function.



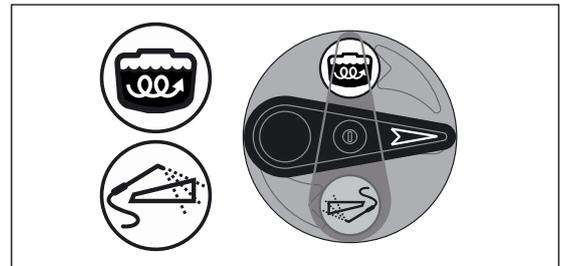
#### Pressure valve = Green symbols

An indicator mark above each valve shows the active function.



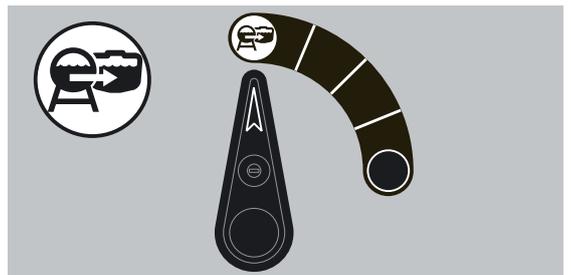
#### Adjustable agitation valve (not available on Intelligent models)

The adjustable valve makes agitation possible whilst spraying with a high volume rate at high pressure. The valve is marked with an arrow on the backing disc that indicates the amount of liquid being used. The tip of the arrow means a small amount of liquid is allowed to pass the valve resulting in less agitation. The wide end of the arrow indicates a larger amount of liquid will pass resulting in greater agitation. Turned to the opposite side, it feeds the (optional) external cleaning device with similar dynamics.



#### External Filling Device valve - Red labels (optional)

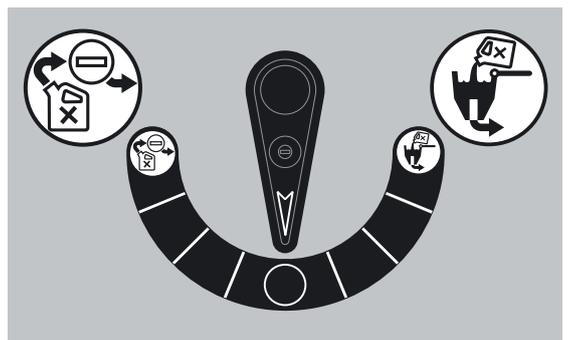
This valve is used to control filling from an external tank or reservoir. Note that the suction SmartValve must be positioned at "Suction from Main tank" or "suction from an external source" to activate the valve.



#### Chemical Source Valve -Red labels

This valve is used to select the desired method of adding chemical. There are 3 positions:

- 1) Centre position "OFF" (leave in this position unless transferring chemical).
- 2) ChemFiller (use this position to activate and empty the ChemFiller).
- 3) Chem Probe / Chem Meter...if fitted (use this position when transferring liquid chemical concentrate from an external drum or container).

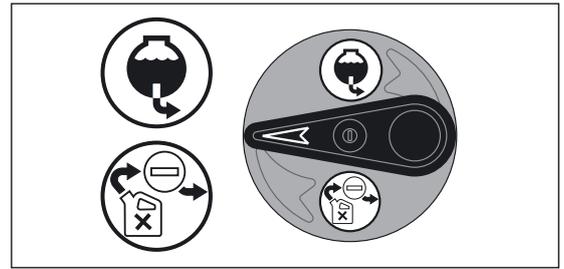


### Chem Probe / Flush Valve

This valve is used for filling liquid chemicals from a drum or a small container using the Chem Meter (if fitted).

#### Flushing the Chem Meter Circuit

The Chem Meter circuit can be quickly and easily flushed of neat chemical by reversing the direction of the valve to draw clean water from the flush tank.



Filling Liquid Chemicals from a drum via the Chem Meter



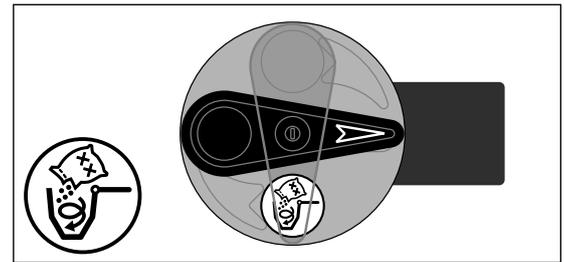
Chem Meter Flushing Circuit

### ChemFiller Vortex nozzle - Yellow label

This valve activates the Vortex flushing of the ChemFiller. The valve is situated behind the ChemFiller and is only visible when the ChemFiller is folded down in the operating position.



Start Vortex



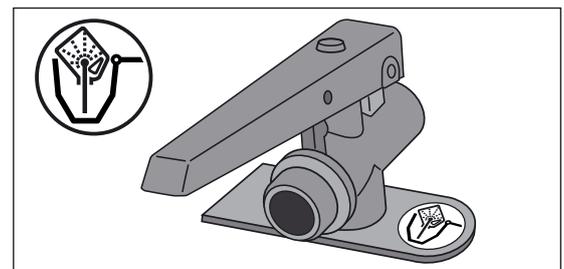
### Chemical container rinse valve - Yellow label

This valve operates the chemical container rinse nozzle and is only accessible when the ChemFiller is folded down in the operating position.

After chemical is added to the hopper the rinse nozzle can be used to flush the chemical container and finally the ChemFiller hopper can be rinsed after use by closing the lid and operating the valve.



Chemical container cleaning



**Danger:** Do not press the lever unless the hopper lid is closed or the nozzle is covered by a chemical container.

### Chem Filler

The HARDI Chem Filler is located on the left side of the sprayer and is used for adding chemicals to the sprayer's main tank.

The chemical hopper folds down on a spring loaded lifting mechanism to a convenient working height and then folds neatly away to match the contoured shape of the sprayer when not being used.

#### Chem Filler components

- A. Release lever
- B. Swings down from the storage position
- C. Lid doubles as a work platform for chemical drums
- D. Vortex nozzle valve
- E. Chemical container rinse valve
- F. Chemical container rinse nozzle



**Danger:** Refer to "Chemical Safety" section at the front of this manual and safety warnings in the "Operation" section of this manual before attempting use.

## 3 - Description

### Chem Meter

The Chem Meter is a metering device for measuring the volume of liquid chemical dispensed from drums and small containers.

Basic instructions for the Chem Meter are provided in the "Operation Section" of this manual, however for more detailed information, please see the manufacturers instruction sheet (supplied with your sprayer).



## Filters

### Introduction

Filters are an important part of the sprayer's fluid system. They remove debris and minimise down time due to blockages. The basic filters on the sprayer are as follows:

- 1) A Cyclone pressure filter is fitted to the sprayer's right side. It has a built-in self-cleaning function.
- 2) An Easy-Clean suction filter is located near the Smart Valves on the left hand side of the sprayer. It has a built-in valve that closes when the filter is opened for inspection or cleaning.
- 3) In-line pressure filters can be fitted at each section as an option.
- 4) Nozzle filters are fitted at each nozzle.



**Attention:** All filters should be fully functional and maintained regularly. Pay attention to the correct combination of filter and mesh sizes. The mesh size should always be less than the flow average of the nozzles being used.

### Cyclone Filter

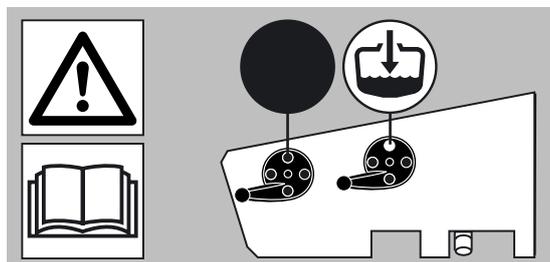
The Cyclone Filter allows the impurities that exist in the spray liquid to by-pass the filter mesh and be re-circulated back to the tank via the return flow.

Function diagram:

- |                   |                   |                |
|-------------------|-------------------|----------------|
| 1. Filter lid     | 2. Flow from pump | 3. To boom     |
| 4. Return to tank | 5. Return valve   | 6. Check valve |



**DANGER:** Before attempting to open the Cyclone filter turn the "Suction" SmartValve to the unused position and the pressure SmartValve to the "Main tank" position (both levers pointing forward). Failure to observe this will result in spray liquid draining from the main tank and being discharged from the filter housing under pressure, risking contamination to the operator.



### EasyClean suction filter

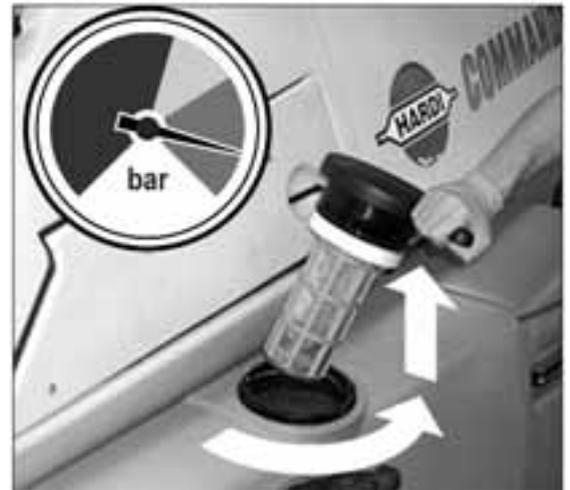
The EasyClean filter is located near the Smart Valves on the left side of the sprayer. It has a built-in isolation valve that automatically closes when the filter lid is opened for cleaning. To open the filter turn the handle counter-clockwise and lift it upwards as shown in the picture to the right.

The EasyClean filter is equipped with a blockage indicator gauge located next to the sprayer's main pressure gauge on the working platform.

A green indicator means no cleaning is necessary.

A yellow indicator means finish your spray job and clean the filter after.

A red indicator means the filter is blocked and must be cleaned immediately.



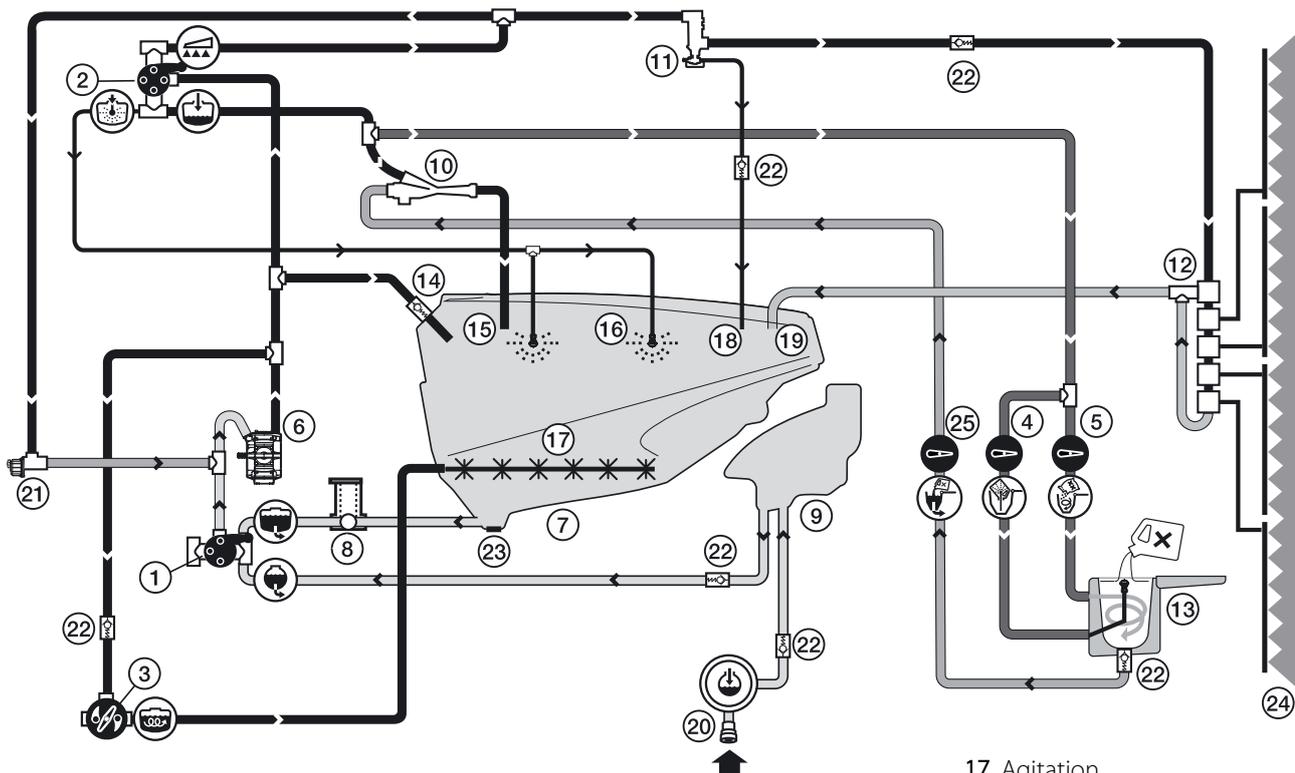
### Draining the filter housing

The EasyClean filter is also fitted with a 0.5 inch ball valve in the base of the filter assembly, making it possible to drain the filter housing of spray liquid containing larger particles of foreign material.



**Attention:** Please refer to the maintenance section of this manual for further details of service procedure.

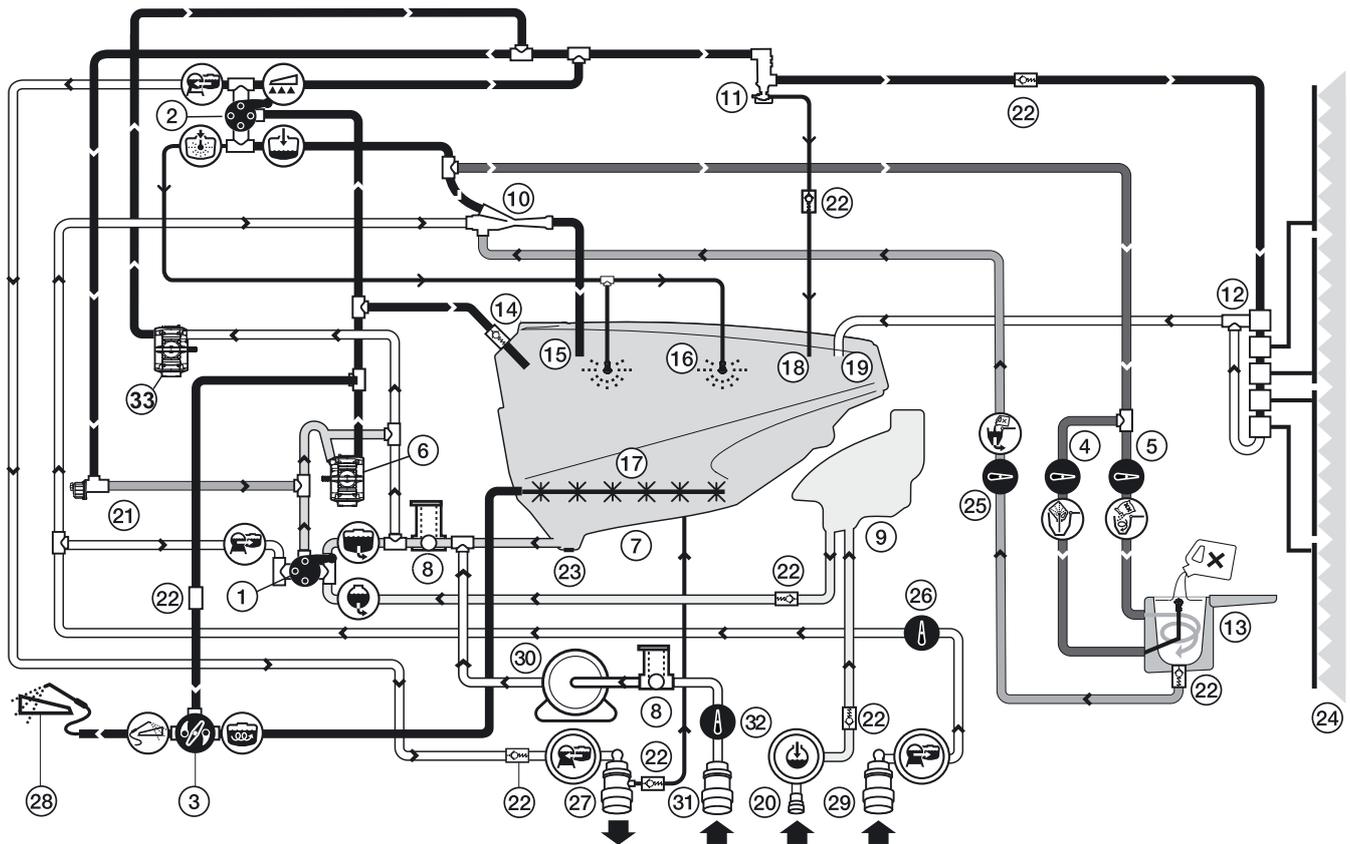
### LookAhead Liquid system (standard)



- |                                     |                                    |                                     |
|-------------------------------------|------------------------------------|-------------------------------------|
| 1. Suction SmartValve               | 9. Rinsing tank                    | 17. Agitation                       |
| 2. Pressure SmartValve              | 10. Ejector                        | 18. Return line for boost function  |
| 3. Agitation valve                  | 11. CycloneFilter                  | 19. Return from distribution valves |
| 4. Chemical container cleaning grip | 12. Section valves                 | 20. Rinsing tank coupler            |
| 5. ChemFiller Vortex nozzle         | 13. ChemFiller                     | 21. PressureControl valve           |
| 6. Pump                             | 14. SafetyValve                    | 22. One-way valve                   |
| 7. Main tank                        | 15. Ejector filling inlet          | 23. Drain valve                     |
| 8. EasyClean filter                 | 16. Internal tank cleaning nozzles | 24. Sprayer boom                    |
|                                     |                                    | 25. ChemFiller suction ON/OFF valve |

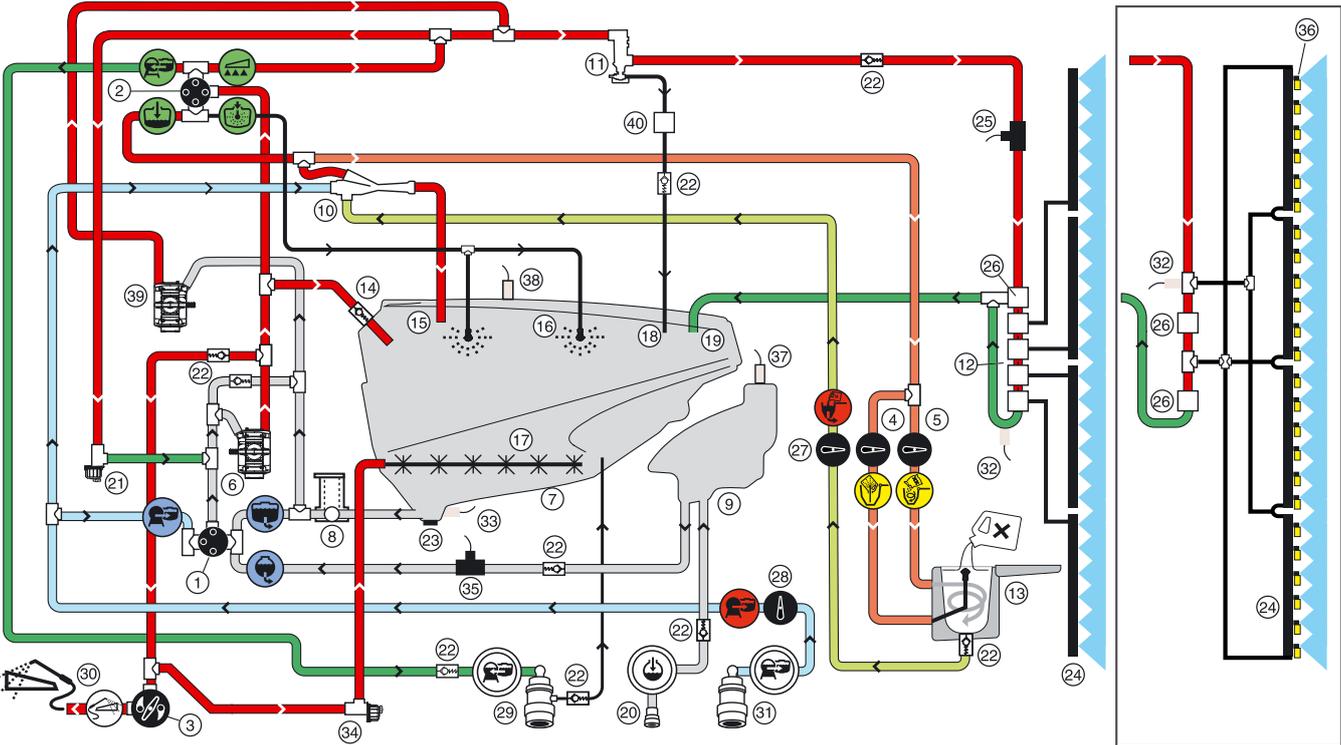
## 3 - Description

### LookAhead Liquid system (with optional extras)



- |   |                                     |  |
|---|-------------------------------------|--|
| 1. Suction SmartValve                       | 12. Section valves                  | 23. Drain valve                        |
| 2. Pressure SmartValve                      | 13. ChemFiller                      | 24. Sprayer boom                       |
| 3. Agitation/External Cleaning Device valve | 14. SafetyValve                     | 25. ChemFiller suction ON/OFF valve    |
| 4. Chemical container cleaning grip         | 15. Ejector filling inlet           | 26. External fast filling ON/OFF valve |
| 5. ChemFiller Vortex nozzle                 | 16. Internal tank cleaning nozzles  | 27. Pressure draining coupler          |
| 6. Pump                                     | 17. Agitation                       | 28. External Cleaning Device           |
| 7. Main tank                                | 18. Return line for boost function  | 29. FastFiller coupler                 |
| 8. EasyClean filter                         | 19. Return from distribution valves | 30. Fast Fill Banjo Pump               |
| 9. Rinsing tank                             | 20. Rinsing tank coupler            | 31. Fast Fill coupler                  |
| 10. Ejector                                 | 21. PressureControl valve           | 32. Fast Fill coupler ON/OFF valve     |
| 11. CycloneFilter                           | 22. One-way valve                   | 33. FlexCapacity pump                  |

## LookAhead Liquid system (with Intelligent features)



- |                                      |                                     |  |
|--------------------------------------|-------------------------------------|--|
| 1. Suction SmartValve                | 15. Ejector filling                 | <b>Options</b>                         |
| 2. Pressure SmartValve               | 16. Internal tank cleaning nozzles  | 28. External fast filling ON/OFF valve |
| 3. External Cleaning Device valve    | 17. Agitation                       | 29. Pressure draining coupler          |
| 4. Chemical container cleaning valve | 18. Return line for boost function  | 30. External Cleaning Device           |
| 5. ChemFiller Vortex nozzle valve    | 19. Return from section valves      | 31. FastFiller coupler                 |
| 6. Pump                              | 20. Rinse tank coupler              | 32. Pressure sensor                    |
| 7. Main tank                         | 21. Pressure control valve          | 33. Main tank gauge                    |
| 8. EasyClean filter                  | 22. One-way valve                   | 34. AutoAgitation valve                |
| 9. Rinse tank                        | 23. Drain valve                     | 35. Rinse tank flow meter              |
| 10. Ejector                          | 24. Sprayer boom                    | 36. PrimeFlow ON/OFF                   |
| 11. Cyclone filter                   | 25. Flow meter                      | 37. Rinse tank full sensor             |
| 12. Distribution valves              | 26. Bypass valve                    | 38. Main tank full sensor              |
| 13. ChemFiller                       | 27. ChemFiller suction ON/OFF valve | 39. FlexCapacity pump                  |
| 14. Safety valve                     |                                     | 40. Boost line valve                   |

# 3 - Description

## Electronic Control units

The NEW COMMANDER range of sprayer's are offered with a choice of two programmable electronic spray control systems. The controller is responsible for fluid management (ie: maintaining the calibrated chemical application rate) but development of new technologies have made a range of other functions possible with "Intelligent Features" now supported by the HC 6500.

Both the HC 5500 and the new HC 6500 controllers have micro processors and LCD display panels, and allow the operator full control of the spray and hydraulic functions of the sprayer from remote switching terminals inside the tractors cab.

### HC 5500 control system

The HC 5500 is a robust purpose built computerised spray control system which responds in real time to input signals from various sensors on the sprayer plus information keyed in by the operator.

The HC 5500 Controller is a modular system and consists of a spray computer/display unit, a manual spray control box and a hydraulic control panel to provide the operator with full control of boom and spray functions from inside the tractors cabin.



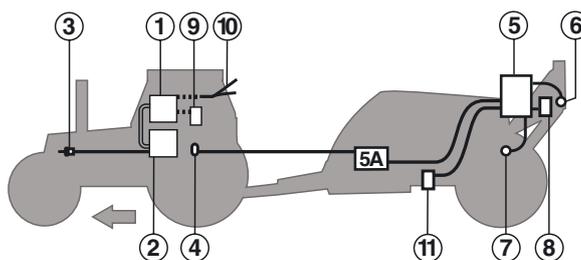
**Attention:** Certain features require fitting an optional "Jobcom" box or Job Computer to function.



**Attention:** Some installation in the tractor is required (see Set-up section of this manual) and certain features are not supported by HC 5500.

### HC 5500 System overview

- |                              |  |
|------------------------------|--|
| 1. Controller                | 6. Flow sensor                               |
| 2. Spray Box '2'             | 7. Speed sensor                              |
| 3. 12 Volt Power Supply      | 8. Hydraulic junction box                    |
| 4. Multi wire plug and cable | 9. Printer (optional)                        |
| 5. Junction box              | 10. Harness for tractor remote floor switch. |
| 5A. JobCom/ Junction box     | 11. Steering junction box                    |



The system consists of 3 main components:

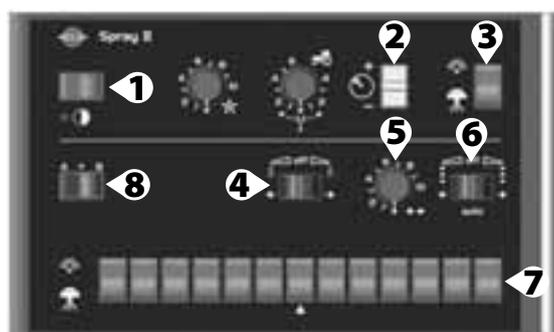
#### 1) HC 5500 Controller and display unit

1. Display panel
2. Navigation keys
3. Quick keys



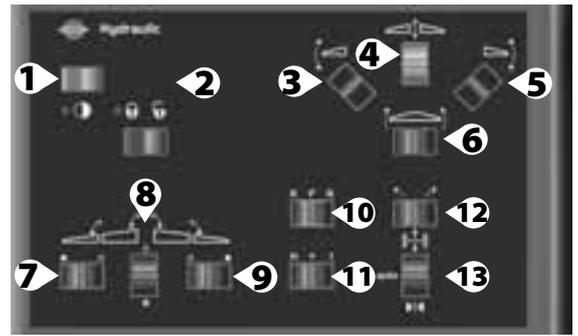
#### 2) Spray '2' Control box:

- |                                |                                 |
|--------------------------------|---------------------------------|
| 1. Power ON/OFF                | 5. Foam marker frequency        |
| 2. Spray pressure regulation   | 6. Foam marker (Left/OFF/Right) |
| 3. Main valve ON/OFF           | 7. Section valves               |
| 4. End nozzle (Left/OFF/Right) | 8. Optional function            |



## 3) Hydraulic Control box

- |                           |   |
|---------------------------|---|
| 1. Power ON/OFF           | 8. Boom inner folding                                     |
| 2. Optional boom lock     | 9. Boom outer folding                                     |
| 3. Boom tilt left         | 10. Optional function                                     |
| 4. Boom lift up/down      | 11. Optional function                                     |
| 5. Boom tilt right        | 12. Manual Safe-track control (left/right) (optional)     |
| 6. (not avail. Australia) | 13. Safe-track control auto (manual/auto/lock) (optional) |
| 7. Boom outer folding     |   |



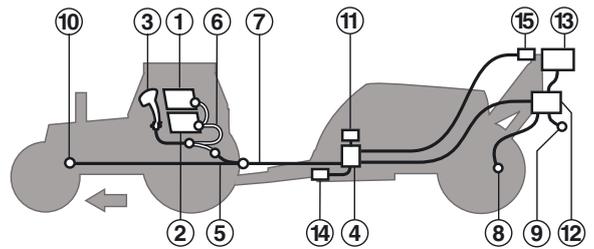
## HC 6500 control system

The HC 6500 controller represents the first of a new generation of HARDI dedicated spray computers with expanded capabilities to accommodate a broader range of functions including "Intelligent features" such as Auto Wash and Auto Fill.

Single cable connection, help menu's, large colour display screen and "Joy Stick" operation for the most common functions make the 6500 a practical and ergonomically designed package.

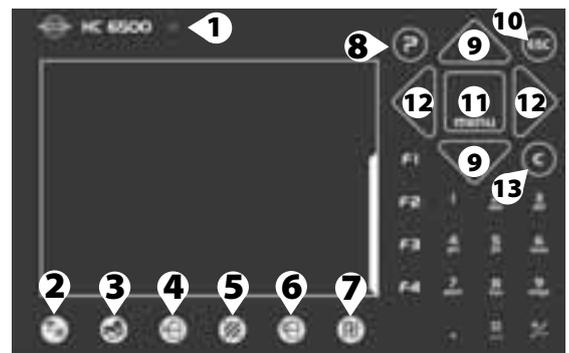
## HC 6500 System overview

- |                                   |                                 |
|-----------------------------------|---------------------------------|
| 1. HC 6500 Display terminal       | 8. Speed sensor                 |
| 2. HC 6400 SetBox                 | 9. Flow sensor                  |
| 3. HC 6300 Grip                   | 10. Power supply to sprayer     |
| 4. HC 6100 Jobcom box             | 11. HC 6200 Fluid Box           |
| 5. Wiring harness for tractor     | 12. EFC Junction Box            |
| 6. Wiring harness for tractor cab | 13. Electric fluid control unit |
| 7. Wiring harness for the sprayer | 14. LookAhead pressure control  |
|                                   | 15. Hydraulic junction box      |



## 1) HC 6500 Display terminal

- |                         |                            |
|-------------------------|----------------------------|
| 1. Status diode         | 8. Help key                |
| 2. Volume rate          | 9. Scroll/Value up or down |
| 3. Speed                | 10. Escape key             |
| 4. Tank contents        | 11. Enter / Accept         |
| 5. Area treated         | 12. Scroll left / right    |
| 6. Total volume sprayed | 13. Clear current value    |
| 7. Area remaining       |                            |



## 2) HC 6400 SetBox

- |                            |                                 |                                   |
|----------------------------|---------------------------------|-----------------------------------|
| 1. Power ON/OFF            | 8. Foam marker (Left/OFF/Right) | 13. SafeTrack centring            |
| 2. Status Diode            | 9. Twin pre-sets                | 14. SafeTrack automatic           |
| 3. Optional boom lock      | 10. Air slot for Twin Force     | 15. Valve function A-B            |
| 4. Boom Fold controls      | 11. Air volume for Twin.        | 16. Headland assist Automatic     |
| 5. Auto volume rate        | 12. SafeTrack Manual control    | 17. Headland assist Boom Centring |
| 6. Manual pressure control |                                 |                                   |
| 7. Foam marker frequency   |                                 |                                   |



## 3 - Description

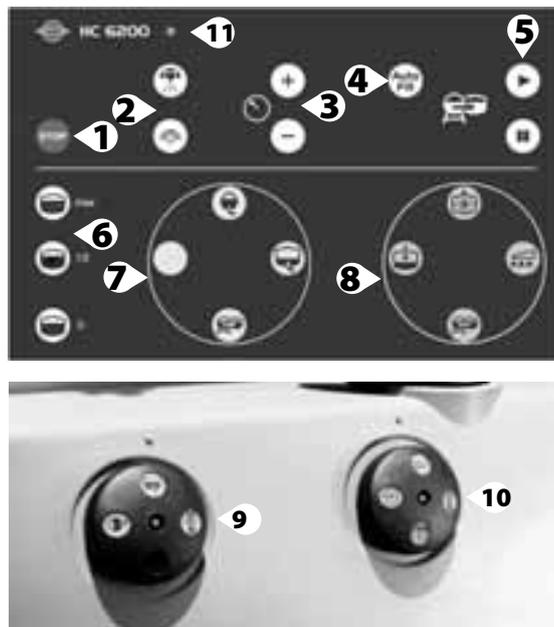
### 3) HC 6300 Grip

1. Main Boom spray ON/OFF switch
2. Status diode
3. Boom section control switches
4. Tilt
5. Boom height
6. Slant (if fitted)
7. Twin Force pre-sets (behind view)



### HC 6200 Fluid box

1. Emergency Stop all functions
2. Main ON / OFF
3. Spray Pressure UP / Down
4. Auto Fill ON / Off
5. Fast Filler START / PAUSE
6. Auto Agitation override control
7. Suction Valve override control
8. Pressure Valve override control
9. Select Suction Valve position
10. Select Pressure Valve position
11. Status Diode



### Operation instructions for Electronic control systems



**Attention:** HC 5500 and HC 6500 controllers each have their own separate "Operators instruction manual" containing the complete installation, set-up and operating instructions. A copy of the book specific to your model of control system has been supplied with your sprayer. It's mandatory anyone intending to operate this equipment read it and understand it.

### Subjects covered:

A separate "Electronic control system" operators manual is supplied with your sprayer. It is compulsory reading and contains important safety information as well as instructions on Safe Track, installing the system in your tractor, navigation keys, dual line, prime flow, auto agitation and auto section control. It also contains instructions on calibration, extended menu's, tool box, maintenance and more.

### Intelligent Features

Intelligent features including optional Auto wash and Auto fill are all covered in the HC 6500 manual. If your controller Operators instruction manual is missing or any further information is needed, please contact your HARDI dealer or visit our web site at:

[www.hardi.com.au](http://www.hardi.com.au)

## Boom

### Boom configurations, terminology and Operators Manual

The New Commander range is available with a choice of optional boom configurations and widths. For this reason a separate "Boom Operators and Maintenance Manual" is supplied with your sprayer and contains detailed information on boom safety, set-up, operation, maintenance and spare parts.



**Danger:** Important information on Safety, Operation and Maintenance specific to your boom configuration is detailed in the "Boom Operators Manual" supplied with your sprayer's documentation. It must be read and fully understood by anyone intending to operate this equipment. Failure to do so could result in serious personal injury or death.

### Terminology

Booms are available in 18, 20, 24, 28, 30, 32, 33 and 36 metre working widths (depending on sprayer model). The 18m up to 28m booms are 2-folded and the 30 m up to 36 m booms are 3-folded (with the exception of 30m Twin Force which are 2 folded).

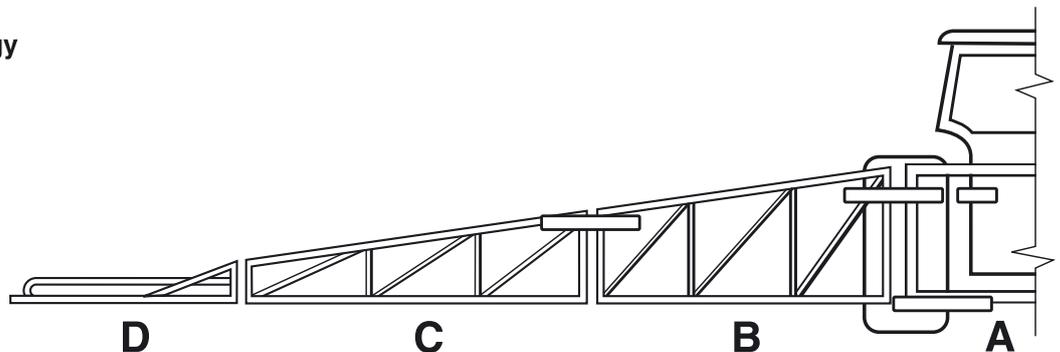
### Folded boom widths

Typical boom configurations and their possible fold variations:

Full width	1/2 folded	2/3 folded
28 meters	14 meters	N/A
30 meters	12 meters	23 meters
32 meters	14 meters	25 meters
36 meters	14 meters	27 meters

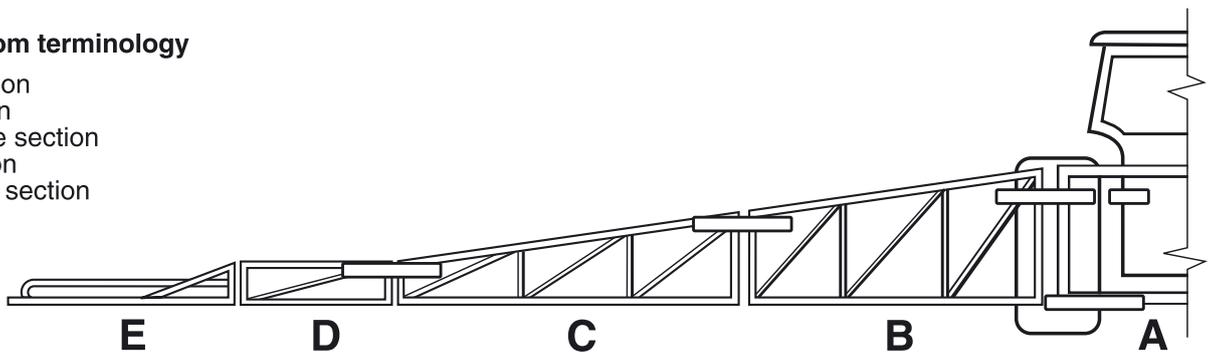
### Two fold boom terminology

- A: Centre section
- B: Inner section
- C: Outer section
- D: Break-away section



### Three fold boom terminology

- A: Centre section
- B: Inner section
- C: Intermediate section
- D: Outer section
- E: Break-away section



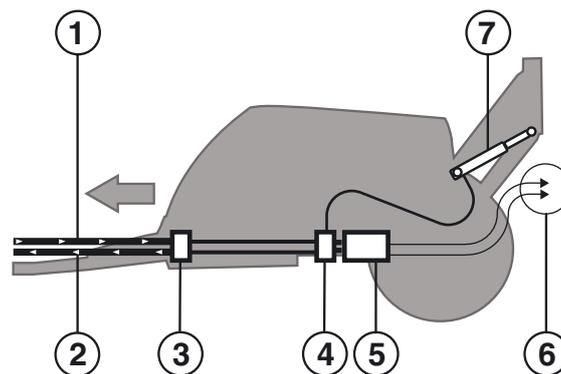
## 3 - Description

### Optional Equipment

#### Hydraulic system overview

The illustration to the right demonstrates the position of the main hydraulic components:

1. Pressure line from tractor
2. Return to tank
3. Open Centre Hydraulic block (optional)
4. Steering block (optional)
5. Paralift block
6. To the boom cylinders
7. Paralift cylinders



#### SafeTrack steering (optional on 5000 and 7000 models only)

The HARDI Safe Track steering system allows the trailer to safely follow the tracks of the tractor providing tighter turning ability, greater stability when turning on sloping ground and minimal crop loss due to crushing.

Be aware however that articulated trailers behave differently than normal trailers, so take some time to become accustomed.

In the tracking position the sprayer's centre of gravity is displaced more forward compared to the centre line of a normal trailer and is therefore potentially less stable when turning at higher speeds.

For track width specifications please see "Altering the track gauge" in the "Set-up" section of this manual.

 **Danger!** No persons are allowed in the operations area of the sprayer when steering is unlocked!

 **Warning!** Never use articulated steering when the boom is in the transport position.

 **Attention:** Please see the "Operation" section of this manual and the "Safe Track" section in the HC 5500 / HC 6500 Controller Instruction book for operating instructions and steering calibration information.

 **Attention:** Optional SafeTrack steering is not available on 9000 model sprayers.



#### ChemLocker (optional equipment)

A ChemLocker for storage of chemical containers etc. can be mounted on the sprayer's right side.

Max. load 100 Kgs./100 litre.



### Pressure empty and Quick fill couplings

The quick couplings located in the work zone have the following functions:

- A. Pressure empty (optional)
- B. Rinse tank fill coupling (standard)
- C. HARDI Quick filler (optional)



### External Cleaning Device (optional equipment)

The optional External Cleaning Device comprises a hose reel and spray gun. To access the External Cleaning Device, open the door on the sprayer's right hand side.

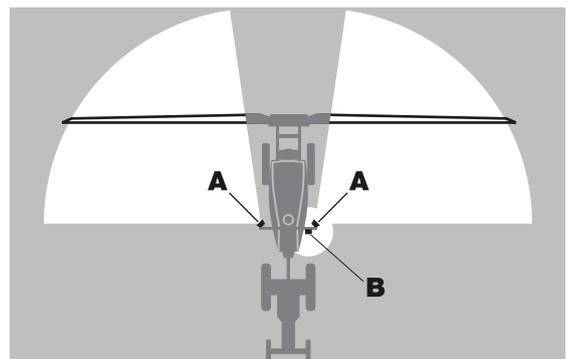
 **Danger:** The External Cleaning Device operates at very high pressure and could potentially cause serious personal injury, it is therefore essential the following Safety rules be observed and strictly enforced:



- 1) Never point the water jet at people, animals, electrical installations or equipment, overhead power lines or other sensitive objects.
- 2) Never try to clean clothing or foot wear, especially if being worn by persons.
- 3) Pressure can penetrate skin and cause severe injury. Never work with un-protected eyes, bare feet or sandals.
- 4) Never operate without approved chemical safety wear including face mask, gloves, respirator, boots and cover-alls.
- 5) Beware of flying particles being dislodged by the cleaning jet.
- 6) The spray gun and hose are affected by "recoil" when the handle is released during operation - therefore always hold the insulation on top of the gun with one hand and the pistol grip with the other hand to facilitate better control of the device.

### Night Spraying Lights (optional equipment)

The 2 boom lights (A) are mounted to the railing of the working platform (one at each side) and are positioned to illuminate both boom wings for night spraying.



### Work Light

The work area light (B) is also mounted to the railing of the working platform, just above the Manifold valves, and illuminates the HARDI ChemFiller, Safety locker and Manifold valves.

 **Attention!** Switch OFF the rear lights of the tractor in order to save power and to avoid reflection problems. Power supply is via the 7-pin socket. A circuit diagram is provided in the Technical specifications section of this manual.



# 3 - Description

## Optional Filling Systems

### Optional Filling systems and equipment:

- 1) Fast Fill system (Venturi -Non Filtered Fill)
- 2) Quick fill system (Filtered -External Pump)
- 3) Fast Fill (with high capacity Banjo Pump)

### Fast Fill System

The "Fast Fill" option uses an on-board venturi system (powered by the HARDI 463 Diaphragm pump) to draw water directly from an external source.

A suction hose is run from an external water source and coupled to the sprayer via a trailer mounted aluminium quick coupler.

 **ATTENTION!** The Fast Fill circuit does not include a filter or strainer! It is highly recommended you use a remote in line filter to remove any debris and impurities. For more information please contact your HARDI dealer.

### Quick Fill System

The filtered "Quick fill" system allows the operator to fill the sprayer from an external water source (such as a dam) using an auxiliary pump. The system includes a high capacity filter. The operator can also control the speed at which filling takes place by adjusting the quick fill ball valve on the sprayer.

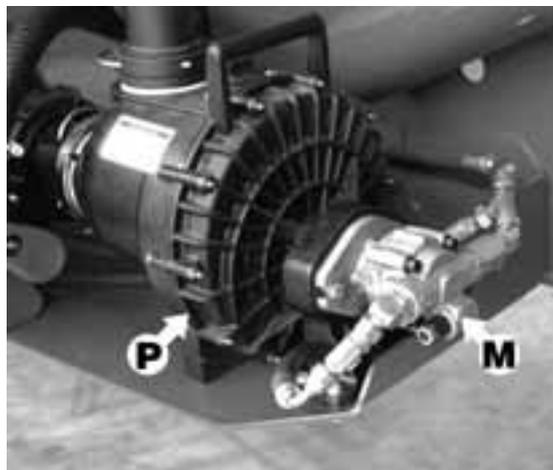
#### Cam Lock coupling sizes:

5000 Litre models.....	2.0 inch
7000 and 9000 Litre models.....	3.0 inch

### Banjo Fast Fill System

The Banjo Fast Fill system employs a high capacity centrifugal pump (P) driven by a hydraulic drive motor (M). The motor is powered by the tractors auxiliary hydraulic system and is protected from over revving by a hydraulic burst valve.

The operator can also control the flow rate by means of a variable speed control valve mounted on a panel just forward of the pump.



#### Pump filling capacity:

5000 Litre models	(Pump, filter and coupling = 2.0")
.....	5-600 Litres per minute
7000 and 9000 Litre models	(Pump, filter and coupling = 3.0")
.....	7-800 Litres per minute

### FlexCapacity pump (Optional on 7000 and Std on 9000)

The FlexCapacity pump system incorporates a second standard 463 fluid pump mounted to the right side of the chassis. The second pump is driven by a hydraulic motor which is powered by the tractors auxiliary hydraulic system and so can be easily activated remotely.

Connect the hydraulic lines (routed along the chassis and hose bundle support bracket) to a free auxiliary hydraulic outlet at the rear of the tractor being sure to connect the pressure and return lines correctly (which are clearly marked for positive identification).



### Foam Marker (optional)

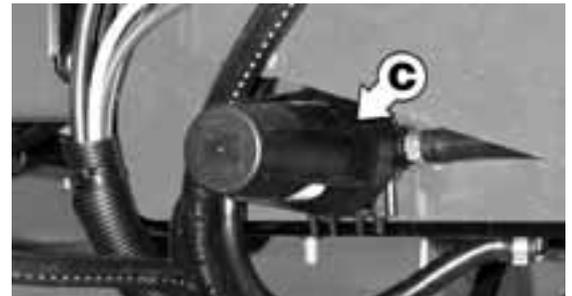
An *up-graded* foam marker system is available as optional equipment featuring a new higher capacity tank (A) which greatly expands the system's working capacity and easy access to the tank lid (B) for filling.

Electronic metering means greater precision and economy.



### Foam Marker filter

A serviceable in line filter (C) is located at the rear of the foam tank just below the compressor.



### Foam Marker controls

Blob size and frequency are both controlled from the remote Spray box in the tractor's cabin and foam solution can be purchased from your HARDI dealer in various size containers.



### Mudguards (optional equipment)

Mudguards are available for all standard wheel configurations and are fitted to the trailer by means of a supporting frame which slides neatly into a mounting toward the rear of the chassis.



## 4 - Sprayer Set-up

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### Set-up

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#### Introduction

This section of the manual deals with taking delivery and preparing the new sprayer for service in the field. It contains important information to help you get started, plus mandatory safety information. Please make sure that anyone intending to use the equipment carefully reads and understand the contents, plus any related documentation.

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#### Safety



**Danger:** Preparing the sprayer for service in the field involves:

- Unloading the sprayer from transport
- Connection and testing of Mechanical components
- Connection and testing of Electrical wiring and systems
- Connection and testing of Hydraulic hoses and systems
- Installation of mounting brackets and electronic components in the tractor
- Reading and interpreting technical information and illustrations
- Testing of Fluid systems

Safety during set-up, service and maintenance procedures requires awareness, preparation and common sense. Below is a list of safety issues which must be observed before commencing set-up:



**Danger:** Before carrying out any set-up procedures observe the following:

- Ensure your work area has lifting and safety equipment of a suitable load bearing capacity.
- Always wear safety eye protection, overalls, safety boots and gloves where appropriate.
- Keep animals and people away from the service area at all times unless involved in the procedure.
- Keep children away.
- If necessary clean and de-contaminate the sprayer and use chemical safety gear (see "Chemical Safety" section 2).
- Position the tractor and sprayer on a suitable flat surface with enough room for the boom to operate.
- Never perform set-up, service or maintenance procedures with the tractor running.
- Turn the tractor's engine off, place in park with the hand brake on *and remove the ignition key!*
- Fit the support leg and retaining pins and use wheel chocks in front and behind of each wheel.
- Always use safety stands when lifting the sprayer off the ground.
- Always re-fit all safety equipment and shields after service procedures.
- Think each job through before commencing work and assess any potential risk.
- Avoid working alone or at least have some-one check on you periodically.
- Carry a mobile phone on you for emergencies.
- Dis-connect the power and clear the area of any flammable material before using an arc welder.
- If any procedure is unclear or requires facilities which are not available, refer the job to your HARDI dealer.

#### Before operating the sprayer

Before operating the sprayer for the first time, it is recommended to apply a film of Castrol Rustillo, Shell Ensis or a similar product to help protect the sprayer's baked enamel and metal surfaces from premature dis-coloration.

Another notable advantage of using this kind of product straight away is that they can help prevent chemical particles from adhering to the sprayer's external surfaces and therefore cleaning and de-contamination becomes a much easier process.

Please note that these products will wash off, so make sure you re-apply the product regularly (especially after using a pressure cleaner) and your sprayer will be easier to clean and well preserved for many years to come.

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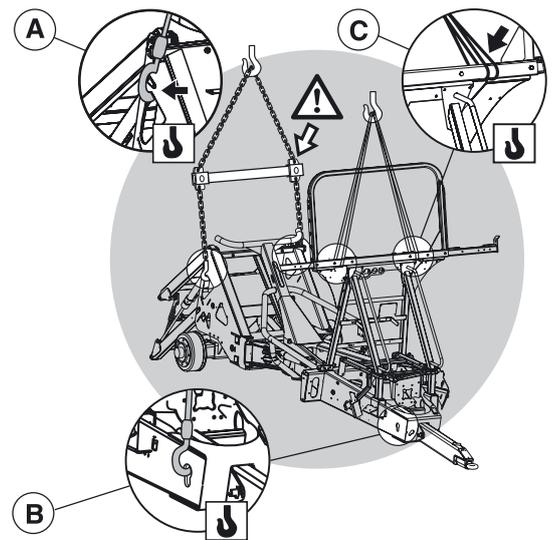
## Taking Delivery

### Un-loading the sprayer from transport

To unload the sprayer from a truck a crane or a fork-lift can be used. When un-loading with a crane please observe the lifting points as shown on the diagram. Make sure that all rigging used is of a suitable load bearing capacity and meets local safety regulations.

Detail A and C: 5000 and 7000 Litre models

Detail A and B: 9000 Litre model only



### Gross weight of sprayer with tanks empty:

5000 Litre.....	3500 kg.
7000 Litre.....	4620 kg.
9000 Litre.....	6495 kg.



**Danger:** Never attempt to transport the sprayer with fluid in the tanks. Remember, 1 Litre of water = 1 Kilogram



**Danger:** When lifting the sprayer a spreader bar must be used as shown in the diagram above. All rigging used must be of a suitable load bearing capacity. Beware of over head power lines!

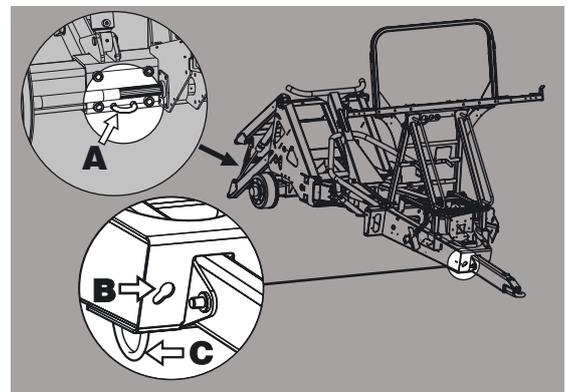
### Securing the sprayer at the tie down hooks

5000 and 7000 models

For moving the sprayer or securing it to a truck it can be pulled in the hooks at the rear-end (A) or a hook can be fastened into the hole in the front end of the sprayer (B).

9000 models

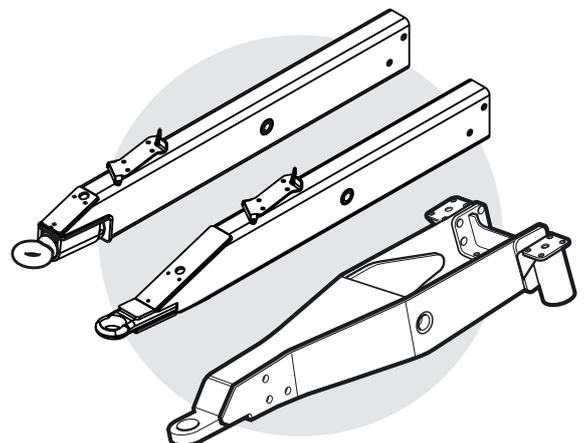
For the tie down at the front of 9000 Litre Commander, refer to (C) in the diagram.



### Drawbars

The following drawbar extensions are available.

Low D33/50 swivel	(5000 with steering)
Low D50 fixed	(5000 no steering)
40/50 fixed	(7000 no steering and 9000)
50 swivel	(7000 with steering)
Fixed suspended	(9000)



## 4 - Sprayer Set-up

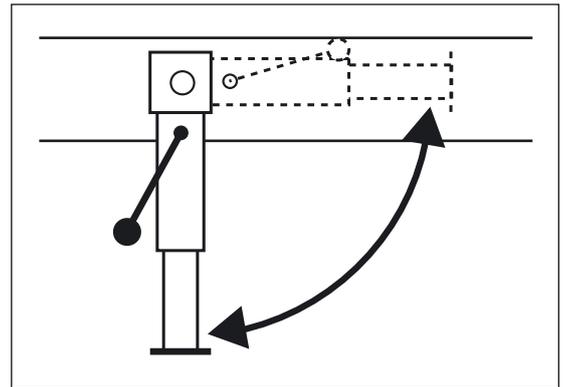
### Mechanical connections

#### Support leg (5000 model)

The support leg for the 5000 Litre model is mounted toward the front of the sprayer on the left side of the chassis. When stowed for transport, it swings upward and is secured in its "transport position" by a spring loaded locating pin.

#### Support leg operation

- 1) Hold the support leg with one hand and release the spring loaded locating pin with the other hand.
- 2) Swing the support leg down until the locating pin snaps into place.
- 3) Turn the crank handle into the operating position and wind the support leg up or down as required.



#### Returning the Support leg to the transport position

- 1) Retract the locating pin and swing the support leg back up towards the chassis until it "clicks" into place.
- 2) Push the crank handle down and turn it so the handle will rest neatly on the support leg while in transit.

#### Support leg (7000 and 9000 models)

The 7000 and 9000 Litre models are fitted with a 'Hydraulic' support leg. The single acting cylinder is fed via a pressure line which connects to the tractor's auxiliary hydraulic circuit via a conventional snap coupling.

#### Support leg operation

- 1) Reverse the tractor as close as possible to the sprayer's draw bar hitch and connect the support leg pressure line to a spare single acting outlet.
- 2) Open the hydraulic locking valve (E) (see the illustration below).
- 3) Operate the hydraulics to raise the trailer's hitch to the correct height.
- 4) Reverse the tractor again into position and connect the sprayer.
- 5) Lower the hydraulics so the sprayer is fully supported by the tractor.



#### Returning the Support leg to the transport position

- 6) Remove the pins (A) & (B) and use the handle (C) to swing the support leg up into the transport position.
- 7) Secure the support leg in the transport position by re-fitting the retaining pins (A) & (B) into the second hole position (D).

#### Un-hitching the sprayer

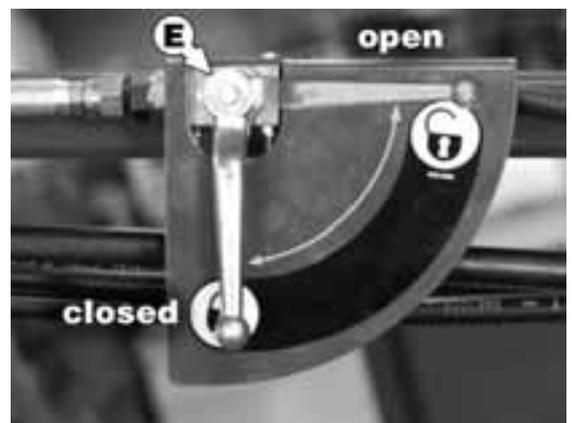
- 1) Remove the pins (A) & (B) from position (D) and return the support leg to the service position. Refit the pins (A) & (B) into the first hole position.
- 2) Raise the support leg and engage the "Hydraulic locking valve" (E).
- 3) Disconnect the support leg pressure line in the usual way, and place some blocks under the drawbar during storage as a safety precaution.
- 4) Disconnect the rest of the hydraulic lines and electrical connections in the usual manner and protect from dust and moisture with some tape.



**Danger:** When leaving the sprayer in storage or performing service procedures, support the draw bar by other suitable means such as blocks.



**Warning:** The spring loaded lynch-pin is a safety device. Do not store or operate the sprayer without it.



### Mechanical connections

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#### Transmission shaft

The transmission shaft assembly transfers drive from the tractors PTO to the input drive shaft of the sprayers main fluid pump. In order to minimise potential risks associated with PTO transmission shafts please observe the following safety rules:

1. Stop the tractors engine and remove the ignition key before attaching the shaft to the tractor's PTO.
2. Most tractor P.T.O. shafts can be rotated by hand to facilitate spline alignment, but only when the tractors engine is stopped.
3. When attaching the shaft, make sure that the snap lock is FULLY ENGAGED - push and pull shaft until it locks.
4. Check and maintain all safety equipment regularly.
5. Never operate a PTO shaft without safety guards.
6. Ensure safety warning labels are clearly visible.
7. Make sure that the safety guards are prevented from rotating by chains, allowing sufficient slack for turns.
8. All rotating parts must be covered including the universal joints at each end of the shaft.
9. Do not touch or stand on the transmission shaft when it is rotating; safety distance: 1.5 meters.
10. Always stop the engine and remove the ignition key before carrying out maintenance or repairs to the transmission shaft.



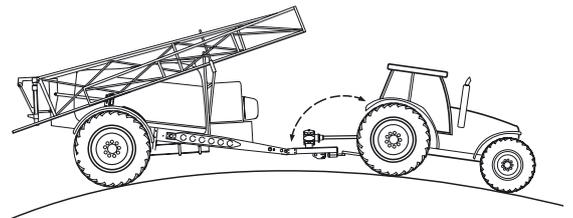
**Danger:** Rotating transmission shafts without safety shields are Deadly! *Serious injury and deaths have been associated with un-protected PTO transmission Shafts. Never operate a PTO transmission shaft without safety shields.*

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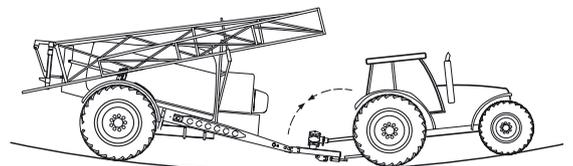
#### Introduction

Under normal operating conditions the distance between the pump and the PTO shaft of the tractor varies: for example, when turning or travelling across uneven road or paddock surfaces.

1. Over rises the transmission shaft is extended.



2. Through dips the transmission shaft is compressed.



#### Transmission shaft components

In order to maintain drive to the sprayer's pump whilst allowing for changes in length the transmission shaft is divided into two halves with matching profiles.

The geometric shape of the profiles locks them together on the rotational axis whilst allowing free lateral movement to absorb changes in length as the implement and tractor move in relation to each other.

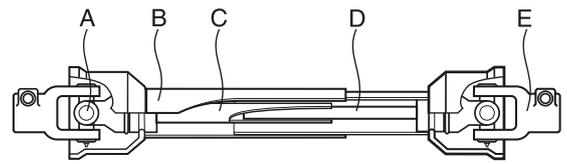
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# 4 - Sprayer setup

## transmission shaft components continued

transmission shaft components are identified as follows:

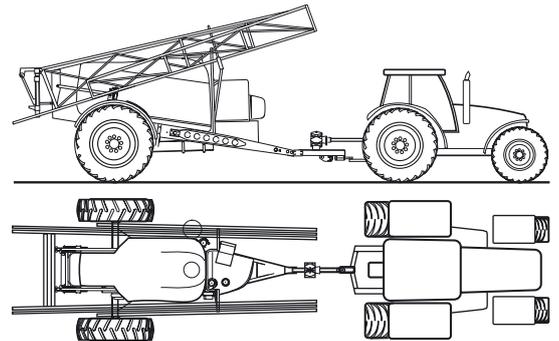
- (A) Universal Joint
- (B) Safety Guard
- (C) Female Section
- (D) Male Section
- (E) Splined Coupling



## Installation

The first installation of the transmission shaft is carried out as follows:

Hitch the sprayer to the tractor on flat ground, ensuring the tractor and sprayer are correctly aligned as shown in the illustration to the right.



This is the neutral position ie: the shaft will be neither compressed nor extended.

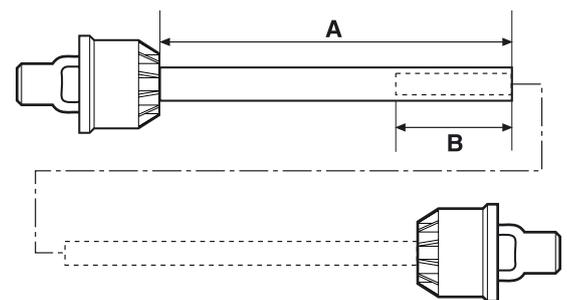
## Inspection

Once the tractor and sprayer are in position, stop the engine and remove the ignition key. Fit the transmission shaft to the tractor's PTO and the sprayer's pump. Inspect the shaft for 'overlap' ie: the amount of the two halves engaged when the shaft is fitted and in the neutral position.

### Pumps with 6 splines / 540 rpm

This shaft must have an overlap of a minimum of 1/3 of the total length of each half of the sliding sections.

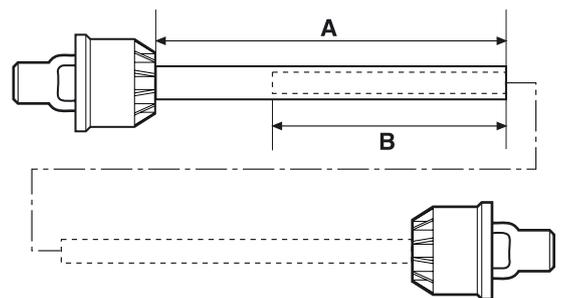
A= Overall shaft length      B= Minimum overlap.



### Pumps with 21 splines / 1000 rpm

This shaft must have an overlap of a minimum of 2/3 of the total length of each half of the sliding sections.

A= Overall shaft length      B= Minimum overlap.



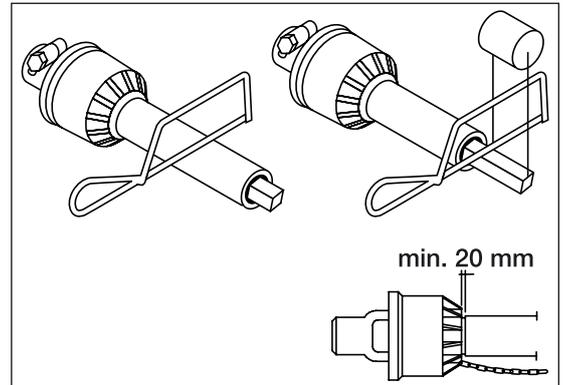
**Attention:** Implement manufacturers specify the minimum overlap required depending on the equipment. (Refer to implement and PTO shaft suppliers literature for details).

## 4 - Sprayer setup

### Modifying the overlap

If the overlap is found to be too great, it is possible that the shaft could bottom out and cause damage to the sprayer. If modification is required, proceed as follows:

1. Remove the shaft and separate the male and female sections.
2. Using a hack-saw or similar remove the total length of the excess from both halves of the shaft equally and file the profiles afterwards to remove any burrs.
3. Carry out a similar procedure for the safety guards.
4. Clean and grease the shaft profiles and assemble the male and female parts being careful to re-assemble the safety guards correctly.
5. Re-fit the shaft to the tractor's PTO and the pump and double check your modified shaft operates within specifications.



### Safety chains

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



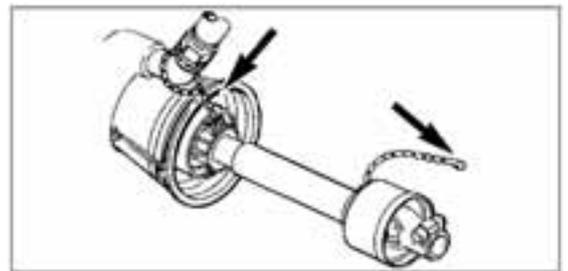
**Attention:** To ensure long life of the transmission shaft, try to avoid working angles greater than 15°.



**Attention:** Upon installation please note that the shaft is marked with a tractor symbol at the female end to indicate the correct orientation.



**Attention:** If the overlap is found to be below the specified minimum the shaft should be replaced with a longer unit and the procedure performed again as above.



**Danger:** Rotating transmission shafts without proper safety shields are Deadly! *Serious injury and deaths have been associated with un-protected PTO transmission Shafts. Never operate a PTO transmission shaft without safety shields.*

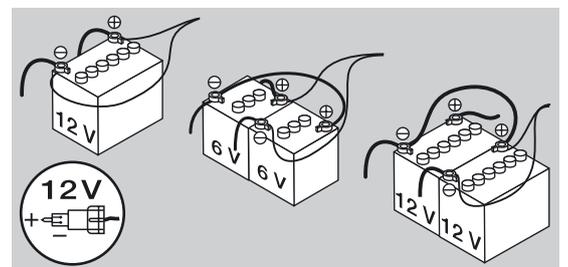
## Electrical connections

### Introduction

The sprayer's electrical system uses 12 volt DC power supplied from the tractor. To connect the sprayer, plug the multiple pin connectors together at the rear of the tractor and secure the cables in the hose bundle support tray allowing enough slack for turns.

### Power supply

The spray controller requires a convenient 12 Volt DC power supply inside the tractor. The controller's supply harness is fitted with a plug which is compatible with most modern tractors however if modification is needed, hard wiring the system into the socket is an acceptable alternative. The supply outlet must be circuit protected by an 8 amp fuse, and directly connected to the tractors battery. It must also have a cross sectional area of at least 4.0 mm to handle the current drawn by the system. It is also important that the tractors battery('s) are arranged in a compatible way and are running the correct polarity (see illustration to the right).



### Connection with optional 12 volt distribution box (p/n 978237)

As mentioned previously, some older model tractors may not have a compatible or convenient 12 v DC power socket in the cab. The optional HARDI 12 volt distribution box (p/n: 978237) is designed for such situations and provides two additional power outlets. It is circuit protected by a 10 amp fuse inside the casing. When installing the unit, remember the following:

**Red wire:** to the Positive terminal of the tractor's battery. **Black wire:** to the Negative terminal of the tractor's battery.

## 4 - Sprayer Set-up

### System Earth and Polarity

The electrical systems of the sprayer are earthed through the wiring harness back to the tractor's battery and therefore a dedicated earth to or for the sprayer's chassis is not required. Generally the HARDI system's internal wiring uses blue wires for negative and brown wires for positive but where this found not to be the case (for example the power supply harness to the spray control box just mentioned) the usual system of black for negative and red for positive is observed.

### Connecting 12 volt power (HC 5500 Controller)

The illustration below shows that the 39 pin data cables (1) and (2) should be routed into the tractors cab and connect to the Spray '2' Control Box (A) and the Hydraulic control box (B).

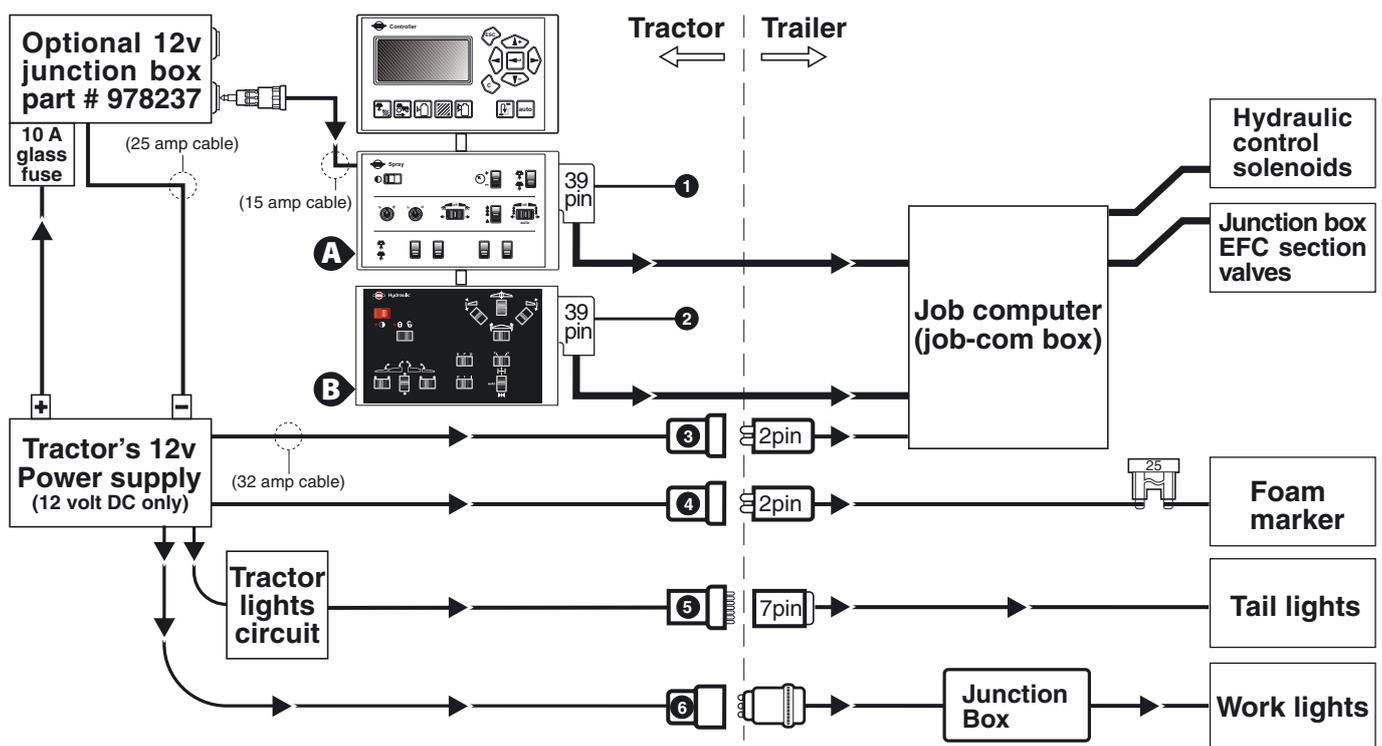
The two pin cable for the Job-com box (3) connects directly to a 12 volt power outlet as does the Foam Marker cable (4).

If optional tail, brake and turning lights (5) are fitted, connect the 7 pin plug to the tractor's 7 pin outlet in the usual fashion.

If optional work lights are fitted connect the 3 pin plug (6) to an auxiliary power outlet fed straight from the tractors battery.

### HC 5500 Controller

The illustration below shows the basic lay out of the HC 5500 Controller's main electrical components and their cables.



### HC 5500 Electrical connections

1. Thirty-nine pin plug from the Spray'2'control box (in the tractor's cab) to the Job-com box.

2.Thirty-nine pin plug from the Hydraulic control box (in the tractor's cab) to the Job-com box.

3. Two pin male/female power cable connector for Job-com box (connects at the draw bar).

4. Two pin male/female power cable connector for Foam Marker (connects at the draw bar).

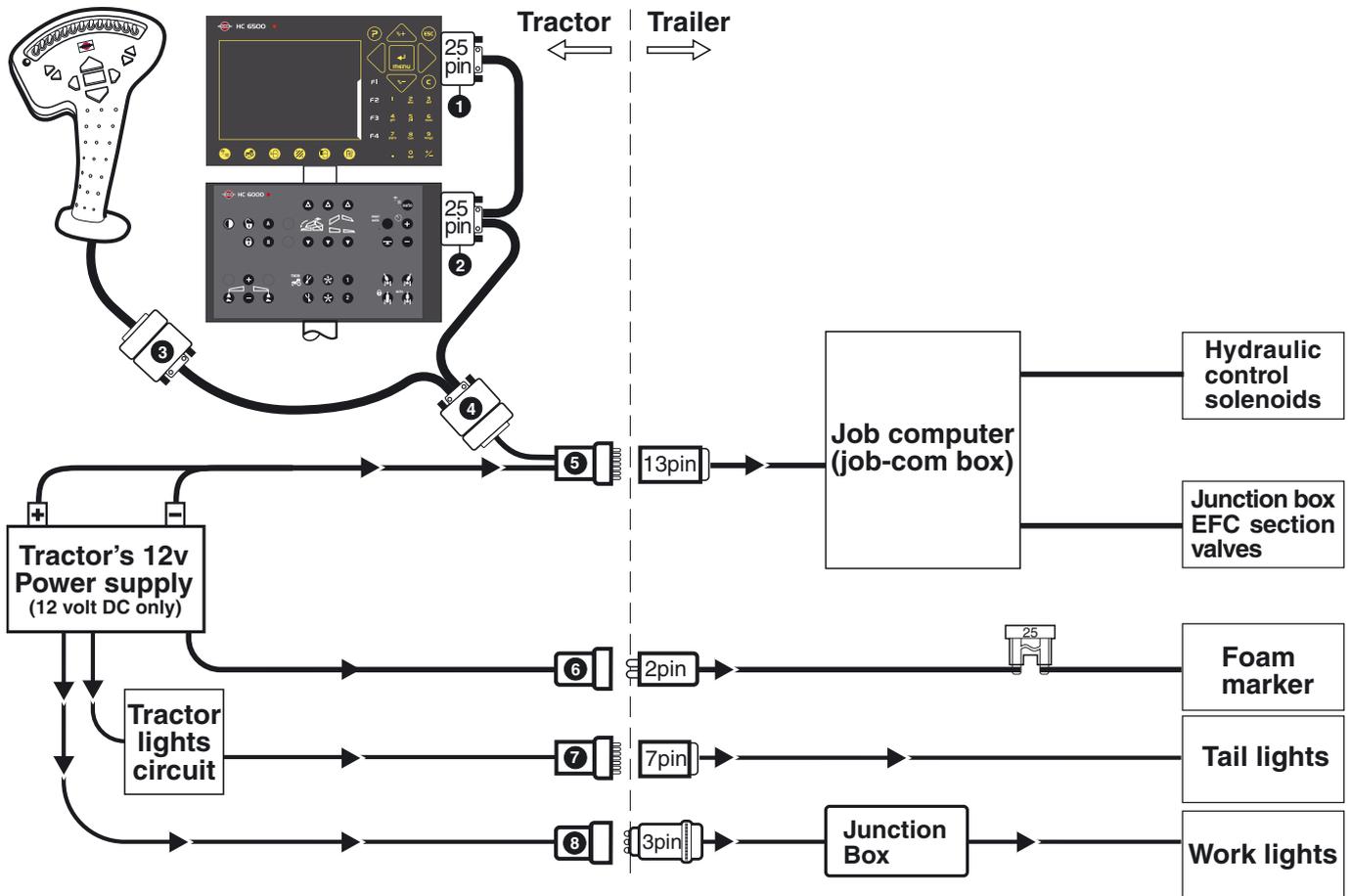
5. Seven pin male/female connector for trailer's stop, turn and tail lights (connects at draw bar).

6. Three pin male/female connector for trailer's work lights (connects at draw bar).

## 4 - Sprayer Set-up

### HC 6500 Controller

The HC 6500 Controller uses a “Daisy chain” type wiring harness to link the control units into one loom. The illustration below shows the basic lay out of the main electrical components and their cables.



### HC 6500 Electrical connections

1. Twenty five pin plug from the HC 6500 Display Terminal (in the tractor's cab) to the HC 6400 Set box.
2. Twenty five pin plug from the HC 6400 Set box (in the tractor's cab) to the Dual/Split Twenty five pin plug.
3. Twenty five pin plug from the HC 6300 Grip (in the tractor's cab) to the Dual/Split Twenty five pin plug.
4. Dual/Split Twenty five pin plug from “Daisy chain” Controller harness to the main supply harness.
5. Thirteen pin male/female Job-com Data/Power plug (connects at the draw bar).
6. Two pin male/female power cable connector for Foam Marker (connects at the draw bar).
7. Seven pin male/female connector for trailer's Tail lights (connects at draw bar).
8. Three pin male/female connector for sprayer's work lights (connects at draw bar).



**Attention:** When diagnosing an electrical problem always check the fuses first. A blown fuse indicates a problem exists in the circuit and should be investigated further for the cause. Never replace fuses with a higher rating than specified.



**Warning:** Never connect the power supply harness for the HARDI system to a starter motor or alternator circuit. *Connection to any source other than directly to the tractors 12 volt DC battery voids warranty.* In cases where the tractor needs electrical attention to fit the control boxes safely, an optional 12 volt power distribution box (p/n 978237) is available through your HARDI dealer.

## 4 - Sprayer Set-up

### Installation of the control unit brackets (HC 5500 and HC 6500)

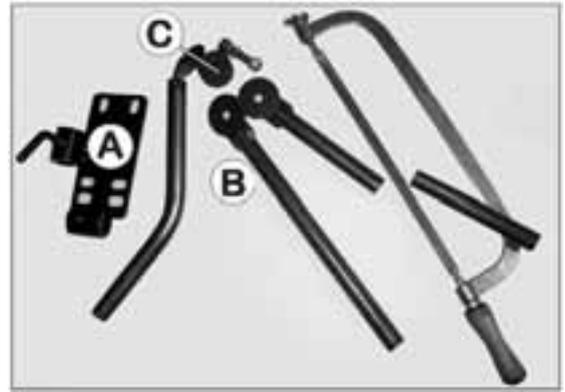
The pillar bracket (A) for mounting the control unit in the tractor cab has a hole spacing of 100mm and 120mm. Check the tractor's instruction manual for important information regarding attachment points.

Three mounting tubes (B) are also supplied. Bend or shorten them as required to do the job and if necessary use all three. A spacer (C) is also supplied to allow further variations. Find the best solution for you and your tractor or vehicle.

Tube (B) has a staggered mounting plate to allow all the control boxes to line up when fitted correctly.

#### Printer

If a printer is being fitted, one of the mounting tubes can be used to support the printer on the same brackets as the controller/terminal.



**Attention:** The controller/terminal should be protected from moisture and removed after use if the tractor has no weather proof cabin.

### Installation of the Hydraulic Control Box / Set Box

The 'tractor pillar bracket' (A) should be mounted securely allowing enough room for the 'Hydraulic control box' (HC 5500) or the 'Set box' (HC 6500) and the 'Spray box 2' (HC 5500) or the 'Display terminal' (HC 6500) to be positioned together.

Find a place in the tractor's cabin where the operator can comfortably see and use the controls without obstructing other control systems in the cab.



### Installation of Spray Box 2 / Display Terminal

For HC 5500 Installation mount the 'Spray box 2' together with the 'Hydraulic control box'.

For HC 6500 Installation mount the 'Display terminal' together with the 6400 'Set box'.

Make sure they are near enough to a 12 volt power source and are secure enough so they will not move, even on rough terrain.

The HC 6300 Grip mounts on a separate bracket assembly supplied in the kit and should be positioned in such a manner that it is comfortably in reach of the operator. Contact your HARDI Service Centre if unsure.



**Attention:** An extension cable is available as an option if the Hydraulics control unit is to be placed further away from the EFC control unit. (Ref. no. 261933)

## 4 - Sprayer setup

### Speed sensor (HC 5500 and HC 6500)

The speed sensor (A) is an inductive type and requires a metallic protrusion like a bolt head to trigger the signal. In this case a slotted ring (B) mounted on the inside of the wheel rim is used.

The recommended distance (or 'air-gap') between the sensor and the slotted ring is 3 to 5 mm.

The air-gap can be adjusted if necessary by:

- 1) Loosen the bolt and nut holding the sensor mounting bracket (C).
- 2) Find something 3 to 5mm thick to use as a gauge and check that the clearance is within specification.
- 3) Re-tension the bolt and nut and re-check your adjustment.



**Attention:** A speed switch harness (D) and extension cable are needed to connect the speed sensor to the Controller / Terminal.

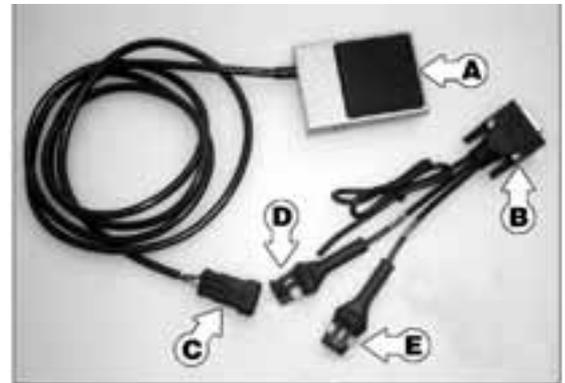


### Foot pedal remote ON/OFF (optional on HC 5500 and HC 6500)

The optional foot pedal (A) is a remote ON / OFF switch designed to provide the operator further control from the tractors cab.

#### Installation

1. Plug the dual wiring harness (B) into the back of the HC 5500 or HC 6500 controller display terminal and tighten the screws.
2. Secure the foot pedal in a convenient place in the tractors cabin and plug its cable (C) into the matching socket on the controller's dual wiring harness (D) (both plugs are marked for clear identification).
3. Connect the second plug (E) to the sprayers speed sensor cable.



**Attention:** The ON/OFF switch on the HC 6300 Grip, over-rides all remote switches. It must be set to ON for the remote foot pedal to function. The foot switch also needs to be activated via the controller's extended menu. Please remind your HARDI representative to do this for you upon delivery of your sprayer.

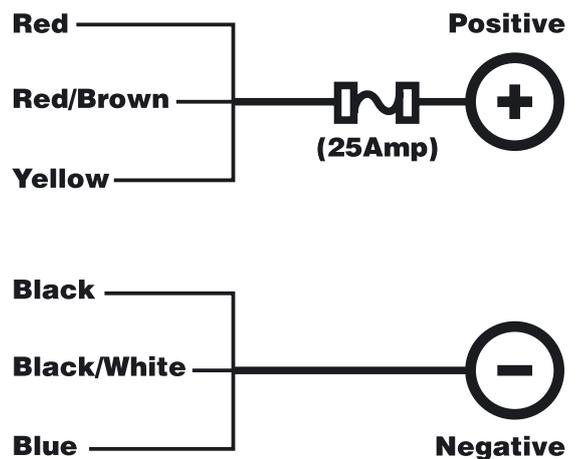
### Mounting the HC 6500 power harness

The HC 6500 controller is powered by a wiring harness (supplied) which must be installed **directly to the tractors battery**.

The illustration to the right shows the correct position for each of the individual cables which make up the power supply harness.

The HC 6500 system is earthed internally, directly back to the tractors Negative battery terminal, **so no other earth is needed** for the sprayer. To install the power supply harness:

1. Rout the harness safely to the tractors battery and secure in place.
2. Remove the 25 Amp fuse (*supplied*) from its casing and connect the fuse cable directly to the positive pole of the battery.
3. Connect the Positive wires from the controllers harness to the other end of the fuse holder.
4. Connect the Negative wires from the power supply harness directly to the Negative terminal of the battery.
5. Re-install the fuse into its casing.



**Warning:** The HC 6500 system is earthed through the wiring harness directly back to the tractor's battery. **DO NOT** connect the system to any other earth. The power supply (Positive) must be connected directly to the Positive terminal of the battery. Do not connect to any other circuit (where power fluctuations could damage the controllers circuits). Failure to observe this warning could result in damage to the controller and void Warrantee.

## 4 - Sprayer setup

### System start-up (HC 5500)

When connecting the 39 pin plug from the sprayer, note the wire lock clip (A) clicks in place to secure the plug in the socket.

When disconnecting the plug, the wire lock clip must be pushed back before the plug is pulled out. After connecting the plugs:

- 1) Turn on the power at the Spray Box.
- 2) The model, software version number, number of boom sections and boom size are displayed briefly.
- 3) At initial start up, the controller also prompts you to input the time and date. (Remember, you must set the clock to activate the work register). Press  to continue.



**Attention:** At first start-up the clock must be set. See “Menu 2.4 Set clock” in the HC 5500 Operators manual.

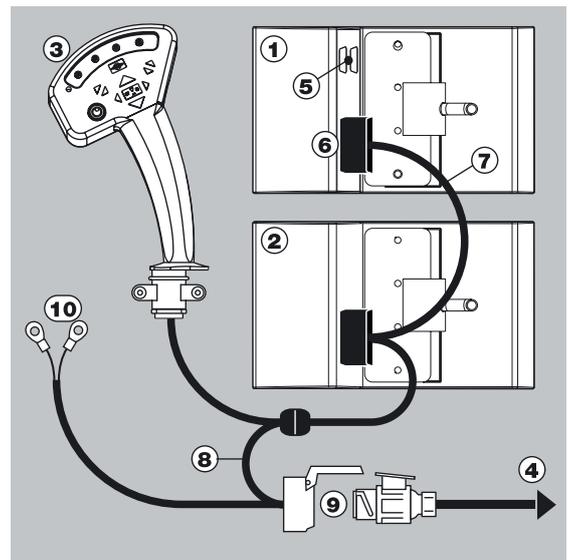
### HC 5500 System calibration

Now the system is installed and powered up, this is as far as we go in this publication. Complete and detailed instructions on set-up, calibration and operation continue in the HC 5500 Operators Instruction Manual P/No: 67000400 supplied with your sprayer.

### System start-up (HC6500)

When connecting the HC 6500 Display terminal, Set box and Grip make sure the anchoring screws on the 25 pin Data cable connections are done up tight.

1. Terminal HC 6500.
2. SetBox HC 6400.
3. Grip HC 6300.
4. To Jobcom HC 6050 on sprayer.
5. Printer connection DB 9 COM1/COM2 port.
6. DB 15 tractor sensor input.
7. DB 25 connector with power and CAN communication.
8. Tractor harness.
9. Connector for tractor to Jobcom HC 6050.
10. Power from tractor battery with a 25 amp fuse.



After connecting the plugs etc:

- 1) Turn on the power at the 6400 Set Box. You will see the New COMMANDER logo displayed briefly on the screen.
- 2) At initial start up, the controller will prompt you to input the time and date. Remember, you must set the clock to activate the work register (see “Menu 2.4 Set clock” in the HC 6500 Operators manual).
- 3) Press  to continue.

### HC 6500 System calibration

Now the system is installed and powered up, this is as far as we go in this publication. Complete and detailed instructions on set-up, calibration and operation continue in the HC 6500 Operators Instruction Manual P/No: 67026204 supplied with your sprayer.

## 4 - Sprayer Set-up

### Potentiometer connection (5000 and 7000 safe track models only)

Connect the potentiometer (A) to the tractor (B) via the 2 springs (C). In order to ensure a high level of precision, fit the springs so they are horizontal and parallel to one another.

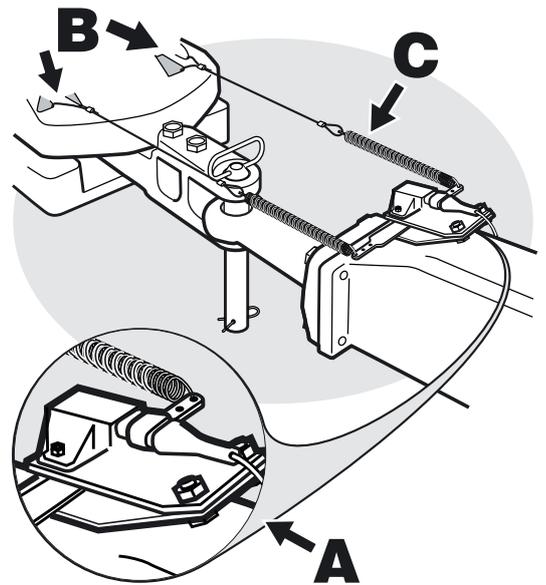
Make sure also they are fitted with even tension, so that the potentiometer returns to the neutral (centre) position when the sprayer is aligned perfectly behind the tractor.



**Attention:** Make sure that enough tension is on the springs to prevent them from oscillating or bouncing when the sprayer is in motion.



**Attention:** For further set-up instructions and calibration of the Safe Track system please refer to the HC 5500 or the HC 6500 operators manual supplied with your sprayer



### Road safety kit (optional)

Connect the plug for the rear lights to the tractor's 7-pin socket, and check the function of the rear lights, stop lights and direction indicators on both sides before driving. (Complies with ISO 1724, see section in "Technical specifications" for further details).

## Look Ahead liquid system

### Introduction

The LookAhead pressure regulation system is a feature of both the HC 5500 and HC 6500 controllers and uses input signals from the Flow and Speed sensors plus information entered by the operator (ie: nozzle size) to calculate and maintain the programmed chemical application rate under a range of forward speeds in the same gear, and is constantly active, even when not spraying.

The correct valve settings are calculated and recorded so when spraying re-commences the programmed application rate is quickly reached.

The intelligent HARDI LookAhead system records the pressure valve position in relation to application rate and speed. The system recalls previous valve settings and uses this information the next time a similar condition occurs.

### Calibration

Set-up of the LookAhead liquid system involves a calibration procedure which is covered in detail in the HC 5500 and HC 6500 operators manual supplied with your sprayer.

## Hydraulic systems

### General info

Ensure that the snap couplers are clean before connection, and after operating the boom for the first time check tractor's hydraulic oil level and top up if necessary.



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



**Danger:** 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.

### Hydraulic Requirements

The sprayer's hydraulic system requires a double acting hydraulic outlet (hydraulic hoses are clearly marked to indicate the direction of oil flow). Also, the hydraulic system requires an oil flow of between 10 and 40 l/min (10.56 Imp. gal/min Maximum) and a minimum pressure of 170 bar (2466 p.s.i.)

## 4 - Sprayer Set-up

### Connecting the hydraulics

Make sure the hydraulic snap couplings are clean and dry taking care to connect the correct hoses to "Pressure" and "Tank" (the hoses are clearly marked for positive identification).

The size and number of hydraulic hoses to connect depends on the optional equipment fitted to the sprayer. To assist in identifying the right hoses they have been tagged with colour coded "Zip-ties" corresponding to the legend in the following table.



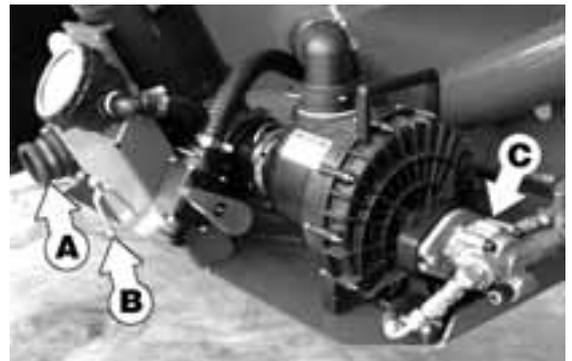
**Attention:** The hydraulic jack on 7000 and 9000 models is powered by a single 1/4" hose and is identified by having no coloured tag.

Function	Activation	Operation	Hose size	Tag colour	Hook up	
					A	B
SPB/SPC Direct Hydraulics	Tractor Remote Control	Lift/Lower	3/8	Green	Lift/Lower	Lift/Lower
	Tractor Remote Control	Fold	1/4	Yellow	Fold-Unfold	Fold-Unfold
SPB/SPC Electric over Hydraulics	Switch Box Control	All	3/4"	Green	Pressure	Tank (Return)
FTZ	Switch Box Control	All	3/4"	Green	Pressure	Tank (Return)
HAZ Twin	Switch Box Control	All	3/4"	Green	Pressure	Tank (Return)
<b>Options</b>						
Hydraulic Jack	Tractor Remote Control	Lift/Lower	1/4	None	Single Line	-
463 Pump Hydraulic Drive	Tractor Remote Control	Pump Drive	1/2	Red	Pressure	Tank (Return)
Flex Capacity Pump	Tractor Remote Control	Pump Drive	1/2	Blue	Pressure	Tank (Return)
Banjo Filling Pump	Tractor Remote Control	Pump Drive	1/2	White	Pressure	Tank (Return)

### Banjo Fast Fill

#### (white zip-tags)

The Banjo Fast Fill system uses a high capacity Centrifugal pump, driven by a hydraulic powered motor (C). A suction hose (from the water source) is fitted to the Cam-lock coupling (A) and the pump speed can be controlled by an adjustable hydraulic by-pass valve (B). The fill rate can also be adjusted by means of the main ball valve (just in-board of the Cam-lock coupling).



#### Set-up

- 1: Stop the tractor's engine, apply the hand brake, remove the ignition key and observe the safety warnings at the front of this section.
- 2: Standing at the drawbar, locate the hydraulic hoses for the Banjo pump motor (*identified with white zip-tags*).
- 3: Note the pressure line (P) (1 zip-tag) and the return line (T) (2 zip-tags).
- 4: Connect the hoses to a spare auxiliary hydraulic outlet on the tractor.
- 5: Secure the hoses to the hose bundle support bracket with zip ties allowing enough slack for turns.
- 6: Run the pump motor briefly and check for hydraulic leaks and correct operation.



**Warning:** Incorrectly fitting hydraulic lines can reduce component life and adversely affect sprayer performance. The hydraulic hoses are clearly marked "Pressure" and "Return" for positive identification. The tank return line (T) is fitted with a check valve positioned so the *spring and ball symbol* is facing away from the tractor as shown in the illustration above.

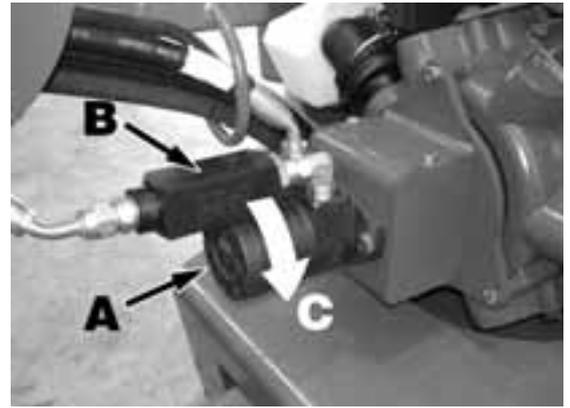
### Hydraulic drive for Main pump (optional) (red zip-tags)

The optional hydraulic drive motor (A) mounts via an adaptor plate directly onto the front of 540 rpm 463 positive displacement pumps. The system is fitted with a Speed Limiting Valve (B) to control pump speed.

Note the correct direction of rotation (C) is clock-wise when viewing the motor with your back to the tractor.

#### Set-up

- 1: Stop the tractor's engine, apply the hand brake, remove the ignition key and observe the safety warnings at the front of this section.
- 2: Standing at the drawbar, locate the hydraulic hoses for the Main fluid pump drive motor (*identified with Red zip-tags*).
- 3: Note the pressure line (P) (1 zip-tag) and the return line (T) (2 zip-tags).
- 4: Connect the hoses to a spare auxiliary hydraulic outlet on the tractor.
- 5: Secure the hoses to the hose bundle support bracket with zip ties allowing enough slack for turns.
- 6: Run the pump motor briefly and check for hydraulic leaks and correct direction of rotation.



#### Hydraulic drive motor specifications:

Oil flow to rpm ratio: 45 litres per minute / 540 rpm.



**Warning:** Incorrectly fitting hydraulic lines can reduce component life and adversely affect sprayer performance. The hydraulic hoses are clearly marked "Pressure" and "Return" for positive identification. The tank return line (T) is fitted with a check valve positioned so the *spring and ball symbol* is facing away from the tractor as shown in the illustration above.



**Attention:** Optional Hydraulic Drive is not available for 1000 RPM pumps or HAZ Twin Force Boom models. Also the HARDI-MATIC pressure control function does not operate with optional hydraulic drive.

### FlexCapacity pump (blue zip-tags)

The FlexCapacity pump is not available for 5000 Litre models, but is optional for the 7000 Litre and standard on the 9000 Litre model.

#### Set-up

- 1: Stop the tractor's engine, apply the hand brake, remove the ignition key and observe the safety warnings at the front of this section.
- 2: Standing at the drawbar, locate the hydraulic hoses for the FlexCapacity pump drive motor (*identified with Blue zip-tags*).
- 3: Note the pressure line (P) (1 zip-tag) and the return line (T) (2 zip-tags).
- 4: Connect the hoses to a spare auxiliary hydraulic outlet on the tractor.
- 5: Secure the hoses to the hose bundle support bracket with zip ties allowing enough slack for turns.
- 6: Run the pump motor briefly and check for hydraulic leaks and correct operation.



#### Hydraulic drive motor specifications:

-Oil flow to rpm ratio: 45 litres per minute / 540 rpm.

#### FlexCapacity system specifications:

	Pump Volume (0 bar)	Agitation Volume	Spray Volume (3 bar)
All flow directed to boom:	552 L/min	0 L/min	504 L/min
Maximum agitation:	552 L/min	200 L/min	304 L/min



**Warning:** Incorrectly fitting hydraulic lines can reduce component life and adversely affect sprayer performance. The hydraulic hoses are clearly marked "Pressure" and "Return" for positive identification. The tank return line (T) is fitted with a check valve positioned so the *spring and ball symbol* is facing away from the tractor as shown in the illustration above.

## 4 - Sprayer Set-up

### Bypass block set-up

The optional hydraulic bypass block can be fitted toward the front of the chassis and allows the operator to select a hydraulic setting which suits his tractor's hydraulic configuration.

Item	1	2	3
Open Centre	Out	Out	Not Connected
Closed Centre	In	In	Not Connected
Closed with Load Sense	In	Out	Connected

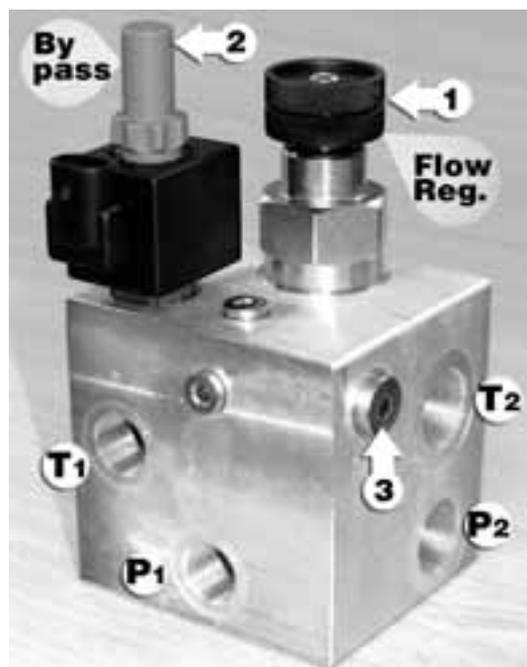
**T1:** Return from Paralift or Steering

**P1:** Pressure to Paralift or Steering

**T2:** Tank (return to tractor)

**P2:** Pressure (from tractor)

**3:** Load sensor line



**Attention:** To change the bypass setting, un-screw the dust cap (2). Push and turn the bayonet screw with your thumb. Replace cap.



**Attention:** To enable load sensing to function the tractor's L/S line must be connected to item (3) in the illustration.

### Jacking up the sprayer

To raise the sprayer place a suitable jack under the axle as shown (A), and immediately place a safety stand of suitable strength under the axle before attempting service.



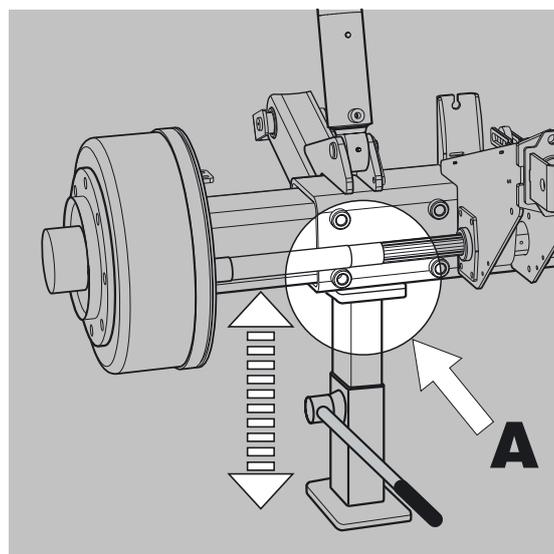
**Danger:** Place the sprayer on a solid and level surface to minimise risk of the sprayer falling and observe the following precautions:

Always use wheel chocks.

Always use Jack safety stands.

Always ensure safety equipment complies with government design rules and regulations and is of a suitable load bearing capacity.

If you lack adequate service equipment and facilities or are in any doubt, leave the job to your HARDI dealer or another suitably equipped workshop. See further warnings in the maintenance section of this manual before attempting any service procedures.



### Altering the track width

To alter the track width of the New Commander proceed as follows:

1. Measure the current track width (centre RH tyre to centre LH tyre). Each side must be extended or retracted half the desired alteration.

2. Attach the sprayer to the tractor and engage the parking brake.

3. Place stop wedges in front of and behind the RH wheel. Jack up the LH wheel and support with safety stands.

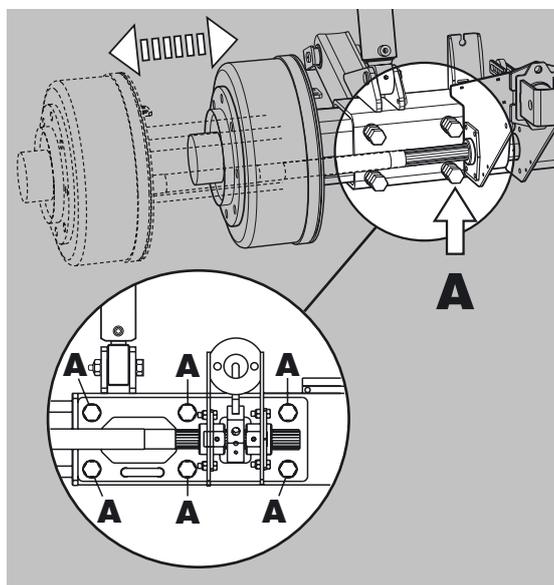
4. Loosen bolts (A) for LH wheel axle.

5. Using a sack truck and a suitable lever, extend or retract the axle.

6. Tighten the clamp bolts (A) to:     5000 and 7000: 370 Nm (270 'lb)  
  9000:             640 Nm (470'lb)

7. Repeat the procedure on RH wheel.

8. Check the distance on each side is even by measuring from the centre of each tyre to the centre of the chassis and after 8 hours of operation, retention bolts (A) and the wheel nuts.



## 4 - Sprayer Set-up

### Maximum and Minimum track widths and optional axles and Mudguard's

Model	Wheel Size	Short Axle 1.5-2.0 m	Standard axle 1.8-2.25 m	Standard fixed 3m	Mudguard's Optional	Clearance under axle
5000	12.4x46"	1500.2000 mm	1800-2250 mm	3000 mm	Narrow	705 mm
5000	18.4x38"	N/A	1800-2250 mm	3000 mm	Medium	675 mm
7000	20.8x38"	N/A	1800-2250 mm	3000 mm	Medium	695 mm
9000	710x70x42	N/A	2200-3000 mm	3000 mm	Wide	850 mm

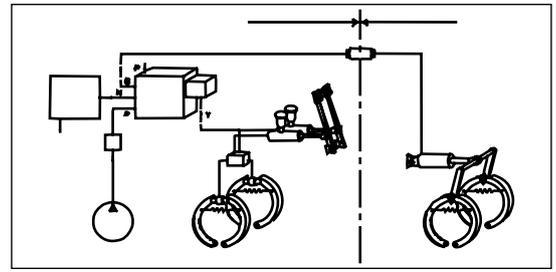
### Further track width adjustment

In addition to the adjustments described in the previous paragraph, the trailers track width can be further adjusted by reversing the steel wheel rims to obtain a variation in offset as follows:

5000 and 7000:	100mm per side	200mm overall
9000:	200mm per side	400mm overall
<b>Optional Mudguards:</b>	Medium = 620 mm	Wide = 790 mm

### Hydraulic activated brakes (optional equipment)

The trailers hydraulic brakes require a trailer brake proportioning valve fitted to the tractor's hydraulic brake system. Connect the quick coupler to the tractor's trailer brake outlet. When the tractor brakes are applied, the trailer brakes will work proportionally to the tractor brakes, and ensure safe and effective braking.



**Warning!** Do not connect the sprayer's brakes directly to the tractor's hydraulic braking circuit without first checking the tractor is equipped with a **TRAILER BRAKE PROPORTIONING VALVE!** Poor braking control will result causing a dangerous situation and potential injury.



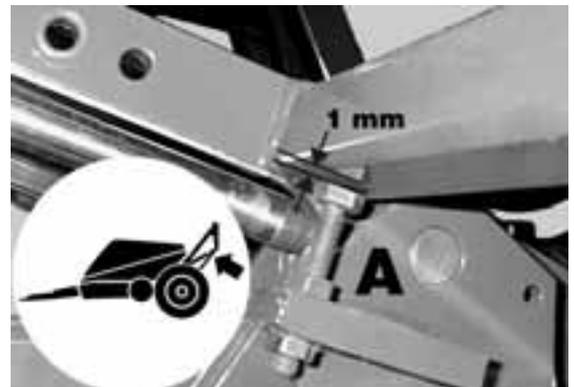
**WARNING!** Maximum fluid pressure is 120 bar (2175 p.s.i.) in the brake line

### Paralift transport lock

The transport position can be set independently to obtain different transport heights.

To change position:

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



**ATTENTION!** Always use both bolts to assemble the lock. The setting must be identical on both sides. Also ensure the rear settings correspond to the front settings so the boom is resting evenly front and rear.

## 5 - Operation

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### Safety

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#### Safety precautions - Operating the Boom



**Attention:** For detailed information on Safety, Set-up, Operation and Maintenance specific to your boom configuration please see the individual "Boom Operators Manual" supplied with your sprayer's documentation.



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



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



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



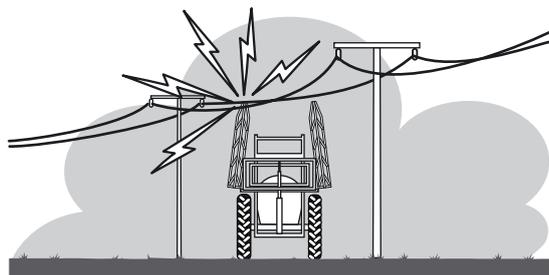
**Danger!** Never use the folding/unfolding functions in areas with overhead power lines. Un-intentional boom movements can cause contact with overhead power lines.



**Attention:** Refer to section 2 of this manual for a diagram of typical power line structures in South Australia and recommended safe working clearances for implements.



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



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#### Safety precautions - Crop protection chemicals



**Warning:** Crop protection chemicals can be dangerous. Always wear correct protective clothing before handling chemicals. For further information on chemical safety see the safety section (sect.2) at the front of this manual.

#### Personal protection

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

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



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



**Warning:** Always have clean water available, especially when filling the sprayer with the chemical.



**Warning:** Always clean the sprayer carefully and immediately after use.



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



**Warning:** Always clean the sprayer before changing to another chemical.

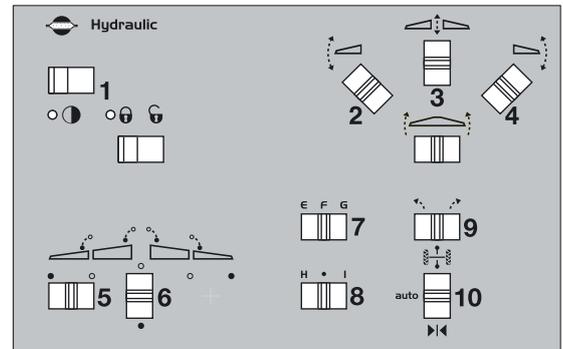
## FTZ FORCE Boom control



**Attention:** The following information is intended as a general guide only. For detailed Safety, Set-up, Operation and Maintenance information for your specific boom configuration please refer to your individual Boom Operators Manual supplied with your sprayer under P/N: 67020704.

The switches on the hydraulic control box control the following functions:

1. Power ON/OFF
2. Boom tilt left
3. Boom lift raise/lower
4. Boom tilt right
5. Boom outer folding (both sides)
6. Boom inner folding (both sides)
7. Optional function
8. Optional function
9. Manual track control (left/right) (optional)
10. Track control auto (manual/auto/lock) (optional)



### Unfolding procedure

To unfold the boom, do the following:

1. Push switch (3) upwards to lift the boom clear of the transport brackets.
2. Push switch (6) downward to unfold the inner sections. Rear transport hooks disengage automatically.
3. Push switches (2) and (4) downward to lower individual tilt rams.
4. Push switch (5) to the left to unfold outer sections.
5. Push switch (3) downward to lower the boom to correct height above crop or ground level.

### Folding procedure

The folding procedure is the reverse of unfolding.



**Warning:** Ensure that the boom is clear from the transport brackets before unfolding.



**Warning:** The folding functions (switches 5 and 6) must only be operated when the sprayer is stationary! Failure to do so will damage the boom.



**Attention:** For detailed set up and operation information for closed centre hydraulic systems please refer to your individual Boom Operators Manual supplied with your sprayer.



**Attention:** The boom cannot be operated with the tractor's hydraulic levers.

### Boom tilt function

The boom tilt function controls (2) and (4) enables you to adjust the boom height individually (right and left-hand side).

# 5 - Operation

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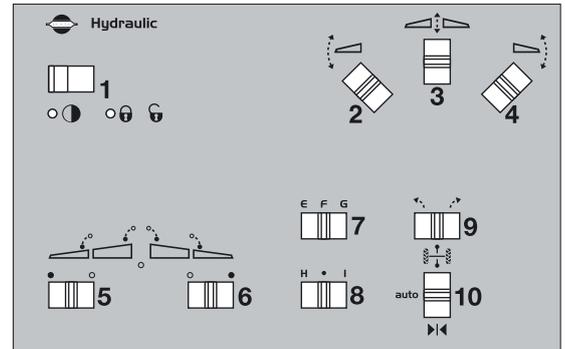
## EAGLE Boom control



**Attention:** The following information is intended as a general guide only. For detailed Safety, Set-up, Operation and Maintenance information for your specific boom configuration please refer to your individual Boom Operators Manual supplied with your sprayer under P/N: 67022304.

The switches on the hydraulic control box control the following functions:

1. Power ON/OFF
2. Boom tilt left
3. Boom lift raise/lower
4. Boom tilt right
5. Boom outer folding (both sides)
6. Boom inner folding (both sides)
7. Optional function
8. Optional function
9. Manual track control (left/right) (optional)
10. Track control auto (manual/auto/lock) (optional)



### Unfolding procedure

To unfold the boom, do the following:

1. Push switch (3) upwards to lift the boom clear of the transport brackets.
2. Push switches (5) and (6) toward the Left to unfold the wings. Rear transport hooks disengage automatically.
3. Push switches (2) and (4) downward to lower individual tilt rams.
4. Push switch (3) downward to lower the boom to the correct height above the ground or crop level.

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### Folding procedure

The folding procedure is the reverse of unfolding.



**Warning:** Ensure that the boom is clear from the transport brackets before unfolding.



**Warning:** The folding functions (switches 5 and 6) must only be operated when the sprayer is stationary! Failure to do so will damage the boom.



**Attention:** For detailed set up and operation information for closed centre hydraulic systems please refer to your individual Boom Operators Manual supplied with your sprayer.



**Attention:** The boom cannot be operated with the tractor's hydraulic levers.

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### Boom tilt function (optional on Eagle booms)

The boom tilt function controls (2) and (4) enables you to adjust the boom height individually (right and left-hand side).

### Alternative boom width

In some cases it is possible to spray at half the normal working width by operating the sprayer with the boom in the half folded position. To do this, unfold the inner sections only by pressing switch (6) downward. Remember to turn off the outer section valves on the spray control box.



**Attention:** 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 support wheels (Optional)

The boom may be equipped with two optional "air suspended boom support wheels". When spraying with the boom set low, for example on bare ground or plants in the first stages of growth, it is recommended to fold down the support wheels. In later growth stages the wheels should remain in the transport position (please see the individual boom Operators Manual supplied with your sprayer's documentation for further details).



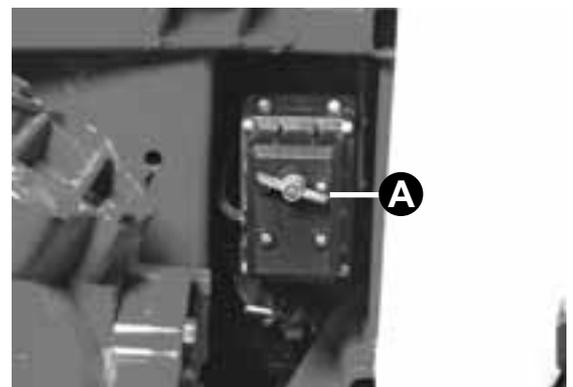
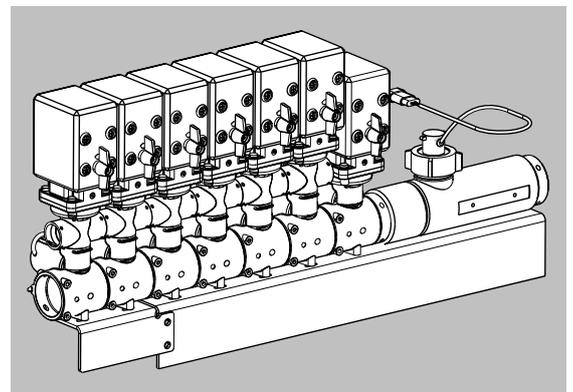
**Attention:** When driving on public roads the support wheels should be folded up and secured in order to keep the machine overall width according to the regulations!

### Adjustment of EFC operating unit

Before spraying, the EFC operating unit must be adjusted using clean water (without chemicals).

To adjust the EFC operating unit:

1. Select the correct nozzle for the spray job by rotating the TRIPLET nozzle bodies, and make sure that all the nozzles are the same type and capacity. See the "Spray Technique" book for further details.
2. Set the valves to the spraying position and activate the power via the spray control box "ON/OFF" switch.
3. Switch on the section valves.
4. From the tractor cab observe the emergency handle (A) on the front of the EFC pressure control valve (located just under the front of the working platform).
5. Set the system to minimum pressure by operating the pressure switch on the "Spray Control Box" until the emergency handle (A) on the EFC pressure control valve stops rotating.
6. Put the tractor in neutral and engage the hand brake.
7. Engage the PTO and set the speed to the number of revs you intend to run whilst spraying. Remember the number of revolutions on the P.T.O. must be kept between 300-600 rpm (for 540 rpm pumps or 650-1100 rpm for 1000 rpm pumps).
8. Adjust the system pressure via the pressure switch on the spray control box until the required pressure is shown on the pressure gauge.

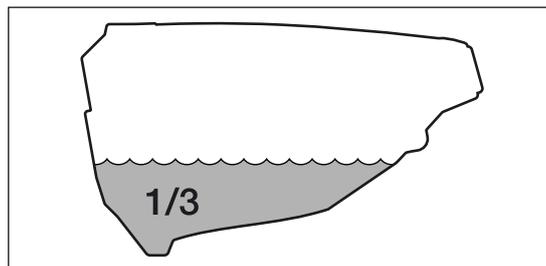


## 5 - Operation

### LookAhead Liquid system

#### Filling of water

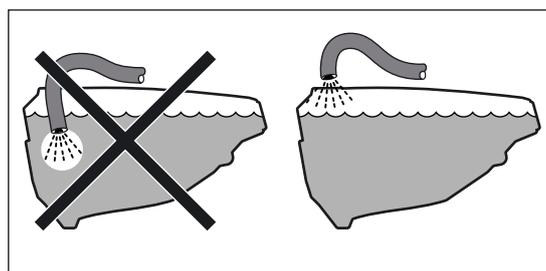
The tank should normally be filled 1/3 with water before adding chemicals. Always follow the instructions on the chemical label.



**Warning:** If the sprayer is put aside with liquid in the main tank all MANIFOLD valves must be closed.

#### Filling the Main Tank through the tank lid

It is not a recommended practice, however in the absence of a suitable alternative the sprayer may be filled through the main tank lid opening, located toward the front of the main tank. Access is possible from the working platform. It is always good practice to use water from the cleanest source possible for spraying. Always use the strainer basket (located under the lid) to prevent debris from entering the tank and causing problems with blocked nozzles etc. An overhead storage tank can be used to obtain a high filling capacity if desired.



**Attention:** Filling via the tank lid is not a recommended practice. It is preferable to use one of the optional filling systems out-lined in this section. Discuss your options with your HARDI dealer.

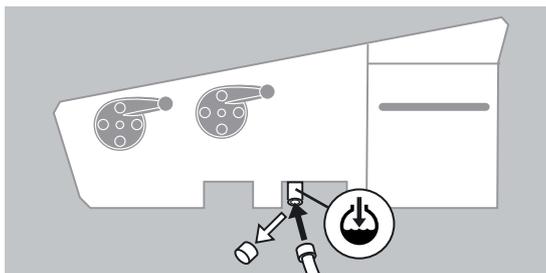


**Warning:** Due to the risk of chemical being siphoned back and contaminating the water source, never allow the the filling hose to enter the tank opening. Direct the flow of water into the tank opening manually for best results.

#### Filling the Rinse tank

The rinse tank is located at the rear end of the sprayer and is filled via the 1.5 inch quick coupler on the left side of the sprayer. To fill the rinse tank proceed as follows:

1. Fit the external water hose to the quick coupler on the sprayer.
2. Engage external water pump, if any.
3. Keep an eye on the level indicator situated on the platform.
4. Stop filling and replace the cover.



#### Capacity of Rinse tanks:

5000 and 7000 models:.....500 litres.

9000 models:.....740 litres.



**Attention:** Only fill the rinse tank with clean water. To avoid algae developing, always drain the rinse tank if the sprayer is not in use for an extended period of time.



**Attention:** For cleaning purposes etc. the rinse tank is accessible via the tank lid on the top of the tank.

### Filling the clean water tank

A clean water tank for hand washing is fitted above the valve manifold and may be accessed for filling from the working platform.

To fill the clean water tank:

- 1) Remove the lid and fill with clean water.
- 2) Replace the lid.

The clean water is accessible via the ball valve tap located just below the safety locker on the left side of the sprayer.

Clean water tank capacity: .....25 litres.



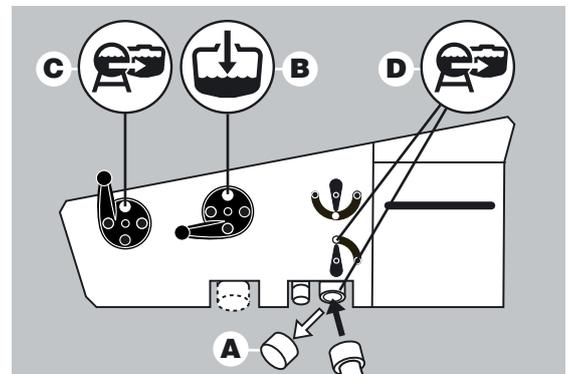
**Warning:** The clean water tank is for washing hands and cleaning blocked nozzles only. Never drink from this, or any other tank. Chemical contamination poses a serious health risk. If poisoning occurs note the chemical(s) involved and seek medical advice immediately.

### Optional Filling Systems

#### Fast Fill System

The “Fast Fill” option uses a venturi system (powered by a standard HARDI 463 pump) to draw water directly from an external source.

1. Remove the cover from the aluminium Quick coupler (A) and connect a suction hose with the other end connected to an external source.
2. Set the Pressure Smart Valve to the Main tank (B) and the Suction SmartValve towards the External tank icon (C) as illustrated.
3. With the P.T.O. at 540 r/min (or 1000 r/min depending on the pump model) engage the External suction valve (D) to fill the tank.
4. Keep an eye on the main tank level indicator to prevent over filling.
5. To stop filling close the external suction valve, disconnect the suction hose and replace the quick coupling dust cover.

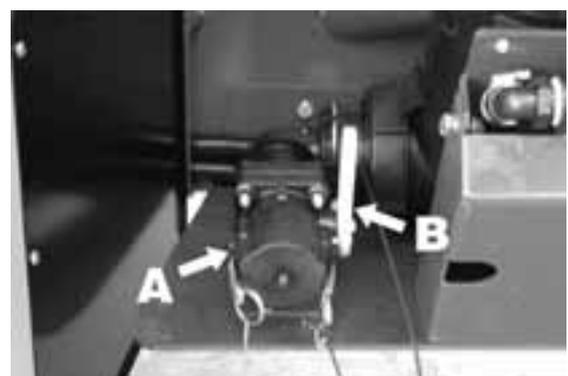


**Attention:** The Fast Fill circuit does not include a filter or strainer! It is highly recommended you use a remote in line filter (available from your HARDI dealer) to remove any debris and impurities.

#### Quick Fill System

The filtered “Quick fill” option allows the operator to fill the sprayer from an external water source (such as a dam or tank) using an auxiliary pump. The system includes a Cam-Lock coupling on the inlet and a high capacity in line filter. The operator can also control the speed at which filling takes place by adjusting the source valve on the sprayer.

1. Remove the cover from the Cam-Lock coupling (A) and connect a hose being fed from an auxiliary pump and external water source.
2. Run the auxiliary pump and engage the Quick-Fill ball valve (B) to fill.
3. Watch the tank level indicator closely to prevent over filling.
4. To stop filling close the Quick-Fill ball valve (B), turn off the pump, disconnect the hose and replace the Cam-lock coupling dust cover.



**Attention:** The optional flow meter is only available on sprayers with the “Quick-Fill” system and is not offered on machines with venturi or Banjo pump fast fill systems.



**Warning:** Do not leave the sprayer while filling the tank and watch the level indicator closely to prevent over filling..



**Attention:** Due to risk of contamination it is prohibited in some areas to fill a sprayer from open water ways such as lakes and rivers etc. Contact your local authorities for information about laws specific to your area.

# 5 - Operation

## Optional Filling Systems continued

### Banjo Fast Fill System

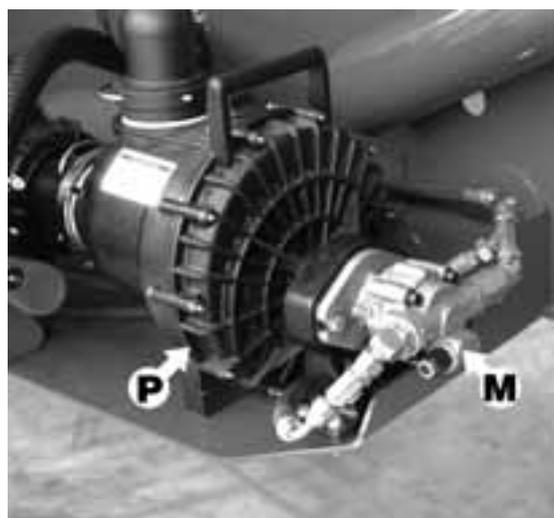
The Banjo Fast Fill system employs a high capacity centrifugal pump (P) driven by a hydraulic drive motor (M). The motor is powered by the tractor's auxiliary hydraulics and is speed limited by a hydraulic burst valve.

The operator can control the flow rate of the pump by use of a variable speed control valve (D) located on a panel just forward of the pump.

### Banjo pump fluid capacity:

5000 Litre models:	(Pump, filter and coupling = 2.0")
.....	5-600 Litres per minute
7 and 9000 Litre models:	(Pump, filter and coupling = 3.0")
.....	7-800 Litres per minute

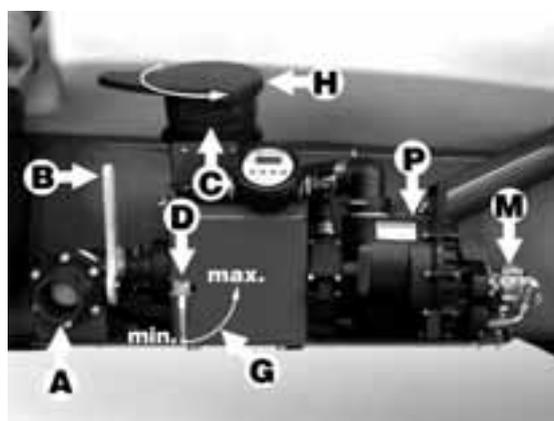
 **Attention:** Do not attempt to run the pump over the recommended Maximum speed.



### Operation

To fill the sprayer using the 'Banjo' fast fill system:

- 1) Park the tractor and sprayer on a level surface, select neutral gear, apply the hand brake and engage the auxiliary hydraulics.
- 2) Remove the cover from the Cam-lock coupling (A) and connect a suction hose to a water source.
- 3) Open the ball valve (B) and gradually engage the hydraulic speed control valve (D) until the desired flow rate is achieved (G).
- 4) When filling is complete dis-engage the hydraulic speed control (D) and close the ball valve (B).
- 5) remove the suction hose and replace the cam-lock cap (A).



### Banjo Fast Fill Filter (7000 and 9000 models only)

Two types of high capacity filters are used (C) for the fast fill circuit:

5000 Model.....	Arag 2"
7000 and 9000 Models.....	HARDI Easy-Clean 3"

### Cleaning the Filter

- 1) Dis-engage the Hydraulic Speed Control valve.
- 2) Shut down the sprayer and the tractor's auxiliary hydraulics. Close the Fast Fill Cam-lock coupling ball valve.
- 3) Turn the filter casing lid (H) anti-clockwise to separate the lid and filter screen from the casing (C). Note: a built in isolation valve automatically closes when the filter lid and screen are removed.
- 4) Clean the filter screen and re-assemble.



 **Attention:** 5000 Litre models have an Arag filter assembly which *does not* incorporate an isolation valve and therefore it is necessary to empty the main tank before cleaning the filter.

 **Attention:** Never leave the sprayer un-attended while filling. Always watch the Main tank sight gauge to avoid over filling the tank.

 **Attention:** It is recommended the filter be cleaned and serviced thoroughly after each spray job, before storage and at any time flow rate slows down due to debris causing a blockage. Wear appropriate safety gear.

### Adjustable Agitation

The adjustable agitation valve is a variable rate control valve, located at the front of the work zone (A). When operated in the opposite position, it controls the optional external cleaning device.

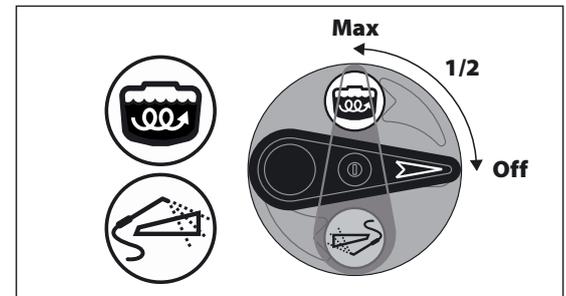
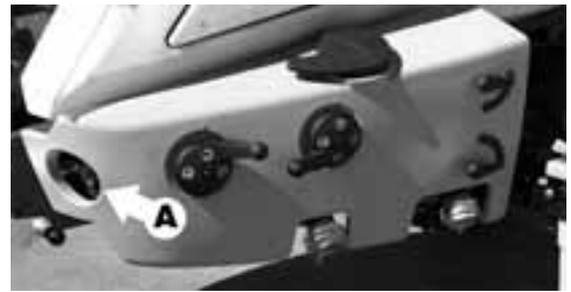
Some level of agitation is always present in the main tank unless the valve is closed completely by the operator.

The level of agitation required during spraying is controlled by the valve position.

In the case of sprayers fitted with HC 6500 controller the system alerts the operator about the level of agitation required for certain chemicals. For full operating instructions including "Auto agitation" for "Intelligent" models refer to the HC 6500 controller Operators Instruction book (p/n: 67026204) supplied with your sprayer.



**Attention:** For high speed or high flow applications a reduced agitation setting or lower ground speed may be required, depending on the boom configuration.

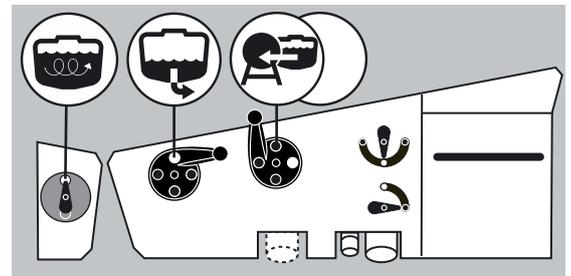


### Agitation before re-starting spraying

If a spraying job has been interrupted for a while, severe sedimentation can occur depending on which chemicals are used. When re-starting the spray job it might be necessary to agitate any sedimentary material first.

1. Turn handle at the suction SmartValve towards "Suction from main tank". Turn pressure SmartValve towards "Pressure emptying" or not used function and turn the Agitation valve towards "Agitation". Other valves closed.

- Engage the pump and set P.T.O. speed at 540 r/min or 1000 r/min (depending on pump model).
- Agitation has started and should be continued for at least 10 minutes.
- Spraying can now resume. Turn the pressure SmartValve towards "Spraying" and start spraying.



### Chem-filler

The Chem-filler is situated in the working zone on the sprayers left side, just behind the MANIFOLD valves. To use the Chem-filler:

- Grab the handle and *push the release lever* (situated just below the handle on the left).
- Pull the hopper outward and lower it until it clicks into the operating position.

To return the Chem-filler to its transport position:

- Release the catch by pushing the release lever.
- Lift the hopper back into the transport position until it locks in place.

When open, the Chem-filler's lid doubles as a working platform for chemical containers and is secured by an over-centre latch when closed.

The Chem-filler incorporates a cleaning nozzle for the hopper and chemical containers which is operated by a valve at the rear of the hopper.

When added, chemical is mixed inside the hopper by a Vortex nozzle which is operated by a second valve at the rear of the Chem-filler unit.



**Danger!** Never operate the cleaning nozzle with the lid open unless it is covered by a chemical container!



**Attention:** Never attempt to move or operate the sprayer with the Chem-filler in the operating position or full of liquid.

## 5 - Operation

### Adding chemicals via the HARDI ChemFiller



**Warning:** Crop protection chemicals can be dangerous. Always wear correct protective clothing before handling chemicals. For further information on chemical safety see the safety section (sect.2) at the front of this manual.



**Attention:** The scale in the hopper can only be used if the sprayer is parked on level ground however the best method is to use a measuring jug to ensure accuracy.



**Danger:** Do not operate the rinse nozzle unless the hopper lid is closed or the nozzle is covered by a container to avoid spray liquid hitting the operator.



**Attention:** Except when filling simultaneously from an external filling device, the rinse nozzle uses spray liquid to rinse containers. Always rinse chemical containers several times afterwards with clean water before disposal.



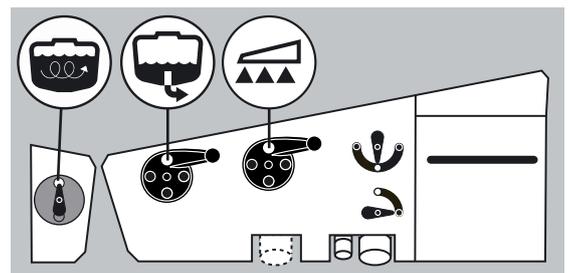
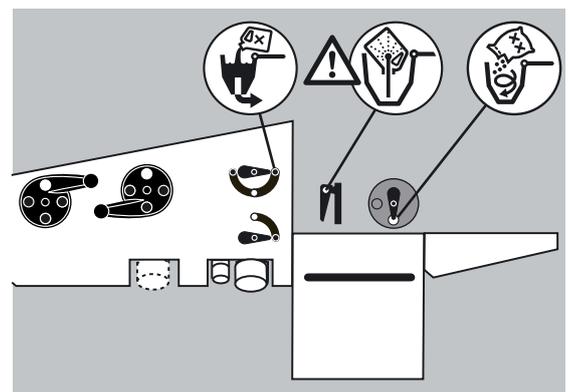
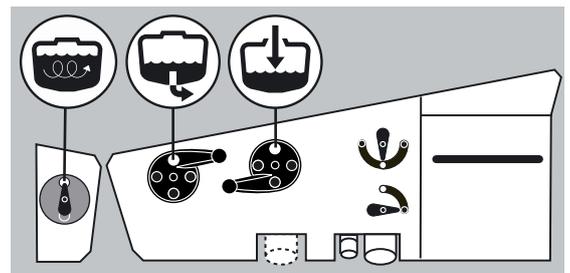
**Attention:** Except when filling simultaneously from an external filling device, the rinse nozzle uses spray liquid to rinse the chemical hopper. Always clean and de-contaminate the ChemFiller with the rest of the sprayer before storage or changing chemicals.

### Operating the HARDI ChemFiller

1. Fill the main tank at least 1/3 with water (unless something else is stated on the chemical container label).
2. Turn the handle at the suction SmartValve towards "suction from Main tank". Turn Pressure SmartValve towards "Main tank" and the Agitation Valve towards "Agitation". Other valves closed.
3. Engage the pump and set P.T.O. speed at 540 r/min or 1000 r/min (depending on pump model) and open the ChemFiller suction valve.
4. Open the ChemFiller lid and engage the hopper by throttling the Chem Filler Vortex valve.
5. Measure the correct quantity of chemical and add it *gradually* to the Chemical Hopper. The chemical will be transferred to the main tank.
6. If the chemical container is empty it can be rinsed by the Chemical Container Rinsing Nozzle. Place the container over the multi-hole nozzle in the middle of the hopper and squeeze the lever behind the ChemFiller.
7. Close the ChemFiller Vortex nozzle and close the hopper lid.
8. Rinse the hopper by using the multi holed rinsing nozzle and close the ChemFiller suction valve.
9. When the spray liquid is well agitated, turn the handle on the pressure SmartValve towards "Spraying" position. Keep P.T.O. engaged so the spray liquid is continuously agitated until it has been sprayed on the crop.



**Attention!** 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.



### Filling by use of the ChemFiller and an External Filling Device

The advantage of using this method is that clean water from the External Filling Device is directly transferred to the ChemFiller Vortex Nozzle and the Chemical Container Cleaning Nozzle. Provided the Chem filler is rinsed with the Cleaning Nozzle, the ChemFiller will always be clean and safe after use.

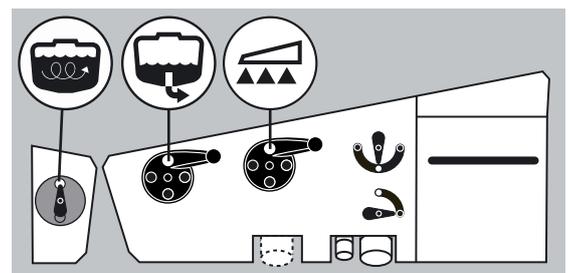
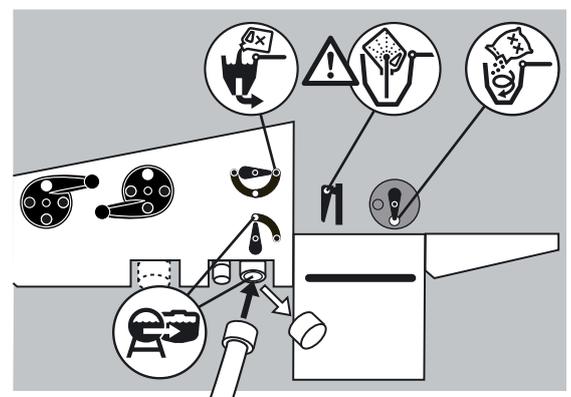
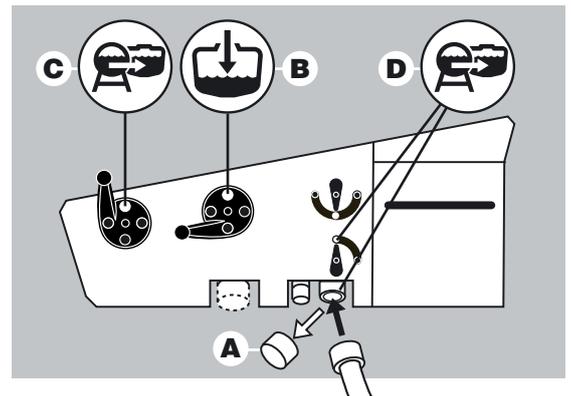
1. Turn the handle at the suction SmartValve towards "suction from External Filling Device". Turn Pressure SmartValve towards "Main tank" and the Agitation Valve towards "Agitation". Other valves closed.
2. Connect external suction hose to the External Filling Device coupler.
3. Engage the pump and set P.T.O. speed at 540 r/min or 1000 r/min (depending on pump model).
4. Open the ChemFiller suction valve and the External Filling Device valve.
5. Open ChemFiller lid and engage the hopper rinsing device by opening the ChemFiller Vortex nozzle.
6. Meanwhile keeping an eye to main tank level indicator, then measure the correct quantity of chemical and fill it into the hopper.
7. The chemical is being transferred to the main tank. If not then partly close the External Filling Device valve to increase vacuum at the ChemFiller suction. This could be the case if filling from high placed external tank or when having syphon effect.
8. When the chemical container is empty it can be rinsed by the Chemical Container Cleaning device. Close ChemFiller Vortex nozzle and place the container over the multi-hole nozzle and press the lever behind the ChemFiller.
9. Close the valve for the External Filling Device when the main tank is full, and also close the ChemFiller suction valve and the ChemFiller lid again.
10. When the spray liquid is well agitated, turn the handle on the pressure SmartValve towards the "Spraying" position. Keep the P.T.O. engaged so the spray liquid is continuously agitated until it has been sprayed on the crop.



**Danger:** Never press the lever unless the multi-hole nozzle is covered by a container to avoid spray liquid hitting the operator.



**Attention!** If there is not enough time to fill all the chemicals into the ChemFiller before the main tank is full, then it is possible to slow down the filling process by partly closing the External Filling Device ball valve.

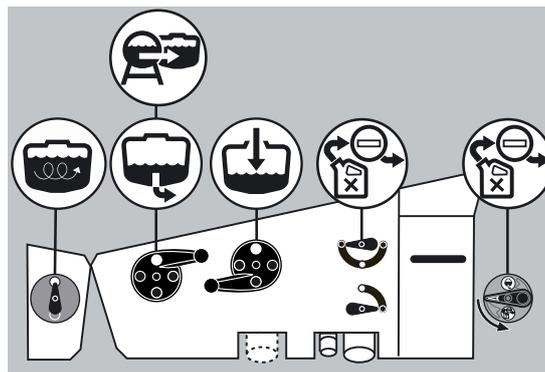


## 5 - Operation

### Adding liquid chemical from a drum (Optional)

Liquid chemical can be transferred from a drum or a small container via an optional chem-probe, suction hose and in-line Chem Meter .

1. Fill the main tank at least 1/3 with water (unless something else is stated on the chemical container label).
2. Turn the suction SmartValve towards your choice of either: "suction from External tank" or "suction from Main tank".
3. Turn the Pressure SmartValve towards "Main tank" and the Agitation Valve towards "Agitation".
5. Turn the Chemical Source Valve towards "Chem Meter" (other valves closed).
6. Connect a vacuum hose and probe to the cam-lock coupling on the Chem Meter suction circuit (A) and insert the probe into the chemical drum.
7. Engage the pump and set the P.T.O. speed at 540 r/min or 1000 r/min (depending on the pump model).
8. To avoid air entering the circuit and causing a false reading on the meter, *slightly open* the Chem Meter / Flush valve (B) in the direction of the Chem Meter icon until a reading is first seen on the Chem Meter. gradually continue to open the valve until the desired volume of chemical has been transferred and close the valve.
9. Remove the suction hose and probe and isolate ready for cleaning.
10. Immediately open the valve in the opposite direction (towards the flush tank icon) to flush the Chem Meter circuit of neat chemical and close the valve.



### Using the Chem Meter



**Attention:** For complete operating instructions for the Chem Meter please refer to the instrument manufacturers instruction sheet (supplied with your sprayer).

#### Operation of function keys

- A) Power On / Displays the "Accumulated Total" when held on.
- B) Resets "Total" to zero when held for 1 second / Resets the meter to normal function from "Cal" or "FLSH" mode.
- C) Changes the "Calibration factor" (see instructions this section)
- D) Changes to "FLSH" (flush) mode when held for 3 seconds (meter will not add to the Total or the Accumulated total when in this mode).



### Using the Chem Meter

- 1) Turn the meter "ON" by pressing button (A).
- 2) Hold the reset button (B) for one second to re-set the meter to zero.
- 3) To avoid air entering the circuit and causing a false reading, gently 'crack open' the Chem Meter / Flush Valve until the meter first registers a reading.
- 4) Gradually continue to open the valve until the desired volume of chemical has been transferred to the tank.
- 5) To avoid over filling, begin to close the valve just before the desired volume of chemical has been transferred to the tank and then open and close the valve repeatedly in small bursts to reach your final figure.



**Attention:** Although the meter display goes blank after 60 seconds of in-activity to save battery power, no data is lost.



**Attention:** If the fill rate (speed of fluid transfer) seems too slow, reduce the amount of agitation being used.

## Using the Chem Meter (continued)

### Changing the "Calibration Factor"

- 1) Hold the third button (C) for 3 seconds until the display shows nothing but the letters 'CAL' and a number.
- 2) Press the third button (C) again repeatedly until the desired calibration factor is displayed.
- 3) Press the second button (B) again to return to normal operating mode.



**Attention:** For calibration charts and further information on calibration procedure, please see the instrument manufacturer's instruction sheet supplied with your sprayer.

### Flushing the Chem-meter circuit

The Chem Meter and its associated hoses etc have been exposed to concentrated chemical and therefore it is vitally important to flush the instrument and its circuit immediately after use. To flush the instrument and its circuit:

- 1) Open the "Chem Meter / Flush Valve" in the opposite direction, towards the Flush Tank icon. This position draws clean water from the flush tank through the Chem Meter and its hoses.
- 2) Allow it to run for a few minutes until the circuit is flushed of chemical and close the valve.

### Chem-meter Specifications

(1) Handles most liquid agricultural chemicals, (2) Stores up to 19 pre-set values, (3) 8 to 60 Litres per minute, (4) 0 to 5 Bar rating, (5) Powered by AA Batteries.

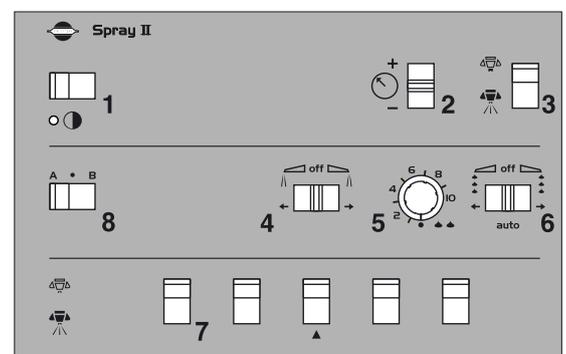


**Warning:** It is essential you flush the Chem Meter circuit immediately after chemical transfer is completed. Failure to do so can result in neat chemical being trapped and cause an unsatisfactory job when the sprayer is cleaned.

### Operating the control unit while spraying

The switches on the spray control box controls the following functions:

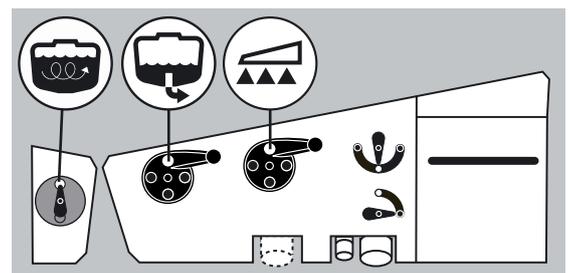
1. Power ON/OFF
2. Spray pressure regulation
3. Main valve ON/OFF
4. End nozzle (Left/OFF/Right)
5. Foam marker blob interval
6. Foam marker (Left/OFF/Right)
7. Section valves
8. Optional function



In order to close the entire boom, switch ON/OFF (3) 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 (7) to off position. The pressure equalisation ensures that the pressure does not rise in the sections which are to remain open.

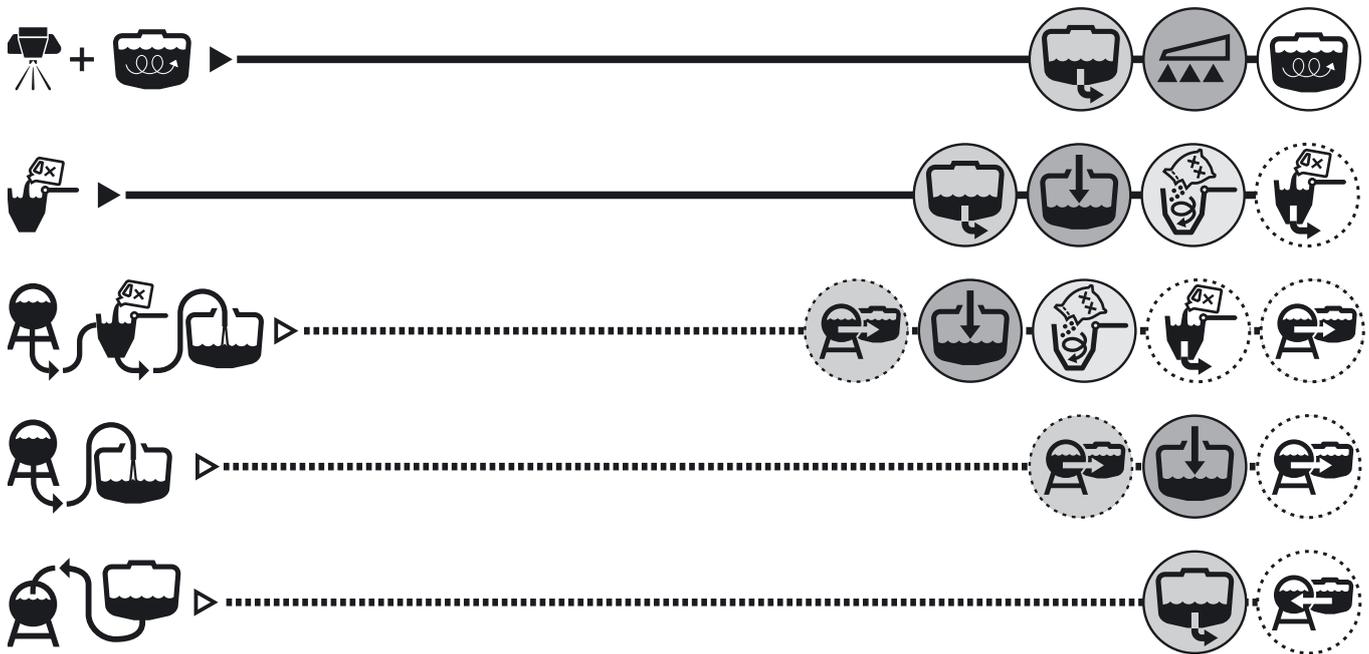
On the sprayer the suction SmartValve should be turned toward "Suction from Main tank" and pressure SmartValve should be turned toward "Spraying". Turn the agitation valve to "Agitation" if necessary.



## 5 - Operation

### Valve operation Quick-guide

In the following diagram, valve positions are described for optional functions.



### Cleaning 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.
- Prolonged life of the pump. The main filter protecting the sprayers internal components is the suction filter. A blocked suction filter will result in pump cavitation. Check it regularly.
- See Maintenance section for further information

### EasyClean filter

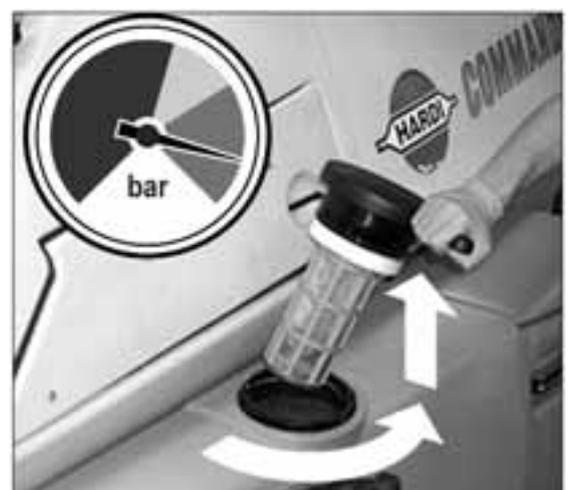
The EasyClean filter is located near the Smart Valves on the left side of the sprayer. It has a built-in isolation valve that automatically closes when the filter is opened for inspection and cleaning. To open the filter turn the handle counter-clockwise and lift it upwards as shown in the picture to the left.

The EasyClean filter is equipped with a clogging indicator located next to the sprayers main pressure gauge on the working platform.

A green indicator means no cleaning is necessary.

A yellow indicator means finish your spray job and clean the filter after.

A red indicator means the filter is clogged and immediate action is required.



### Cyclone Filter

The Cyclone Filter allows the impurities in the spray liquid to by-pass the filter mesh and be re-circulated back to the tank via the return flow.

#### Function diagram:

- |                   |                   |                |
|-------------------|-------------------|----------------|
| 1. Filter lid     | 2. Flow from pump | 3. To boom     |
| 4. Return to tank | 5. Return valve   | 6. Check valve |

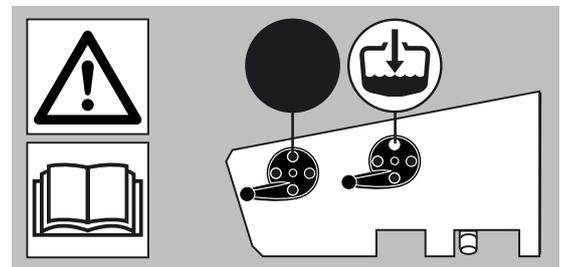
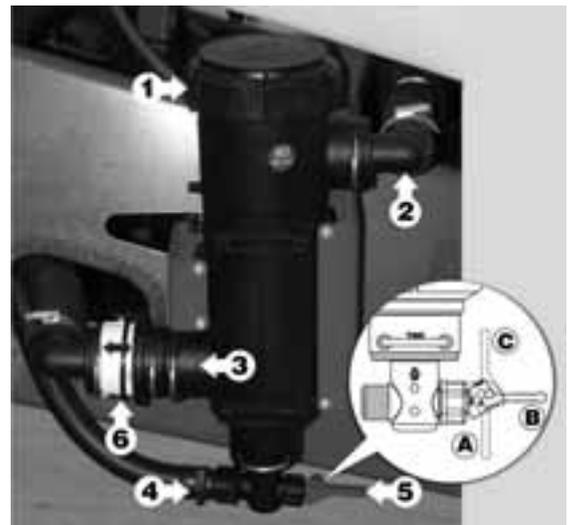
The Return valve (see inset) has three positions marked with small dots on the lever:

**Position A** (Marked with 1 dot): This position prevents return flow and is used for rinsing the boom when spray liquid remains in the main tank. It is also used when high spraying volume is required.

**Position B** (Marked with 2 dots): Normal spraying position with return flow to prevent filter from being clogged during spraying. This position is also used when rinsing the boom if the main tank is empty.

**Position C** (Marked with 3 dots): Flushing position for use if filter is clogged. Lift and hold the lever to increase return flow and clean the filter.

 **DANGER:** Before attempting to open the Cyclone filter turn the "Suction" SmartValve to the unused position and the pressure SmartValve to the "Main tank" position (both levers pointing forward). Failure to observe this will result in spray liquid draining from the main tank and being discharged from the filter housing under pressure, risking contamination to the operator.



## Cleaning

### Introduction

The best performance and service life can be expected when the sprayer is properly cleaned and maintained. Clean sprayers are safe and ready for action. Clean sprayers are less likely to be damaged by pesticides and their solvents.

 **Danger:** Agricultural chemicals can be dangerous. Read chemical labels and carefully follow safety recommendations to the letter. Always use appropriate safety clothing and equipment (see section 2 of this manual for further information).

 **Attention:** Read instructions for cleaning carefully before starting on the job. This includes the instructions on the chemical label which must be observed to the letter. Further information such as local restrictions on the disposal of chemical washings and licensing for operators specific to your area can be obtained from the Department of Primary Industries and the Environmental Protection Agency.

### Cleaning 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 the disposal of chemical washings, mandatory decontamination methods, etc. Contact the appropriate department, e.g. Department of Primary Industries / Environmental Protection Agency.
3. Legislation demands that you prevent seepage or run off of residue into streams, water courses, ditches, wells, springs, etc. The washings from the cleaning area must not enter sewers. Drainage must be confined to an approved catchment.
4. Cleaning starts with accurate calibration. A well calibrated sprayer will ensure the minimum amount of spray solution remains in the tank once the spray job is completed.
5. It is good practice to clean and decontaminate the sprayer immediately after use, rendering the sprayer safe and ready for the next spray job. This also prolongs the life of the components. Be aware that if chemicals are left to dry out on the sprayers surfaces, they become much more difficult to remove.

## 5 - Operation

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6. It is sometimes necessary to leave spray liquid in the tank for short periods, e.g. overnight, or until the weather improves. Animals and unauthorised persons *must not* have access to the sprayer under these circumstances.

7. If the product to be used is corrosive (ie: liquid fertiliser) apply a coat of a suitable rust inhibitor before and after the job.

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### Rinse tank and rinse nozzles

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#### The rinse tank is used in two main scenarios:

**A:** In-field dilution and expulsion of "Technical Residue" (ie: the residual spray liquid remaining in the tank and spray circuit after the first clear pressure drop is seen on the pressure gauge). This procedure is divided into three main steps:

#### Rinsing the liquid system

1. Empty the sprayer as much as possible by closing the Agitation Valve (no agitation) and spraying until air comes out of all the nozzles.
2. Turn the Suction SmartValve to the "Rinse tank" position and the pressure SmartValve to the "Main tank" position.
3. Engage the pump and run at approximately 300 r.p.m.
4. When 1/3 of the contents of the rinse tank have been used, turn the "Suction Smart Valve" towards "Main tank" and operate all the valves on the pressure side of the system in the following order: **(A)** Open the ChemFiller suction valve. **(B)** Open the ChemFiller Vortex nozzle until clean water comes out and close the valve. **(C)** Close the ChemFiller lid and operate the Chemical Container Cleaning device to rinse the hopper. **(D)** Open the ChemFiller lid again and make sure that the ChemFiller is empty. Close the ChemFiller suction valve.
5. Turn the suction SmartValve to the "Main tank" position and the pressure SmartValve to the "Spraying" position and spray liquid in the field you have just sprayed.

#### Rinsing the main tank

6. Turn the suction SmartValve to the "Rinse tank" position and the pressure SmartValve to "Internal Tank Cleaning" until another 1/6 of the contents of the rinse tank have been used. Turn the suction SmartValve towards "Suction from Main tank".
7. Turn the pressure SmartValve towards "Spraying" and spray the same quantity of liquid onto the field you have just sprayed, repeating items 6 and 7 one more time.

#### External cleaning

10. Turn the suction SmartValve towards "Rinse tank" and the pressure SmartValve towards "Internal Tank Cleaning".
  11. When another 1/3 of the contents of the rinse tank are used, turn the suction SmartValve towards "Main tank" and turn the "Agitation valve" to the "External Cleaning Device" position.
  12. Wash the sprayer with the external cleaning device (located on right side of the sprayer as previously described).
  13. Disengage the pump.
- 

#### The second scenario is:

**B:** Rinsing the pump, operating unit and spray lines etc in the event of an interruption to spraying before the main tank is empty (for example when poor weather prevents further spraying or night falls). To flush the system proceed as follows:

#### Rinsing the pump, operating unit and spray lines

1. Turn the Suction SmartValve to the "Rinse tank" position, and the pressure SmartValve to the "Spraying" position.
2. Close the Agitation Valve (no agitation) and turn the CycloneFilter valve to position 'A' (marked with one dot) to prevent return flow from diluting the contents of the main tank (see CycloneFilter operating instructions earlier this section).
3. Engage the pump and spray water from the rinse tank onto an area of the field not yet sprayed until all nozzles and tubes are flushed with clean water. Disengage the pump again.



**Warning:** To avoid over-dosing the crop, spray out diluted residues over as large an area as possible by increasing your forward speed (to double if possible) and halve your working pressure to somewhere around 1.5 bar (20 psi).

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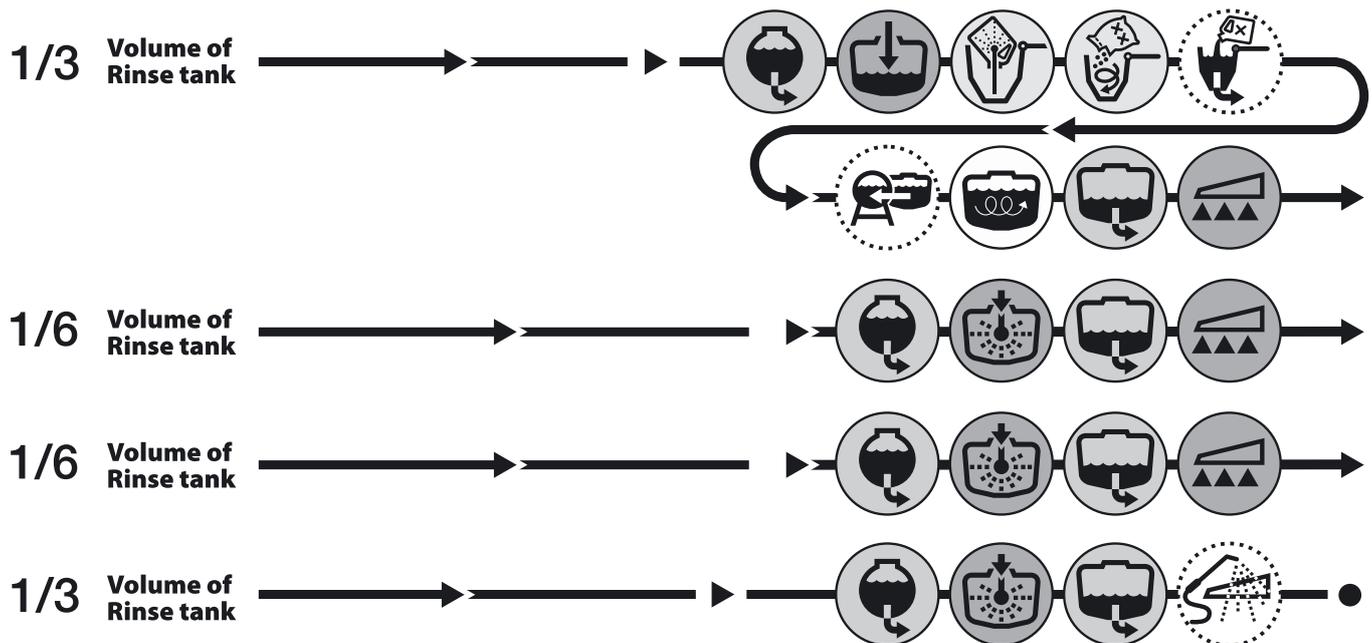


**Attention:** High pressure cleaners (such as the external cleaning device) can penetrate greased and lubricated components. It is therefore good practice to re-lubricate the machine and re-apply your protective product (ie: Castrol Rustilo or similar) to avoid operating the sprayer with dry mechanical joints.

### Cleaning operation Quick-guide

The following pictogram is a quick-guide to valve positions and approximate percentages of rinse tank volume required for each stage of the initial cleaning process.

It should be noted that thorough de-contamination *must follow* (as described in the next chapter of this manual) before the sprayer can be considered safe for use on another crop, changing chemicals or preparation for off season storage.

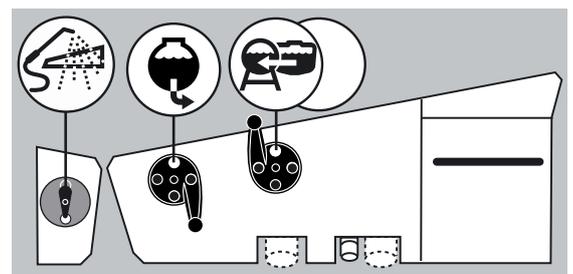


### Operating the External Cleaning Device (optional equipment)

The External Cleaning Device can be used to wash the outside of the sprayer. This prevents contamination of the storage shed area, and helps extend the sprayers service life.

To operate the External Cleaning Device:

1. Locate the hand gun inside the cover on the right hand side of the sprayer.
2. Un-roll the hose from the reel.
3. Engage the pump at approximately 300 r.p.m (or 600 for 1000 rpm pumps)
4. Turn suction SmartValve towards "Suction from Rinsing tank" and pressure SmartValve towards "External filling device" (or un-used position).
5. Turn the agitation valve towards "External Cleaning Device" and clean the sprayer.
6. After cleaning, close the agitation valve again.
7. Return the hose to the reel, stow the hand gun and close the cover.



**Attention:** The contents of the Main tank can be diluted with rinse water if the Safety by-pass valve activates when the external cleaning device is in operation. If this occurs lower your pump speed to reduce the working pressure.



**Danger:** The External Cleaning Device operates at very high pressure and could potentially cause serious personal injury. It is therefore essential the following Safety rules be observed and strictly enforced (continued next page).

## 5 - Operation

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### External cleaning device (Safety continued)



**Danger:** Pressure can penetrate skin and cause severe injury. Never work with un-protected eyes, bare feet or sandals. Beware of flying particles being dislodged by the cleaning jet. Never try to clean clothing or foot wear, especially if being worn by persons.



**Danger:** Never operate without approved chemical safety wear including face mask, gloves, respirator, boots and coveralls. Never point it at people, animals, electrical installations or equipment, overhead power lines or other sensitive objects.



**Danger:** "Recoil" may be experienced when the handle is released during operation - therefore always hold the insulation on top of the gun with one hand and the pistol grip with the other hand to facilitate better control of the device.

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### De-contamination

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#### Introduction

A complete cleaning and storage procedure consists of six steps:

1. Read Labels
2. Flush
3. Drain
4. Decontamination
5. Inspect
6. Store

In addition to the cleaning information previously described, complete sprayer cleaning includes "De-contamination" which is essential to reduce risk to other crops sprayed and ensures the sprayer is safe and ready for the next spray job. It is especially critical after using herbicides where even tiny traces of chemicals left in machinery can damage later sprayed crops. Always remember, if it's not clean, it's not safe!

It is therefore necessary to neutralise any chemical residues left within the sprayer's fluid system, before changing crops, chemicals or off-season storage. This includes the main tank, flush tank, chemical induction system, all hoses, valves, spray lines, nozzles and the external surfaces of the sprayer and tractor.



**Warning:** Always use personal safety equipment and clothing, and ensure contaminated equipment and clothing is stored, cleaned, or disposed of in an appropriate manner (See "Chemical Safety" in section 2 of this manual).

#### De-contamination agents

Some chemicals require particular neutralising agents and stringent decontamination procedures to ensure particles that may have adhered to sprayer system surfaces are rendered neutral before spraying a new crop or changing chemicals.

Chemical labels contain important information regarding safety, cleaning, neutralising agents and decontamination procedures. Read them and take note of recommended de-activating agents and follow their instructions to the letter.



**Warning:** Local laws may vary from state to state regarding the use and disposal of certain agricultural chemicals. Contact your local authorities for details. Information can also be obtained from the Department of Agriculture, the Department of Primary Industries or the Environmental Protection Authority.



**Warning:** Contamination of one chemical to another can adversely affect chemical properties and damage or destroy your next crop. The sprayer must be cleaned *and decontaminated* when changing chemicals or crops.

#### Decontamination:

After your sprayer has been flushed/rinsed and drained, it's time to clean and decontaminate it. Using the recommended decontamination agent and dose listed on the product label (personal protective equipment is essential). Be sure to decontaminate both the interior and exterior of the machine, running the de-contaminating solution right through the fluid system and boom structure and out the nozzles.

As most chemicals used have a tendency to block nozzles and filters, remove and clean in the appropriate decontamination solution with a soft brush. Check also for sediment on the pressure side of the safety valve.

#### Tank rinsing:

If tank rinse nozzles are fitted add clean water to the spray tank until it is approximately a quarter (25%) full. Then mix in a cleaning agent recommended for sprayer decontamination at the correct dilution rate for the volume of liquid in the spray tank. No further water needs to be added at this stage. Use the tank rinsing nozzles, re-circulate and discharge via the boom nozzles.

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**Attention:** The tank rinse nozzle cannot guarantee a 100% effective cleaning job. It is recommended to clean the tank manually with a long handled brush or high pressure cleaner.

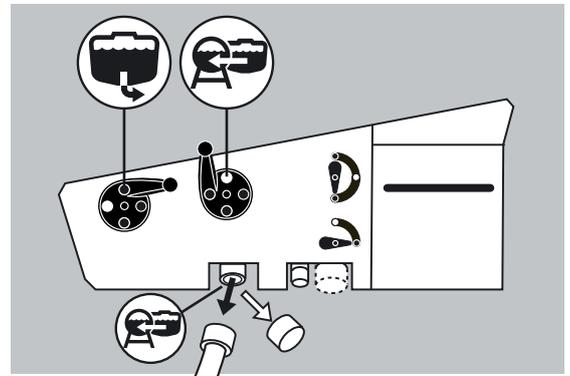


**Attention:** For further information on cleaning and de-contamination please contact your HARDI Dealer or visit our web site at [www.hardi.com](http://www.hardi.com)

### Pressure draining (optional equipment)

It is possible to drain to an external tank. This is done the following way:

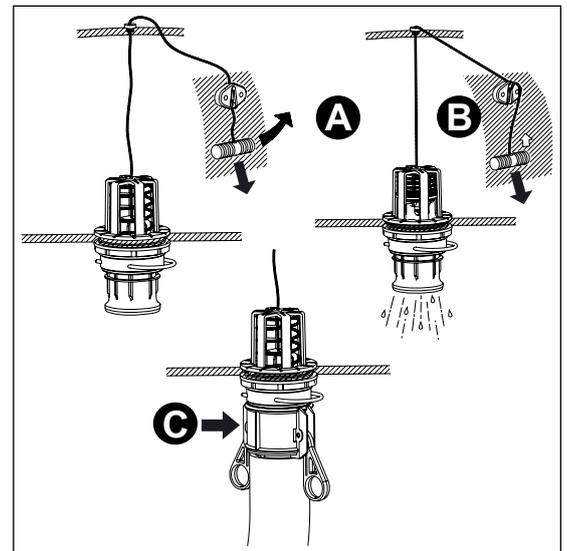
1. Connect a hose from an external tank to the suction quick coupler on the sprayer (pressure).
2. Turn the Pressure SmartValve towards "External tank".
3. Turn the Suction SmartValve towards "Suction from main tank".
4. Engage the P.T.O to start the pump.



### Using the drain valve

The drain valve is located and operated from the platform just beside the main tank lid. Pull the string to open the drain valve. The valve is spring-loaded, but can be kept open by pulling the string upwards in the V-shaped slit (A). To release, pull the string downward (B) and the valve will close automatically.

If draining residues, (for example: liquid fertiliser) into a reservoir, a snap-coupler and hose (C) can easily be connected to the drain valve and the liquid safely drained.



### Work light selector switch

The boom and work lights selector switch is placed into the SafetyLocker and has three positions:

1. Boom lights ON
2. Lights OFF (neutral position)
3. Work light ON

It is recommended to switch OFF the rear lights of the tractor in order to save power consumption and to avoid reflection.



### Further Information

For information on specific features of your machine not covered in this manual like the boom for example, please see the supporting booklets supplied with your sprayer's documentation.

It is also recommended you read the "Spray Techniques" booklet available from your HARDI dealer or visit our web site at [www.hardi.com.au](http://www.hardi.com.au) for further information.

# 5 - Operation

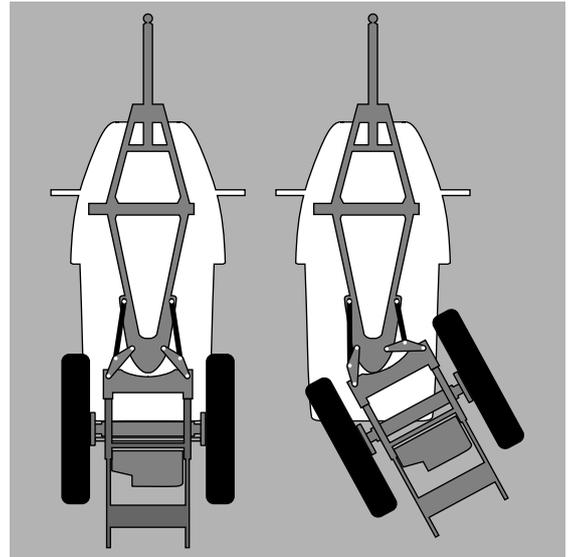
## Driving technique for SafeTrack (5 & 7000 models only)

Compared to a conventional trailer, articulated trailers have greater stability when turning, especially on hillsides.

Be aware however that articulated trailers behave differently than normal trailers. In the tracking position the vehicle's centre of gravity is displaced more forward compared to the vehicle centre line of a normal trailer.

To avoid overbalancing, pay attention to these guidelines:

1. Avoid sudden, tight turns.
2. Slow down before entering a curve or turning, and drive with a constant, low speed during the turn.
3. Never slow down too fast, never brake heavily and never stop suddenly in a curve, or when turning on a hillside, when the sprayer is articulated.
4. Be careful when turning on uneven ground.
5. Set the track gauge as wide as possible.



6. The proper function of the hydraulic system is essential to obtain good stability.

7. For safety reasons, the following limitations are set for the articulated trailer (with booms unfolded):

Maximum turning speed:.....15 km/h

Maximum ground inclination for turning:.....8°

For track width specifications please see page 4.12 "Altering the track gauge" in the set-up section of this manual.



**Attention:** Please see separate "Safe Track" section in the HC 5500/6500 instruction book for steering calibration and operation instructions.



**Danger!** No persons are allowed in the operations area of the sprayer when steering is unlocked!



**Warning!** Never use articulated steering when the boom is in the transport position.

## Foam Marker

The foam marker's working range is determined by the concentration of foam solution to water, plus (more importantly) the "Foam" settings made by the operator on the sprayer control box.

Approximate working range:

Minimum flow rate .....3.0 Hrs @ 0.4 Litres per minute

Maximum flow rate .....0.5 Hrs @ 2.4 Litres per minute

Water and foam solution are added to the tank (A) via the vented tank lid (B). Follow the directions on the label of the foam concentrate container to obtain the correct dilution ration.



## Foam Marker filter

The foam marker system is protected by an in-line filter (C) located rearward of the foam tank, just below the compressor. It is critical to the system's performance that you check it and clean it often.



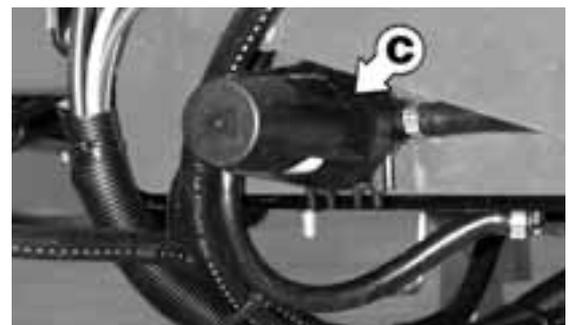
**Attention:** For further information on "Operation" refer to your HC 5500 or HC 6500 Operators manual supplied with your sprayer.



**Attention:** The foam system's settings range widely from zero flow up to 2.4 Litres per minute. It is recommended you explore the settings carefully to achieve the best possible performance.



**Attention:** Filter maintenance is critical to the overall performance of the Foam marker system.



### Preparation

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#### Introduction

This section of the manual deals with maintenance. It is vitally important that you prepare the service area, the sprayer and tractor to minimise any potential risk to the operator or service technician. The following suggestions are made in the interests of safe work practices.

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#### Safety



**Danger:** Maintenance procedures involve:

- Reading and interpreting technical information and illustrations
- Lifting the sprayer's axle off the ground
- Cleaning of filters
- Brake adjustments
- Servicing hydraulic components
- Testing and servicing of fluid systems
- Servicing PTO shaft safety shields
- Lubrication

#### Before you get started...

Performing service and maintenance procedures safely requires awareness, preparation and common sense. Below is a list of safety issues which must be observed before commencing service or maintenance procedures:



**Danger:** Before carrying out any service procedures observe the following:

- Clean and de-contaminate the sprayer and use chemical safety protection gear (see "Chemical Safety" section 2 and "Cleaning and De-contamination" section 5)
- Ensure your work area has lifting and safety equipment of a suitable load bearing capacity
- Always wear safety eye wear, overalls, safety boots and gloves where appropriate
- Keep animals and people away from the service area at all times unless involved in the procedure
- Keep children away
- Position the tractor and sprayer on a suitable flat surface with enough room for the boom to operate
- Never perform set-up, service or maintenance procedures with the tractor running
- Turn the tractor's engine off, place in park with the hand brake on *and remove the ignition key!*
- Fit the support leg and retaining pins and use wheel chocks in front and behind of each wheel
- Always use safety stands when lifting the sprayer off the ground
- Always re-fit all safety equipment and shields after service procedures
- Think each job through before commencing work and assess any potential risk
- Avoid working alone or at least have some-one check on you periodically
- Carry a mobile phone on you for emergencies
- Dis-connect the power and clear the area of any flammable material before using an arc welder
- If any procedure is unclear or requires facilities which are not available, refer the job to your HARDI dealer.

# 6 - Maintenance

## Lubrication

### General info

To avoid contamination from dirt and condensed water, always keep lubricants clean, dry and cool - preferably at a constant temperature.

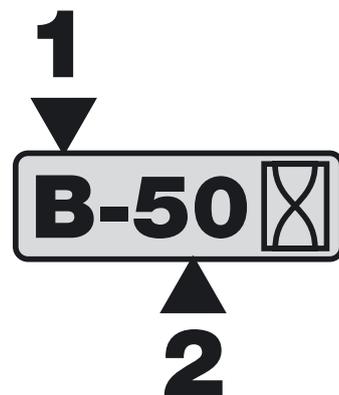
Keep oil filling jugs, hoppers and grease guns clean, and clean the lubricating points thoroughly before applying lubricant.

Avoid skin contact with mineral oil products for long periods.

Always follow the directions concerning recommended quantity. If no recommended quantity is given, feed the lubricator until new grease becomes visible.

Pictograms in lubrication & oiling plans indicate the following:

1. Lubricant to be used (see "Recommended lubricants").
2. Operating hours before next lubrication.



**Attention:** If the sprayer is cleaned with a high pressure cleaner lubrication of the entire machine is recommended.

### Recommended lubricants



**A** BALL BEARINGS:  
Castrol EPL2 Grease  
or equivalent.



**B** SLIDE BEARINGS:  
Castrol Molybdenum-  
disulphide  
grease or equivalent.

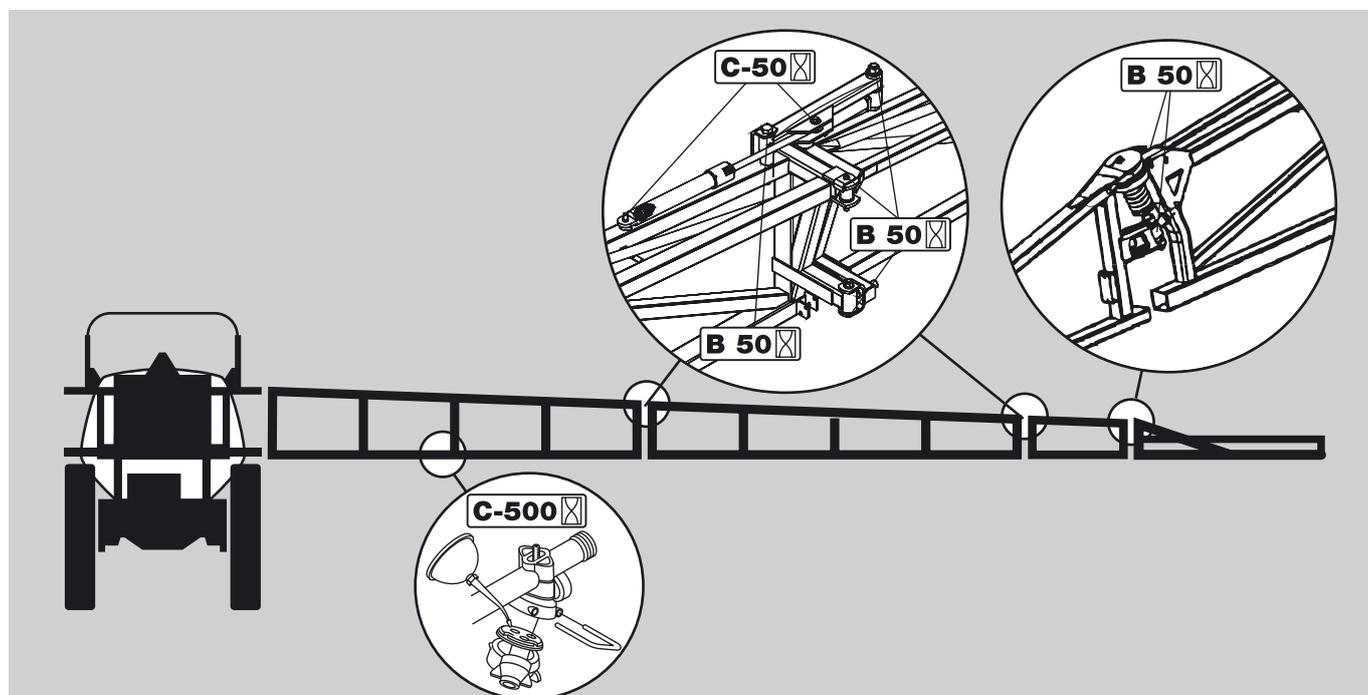


**C** OIL LUB. POINTS:  
Castrol EPX  
80W/90  
or equivalent.



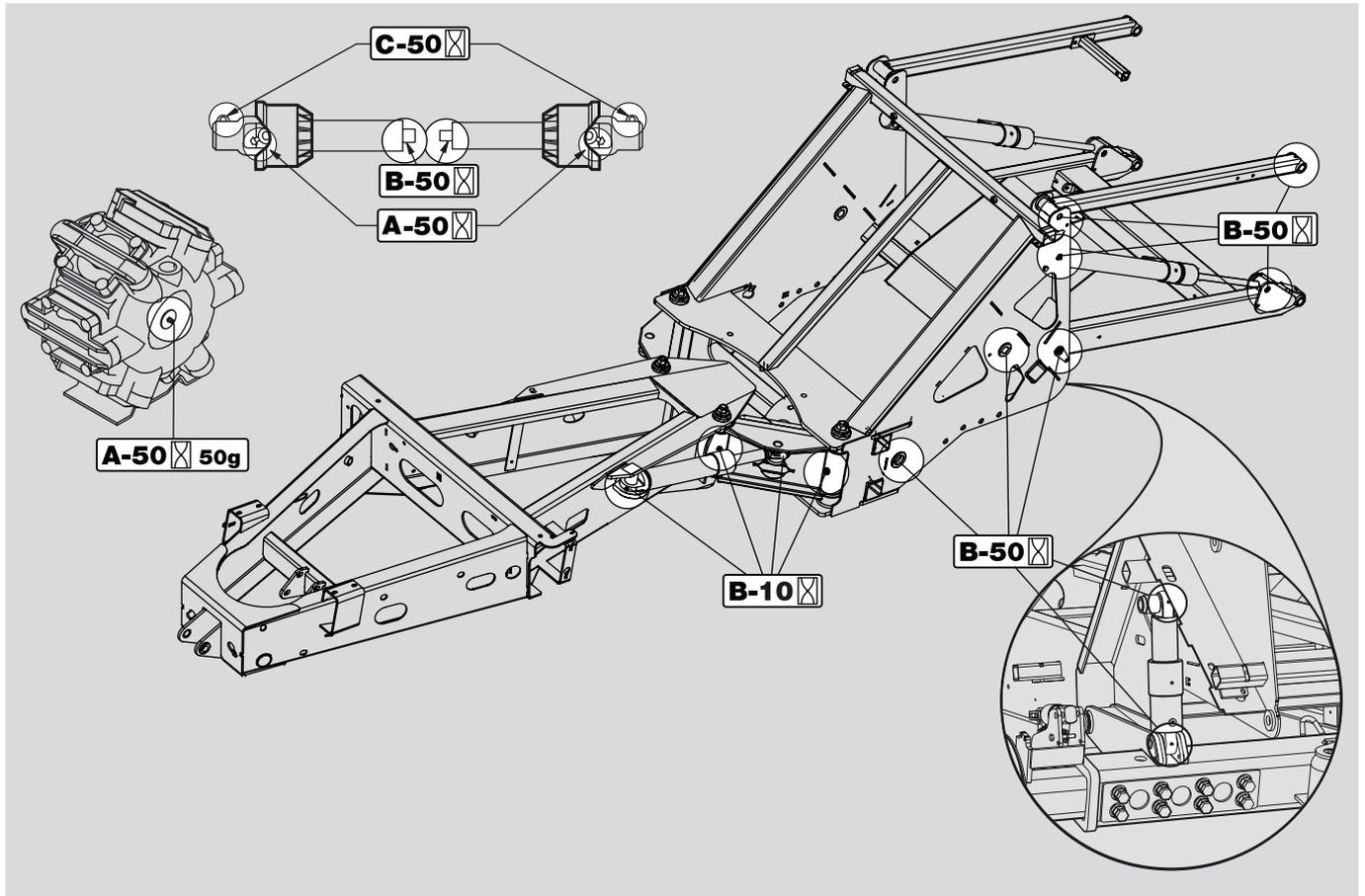
**D** "O" Ring Seals:  
Castrol Non-  
mineral based  
Rubber grease  
or equivalent

### Boom lubrication & oiling plan



**Attention:** for complete Boom service information and procedures please refer to your Boom Operators Manual supplied with your sprayer's documentation.

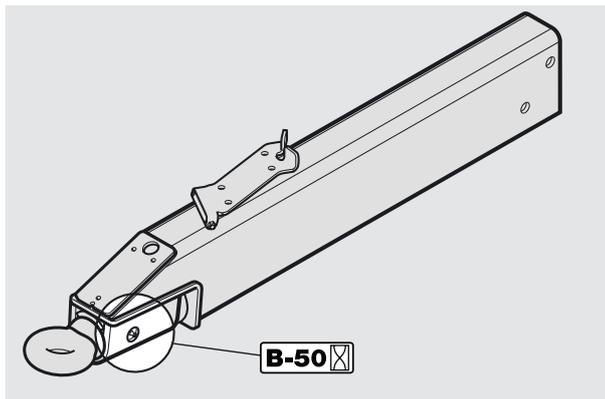
## Trailer lubrication & oiling plan



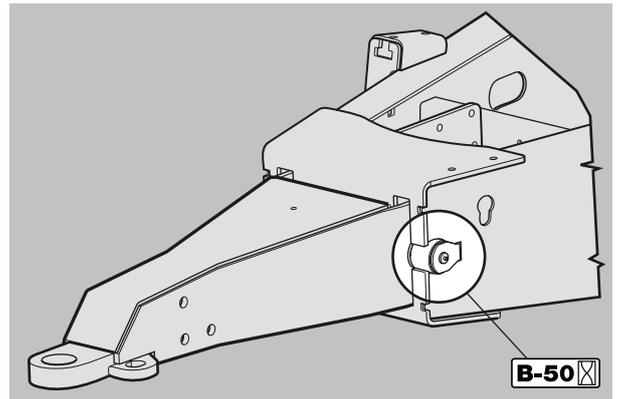
## Drawbar Lubrication

There are two types of drawbar which require lubrication:

*5000 and 7000 Litre with Steering (swivel)*



*9000 Standard drawbar*



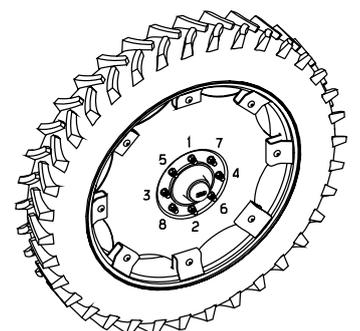
## 1.0 hours service - Wheel bolts and nuts

An initial check of wheel bolts and nuts after approximately 1.0 hour of service is recommended. Tension to 490 Nm (362 lbft) in a conventional star pattern (see illustration to the right).

An initial check of fluid joints and couplings is also recommended after approximately 1.0 hours service.

Check hydraulic couplings and drawbar security.

General check over the sprayer.



## 6 - Maintenance

### Service and Maintenance intervals

#### 10 hours service - Cyclone filter

##### To service the Cyclone filter:

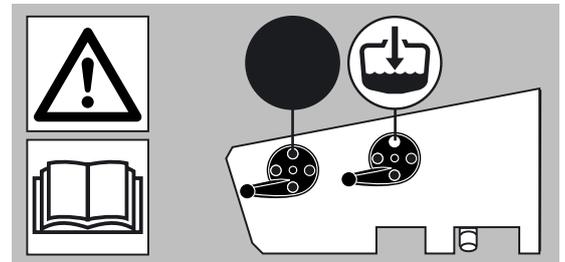
1. Turn the suction SmartValve to the "OFF" (or 'un-used') position and the pressure SmartValve to the "Main Tank" position.
2. Unscrew the filter lid (A) and remove it with the filter screen (B).
3. Separate the filter from the integrated filter guide in the lid and clean the filter.

##### To reassemble:

1. Grease the two O-rings on the lid / filter guide (use a small tool or brush if necessary).
2. Mount the filter onto the recess in the lid / filter guide.
3. Place the filter / filter lid into the housing and screw the lid until it hits the stop.



**Danger:** To avoid spray solution draining from the main tank and possibly hitting the operator with some force, turn the suction SmartValve to the off (or un-used position) and turn the pressure SmartValve to the "Main tank" position (both levers pointing forward) before opening the Cyclone filter!



#### 10 hours service - EasyClean filter

In addition to the conditions indicated by the blockage filter, outlined in the "Description" section of this manual, the EasyClean filter should be cleaned regularly every 10 hours.

##### To service the Easy-clean filter:

1. Turn the filter lid counter clockwise to open.
2. Lift out the lid and filter from the filter housing and Separate the filter element from the lid/filter guide.
3. Clean the filter and if necessary drain the housing of larger impurities.



##### To drain the filter housing:

1. With the filter dis-assembled, locate the half inch ball valve in the bottom of the filter housing.
2. Open the valve to drain the housing of fluid and close the valve.

##### To reassemble:

1. Grease the O-ring on the filter lid.
2. Press the filter onto the filter guide/lid *and be sure it has engaged the guides.*
3. Lift the filter & lid into the housing *and be sure it has engaged the guides in the bottom of the housing.*
4. Turn the lid clockwise to close the lid and re-open the isolation valve.

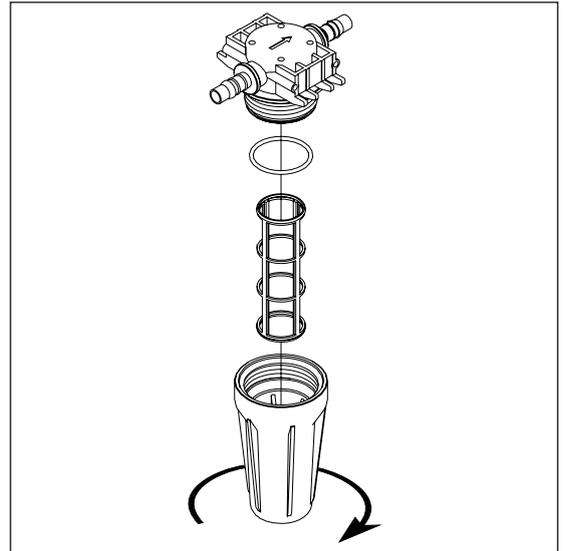


## 6 - Maintenance

### 10 hours service - In-Line filter (optional equipment)

If the boom is equipped with In-Line Filters unscrew the filter bowl to inspect and clean the filter. When reassembling the O-ring should be greased.

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



### 10 hours service - Nozzle filters

Check and clean.



### 10 hours service - Brakes (optional equipment)

Apply brake pedal and check function of trailer brakes and lights.

### 50 hours service - Spraying circuit

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

### 50 hours service - Transmission shaft

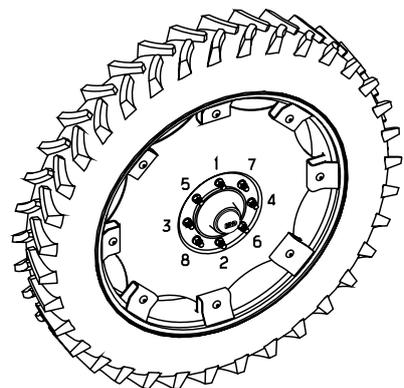
Check function and condition of the transmission shaft protection guard. Replace possible damaged parts.

### 50 hours service - Wheel bolts and nuts

Tighten wheel bolts and nuts as follows with following torque wrench settings:

Wheel hub to rim plate: 490 Nm (362 lbft)

Tightening sequence: See illustration and tighten in order of numbering.



## 6 - Maintenance

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### 50 hours service - Tyre pressure

Check the tyre pressure according to the table in "Technical specifications".



**DANGER!** Never inflate tyres more than to the pressure specified in the table. Over-inflated tyres can explode and cause severe personal injuries! See the part "Occasional maintenance - Change of tyre".



**WARNING!** If renewing tyres always use tyres with min. load index as specified.

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### 250 hours service - Readjustment of the boom

See section "Sprayer Set-up" and refer to you Boom Operators and Maintenance Manual for detailed service information.

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### 250 hours service - Hydraulic circuit

Check the hydraulic circuit for leaks and repair if any.

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### 250 hours service - Hoses and tubes

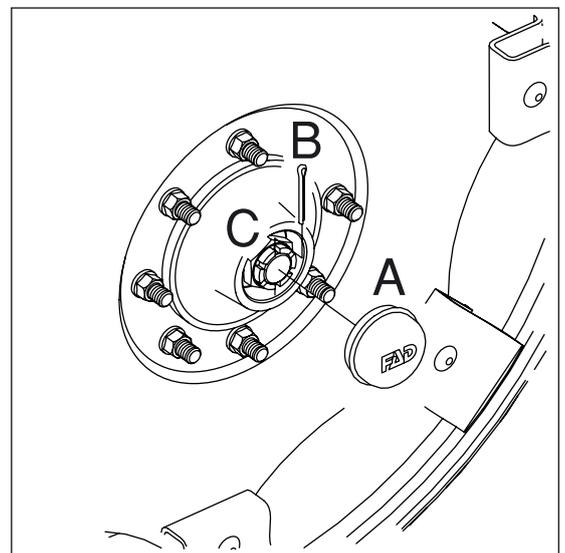
Check all hoses and tubes for possible damages and proper attachment. Renew damaged hoses or tubes.

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### 250 hours service - Wheel bearings

Check for play in the wheel bearings:

1. Place stop wedges in front of and behind LH wheel and jack up RH wheel.
2. Rock the RH wheel to discover possible play in the bearings.
3. If any play, support the wheel axle to prevent the trailer from falling down from the jack.
4. Remove hub cap (A) and cotter pin (B). Turn the wheel and tighten the castellated nut (C) until a slight resistance in the wheel rotation is felt.
5. Loosen the castellated nut until the first notch - horizontal or vertical - is aligned with the cotter pin hole in the shaft.
6. Fit a new cotter pin and bend it.
7. Fill the hub cap with fresh grease and screw it on to the hub again.
8. Repeat the procedure on LH wheel.



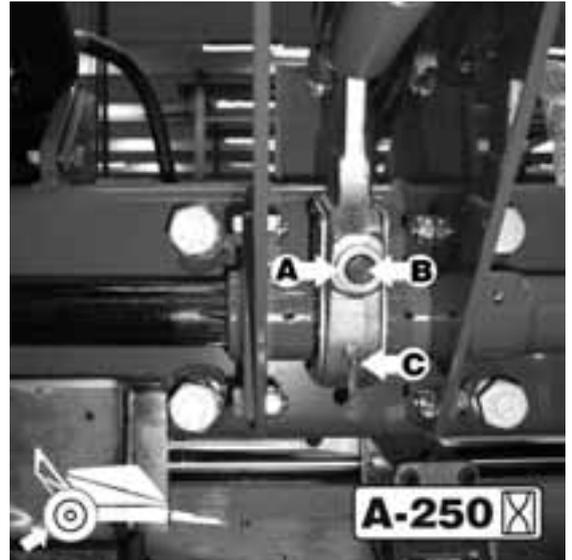
### 250 hours service - Brake adjustment

As the brakes become worn through normal service in the field, the clearance between the brake shoes and the brake drums increases resulting in slower braking response and the need for adjustment.

#### Adjustment procedure

To adjust the brakes proceed as follows:

1. Prepare the sprayer for maintenance / service procedures (see "Preparation" in the safety notes at the beginning of this section).
2. Lift the axle assembly off the ground (two lifting jacks, placed underneath the axle is recommended) and secure with safety stands.
3. Adjustment can now be checked by rotating the wheel/drum and feeling the amount of contact between the drum and the brake shoes.
4. To adjust the brakes, depress the locking collar (A) and turn the hex head adjuster (B) clockwise through 90° (1/4 turn at a time) until light resistance is felt from the brake shoes coming in contact with the drum (there should be some light resistance when turning by hand).
5. Adjust each side equally and remember to apply lubricant to the grease nipple (C) in the usual fashion.
6. Once service is completed test the brakes for response and binding.



**Warning:** This adjustment must be carried out on both sides of the sprayer at the same time.

### 250 hours service - Hydraulic brakes

Apply the brakes to full pressure (maximum 120 bar) and inspect brake lines for damages or leaks. Replace damaged parts. If the hydraulic brake lines have been dismantled the circuit must be primed afterwards:

1. Loosen brake hose at both brake cylinders.
2. Apply brake until oil without air bubbles come out.
3. Tighten brake hose before relieving the brake again.



**Warning:** Always prime (bleed) the circuit of air if the hydraulic brake lines have been opened.

### 1000 hours service - Transmission shaft

Change the protection tube nylon bearings as described under "Shield renewal on transmission shaft".



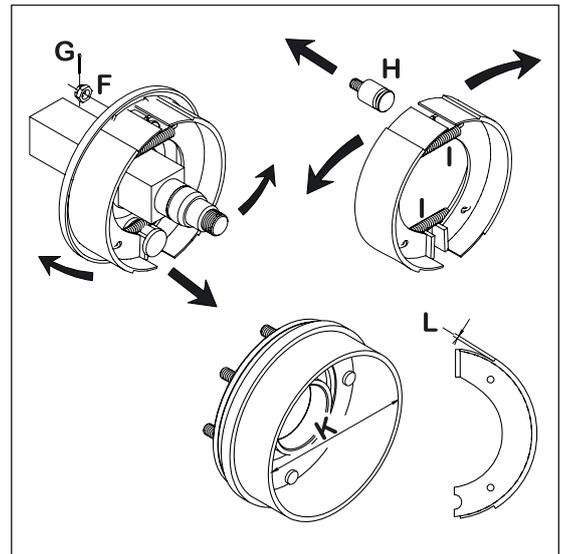
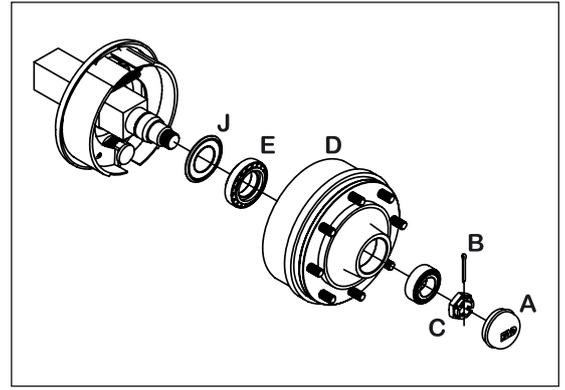
**Danger:** Un-protected / rotating PTO Transmission shafts are potentially lethal, and have been the cause of severe bodily injury and deaths. See the safety warnings and precautions in the "Sprayer Set-up" section of this manual for further information before attempting service of a Transmission shaft.

## 6 - Maintenance

### 1000 hours service - Wheel bearings and brakes

Check the condition of the bearings and brake wear parts in the following way:

1. Place stop wedges in front of and behind LH wheel and jack up RH wheel.
2. Support the trailer with axle stands.
3. Remove the wheel.
4. Unscrew the 6 Allen bolts and remove the hub cap (A), cotter pin (B) and castle nut (C).
5. Pull off the wheel hub and brake drum assembly. Use a wheel puller if necessary.
6. Vacuum clean the brake drum (D) for brake dust or rinse with water.
7. Rinse the remaining parts on the brake carrier plate with water and dry them.
8. Remove roller bearings (E), clean all parts in degreasing detergent and dry them.
9. Check the brake drum diameter and lining thickness - renew if worn.
10. Remove the clevis pin between the hydraulic cylinder and brake cam lever.
11. Remove the cotter pin (G) and nut (F), the brake shoe anchor bolt (H) and slide the brake shoes over the cam. Twist the pair of brake shoes to remove the shoe return springs (I). Replace brake shoes if the linings are worn.
12. Apply a small qty. of copper paste on moving parts and assemble the brake shoes and shoe return springs again.
13. Fit the shoe assembly with the anchor bolt first. Then pull the shoes away from each other and slide them over the cam afterwards. Tighten the anchor bolt castellated nut again and fit a new cotter pin.
14. Check roller bearings for discolouration and wear - renew if worn or damaged.
15. Assemble the hub and bearings using a new sealing ring.
16. Fill the hub and bearings with fresh grease before fitting it to the shaft.



17. Fit the castellated nut. Rotate the hub and tighten the castellated nut until a slight rotational resistance is felt.
18. Back off the castellated nut slightly until the first notch is aligned with the first cotter pin hole reached in the axle shaft.
19. Fit a new cotter pin and bend it.
20. Fill the hub cap with fresh grease and carefully press it on to the hub. Slightly tighten the 6 Allen bolts.
21. Adjust the brakes as described in "250 hours service".
22. Fit the wheel again and tighten the wheel nuts. See section "50 hours service" regarding torque wrench setting. Tighten all bolts to half the specified torque first, then to the full specified torque.
23. Tighten again after 10 hours of work. Check the torque every day until it is stabilised.

### Maximum brake wear service limits

Wheel bearings and brakes 1000 hours service information continued next page.

### Wheel bearings and brakes 1000 hours service information continued

Max. wear rates on brake parts for 5000 sprayers:

Max. drum diameter: 302 mm (11.8897 in)

Min. lining thickness: 2.0 mm (0.07874 in)

Max. wear rates on brake parts for 7000 & 9000 sprayers:

Max. drum diameter: 402 mm (15.8388 in)

Min. lining thickness: 4.0 mm (0.15748 in)



**Danger:** Brake dust presents a potential health risk! Avoid inhalation of brake dust! Use a respirator when servicing the brakes. Do not use compressed air! Use a vacuum cleaner or rinse with water to avoid brake dust being blown around.



**Warning:** The specified minimum lining thickness is the absolute minimum allowed. If upon inspection they are found to be close to the minimum thickness, replace them immediately. Do not wait until the next service period is reached and always replace both sides at once.



**Attention:** If the brake drum must be removed from the hub, a hydraulic press is required to press the wheel studs out.



**Warning:** Do not get oil, grease or copper paste in contact with the brake linings and drums.



**Warning:** If you are not confident changing wheel bearings or brake shoes contact your HARDI dealer's workshop.

### Occasional maintenance

#### General info

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

#### Level indicator adjustment

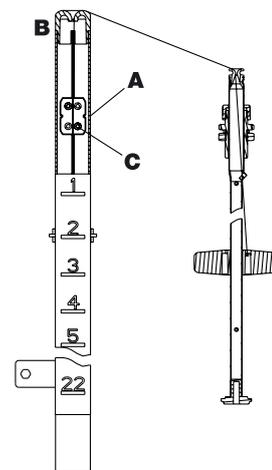
The level indicator reading should be checked regularly. When the tank is empty, the float should lie on the stop pin, of the rod, and the O-ring on the indicator should be positioned at the top position line (A).

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

#### Level indicator cord renewal

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 "Drain valve seal renewal") 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 enter the inside of the tank - the parts can be changed from the outside of the tank!

## 6 - Maintenance

### Pump valves and diaphragm service

Pump overhaul kit (valves, seals, diaphragms etc) for model 463 HARDI pumps should be ordered under part No. 750343 from your HARDI dealer.

#### Valves

Remove the valve cover (1) and replace the valves (2) and (2A). Note their position when dismantling the pump to aid in correct re-assembly.

 **Attention:** The valves with white flaps (2A) go in the two *upper side inlets* as shown in the diagram to the right. Valves with black flaps are fitted to the rest. Always use new gaskets (3) when servicing the valves and lubricate 'O' rings with rubber grease upon re-assembly.

#### Diaphragms

To replace the diaphragms remove the diaphragm cover retaining bolt (4) and the diaphragm cover (4A) and replace the diaphragm (5).

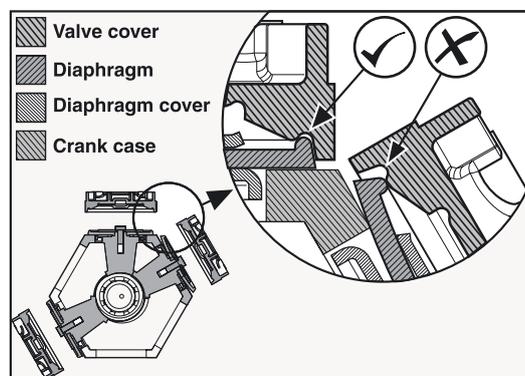
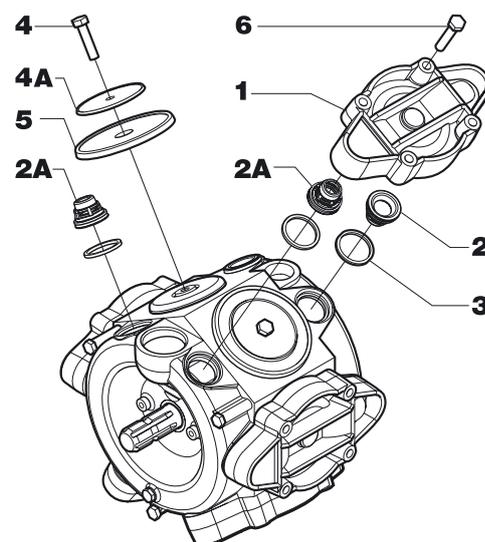
 **Attention:** If fluid is present in the crankcase, drain and re-grease the pump thoroughly. Also check that the drain hole at the bottom of the pump is clear.

#### Torque settings for re-assembly

Valve cover bolts: 90 Nm / 66.6 lbft

Diaphragm cover bolts: 90 Nm / 66.6 lbft

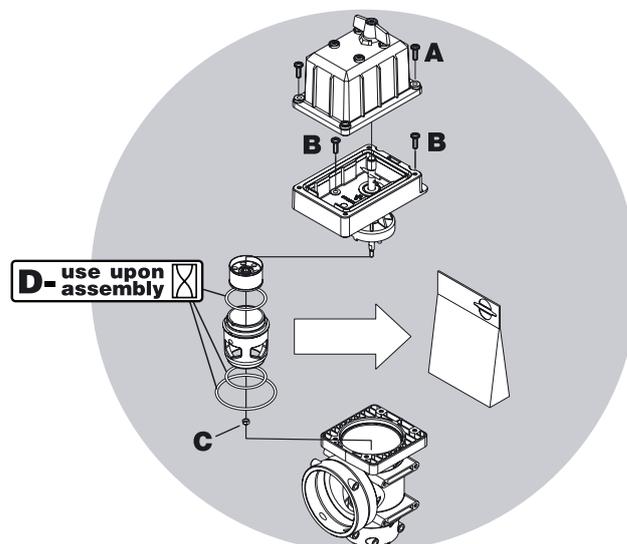
 **Attention:** Before tensioning the 4 bolts on each valve cover (6) rotate the crank shaft to position the diaphragm at the centre of the stroke (ie: diaphragm is de-tensioned and sitting flush with the face of the pump housing) as shown in the diagram to the right.



### Cone check/renewal for EFC operating unit

If it becomes difficult to build up sufficient pressure or if pressure fluctuations occur, it may be necessary to renew cone and cylinder. A spare parts kit can be ordered - contact your local dealer to service the unit.

1. Remove 4 x screws (A) and remove the housing.
2. Remove 4 x screws (B) and remove cone.
3. Loosen nut (C) in bottom of the cone.
4. Replace with parts from spare parts kit.
5. Reassemble in reverse order.



### EFC distribution valve service

It is important the section valves (A) and the ON/OFF bypass valve (B) are maintained properly as the reliability of your sprayer calibration relies on it. Poor seals result in reduced application rate and possible under-dosing.

 **Danger:** Always clean and de-contaminate the sprayer before Servicing the fluid system (see "Operation" for cleaning instructions and "Chemical Safety" sections also).



## EFC distribution valve service continued

### Testing the section valves:

1. Remove the slide clip (A) and the return hose fitting (B) and allow the manifold and return hose to drain completely.
2. Run the sprayer on clean water at full working pressure (ie: 3.0 bar) and switch on all the boom sections electrically at the Spray control box.
3. Observe the open manifold for any sign of a continuous discharge of water.
4. If suspect, collect the discharged fluid into a container for a period of 60 seconds and measure the total volume of the discharged fluid.
5. If the volume of the discharged fluid exceeds 2.0 percent of your calibrated application rate per hectare it is recommended you service the valves.



**Attention:** In most cases no single valve is responsible for excessive fluid by-pass but rather all the valves combined. It is therefore recommended they are all overhauled together.

### Testing the ON/OFF bypass valve

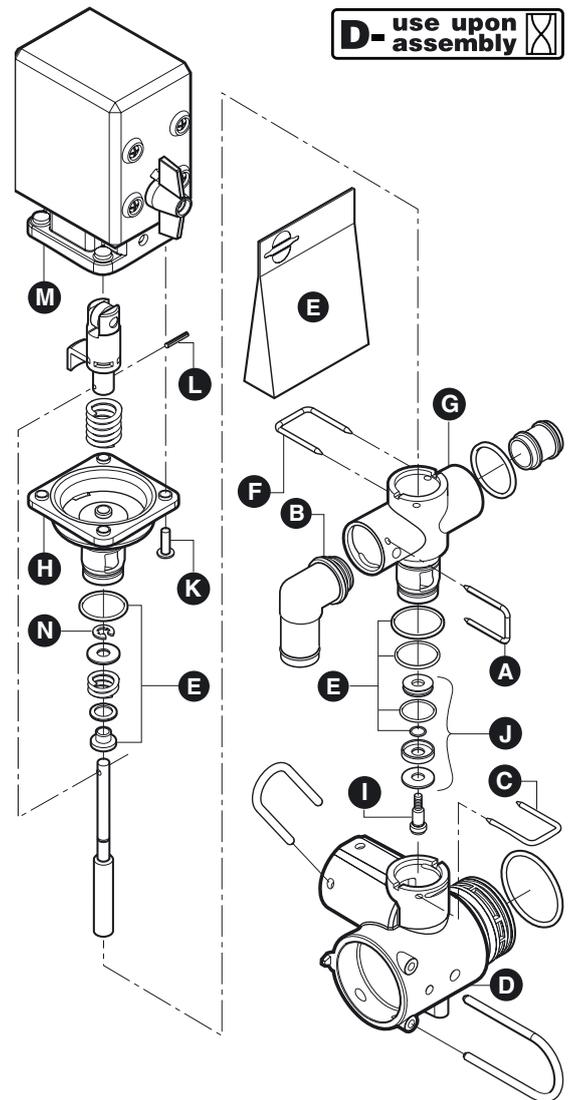
The condition of the ON/OFF Bypass valve is also crucial to sprayer performance and can be tested at the same time as the section valves simply by observing the fluid discharged from the return hose fitting (B) under the same conditions as before. If the volume of the discharged fluid exceeds 2.0 percent of your calibrated application rate per hectare it is recommended you service the valve.

### Section valves service procedure.

The section valves are removed from the manifold as a unit and then separated on a work bench for Servicing.

To remove the EFC valves proceed as follows:

1. Remove the slide clips (C) that separate the valve assemblies from the base manifold (D) leaving the base manifold intact.
2. Remove the return line fitting (B) and the EFC junction box cover.

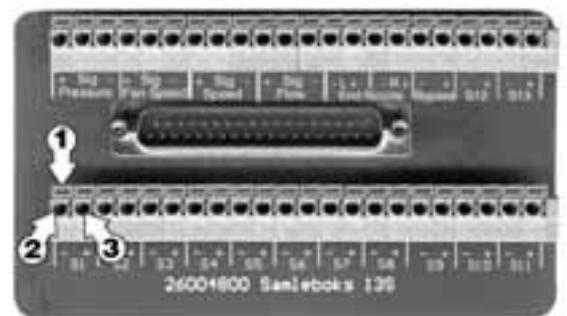


### Section valves service continued (EFC circuit board)

3. Referring to the circuit board diagram to the right, depress the terminal quick release (1) with a small screw driver and remove each wire from it's terminal, paying close attention to their position to aid re-assembly.
4. Cut the zip tie that anchors the wiring harness into the junction box and pull the harness free. Repeat the process for the rest of the valves.



**Attention:** The valves are numbered from Left to Right on the sprayer when viewing the sprayer from the rear, and the power harness connections are also numbered Left to Right in a similar fashion.



EFC Circuit board diagram: 1= Terminal quick release. 2= Blue wire (negative section 1) 3= Brown wire (positive section 1)

## 6 - Maintenance

### EFC Dis-assembly procedure

Move the valves to a clean work bench, and remove the slide clips to separate each unit. With the end of the shaft now exposed, remove the retaining screw (I) and valve components (J). Remove the slide clip (F) and separate the lower section (G) from the lower section of the upper valve assembly (H). Remove the four screws (K) and separate (H) from the valve motor (M). Remove the roll pin (L) and extract the shaft from it's support housing. Remove the "C" clip (N) and replace the worn parts of the valves using the overhaul seal kit (E) available from your HARDI dealer under PN: 755754.

Re-assemble in the reverse order.

### Drain valve seal renewal

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

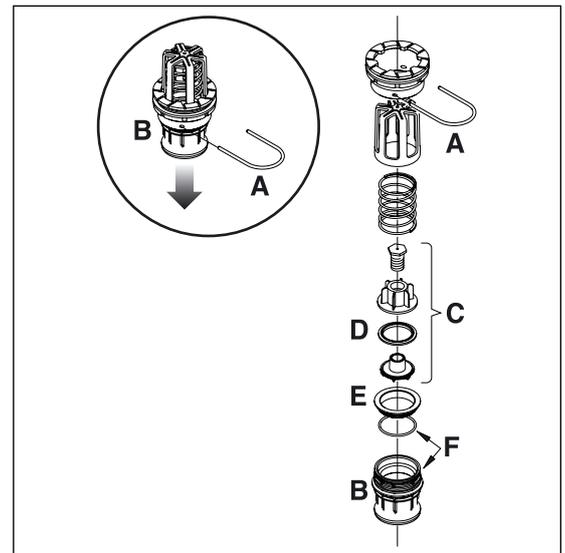


**DANGER!** Do not enter the inside of the tank - the parts can be changed from the outside of the tank!



**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.



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

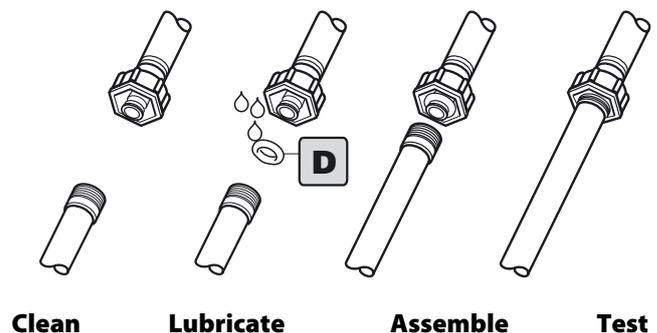
### Nozzle tubes and fittings

Poor seals are usually caused by:

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

If a leak is detected:

1. Disassemble the joint and check the condition and position of the O-ring or gasket.
2. Clean, lubricate, reassemble and test.



**Attention:** Before fitting O-rings, *cover them all over* in a rubber safe grease (non mineral based lubricant) before sliding them into position.



**Attention:** Avoid trying to repair a leaking joint by over-tightening the coupling.

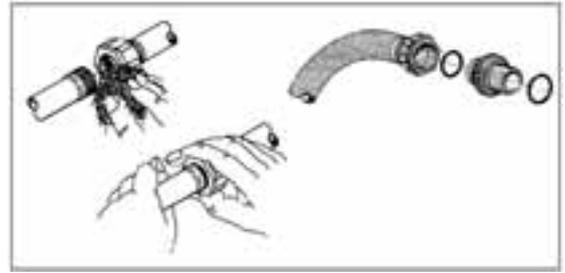
### 'O' ring seals...rules of thumb

Never over tighten 'O' ring seals.

Disassemble, check condition and position of O-ring or gasket. Clean, lubricate and reassemble.

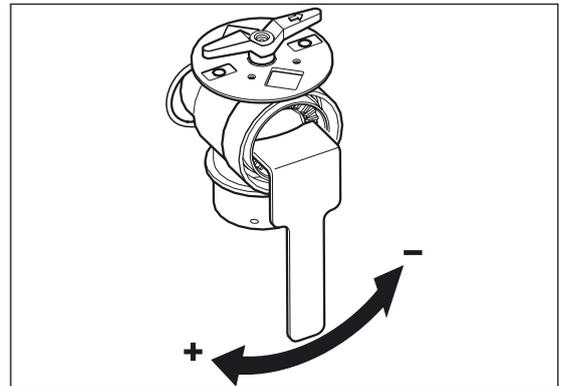
For RADIAL connections only hand-tighten them, *no mechanical assistance allowed*.

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



### Adjustment of 3-way-valve

The MANIFOLD valve can be adjusted if it is too tight to operate - or if it is too loose (=liquid leakage). Correct setting is when the valve can be operated smoothly by one hand. Use a suitable tool and adjust the toothed ring inside the valve as shown on the drawing.



### Boom adjustment and service

Because of the range of optional boom configurations being offered on New COMMANDER sprayers, a separate Boom Operators and Maintenance manual is supplied with your sprayer.



**Attention:** See your Boom Operators and Maintenance manual supplied with your sprayer for detailed technical information and service procedures specific to your boom configuration.

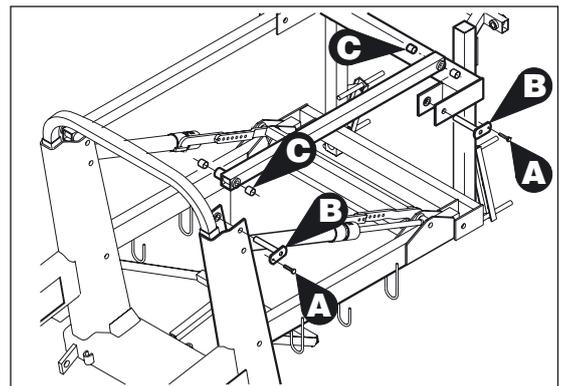


**Warning:** Nobody is allowed to be under the boom whilst adjustment is being carried out. Never walk under the boom unless it is safely folded and stowed on the transport brackets.

### Wear bushing renewal on 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 (C).
4. Refit the arm.
5. Repeat this on the other upper arm.
6. The lower arms must be disconnected simultaneously.
7. Grease all the grease nipples.
8. Remove the lifting gear again.



### Wear bush renewal on steering

If too much free play is found in the steering, the wear bushes must be renewed. This should be done at an authorised work shop facility. Contact your local HARDI dealer for assistance.

## 6 - Maintenance

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### Changing bulbs (conventional work lights)

1. Switch off the light.
2. Loosen the screws on the lamp and remove the cover or lens.
3. Remove the bulb.
4. Fit a new bulb, refit the cover and tighten the screws.



**Attention:** If halogen bulbs are used, never touch the bulb with the fingers. Natural moisture in the skin will cause the bulb to burn out when the light is switched on. Always use a clean cloth or tissue when handling halogen bulbs.

---

### Changing bulbs (LED Tail lights)

The optional road kit includes high quality moisture, vibration and dust resistant LED tail lights. If a problem is encountered check the power source first and if necessary order a new LED insert from your local HARDI Dealer.

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### Hydraulic suspension

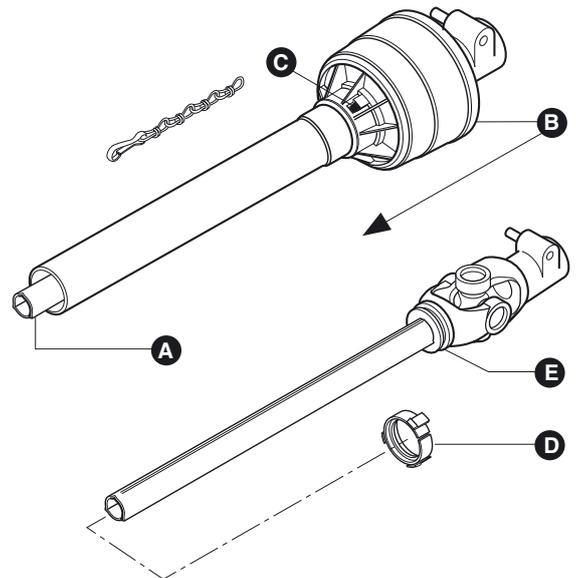
The hydraulic suspension system requires specialist knowledge and workshop facilities to service. Please contact your HARDI dealer for assistance.

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### Shield renewal on transmission shaft

To replace the transmission shaft safety guards:

1. Separate the two halves of the shaft and lay one section on a work bench
2. Secure the exposed end of the shaft (A) against a solid object. Pull the flared end of the guard in the direction shown (B) whilst depressing the three locking tabs (C) with a screw driver. Remove the protection tube.
3. Remove the safety guard bush (D) from the inner shaft yoke (E).
4. Repeat the process for the other sections
5. Clean and grease the shaft and re-assemble in the reverse order using new parts where necessary.



**Danger:** Remember to re-fit the safety chains.

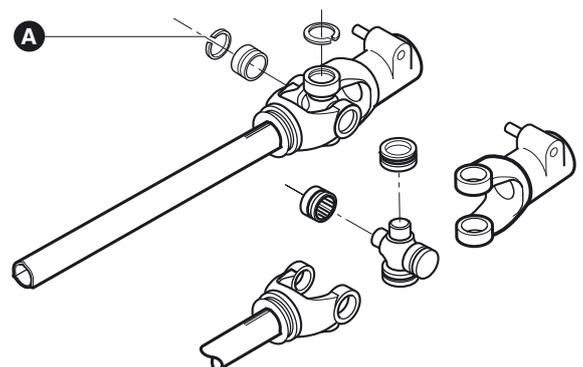


**Attention:** Only use genuine HARDI spare parts to service the transmission shaft.

---

### Replacement of transmission shaft cross journals.

1. Remove the protection guards as described previously.
2. Remove the cir-clips (A).
3. Press the cross journal sideways, use a hammer and drift if necessary.
4. Remove the needle bearing cups and cross journals.
5. Carefully remove the needle bearing cups from the new cross journal and install it in the reverse order. Before fitting the needle bearing cups again, check that the needles are placed correctly. Avoid dust and dirt in the new bearings.



### Off-season storage

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#### Off-season storage program

When the spraying season is over, you should devote some extra time to the sprayer. If chemical residue is left over in the sprayer for longer periods, it can reduce the life of the individual components. To preserve the sprayer intact and to protect the components, carry out following off-season storage program.

1. Clean the sprayer completely - inside and outside - as described under "Cleaning of the sprayer". Make sure that all valves, hoses and auxiliary equipment have been cleaned with detergent and flushed with clean water afterwards, so no chemical residue is left in the sprayer.
2. Renew possible damaged seals and repair visible 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. Engage the pump and operate all valves and functions on the MANIFOLD, operating unit, chemical inductor 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.
5. Lubricate all lubricating points according to the lubricating scheme - regardless of intervals stated.
6. When the sprayer is dry, remove rust from possible scratches or damages in the paint and touch up the paint.
7. Remove the glycerine-filled pressure gauges and store them frost free in vertical position.
8. Apply a thin layer of anti-corrosion oil (e.g. SHELL ENSIS FLUID, CASTROL RUSTILLO or similar) on all metal parts. Avoid oil on rubber parts, hoses and tyres.
9. Fold the boom in transport position and relieve pressure from all hydraulic functions.
10. All electric plugs and sockets are to be stored in a dry plastic bag to protect them against damp, dirt and corrosion.
11. Remove the control boxes and computer display from the tractor, and store them dry and clean (in-house).
12. Wipe hydraulic snap-couplers clean and fit the dust caps.
13. Apply grease on all hydraulic ram piston rods which are not fully retracted in the barrel to protect against corrosion.
14. Chock up the wheels, to prevent moisture damage and deformation of the tyres. Tyre blacking can be applied to the tyre walls to preserve the rubber.
15. Drain air brake tank for condensed water (if fitted)
16. To protect against dust the sprayer can be covered by a tarpaulin. Ensure ventilation to prevent condensation.

---

#### Preparing the sprayer for use after storage

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

1. Remove the cover.
2. Remove the support from the wheel axle and adjust the tyre pressure.
3. Wipe off the grease from hydraulic ram piston rods.
4. Fit the pressure gauges again. Seal with Teflon tape.
5. Connect the sprayer to the tractor including hydraulics and electric's.
6. Check all hydraulic and electric functions.
7. Rinse the entire liquid circuit on the sprayer with clean water.
8. Fill with clean water and check all functions.
9. Check function of brakes. Please note that brake power will be reduced until the rust are worn off the drums. Always brake lightly until the drums are clean.

## 6 - Maintenance

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### Spare parts

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#### Spare parts information

For spare parts diagrams, please see the section at the back of this manual, visit the web site at [www.agroparts.com](http://www.agroparts.com) and register for free, or contact your HARDI dealer.

**Note:** Due to on-going development the parts information at [www.agroparts.com](http://www.agroparts.com) may not currently contain all the spare parts drawings specific to the Australian product.

Please contact your HARDI dealer for further information and updates.



## Operational problems

### Introduction

In most cases where faults are experienced the most commonly accepted diagnostic approach is to rule out possible causes systematically by a process of elimination. As a rule this process can begin by investigating the following factors which have previously been found responsible:

1. Minor leaks on the suction side of the pump will reduce the pump capacity or stop the suction completely.
2. A blocked suction filter will hinder or prevent suction so that the pump does not operate efficiently.
3. Pressure filters becoming blocked will result in rising pressure at the pressure gauge but falling pressure at the nozzles.
4. Foreign material which has found it's way to the pump valves will reduce pump efficiency.
5. Poorly re-assembled pumps, especially diaphragm covers, will allow the pump to suck air resulting in reduced or no fluid capacity (investigate this if the pump was recently overhauled / serviced).
6. Contamination of the hydraulic system will result in rapid wear to hydraulic components.

### It is good practice to start by checking these basics:

1. Suction, pressure and nozzle filters are clean.
2. Check hoses for leaks and cracks, paying particular attention to suction hoses.
3. Check gaskets and O-ring seals are present and in good condition.
4. Check that the pressure gauge is in good working order (accurate calibration and chemical dosage depends on it).
5. Check the operating unit functions properly (always use clean water for testing)
6. Flow meter and speed sensor are functioning correctly (further information is given on this at the end of this section).

### Prevention

Naturally prevention is the best policy. Regular maintenance protects your investment, maximises sprayer efficiency, minimises expensive down time and risk of personal injury.

To achieve the best possible service from your HARDI sprayer always ensure:

1. Hydraulic system components are maintained and kept clean (keep hose couplings up out of the dirt and covered when not in use to prevent moisture contamination).
2. Proper cleaning and de-contamination is carried out after each spray job and before changing chemicals or crops. Never put off cleaning until later (crop protection chemicals are much harder to remove once they've dried out).
3. Regular and thorough maintenance is carried out *on time* (see maintenance section of this manual for schedule).

### Hydraulic system

Fault	Possible cause	Suggested action
No boom movements when activated.	Insufficient hydraulic 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(s).	Check / replace fuse in junction box.
	Poor / corroded electrical connections.	Check and clean connections, multi pin connections etc.
	Insufficient power supply.	Voltage on activated solenoid valve must be more than 8 Volts. Use wires of at least 4 mm for power supply.
	Defective relay / diodes in junction box.	Check relays, diodes and soldering at PCB in junction box.

# 7 - Fault finding

## Hydraulic system continued

<b>Fault</b>	<b>Possible cause</b>	<b>Suggested action</b>
No boom movements when activated (continued)	Blocked line restrictor (A) or (B) in by-pass block.	Remove and clean restrictors (A) and (B) in bypass block (See hydraulic diagram) Change hydraulic oil + filter.
Boom lift raises to max. pos. when tractor hydraulics are engaged.	Wrong oil inlet to by-pass block. Back pressure in return line exceeds 20 bar.	Connect hydraulic snap couplers opposite in tractor outlets, or engage spool valve lever in opposite direction. 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. Internal leaks in flow regulator.	Check / close (screw in) by-pass valve 0. Replace flow regulator O-rings and back-up rings. Replace flow regulator.
Individual ram does not move.	Blocked restrictor.	Dismantle and clean restrictor.

## Fluid system

<b>Fault</b>	<b>Possible cause</b>	<b>Suggested action</b>
No spray from boom when turned on.	Air leak on suction line. Air in system. Suction/pressure filters blocked. Suction hoses or fittings blocked.	Check if suction filter O-ring is sealing. Check suction tube and fittings. Check tightness of pump diaphragm and valve covers. Fill suction hose with water for initial prime. Clean filters. Check fluid pick up in the tank is free of obstruction / sedimentation etc.
Lack of pressure.	Incorrect assembly. Pump valves blocked or worn. Defective pressure gauge.	Check the ChemFiller valves are closed. Check the boost valve on the CycloneFilter is closed Check for obstructions and wear. Check for dirt at inlet of gauge.
Pressure dropping.	Filters becoming blocked Nozzles worn. Sucking air towards end of tank load. Vacuum building in main tank.	Clean all filters. Fill with cleaner water. If using powders, make sure agitation is on. Check flow rate and replace nozzles if it exceeds 10%. Lower pump r.p.m. Check that the vent to atmosphere at the top of the main tank is clear of obstruction.

## Fluid system continued

Fault	Possible cause	Suggested action
Pressure increasing.	Boom nozzle filters becoming blocked	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.p.m. Check safety valve is tight. Ensure returns inside tank are present. Use foam damping additive.
Liquid leaks from the bottom of pump.	Damaged diaphragm.	Replace. See "Maintenance" section of this manual for instructions on servicing valves and diaphragms.
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. (-).
	Section valves not closing properly.	Check valve seals for obstruction and wear, overhaul if necessary (see "Maintenance" section of this manual for details). Check micro-switch plate position. Loosen screws holding plate a 1/2 turn. Check that the micro-switches in the EFC valve motors are shutting the motors off correctly
	No power.	Wrong polarity. Check that brown is pos. (+), Blue is neg. (-). Check printed circuit board for dry solders or loose connections. Check fuses and holders for integrity and security.

## Sensors

### Introduction

There are several sensors on the sprayer which are crucial to maximum sprayer performance. A basic understanding of sensor functions and their locations is valuable knowledge when diagnosing system faults.

In this section we will cover a general overview of type and location, and look at the test procedures for two of the main sensors associated with the fluid management system, in particular the "Speed" sensor and the "Flow" sensor.

### Sensor types

Three types of sensors are used on the New COMMANDER series sprayers:

1. Inductive pick up
2. Potentiometers
3. Proximity

The Speed sensor (*inductive pick-up*) and Flow sensor (*proximity type*) are critical in maintaining correct calibration constants and may be tested using simple procedures covered briefly later in this section.

Potentiometers are best tested via the Tool-box function built into the HC 5500 and HC 6500 spray controllers (for full details see Section 8: "Menu 4 Tool-box" in your respective controller manual supplied with your sprayer).

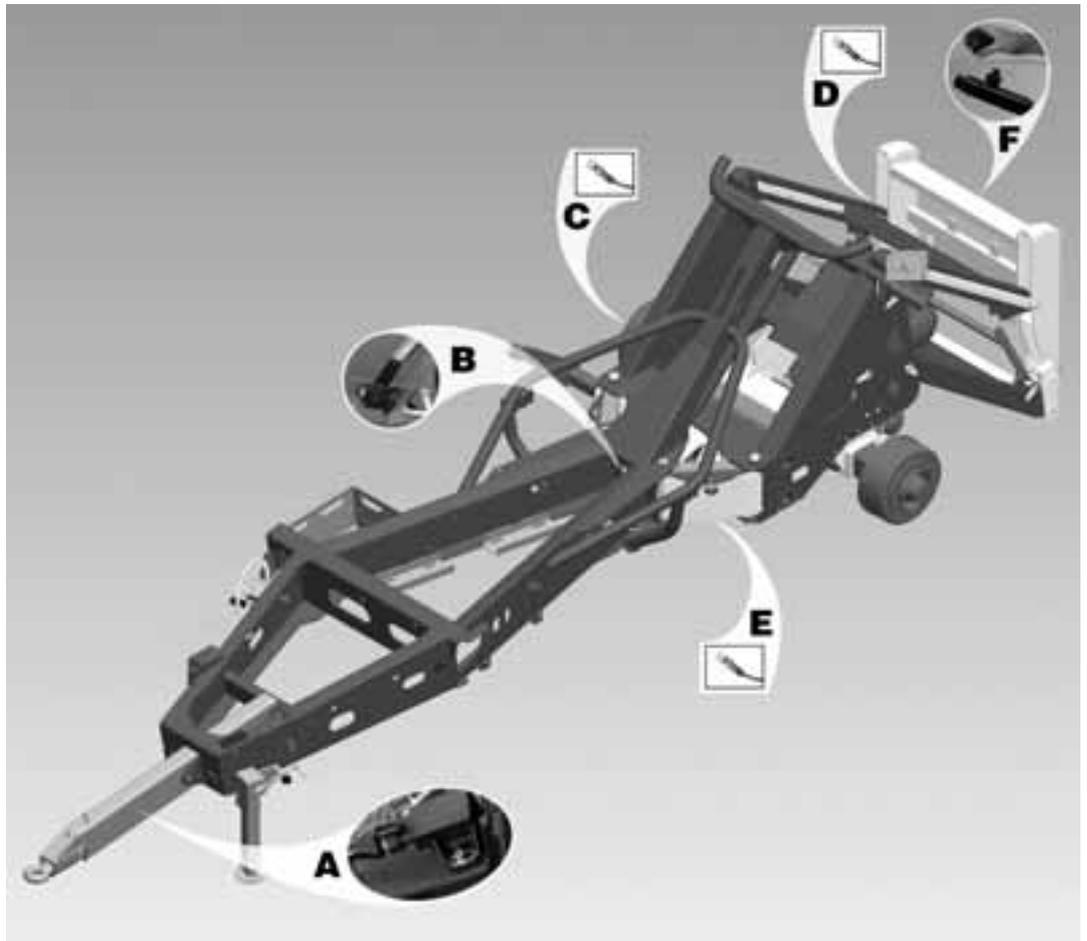
## 7 - Fault finding

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### Sensor locations:

The diagram below illustrates the location and function of the main sensors on the sprayer. In the case of 9000 Litre machines, and 5000 and 7000 Litre non-steering models, only C, D and F apply.

- A) Steering sensor  
(Potentiometer)
- B) Back angle sensor  
(Potentiometer)
- C) Speed sensor  
(Inductive type)
- D) Boom sensor  
(Inductive type)
- E) Steering lock sensor  
(Inductive type)
- F) Flow sensor  
(Proximity type)



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### Speed sensor

The speed sensor is an inductive pick-up and may be tested for correct operation as follows:

1. Switch on the power to the sprayer.
2. Locate the speed sensor inside the right wheel rim and loosen its mounting bracket to gain access.
3. Pass a metal object (such as a screw driver) within 2-3mm of the front of the sensor and watch the LED test light for a signal.

If the sensor is working correctly the red LED will illuminate with each pass of the metal object. If the sensor is found to be functional, return it to its original position and re-set the "air-gap" (distance from the slotted inductor ring). See 'Set-up' section of this manual for set-up information and specifications)

**Signal range:** 0.8 volt with light 5.0 volt without light (the sensor has an in-built red LED light)

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### Flow sensor

The flow sensor is a "Proximity" type sensor and may be tested for correct operation as follows:

1. Switch on the power to the sprayer but do not run the pump (ie 0 bar).
2. Locate the Flow sensor in the fluid supply manifold at the rear of the sprayer and loosen its threaded retaining nut.
3. Rotate the spindle by hand (do not use compressed air) and watch the in-built LED test light for a signal.

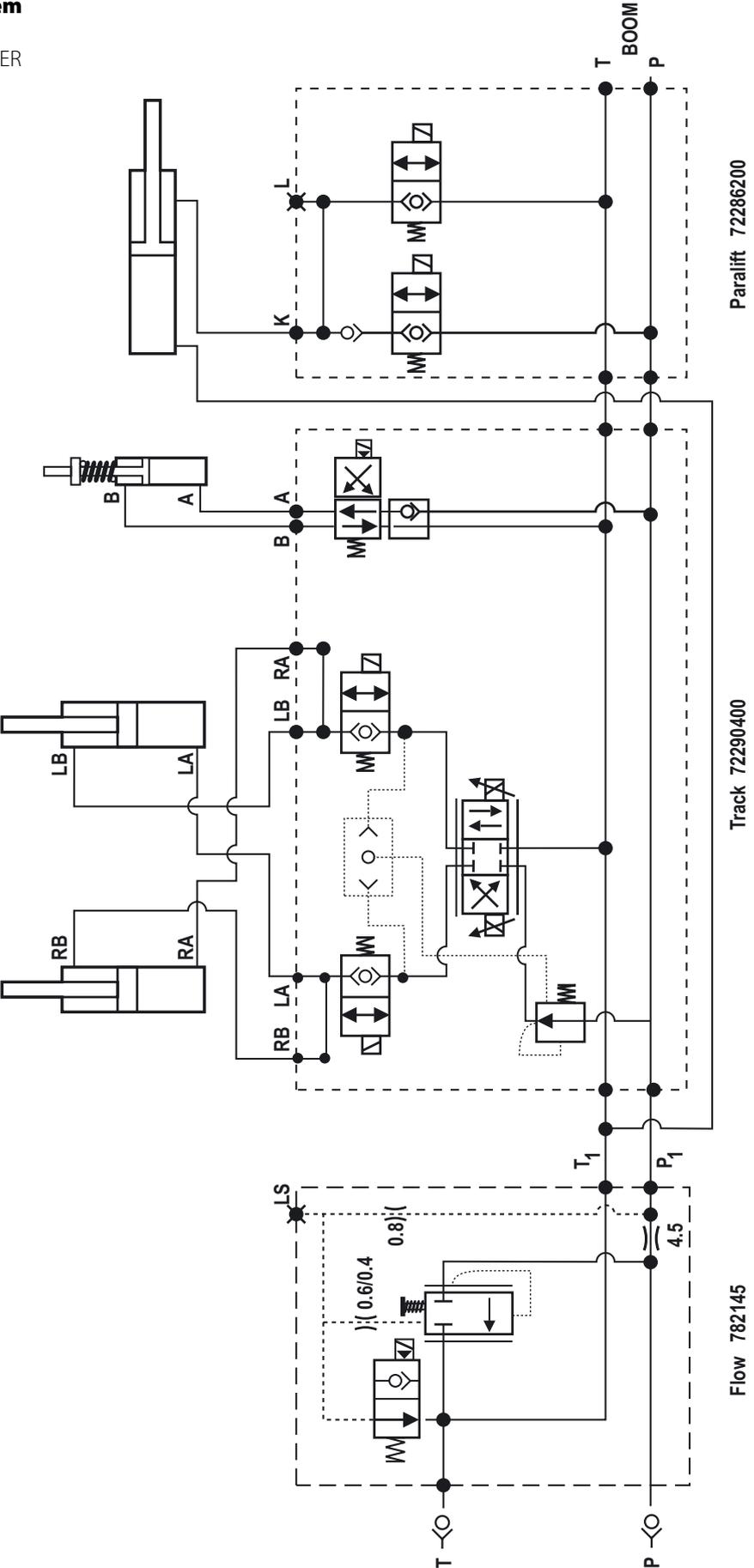
If the sensor is working correctly the red LED will pulse with each revolution of the spindle. If the Flow sensor is found to be functional, re-install it in the manifold taking care not to damage the "O" ring seal (use rubber grease on re-assembly).

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Hydraulic diagrams

New COMMANDER trailer hydraulic system

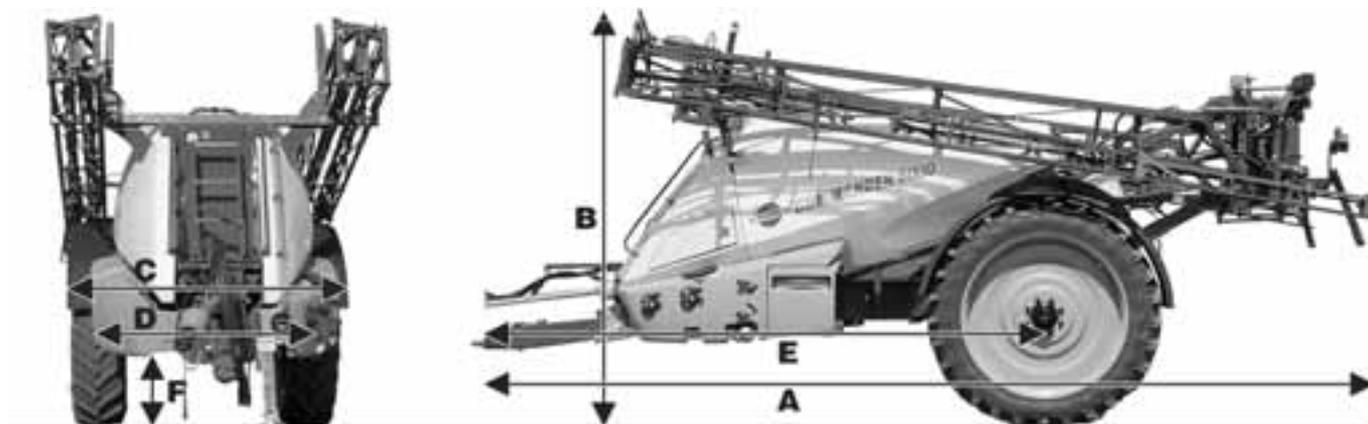
Hydraulic diagram for the New COMMANDER with optional SafeTrack steering.



## 8 - Technical specifications

### Dimensions

#### Overall dimensions



	<b>A</b>	<b>B</b>	<b>C1*</b>	<b>C2**</b>	<b>D</b>	<b>E</b>	<b>F</b>
5000	7.30	3.60	2.55	3.00	1.50 to 2.25	4.80	0.8
7000	7.80	3.60	N/A	3.00	1.50 to 2.25	5.30	0.8
9000	8.85	3.65	N/A	3.50	2.20 to 3.00	6.05	xx

\*SPB/SPC boom

\*\*FTZ FORCE and HAZ TWIN FORCE boom

All measures are in meters.

#### Weight

	<b>5000*</b>	<b>5000**</b>	<b>7000*</b>	<b>7000**</b>	<b>9000*</b>	<b>9000**</b>
Weight at drawbar:	500	1350	700	2100	1095	xxxx
Weight on axle:	3000	6000	3920	7800	5400	xxxx
Weight total:	3500	7350	4620	9900	6495	25495

\*Weights with empty tank

\*\*Weights with full tank

All weights in Kilograms (Kg.)

#### Wheel and axle dimensions

<b>Wheel</b>	<b>Short axle</b>	<b>Long axle</b>	<b>Mudguard's</b>	<b>Clearance*</b>
11.2x48"	1500-2000 mm	1800-2250 mm	345 mm	700 mm
12.4x46"	1500-2000 mm	1800-2250 mm	345 mm	705 mm
12.4x52"	1500-2000 mm	1800-2250 mm	N/A	790 mm
13.6x48"	1520-2000 mm	1800-2250 mm	345 mm	735 mm
18.4x38"	N/A	1800-2250 mm	590 mm	675 mm
20.8x38"	N/A	1800-2250 mm	590 mm	695 mm

\*under axle

## 8 - Technical specifications

### Conversion factors: Metric to Imperial units

As a general rule metric units of measure are used in this manual, however the following conversion table is provided for the occasions where imperial measures occur.

	Metric	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
Velocity	km/h	mile/h	x 0.621
	km/h	m/s	x 0.277
Quantities/Area	l/ha	gal/acre	x 0.089
Volume	ml	fl. oz	x 0.0352
	l	Imp. pt.	x 0.568
	l	gal	x 0.22
Pressure	bar	lb./inv (p.s.i.)	x 14.504
Temperature	°C	°F	(°C x 1.8) + 32
Power	kW	hp	x 1.341
Torque	Nm	lb.ft.	x 0.74

## Specifications

Pump Specifications are given on the Specification tag on each unit and duplicated here for general reference.

### Pump model 463/5.5

HARDI HARDI INTERNATIONAL A/S TAASTRUP DENMARK				
Type 463/5.5 r/min.max. 1100				
No.				
r/min.	l/min.	bar	kW	
1000	295	0	3.1	
1000	256	max.15	7.5	

### Pump model 463/10.0

HARDI HARDI INTERNATIONAL A/S TAASTRUP DENMARK				
Type 463/10 r/min.max. 700				
No.				
r/min.	l/min.	bar	kW	
540	276	0	1.8	
540	256	10	5.9	
		max.15		

### Pump model 463/6.5

HARDI HARDI INTERNATIONAL A/S TAASTRUP DENMARK				
Type 463/6.5 r/min.max. 1100				
No.				
r/min.	l/min.	bar	kW	
1000	338	0	3.2	
1000	280	max.15	10.3	

### Pump model 463/12.0

HARDI HARDI INTERNATIONAL A/S TAASTRUP DENMARK				
Type 463/12 r/min.max. 600				
No.				
r/min.	l/min.	bar	kW	
540	322	0	2.2	
540	295	max.15	7.4	

### Filter mesh specifications

Filter gauze width

30 mesh: 0.58 mm

50 mesh: 0.30 mm

80 mesh: 0.18 mm

100 mesh: 0.15 mm

## 8 - Technical specifications

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### 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)

---

### Power consumption

The following table is provided as a guide only and represents the minimum power requirements for tractors, operating under ideal conditions (ie: flat terrain and firm ground).

Sprayer	Hp	kW
5000	100	75
7000	140	104
9000	180	134

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**Attention:** Sprayers fitted with HAZ Twin Force booms require an additional 60 Hp (45 kW) to be added to the above figures.

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### Brakes

Max. wear rates on brake components:

Max. drum diameter: For 5000 sprayers: 302 mm (11.8897 in); For 7000 and 9000 sprayers: 402 mm (15.8388 in)

Min. lining thickness: For 5000 sprayers: 2.0 mm (0.07874 in); For 7000 and 9000 sprayers: 4.0 mm (0.15748 in)

### Hydraulic brake specifications

Max. hydraulic pressure: 120 bar (2176 p.s.i.)

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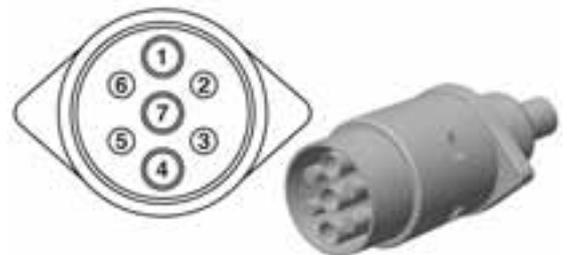
## Electrical connections

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### Rear lights

The wiring is in accordance with ISO 1724.

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

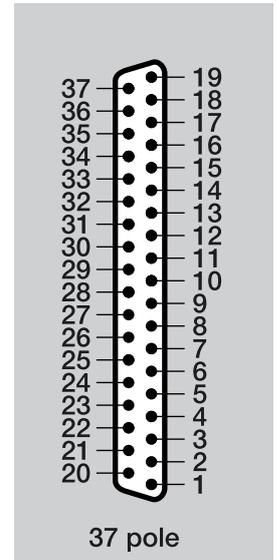
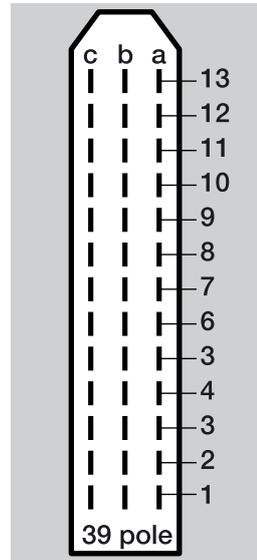


## 8 - Technical specifications

### Electrical connections for SPRAY and SPRAY II

39 or 37 poled plug with cable.

39-pole	37-pole	SPRAY	SPRAY II
1a	5	S1+	S1+
1b	6	S1-	S1-
1c	26	End nozzle L	End nozzle L
2a	7	S2+	S2+
2b	8	S2-	S2-
2c	25	End nozzle R	End nozzle R
3a	9	S3+	S3+
3b	10	S3-	S3-
3c	29	+12V sensor	+12V sensor
4a	11	S4+	S4+
4b	12	S4-	S4-
4c	4	GND1	PWM 1TX
5a	14	S5+	S5+
5b	15	S5-	S5-
5c	27	GND2	GND
6a	16	S6+	S6+
6b	17	S6-	S6-
6c	13	GND3	Optional 5 Reg. feedback
7a	18	S7+	S7+
7b	19	S7-	S7-
7c	33	Option1 4-20mA	Option 1 4-20mA
8a	37	3-pos 1a	S8+
8b	36	3-pos 1b	S8-
8c	32	Option2 Frq	Option 2 Frq
9a	35	3-pos 2a	S9+/Air angle 0-5V
9b	34	3-pos 2b	S9-/Fan speed 0-5V
9c	not connected	(Option3)	Option 3/Tank gauge
10a	21	On/off+	On/off+
10b	22	On/off-	On/off-
10c	not connected	(Option4)	PWM Output option
11a	23	Pressure+	Pressure+
11b	24	Pressure-	Pressure-
11c	28	Flow	Flow
12a	20	FM up	Foam blop 0-5V
12b	1	FM dn	option 4 Rx
12c	31	Speed	Speed
13a	3	FM L	FM L
13b	2	FM R	FM R
13c	30	Gnd sensor	Gnd sensor



## 8 - Technical specifications

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### EFC

When connecting an optional function into the EFC distribution box be aware that the maximum current for every connection is 2 Amp. The total current draw allowed for the whole connector box may not exceed 10 Amp.



Remember that as a rule the sprayers internal wiring is colour coded:

Blue.....= + Positive

Brown.....= - Negative



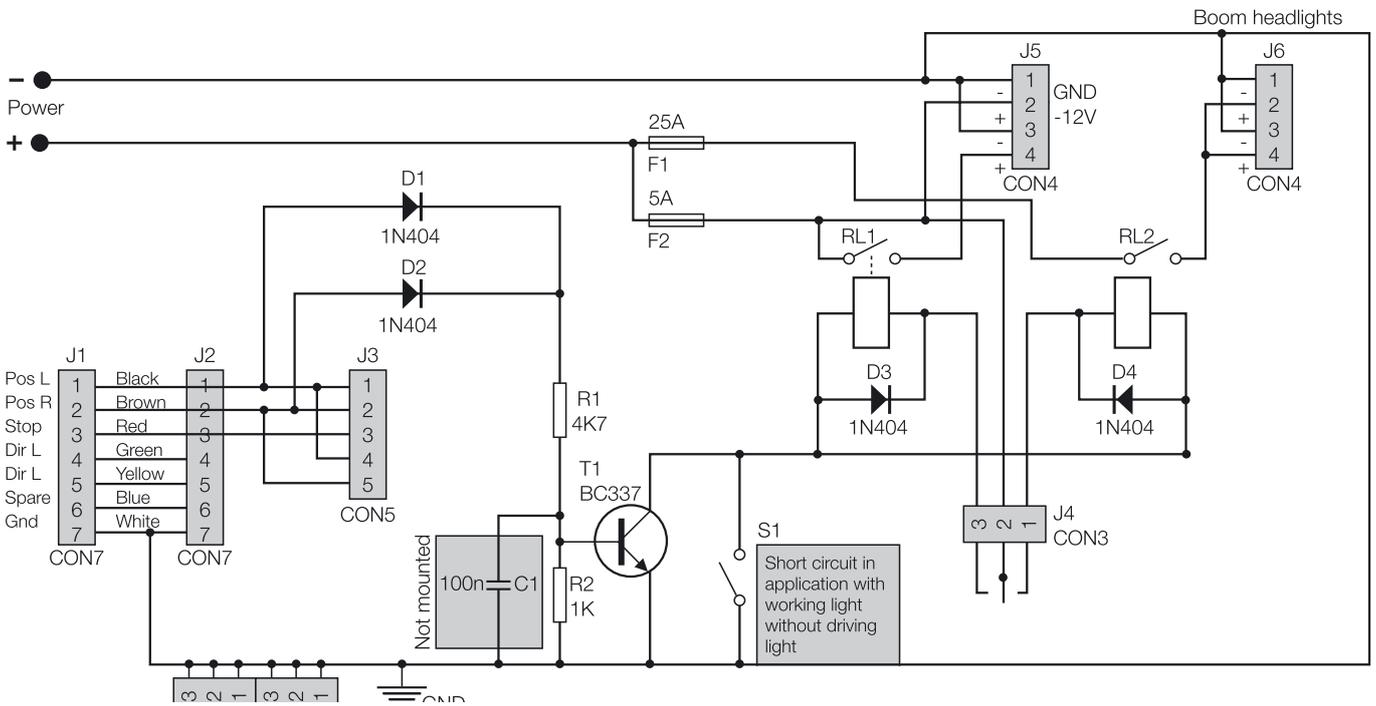
**Attention:** For more information on EFC circuit board service, see *EFC service procedure* in the "Maintenance section" of this manual

# 8 - Technical specifications

HC 5500	Function	Pos	Sig.	Neg		
Opt 1	Pressure sensor	Brn	Blu	-		
Opt 2	RPM sensor or anemometer	Brn	Blu	Blk		
Speed		Brn	Blu	Blk		
Flow		Brn	Blu	Blk		
L end nozzle	Pendulum lock at HAY/LPY	Brn		Blu		
R end nozzle	Pendulum lock at HAY/LPY	Brn		Blu		
Reg (Yellow)		Brn		Blu		
Bypass	EC on/off	Brn		Blu		
Sec 9	User defined A&B 2	x		x		
Sec 8	User defined A&B 1	x		x		
Sec 7	Twin speed	Brn		Whi		
Sec 6	Twin angle	Yel		Gre		
Sec 5		Brn		Blu		
Sec 4		Brn		Blu		
Sec 3		Brn		Blu		
Sec 2		Brn		Blu		
Sec 1		Brn		Blu		
		Gnd	L	R	-	+
Foam marker	No. 4 Not used	2	6	5	1	3

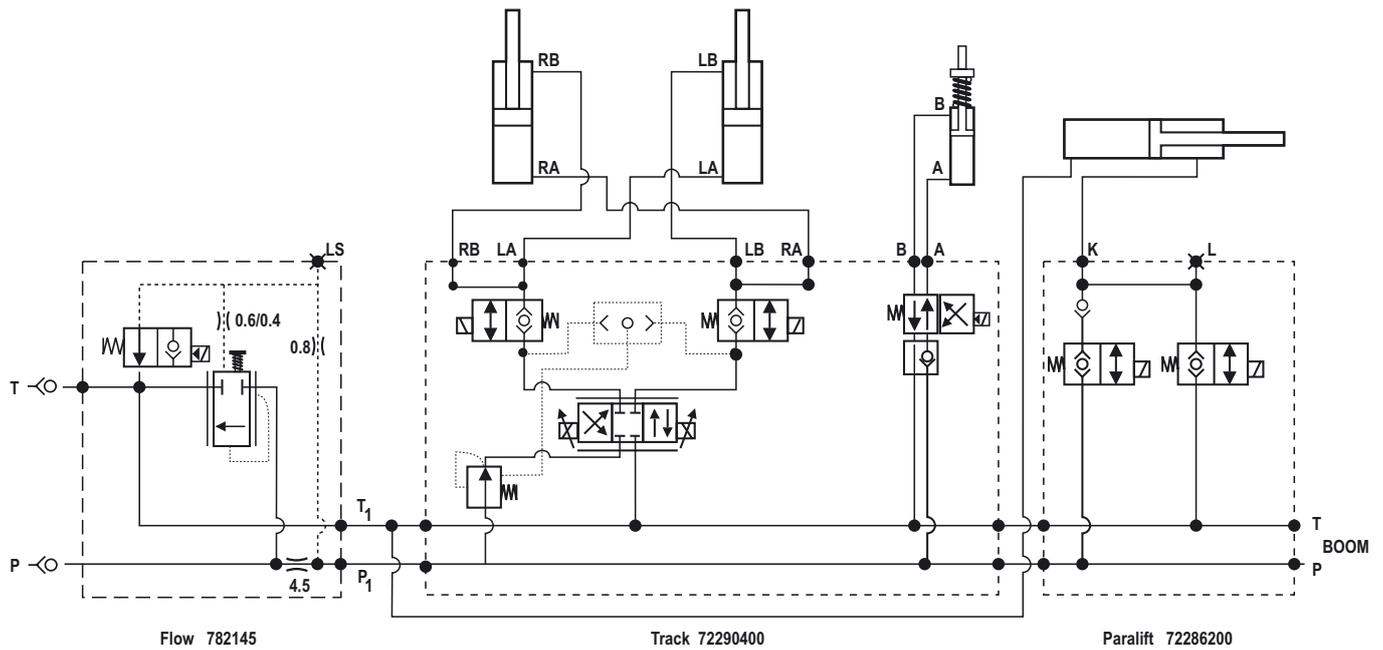
## Diagrams

### Electrical circuit diagram for boom and work light



# 8 - Technical specifications

## Sprayer hydraulics



## Materials and recycling

### Disposal of the sprayer

When the equipment has completed its working life, it must be thoroughly cleaned and de-contaminated before disposal. The tank, hoses and synthetic fittings can be incinerated at an authorised disposal depot. The metallic parts can be scrapped. Contact your local Authorities for information regarding safe disposal of the following materials:

- 1) Tank: HDPE
- 2) Hoses: PVC
- 3) Valves: mainly glass-filled PA.
- 4) Fittings: PA

## Further information

### HARDI spare part and technical support

HARDI Australia continues to invest heavily in research and development of sprayer technology to bring the best and most innovative spray products to the Australian market.

In addition our spare parts and field support staff are working closely with our regional dealer network to provide you the best after sales service and technical advice available.

Further information about spraying, our organisation and it's product range is available through your HARDI dealer or visit our web site at: [www.hardi.com.au](http://www.hardi.com.au)

### Spare part information

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#### **HARDI spare parts pages**

HARDI Australia would like to advise that the spare parts pages for the NEW COMMANDER are in development and will be included in the next issue of this manual.

In the meantime, either contact your HARDI dealer, log onto **www.agroparts.com** (register for free and click on the HARDI International Spare parts and service link) or visit our web site at:

**www.hardi.com.au**

**We apologise for any inconvenience.**

## 1 - Entanglement

	Risk item	Risk Assessment	Control measure
#	Can anyone's hair, clothing, gloves, jewellery, cleaning brushes, rags or other material become entangled in moving parts of plant	YES – If in contact with an exposed PTO shaft	Operators to ensure appropriate PTO guards are in place – see manual for details. Turn off tractor before servicing

## 2 - Crushing

#	Can anyone be crushed due to:		
<b>A</b>	Material falling off the plant	Yes- If improperly secured on trailer	Operator to ensure all parts are properly secured – visual inspection required before start-up
<b>B</b>	Uncontrolled or unexpected movement of the plant	Yes- If improperly secured to tractor or if used on excessively inclined slopes  Yes – Unhitching trailer on uneven ground or slope may cause trailer to roll	Operator to ensure trailer is properly secured to tractor – see manual for details  Always unhitch trailer on level firm ground and when tank is empty
<b>C</b>	Lack of capacity of plant to be slowed, stopped or immobilised	Yes – if improperly controlled from tractor	Operator must be trained to ensure that the trailer is controlled from the tractor in the required manner
<b>D</b>	Plant tipping or rolling over	Yes – If improperly secured to the tractor or if it is used on excessively inclined slopes and if improperly controlled from the tractor  Yes- If the trailer's steering system is applied manually when turning tight corners at high speeds	Ensure the tractor is of a suitable size and horse power to operate the trailer. Use a low gear on steep inclines. The trailer will tend to push the tractor into downhill turns, so reduce speed accordingly. Operator to ensure the trailer is properly secured to the tractor (see operators manual for details of set-up). Please note: Swivel drawbar hitches are fitted as standard on trailers with steering option. Operator to ensure the trailer is operated at a safe turning speed, taking into consideration field conditions and terrain (see operators instruction manual for further details).
<b>E</b>	Parts of the plant collapsing	Yes – If fasteners are not tightened to specifications	Periodic checking of all fasteners (bolts & Nuts etc) – see manual for details
<b>F</b>	Coming in contact with moving parts of the plant	Yes – If in contact with an exposed PTO shaft, wheels or boom when in motion Yes – breakaway claws on boom	Operator to ensure appropriate PTO guards are in place and not allow anyone near the boom or wheels when in motion - see manual for details.  Never place fingers in breakaway claws
<b>G</b>	Thrown off or under the plant	Yes – If standing on the Trailer while it is in motion	Do not allow passengers to ride on the Trailer when it is in motion – see manual for more details
<b>H</b>	Being trapped between the plant & materials of fixed structure	No	
<b>I</b>	Other factors not mentioned	No	

**3 - Cutting, Stabbing, Puncturing, Striking**

<b>#</b>	Can anyone be cut, stabbed or punctured due to:		
<b>A</b>	Coming into contact with sharp or flying objects	No	
<b>B</b>	Coming in contact with moving parts of the plant	Yes – If in contact with an exposed PTO shaft wheels or boom when in motion	Operator to ensure appropriate PTO guards are in place and not allow anyone near the wheels or boom when in motion - see manual for details
<b>C</b>	Plant, parts of plant or work pieces disintegrating	No	
<b>D</b>	Work pieces being ejected	No	
<b>E</b>	Mobility of the plant	No	
<b>F</b>	Uncontrolled or unexpected movement of the plant	Yes – If improperly secured to tractor or if used on excessively inclined slopes and if improperly controlled from tractor	See Control Measures in 2(A) and 2(B)
<b>G</b>	Other factors not mentioned	No	

**4 - Shearing**

<b>#</b>	Can anyone's body parts be sheared between two parts of the plant or between a part of the plant and a work piece or structure?	Yes – If on or near trailer while it is in operation.	Ensure no one rides on the Trailer when it is motion or is in area when operating boom – see manual for more details
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**5 - Friction**

<b>#</b>	Can anyone be burnt due to contact with moving parts or surfaces of the plant or materials handled by the plant?	No	Ensure no one rides on the Trailer when it is motion or is in area when operating boom – see manual for more details
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**6 - Pressure**

<b>#</b>	Can anyone come in contact with fluids/gases under high pressure due to plant failure or misuse of the plant?	Yes – If pressure hoses burst due to damage or improper fittings	Operator to inspect (before start-up) all hoses for damage and improper fittings and take corrective action where necessary
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## 7 - Electrical

<b>#</b>	Can anyone be burned or injured by electric shock due to:		
<b>A</b>	Plant contacting live electrical conductors	Yes	Operator must be aware of any electrical conductors present (overhead, on ground or in ground) in the area of the field being sprayed or travelling to or from the field.
<b>B</b>	Plant working in close proximity to electrical conductors	Yes	Operator must be aware of any electrical conductors present (overhead, on ground or in ground) in the area of the field being sprayed or travelling to or from the field
<b>C</b>	Overload of electrical circuits or lack of isolation procedures	No	
<b>D</b>	Damaged or poorly maintained electrical leads, cables	Yes- Low voltage only	Inspect and replace damaged leads, switches or connections
<b>E</b>	Damaged electrical switches	No	
<b>F</b>	Water near electrical equipment	Yes- operating near electrical equipment is dangerous	Do not operate near electrical equipment
<b>G</b>	Other factors not mentioned	No	

## 8 - Explosion

<b>#</b>	Can anyone be injured by explosion of gases, vapours, liquids, dusts or other substances, triggered by the plant?	No	
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## 9 - Slips, Trips and Falls

<b>#</b>	Can anyone using the plant or in the vicinity of the plant, slip, trip or fall due to:		
<b>A</b>	Un-even or slippery work surface	YES – Depending on the ground surface and the task to be performed. Slope angle, slippery surface will affect safety.	Use handrails provided. Operator to perform risk assessment of task and conditions.
<b>B</b>	Poor housekeeping, e.g. spillage not cleared, build up of waste	Yes	Operator to maintain a safe work area.
<b>C</b>	Obstacles being placed in the vicinity of plant	No	
<b>D</b>	Other factors not mentioned	No	

**9 - Slips, Trips and Falls (continued)**

#	Can anyone fall from a height due to:		
<b>A</b>	Lack of proper work platform	Yes – If the platform is dirty or slippery due to mud or water and if the hand-rails are missing or damaged.	Keep work platform clean all times and ensure hand-rails and steps are in good condition.
<b>B</b>	Lack of proper stairs or ladders	No	
<b>C</b>	Lack of guard rails or other suitable edge protection	No	
<b>D</b>	Steep walking surfaces	No	
<b>E</b>	Collapse of supporting structure	No	
<b>F</b>	Other factors not mentioned	No	

**10 - Ergonomics**

#	Can anyone be injured due to:		
<b>A</b>	Poorly designed seating	No	
<b>B</b>	Repetitive body movement	Yes - Continuous movement on tractor and sweeping head and arm movements	Rest when needed
<b>C</b>	Constrained body posture or the need for excessive effort	No	
<b>D</b>	Design deficiency causing mental or psychological stress	No	
<b>E</b>	Inadequate or poorly placed lighting	No	
<b>F</b>	Lack of consideration given to human error or behaviour	Yes	Must operate responsibly & only perform tasks that unit is designed for. If in doubt, always consult manual or an authorised HARDI representative
<b>G</b>	Other factors not mentioned	No	

**11 - Suffocation**

#	Can anyone be suffocated due to lack of oxygen or atmospheric contamination?		
		Yes – Main Tank may contain dangerous fumes	Never enter the main tank

## 12 - High Temperature or Fire

<b>#</b>	Can anyone be injured due to:		
<b>A</b>	Coming in contact with objects at high temperature	No	
<b>B</b>	Can anyone be injured by fire	No	
<b>C</b>	Can anyone suffer ill-health due to exposure to high or low temperature	No	
<b>D</b>	Other factors not mentioned	No	

## 13 - Other Hazards

<b>#</b>	Can anyone be injured or suffer ill-health from exposure to:		
<b>A</b>	Chemicals	Yes- Due to spills or equipment failure	Personal protection equipment must be worn. Inspect all hoses, guns, fittings and clamps and replace if worn. Follow chemical manufacturers label instructions
<b>B</b>	Toxic gases or vapours	Yes- Incorrect chemical use	Read chemical label to ensure suitability. Check with chemical manufacturer before mixing chemicals
<b>C</b>	Fumes	Yes- Incorrect chemical use	Read chemical label to ensure suitability. Check with chemical manufacturer before mixing chemicals
<b>D</b>	Dust	No	
<b>E</b>	Noise	No	
<b>F</b>	Vibration	No	
<b>G</b>	Radiation or Lasers	No	
<b>H</b>	Other factors not mentioned	No	

## 14 - Condition / Suitability

<b>#</b>	Are there other hazard sources such as:		
<b>A</b>	The condition of the plant: Is it old? What's its service / maintenance history? How hard has the plant been worked? Has it been constantly or rarely?	Yes- poorly maintained equipment increases risk	Inspect & service as required – see manual for more details
<b>B</b>	The suitability of the plant for its intended purpose, ie: is it being used for its intended purpose? If not what hazards arise from its unintended use?	Yes – if the trailer used for purposes other than its intended use eg., carrying people, transport materials etc	Trailer-sprayer must be used only for its intended purpose

## 15 - Environment

#	Does the location of the plant:		
A	Affect safety in the area where it is located?	Yes- Toxicity level of product used will determine the level of hazard	Be aware of withholding periods and task suitability of the chemical being used. Information found on product label/NSDS if unsure contact product manufacturer. Minimise spray drift by using correct size nozzles and pressures as described in manual. DO NOT spray on days where conditions increase the risk of spray drift
B	Affect the safety of the factory environment / terrain?	Yes- Toxicity level of product used will determine the level of hazard	
C	Affect other people in the vicinity?		

## 16 - Abnormal Situations

A	Are there any abnormal situations, misuse or fluctuations in operating conditions which you can foresee?	Yes- If operated by an untrained person	Trailer and/or Sprayer should only be operated by a trained person
B	Would the failure of the plant have any adverse effect?	No	
C	What would be the effect of a loss of load, contents, unintended ejection of work pieces etc?	No	
D	Can the plant be moved or operated inadvertently?	Yes – If not secured correctly to tractor or if jack is not secured and positioned correctly	Operator to ensure correct attachment to tractor and correct positioning of the Jack when detached from tractor

## 17 - Systems of Work

A	Do the systems of work present a concern?	Yes	Operators to have Standard Operating Procedures in place for all processes encompassing before, during and after spraying.
B	Could they create any hazard?	Yes - Improper systems of work can create any of the above hazards	Improper systems of work can create any of the above hazards.
C	What are the arrangements for access and egress to plant during operation; for maintenance; in an emergency?	Improper access and egress can create any of the above hazards	Proper housekeeping and systems of work should be incorporated by the operator.
D	Does the safety of the plant depend on the competence of the operator?	Incompetent operator can create any of the above hazards	Operator training and understanding of all the operations and safety aspects of the trailer
E	Current control measures : are there any? are they effective?	Control measures as identified above must be implemented and monitored to operate the trailer-sprayer in a safe manner.	

