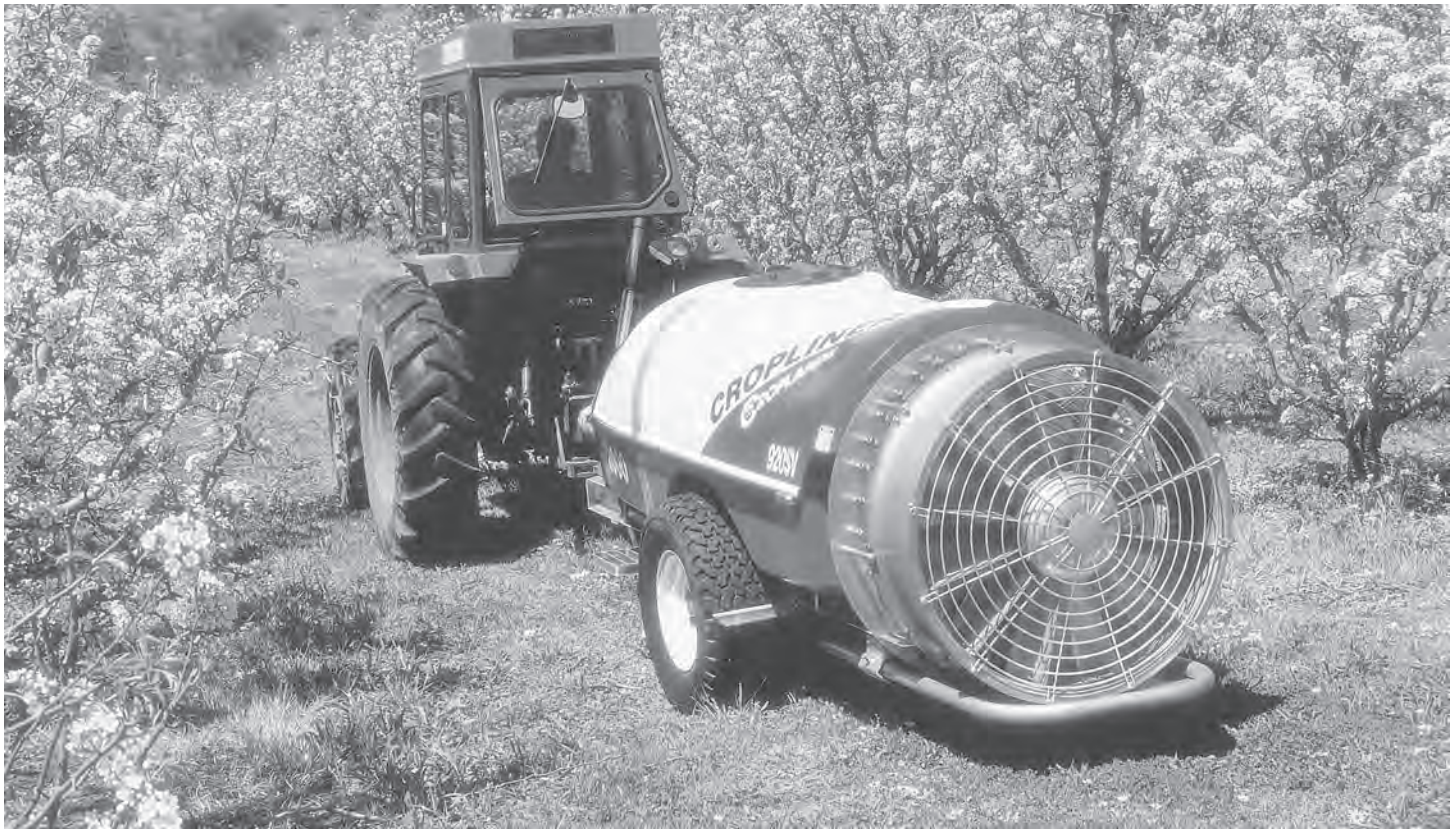
CROPLANDS

Cropliner



Parts & Operator's Manual

Part No. HTPOM 009612

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Welcome to Croplands

Congratulations on your astute purchase of this Croplands Sprayer!

This high quality, Australasian made sprayer is backed by local service and a highly reputable company with years of experience and dedication to the rural industries of Australasia.

We are committed to research and development of new and better spraying technology. We also welcome user comments on our product and service.

Our objective is simply to be the most excellent supplier of chemical application equipment in Australasia. Your communication will benefit both of us.

We recommend you read this manual thoroughly so that you are well versed with the proper operation and maintenance of your sprayer.

Properly used this sprayer will give you years of efficient, reliable operation.

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Product Identification

Serial Number Location

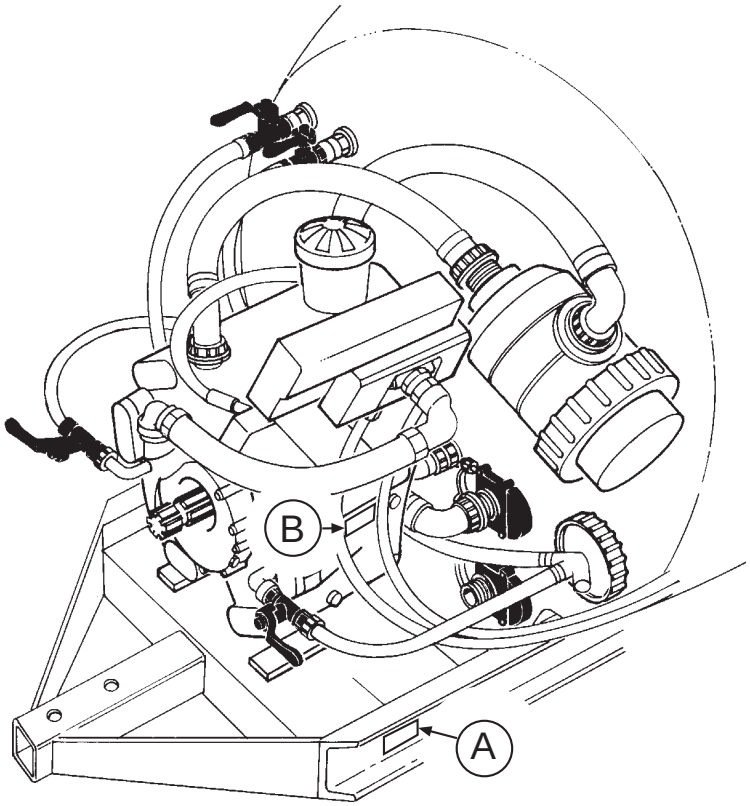
Always use the serial number of the Cropliner when requesting service information or when ordering parts. Early or later models (identification made by serial number) may use different parts, or it may be necessary to use a different procedure for specific service operations.

Cropliner Serial Number Plate

The Cropliner Serial Number Plate is located on the main frame at the front of the frame near the drawbar **(A)**. This plate shows name of manufacturer, serial number, date of manufacture, tare weight and maximum towing (transport) speed.

Pump Serial Number Plate

The Pump Serial Number Plate is located on the pump **(B)**.This plate shows name of manufacturer, serial number, type of pump, year of manufacture, maximum flow rate and maximum working pressure of the pump.



Shipping Information & Assembly Instructions

Shipping Information

The following shipping information is provided but variations can occur without prior notification.

Dry Weight (approx)	1500 litre	600kg
(fitted with 820SV fans)	2000 litre	640kg
	3500 litre	900kg
Dimensions (m)		
W x L x H	1500 litre	1.4 x 3.8 x 1.45
	2000 litre	1.4 x 4.5 x 1.45
	3500 litre	1.85 x 4.6 x 1.8

Maximum Towing Speed: Do not exceed 20kph when towing on roads.

Assembly Instructions

The Cropliner is supplied fully assembled with only four components requiring some assembly after shipping from the factory:

- Tractor to Cropliner PTO shaft.
- Manual Controller (if ordered).
- Electric QP Controller (if ordered).
- MT3000 Controller (if ordered).

Tractor to Cropliner PTO Shaft

The PTO shaft has been fitted and fully tested at the factory but has been disconnected and packed for transit. Follow the instructions below to fit and operate the unit after transit:

1 Remove the PTO shaft which is strapped to the Cropliner frame.
2 Check the PTO shaft has not been damaged in transit.
3 Grease the universal joins and telescoping shafts.
4 Fit PTO to the Cropliner.

Manual Controller (if ordered)

The manual By-Matic controller that has been fitted and fully tested at the factory is packed around the pump for transit. Follow the instructions below to fit and operate the unit after transit:

1 Unpack the manual controller from under the front cover of the Cropliner.
2 Unfold the controller hose connection and fit the manual controller onto the tractor in a convenient and safe position for the operator.

Electric QP Controller (if ordered)

The electric QP Controller has been fitted and fully tested at the factory but has been disconnected and packed for transit. Follow the instructions below to fit and operate the unit after transit:

1 Unpack the QP controller from the Cropliner.
2 Connnect the QP controller couplings together, and fit the controller console onto the tractor in a convenient and safe location for the operator.
3 Follow the QP controller instructions to connect the unit power connections to the tractor battery.
4 Follow instructions to test, calibrate and operate the QP controller.

MT3405 Controller (if ordered)

The MT3405 controller has been fitted and fully tested at the factory but has been disconnected and packed for transit. Follow the instructions below to fit and operate the unit after transit:

1 Unpack the MT3405 controller from the Cropliner.
2 Connnect the MT3405 controller couplings together, and fit the controller console onto the tractor in a convenient and safe location for the operator.
3 Locate the MT3405 operators manual and follow the instructions to connect the unit power connections to the tractor battery.
4 Follow the instructions in the MT3405 operators manual to test, calibrate and operate the controller.

Description & Specification

The Cropliner airblast sprayers provide versatility and efficiency with unique capabilities in air volume, spray volume and droplet size control. Air volume, spray volume and droplet size can be varied from ultra low volume to high volume applications to meet specific crop requirements. Sprayers incorporate high performance, easy to use operator controls and safety features.

Cropliner Specifications

Tank Size: 1500, 2000 & 3500 litres
Fibreglass construction with calibrated sight gauge. Quick release, hinged lid, premix filling basket, sump, tank baffles, supa mix and venturi agitators. QP models have tank rinsing and chemical induction facilities.

Fan Range: High quality, proven fans with 2 speed gearbox and centrifugal clutch in 720, 820 & 920mm fan diameters. Variable pitch blades fitted to 720, 820 & 920mm fans. Larger models available with or without straightening vanes (SV).

Pump Range: Croplands A & R constant displacement, high pressure diaphragm pumps fitted with long life, chemical resistant diaphragms - designed for long life, economy and ease of maintenance.
- AR 904 95 l/min 5000 kPa (711 psi)
- AR 1105 120 l/min 5000 kPa (711 psi)
- AR 1254 130 l/min 5000 kPa (711 psi)
- AR 1554 156 l/min 5000 kPa (711 psi)
- AR 1900 185 l/min 6000 kPa (853 psi)
- Also piston type available 230 l/min 5000 kPa (711 psi)

Controller Range:
- Manual multi-outlet control valves
- Electric remote control valves (mechanical type)
- Electric remote pressure regulation
- Spray application monitor (Flow Trak)
- Automatic rate controller (MT3405).

Drive: Heavy duty PTO shaft with safety covers to tractor. Optional Wide Angle PTO shaft (standard - QP models).

Chassis: Heavy duty, galvanised, corrosion resistant design. Height adjustable axles with optional spacers. Adjustable swivel draw bar, jockey wheel, rear bumper bar and leaf deflector.

Filtration: Full filtration system - tank filling basket, suction line and pressure line filters.

Agitation: Supa mix and venturi agitators with valve control.

Chemical Handling: Fully integrated suction probe. Powder and granular basket.

Tank Cleaning: Optional fully integrated self rinsing facility (standard on QP models).

Machine specifications are subject to change without prior notification.

Description & Specification

Fan Output and Power Specifications

Fan Dia.	No. of non-drip Rollover Nozzles	Gear selection	Blade pitch	Fans W/O Straightening Vanes		Fans with Straightening Vanes	
				Air output M3/HR	Power required KW (HP)	Air output M3/HR	Power required KW (HP)
720mm	12	1st	25°	43000	13 (17)		
			35°	45000	13 (18)		
			45°	48000	14 (19)		
		2nd	25°	46000	14 (19)		
			35°	52000	17 (21)		
			45°	57000	19 (23)		
820mm	20	1st	25°	42000	15 (20)	51000	18 (24)
			35°	46000	17 (22)	56000	20 (27)
			45°	52000	19 (25)	63000	23 (30)
		2nd	25°	50000	18 (24)	60000	22 (29)
			35°	60000	23 (31)	72000	28 (37)
			45°	72000	27 (36)	85000	32 (43)
920mm	20	1st	25°	52000	20 (26)	62000	23 (31)
			35°	61000	23 (31)	74000	28 (37)
			45°	68000	26 (35)	82000	31 (42)
		2nd	25°	63000	24 (32)	76000	28 (38)
			35°	74000	29 (39)	89000	35 (47)
			45°	80000	31 (42)	95000	38 (51)

Description & Specification

Estimated kW Required at PTO

Please note estimated kW (HP) requirements are based on medium pitch fan blade and pump operating at 20 bar(300psi) at 540rpm.
Estimates do not include power required to pull sprayers.

FAN SIZE - PUMP MODEL (Diameter)	MINIMUM PTO POWER KW (HP)	GEARBOX LOW GEAR KW (HP)	GEARBOX HIGH GEAR KW (HP)	MAXIMUM PTO POWER KW (HP)
720mm SINGLE SPEED FAN - AR904 - AR1105				 24 (32) 26 (35)
720mm STANDARD FAN 720mm - AR1105/1254		25 (34)	30 (40)	25 (34)
820SVmm - AR1554 820SVmm - AR1254/1105	31 (42) 30 (40)	34 (46) 31 (42)	42 (56) 39 (52)	46 (62) 43 (58)
920SVmm - AR1554 920SVmm - AR1254/1105	36 (48) 34 (46)	42 (56) 39 (52)	49 (66) 46 (62)	52 (70) 49 (66)

Pre-Delivery Check List

The Croplands dealer must check the following factors thoroughly to ensure the unit is in good order and operating correctly before delivery.

1 Operator's Manual Supplied
- Cropliner.
- MT3000 (if applicable).

2 Trailer
- Undamaged.
- Hitch adjustment bolt tight.
- Jockey wheel: check and lubricate.
- Wheel hubs:
    - Greased.
    - Bearings adjusted.
    - Split pin and dust caps in place.
- Wheel nuts tight.
- Tyre pressure 250kPa (35psi).
- Main axle adjustment bolts tight.
- Sump Guard in place.
- Rear bumper bar and leaf deflector in place.

3 Tank
- Undamaged.
- Check mounting bolts are in place.
- Check all outlets sealed:
    - Suction line.
    - Drain outlet.
    - By-pass line.
    - Mixing basket line.
    - Agitators.
- Check tank lid opens and seals shut correctly.
- Chemical mixing basket in place.

4 Booms
- Undamaged.
- Check boom mounting clamps tight.
- Hose fittings tight.

5 Power Drive

(a) PTO to tractor:
- Check quick release pins operate easily and lock into place.
- Check universal joints work correctly.
- Adjust PTO length to suit tractor.
- Grease telescopic sliding shaft.
- Grease universal joints.
- Check safety shields are in place.

(b) Pump to Fan PTO:
- Check quick release pins are locked into place.
- Check universal joints work correctly.
- Grease universal joints.

6 Pump
- Check mountings.
- Check oil level.
- Check tightness of pump head bolts.
- Check correct air dome pressure - 200-280kPa (30-40psi).
- Check operation.
- Write in pump size .....

7 Suction Lines
- Undamaged.
- Wire reinforced suction hose.
- Hose unobstructed, no kinking, no restrictions.
- All joins sealed (no air leaks).
- Suction filter 50 mesh screen, clean and sealed.

Pre-Delivery Check List

8 Pressure Lines
- Undamaged.
- Hose unobstructed, no kinks, no restrictions.
- All joins sealed (no leakages) - check all joins from pump to filter to controller, solenoids and boom nozzles.
- Main pressure filter (80 mesh) clean.

9 Nozzles
- Undamaged.
- Nozzle not worn.
- Nozzles correct type throughout.
- Nozzle caps sealed (no leakages).
- Non-drip diaphragms working.
- Check all nozzle assemblies for cracks or leaks.
- Roll-overs operate correctly.

10 Agitation
- Check that tank agitation works.
- Check there are no leakages from joins.

11 Chemical Induction
- Check hose and probe undamaged.
- Check fittings seal correctly.
- Check induction system works.
- Check camlock fittings (cap and plug) are in place.

12 Controllers
- Check installation is correct.
- Check battery is connected on QP units.
- Fully check operation of controller and control valves.

13 Valves
- Check all manual valves open and close easily and do not leak.

14 Fan Gearbox
- Check gearbox oil level.
- Check gear lever clearance.
- Check neutral and gear engagement.

15 Fan
- Check blade pitch settings.
- Check centrifugal clutch works.
- Check blades undamaged.
- Write in fan size .....

16 Fan Housing
- Undamaged.
- Bolts tight.
- Fan guard fitted securely.
- Volutes fitted correctly (if applicable).

17 Decals
- Check all decals are on the machine.
- Ensure all safety and warning decals are in place.

Warranty Policy

Croplands Equipment Pty Ltd (trading as Croplands) warrants to its authorised Dealer, who in turn, warrants to the original purchaser (Owner) that each new Croplands' sprayer, part or accessory will be free from proven defects in material and workmanship for twelve (12) months after delivery to the first Owner according to the conditions outlined.

This warranty does not cover damages resulting from abuse, accidents, alterations, normal wear or failure to maintain or use the Croplands product with due care.

During the warranty period, the authorised Croplands Dealer shall repair or replace, at Croplands option, without charge for parts and labour any part of the Croplands product which fails because of defects in material or workmanship. The Owner must provide the authorised Dealer with prompt written notice of the defect (within 14 days of its occurrence), and allow reasonable time for replacement or repair.

Croplands (at its option) may request failed parts to be returned to the factory. Any travel time of a service technician and/or transportation of the Croplands product to the authorised servicing Dealer for warranty work are the responsibility of the Owner.

This warranty is in lieu of all other warranties (except those of title), expressed or implied, and there are no warranties of merchantability or fitness for a particular purpose.

In no event shall the authorised selling Dealer or Croplands be liable for downtime expenses, loss of chemicals, loss of machine use or other incidental, consequential or special damages.

Conditions of Warranty

1. The warranty is not transferable.
2. The Warranty Registration Form must be returned to Croplands by the Owner Operator within 14 days of taking delivery of the unit.
   Only when warranty registration is completed and returned, can Croplands fulfill all warranty obligations.
3. **Components and conditions <u>not covered</u> by warranty are:**

Abuse — Failure resulting from neglect, such as improper operation, lack of required maintenance or continued use of a sprayer after the discovery of a defect which results in greater damage to the unit.

Environmental Conditions and Application — Deteriorated or failed components such as: diaphragms, O-rings, hoses, seals, electrical wiring and connections damaged by corrosive chemicals, dirt and sand, excessive heat or moisture. Owners should ensure the type and strength of chemicals used in the sprayer are compatible with the design of the unit.
Warranty determination for these types of failures will be made by Croplands only after inspection of failed components. In most instances these will incur inspection charges and cost of replacement parts.

Normal Wear — Normal wear and consumable items such as: oils and lubricants, diaphragms, filter elements, flow meters, clutches, fan belts, drive belts, pivot pins, paint, light bulbs and nozzles are considered to be normal wear items and are not warranted.

Maintenance — Component failure caused by not performing scheduled maintenance service such as: oils, grease, failure to clean tanks, pumps, filters, spray lines, nozzles or any other blocked components. Not tightening or replacing loose or missing bolts, nuts, fittings, shields and covers.

Damage — Damages or machine failure caused by carelessness or accidental damage, improper operation, inappropriate transportation or storage of the sprayer or attachment.

Power Source — Failures due to faulty or inadequate electrical sources of power. Owners who use their own 12 volt power source must make sure that it is suitable for operating the spraying equipment.

Alterations — Any unauthorised alteration, modification, attachments or unauthorised repairs to the Croplands sprayer or attachments. Written approval must be obtained from Croplands for any such items to maintain warranty.

Removal & Installation — The time taken to remove and re-install a warranted part or component into other brands of sprayers will not be covered by Croplands warranty. Only parts and labour directly attributable to the repair of the Croplands unit is covered.

Clean-up Time — Croplands does not pay for cleaning the sprayer, parts, accessories or work area before or after the warranty repair. Clean-up time is affected primarily by the application or conditions in which the sprayer is operated and maintained. Since clean-up time can be so variable, cleaning time should be considered a customer expense.

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Transportation Costs — Warranty does not cover transportation or insurance costs for sprayers or other equipment needing repair or replacement of warranted components. Nor does it cover any freight or insurance costs in obtaining new parts or returning old parts to Croplands for inspection purposes.

Travel Time — Travel time required for warranty repairs is the responsibility of the Owner.

Diagnostic Time — Warranty does not cover time required to diagnose a warranty problem.
Diagnostic time is affected greatly by the training and expertise of the technician employed to do the job. With proper training of service personnel, diagnostic time should be at a minimum.

Non-Genuine Parts — Croplands expects that Dealers will assign a well trained and proficient technician to handle any warranty repairs. Since Croplands is not in control of either of these responsibilities, we elect not to cover diagnostic time.

Unauthorised Repairs — Use of parts other than Croplands parts for repair of warranted parts will automatically negate any warranty. Warranted components must be replaced with genuine Croplands repair parts.
Repairs by an unauthorised agent will automatically forfeit any warranty. Warranty repairs must be carried out by an authorised Croplands Dealer only.

Safety Instructions

Safety is the Operator's Responsibility

The Cropliner is an airblast sprayer. In operation, it is rugged and useful under a wide variety of conditions. This presents an operator with hazards associated with on-road transport and off-road varying terrain applications. The Cropliner is capable of spraying a wide range of pesticides and fungicides and the operator must be aware of the hazards associated with the Cropliner's operation

The dealer explains the capabilities, application and restrictions of the Cropliner. The dealer demonstrates the safe operation of the Cropliner according to Croplands instructions materials; which are also available to operator. The dealer can also identify unsafe modifications or use of unapproved attachments.

The following publications provide information on the safe use and maintenance of the Cropliner and attachments:

- The Operator's Manual delivered with the Cropliner gives operating information as well as routine maintenance and service procedures. It is a part of the Cropliner and must stay with the machine when it is sold. Replacement Operator's Manuals can be ordered from your Cropliner dealer.

- The Cropliner has machine signs (decals) which instruct on the safe operation and care. The signs and their locations are shown in the Operator's Manual. Replacement signs are available from your Cropliner dealer.

Safe Operation Needs a Qualified Operator

A Qualified Operator Must Do the Following:

1 Understand the Written Instructions, Rules and Regulations

- The written instructions from Croplands are included in the Cropliner Operation & Maintenance Manual and on machine decals.

- Check the rules and regulations at your location. The rules may include any Federal and State safety requirements for the chemical applicator.

2 Have Training with Actual Operation

- Operator training must consist of a demonstration and verbal instruction. This training is given by your dealer before the Cropliner is delivered.

- The new operator must start in an area without bystanders and use all the controls until he can operate the Cropliner safely under all conditions of the work area.

3 Know The Work Conditions

- The operator must know any prohibited uses or work areas, he needs to know about excessive slopes and rough terrain.
- Wear protective clothing as recommended by the chemical manufacturer.
  Always wear safety goggles when maintaining or servicing Cropliner.
- For an operator to be qualified, he must not use drugs or alcoholic drinks which impair his alertness or coordination while working. An operator who is taking prescription drugs must get medical advice to determine if he can safely operate a machine.

Safety Instructions

Rules for Safe Cropliner Operation

Warning!

- Always read your sprayer operator's manual thoroughly before operating. Accidents occur every year because of careless use of farm chemicals and farm machinery. You can avoid these hazards by observing these safety instructions.
- Dispose of all chemical containers as per instructions on label. Failure to do so could result in contaminating the environment with chemicals.
- Inspect hose and hose connections daily. Always wear rubber gloves when tightening connections. Damaged, loose or worn hoses could result in operator being exposed to toxic chemicals which could result in serious illness or faulty sprayer operation.
- Always use the proper application rate. To assure proper application rate calibrate sprayer frequently. The wrong application rate of a pesticide concentration that is too high may expose the operator and the environment to danger.
- Follow the chemical manufacturer's precautions before cleaning the sprayer. Exposure to chemicals could result in serious illness or death.
- Always wear gloves and wash the machine before doing any disassembly repair work. Chemical residues on the machine parts could contaminate operator or service personnel causing serious illness.
- Always relieve system pressure before doing any work on the machine. Failure to do so could cause operator to be exposed to high pressure spray of chemical resulting in serious injury or machine damage.
- Always be sure all guards are properly installed on machine before operating. Failure to do so could result in entanglement in moving parts resulting in serious injury to operator.
- Always keep PTO guard in place when sprayer is operating. Failure to do this might result in entanglement.
- Always wear relatively tight and belted clothing to avoid entanglement in moving parts. Failure to do so could result in serious injury.
- Always stay out from under the sprayer unless it is resting on the ground or supported on solid blocks. Hydraulics or jacks could fail letting the sprayer fall. This could result in pinning or crushing of personnel.
- Check the entire sprayer, prior to each use, for any loose bolts or mechanical connections. These precautions can prevent injury to personnel and damage to equipment.
- Only inflate tyres to rated pressures. Over inflating causes tyres to burst resulting in serious injury.
- Use only genuine Croplands parts for any necessary replacement. Special alloy steels are used in many parts which are important to the equipment design. Home made parts may look the same but might be dangerous in operation.
- Do not ride on machine when in motion. This is an unsafe practice and can lead to serious injury should the rider fall from the machine.
- Always replace warning decals when damaged and make certain operator understands proper safety practices.
- Always stand well clear of sprayer when operating. The sprayer is capable of spraying chemicals 20-30 metres from the boom which may be hazardous to humans.
- Do not disconnect any hoses nozzles or filters while sprayer is operating. Disconnecting components while under pressure will result in uncontrolled spray discharge which may be hazardous to humans.

Safety Instructions

- Always clean the Cropliner and disconnect the battery before doing any welding repairs. Cover rubber hoses, and all other flammable parts. Keep a fire extinguisher near the Cropliner when welding. Have good ventilation when grinding or welding painted parts. Wear dust mask when grinding painted parts. Toxic dust or gas can be produced.

- Be sure to disconnect the battery before attempting welding repairs.

Rules for Safe Use of Chemicals

Warning!

- Always read the label before using chemicals. Follow instructions from chemical manufacturer on how to select, use and handle each chemical. Note protection information each time before opening the container.

- Always observe all warnings on chemical products. Failure to do so could result in operator or others being exposed to toxic chemicals which could result in serious illness. Remember chemical manufacturers go to much research and expense to develop labels for your protection.

- Be sure you recognise the categories of toxicity and their key words.

- Verbal warnings must be given if written warnings cannot be understood by workers.

- Do not spill chemicals on skin or clothing. If chemicals are spilled, remove contaminated clothing immediately and wash skin (and clothing) thoroughly with soap and water. Wash hands and face with soap and water and change clothing after spraying. Wash clothing each day before reuse.

- The spray tank and system should be emptied of chemical mixture and flushed with clean water before servicing the spray system or spraying components. Clean the Cropliner of all chemical residue before servicing.

- Avoid inhaling chemicals. When directed on the label, wear protective clothing, face shield or goggles.

- Never smoke while spraying or handling chemicals.

- Cover food and water containers when spraying around livestock or pet areas.

- If symptoms of illness occurs during or shortly after spraying, call a physician or go to a hospital immediately.

- Follow label directions and advice to keep residues on edible portions of plants within the limits permitted by law.

- Keep chemicals out of the reach of children, pets and unauthorized personnel. Store them outside of the home, away from food and feed and lock them in a secure area.

- Keep bystanders away from spray drift.

- Always store chemicals in original containers and keep them tightly closed. Never keep them in anything but the original containers. Read labels for hazards about chemical reaction with certain types of metals.

For further information, see pages 76-81, Chemical Handling and Safety.

Connection of Cropliner to Tractor

Hitching Cropliner to the Tractor

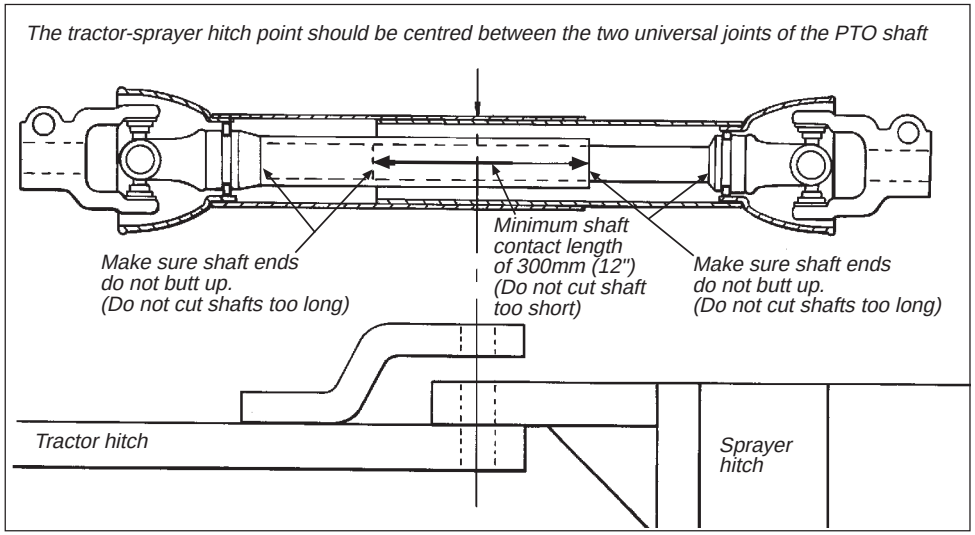
1 Align drawbars of tractor and Cropliner, insert and lock drawbar pin in position ensuring the drawbar pin cannot come out while transporting or operating. Lift up and/or remove the hitch jack for sprayer operation.
2 Check the Cropliner is level fore and aft. The sprayer should be slightly lower at the front. If not make the necessary adjustments to tractor and/or sprayer drawbars and axle to achieve level position.
3 Connect the Cropliner PTO shaft to the tractor following the instructions below on "Correct Positioning of the Hitch & PTO Shaft".
4 Connect the Cropliner controller to the tractor following the instructions given for the controller supplied.

Unhitching Cropliner from Tractor

1 Locate sprayer on level ground and chock wheels so that sprayer does not roll when drawbar pin is removed.
2. Disconnect PTO shaft and sprayer control leads from the tractor.
3 Attach and adjust the hitch jack and then remove the drawbar pin.

Correct Positioning of the Hitch & PTO Shaft

1 When travelling straight ahead, the point at which the sprayer drawbar pin is joined to the tractor should be halfway between the universal joints of the PTO shaft as illustrated. The tractor is then able to make maximum turns with minimal bending of the universals.
2 When the tractor is towing the sprayer straight ahead, the two telescopic sections of the power take off shaft are at maximum extension. Correct location of shaft and drawbar is shown below. When turning or crossing an inversion, the telescopic shaft sections close up. Ensure that the drive shaft is the correct length to avoid "butt up" damage to the pump.



3 If sprayer is hitched too closely remove excess PTO shaft to avoid the "butt up" damage. The PTO shaft can be cut to length by measuring the amount to be removed and cutting this amount from both halves of the shaft and the safety shields.
4 When operating the drive shaft, be sure that all safety guards are in place.
5 Incorrect hitching of PTO shaft will result in excess pump vibration. Pump WARRANTY is NOT VALID for damage caused by incorrect PTO shaft mounting.

Controller Installation

Three types of controllers can be supplied with Cropliners - the manual By-Matic 50 controller, electric QP controller or MT3000 automatic contol system.
Locate and mount the controller in the cab of the tractor or vehicle in a convenient place for operation. Follow the installation instructions supplied for each controller.

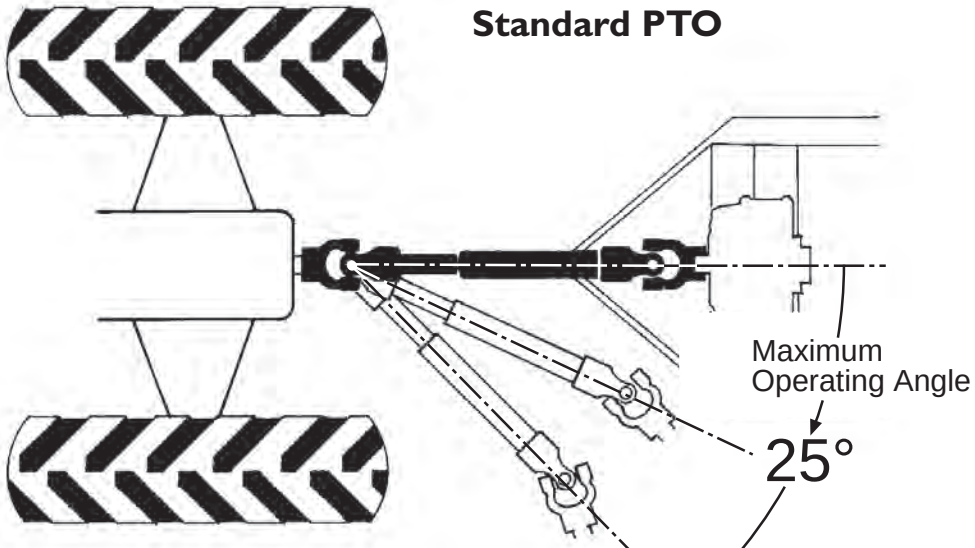
Connection of Cropliner to Tractor

PTO Operating Limits

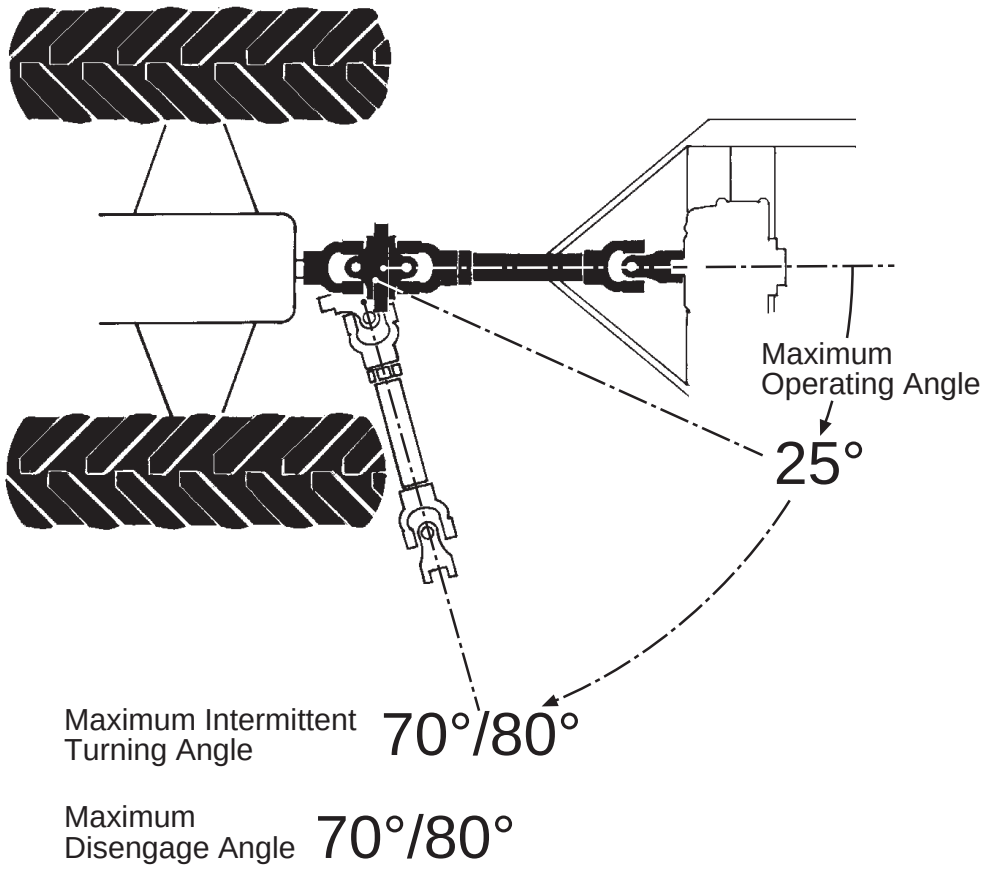
Cropliners may be fitted with standard or wide angle PTO shafts. These shafts perform very differently when turning the tractor and sprayer at the end of rows. The wide angle (constant velocity) PTO is recommended where tight turning requires greater than 45° turning angle of the PTO as shown below.

Warning! Always operate the PTO fitted to your machine within the limits and according to the illustrations below. Failure to operate the PTO as instructed can result in serious damage to the pump, PTO and any components connected to the drivetrain of the tractor and Cropliner. Incorrect operating will void warranty claims.

Standard PTO



Wide Angle (Constant Velocity) PTO



Operation of the Cropliner

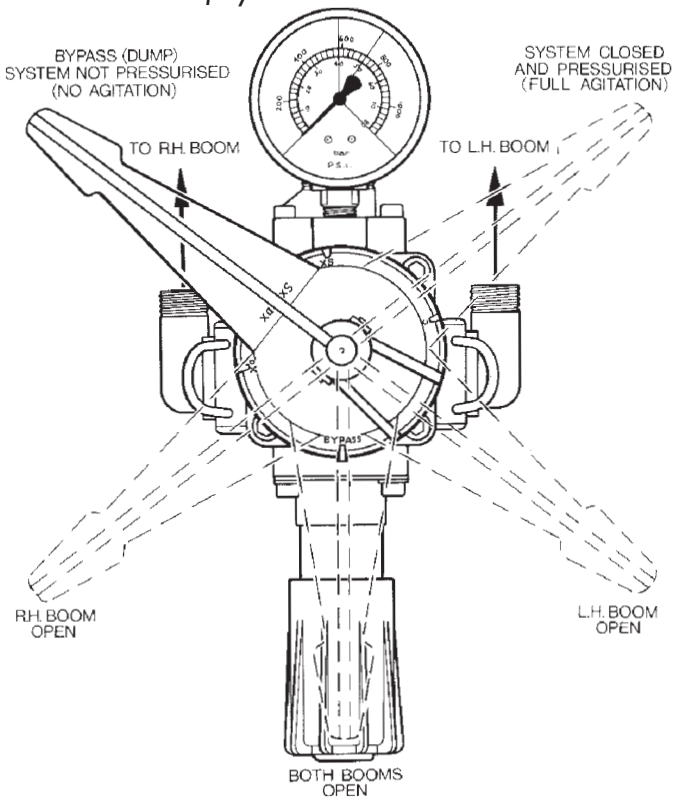
Pre-Operation Checklist

1 Before attempting to use this machine, Read Operator's Manual thoroughly.
2 Read and follow instructions on chemical manufacturers labels.
3 Always wear applicable protective clothing.
4 Check that all maintenance procedures have been followed.
5 Check all plumbing and fittings to ensure they are tight, not damaged or leaking.
6 Check PTO shaft is correctly set up.
7 Check air pressure in pump air chamber is 210 - 280 kPa (30 - 40 psi). Should be 10% of operating pressure as a general guideline.
8 Check suction filter and pressure filter are clean.
Note: Whilst all precautions are taken in assembly, it is possible to get tank filings in the line. These will accumulate in the suction filter when first used. Clean all filters out after initial use, and nozzles if necessary.
9 Check that fan pitch and air output is suitable for planned application.
10 Ensure maximum pump speed (550 RPM) is not exceeded.
11 Check nozzle selection, rates and layout suit application. Check that all roll-over nozzles are aligned correctly. Check that nozzles are not worn.
12 Check oil level of fan drive gearbox.

How to Check the Sprayer is Operational

Three types of controllers can be supplied with Cropliners - a manual By-Matic 50 controller, an electric QP controller or MT3000 automatic contol system.
Operating instructions follow for each of these controllers:

Illustration of By-Matic 50 Controller Functions



By-Matic 50 Controller

Maximum flow rate of this controller is 160 litres/minute at maximum pressure of 50 bar. To operate the Cropliner:

1 Connect Cropliner to tractor - connecting hitch, PTO and controller.
2 Check fan gearbox is engaged.
3 Fill appropriate quantity of clean water into spray tank.
Important: Do not have pesticides in the spray tank when checking sprayer.
4 Check agitator valves (located on pump) are open.
5 Check suction valve (located at the front of the tank) is open.

Operation of the Cropliner

6 Place sprayer controls in start up position by placing the By-Matic 50 contol lever in “By Pass” position.
7 Engage PTO and bring pump speed up to 540 RPM.
All pumped liquid is now being passed through the dump valve back into the tank. The system is not pressurised and tank agitators are not working.
8 Pressurise the system and operate the tank agitators by placing the control lever in “C” (closed) position.
9 Adjust pressure to desired operating pressure by adjusting the pressure control knob of the controller.
10 Check that both agitators are working.
11 Turn spray booms ON and OFF to check that they are operational:
- To operate both booms - place lever in forward “Sx - Dx” position.
- To operate LH boom only - place lever in left “Sx” position.
- To operate RH boom only - place lever in right “Dx” position.
- To turn booms off - place lever back into “C” (closed) position.

12 While water is being pumped through both booms check for any leakages or blockages throughout the sprayer. Check hoses, connections, valves, filters, boom fittings etc. Also check nozzles are operating correctly and that roll-overs are aligned and work correctly. Rectify any problems. Always ensure the sprayer controls are turned off and PTO disengaged when making any repairs or adjustments. Making adjustments while sprayer is operating can lead to serious injury.
13 With both booms operating check operating pressure and make appropriate adjustment.
14 Switch booms ON and OFF several times and check that non-drip diaphragms are working.
15 On completion of checking the sprayer turn controls off by placing the control lever into “By Pass” position.
16 Disengage PTO after controls are turned off.

QP Sprayer Controller

Electric QP Controller

This controller gives in-cab switch control of left and right booms, pressure adjustment, and pressure dump. To operate the Cropliner:

1 Connect Cropliner to tractor - connecting hitch, PTO and controller.
2 Check fan gearbox is engaged.
3 Fill appropriate quantity of clean water into spray tank.
Important: Do not have pesticides in the spray tank when checking sprayer.
4 Check agitator valves (located on pump) are open.
5 Check suction valve (located at the front of the tank) is open.
6 Place sprayer controls in start up position by placing the master switch in OFF position.
7 Engage PTO and bring pump speed up to 540 RPM.
All pumped liquid is now being passed through the dump valve back into the tank. The system is not pressurised and tank agitators are not working.
8 Pressurise the system and operate the tank agitators by placing the master switch in ON position.
Note: The Pressure Relief Valve must be manually adjusted to maximum operating pressure. See Setting Pressure Relief Valve on page 25.

Operation of the Cropliner

9 Adjust pressure to desired operating pressure:

(i) Manual Pressure Control

Manually adjust pressure using the pressure control knob on bypass valve controller located at the Main On/Off valve.

(ii) Electric Pressure Control Option (when fitted)

Adjust pressure up or down using the toggle switch on the QP Sprayer Control Centre.

10 Check that both agitators are working.

11 Turn spray booms ON and OFF to check that they are operational:

- To operate both booms - place left and right boom switches into ON position.
- To operate LH boom only - place LH boom switch ON (whilst leaving RH switch OFF).
- To operate RH boom only - place RH boom switch ON (whilst leaving LH switch OFF).
- To turn both booms off - place both boom switches in OFF position.

12 While water is being pumped through both booms check for any leakages or blockages throughout the sprayer. Check hoses, connections, valves, filters, boom fittings etc. Also check nozzles are operating correctly and that roll-overs are aligned and work correctly. Rectify any problems. Always ensure the sprayer controls are turned off and PTO disengaged when making any repairs or adjustments. Making adjustments while sprayer is operating can lead to serious injury.

13 With both booms operating check operating pressure and make appropriate adjustment.

14 Switch booms ON and OFF several times and check that non-drip diaphragms are working.

15 On completion of checking the sprayer turn controls off by placing the master switch and boom switches in OFF position.

16 Disengage PTO after controls are turned off.

MT3405 Controller

MT3405 Controller

This automatic controller takes control of all aspects of spray application rates. Set the rates you want and the controller ensures constant application rate - irrespective of undulating terrain, engine speed, ground speed and variations in nozzle wear. To operate the unit:

1 Connect Cropliner to tractor - connecting hitch, PTO and controller.

2 Check fan gearbox is engaged.

3 Fill appropriate quantity of clean water into spray tank.

Important: Do not have pesticides in the spray tank when checking sprayer.

4 Check agitator valves (located on pump) are open.

5 Check suction valve (located at the front of the tank) is open.

6 Follow instruction in the MT3405 Controller Instruction Manual to calibrate and operate the Cropliner using this automatic controller.

Note: For Full Tank Agitation While Filling

It is necessary to switch over a switch located on the relay box at the sprayer pump to gain full tank agitation when filling with the MT3405 controller. After filling, return the switch to resume normal spraying operations.

Operation of the Cropliner

General Sprayer Operation

Agitation

1 Check to see that both agitators in the tank are working.
2 When chemical is in the tank, the pump must be operating at all times to ensure the venturi agitators are in operation so chemical does not settle in the tank. If chemical settles, through pump break down or another reason, start up the sprayer after the fault has been rectified and let the mixture in the tank agitate for a length of time to ensure thorough mixing of the chemical.
3 If maximum agitation causes too much foaming in the tank, partly close the agitator valve to reduce foaming.

Mixing

1 Fill the tank with an appropriate amount of water.
2 Measure out the required liquid chemical in a graduated measuring cylinder or bucket. See page 42, step 10. Add chemical to a small volume of water, fill via the chemical probe with the agitator operating. See page 22. Always follow chemical label instructions.
3 Weigh the required amount of wettable powder and add to the tank using the chemical mixing basket. See page 15.
4 Top up the tank to required volume.
5 When handling chemicals always wear protective clothing i.e gloves, face mask, spray suit. Should chemical come in contact with skin immediately rinse off with water. Always follow chemical label safety instructions.

Tank and Hoses

1 Ensure all hose clamps are tight.
Inspect all hose lines for damage or leaks regularly.
2 Ensure basket filter is in place when filling. Filters will ensure that no solids enter the system to block or damage pump or nozzles.
3 Check and tighten tank holding bolts as necessary.

Water

1 Use fresh water (preferably rainwater), free of suspended organic matter or clay. Some chemicals are deactivated when they contact these materials.
2 Ensure water quantity is sufficient to allow correct product blending.

Filters

1 All filters should be cleaned regularly or after each spraying period. If the filter screen is damaged, replace with a new screen.
2 Be careful not to damage or deform the mesh or O-ring while cleaning and refitting the suction filter.
3 A high pressure, 100 mesh pressure line filter is fitted to the sprayer. Foreign matter can be exhausted from the filter via the ball valve at the bottom of the filter bowl.

Operating Pointers

While spraying continually observe that:

1 Engine and PTO speed are correct.
2 Correct operating pressure is being maintained.
3 Ground speed is correct and constant.
4 Nozzles are operating correctly.
5 Nozzle selection matches tree size.
6 The agitators are functioning.
7 Periodically check and clean filters.
8 Avoid going below selected speed where possible because over application will occur. Conversely avoid going over selected speed because under application will occur.

Operation of the Cropliner

Adding Chemical to the Spray Tank

How to Fill the Spray Tank - Overhead Filling

Open the spray tank lid and fill the spray tank from the top making sure the basket filter is in place.

How to Use the Liquid Chemical Auto-fill

1 Calculate chemical and water requirements. Refer page 42 step 10.
2 Partly fill sprayer tank with clean water.
3 Calibrate/measure the chemical required in chemical mixing bucket(s) or drum(s).
4 (a) Connect chemical suction probe to chemical suction line (Camlock fitting).
(b) Check suction line valve is open (located at the front of the tank).
(c) Check agitator valves (located on pump) are open.
5 Check sprayer controls are in start up position:
(a) By-Matic 50 (when fitted). Check lever is in "By Pass" position.
(b) Electric QP Control Centre (when fitted). Check master switch is in OFF position. Check boom switches are in OFF position.
6 Engage PTO and bring pump speed to 540 RPM.
7 Pressurise the system so that tank agitators are working.
(a) By-Matic 50 (when fitted). Place lever in "C" (closed) position.
(b) Electric QP Control Centre (when fitted). Place master switch in ON position.
8 Place chemical probe into the bucket or drum of chemical.
9 Open suction probe valve. Chemical will now transfer to the tank. If suction is insufficient, increase suction by partly closing the suction line valve. **Warning** - Do not fully close suction line valve otherwise pump damage will occur.
10 Shut off probe after chemical is transferred.
11 Rinse chemical container and probe with water and transfer liquid into the spray tank with the suction probe.
12 Repeat steps 10 & 11, two or three times to rinse chemical container thoroughly.
An optional Drum Rinse Probe is available to simplify rinsing of drums.
13 Shut off suction probe valve.
14 Check suction line valve is fully open.
15 Disconnect chemical suction probe from sprayer and store in a safe place.

How to Use the Chemical Mixing Basket

1 Calculate chemicals (powders or granules) and water requirements - refer page 42 step 10 .
2 Partly fill spray tank with clean water.
3 Calibrate/measure the correct amount of chemical (powder or granules).
4 Place chemical (powder or granules) into the mixing basket.
5 Close tank lid securely.
6 Check sprayer controls are in start up position. Refer page 19 step 6 for details.
7 Engage PTO and bring pump speed to 540 RPM.
8 Pressurise the system so that tank agitators are working. Refer Page 12 & 20 step 8 for details.
9 Open mixing basket valve (located on pressure filter) and operate sprayer until all chemical is mixed into the tank.
Important: Always close mixing basket valve on completion of mixing.

Operating the Cropliner after Adding Chemical

1 Keep the sprayer pressurised so that agitators are operating and mixing the spray:
(a) By-Matic 50 (when fitted). Keep lever in "C" (closed) position with pump operating.
(b) Electric QP Control Centre (when fitted). Keep master switch in ON position with pump operating.

2 Once in spraying position:
   (a) Operate booms as required.
      (i) By-Matic 50 (when fitted)
         - lever forward "Sx - Dx" position - operates both booms.
         - lever left "Sx" position - operates LH boom.
         - lever right "Dx" position - operates RH boom.
      (ii) Electric QP Control Centre (when fitted).
         Place LH and RH boom switches ON as required.
   (b) Drive at selected and calibrated speed.

How to Completely Flush the Sprayer with Fresh Water - Between Chemical Changes or at the End of the Day

Ensure the site for flushing and cleaning the Cropliner meets with environmental and statutory regulations.

1 Open tank drain valve (slice valve located at the base of the front of the trunk) to drain spray mixture from the tank. Ensure drained mixture is disposed of as required by law. Read chemical instructions.
2 Close tank suction line valve (slice valve located in the suction line at the front of the tank above the drain valve).
3 Remove fresh water inlet Camlock cap from the base of the suction line.
4 Connect fresh water supply hose (requires 1½" Female Camlock fitting) to the fresh water inlet.
   Water flow rates required to operate pumps at suggested 50% normal PTO speed:

- AR 904	48 l/min (10.7 gpm)
- AR 1105	60 l/min (13.3 gpm)
-AR 1554	78 l/min (17.3 gpm)

5 Remove and clean suction filter screen and replace.
6 Open tank rinse valve. Ensure tank lid is closed.
7 Open mixing basket valve.
8 Check agitator valves are open.
9 Turn on fresh water supply.
10 Check sprayer controls are in start up position (See page 19step 6 for details).
11 Engage PTO and bring pump speed to half normal operating speed.
12 Pressurise the system:
   (a) By-Matic 50 (when fitted). Place lever in "C" (closed) position.
   (b) Electric QP Control Centre (when fitted). Place master switch in ON position.
      Fresh water now flushes through the suction line, suction filter, pump, pressure line, pressure filter, agitators, mixing basket line, "By-Pass" and tank rinse. All water comes into the tank and drains out the tank drain outlet.
13 Clean the pressure filter screen opening the valve at the base of the pressure filter for approximately 3 seconds. Close valve.
14 Turn ON the spray booms to flush clean water through them (See pages 19 &20 step 11 for details).
15 On completion of flushing turn the booms off, turn the controls off (See pages 19 & 20 step 15 for details), and disengage the PTO.
16 Close off fresh water supply and disconnect hose. Be sure to refit and lock the Camlock cap onto the base of the suction line.
17 Adjust all valves back to non-flushing mode.
   (a) Close mixing basket valve.
   (b) Close tank rinse valve.
   (c) Open tank suction line valve.
   (d) Close tank drain valve.
18 Wash/hose down the outside of the sprayer.

Operation of the Cropliner

How to Use Tank and Equipment Cleaners

If a cleaning agent is required (refer to chemical label), first completely flush the Cropliner with water as outlined in Steps 1 - 18 above then:

1 Fill the spray tank with approximately 300 litres of fresh water.
2 Add cleaning agent (use according to instructions).
3 With controller in start up position (Refer page 19 step 6), engage PTO and bring to half normal operating speed.
4 Pressurise the system (Refer pages 19 & 20 step 12).
5 Open tank rinsing valve to wash the tank with cleaner.
6 Turn the booms on to put cleaner through the spray lines and booms.
7 If you require the cleaning agent to soak or stand for a period, shut unit down by turning booms off, turn controls off (Refer pages 19 & 20 step 15) and disengage PTO.
8 When soaking is completed, start the machine following steps 3,4 & 6 to flush the tank and spraylines.
9 Stop flushing by switching booms off, turning controls off and disengaging PTO.
10 Open spray tank drain valve and allow cleaning mixture to drain from the tank.
11 Again completely flush the sprayer with fresh water as outlined in Steps 1-18 above.

Check Actual Pressure at the Nozzles

There will always be some pressure drop between the pressure gauge (usually located near the pump) and the spray nozzles (located some distance away) at the rear of the machine.

To accurately know the pressure at the nozzles a pressure gauge can be temporarily attached in place of a nozzle to check the pressure.

Once the nozzle operating pressure is measured, it can be checked against the operating pressure shown on the main gauge. Allowance can then be accurately made for any pressure drop in the system when setting up, calibrating and operating the system.

Check Actual Flow Rate of Nozzles

There can be variations between specified nozzle flow rate or output (shown on charts) and actual nozzle flow rates.

It is also wise to check the actual flow rate of nozzles. This can be easily acheived by using a Spraying Systems tip tester or a hose attachment and container and measuring the output of each nozzle. See step 6 on page 41.

Nozzle flow rates should be checked regularly to avoid excessive wear, ineffective spraying patterns and wastage.

Operation of the Cropliner

Setting Pressure Relief Valve on Electric QP Control Systems

The pressure relief valve avoids excessive pressure build up in the system when booms are turned off.

This valve must be set manually to slightly above the maximum operating pressure to be used. Follow the instructions below to set the pressure correctly:

1 Connect Cropliner to tractor - connecting hitch, PTO and controller.
2 Check fan gearbox is engaged.
3 Fill appropriate quantity of clean water into spray tank.
Important: Do not have pesticides in the spray tank when checking sprayer.
4 Check agitator valves (located on pump) are open.
5 Check suction valve (located at the front of the tank) is open.
6 Place sprayer controls in start up position by placing the master switch in OFF position.
7 Set the manual pressure relief valve so that the handle is screwed mostly out (anti-clockwise direction).
8 Engage PTO and bring pump speed up to 540 RPM.
All pumped liquid is now being passed through the dump valve back into the tank. The system is not pressurised and tank agitators are not working.
9 Pressurise the system by placing the master switch in ON position and boom switches in OFF position.
10 Adjust the electric pressure control switch to maximum operating pressure (pressure control valve fully closed).
11 Turn spray booms ON.
12 Adjust the pressure relief valve to slightly above selected operating pressure. It is normally set about 1 bar above selected operating pressure too allow some margin for pressure adjustment while spraying.
13 Turn boom switches OFF and check that system pressure does not build up excessively. A slight rise in pressure is acceptable.
If pressure build up is too great, repeat steps 6 to 13 to obtain the correct pressure reading.
14 Adjust the electric pressure control switch to bring pressure down to selected operating pressure.
15 On completion, turn controls off by placing the master switch and boom switches in OFF position.
16 Disengage PTO after controls are turned off.

WARNING: Constant pressure adjustments are valid for specific spray tips delivery only. Taking note of the handle number and valve body marks combination will help the operator for future by-pass settings.

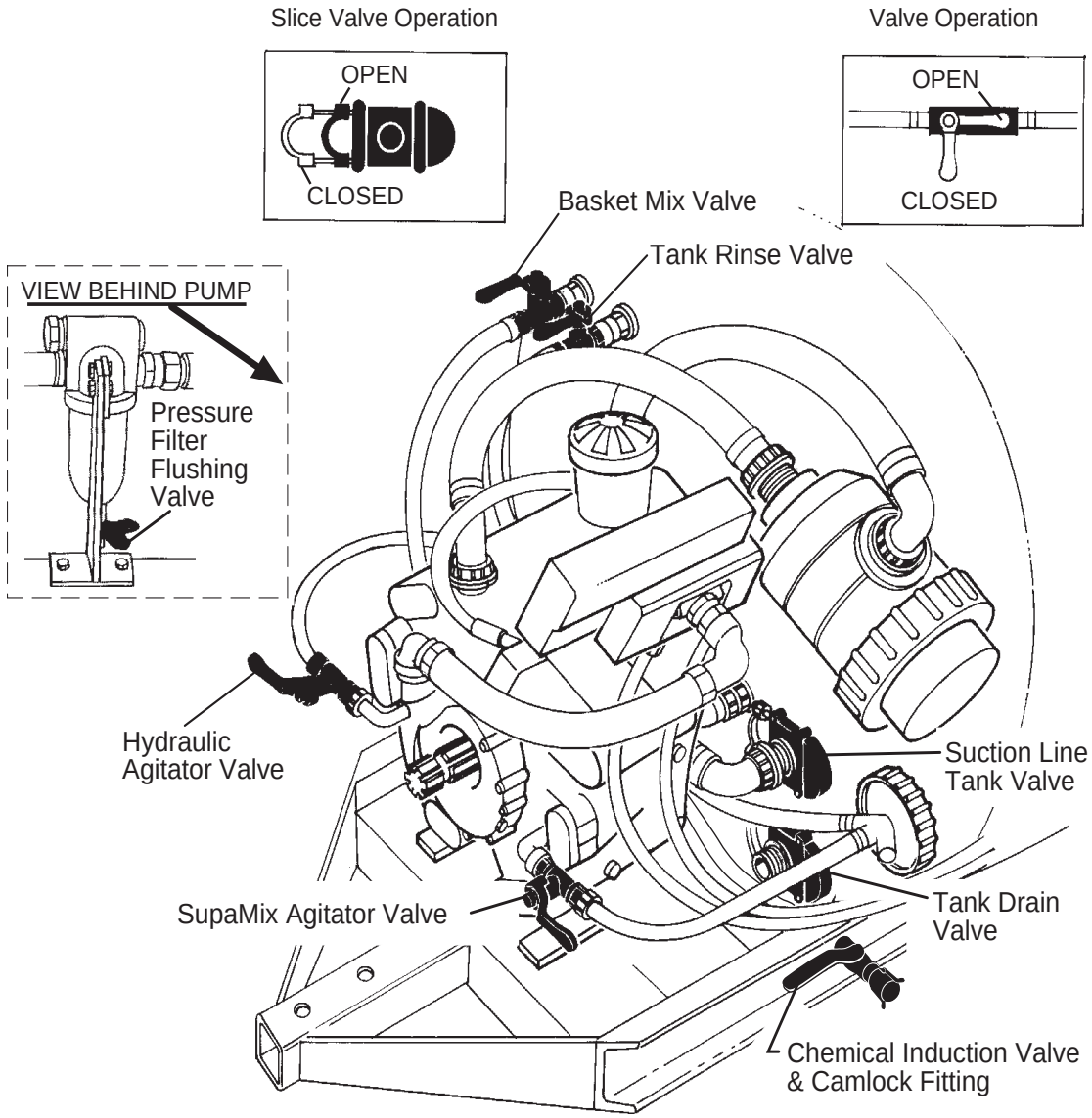
Operation of the Cropliner

Identification of Manual Control Valves

The illustration (right) provides easy identification of Cropliner manual control valves and shows the open and closed position of the slide and lever action valves.

Be sure you read this manual thoroughly and understand the operation of the manual valves before attempting to operate the Cropliner.

Warning! Failure to correctly operate the valves may cause pump damage, particulary if the pump is operated for any length of time with the suction line valve is fully closed.



Lubrication & Maintenance

Greasing and Service Procedures
Daily & 50 Hour Service Procedures

1 Grease universal joints every 50 hours. Grease lightly until grease becomes firm in seals. Over greasing will break seals and allow dust and moisture to penetrate - increasing wear.
2 Check oil level in pump daily.
3 Grease PTO through-shaft once per year.
4 Clean suction line and pressure line filters with each tank load.
5 Clean nozzles regularly.
6 Grease PTO shaft slides daily. Slide PTO shaft apart, clean telescopic tubes, grease and reassemble.
7 Check tyre pressure (250kPa), and tighten wheel nuts regularly.
8 Check tank bolts regularly.
9 Check pump air chamber pressure (210-280kPa), on a regular basis.
10 Change pump oil after the first 50 hours of operation, and there after, every 250 hours or seasonally.
11 Check oil level of 2 Speed Fan Gearbox twice yearly.
12 Check all bolts and nuts, especially on wheels.
13 To ensure trouble free spraying, flush the sprayer thoroughly each day and before changing chemicals. Dispose of tank wash according to chemical manufacturers instructions.

Every 200 Hour Service Procedures

1 Drain and refill diaphragm pump with SAE 20W/30 or 20W/40 oil.
2 Remove pump heads and inspect diaphragms, valves, seals and springs for wear. Replace if necessary.
3 Lubricate quick release lock pins on PTO shaft.
4 Re-pack wheel bearings with grease.

Pump Operation and Maintenance

Annovi & Reverberi (A&R) pumps are of the piston-diaphragm type. All parts in contact with the spray liquid, which are subject to corrosion, are protected, making them ideal for spraying (herbicides, insecticides, fungicides, fertilisers, etc.), disinfection and washing.

Daily Before Starting the Pump

1 Check that oil is visible in sight glass (half way up) and top up if necessary with good clean motor oil 20W/30 or 20W/40.
2 Clean all sprayer filters. Blocked or semi blocked filters place extra stress on diaphragms.
3 Start with zero pressure and the pump will self prime immediately and clear air locks in suction line.
Note: Running a diaphragm pump faster than specified will not improve performance but will damage and wear out moving parts.
Warranty willbe made void by speeds in excess of those indicated on the pump name plate.

Daily after Use

1 Flush pump with clean water.
2 Drain filters and clean. A high percentage of pump failures are due to blocked filters.

Every 250 Hours

1 Check surge chamber pressure and adjust as follows:
Air pressure 210-280kPa (30-40psi) - Should be 10% of operating pressure.
Vibration of the delivery hose usually indicates that the air pressure in the surge chamber is incorrect. The main cause of surge chamber diaphragm fracture is low pressure in this chamber.
Surge chamber pressure can be checked with an ordinary tyre gauge.

Lubrication & Maintenance

The above pressure range is a guide to the correct pressure however if difficulties re encountered adjust this pressure till an even flow is obtained from the pump. The pressure is best increased with a bicycle pump.

2 Change oil and refill with 20W/30 oil. Attention should be made to removing trapped air behind the diaphragms by rocking from side to side as instructed. It is also a good practise to run the pump for 10 minutes without pressure and top up with oil before working the pump.

3 When changing the oil, check diaphragms, replacing them if they are showing signs of wear. This is normally a pre-season maintenance procedure which can be done quickly and easily as no special tools are required. Avoid down time when the pump should be working by proper maintenance.

4 Also check inlet and outlet valves and replace if worn. Worn valves not only reduce the output of the pump, but also may reduce the life of the diaphragm.

Excessive Diaphragm Failure

If you have Excessive Diaphragm Failure check the following points which will cause failure of diaphragms due to added stress or chemical attack.

1 Most Important - Pump not being flushed out daily with clean water after use.
2 Oil level too low allowing air between piston and diaphragm.
3 Air leaks in suction line.
4 Restricted suction line.
5 Restriction through suction filter.
6 Not cleaning suction filter regularly.
7 Worn suction and discharge valves.
8 Bypass line too small to carry full capacity of pump.
9 In Cold Climates - frozen suction/discharge lines or water remaining in the pump after flushing.
10 Incorrect air setting or no air in air chamber.
11 Agitator excessively restricting bypass from pump.
12 Diaphragm material construction incorrect for chemical or solution being pumped.
13 Chemicals containing toluene or other aggressive solvents may require viton diaphragms - particularly if the pump is not properly flushed after use.

Pre-Season Servicing

For thorough pre-season servicing - check all aspects of the Cropliner and its operating components as outlined in the pre-delivery check list on pages 10 & 11.

Lubrication & Maintenance

Maintenance/Repair of Control Valves

Repair kits available:

Main On/Off (Dump) Valve - Repair kit Code no. 180.302.31 see page100
Boom On/Off Valve - Repair kit Code no. 180.302.31 see page101
Pressure Regulating Valve - Repair kit Code no. 180.302.32 see page101

IMPORTANT:
Flush the system with clear water after each use with chemicals. Always wear protective garments. Maintenance must be performed without pressure inside the liquid feeding line. The machine must be shut off.

The following tools are needed:

- CH14 Allen wrench
- CH32 (5 - 60Nm) torque wrench
- CH19 socket wrench
- Ø 5 round screwdriver
- CH17 socket wrench
- Ø 10 flat screwdriver
- CH24 socket wrench
- Eyelet pliers for Seeger rings
- SELON 626 anaerobic thread sealant

A. DISASSEMBLY

- Shut off current to control box, disconnect wiring.
- Remove supply, by-pass and delivery lines from valves.
- Remove all accessories fitted on the valves.
- Hold firmly the valve body on inlet 2 side (1 ¼"BSPF threads).

WARNING: Protect the valve body 15 avoiding damages to O-Ring 36/30 seats)

- Loosen with the CH32 wrench the nipple 25 and remove it from valve body. Take care of plate 24.
- Inspect and, if needed, replace the seal 16 assembled on nipple 25.
- Remove ball 23 and replace the seal 16 assembled on valve body.
- Pull the clamp 35/29 with Ø 10 screwdriver.
- Remove the gearmotor unit 1 from valve body. Inspect and, if needed, replace O Rings 14-34/28.
- Use CH24 socket wrench to remove the sub assembly 17.
- Remove the lock ring 22 with pliers and pull the stud with washer 18. Check and replace O Rings 19/21 and stud washer.

B. ASSEMBLY

IMPORTANT: Clean and dry all parts carefully from dirt and sealant residuals.

- Hold firmly the valve body on inlet 2 side (1 ¼"BSPF, threads).

WARNING: Protect the valve body 15 avoiding damages to O-Ring 36/30 seals.

- Have these sub assemblies ready before assembly:
  - Nipple 25 and seal 16.
  - Drive sub assembly 17.
    - For by-pass valves only:
    - Sleeve 26 and stud 27 with O-Rings 28.
    - Screw stud on sleeve up to beat with Ø 5 screwdriver.

WARNING: Lubricate O Rings and sliding surfaces.

- Assemble and lubricate seal 16 into valve body.
  Do not damage the seal surface.

Lubrication & Maintenance

- Apply thread sealant on guide 20 of sub-assembly 17 and screw the assembly on valve body up to beat using the CH24 wrench.

WARNING - IMPORTANT: Before proceeding, position the notch on stud 18 as indicated on **Drawing 1** using a screwdriver.

- Insert ball 23 on stud 18.

WARNING - IMPORTANT: Follow **Drawing 1** to obtain the correct position of ball 23. This is essential for the correct valve operation.

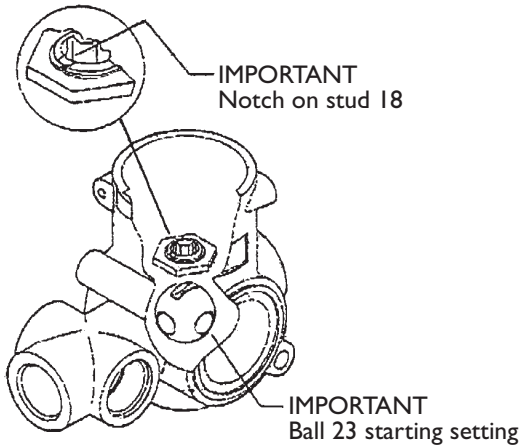
- Assemble the plate 24.
- With the CH32 wrench, assemble up to beat, without forcing, the nipple 23 and the seal 16. Before assembly, lubricate seal 16 with waterproof grease. Apply thread sealant on nipple.
  IMPORTANT: Max torque 35Nm.
- Place O-Ring 34/28 into valve body.

C. GEARMOTOR UNIT 1

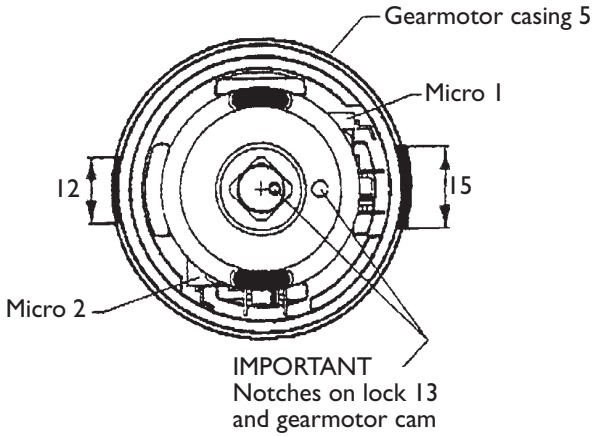
WARNING: To operate the gearmotor unit 1, install 1.25A fuse on 12Vdc line.

- The mark on lock 13 and gearmotor cam must be aligned like **Drawing 2**. These marks are referred to notch on casing 5.
  To obtain the correct position, connect the brown cable to + pole of battery and blue one to - pole.
- Lubricate casing 5 and O-Ring 14. Insert unit 1 inside the valve body. The cap 9 must beat on valve body 15.
- Assemble the lock 35/29.
- Assemble all accessories and connect wiring.

Drawing 1



Drawing 2



IMPORTANT
To obtain this position connect brown cable to + pole.

Trouble Shooting Pump Problems

PROBLEM	PROBABLE CAUSE	REMEDY
A Pump does not draw or deliver liquid. Pressure gauge fluctuates badly.	(1) One or more valves are not seating properly. (2) The pump is sucking in air through suction line. (3) Air has not been entirely evacuated from the pump. (4) Blocked suction filter. (5) Damaged or worn suction valves.	Clean valve seating. Examine the suction hose and ensure it is firmly secured. Rotate the pump with outlet hose and taps open. Clean suction filter. Replace suction valves.
B Liquid flow is irregular (Also check items under A)	(1) The air in the air chamber of the pump is incorrectly set. (2) Diaphragm split. (3) Damaged or worn valves. (4) Foreign matter holding valves open.	Check pressure in air chamber of pump. Set at 210-280Kpa (30-40 psi). Replace diaphragm. Replace valves. Clean valves.
C Pump delivers insufficient pressure	(1) Regulating valve: - sticking open - not set for pressure. - damage or worn seat or spring. (2) Cylinder diaphragm ruptured. (3) Pump valves blocked, worn or damaged. (4) Spray nozzles worn, missing or exceed pump capacity.	 Unstick valves. Set pressure. Replace spring. Replace diaphragms. Unblock valves and or replace. Replace spray nozzles with appropriate size.
D Output drops & pump is noisy.	Oil level is too low.	Top up with oil to correct level (1/2 way up the sump sight glass).

Trouble Shooting Pump Problems

PROBLEM	PROBABLE CAUSE	REMEDY
E Oil being discharged through delivery line or discoloured oil in sight glass of pump.	One or more diaphragms split or ruptured.	Immediately drain oil from pump and flush to remove all spray residues from sump. Remove pump heads & fit new diaphragms. Fill to correct level with motor oil 20W/30.
	SUCTION SIDE OF PUMP	
F Suction hose vibration.	Air getting into suction.	Seal all joints securely with tape or stag. Firm up clamps.
G Pump valves hammering.	(1) Suction tap partly turned off. (2) Suction strainer(s) blocked.	Turn tap fully on. Clean filters.
H No water flow on suction hose.	Obstruction in tank or suction line.	Clean foreign material from tank & suction line.
	DISCHARGE SIDE OF PUMP	
I Pressure gauge pointer swings violently.	Pressure control valve spindle doesn't move easily.	Lubricate with light oil or C.R.C.
J AR control valve leaking from spindle.	Split diaphragm or 'O'-rings.	Remove 4 body set screws replace diaphragm and O-rings.
K Pressure gauge showing correct working pressure no pressure at nozzle.	(1) Burst discharge line. (2) Blocked discharge filter where fitted. (3) O-ring(s) jamming flow in discharge line. (4) Ants, wasps build nests in discharge line or nozzles.	Replace discharge line. Clean discharge filter. Clean discharge line of foreign materials. Clean nozzles of foreign materials with tooth brush

Trouble Shooting General Sprayer Problems

PROBLEM	PROBABLE CAUSE	REMEDY
1 No spray when turned on.	(1) Filter on the inlet side of the pump blocked. (2) Faulty pump.	Dismantle, clean & re-assemble. Change pump.
2 Sprays for short time only.	(1) Air inlet to tank blocked. (2) Filter on suction side of pump blocking or blocked.	Clean air vent. Dismantle, clean & re-assemble the filter. If filter problem persists, clean out the tank & start again.
3 Spray is uneven around the boom.	(1) Some nozzle filters or tips are blocked. (2) Nozzle tips worn. (3) Different pressure along the boom.	Remove, clean & check. Check output & for streaks. Check nozzle output, replace worn nozzles. Remove a nozzle in each boom section & check that flow rate is the same. If different, check for blockages.
4 Pressure going up - output going down.	Nozzle filters blocking.	Dismantle, clean & refit. Check pressure returns to normal. Check all filters and spray mixture.
5 Pressure falling.	(1) Filter on suction side blocked. (2) Nozzle tips worn. (3) Pressure gauge faulty. (4) Pump worn.	Dismantle & clean the filter. Check nozzle output, replace worn nozzles. Check with new pressure gauge. Repair or replace the pump.
6 Spray pattern narrow.	(1) Pressure too low. (2) Pressure too low & spluttering.	Check that the correct nozzles are being used. Check that the tank is not empty. If not, there is an air leak between the pump & tank or in the pump. Check plumbing & repair.
7 Foam in the tank.	Too much agitation.	Check that the return line is at the bottom of the tank. Partly close agitation and valve
8 Spray pattern streaky.	Nozzle partly blocked.	Remove & clean. If it continues, the nozzle is damaged. Replace with same size tip, check flow rate of replacement nozzle.

Trouble Shooting Control Valve Problems

In the case of trouble with valves, shut off the pump and disconnect the power to the control box. Please follow the trouble shooting guide below.

FAILURE OF THE VALVE

1 Disconnected valve: Check the cable connections consulting the wiring diagram on page 104.
2 Oxidated cable connections: Inspect and clean.
3 Blown fuse: Replace fuse (1.25A time lag).

WARNING - IMPORTANT: Never use fuses rated over 1.25A in case of failure a rush of over 7A will damage the gearmotor.

REPEATED FUSE BLOW OUT

1 Remove the clamp 35/29 with a Ø 10 flat screwdriver.
2. Disconnect cables from connecting box and remove the unit from body. Take care of O Ring 34/28.
3 Check the rotation of ball 23 using a Ø 10 flat screwdriver inserted in the square of stud 18. If the rotation is not smooth please replace seal 16 and ball 23. Follow the instructions on pages 29-30.
4 In case of smooth running, check unit 1.

WARNING - IMPORTANT: Before proceeding, position the notch on stud 18 as indicated on **Drawing 1** (see page 30) using a screwdriver.

5 Check the running of unit 1 by connecting the blue and brown cable to a 12Vdc line. Running is correct if the rotation happens between the two microswitches (90 degrees working).
6. If the unit 1 does not rotate correctly, replace the whole unit.

ASSEMBLING OF GEARMOTOR UNIT 1

WARNING - IMPORTANT: Before proceeding, position the notch on stud 18 as indicated on **Drawing 1** (see page 30) using a screwdriver.

1 On a new gearmotor unit 1, make sure that the mark on lock 13, the notch on gearmotor cam and casing 5 are positioned as per **Drawing 2** on page 30.
2. The correct position is obtained connecting the brown cable to + pole and the blue to the - pole.
3 Insert O Ring 34/28 inside valve body 15.
4 Lubricate casing 5 and O Ring 14. Insert unit 1 inside the valve body. The cap 9 must beat on valve body 15.
5 Insert the clamp 35/29.

LEAKAGE FROM SEALS

Replace seals using the Repair kit Code no.180.302.31 following the instructions at page 29-30.

Airblast Spraying Methodology

Traditionally very large spray volumes have been used when treating orchard trees and vineyards. Volumes of 2000 - 3500 l/ha for deciduous fruit orchards and vineyards, and 10000 - 30000 l/ha for citrus have been common.

These high volumes originated with the early use of hand spray guns using large droplets (approximately 1000 microns) for maximum throw, and penetration of spray. A continuing perception that effective spray coverage requires thorough wetting (washing) of the foliage still sustains the use of high volume dilute spraying practices even when using air-assisted technology today.

Air assisted sprayers, however, have three fundamental differences when compared to traditional hydraulic sprayers:

(a) Air carries the spray droplets

A fan is used to carry spray droplets to the target with a volume of directed air.

(b) Smaller droplet size

Spray droplets of hydraulic sprayers (eg. hand guns, boom sprayers) rely on kinetic energy to carry them to the target. Large droplets carry further and are therefore used to carry further distances, eg. to the top or furthest part of the target.

However, spray droplets of airblast sprayers, do not require their own momentum. The air stream is used to transport droplets to their targets. Since target deposition is no longer dependent on the inertia of large droplets, it is possible to use smaller, much finer droplets. This has a two fold affect of increasing the effectiveness of coverage and reducing the amount of liquid needed.

(c) Lower spray volumes

Reducing droplet size markedly reduces spray volumes. By halving droplet diameter the same number of droplets can be produced from one eighth of the liquid volume. (See Page xx)

Smaller spray volumes of the order of 150 - 700 l/ha, are now being used in deciduous fruit orchards and vineyards, depending on the pest being controlled.

Air Volume Replacement (AVR)

By using air as the medium for transporting spray droplets, target deposition can only occur when air delivered by the airblast sprayer reaches the target.

This means that all ambient air in a tree or bush must be replaced by air from the sprayer for droplets to reach their target. This principle is known as Air Volume Replacement (AVR).

Air Volume Replacement (AVR) means total displacement of air within a tree, vine or bush, and replacing it with spray laden air from the sprayer. Factors which effect AVR are tree size, row spacing, foliage type and density, sprayer air capacity, speed of travel, wind speed and direction.

The airstream and spray nozzles of the airblast sprayer must be calculated and arranged to meet the AVR and spray coverage requirements of the trees and planned spray program.

Guidelines

Excess spray application can result in major pesticide wastage, uneven fruit drop or foliage burn or inadequate spray application will result in poor pest control. Both these extremes can be avoided by proper selection and calibration of the sprayer.

Airblast Spraying Methodology

Matching tractor speed to available air volume produced by the sprayer will determine the overall efficiency of a spraying operation.
If a sprayer is operated at a speed which is too fast for the volume of air then inadequate air penetration will be the result. Increasing spray volume cannot compensate for inadequate air penetration of a tree canopy.

The following factors are important when initially purchasing or setting up airblast sprayers:

1 Adequate Air Volume

The airblast sprayer must match the task. There should be enough air to blow through the tops or furthermost parts of trees. Large trees require more air. Smaller trees require less air.

The purchase of a sprayer should be based on the most demanding tasks required. Both air volume (i.e. fan specification) and spray volume (pump specification) should be considered. The greater the air volume of the sprayer, the better the coverage that can be achieved.

Required air output or fan capacity required can be calculated using the following formula:

Fan capacity required (M3/hr) =
Speed (km/hr) x Crop Height (m) x Row Spacing (m) x 1000
e.g. 5 km/hr x 4m x 5.2m x 1000
= 104,000 m3/hr.

2 Actual Fan Capacity

Actual fan capacity can be measured for each sprayer by calculating the area of the air inlet, measuring the air speed at the inlet and then calculating the air volume available.

(a) Air Inlet Area

Measure the diameter (D) of the air inlet (m) and calculate the area using the formula:

Inlet Area (m2) = 0.79 x D x D
eg. 0.79 x 0.82 x 0.82
= 0.53 m2

(b) Air Speed

Operate the sprayer fan at recommended RPM and determine the average airspeed at the fan inlet. Do this by measuring the air velocity (m/sec) as illustrated below, and averaging the readings.

(c) Air Volume Calculation

Calculate the air volume (m3/hr) using the formula:

Air Volume (m3/hr)
= E* x Inlet Area (m2)x Air Speed(m/sec)
eg. 3.0 x 0.53 x 25 x3600
= 143,100 m3/hr.

***Entrainment Factor**

The Entrainment Factor is an estimation of the amount of still air which is drawn into the airstream to the tree as the sprayer is operating.
In open orchard tree canopies such as apples the entrainment factor may be as high as 3 to 3.5. In Dense orchard canapies such as citrus the entrainment factor is lower, usually 2 to 2.5.

3 Speed of Travel

Correct application requires exact forward speeds to be known.
Forward speed affects the penetration of air generated by the fan.
This can be illustrated by filling up a line of cups with water from a hose. Move the hose too fast and the cups will not be filled properly.

Airblast Spraying Methodology

Similarly you cannot fill the tree with spray laden air if you travel too fast. Correct speed simply ensures total air volume replacement (AVR) is achieved. Full foliage requires slower speeds than sparse foliage.

Maximum speed of travel can be calculated using the following formula:

Travel Speed (Km/hr) =

$$\frac{\text{Fan Capacity (m3/hr)}}{\text{1000 x Crop Height(m) x Row Spacing (m)}}$$

e.g. $\frac{\text{143,100 m3/hr}}{\text{1000 X 4m X 5.2m}}$

= 6.87km/hr Travel Speed.

Other factors such as foliage density(partially considered with the entrainment factor), wind speed and direction must be evaluated when using the above formula. For example the dense foliage of citrus trees require slower speeds of travel for total AVR than open trees of similar size. Full foliage of deciduous trees requires slower speeds than sparse foliage.

Spray application should always be checked to assess effectiveness of coverage.

4 Effective Nozzle Arrangement or Spray Pattern

The key objective of airblast spraying is to distribute the required amount of chemical accurately and evenly over the whole target area without over spraying or under spraying any part of the tree, vine or plant.

Under-spraying results in poor disease and pest control. Over-spraying wastes spray, may damage fruit and is environmentally unsound.

Effective airblast spray application depends on two factors being fulfilled:

(a) Effective air volume replacement (AVR) which means the total displacement of air within a tree or vine and replacing it with spray laden air.

(b) Effective nozzle arrangement which means correct injection of spray liquid into the sprayer airstream so that it is evenly deposited on the tree or vine.

This includes the correct selection of nozzle (rate and type) and correct placement in the boom.

Airblast sprayers should be calibrated so the 2/3rd of the spray volume is directed into the bulk of the tree foliage which is usually the top 1/2 to 2/3 of the tree. Tree shape, size and density determines the selection of nozzle capabilities and layout.
If this is not done (and spray discharge is left equal throughout the airstream), the closest part of a tree to the sprayer is usually over sprayed and the furthest or uppermost parts of the tree will be under sprayed.

The diagram below illustrates the effect of distribution of spray liquid entering the airstream (nozzle arrangement on spray coverage of airblast sprayers.

Airblast Spraying Methodology

As a general rule you should aim to direct 70% of the spray to the upper 1/2 to 2/3 of the tree.

Dyes with fluorescent tracers or papers sensitive to oil or water can be used to help assess the effectiveness of sprayer coverage.

5 Other Factors which Affect Spray Coverage

WIND restricts air penetration on the windward side and vertically. This generally under sprays the windward trees and over sprays trees on the leeward side.

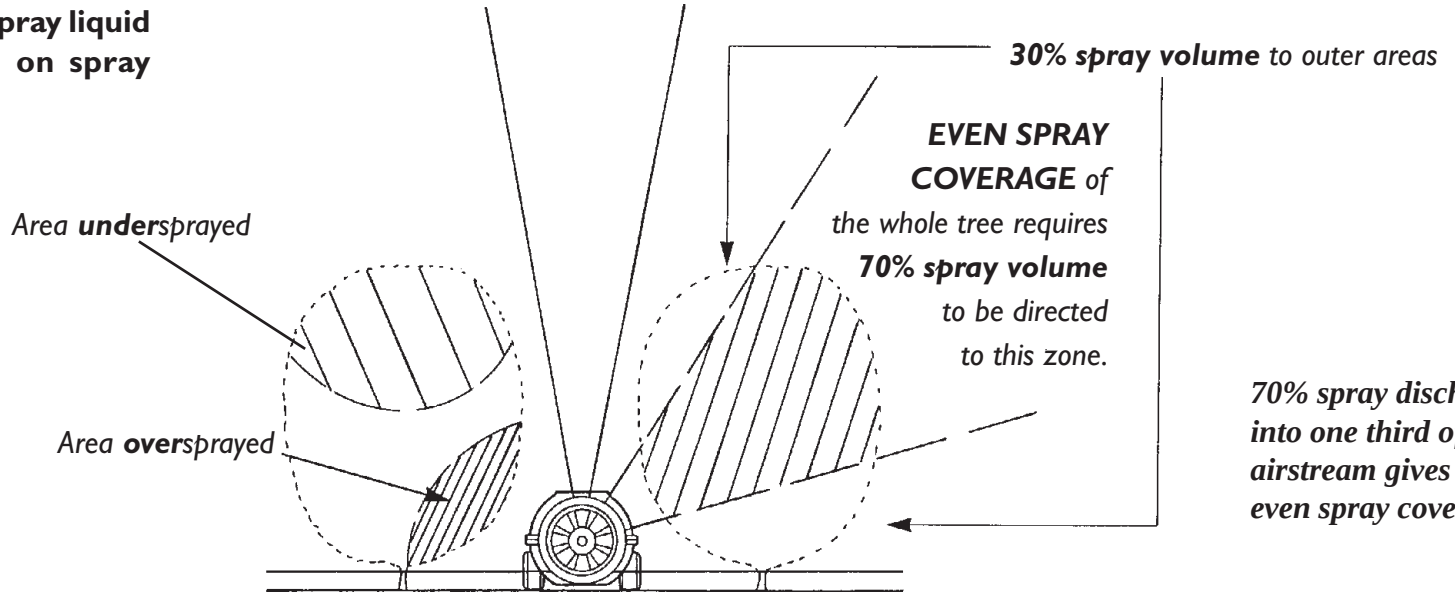
Large air capacity sprayers will handle more wind than smaller units, but for best results only spray in the best wind conditions of a light breeze 3.2 - 6.5 km/hr (3 - 4mph) wind speed e.g. leaves rustle, wind can be felt on the face. See page 81 for further details.

HIGH TEMPERATURES restrict penetration because droplets can evaporate and become too small to contact their target. See page 80 for further details.

LOW HUMIDITY can have a similar effect to high temperature on droplet size and coverage. See page 80 for further details.

Efficient, effective spray application delivers the correct rate of chemical to the right place. This saves time, money and produces a better quality crop.

Effect of distribution of spray liquid entering the airstream on spray coverage.



Uniform spray discharge into the air stream causes uneven coverage of foliage

70% spray discharged into one third of the airstream gives more even spray coverage

Airblast Spraying Methodology

Cropliner Versatility

The Cropliner maximises application versatility and efficiency with its unique capabilities in Air Volume, Droplet Size and Spray Volume.

Air Volume

The Cropliner provides a large volume of air at reasonably low speed when it leaves the sprayer, ie. 30-40 m/sec.(108-144 km/hr).
This large, relatively slow speed mass of air has much more effective air volume replacement (AVR) than smaller volumes at very high speeds, eg. 300 km/hr. Large volumes of air are also less affected by adverse wind conditions.

Cropliner air volume is adjustable by gear change and blade pitch selection to match conditions.

Droplet Size

The Cropliner offers a total range of droplet sizes by choice of nozzle type, size and spraying pressure. Droplet Volume Median Diameters (VMD) are available from 50 to 450 microns. (See pages 50-59).

The use of 20 roll-over nozzles aids the versatility and efficiency of spray application. Nozzle type and location are matched to the crop being sprayed. If required the number of nozzles can be increased up to 40.
Full details of calibration procedures, nozzle selection and location, pressures and droplet size are given in this manual to enable you to acheive the best results. Many growers have made significant gains using the Cropliner, eg. increasing export quality fruit from 75% to 95%.

Controlled droplet application is often thought only possible with very low volume spraying. This is not the case because the Cropliner allows both volume and droplet size to be controlled as needed. Growers can achieve very small droplet size with very low volume spraying or using higher volumes.

In horticultural spraying a range of droplet sizes is preferred due to the variety and distance of target areas, eg. leaf, branch, fruit, etc. Larger droplets usually travel further and are less likely to be lost to evaporation or drift. Droplets that are too large can cause run off and wastage to occur.

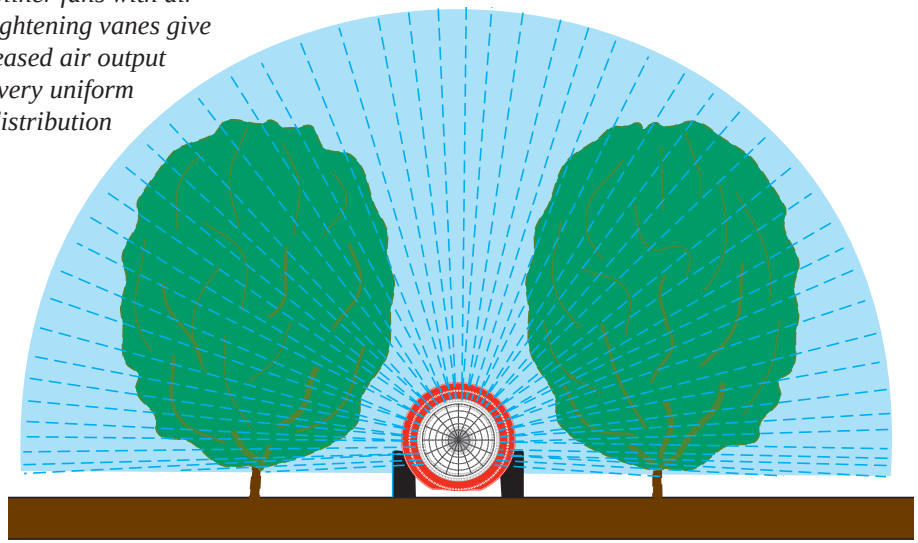
The ideal droplet size (VMD) is generally considered to be 150 microns. A range of droplets between 100 and 200 microns is considered to be the most effective.

Spray Volume

The Cropliner gives growers total versatility to spray using very low water rates (35 l/ha or less) to very high water rates (9000 l/ha or more), according to their needs.

Many fungicides and insecticides work well with low rates, but miticides and oil sprays need higher rates. Unlike many sprayers the Cropliner has the ability to do both.

Cropliner fans with air straightening vanes give increased air output and very uniform air distribution



Airblast Sprayer Calibration

Today, we must strive for the most efficient use of spray chemicals for effective pest and disease control. Increasing costs, as well as consumer and public pressures to minimise residues requires us to achieve even spray coverage without over spraying or under spraying.

Correct calibration of your airblast sprayer involves the following steps:

1 Ensure Equipment is in Good Working Order

Tank, pump, plumbing, filters, boom and nozzles should be clean, free of leakages and functioning properly. Ensure fan speed and pitch settings are correct. Follow manufacturers pre-operation checklist, maintenance and operating instructions.

2 Determine Speed of Travel

(i) Maximum speed of travel for effective air volume replacement (AVR) can be calculated using the following formula:

$$\textbf{Travel Speed (km/hr)} = \frac{\textbf{Fan Capacity (m3/hr)}}{\textbf{1000 x Crop Height (m) x Row Spacing (m)}}$$

eg. $\frac{70{,}000}{1000 \times 3 \times 5}$

= 3.9 km/hr

Maximum speed of travel can be altered by foliage density, wind speed, temperature and humidity levels.

(ii) Determine Actual Speed of Travel

Half fill the sprayer tank with water and mark out a test strip of 100 metres (simulating spraying conditions).

Set the sprayer operating and record the time of travel 100 metres at selected working speed.

Calculate the actual speed of travel using the formula:

$$\textbf{km/hr} = \frac{\textbf{Distance (m) x 3.6}}{\textbf{Time (sec)}}$$

eg. $\frac{100 \times 3.6}{100}$

= 3.6 km/hr

An alternative formula is:

km/hr = Metres travelled in 1 minute

eg. 16.7

3 Determine Spray Volume Rate per Hectare

If in doubt use the Tree Row Volume (TRV) formula discussed under Spraying Volume Guidelines (Page 66).

$$\textbf{Spray Volume (l/ha)} = \frac{\textbf{Tree Height (m) x Tree Width (m) x Spray Volume/1000m3 TRV x 10}}{\textbf{Distance between Rows}}$$

eg. Dormant Fruit Trees

$\frac{3 \times 4 \times 60 \times 10}{6}$

= 1200 litres/ha Dilute Spray Volume

Lower volume spray rates will be determined relative to experience and equipment being used.

4 Determine Spray Output Required for Each Side of the Sprayer

Spray output from each side of the sprayer per minute can be calculated using the following formula:

Airblast Sprayer Calibration

Litres/min/side =

$$\frac{\text{Spray Volume (l/ha) x Row Spacing (m) x Speed (km/hr)}}{1200}$$

eg. $\frac{1200 \times 6 \times 3.9}{1200}$

= 23.41 litres/min/side

5 Select and Design Nozzle Layout

(i) Determine the number of nozzles (one side) in the effective air stream of trees to be sprayed. Depending on size and shape of trees it may be necessary to turn some outer nozzles off.

(ii) Divide the nozzles within the sprayer airstream into three portions relative to tree size, bulk and density of foliage. Note them down on a diagram or work sheet (see calibration work sheet on page 44).

(iii) Allocate 2/3 of the spray output per side to those nozzles which are within the effective air stream directed towards the bulk of the trees foliage. Spray output is normally weighted towards the top 1/2 to 2/3 of the tree.

The remaining 1/3 of spray output is allocated to those outer upper and lower areas of the airstream.

eg. 23.4 litre/min/side

23.4 ÷ 3 = 7.8 litres (1/3 allocated to outer areas)

15.6 litres (2/3 allocated to bulk of the tree)

(iv) Choose spraying pressure and select nozzles using the sprayer calibration work sheet on page 45, and nozzle charts on page 48-59. From the nozzle charts find and allocate the operating pressure and nozzle disc/swirl plate (core) combinations which fulfill the required discharge rate and nozzle layout and droplet size required.

6 Fit and Test Nozzles

(i) Fit selected nozzles to one side of the sprayer.

(ii) Fill the sprayer tank with water, set the pump pressure and operate the sprayer for a short period to make sure all lines are full and nozzles are working properly (no blockages, leaks etc.).

(iii) Stop the sprayer and top up the tank with water to a known mark or brim.

(iv) Operate the sprayer in the stationary position at selected pressure for one minute.

(v) Measure how much water is required to refill the tank to the mark or brim.

Divide the volume measured by the time taken (minutes).

Volume (litres) divided by Time (minutes) gives actual Output/min/side (l/min).

eg. 28 litres ÷ 1.25 minutes

= 23.21 l/min/side.

Output for both sides

= 23.2 x 2 = 46.41 l/min.

An alternative method of measuring output is to fit each nozzle with a clamped rubber tap fitting and hose. Then run the sprayer with the fan disconnected, and collect the liquid in a container and measure it.

7 Calculate Actual Application Rate

Use the following formula:

Application Rate (l/ha) = $\frac{\text{600 x Sprayer Output (l/min)}}{\text{Row spraying (m) x Speed (km/hr)}}$

eg. $\frac{600 \times 46.4}{6 \times 3.9}$

= 1190 litres/ha.

Airblast Sprayer Calibration

8 If the Tested Application Rate is not Satisfactory Your Options are:

(i) Adjust pressure up or down to increase or decrease rate of application.

(ii) Adjust speed of travel up or down to decrease or increase application rate.

(iii) Change to different nozzle capacities.

Repeat necessary testing procedures and calculation of application rate if adjustments or changes are made.

When satisfied with actual application rate fit nozzles to the second side of the sprayer.

9 Field Test Sprayer to Check Spray Coverage of Foliage

Operate the sprayer in the orchard or vineyard and check actual spray coverage of foliage.

This can be done very thoroughly using a fluorescent dye, often available through chemical and application equipment manufacturers. If this is not available use water or oil sensitive papers or an extensive visual check. When using a visual check a surfactant must be added to the water in the sprayer.

10 Add the Correct Amount of Chemical to the Tank

For land area rates (litres or kg per hectare) use the formula:

Chemicals required (litres)

$$= \frac{\text{Tank Volume (l) x Rec.Chemical Rate (l/ha)}}{\text{Spray Application Rate (l/ha)}}$$

eg. $\frac{1500 \times 5}{1190}$

= 6.3 litres.

For water volume rates, use formula:

Chemicals Required (litres)

$$= \frac{\text{Tank Volume (l) x Rec.Chemical Rate (l/100l)}}{100}$$

e.g. $\frac{1500 \times 0.45}{100}$

= 6.75 litres.

IMPORTANT: Be sure to mix only enough spray mixture to cover the area required. Avoid wastage and problems of needless chemical disposal.

Tank Volume Required (litres)

= Area (ha) x Spray Application Rate (l/ha)

Area Covered (ha) = $\frac{\text{Tank Volume (litres)}}{\text{Spray Application Rate (l/ha)}}$

eg. $\frac{1500}{1190}$

= 1.26 ha

Airblast Sprayer Calibration

11 Record All Data For Future Reference

Tractor Model.....

Gear.....

Range.....

Dual Power.....

Engine RPM.....

Speed in KPH.....

Type of Tree or Vine.....

Row Spacing (single or double spacing).....

Tree Spacing.....

No. Trees per Hectare.....

Tree Height.....

Tree Width.....

Foliage Density.....

Litres per Tree.....

Litres per Hectare.....

Sprayer Model.....

Number of Nozzles (single or double sided).....

Total Output of all Nozzles in Litres per Minute.....

Litres per minute per Nozzle.....

Working Nozzle Pressure.....

Type of Nozzle.....

Size & Colour of Nozzle.....

Fan Size.....

Fan Pitch.....

Fan Gear.....

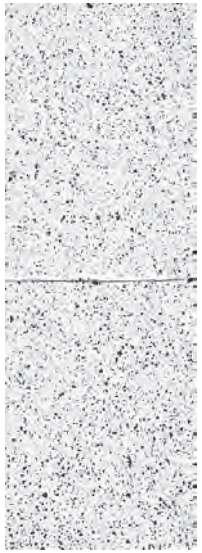
Tank Size.....

Chemicals & Useage per Hectare.....

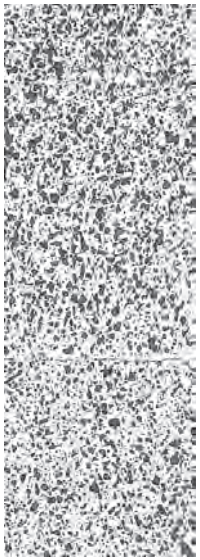
or per 100 litres.....

Chemical Usage per Tank.....

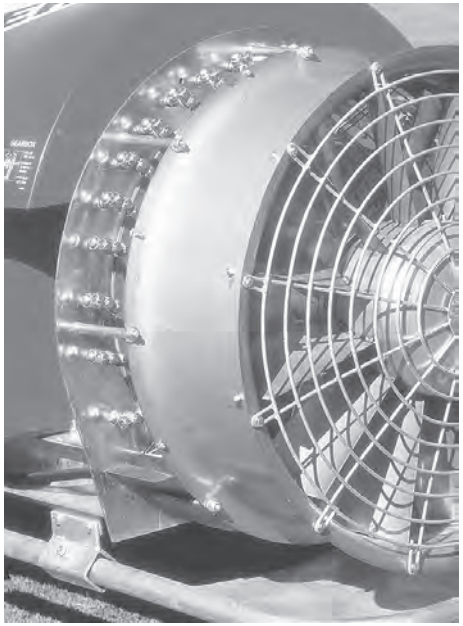
50 litre/hectare on small apple trees



720 litre/ hectare on large pear trees



820SV fan assembly with stainless steel air straightening vanes - 20 roll-over nozzle assemblies - 10 each side.



Airblast Sprayer Calibration

Work Sheet for Orchard Sprayer Calibration

1. TRACTOR INFORMATION				
Tractor Model				
Gear				
Range				
Dual Power				
Engine RPM				
Speed in KPH				
2. ORCHARD INFORMATION				
Type of Tree or Vine				
Row Spacing (single or double spacing)				
Tree Spacing				
No. Trees per Hectare				
Tree Height				
Tree Width				
Foliage Density				
Litres per Tree				
Litres per Hectare				

3. SPRAYER INFORMATION				
Sprayer Model				
Number of Nozzles (single or double sided)				
Total Output of all Nozzles in Litres per Minute				
Litres per minute per Nozzle				
Working Nozzle Pressure				
Type of Nozzle				
Size & Colour of Nozzle				
Fan Size				
Fan Pitch				
Fan Gear				
Tank Size				
4. CHEMICAL INFORMATION				
Chemicals & Useage per Hectare or per 100 litres				
Chemical Usage per Tank				

Comments: _____

_____

Airblast Sprayer Calibration

Sprayer Calibration Work Sheet

(i) **Speed** m/minute / 16.7 = _____ km/h

(ii) **Between row spacing** = _____ metres

(iii) **Volume of spray/ha** = _____ litres/ha

Calculate Discharge Rate/Side

l/minute = l/ha (iii) x m(ii) x km/hr(i) / 1200

= _____ l/minute

Pump pressure = _____ kPa

Nozzle Diagram

1/3 Spray Volume= ___l/minute

2/3 Spray Volume= ___l/minute

*Read these from your spray nozzle discharge charts for your pump pressure.

DISCLAIMER:
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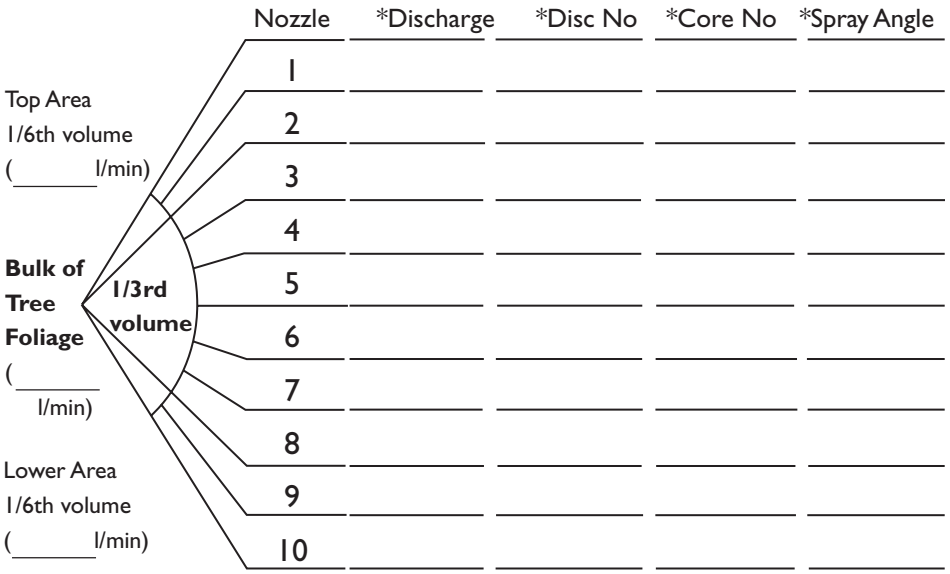

Sprayer Calibration Work Sheet

(i) **Speed** m/minute / 16.7 = _____ km/h

(ii) **Between row spacing** = _____ metres

(iii) **Volume of spray/ha** = _____ litres/ha

Calculate Discharge Rate/Side

l/minute = l/ha (iii) x m(ii) x km/hr(i) / 1200

= _____ l/minute

Pump pressure = _____ kPa

Nozzle Diagram

1/3 Spray Volume= ___l/minute

2/3 Spray Volume= ___l/minute

*Read these from your spray nozzle discharge charts for your pump pressure.

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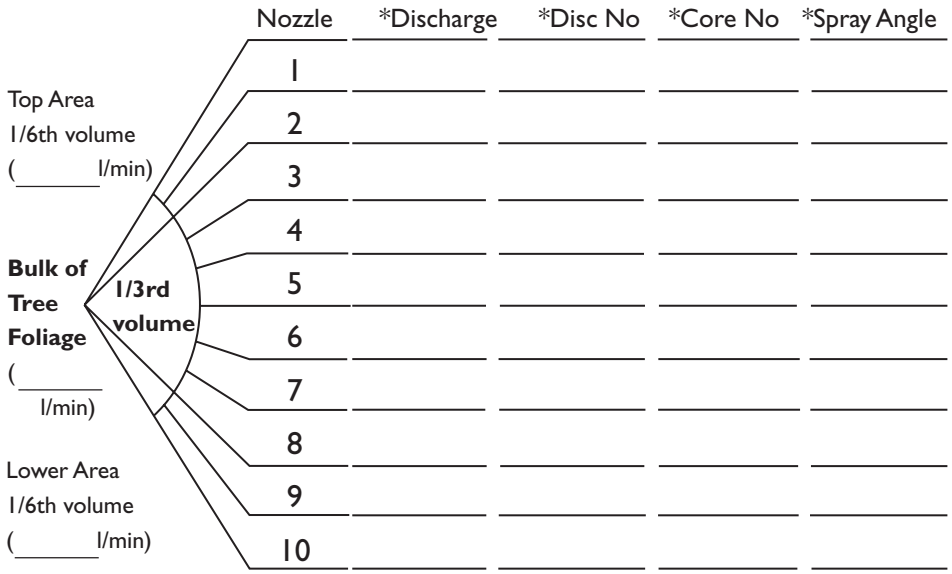

Airblast Sprayer Calibration

Dilute Volume Rate Example

(i) **Speed** 83.5 m/minute = 5 km/h
16.7

(ii) **Between row spacing** = 5 metres

(iii) **Volume of spray/ha** = 2000 litres/ha

Calculate Discharge Rate/Side

l/minute = 2000l/ha (iii) x 5 m(ii) x 5 km/hr(i)
1200

= 41.66 l/minute

Pump pressure = 1380 kPa

Nozzle Diagram

1/3 Spray Volume= 13.89 l/minute

2/3 Spray Volume= 27.77 l/minute

*Read these from your spray nozzle discharge charts for your pump pressure.

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Top Area 1/6th volume (7.32 l/min)

Bulk of Tree Foliage (26.49 l/min)

1/3rd volume

Lower Area 1/6th volume (7.32 l/min)

Nozzle	*Discharge	*Disc No	*Core No	*Spray Angle
1	3.66	D5	45	76°
2	3.66	D5	45	76°
3	4.66	D4	46	32°
4	4.17	D4	35	63°
5	4.66	D4	46	32°
6	4.17	D4	35	63°
7	4.66	D4	46	32°
8	4.17	D4	35	63°
9	3.66	D5	45	76°
10	3.66	D5	45	76°

Total 41.13 per side

Low Volume Rate Example

(i) **Speed** 83.5 m/minute = 5 km/h
16.7

(ii) **Between row spacing** = 4 metres

(iii) **Volume of spray/ha** = 700 litres/ha

Calculate Discharge Rate/Side

l/minute = 700l/ha (iii) x 4 m(ii) x 5km/hr(i)
1200

= 11.66 l/minute

Pump pressure = 1380 kPa

Nozzle Diagram

1/3 Spray Volume= 3.89 l/minute

2/3 Spray Volume= 7.77 l/minute

*Read these from your spray nozzle discharge charts for your pump pressure.

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Top Area 1/6th volume (2.0 l/min)

Bulk of Tree Foliage (7.62 l/min)

1/3rd volume

Lower Area 1/6th volume (2.0 l/min)

Nozzle	*Discharge	*Disc No	*Core No	*Spray Angle
1	1.0	HC10		70°
2	1.0	HC10		70°
3	1.27	HC12		45°
4	1.27	HC12		45°
5	1.27	HC12		45°
6	1.27	HC12		45°
7	1.27	HC12		45°
8	1.27	HC12		45°
9	1.0	HC10		45°
10	1.0	HC10		70°

Total 11.62 per side

Airblast Sprayer Calibration

Sprayer Calibration Work Sheet

(i) **Speed** m/minute / 16.7 = _____ km/h

(ii) **Between row spacing** = _____ metres

(iii) **Volume of spray/ha** = _____ litres/ha

Calculate Discharge Rate/Side

l/minute = l/ha (iii) x m(ii) x km/hr(i) / 1200

= _____ l/minute

Pump pressure = _____ kPa

Nozzle Diagram

1/3 Spray Volume= ___l/minute

2/3 Spray Volume= ___l/minute

*Read these from your spray nozzle discharge charts for your pump pressure.

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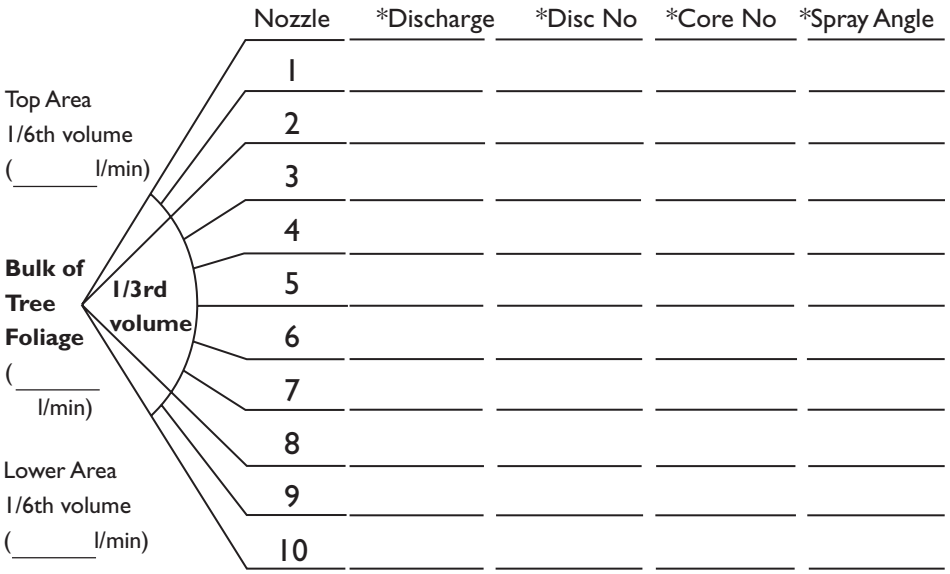

Sprayer Calibration Work Sheet

(i) **Speed** m/minute / 16.7 = _____ km/h

(ii) **Between row spacing** = _____ metres

(iii) **Volume of spray/ha** = _____ litres/ha

Calculate Discharge Rate/Side

l/minute = l/ha (iii) x m(ii) x km/hr(i) / 1200

= _____ l/minute

Pump pressure = _____ kPa

Nozzle Diagram

1/3 Spray Volume= ___l/minute

2/3 Spray Volume= ___l/minute

*Read these from your spray nozzle discharge charts for your pump pressure.

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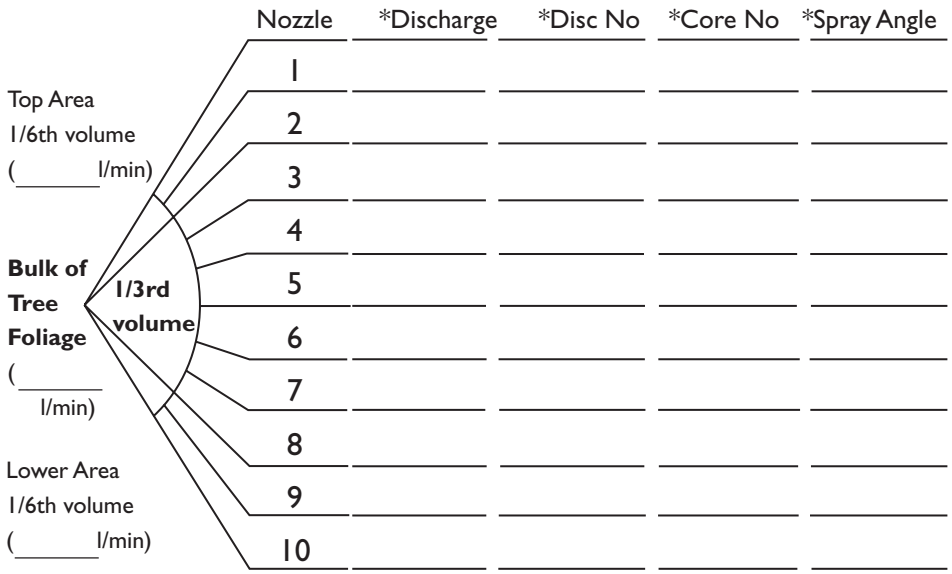


Disc and Core Chart

The core and disc sizes listed are the most commonly used in airblast spraying. For more information on nozzles contact Croplands.
For Hollow Cone Spray Patterns use cores 23, 25, 45 & 46. For Full Cone Spray Patterns use cores 33, 35 & 56.

Spray Outputs per nozzle in litres per minute, and Spray Angle at disc orifice - at 5 different pressures.

Disc	Core	700 kPa (100 psi)	1040 kPa (150 psi)	1380 kPa (200 psi)	2070 kPa (300 psi)	2760 kPa (400 psi)
D1	23	0.41	0.47	0.53	0.62	0.70
		60°	63°	64°	65°	65°
	25	0.59	0.70	0.80	0.97	1.10
		46°	49°	50°	51°	51°
	33	0.83	0.99	1.14	1.40	1.59
		36°	37°	38°	37°	37°
	35	0.83	0.99	1.10	1.33	1.52
		27°	27°	27°	27°	26°
	45	0.72	0.85	0.97	1.17	1.33
		36°	39°	40°	40°	40°
	46	0.87	1.06	1.21	1.48	1.71
		16°	17°	17°	17°	16°
	56	0.87	1.06	1.21	1.48	1.71
		16°	17°	17°	17°	16°
D1.5	23	0.49	0.59	0.66	0.80	0.90
		64°	66°	67°	67°	67°
	25	0.78	0.93	1.06	1.25	1.44
		51°	54°	55°	55°	55°
	33	1.14	1.36	1.55	1.90	2.16
		45°	46°	46°	45°	43°
	35	1.10	1.29	1.48	1.74	1.97
		30°	30°	30°	30°	29°
	45	0.95	1.17	1.33	1.63	1.86
		46°	48°	49°	50°	50°
	46	1.25	1.55	1.74	2.12	2.43
		18°	18°	18°	18°	17°
	56	1.25	1.55	1.78	2.16	2.46
		16°	16°	16°	16°	15°

Disc	Core	700 kPa (100 psi)	1040 kPa (150 psi)	1380 kPa (200 psi)	2070 kPa (300 psi)	2760 kPa (400 psi)
D2	23	0.61	0.72	0.80	0.95	1.06
		71°	72°	72°	72°	72°
	25	0.95	1.10	1.29	1.55	1.74
		60°	61°	61°	61°	60°
	33	1.40	1.71	1.97	2.39	2.73
		55°	55°	55°	52°	48°
	35	1.40	1.71	1.93	2.27	2.58
		47°	45°	44°	40°	38°
	45	1.21	1.44	1.67	2.01	2.31
		57°	58°	58°	58°	57°
	46	1.59	1.90	2.16	2.58	2.96
		21°	20°	19°	18°	18°
	56	1.48	1.78	2.08	2.54	2.92
		18°	18°	17°	16°	16°
D3	23	0.68	0.80	0.91	1.06	1.21
		76°	77°	77°	77°	77°
	25	1.10	1.33	1.52	1.82	2.08
		68°	69°	69°	69°	68°
	33	1.71	2.08	2.39	2.88	3.34
		57°	57°	57°	56°	54°
	35	1.71	2.08	2.35	2.80	3.22
		52°	48°	45°	42°	40°
	45	1.36	1.67	1.93	2.35	2.69
		61°	62°	62°	62°	61°
	46	1.93	2.31	2.65	3.26	3.75
		24°	23°	22°	21°	21°
	56	2.01	2.46	2.84	3.49	4.06
		24°	24°	23°	22°	22°

Disc and Core Chart

The core and disc sizes listed are the most commonly used in airblast spraying. For more information on nozzles contact Croplands.
For Hollow Cone Spray Patterns use cores 23, 25, 45 & 46. For Full Cone Spray Patterns use cores 33, 35 & 56.

Spray Outputs per nozzle in litres per minute, and Spray Angle at disc orifice - at 5 different pressures.

Disc	Core	700 kPa (100 psi)	1040 kPa (150 psi)	1380 kPa (200 psi)	2070 kPa (300 psi)	2760 kPa (400 psi)
D4	23	0.87	1.06	1.21	1.44	1.67
		88°	88°	88°	88°	88°
	25	1.71	2.05	2.35	2.84	3.26
		81°	82°	82°	82°	81°
	33	2.27	2.77	3.15	3.87	4.43
		62°	63°	63°	63°	58°
	35	2.99	3.52	4.17	4.93	5.69
		70°	68°	63°	60°	54°
	45	2.12	2.58	2.96	3.60	4.21
		73°	73°	73°	72°	72°
	46	3.34	4.06	4.66	5.76	6.67
		33°	32°	32°	31°	31°
	56	3.30	4.02	4.66	5.72	6.59
		30°	30°	29°	28°	28°
D5	23	1.06	1.29	1.44	1.74	2.01
		95°	96°	96°	95°	95°
	25	2.05	2.46	2.84	3.41	3.94
		85°	85°	84°	84°	84°
	33	Not recommended				
	35	3.79	4.55	5.31	6.44	7.20
		71°	69°	65°	65°	59°
	45	2.69	3.26	3.75	4.62	5.31
		76°	76°	76°	75°	75°
	46	4.74	5.69	6.56	8.07	9.36
		42°	41°	41°	40°	40°
	56	4.55	5.57	6.41	7.88	9.10
		35°	35°	34°	33°	33°

Disc	Core	700 kPa (100 psi)	1040 kPa (150 psi)	1380 kPa (200 psi)	2070 kPa (300 psi)	2760 kPa (400 psi)
D6	23	1.21	1.49	1.71	2.05	2.35
		99°	100°	100°	99°	99°
	25	2.65	3.22	3.68	4.51	5.19
		89°	89°	89°	88°	88°
	33	Not recommended				
	35	Not recommended				
	45	3.52	4.36	5.04	6.22	7.20
		81°	80°	80°	79°	79°
	46	6.56	8.19	9.48	11.60	13.34
		50°	49°	48°	47°	47°
	56	6.59	8.07	9.32	11.45	13.19
		41°	40°	39°	38°	38°
D7	23	Not recommended				
	25	3.07	3.71	4.47	5.19	6.03
		93°	92°	92°	91°	91°
	33	Not recommended				
	35	Not recommended				
	45	4.21	5.12	5.95	7.35	8.53
		87°	86°	86°	85°	85°
	46	8.41	10.35	11.94	14.99	16.75
		56°	55°	54°	53°	53°
	56	9.10	11.14	12.89	15.77	18.23
		54°	53°	52°	51°	51°

Delavan HC Nozzle Chart

Nozzle No.	Orifice Diameter	Screen Mesh	Output in l/min (litres per minute) at varying pressures (Kilopascal)										
			100	150	200	300	400	500	600	700	1000	2000	2500
HC1	0.41 mm	100					.07	.08	.09	.09	.11	.14	.16
HC1.25	0.46 mm	100				.08	.09	.10	.11	.12	.14	.18	.20
HC1.5	0.53 mm	100			.08	.10	.11	.12	.13	.14	.16	.22	.24
HC2	0.64 mm	100		.10	.11	.13	.15	.16	.18	.19	.22	.30	.33
HC2.5	0.71 mm	100		.12	.14	.16	.19	.21	.22	.24	.28	.37	.42
HC3	0.76 mm	100		.15	.17	.20	.22	.25	.27	.28	.33	.45	.50
HC4	0.84 mm	100		.19	.22	.26	.30	.33	.37	.38	.45	.62	.68
HC5	0.94 mm	100	.20	.24	.27	.33	.37	.42	.45	.48	.57	.78	.87
HC6	1.0 mm	50	.24	.29	.33	.40	.45	.50	.53	.58	.68	.93	1.03
HC8	1.2 mm	50	.31	.38	.43	.53	.60	.67	.78	.87	.93	1.30	1.45
HC10	1.3 mm	50	.38	.47	.55	.65	.75	.83	.92	.98	1.17	1.50	1.80
HC12	1.4 mm	50	.47	.57	.65	.78	.90	1.00	1.10	1.18	1.40	1.95	2.17
HC14	1.5 mm	50	.53	.65	.75	.92	1.07	1.18	1.30	1.40	1.67	2.37	2.63
HC18	1.7 mm	50	.68	.83	.97	1.18	1.37	1.53	1.67	1.80	2.15	3.03	3.37
HC22	1.9 mm	50	.83	1.03	1.18	1.45	1.67	1.87	2.03	2.20	2.63	3.75	4.17
HC26	2.1 mm	50	1.00	1.22	1.40	1.72	1.97	2.20	2.42	2.60	3.10	4.33	4.92

Available Spray Angles are 45°, 70° & 90°.

Volume Median Diameters for Droplets of HC Nozzles

VOLUME MEDIAN DIAMETERS FOR DROPLETS VMD DROPLET SIZE SHOWN IN MICRONS based on water at 21°C (70°F)

TIP SIZE & ANGLE	PRESSURE kPa (psi) 210 (30)	280 (40)	420 (60)	630 (90)	840 (120)	1050 (150)	2100 (300)	3500 (500)
HC 1-90°	118	108	96	85	78	73	59	51
HC 1.25-90°	126	115	102	91	83	78	63	54
HC 1.5-90°	132	121	108	95	87	82	66	57
HC 2-90°	143	131	116	103	94	88	72	61
HC 2.5-90°	151	138	123	109	100	93	76	65
HC 3-90°	157	144	128	113	104	97	79	68
HC 5-90°	176	161	143	127	116	109	88	76
HC 6-90°	182	167	148	131	120	113	91	78
HC 8-90°	193	177	157	139	127	119	97	83
HC10-90°	201	184	163	145	133	124	101	86
HC12-90°	208	190	169	149	137	128	104	89
HC14-90°	213	195	173	153	141	131	107	92
HC18-90°	222	204	180	160	147	137	111	96
HC22-90°	229	210	186	165	151	142	115	99
HC 1-70°	133	122	108	96	88	82	67	57
HC 1.25-70°	142	130	115	102	94	88	71	61
HC 1.5-70°	149	137	121	107	99	92	75	64
HC 2-70°	161	148	131	116	106	99	81	69
HC 2.5-70°	170	156	138	122	112	105	85	73
HC 3-70°	178	163	144	128	117	110	89	76
HC 5-70°	198	182	161	143	131	122	99	85

TIP SIZE & ANGLE	PRESSURE kPa (psi) 210 (30)	280 (40)	420 (60)	630 (90)	840 (120)	1050 (150)	2100 (300)	3500 (500)
HC 6-70°	206	189	167	148	136	127	103	89
HC 8-70°	218	200	177	156	144	134	109	94
HC10-70°	227	208	184	163	150	140	114	97
HC12-70°	234	215	190	168	154	144	117	101
HC14-70°	240	221	195	173	159	148	120	103
HC18-70°	251	230	204	180	165	155	126	108
HC22-70°	259	237	210	186	171	160	130	111
HC 1-45°	165	151	134	119	109	102	83	71
HC 1.25-45°	176	162	143	127	116	109	88	76
HC 1.5-45°	185	170	151	133	122	114	93	80
HC 2-45°	200	183	162	144	132	123	100	86
HC 2.5-45°	211	194	172	152	139	130	106	91
HC 3-45°	221	202	179	159	145	136	111	95
HC 5-45°	246	226	200	177	163	152	123	106
HC 6-45°	256	234	208	184	169	158	128	110
HC 8-45°	270	248	219	194	178	167	135	116
HC10-45°	281	258	229	202	186	174	141	121
HC12-45°	291	267	236	209	192	179	146	125
HC14-45°	298	274	242	215	197	184	150	128
HC18-45°	311	285	253	224	205	192	156	134
HC22-45°	321	295	261	231	212	198	161	138

Spraying Systems Disc and Core Hollow Cone Spray Tips

DISC & CORE	P.S.I.	BAR	LITRES PER MINUTE	CUMULATIVE VOLUME PERCENTAGE OF MICRONS *											
				0-50 µm	0-100µm	50-100 µm	50-150 µm	100-150 µm	100-200 µm	100-300 µm	150-200 µm	300-400 µm	400+ µm	V.M.D. µm	SPRAY ANGLE
D1 C13	50	3.45	.28	1	15	14	48	34	63	84	29	1			51°
	100	6.89	.36	1	24	23	61	38	65	75	27	3			62°
	200	13.79	.48	8	62	54	88	34	37	38	3				
	300	20.69	.58	22	92	70	78	8	8	8					
	400	27.59	.67	40	98	48	60	2	2	2					
D2 C13	50	3.45	.35		9	36	36	27	57	88	32	3			67°
	100	6.89	.47	1	15	47	47	33	63	83	30	4			72°
	200	13.79	.60	4	19	86	86	40	49	50	9				
	300	20.69	.71	13	24	87	87	16	16	16					
	400	27.59	.82	22	92	78	78	8	8	8					
D3 C13	50	3.45	.38		7	28	28	21	51	84	24	6	1		70°
	100	6.89	.51		11	48	48	37	57	85	20	3	1		75°
	200	13.79	.65	2	38	81	81	47	63	56	1				
	300	20.69	.78	7	68	92	92	31	32	32					
	400	27.59	.90	15	80	77	77	20	20	20					
D4 C13	50	3.45	.50		5	22	22	17	33	82	26	1	1		79°
	100	6.89	.68		9	34	34	25	53	85	28	2	2		83°
	200	13.79	.85	1	30	75	75	46	67	70	21	3			
	300	20.69	1.02	5	56	93	93	42	42	42	2				
	400	27.59	1.17	11	74	88	88	25	25	25	1				

Information gathered from Spraying Systems DATA SHEET N° 12135-19/21/23/25/27 December 19, 1967. **There are 1000 µm (microns) in 1mm.*

Spraying Systems Disc and Core Hollow Cone Spray Tips

DISC & CORE	P.S.I.	BAR	LITRES PER MINUTE	CUMULATIVE VOLUME PERCENTAGE OF MICRONS *											
				0-50 µm	0-100µm	50-100 µm	50-150 µm	100-150 µm	100-200 µm	100-300 µm	150-200 µm	300-400 µm	400+ µm	V.M.D. µm	SPRAY ANGLE
D1	50	3.45	.30	1	10	10	40	30	60	89	30	1			
C23	100	6.89	.41	6	14	13	45	32	50	85	30	1			60º
	200	13.79	.52	15	48	42	83	51	51	51	9			100	64º
	300	20.69	.62	27	82	67	85	28	28	28				75	65º
	400	27.59	.72		90	63	73	10	10	10				66	65º
D2	50	3.45	.46	1	5	4	39	35	47	89	28	5	1		
C23	100	6.89	.61	1	9	8	34	25	55	88	30	3	1		71º
	200	13.79	.80	4	38	34	76	42	60	62	18			120	72º
	300	20.69	.95	8	66	58	89	31	31	31	2			87	72º
	400	27.59	1.09	15	76	61	83	22	24	24	2			75	72º
D3	50	3.45	.49		3	3	17	14	47	81	23	16	1		
C23	100	6.89	.66		6	6	26	20	46	84	26	9	1		76º
	200	13.79	.89	2	28	26	68	42	65	67	25			130	77º
	300	20.69	1.12	5	50	45	87	42	49	50	8			100	77º
	400	27.59	1.29	7	60	53	89	36	40	40	4			87	77º
D5	50	3.45	.77		1	1	8	7	23	67	16	26	5		
C23	100	6.89	1.05		3	3	18	15	35	77	33	18	2		95º
	200	13.79	1.44	1	18	17	55	38	67	81	29	1		150	96º
	300	20.69	1.73	2	34	32	76	44	64	66	20			120	95º
	400	27.59	2.00	4	50	46	86	40	49	50	9			105	95º
D6	50	3.45	.89		1	1	5	4	7	57	13	29	10		
C23	100	6.89	1.29		2	2	10	8	26	68	18	24	6		99º
	200	13.79	1.73		14	14	48	34	66	85	30	1		162	100º
	300	20.69	2.03	1	28	27	71	44	66	69	25			125	90º
	400	27.59	2.35	3	42	39	82	43	57	58	14			105	99º

Information gathered from Spraying Systems DATA SHEET NO 12135-19/21/23/25/27 DECEMBER 19,1967. **There are 1000 µm (microns) in 1mm.*

Spraying Systems Disc and Core Hollow Cone Spray Tips

DISC & CORE	P.S.I.	BAR	LITRES PER MINUTE	CUMULATIVE VOLUME PERCENTAGE OF MICRONS *											
				0-50 µm	0-100µm	50-100 µm	50-150 µm	100-150 µm	100-200 µm	100-300 µm	150-200 µm	300-400 µm	400+ µm	V.M.D. µm	SPRAY ANGLE
D1	50	3.45	.43		5	5	24	19	47	89	28	5	1		
C25	100	6.89	.58		8	8	32	24	52	86	28	5	1		46º
	200	13.79	.80	2	30	28	68	40	65					130	50º
	300	20.69	.97	5	54	49	89	40	45	46	5			100	51º
	400	27.59	1.12	11	78	67	89	22	22	22				75	51º
D2	50	3.45	.66		3	3	16	13	35	77	12	16	2		
C25	100	6.89	.92		5	5	22	22	33	82	26	11	2		60º
	200	13.79	1.25	1	20	19	57	38	65	79	27			150	61º
	300	20.69	1.53	3	38	3	78	43	60	62	17			115	61º
	400	27.59	1.76	5	58	53	90	37	42	42	5			95	60º
D3	50	3.45	.80		1	1	5	4	27	69	16	24	6		
C25	100	6.89	1.07		3	3	16	13	35	75	22	19	3		68º
	200	13.79	1.53	1	13	12	43	31	67	83	36	2		160	69º
	300	20.69	1.83	1	28	27	69	42	68	72	26			125	69º
	400	27.59	2.11	2	40	38	86	48	60	60	18			105	68º
D5	50	3.45	1.50				6	6	16	50	10	31	20		
C25	100	6.89	2.04		1	1	8	7	21	59	14	25	15		85º
	200	13.79	2.78		8	8	32	24	54	88	30	3	1	185	84º
	300	20.69	3.36	1	18	17	53	36	68	82	32			145	84º
	400	27.59	3.88	1	26	25	69	44	69	74	25			125	84º

Information gathered from Spraying Systems DATA SHEET Nº 12135-19/21/23/25/27 December 19, 1967. **There are 1000 µm (microns) in 1mm.*

Spraying Systems Disc and Core Hollow Cone Spray Tips

DISC & CORE	P.S.I.	BAR	LITRES PER MINUTE	CUMULATIVE VOLUME PERCENTAGE OF MICRONS *											
				0-50 µm	0-100µm	50-100 µm	50-150 µm	100-150 µm	100-200 µm	100-300 µm	150-200 µm	300-400 µm	400+ µm	V.M.D. µm	SPRAY ANGLE
D7	50	3.45	2.14				3	3	10	38	15	30	32		
C25	100	6.89	3.11		1	1	5	4	14	45	17	25	26		93º
	200	13.79	4.31		7	7	22	15	43	85	28	8	1	200	92º
	300	20.69	5.19		12	12	44	32	73	87	31	1		165	91º
	400	27.59	5.99	1	19	18	63	45	75	81	28			135	91º
D10	50	3.45	3.22				2	2	5	20	18	28	52		
C25	100 200	6.89	4.50				3	3	10	36	7	28	36		
	300	13.79	6.42		2	2	15	13	36	82	23	13	2	225	102º
	400	20.69	7.83		7	7	34	27	61	92	34	1		175	103º
		27.59	9.04		16	16	60	44	74	74	30			150	
	50														
D14	100 200	3.45	4.40				1	1	3	14	2	22	64		
C25	300	6.89	6.22				2	2	5	24	3	26	50		113º
	400	13.79	8.73		2	2	9	7	24	70	17	26	2		114º
		20.69	10.37		5	5	26	21	55	94	73	1			
		27.59	11.98		12	12	60	48	74	74	34				

Information gathered from Spraying Systems DATA SHEET Nº 12135-19/21/23/25/27 December 19, 1967.

**There are 1000 µm (microns) in 1mm.*

Spraying Systems Disc and Core Hollow Cone Spray Tips

DISC & CORE	P.S.I.	BAR	LITRES PER MINUTE	CUMULATIVE VOLUME PERCENTAGE OF MICRONS *											
				0-50 µm	0-100µm	50-100 µm	50-150 µm	100-150 µm	100-200 µm	100-300 µm	150-200 µm	300-400 µm	400+ µm	V.M.D. µm	SPRAY ANGLE
D1	50	3.45	.51		7	7	24	24	39	73	22	16	4		
C45	100	6.89	.72		9	9	21	21	43	78	21	11	28		36º
	200	13.79	.96	10	62	52	85	33	48	48	5		5	137	40º
	300	20.69	1.22	5	44	39	79	40	56	50	16			112	40º
	400	27.59	1.41	10	62	52	85	33	38	38	5			90	40º
D2	50	3.45	.86		3	3	15	15	31	67	19	22			
C45	100	6.89	1.18		5	5	20	15	35	73	20	15			57º
	200	13.79	1.63	5	46	41	82	41	54	54	13			162	58º
	300	20.69	2.03	3	30	27	67	40	63	70	23			125	50º
	400	27.59	2.35	4	46	42	82	40	54	54	24			100	57º
D3	50	3.45	.98		1	1	10	10	23	61	16	24	12		
C45	100	6.89	1.39		2	2	12	18	28	68	18	23	7		61º
	200	13.79	1.92	3	34	31	77	46	64	66	18			180	62º
	300	20.69	2.34	1	22	21	59	38	65	78	35			137	62º
	400	27.59	2.70	2	34	32	78	46	64	66	18			120	61º
D5	50	3.45	1.93				3	3	12	42	9	30	38		
C45	100	6.89	2.68				45	45	15	54	11	31	15		76º
	200	13.79	3.74	1	18	17	63	46	76	82	30			205	76º
	300	20.69	4.58		12	12	44	32	64	88	32			160	75º
	400	27.59	5.29	1	19	18	63	45	75	81	30			137	75º

Information gathered from Spraying Systems DATA SHEET NO 12135-20/22/24/26/28 December 19, 19967. **There are 1000 µm (microns) in 1mm.*

Spraying Systems Disc and Core Hollow Cone Spray Tips

DISC & CORE	P.S.I.	BAR	LITRES PER MINUTE	CUMULATIVE VOLUME PERCENTAGE OF MICRONS *											
				0-50 µm	0-100µm	50-100 µm	50-150 µm	100-150 µm	100-200 µm	100-300 µm	150-200 µm	300-400 µm	400+ µm	V.M.D. µm	SPRAY ANGLE
D7	50	3.45	2.89				1	1	6	26	5	28	46		
C45	100	6.89	4.17				2	2	8	36	6	32	32		87º
	200	13.79	5.94	1	14	13	55	42	75	86	33			225	86º
	300	20.69	7.32		7	7	32	25	53	90	32	3		175	85º
	400	27.59	8.47	1	14	13	55	42	34	86	34			145	85º
D10	50	3.45	4.71						2	14	2	20	64		
C45	100	6.89	6.65				1	1	3	20	2	28	52		93º
	200	13.79	9.40	1	11	10	47	37	74	89	45			250	93º
	300	20.69	11.70		4	4	24	20	50	91	30	5		187	
	400	27.59	13.51	1	11	10	49	39	74	89	35			155	
D14	50	3.45	6.50						1	6	1	14	80		
C45	100	6.89	9.22						2	10	2	20	70		104º
	200	13.79	13.04	1	10	9	43	34	71	91	36				105º
	300	20.69	16.17		3	3	17	14	43	87	28	10			
	400	27.59	18.67		10	10	44	34	70	80	36				
D16	50	3.45	7.62							5		11	84		
C45	100	6.89	10.93						1	7	1	18	76		111º
	200	13.79	15.63		8	8	38	30	68	92	38				112º
	300	20.69	19.43		2	2	15	13	38	84	25	14			
	400	27.59	22.43		2	8	40	32	68	92	36				

Information gathered from Spraying Systems DATA SHEET NO 12135-20/22/24/26/28 December 19, 19967. **There are 1000 µm (microns) in 1mm.*

Spraying Systems TX Ceramic Nozzles

TIP	BAR	LITRES PER MINUTE	CUMULATIVE VOLUME PERCENTAGE OF MICRONS *											
			0-50 µm	0-100µm	50-100 µm	50-150 µm	100-150 µm	100-200 µm	100-300 µm	150-200 µm	300-400 µm		V.M.D. µm	SPRAY ANGLE
YELLOW NO 3	4 8 20	.22 .30 .45	7 9 10	44 54 80	37 45 70	80 87 90	40 41 20	54 45 20	56 46 20	13 4			107 95 87	74º 80º 83º
GREEN NO 4	4 8 20	.30 .41 .62	4 7 9	38 48 62	34 41 53	73 85 91	40 44 38	60 45 38	62 52 38	19 7			115 101 92	75º 80º 81º
RED NO 6	4 8 20	.45 .62 .93	2 4 6	28 36 44	26 32 38	60 76 94	34 44 58	66 63 58	72 64 58	27 19			132 117 106	75º 80º 80º
GREY N0 8	4 8 20	.60 .84 1.30	2 2 4	20 26 30	20 24 26	43 66 96	28 36 70	58 66 70	77 74 70	32 28			150 132 120	75º 80º 80º
BLACK N0 10	4 8 20	.75 1.00 1.60	2 2 3	16 23 24	14 21 21	40 52 76	26 31 67	66 65 74	83 77 74	30 34 7			164 145 132	76º 80º 79º
BROWN NO 12	4 8 20	.90 1.30 2.00	1 1 2	11 18 21	10 17 19	33 41 54	23 24 35	49 60 35	84 84 35	24 36 44	6		180 159 145	76º 80º 78º
ORANGE N0 18	4 8 20	1.40 1.90 3.00	1 1 2	10 10 12	9 9 10	25 33 34	18 25 26	40 53 90	82 86 90	22 28 62	8 4		203 180 164	77º 80º 77º
LIGHT BLUE N0 26	4 8 20	2.00 2.80 4.40	1 1 2	5 7 9	4 6 7	19 24 24	15 18 18	31 41 51	71 83 40	16 23 33	16 10		233 206 187	78º 80º 76º

Information gathered from Spraying Systems DATA SHEET NO 12135-168M 12135 169M 12135-170M April 14, 1993. *There are 1000 µm (microns) in 1mm.*

Albuz ATR Ceramic Nozzles

TIP	BAR	LITRES PER MINUTE	CUMULATIVE VOLUME PERCENTAGE OF MICRONS *											
			0-50 µm	0-100µm	50-100 µm	50-150 µm	100-150 µm	100-200 µm	100-300 µm	150-200 µm	300-400 µm	400+ µm	V.M.D. µm	SPRAY ANGLE
LILAC	5	.37	19	74	55	70	16	23	26	7			77	80º
	10	.50	29	79	50	64	14	18	21	5			68	
	15	.61	39	81	43	55	14	16	19	3			61	
BROWN	5	.48	17	67	50	69	20	28	33	8			81	80º
	10	.66	29	79	50	64	15	19	22	6	1	1	70	
	15	.78	35	80	46	58	13	18	19	5	1	1	64	
YELLOW	5	.74	18	59	41	61	21	31	40	11			88	80º
	10	1.02	27	65	37	56	18	27	35	9	1	1	78	
	15	1.23	33	70	38	54	16	26	30	8	2	1	71	
ORANGE	5	.98	16	53	38	58	21	32	46	11	1	1	96	80º
	10	1.34	23	60	37	56	19	29	40	11	1	1	84	
	15	1.62	28	62	34	51	18	28	38	10	2	2	79	
RED	5	1.39	14	45	30	47	19	32	55	14	3	1	116	80º
	10	1.91	22	51	29	47	18	31	49	14	3	2	100	
	15	2.30	26	57	31	47	16	29	43	13	5	3	88	
GREEN	5	1.77	13	50	26	43	14	20	61	14	2	2	131	80º
	10	2.44	19	57	28	45	17	20	53	13	4	4	109	
	15	2.94	24	64	29	46	17	19	47	12	8	5	94	
BLUE	5	2.45	8	33	17	30	13	24	75	10	6	4	207	80º
	10	3.37	14	44	20	34	16	29	65	12	9	10	150	
	15	4.06	20	55	26	42	16	29	54	13	13	15	114	

Information gathered from ALBUZ Research and Development March 1989.

**There are 1000 µm (microns) in 1mm.*

Practical Considerations for Airblast Sprayer Application

Croplands Seven 'C's' of Crop Protection

The art of achieving successful crop protection is simply and probably best described as "getting it right".
Seven considerations or steps are vital for achieving good crop protection. These steps are the seven "C's" of crop protection, namely:

1 Correct Identification of the Pest.
2 Correct Choice of Pest Control. (Biological and/or chemical).
3 Correct Method of Application.
4 Correct Application Rate.
5 Correct Timing of Spraying Application.
6 Correct Chemical Handling and Safety.
7 Correct Maintenance Procedures.

Making the right decisions within each step will ensure the best crop protection available. Conversely, failure to correctly address any one of these steps can seriously jeopardise crop production.

Correct Identification of the Pest

Simply stated, you cannot effectively control a pest if you do not correctly identify it.

It is not only imperative to correctly identify a pest, but also to recognise it soon enough to take appropriate measures before the pest causes economic damage.

This presupposes a certain amount of knowledge and experience in producing a crop and knowledge of the pests that might threaten production. Without it you may not recognise the problem until it is too late.

You should learn as much as possible about what you are producing and what may threaten it. Learn the life cycles and habits of relevant pests so that you can control them in the most efficient and effective manner.

Life cycles of pests can be quite complicated and most are only susceptible to chemical control measures at certain stages. As a general rule the younger the life stage of an insect, the more susceptible it is to insecticides. The same principle applies with plants or weeds and herbicides.

Information can be sought through literature, local Farmers, relevant Industry Associations, Departments of Agriculture and their representatives, local Agronomists and Advisory Services.

Regular Inspection

Nothing beats regular inspections of crops for early identification of a problem or pest. If you are not looking you will not see it.

If you don't have the time or knowledge to monitor crops for pests, it may be a viable alternative to contract a monitoring agent to do it for you.

Correct Selection and Use of Chemicals

The use of chemical control measures are simply an economic necessity because biological control organisms, resistant varieties and other control measures are usually inadequate. Chemical control is often the most effective and economically viable method of pest control available.

Agricultural chemicals are one of modern man's most important tools in crop protection. However, like other tools he uses, they can be hazardous to man and his environment if they are not used correctly.

The only way to use a chemical or pesticide is the correct way.
Always select the chemical which poses least risk to humans, livestock and the environment, yet deals effectively with the identified pest.

Practical Considerations for Airblast Sprayer Application

The following factors are important:

- manufacturers recommendations and label claims.
- toxicity of the chemical.
- mode of action.
- persistence.
- withholding period to harvest.
- target resistance to chemical.
- drift hazard
- market requirements or limitations

It is essential to learn as much about pesticides as it is to learn about the pests they are designed to control.

The proper use of agricultural chemicals or pesticides not only involves a sound knowledge of the pest to be controlled, but also a proper knowledge of the pesticide, its application and safe handling.

Correct Method of Chemical Application

The correct method of chemical application is that which places the correct amount of chemical in contact with the target in the most efficient and effective manner.

Selecting the correct method of application and appropriate equipment requires a good understanding of the chemical, the target area and what interaction is required (between the pest, plant or animal, and pesticide).

Define the Target

The target of chemical application depends on the pest, its life cycle and location on the crop.
It is important to define what the target is, where it is and how it can be reached effectively and efficiently.

Complexities of Reaching the Target

The complexity or difficulty of reaching a target has a major influence of what equipment is needed to apply the chemical. Nozzle requirements for soil applied pesticides can be quite different to pesticides applied to foliage. Plant factors which effect the method of spray application are:

- the type of plant.
- the size of plant.
- the shape of plant.
- the shape of foliage.
- the density of foliage or crop.
- crop management practices.

Leaf shape, size and density vary enormously, and interact differently with varying droplet sizes, wind speed and use of wetting agents or surfactants.

Leaf surfaces may be smooth or rough, waxed or unwaxed, hairy or hairless. Each factor has an important bearing on how droplets attach or don't attach to the foliage.

The use of wetting agents or surfactants can play an important part in surface attachment of droplets.

It is important to understand the chemical, the target, the application technique and how they interact to ensure the best results in crop protection.

The use of water or oil sensitive paper and especially the use of fluorescent dyes is recommended to check effectiveness of spray coverage. These can be a useful tools in selection of the correct equipment or method of spray application.

Practical Considerations for Airblast Sprayer Application

Relationship Between Droplet Size, Droplet Numbers, Spray Volume and Effective Spray Coverage

The effectiveness of applied pesticides is directly related to droplet size and the number of droplets deposited and retained on the target.

Contact Pesticides

Most contact pesticides (fungicides, insecticides and herbicides) require as much coverage of the plant as possible. In many cases both sides of foliage should be covered. This type of spray coverage requires very fine (50-150 micron) droplets. A minimum of 70 droplets/cm2 of target area is required for most contact pesticides.

Systemic Pesticides

Pesticides with systemic action (fungicides, insecticides, herbicides and growth regulators) are absorbed by plants and translocated within the plant. In this instance total coverage is not as critical as with contact pesticides.

A minimum of 20 droplets/cm of target area is required for most systemic pesticides. Larger droplet sizes (200-400 microns) are generally preferred because finer droplets may dry too quickly in dry weather conditions and therefore not be absorbed by the plant.

As a general rule, heavy droplets above 600 microns, will not remain on a plant but run off.

Droplet Size

The relationship between droplet size and number is such that, if the diameter of a droplet is halved, there is approximately an eight fold increase in the number of new droplets from the same volume.

The illustration on the next page, using cubes and spheres, demontrates the eight fold increase in droplet numbers as droplet size is halved.

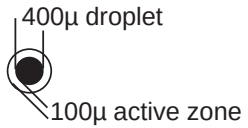
Droplet size is normally measured and recorded by droplet diameter in microns. One micron equals 0.001 mm.

DROPLET SIZE (MICRONS)	NUMBER OF DROPLETS FROM ONE MILLI LITRE OF WATER
400	29842
300	70736
200	238931
100	1908397

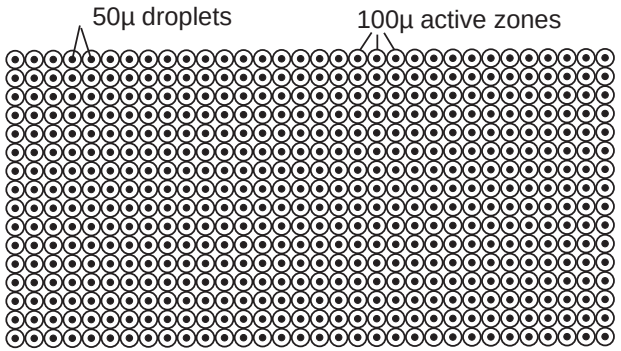
Coverage and Spray Volume

By drawing a chemical active zone of 100 micron width around each droplet, we can illustrate comparative areas of effective cover which can be achieved using the same volume but different droplet size.

AREA COVERED BY ONE 400 MICRON DROPLET

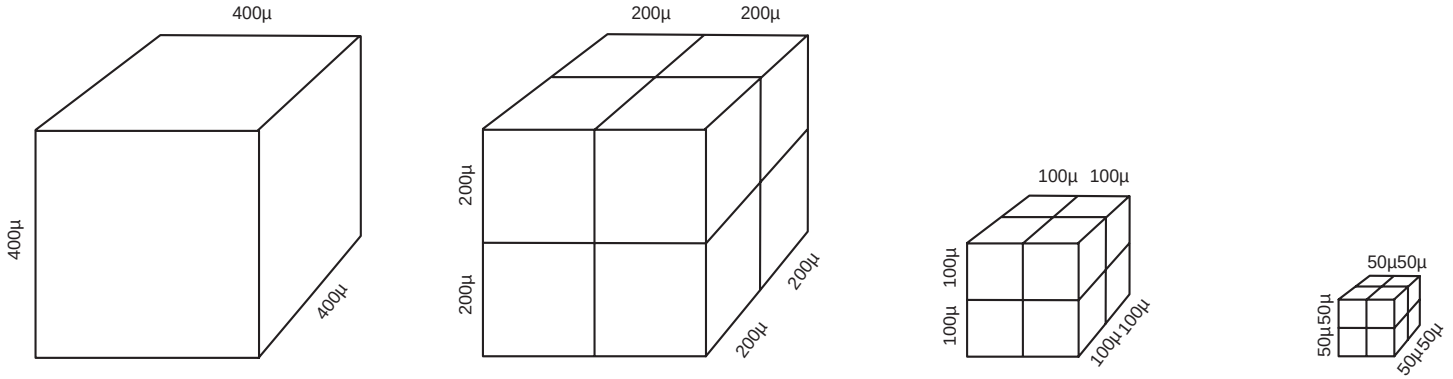


AREA COVERED BY 512 DROPS OF 50 MICRONS
(obtained with the same amount of water as one drop 400 microns)



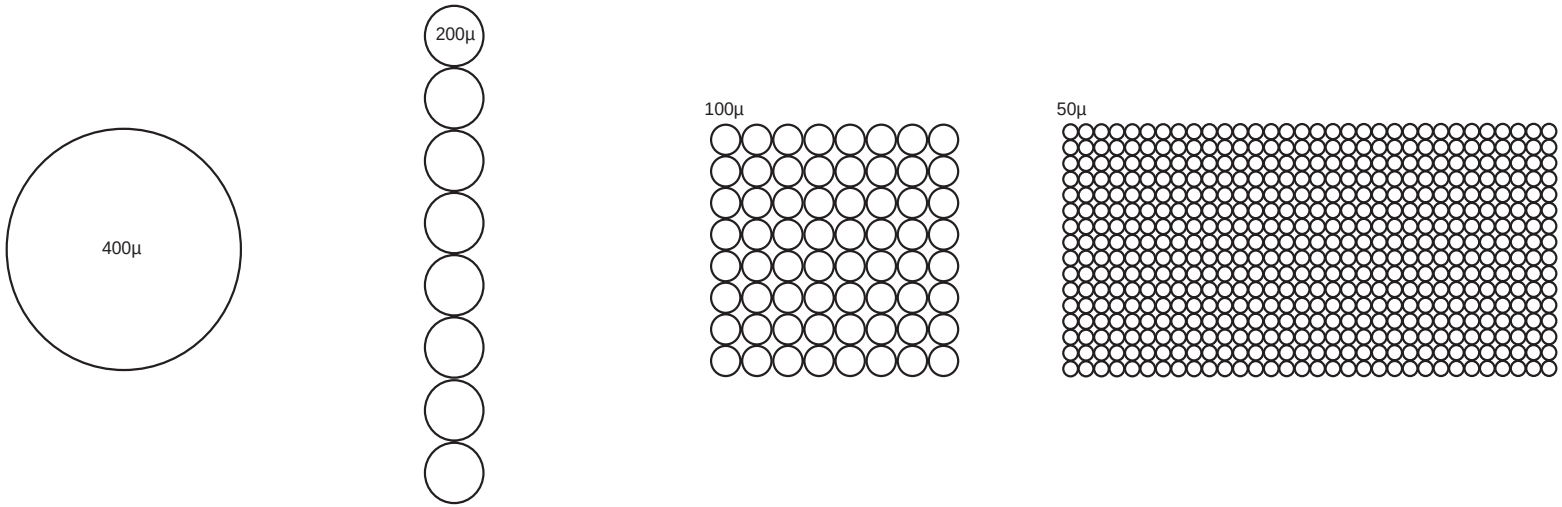
Practical Considerations for Airblast Sprayer Application

The effect of reducing droplet size (diameter) by half, is graphically illustrated by dividing a cube.
The ratio in the division of the cubes is similar to spheres or droplets.



ONE 400µ CUBE = 8 X 200µ CUBES = 64 X 100µ CUBES = 512 X 50µ CUBES

One 400 micron cube produces 8 x 200 micron cubes. Each 200 micron cube produces a further 8 x 100 micron cubes.
Each 100 micron cube further produces 8 x 50 cubes and so on.



ONE 400µ DROPLET = 8 X 200µ DROPLETS = 64 X 100µ DROPLETS = 512 X 50µ DROPLETS

The volume of one 400 micron droplet produces 8 x 200 micron droplets, 64 x 100 micron droplets or 512 x 50 micron droplets.
The ratio of reduction of droplets is similar to cubes.

Practical Considerations for Airblast Sprayer Application

More Effective Cover

The area of surface coverage, and frequency of impact is dramatically increased by reducing droplet size.

As illustrated, reducing droplet size by 1/2 increases the area of surface cover by a factor of 4, and droplet impact by a factor of 8, without increasing liquid volume.
As modern technology allows spray volumes to be reduced, attention to droplet size becomes more important.
High volumes and coarse droplets can cause run off and needless wastage. Very fine droplets can cause drift and evaporative problems.

Beware of Run-Off

Gone are the days of believing more effective coverage is simply a matter of increasing spray volume.

The origins of pesticide application saw high volume hand spraying (2000-3500 litre/ha.) being used as the norm for effective cover.

Today it is difficult for knapsack users or hand gun operators to perceive that it may not be desirable or necessary to drench (visually wet), foliage to get effective cover.

High volume spraying onto foliage can in fact be less effective than lower volumes.

Run-off occurs when drops coalesce (come together and form a whole). When this happens, the chemical or pesticide accumulates at the leaf tip, and eventually drops on to the soil.

Many chemicals are heavier (denser) than water and are the first to gravitate to the leaf tip and drop onto the soil leaving mostly water on the plant or target. Depending on the pesticide, run - off can cause leaf burn, bud burn, soil contamination and unnecessary wastage of chemicals.

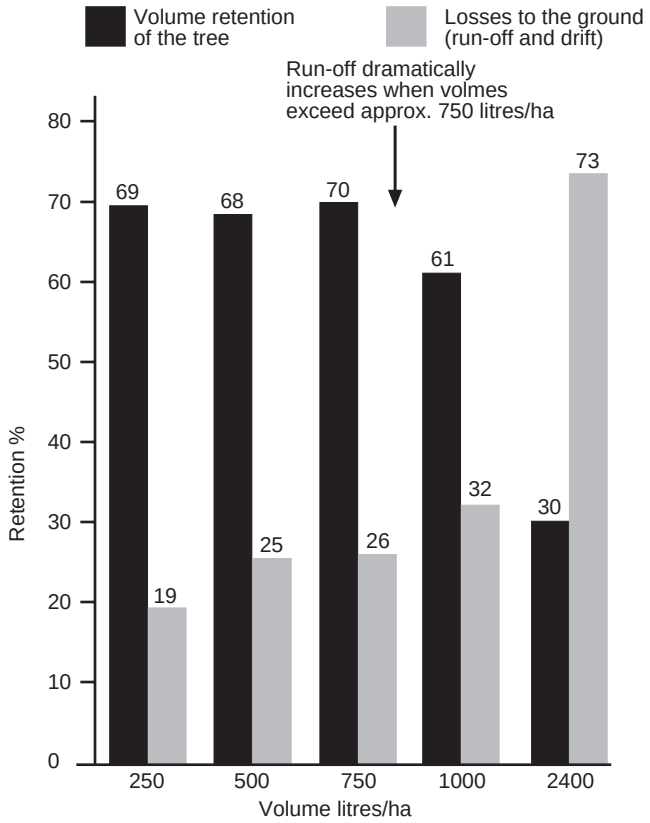


Figure 1: *Data established for vines (Dr J Fischer et al.: Spritzbruhe - Retentionsversuche, CG international report AG 2.57, p8/1982. The fully grown crop can retain approx. 750 l/ha. Larger spray volumes will result in increasing run-off.*

Plants have a limited ability to retain surface liquid. Excessive spray volumes do not lead to improved chemical deposits. They only result in increased soil contamination due to run-off.

Practical Considerations for Airblast Sprayer Application

Factors which effect or influence spray volume retention or conversely, the point at which run off may begin are:

- Application rate and droplet size.
- The size of the plant or tree.
- The development stage of its foliage.
- The type of leaf surface (smooth or rough, waxed or unwaxed, hairy or hairless, etc.)
- The humidity of the leaf surface due to rain, dew, irrigation, etc.
- The humidity in the air.
- Temperature

It should be remembered that plants have a limited ability to retain spray volume. Once the point of run off occurs spray is simply wasted.

Beware of Drift and Evaporation

Droplets that are too fine may be carried away from the target directly by the wind, or by evaporation, and air movement. These represent wasted chemical, and a potential hazard to nearby crops, animals and people.

The following table shows theoretical drift potential in relation to droplet size.
As the table illustrates very fine droplets (below 50 microns) float in the air for a considerable length of time, and therefore are subject to being carried long distances.

With any pesticide, drift is related to the equipment, droplet size, wind speed, height of application and climatic conditions.

Spraying using higher than recommended pressures for nozzles will produce a higher proportion of fine droplets which are subject to drift. Correct nozzle selection and operation are very important in minimising drift. For further information on nozzles, see pages 48-59, 68-72 & 75.

The aim is to select a method of spraying and appropriate spray volumes, which give full coverage but no coalescence or run-off, and minimal spray drift.

THEORETICAL DRIFT IN RELATION TO DROPLET SIZE

(Figures are based on water droplets and assume no evaporation, no convention currents and uniform wind speed or drift)

Droplet Diameter (Microns)	Time to Fall 3 Metres (Seconds)	Distance Carried by 8km/h Wind (Metres)	Distance Carried by 16km/h Wind (Metres)
500	1.6	3.5	7
400	1.9	4.5	9
200	4.2	10.0	20
100	10.5	25.0	50
50	40.8	91.0	182
20	4 minutes	540.0	1.08 km
10	6.8 minutes	2.4 km	4.8 km
5	1.1 hours	8.8 km	17.6 km

Practical Considerations for Airblast Sprayer Application

Tree Spraying

Spray volume and chemical rate for trees and other row crops, must be related to the total amount of leaf area or foliage area, and not just land area.

Chemical rates specified in quantities per hectare may not relate accurately to quantities required per area of leaf. The larger the foliage area the greater the rate of chemical per hectare required.

This is a difficult one because recommended chemical rates are mostly given in rate per hectare or rate per 100 litres water or both, based on dilute spraying rates. Neither of these measurements relate to the diversity of foliage areas encountered with trees and row crops and their various stages of growth.

Tree Row Volume

Tree Row Volume (TRV), is a method of equating volumes of spray to volumes of tree foliage. Tree row volume measures tree height, tree width and length of rows per hectare.

TRV (m3/ha) =
Tree Height (m) x Tree Width (m3) x Length of Row/ha. (m).

This formula gives volume of foliage assuming a hedgerow effect (gaps between trees are treated as trees). This is reasonable since most sprayers continuously spray the row without switching off between trees.

The calculation, however, does not take into account the density or type of foliage, stage of growth or whether a deciduous tree has its leaves or not. It is therefore necessary to equate a volume of spray per 1000m3 TRV for various crops and stages of growth.

Dilute spray volume guidelines for deciduous fruit trees are:

- 60 litres per 1000m3 TRV for dormant trees.
- 100 litres per 1000m3 TRV for low foliage density.
- 150 litres per 1000m3 TRV for high foliage density.

These are approximate guidelines and local experience will determine variations from these guidelines.

Dilute spray volumes for citrus trees are 200-300 litres per 1000m3 TRV. Volume of spray can be calculated as follows:

$$\textbf{Spray Volume (l/ha.)} = \frac{\textbf{Tree Height (m) x Tree Width (m) x Spray Volume/1000m3 TRV (l) x 10}}{\textbf{Distance Between Rows (m)}}$$

eg. Dormant Fruit Trees

$$\frac{3 \times 4 \times 60 \times 10}{6}$$

= 1200 litres/ha.

eg. Cirtrus Trees

$$\frac{4 \times 5 \times 300 \times 10}{8}$$

= 7500 litres/ha.

Tree Height Volume

Another method of calculating spray volume is to use the following guidelines for tree height.

Tree Height (m)	Volume (Litres per Tree)
1- 3	1 - 3
4 - 6	3 - 7
7 - 9	5 - 10
10+	7 - 10

Practical Considerations for Airblast Sprayer Application

Spraying Volume (l/ha) =

$$\frac{\text{10,000 m2 x Tree Height Volume (Litre)}}{\text{Tree spacing (m) x Row Spacing (m)}}$$

eg. 4 metre high trees

$$\frac{\text{10,000 m2 x 6 litre/ha}}{\text{5m x 6m}}$$

= 2000 litres/ha

Low Volume

The choice to use lower volumes of spray application will depend on experience and equipment being used.

When using lower spray volumes it should be remembered the concentration of chemical is increased in inverse proportion to the reduction in volume from dilute volume recommendations.

eg. 1/2 of the spray volume requires 2 times concentrate
1/4 of the spray volume requires 4 times concentrate
1/8 of the spray volume requires 8 times concentrate, and so on.

The following tables show comparisons between spray application rates, chemical requirements, chemical concentration and relative areas treated with the same amount of water.

There can of course, be significant savings in time with lower volume spray application because of less down time in refilling. This often allows quicker, more effective intervention of pests.

Calculating chemical concentration for lower spray volumes in citrus trees should be based on normal dilute application rates of 100-150 litres/1000 m^3 TRV rates, not the double dilute rate of 200-300 1/1000 m3 TRV recommended for dilute citrus applications.

Type of Spray Application	Liquid Delivered	Area Treated	Quantity of Chemical	Relative Concentration of Chemical	Type of Spray Application	Tank Capacity	Area Treated	Quantity of Chemical	Relative Concentration of Chemical
High volume	2000 litres	1 hectare	2kg	1 time	High volume	1000 litres	0.5 hectare	1kg	1 time
High volume	1000 litres	1 hectare	2kg	2 times	High volume	1000 litres	1 hectare	2kg	2 times
Low volume	666 litres	1 hectare	2kg	3 times	Low volume	1000 litres	1.5 hectare	3kg	3 times
Low volume	333 litres	1 hectare	2kg	6 times	Low volume	1000 litres	3 hectare	6kg	6 times
Low volume	200 litres	1 hectare	2kg	10 times	Low volume	1000 litres	5 hectare	10kg	10 times
Very low volume	125 litres	1 hectare	2kg	16 times	Very low volume	1000 litres	8 hectare	16kg	16 times
Very low volume	100 litres	1 hectare	2kg	20 times	Very low volume	1000 litres	10 hectare	20kg	20 times
Very low volume	83 litres	1 hectare	2kg	24 times	Very low volume	1000 litres	12 hectare	24kg	24 times

Practical Considerations for Airblast Sprayer Application

Nozzle Selection

Choosing the right nozzles and boom arrangement is one of the most important steps in achieving accurate pesticide application.

Nozzles

Nozzles are one of the smallest and least expensive parts of a sprayer but they perform the most vital function of applying the pesticide to the target.

Nozzles are precision made and multi - functional in that they:

- Meter the liquid flow or application rate.
- Atomise liquid in to droplets.
- Control the size of droplets formed.
- Dispense droplets in a specific spray pattern for correct impact on the target.

Nozzle performance is the key to effective and efficient pesticide application. All efforts to correctly identify the pest, select the correct pesticide and apply it correctly can be a complete waste of time and money if nozzles are not correctly selected, installed, operated and maintained.

Nozzle performance and effectiveness of application depends on:

- Nozzle type.
- Nozzle size or capacity.
- Nozzle spray angle.
- Operating pressure.
- Nozzle spacing on boom.
- Distance of nozzle from target.
- Condition or maintenance of the nozzle (worn, damaged, blocked etc.).

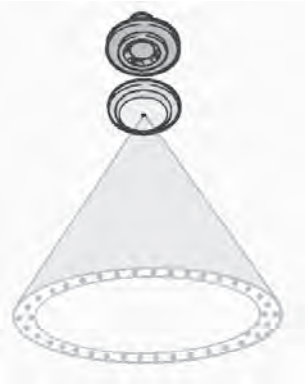
Types of Spray Nozzles

There are many nozzle types available and it is important to understand the use and characteristics of a nozzle before selecting or using it.

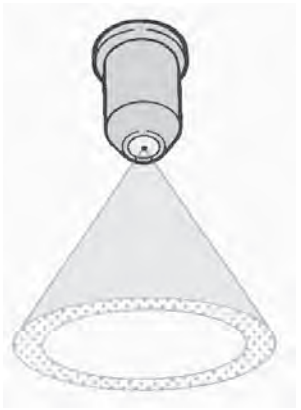
The more commonly used nozzle types are listed here.

1 Hollow Cone Nozzle

The Hollow Cone nozzle most commonly comprises a disc and a swirl plate (core) which form a conical spray pattern with a hollow centre using high spraying pressure. Fully integrated hollow cone nozzles are also available.



These generally produce the finest droplets of any nozzle type and are used mainly in air assisted or air-blast sprayers. They are also used in hydraulic boom sprayers for maximum penetration into more complex foliage in vegetables and other crops.

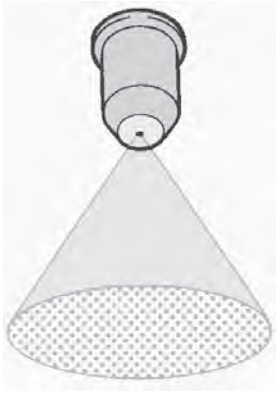


They are used mainly to apply insecticides and fungicides but also for foliar fertilisers and herbicides.

2 Full Cone Nozzles

These may be disc/core or fully integrated cone nozzles which produce evenly distributed conical spray patterns.

They generally produce larger droplets and apply larger volumes. Used mainly for high volume application in very dense crops.



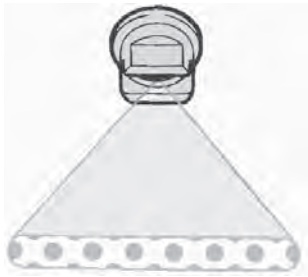
Practical Considerations for Airblast Sprayer Application

3 Flat Spray Nozzles

These produce a flat fan shaped spray pattern as the liquid leaves the nozzle. An elliptical or oval shaped spray pattern is formed which is tapered at both ends for nozzle overlap and even coverage.

These are the most widely used nozzle type in broadacre or broadcast applications. They are used for applying herbicides, insecticides, fungicides and foliar fertilisers.

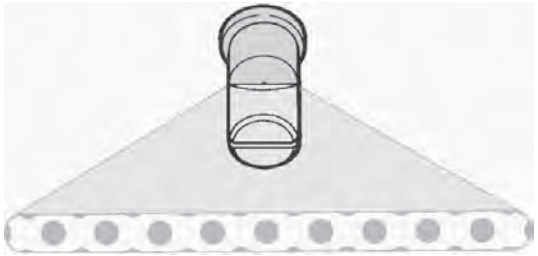
4 Even Flat Spray Nozzles



These produce a rectangular spray pattern with even distribution across the full width. The edges of the pattern are not tapered like flat spray nozzles. Overlapping of spray is not needed or intended.

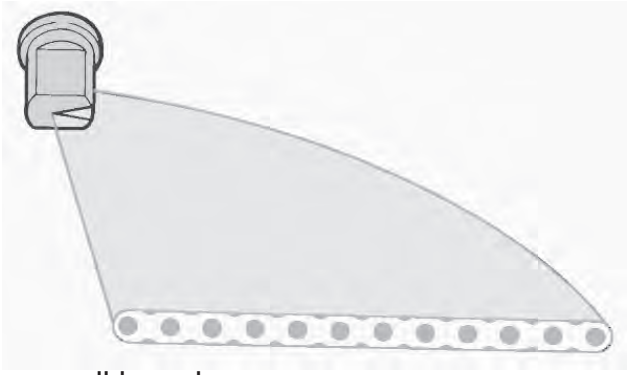
They are widely used for banding or row spraying for vegetables or other row crops. They are used for herbicides, insecticides, fungicides and foliar fertilisers.

5 Flooding or Reflex Spray



These form a rectangular spray pattern similar to the even flat spray nozzle but much wider angle.
Wide spray angles up to 145degrees allow wider nozzle spacings and lower boom heights.
Used mainly for herbicide and liquid fertiliser applications.

6 Off-Centre Spray Nozzles



Off-Centre elliptical spray pattern. Used at the ends of booms to extend boom coverage.
Widely used for strip spraying under trees, vines and along roadsides and fencelines. Often used on small boomless sprayers.
Used mainly to apply herbicides and liquid fertilisers.

7 Variable Cone Nozzles

These produce a variable spray pattern from a solid stream to a hollow cone spray pattern. Commonly used in handguns and lances of knapsack, utility and other sprayers for a wide range of applications.

Practical Considerations for Airblast Sprayer Application

Droplet Size

One of the important functions of a nozzle is to atomise liquid into droplets of various sizes to meet the requirement of effective pesticide application.

Atomising is usually caused by the collapse of unstable sheets or jets of liquid, or by the tearing action of air or a combination of both.

Hollow Cone type nozzles impart a swirling motion to the liquid by means of slots or cores. The swirling film or liquid emerges through the circular orifice as a thin hollow sheet. The instability of the sheet causes it to collapse into ligaments which then break up into droplets of various sizes.

Flat Spray type nozzles produce unstable liquid sheets which atomise into droplets of more uniform size. No nozzle is capable of atomising or producing droplets of equal size.

Volume Median Diameter (VMD) is a common means of expressing droplet size of a nozzle. VMD (Volume Median Diameter) is a value at which 50% of total volume of liquid sprayed is made up of droplets with larger diameter than the median value, and 50% of droplets with diameters smaller than the median value.

The lower the VMD, the finer the droplet sizes or nozzle atomisation.
All VMD values are based on atomisation of water. Droplet VMD for HC Nozzles is given on page 51.

Cumulative Volume Percentage of Droplet Size (microns) is another method of determining which nozzle will give the best range of droplet sizes.
Cumulative Volume Percentage of Droplet Sizes are shown for Disc and Cores, TX and ATR ceramic nozzles on pages 52-59.

Primary factors affecting droplet size are:

- Nozzle type.
- Spray Angle.
- Nozzle Capacity.
- Spraying Pressure.

It should be emphasised that nozzles are designed to operate within specific pressure ranges. Using pressures higher and lower than recommended by the manufacturer will negatively effect results.

Droplet sizes are finer when:

- Nozzle flow rate or capacity decreases.
- Spray angle increases.
- Pressure increases.

Droplet sizes are larger when:

- Nozzle flow rate or capacity increases.
- Spray angle decreases.
- Pressure decreases.

This is demonstrated in the table below which gives the percentage of spray volume in droplets smaller than 100 microns, produced by various popular sizes and Fan Nozzles.

PERCENTAGE OF DROPLETS FINER THAN 100 MICRONS						
Spray Angle (degrees)		80°			100°	
Pressure (kPa)	200	300	400	200	300	400
Nozzle Size	%	%	%	%	%	%
01	5.6	6.6	10.2	7.6	9.4	13.0
015	4.2	7.4	7.0	.9	5.3	7.6
02	2.2	4.4	5.7	2.0	3.9	7.2
03	2.1	3.3	4.1	2.3	3.5	5.3
04	1.9	2.4	3.3	2.8	4.1	5.3

Practical Considerations for Airblast Sprayer Application

Liquid Properties

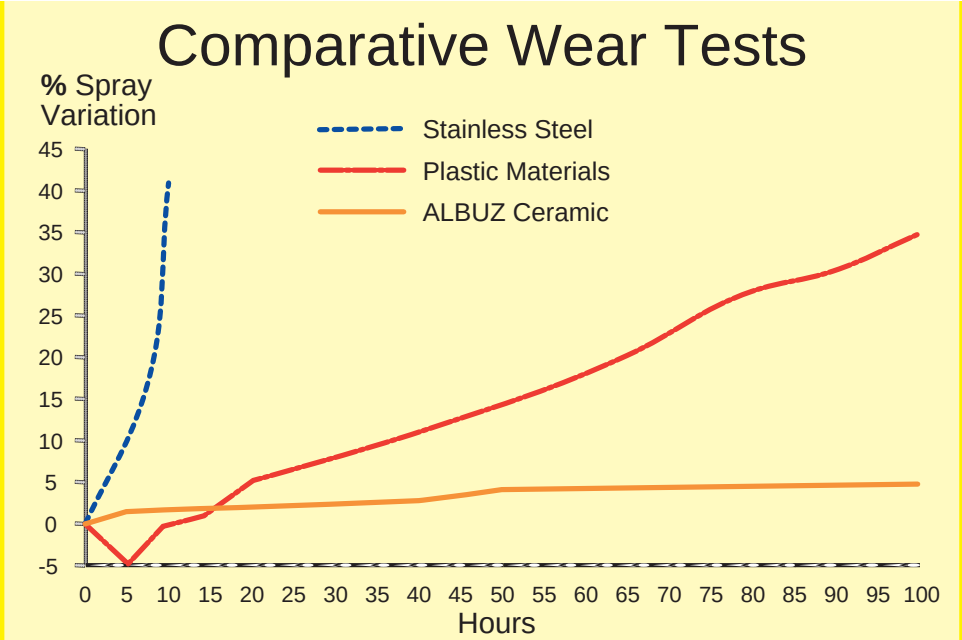
Various liquid properties affect spray droplet sizes. These include viscosity, surface tension and specific gravity. Each has varying degrees of effected or liquid atomisation and droplet size.

Nozzle Wear Characteristics

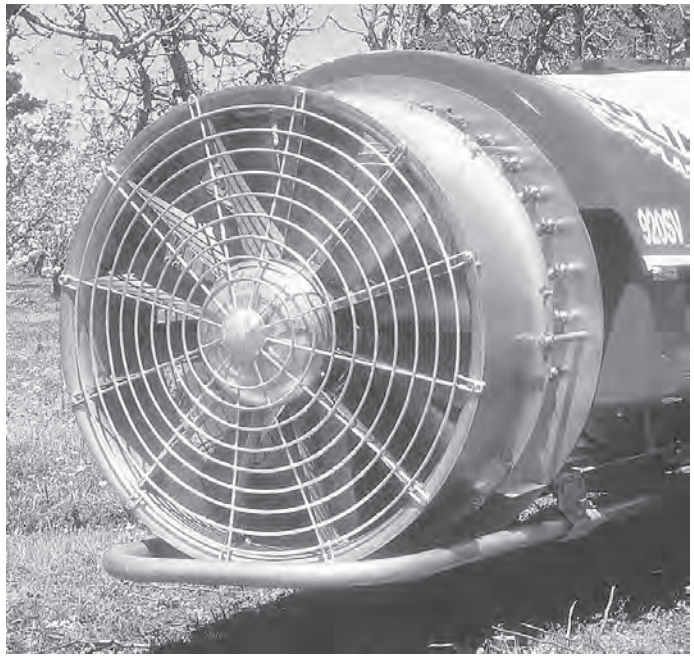
Nozzles are one of the most critical components of a sprayer for achieving effective pesticide application. However, they are often the least understood and most neglected part of spraying technology.

Nozzles are precision devices which operate under varying pressures and often with very abrasive or corrosive chemicals. The result is that they simply wear out. Nozzles don't last forever.

Proper consideration should be given to types of nozzle materials available and required maintenance.



920SV Cropliner fan assembly with 10 roll-over nozzles on each side



Practical Considerations for Airblast Sprayer Application

How to Select the Right Nozzle

Step 1 Read the Product Label
- What is the pesticide?
- What is the active ingredient?
- What is its mode of action?
- What volumes of application are recommended?
- Is a nozzle type or droplet size recommended?

Step 2 Determine Method of Application
- What spraying equipment is being used?
- What are the crop requirements?

Step 3 Determine Spray Volume
- Choose the spray volume most applicable for the crop, with minimal run-off and drift wastage.
- Allow for any differences between the specific gravity. (density), of water and the specific gravity of the spray mixture to be used.

Step 4 Select Nozzle Type
- What type of spray pattern and droplet size is recommended or most suitable?
- Contact or Systemic pesticides, Oils or Miticides?
- Choose nozzle type with the assistance of selection guide (page 75), and nozzle performance data (pages 48-59).

Step 5 Choose Correct Nozzle Capacity (Size)

Choice of nozzle capacity is dependent on:
- Volume per hectare required.
- Speed of travel.
- Spraying pressure.
- Position of nozzle on the boom in relation to tree or vine.
- Droplet size required.

Selection of the size of nozzle can be made from nozzle performance referencing all these factors

Refer to page 40-47 for detailed calibrating procedure and pages 48-59 for nozzle selection.

Step 6 Check Nozzle Output
- Install nozzles.
- Check nozzle output for accuracy.

Varying Density of Spray Solutions

All nozzle flow specifications are based on water.
If a spray mixture has a different density to water then adjustment should be made to the application rate using a conversion factor relative to the weight of the solution.

NB: Proper application rate must be determined before nozzle selection is made.

Practical Considerations for Airblast Sprayer Application

How To Select The Correct Nozzle Size For Solutions Whose Density Is Different Than Water

If you plan to spray a solution whose density is different than water, such as liquid fertiliser, use the conversion factors listed below.

1. Divide the desired flow by the proper factor.
   Example: $\frac{\text{100L/ha of 28\% Nitrogen}}{0.89}$
   = 112.4 L/min.

2. Use this adjusted flow rate to select the correct nozzle size
   Note: The table below is based on theoretical solution densities only and may vary in actual practice because of differing solution characteristics - applies to flood nozzles but not raindrop nozzles.

Weight of Solution (kg/L)	Specific Gravity (Percent of Water)	Conversion Factor
85	.84	1.08
.90	.90	1.05
.95	.96	1.03
1.00 (water)	1.00	1.00
1.05	1.02	.98
1.10	1.08	.95
1.15	1.14	.93
1.20	1.20	.91
1.25 (28% nitrogen)	1.26	.89
1.30	1.32	.88
1.35	1.38	.86
1.40	1.44	.85

Useful Formulae for Calibrating Orchard Sprayers

1 Calculating Trees per Hectare

$$\text{Trees per Hectare} = \frac{10{,}000}{\text{Row Spacing (m)} \times \text{Tree Spacing (m)}}$$

2 Calculating Total Litres per Minute (single sided)

$$\text{Total Litres/ Min} = \frac{\text{Row Spacing (m)} \times \text{Litres/ha} \times \text{Speed (km/hr)}}{600 \times 2}$$

3 Calculating Total Litres per Minute (double sided)

$$\text{Total Litres per Minute} = \frac{\text{Row Spacing (m)} \times \text{Litres/ha} \times \text{km/hr}}{600}$$

4 Calculating Tractor Speed

$$\text{km/hr} = \frac{\text{metres travelled in one minute}}{16.7}$$

$$\text{mph} = \frac{\text{feet travelled in one minute}}{88}$$

5 Calculating Distance Travelled per Hectare

$$\text{km travelled to spray one hectare} = \frac{10{,}000}{\text{Row spacing (m)} \times 1000}$$

Practical Considerations for Airblast Sprayer Application

6 Calculating Litre per Hectare

$$\text{Litres/Ha} = \frac{\text{Total Litres per Minute} \times 600}{\text{Row Spacing (m)} \times \text{Speed (km/hr)}}$$

7 Calculating New Output (litres per minute)

$$\text{New Output (l/min)} = \frac{\text{Known Output (l/min)} \times \text{New Pressure (bar)}}{\text{Known Output (bar)}}$$

8 Calculating New Pressure (litres per minute)

$$\text{New Pressure (bar)} = \frac{\text{New Output}^2\text{ (l/min)} \times \sqrt{\text{Known Pressure (bar)}}}{\sqrt{\text{Known Output}^2\text{ (l/min)}}}$$

9 Calculating Time to Spray One Hectare

$$\text{Time (minutes)} = \frac{600}{\text{Row Planting width in metres} \times \text{km/hr.}}$$

3 km/hr = 100m travelled in 120 seconds.
4 km/hr = 100m travelled in 90 seconds.

10 Calculating Vertical Target Volume

$$\text{Target Volume(m3)} = \frac{\text{Land Area (ha)} \times 2 \times \text{Tree height (m)}}{\text{Row Spacing (m)}}$$

11 Calculating Trees per Hectare

$$\text{Trees per Hectare} = \frac{10000}{\text{Row Spacing(m)} \times \text{Tree Spacing (m)}}$$

12 Calculating Litres/Minute per Nozzle

$$\text{Litres/Minute per Nozzle} = \frac{\text{Total Litres per Minute}}{\text{Number of Nozzles}}$$

13 Calculating Volume of Spray Required per Hectare

Volume of Spray per Hectare (litres) =

$$\frac{10 \times \text{Tree Height (metres)} \times \text{Tree Width (metres)} \times \text{Spray Volume Factor}}{\text{Tree Row Spacing (metres)}}$$

14 Calculating Number of Trees per Spray Tank

$$\text{Number of Trees per Spray Tank} = \frac{\text{Spray Tank Size} \times 1000}{\text{Tree Height (m)} \times \text{Tree Width (m)} \times \text{Row Spacing (m)} \times \text{Spray Volume Factor}}$$

Nozzle Selection Guide

Nozzle Selection Guide for Broadacre (Broadcast) and Banding or Directed Spraying		HERBICIDES				INSECTICIDES		FUNGICIDES		FOLIAR OR LIQUID FERTILISER
		PRE-EMERGENT		POST-EMERGENT						
		Soil Incorporated	Soil Surface	Contact	Systemic	Contact	Systemic	Contact	Systemic	
BROADACRE (BROADCAST) SPRAYING	Flat Fan Spray Nozzles (Dura-Jet/Ceramic Orifice)		**EXCELLENT**	**EXCELLENT**	**GOOD**	**GOOD**	**GOOD**	**GOOD**	**GOOD**	**GOOD**
	Extended Range Flat Fan Nozzles	**GOOD**	**EXCELLENT**	**GOOD**	**EXCELLENT**	**GOOD**	**EXCELLENT**	**EXCELLENT**	**EXCELLENT**	**EXCELLENT**
	Flat Spray Raindrop Nozzles (Low drift)	**EXCELLENT**	**EXCELLENT**		**EXCELLENT**		**EXCELLENT**		**EXCELLENT**	**EXCELLENT**
	Flooding Spray Nozzles	**EXCELLENT**	**EXCELLENT**		**GOOD**					**GOOD**
	Off-Centre Spray Nozzles		**GOOD**	**GOOD**	**GOOD**					
	Even Flat Spray Nozzles	**GOOD**	**EXCELLENT**	**EXCELLENT**	**GOOD**	**GOOD**	**GOOD**	**GOOD**	**GOOD**	**GOOD**
BANDING OR DIRECTED SPRAY	Twin Orifice Nozzles		**EXCELLENT**	**EXCELLENT**	**GOOD**					
	DC (Disc Core) Hollow Cone & Full Cone Nozzles					**EXCELLENT**	**GOOD**	**EXCELLENT**	**GOOD**	**GOOD**
	HB & HC Hollow Cone Nozzles			**EXCELLENT**		**EXCELLENT**		**EXCELLENT**		
	TX & ATR Ceramic Nozzles			**EXCELLENT**		**EXCELLENT**		**EXCELLENT**		

Chemical Handling and Safety

Safety must be an Integral Part of Chemical Farming Operations – Not Just an After Thought!

The Hazard

All agricultural chemicals or pesticides, as they are commonly called, are biologically active. When handled incorrectly or carelessly, they can be dangerous to all living organisms such as humans, birds, fish, bees, domestic animals and plants.

Method of Entry of Pesticides

- ☞ Oral - Direct by drinking, splashing into mouth, eating and smoking with contaminated hands, eating sprayed produce, cleaning nozzles with mouth.
- ☞ Inhalation - Nose, mouth, but predominately the lungs.
- ☞ Dermal - Absorption through the skin. Increased when skin is broken or perspiring.

Rate of Absorption

While pesticides are absorbed more completely orally and by inhalation, greater exposure and more poisonings occur through skin (dermal) contact.

Hazard and Chance of Poisoning

The hazard and chance of poisoning is much higher when handling pesticides in concentrate form than in the dilute form.

Safe Handling

Know your Pesticides

- ☞ STOP!! Read the label
- ☞ Is it the right pesticide? Would a less toxic one do?
- ☞ What is its poisons schedule or toxicity?
- ☞ What safety precautions are required?
- ☞ What is its persistence and withholding period?
- ☞ What is its mode of action?
- ☞ Will it be a hazard to neighbouring crops and people?
- ☞ What protective clothing and equipment is needed?
- ☞ Know the correct first aid/safety in case of poisoning.
- ☞ Seek medical advice if health is affected by chemicals.

Mixing the Pesticide

- ☞ Reduce or eliminate operator contact by using closed loading systems, auto fillers, wettable powder mixtures or wettable dispersable granules.
- ☞ Use the right protective clothing when handling the concentrate. The user is at greatest risk when handling chemical in concentrate form.
- ☞ Open bags carefully. Cut to open, do not tear.
- ☞ Do not stir chemicals with hands or arms.
- ☞ Choose carefully the mixing site, and the fate of the probable residues that may drain from it.
- ☞ Do not mix more spray solution than is needed and avoid needless disposal of unwanted chemicals.

Plan your Spray Route

- ☞ Observe weather conditions, especially wind direction and speed.
- ☞ Try to travel across wind and into untreated crop.
- ☞ Prevent double or over spraying.
- ☞ Prevent or minimise drift onto other crops, workers, etc.

Disposal of Unwanted Pesticides and Containers

- ☞ Calibrate correctly to ensure you do not have a large quantity of un wanted spray left over.
- ☞ Rinse empty containers and pour residue into the spray tank.

Chemical Handling and Safety

- ☞ Dispose of containers in the correct manner and where provided, use pesticide drum disposal schemes.

Decontamination

- ☞ Change out of protective clothing and shower as soon as possible after spraying.
- ☞ Wash before eating, drinking or smoking.
- ☞ Provide clean water at filling site and on sprayer in case of field contamination.
- ☞ Wash and clean respirators regularly.

Keep Sprayers and Safety Equipment in Good Working Condition

- ☞ Replace hoses and fittings when they leak.
- ☞ Clean sprayer regularly.
- ☞ Replace respirator filters regularly.
- ☞ Do not use worn, faulty or contaminated safety equipment.

Storage

- ☞ Store pesticides in a locked, well ventilated store.
- ☞ Do not pour pesticides into other containers, especially not drink containers.

Pesticide Free Tractor Cabs

- ☞ Ensure the cab filter is adequate for the pesticide used.
- ☞ Be careful not to contaminate the cabin environment.
- ☞ Cabin filters alone are not adequate when the operator is required to leave the cab to refill the sprayer. Safety equipment used outside the cab should not be stored in the cab.

Operator Safety Protective Equipment

The amount and type of protective clothing and equipment is determined by the type of chemicals; degree and duration of exposure, weather conditions and application equipment used. Read and obey the direction on the label. Overprotection can be uncomfortable and unnecessary. A respirator left hanging around your neck is useless.

Clothing

- ☞ Cover as much of the body as possible, especially the neck, chest and forearms. Use washable fabric overalls, disposable overalls or preferably waterproof clothing especially when coming in contact with large quantities of pesticides. Wear the trouser legs outside the boots.

Croplands Breathable Spray Suits are especially designed and ideally suited to Australian climatic conditions and provide greater protection than ordinary fabric and disposable overalls.

Gloves and Boots

- ☞ Never use leather or cloth materials because they absorb pesticides and provide a constant source of contamination. Gloves should be unlined for this reason.
  Croplands Nitrile Chemical Handling Gloves are recommended.

Chemical Handling and Safety

Head & Face

☞ Hard hats, washable hats, goggles, spray helmets and face shields are important when handling concentrates.

Croplands Spray Goggles feature sealed, anti-fog, double lens goggles for practical, comfortable eye protection.
Croplands Kasco Spray Hood is fully approved by D.I.R.

Respirators

☞ Choose the correct type and have the correct cartridge fitted. Replace cartridges regularly and write the date on each cartridge. Ensure there is an adequate fit to the face. Croplands Sundstrom Respirator is recommended for most spraying applications.

Measuring

☞ Croplands' calibrated, easypour 1, 3 and 5 litre measuring jugs and 25 litre chemical mixing bucket are practical, easy to clean, U.V. resistant and chemical resistant.

Operator Safety

When handling pesticides, always use elbow-length gloves, long clothes and above all, a respirator.

If you and your clothing become contaminated with spray, DO NOT WORK ON. Stop work, remove clothing and wash affected areas thoroughly with soap and water. Put fresh clothing on before starting again. Ensure that contaminated clothing is washed thoroughly before being used again.

Don't guess when choosing protective equipment. Feel free to call Croplands and make use of our safety database for comprehensive information on safety, handling and storage exposure levels, symptoms, health effects, First aid and Personal Protection.

Spraying Precautions

Agricultural chemicals applied under unfavourable weather conditions or from poorly adjusted and operated equipment can cause damage due to run-off and/or drift problems.

Crops and pastures are more susceptible to spray drift of herbicides while people, stock and water supplies are generally more susceptible to insecticide drift. Pollution, crop damage and the potential health hazards are something agriculture can ill afford. It is simply not acceptable , socially or environmentally.

Additionally, pesticide which drifts or runs off the target reduces the efficiency of the pesticide on the target. Spray failures are a waste of money and effort.

☞ Be SURE the equipment is functioning correctly. Check that nozzles are in good condition. Check all other aspects of machine operation are correct.
☞ Be SURE pesticides are mixed thoroughly and according to the label.
☞ Be SURE the recommended registered pesticide is used for the job at hand.
☞ Be SURE pesticides are applied at recommended rates.
☞ Be SURE only target plants are sprayed.
☞ Be SURE to follow the safety precautions on the label.

Chemical Handling and Safety

Spray Drift/Run Off

The movement of spray droplets or dust particles onto nearby susceptible crops is a grave risk. Several factors can contribute to drift including:

- ☞ Weather conditions during and immediately after application.
- ☞ Droplet and particle size. This is determined by the application method and equipment used. Larger droplet sizes are more prone to run off and less prone to drift. Finer droplets are more prone to drift but less prone to run off.
- ☞ Nature of the spray mixture especially its volatility.
- ☞ Rate of Application. Plants have limited ability to retain spray liquid. Over application causes excessive run off, waste and contamination of soil and water ways.
- ☞ Height and distance. The greater the height or distance from the target at which spray is discharged the greater is the risk of drift.

Safe Distances

Safe distances with respect to drift from spraying operations are entirely dependent on weather conditions and appropriate application.

Some wind is essential and light cross winds highly desirable because they help carry droplets into the target.

Provided there is light wind there should be no problems of wind drift and no risk to susceptible crops, homes, stock, sheds and water supplies - downwind from the target area.

Safe distances downwind are relatively small under the correct spraying conditions and use of good equipment. Buffer zones 50 to 300 metres may be adequate but this relies totally on the chemical type, droplet size, wind conditions, humidity, temperature and distance from discharge to the target.

If the conditions are wrong, equipment is incorrectly calibrated or operated badly, drift can be substantial and safe distances simply cannot be defined. Under high winds, very fine droplets can drift several kilometres. Likewise, fine droplets suspended in the air under calm conditions or hot dry conditions can drift almost anywhere.

See Pages 64-74 & 79-81 of this manual for information on the effects of droplet size, coverage, wind speeds and drift.

The best conditions in which to spray are when a light wind conditions breeze is blowing - approximate wind speed range 5 to 15 km/hr; preferably blowing away from problem areas. Do not spray in strong winds greater than 15 - 20 km/hr, or if the wind is in the direction of nearby susceptible crops, homes, sheds, stock or water supplies. Avoid spraying under still, warm conditions as fine particles can travel considerable distances. It is impossible to predict where they will come down as they will drift in which ever direction the next wind carries them.

As a guide to estimating wind speed use the table on page 81, which is part of the Beaufort Scale of Wind speeds. Chemical spraying should be confined to wind forces 1 to 3, outside of which spraying should not be attempted.

Inversions

Do not spray under 'Inversion' conditions. This is where a blanket of cold air is trapped above the ground and temperatures increase with altitude rather than decrease.

Blankets of fog or smoke indicate such conditions as smoke will not rise, but drift at a constant height under the inversion layer.

Chemical Handling and Safety

Temperature

High temperatures can have a two-fold affect on drift - that of volatilisation and evaporation.

Firstly, higher ground temperatures establish air currents which result in spray mists carried high and dispersed over a wide area.

Secondly, the high temperatures can evaporate the liquid in the droplets and the particles of pesticide or herbicide can be carried as a fine dust over long distances.

Avoid spraying in temperatures greater than 30°c, especially for growth regulating herbicides, for example, Dicamba, 2,4-D and MCPA.

Humidity

It is preferable to spray under high humidity. This is particularly important when water is the carrier as low humidities are often associated with high temperatures and thus, high rates of evaporation. Avoid spraying when relative humidities drop below 45%.

Under inversion conditions, do not spray with high humidity as it extends droplet lift and increases herbicide uptake, thus increasing drift hazard.

Environmental Safety

Spray can drift considerable distances. Observe label precautions and seek advice from the Department of Agriculture or other experts if IN ANY DOUBT.

Remember, not only are some crops sensitive to herbicides but sheep, cattle and bees are susceptible to some insecticides. Always follow instructions on labels carefully.

When spraying is completed and left-over spray is to be disposed of, be careful not to contaminate underground or surface water supplies. Always follow label recommendations.

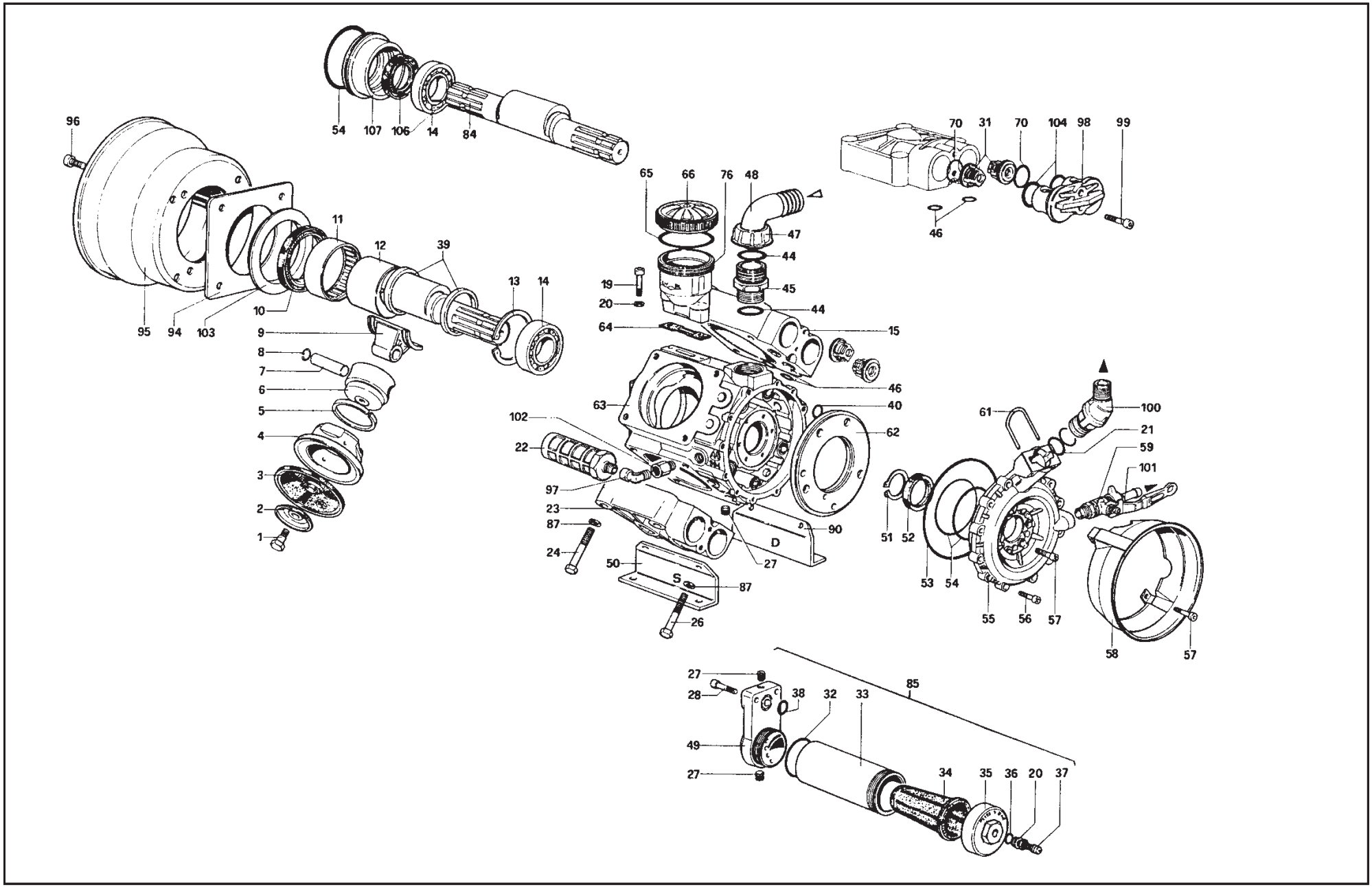
Chemical Handling and Safety

BEAUFORT SCALE OF WIND SPEEDS					
Beaufort Seal	**Wind Speed at 10m height (km/h)**	**Approx Wind Speed at boom Height (600mm) km/hr**	**Description**	**Visible Signs**	**Spraying Guidelines**
Force 0	Less than 2	Less than 1	Calm	* Smoke rises vertically	Spraying inadvisable.
Force 1	2-5	1-3.2	Light Air	Direction of wind shown by smoke drift. Wind vanes not moved.	Avoid spraying in warm, sunny conditions.
Force 2	6-11	3.2-6.5	Slight Breeze	Wind felt on face: Leaves rustle; ordinary vane moved by wind.	Ideal Spraying.
Force 3	12-20	6.5-9.6	Gentle Breeze	Leaves and small twigs in constant motion; wind extends light flag.	Avoid spraying Herbicides.
Force 4	21-30	9.6-14.5	Moderate Breeze	Small branches moved. Raises dust or loose paper.	Spraying inadvisable.

**Avoid spraying if smoke rises vertically.*

Parts
Assembly Drawings
&
Parts Listings

AR904 Pump Parts

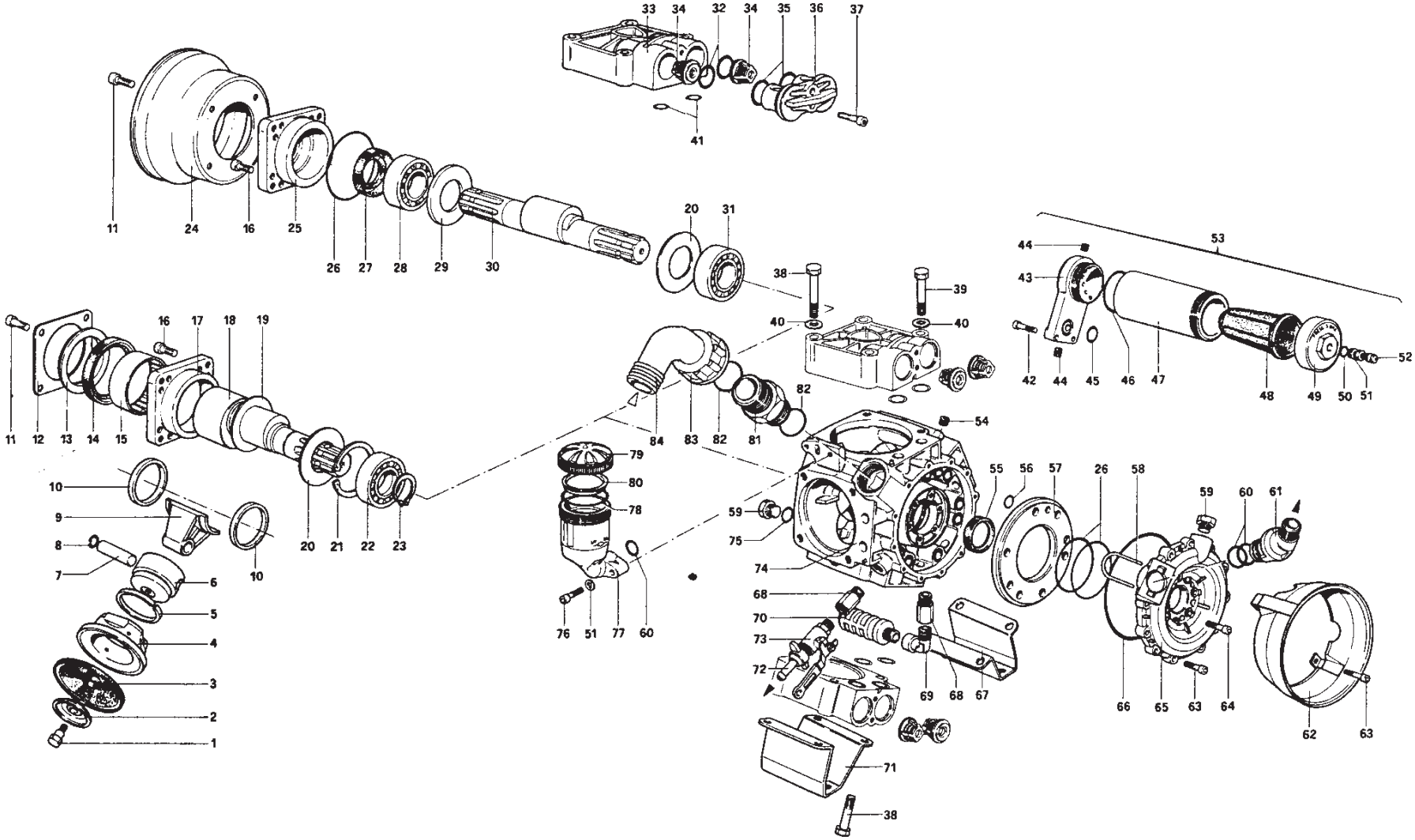


AR904 Pump Parts List

Pos	Part No	Description	Qty
1	ar580360	Diaphragm stud	3
2	ar1040180	Diaphragm return plate	3
3	ar1040081	Diaphragm - Rubber	3
	ar1040080	Diaphragm - Desmopan	3
4	ar1040110	Cylinder liner 63mm	3
5	ar650190	Piston ring 63x3mm	3
6	ar1040120	Piston 63mm	3
7	ar1040070	Gudgeon pin 15x55mm	3
8	ar1040270	Gudgeon pin circlip 15mm	6
9	ar1040141	Conrod	3
10	ar1400150	Conrod ring 68x90x7mm	1
11	ar650200	Roller bearing NK 68/25	1
12	ar1040170	Eccentric shaft C/SP	1
13	ar161050	Circlip 72mm	1
14	ar161060	Bearing 6207	2
15	ar1040551	RH head	2
16	ar1040320	Oil filler cap	1
17	ar650920	O-Ring 53.6x2.62	1
18	ar1040310	Oil filler sight glass	1
19	ar680350	Bolt M8x35	2
20	ar380241	Lock washer `8.5x15x1.5mm	3
21	ar390180	O-Ring 18.72x2.62mm	3
22	ar269050	Safety valve	1
23	ar1040552	LH head	1
24	ar750060	Bolt M12x65	8
25	ar1040202	Pump mounting bracket LH	1
26	ar750070	Bolt M10x8	4
27	ar1040470	Plug M10x8	2
28	ar320360	Bolt M8x22	2
29	ar1040260	Plug M10x25	1
30	ar1040210	Air chamber mounting	1
31	ar1049050	Valve complete	6
32	ar540360	O-Ring 44.12x2.62	1
33	ar1040220	Air chamber	1
34	ar1040240	Air diaphragm - Rubber	1
35	ar1040230	Air chamber cap	1
36	ar650542	Seal	1
37	ar550300	Air valve	1

Pos	Part No	Description	Qty
38	ar640070	O-Ring 13.9x2.62	1
39	ar1040340	Conrod ring	2
40	ar1200690	O-Ring 15.6x1.78	5
41	ar1040020	Manifold plate	1
43	ar1040010	Pump body	1
44	ar250310	O-Ring 36.14x2.62	2
45	ar540530	Nipple 1 1/4”M - 1 3/4”M	1
46	ar770570	O-Ring 18.77x1.78	6
47	ar540540	Fly nut 1 3/4”	1
48	ar540550	Elbow 40mm	1
51	ar1040570	Circlip 35mm	1
52	ar1040050	Oil seal 35x47x7	1
53	ar1040090	O-Ring 142.5x3.53	1
54	ar1040060	O-Ring 72.69x2.62	3
55	ar1040150	Discharge Manifold	1
56	ar1040370	Bolt M6x22	12
57	ar780060	Bolt M6x25	6
58	ar1500130	Protector - optional	1
59	ar130491	RH valve	1
61	ar1040690	Retaining clip	1
70	ar620030	O-Ring 25.8x3.53	6
84	ar1400080	Eccentric shaft C/C	1
85	ar1524	Air chamber complete	1
87	ar250141	Spring washer 12.5mm	12
89	ar1040201	Pump mounting bracket RH	1
94	ar1400140	Retaining flange	1
95	ar540660	Protector - optional	1
96	ar820670	Bolt M10x16	4
97	ar900210	Elbow 3/8” M/F	1
98	ar1300190	Valve cover	3
99	ar620610	Bolt M8x30	6
100	ar1040760	Outlet 3/4”M	1
101	ar110131	Nut 1/2” & tail 3/8”	1
102	ar1040490	Joiner 3/8”M/F	1
103	ar1400110	Seal retaining collar	1
104	ar540361	O-Ring 33.05x1.78	6
106	ar230380	Oil seal 35x62x10	1
107	ar1040560	Bearing retainer	1

AR1105 Pump Parts

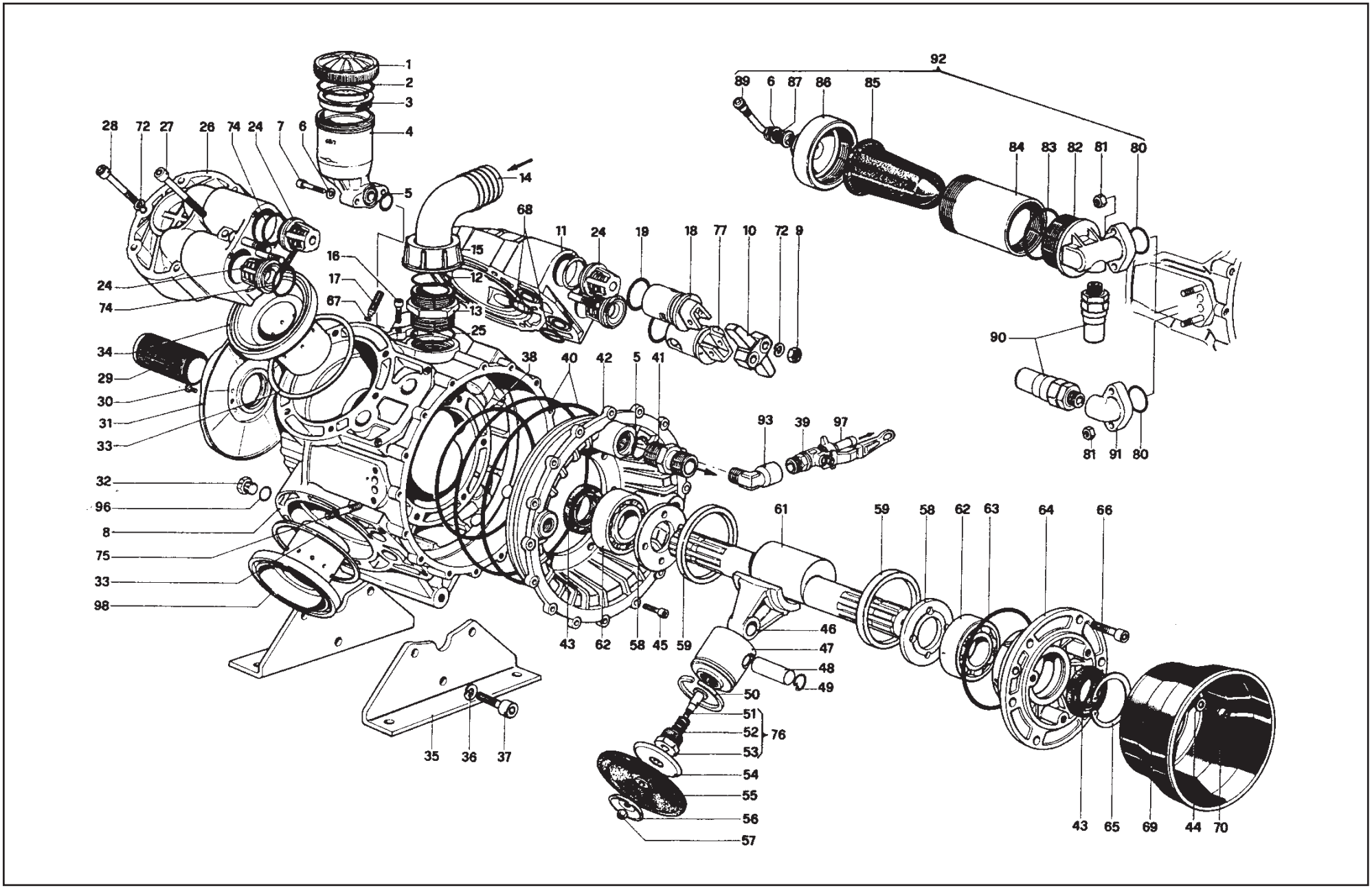


AR1105 Pump Parts List

Pos	Part No	Description	Qty
1	ar580360	Diaphragm stud	5
2	ar1040180	Diaphragm return plate	5
3	ar1040081	Diaphragm - Rubber	5
	ar1040080	Diaphragm - Desmopan	5
4	ar1040110	Cylinder liner 63mm	5
5	ar650190	Piston ring 63x3mm	5
6	ar1040120	Piston 63mm	5
7	ar1040070	Gudgeon pin 15x55mm	5
8	ar1040270	Gudgeon pin circlip 15mm	10
9	ar1400070	Conrod	5
10	ar1040340	Conrod ring	2
11	ar820670	Bolt M10x16	4
12	ar1400140	Retaining flange	1
13	ar1400110	Locating collar	1
14	ar1400150	Oil seal 68x90x7mm	1
15	ar650200	Roller bearing NK68/25	1
16	ar850370	Bolt M8x16	8
17	ar1400040	Flange	1
18	ar1040170	Eccentric shaft C/SP	1
19	ar1400130	Spacer	1
20	ar1400090	Spacer	1
21	ar161050	Circlip 72mm	1
22	ar1409010	Bearing	1
23	ar1040570	Circlip 72mm	1
24	ar540660	Shaft protector	1
25	ar1400030	Flange C/C	1
26	ar1040060	O-Ring 72.69x2.62mm	3
27	ar230380	Oil seal 35x62x10mm	1
28	ar540420	Bearing 3207	1
29	ar1400100	Spacer 3.5mm	1 30
ar1400080		Eccentric shaft C/C	1
31	ar1400170	Bearing NJ207	1
32	ar620030	O-Ring 25.8x3.53	10
33	ar1040551	RH head	2
	ar1040552	LH head	3
34	ar1049050	Valve complete	10
35	ar540361	O-Ring 33.05x1.78mm	10
36	ar1300190	Valve cover	5
37	ar620610	Bolt M8x30	10
38	ar1400180	Bolt M12x75	16
39	ar750060	Bolt M12x65	4
40	ar250141	Washer 12.5mm	12
41	ar770570	O-Ring 18.77x1.78mm	10
42	ar320360	Bolt M8x22	1

Pos	Part No	Description	Qty
43	ar1040420	Air chamber mounting	1
44	ar1040470	Grub screw M10x8	2
45	ar640070	O-Ring 13.95x2.62mm	1
46	ar540360	O-Ring 44.12x2.62mm	1
47	ar1040220	Air chamber	1 48
ar1040240		Air diaphragm - Rubber	1
49	ar1040230	Air chamber cap	1
50	ar650542	Seal	1
51	ar380241	Lock washer 8.5x15x1.5mm	3
52	ar550300	Air valve	1
53	ar1525	Air chamber complete	1
54	ar770070	Plug M10x10	1
55	ar1040050	Oil seal 35x47x7mm	1
56	ar1200690	O-Ring 15.6x1.78mm	9
57	ar1400020	Manifold plate	1
58	ar1040690	Retaining clip	1 59
ar130171		Plug 3/8"M	2
60	ar390180	O-Ring 18.72x2.62mm	3
61	ar1040760	Outlet 3/4"	1
62	ar1500130	Protector (optional)	1
63	ar1040370	Bolt M6x22	12
64	ar780060	Bolt M6x25	6
65	ar1040150	Discharge manifold	1
66	ar1400120	O-Ring 145.72x2.62mm	1
67	ar1400050	Pump mounting bracket RH	1
68	ar1400210	Joiner M/F 3/8"x25	3
69	ar900210	Elbow 3/4" M/F	1
70	ar269050	Safety valve	1
71	ar1400060	Pump mounting bracket LH	1
72	ar110131	Nut & tail 1/2"	2
73	ar130491	RH valve	1
	ar130491	LH valve	1
74	ar1400010	Pump body	1
75	ar740290	O-Ring 14x1.78mm	1
76	ar680350	Bolt M8x35	2
77	ar680030	Oil filler sight glass	1
78	ar580230	O-Ring 69.52x2.62mm	1
79	ar750050	Oil filler cap	1
80	ar680040	Oil retaining membrane	1
81	ar540530	Nipple 1 1/4"M x1 3/4"M	1
82	ar250310	O-Ring 36.14x2.62mm	2
83	ar540540	Fly nut 1 3/4"	1
84	ar540550	Elbow 40mm	1

AR1254 Pump Parts

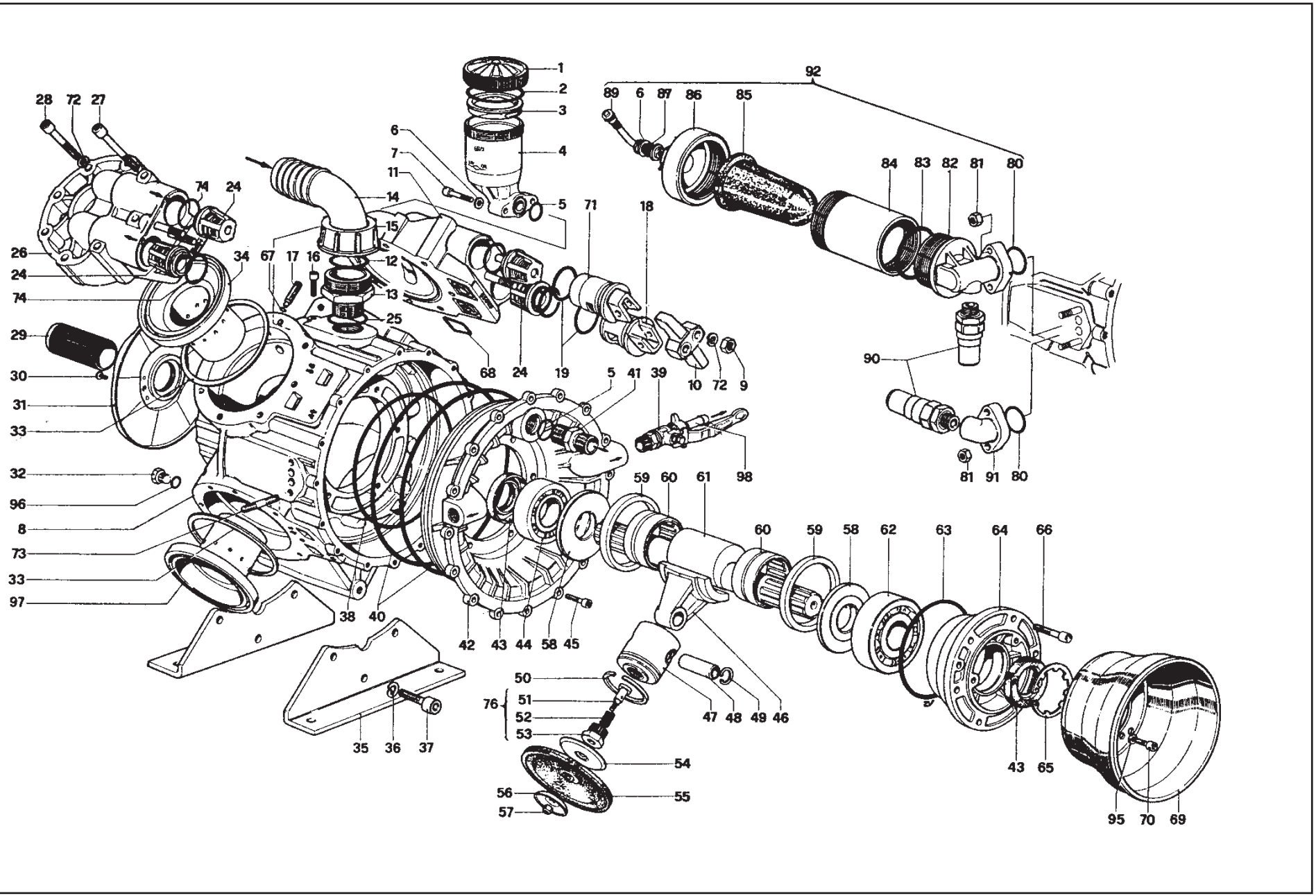


AR1254 Pump Parts List

Pos	Part No	Description	Qty
1	ar750050	Oil filler cap	1
2	ar580230	O-Ring 69.52x2.62	1
3	ar680040	Oil retaining diaphragm	1
4	ar680030	Oil filler sight glass	1
5	ar390180	O-Ring 18.72x2.62mm	2
6	ar380241	Washer 8.5x15x1.5mm	3
7	ar680350	Bolt M8x35	2
8	ar900010	Pump body	1
9	ar851300	Nut M10	8
10	ar850271	Valve clamp	4
11	ar900103	RH head	2
12	ar250310	O-Ring 36.14x2.62mm	1
13	ar391920	Nipple 1 1/4"M x 1 3/4"M	1
14	ar540550	Elbow 40mm	1
15	ar540540	Fly nut	1
16	ar850370	Bolt M8x16	1
17	ar850190	Stud M10x40	2
18	ar900180	Valve cover	4
19	ar230060	O-Ring 34.52x3.53mm	8
24	ar909050	Valve complete	8
25	ar540360	O-Ring 44.12x2.62mm	1
26	ar900104	LH head	2
27	ar620870	Bolt M10x70	12
28	ar700020	Bolt M10x55	12
29	ar850920	Protector	1
30	ar850930	Bolt M6x12	3
31	ar850910	Flange	1
32	ar130171	Plug 3/4"	
33	ar900220	Seal	4
34	ar900112	Cylinder liner 60mm	2
35	ar900201	Pump mounting bracket	2
36	ar250142	Spring washer 12.5mm	6
37	ar850330	Bolt M12x30	6
38	ar850300	O-Ring 171x3.53mm	1
39	ar130491	RH valve	1
	ar130492	LH valve	1
40	ar900040	O-Ring 208.92x5.23mm	2
41	ar850740	Nipple 3/4"M-3/4"M	1
42	ar900150	Inlet & pressure manifold	1
43	ar230380	Oil seal 35x62x10mm	2
44	ar390311	Washer	3
45	ar320360	Bolt M8x22	16
46	ar900140	Conrod	4
47	ar850121	Piston 60mm	4
48	ar160700	Gudgeon pin 18x48mm	4

Pos	Part No	Description	Qty
49	ar160691	Gudgeon pin circlip 18mm	8
50	ar850240	Piston Ring 60mm	4
51	ar850220	Diaphragm stud	4
52	ar850090	Spring	4
53	ar850230	Retaining bush	4
54	ar650090	Diaphragm base plate	4
55	ar900080	Diaphragm - Rubber	4
	ar900085	Diaphragm - Desmopan	4
	ar900081	Diaphragm - Viton	4
56	ar650390	Diaphragm return plate	4
57	ar160311	Nut M8	45
58	ar680160	Spacer ring	2
59	ar680130	Conrod ring	2
61	ar850170	Eccentric shaft C/C	1
62	ar230350	Bearing 6307	2
63	ar850290	O-Ring 117.07x3.53mm	1
64	ar900020	Retaining plate	1
65	ar200390	Circlip 62mm	1
66	ar540310	Bolt M10x40	6
67	ar851280	Washer 5.2mm	2
68	ar550350	O-Ring 23.81x2.62mm	8
69	ar540660	Protector (optional)	1
70	ar850250	Bolt M8x12	3
72	ar200231	Spring washer 10.5mm	32
74	ar680070	O-Ring 31.5x4.25mm	8
75	ar851250	Stud M8x40	2
76	ar859060	Diaphragm return assembly complete	4
77	ar900160	Valve cover	4
80	ar390290	O-Ring 29x3mm	1
81	ar380240	Nut M8	2
82	ar851210	Air chamber base	1
83	ar851270	O-Ring 65.09x3.53mm	1
84	ar851220	Air chamber	1
85	ar851230	Air diaphragm rubber	1
86	ar851240	Air chamber cap	1
87	ar650542	Seal	1
89	ar380440	Air valve	1
90	ar269050	Safety valve	1
91	ar851260	Safety valve flange	1
92	ar1526	Air chamber complete	1
93	ar900210	Elbow 3/8" M/F	2
95	ar160660	Bolt M8x35	3
96	ar740290	O-Ring 14x1.78mm	1
97	ar110130	Nut & hose tail	2
98	ar900110	Cylinder liner	

AR1554 Pump Parts

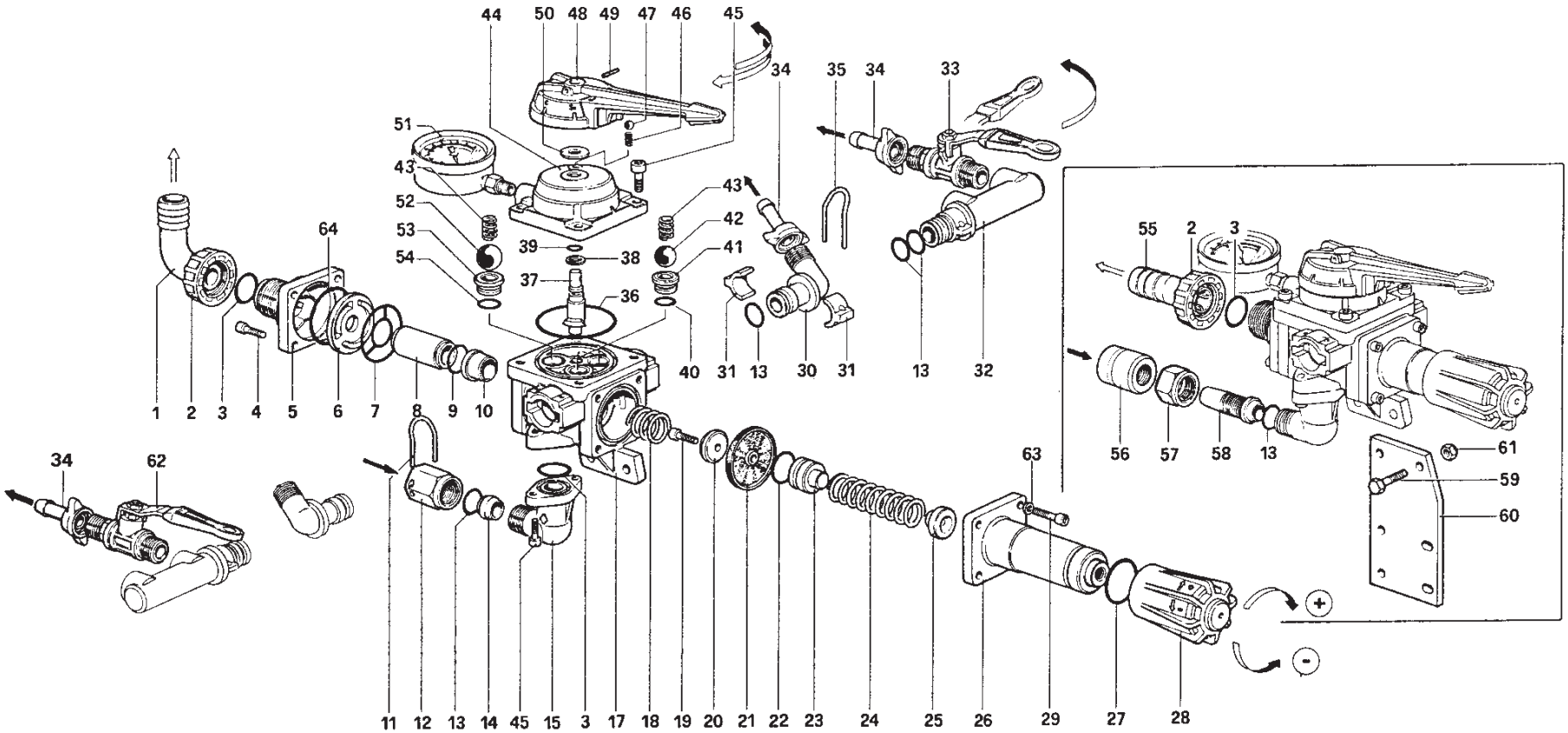


AR1554 Pump Parts List

Pos	Part No	Description	Qty
1	ar750050	Oil filler cap	1
2	ar580230	O-Ring 69.52x2.62	1
3	ar680040	Oil retaining diaphragm	1
4	ar680030	Oil filler sight glass	1
5	ar390180	O-Ring 18.72x2.62mm	2
6	ar380241	Washer 8.5x15x1.5mm	3
7	ar680350	Bolt M8x35	2
8	ar850010	Pump body	1
9	ar851300	Nut M10	8
10	ar850271	Valve clamp	4
11	ar850103	RH head	2
12	ar250310	O-Ring 36.14x2.62mm	1
13	ar391920	Nipple 1 1/4"M x 1 3/4"M	
14	ar540550	Elbow 40mm	1
15	ar540540	Fly nut	1
16	ar850370	Bolt M8x16	1
17	ar850190	Stud M10x40	2
18	ar850161	Valve cover	4
19	ar230060	O-Ring 34.52x3.53mm	8
24	ar909050	Valve complete	8
25	ar540360	O-Ring 44.12x2.62mm	1
26	ar900104	LH head	2
27	ar850260	Bolt M10x90	12
28	ar620870	Bolt M10x70	20
29	ar850920	Protector	1
30	ar850930	Bolt M6x12	3
31	ar850910	Flange	1
32	ar130171	Plug 3/4"	1
33	ar8502280	Seal	4
34	ar850112	Cylinder liner 66mm	2
35	ar850200	Pump mounting bracket	2
36	ar250142	Spring washer 12.5mm	6
37	ar850330	Bolt M12x30	6
38	ar850300	O-Ring 171x3.53mm	1
39	ar160141	RH valve	1
	ar160142	LH valve	1
40	ar850310	O-Ring 247.02x5.33mm	2
41	ar850740	Nipple 3/4"M-3/4"M	1
42	ar900150	Inlet & pressure manifold	1
43	ar230380	Oil seal 35x62x10mm	2
44	ar230350	Bearing 35x80x21mm 6307	1
45	ar320360	Bolt M8x22	16
46	ar850140	Conrod	4
47	ar850120	Piston 66mm	4
48	ar650071	Gudgeon pin 18x55mm	4
49	ar160691	Gudgeon pin circlip 18mm	8

Pos	Part No	Description	Qty
50	ar260231	Piston Ring 66x3mm	4
51	ar850220	Diaphragm stud	4
52	ar850090	Spring	4
53	ar850230	Retaining bush	4
54	ar650090	Diaphragm base plate	4
55	ar850080	Diaphragm - Rubber	4
	ar850085	Diaphragm - Desmopan	4
56	ar650390	Diaphragm return plate	4
57	ar160311	Nut M8	45
58	ar540040	Spacer ring	2
59	ar850130	Conrod ring	2
60	ar850320	Bearing NK 60/35	2
61	ar850170	Eccentric shaft C/C	1
62	ar160750	Bearing 35x100x25mm 6407	1
63	ar850290	O-Ring 117.07x3.53mm	1
64	ar900020	Retaining plate	1
65	ar200390	Circlip 62mm	1
66	ar540310	Bolt M10x40	6
67	ar851280	Washer 5.2mm	2
68	ar850030	Valve seal	8
69	ar540660	Protector (optional)	1
70	ar850250	Bolt M8x12	3
71	ar850181	Valve cover	4
72	ar200231	Spring washer 10.5mm	40
73	ar851250	Stud M8x40	2
74	ar680070	O-Ring 31.5x4.25mm	8
75	ar851250	Stud M8x40	2
76	ar859060	Diaphragm return assembly complete	4
77	ar900160	Valve cover	4
80	ar390290	O-Ring 29x3mm	1
81	ar380240	Nut M8	2
82	ar851210	Air chamber base	1
83	ar851270	O-Ring 65.09x3.53mm	1
84	ar851220	Air chamber	1
85	ar851230	Air diaphragm rubber	1
86	ar851240	Air chamber cap	1
87	ar650542	Seal	1
89	ar380440	Air valve	1
90	ar269050	Safety valve	1
91	ar851260	Safety valve flange	1
92	ar1526	Air chamber complete	1
95	ar390311	Washer 8.5x17x1.5mm	3
96	ar740290	O-Ring 14x1.78mm	1
97	ar850110	Cylinder liner 60mm	2
98	ar110130	Nut & hose tail	2

Manual By-Matic 50 Controller Parts

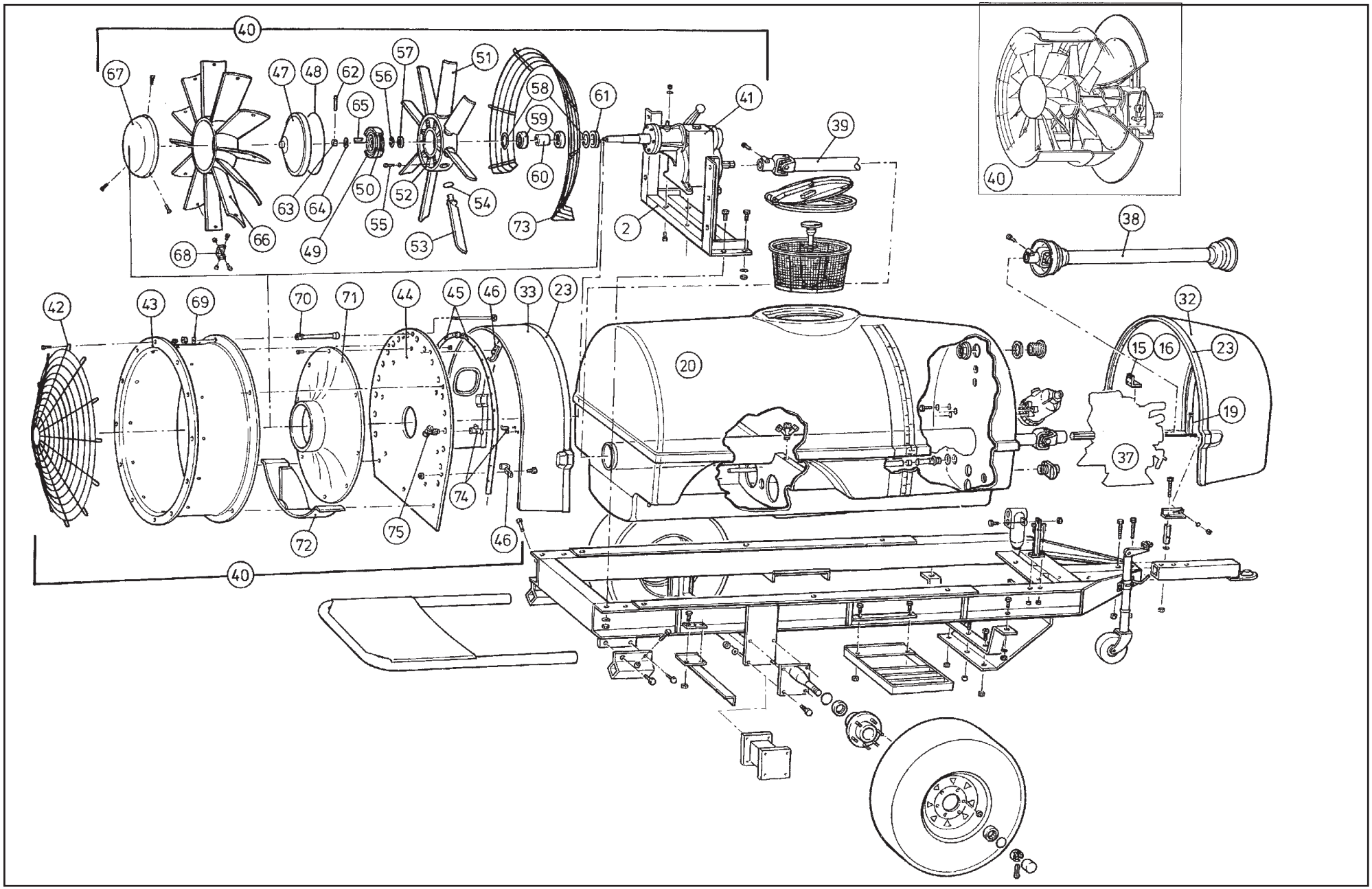


Manual By-Matic 50 Controller Parts List

Pos	Part No	Description	Qty
1	ar550370	Elbow 25mm	1
2	ar550242	Fly nut 1”	1
3	ar550350	O-Ring 23.81x2.62mm	2
4	ar780060	Bolt M6x25	4
5	ar1150030	Bypass flange 1”	1
6	ar1150020	Seperating disc	1
7	ar1150040	Seal desmopan	1
8	ar1150050	Transfer tube	1
9	ar770590	O-Ring 21.95x1.78mm	1
10	ar1150060	Valve seat	1
11	ar850760	Retaining clip	1
12	ar850750	Outlet port adaptor	1
13	ar390180	O-Ring 18.72x2.62mm	5
14	ar850490	Olive joiner	1
15	ar850710	Outlet port	1
17	ar1150010	Main body	1
18	ar320420	Spring	1
19	ar680700	Bolt M6x20	1
20	ar1150070	Valve	1
21	ar1150131	Diaphragm - Rubber	1
	ar1150130	Diaphragm - Desmopan	1
22	ar660160	O-Ring 24.99x3.53mm	1
23	ar1150180	Piston	1
24	ar1150190	Pressure regulation spring	1
25	ar1150200	Main spring pressure block	1
26	ar1150170	Pressure adjustment housing	1
27	ar820490	O-Ring 34.65x1.78mm	1
28	ar1150210	Pressure adjustment knob	1
29	ar1040370	Bolt M6x22	4
30	ar1150140	Outlet manifold 1/2”M	2
31	ar1150150	Outlet clamp	4
32	ar1150160	2 outlet manifold	2

Pos	Part No	Description	Qty
33	ar160142	LH valve	2
34	ar110130	Nut & hose tail 1/2”	4
35	ar1040690	Retaining clamp	2
36	ar1150250	O-Ring 65x2mm	1
37	ar1150120	Selecta shaft	1
38	ar850720	Washer	1
39	ar390340	O-Ring 7.3x2.4mm	1
40	ar740290	O-Ring 14x1.78mm	2
41	ar850650	Pressure port seat	2
42	ar850660	Stainless steel ball 13/16”	2
43	ar850680	Spring	3
44	ar1150081	Top body cover	1
45	ar320360	Bolt M8x22	6
46	ar850830	Spring	1
47	ar621160	Stainless steel ball 5/16”	1
48	ar1150110	Roll pin 4x28mm	1
49	ar480520	Contol lever	1
50	ar391460	Washer	1
51	ar550545	Pressure gauge 63mm 0-80 bar	1
52	ar1150100	Stainless steel ball 15/16”	1
53	ar1150091	Bypass seat	1
54	ar880270	O-Ring 17.17x1.78mm	1
55	ar550210	Bypass hose tail 21mm	1
56	ar850770	Hose ferrule	2
57	ar850790	Nut 3/4”	2
58	ar850780	Hose barb 19x32mm	2
59	ar1880370	Bolt M8x25	2
60	ar850690	Mounting bracket	1
61	ar390270	Nut M8	2
62	ar160141	RH valve	2
63	ar550331	Washer 6.5x12.5x1.5mm	4
64	ar1150280	O-Ring 50.52x1.78mm	1

920 & 820 SV Fan Assemblies, Frame & Tanks - 1500 & 2000 litre

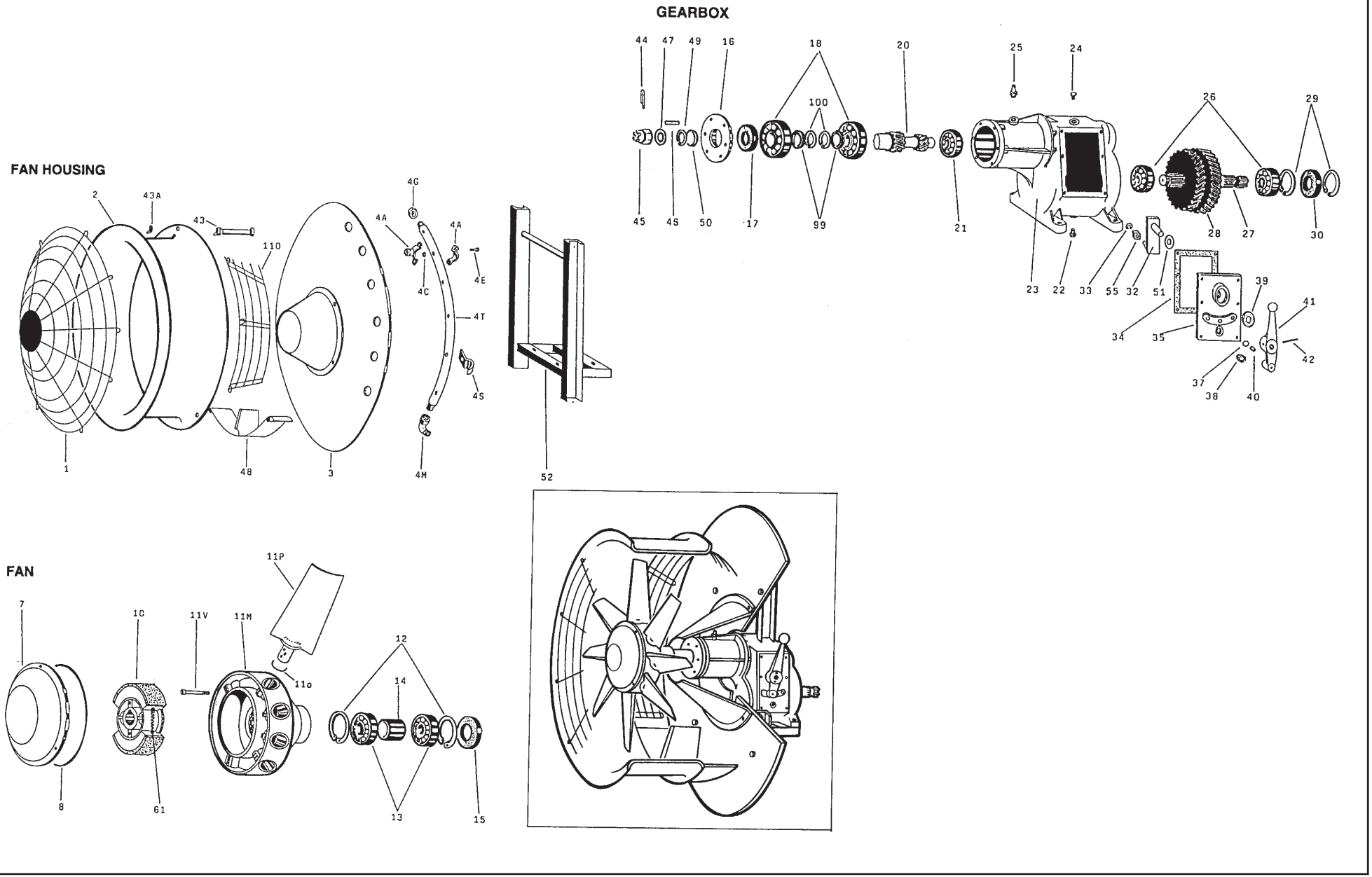


920 & 820 SV Fan Assemblies, Frame & Tanks - 1500 & 2000 litre

Pos	Part No	Description	Qty
	ht010	1000 L Cropliner chassis assy complete	1
	ht015	1500 L Cropliner chassis assy comlete	1
	ht020	2000 L Cropliner chassis assy complete	1
2	ht065	Fan mounting frame assembly	1
15	ht079	Pump mounted controller bracket	1
16	ht080	Controller bracket spacer	1
19	ht083	Hinge angle assembly	2
20	ht1000	1000 L Cropliner tank assy complete	1
	ht1500	1500 L Cropliner tank assy complete	1
	ht2000	2000 L Cropliner tank assy complete	1
23	abmrubber	Cowling & hood rubber	6m
32	cp512	Cropliner nose cone	1
33	cp242	Gearbox cowl for 820 & 720 fan	1
		Gearbox cowl for 920 fan	1
37	ar904apc	AR 904 thru shaft pump w/o control	1
	ar1105apc	AR 1105 thru shaft pump w/o control	1
	ar1254apc	AR 1254 thru shaft pump w/o control	1
	ar1506apc	AR 1506 thru shaft pump w/o control	1
	ar1554apc	AR 1554 thru shaft pump w/o control	1
	ar1900apc	AR 1900 thru shaft pump w/o control	1
38	sh5ag	Heavy duty PTO drive shaft	1
	shcv	Heavy duty wide angle PTO drive shaft	1
39	shabtt1000	1000 L thru tank airblast shaft	1
	shabtt1500	1500 L thru tank airblast shaft	1
	shabtt2000	2000 L thru tank airblast shaft	1
40	fan-920sv-assy	920SV fan assembly complete	1
	fan-820sv-assy	820SV fan assembly complete	1
41	fieni23-920	Gearbox for 820SV,920 & 920SV fans	1
42	fi20000070	Galvanised protector mesh-920	1
	fi20000060	Galvanised protector mesh-820	1
		(See p96-97 for gearbox parts)	
43	fi20000270	Stainless steel fan housing-920	1
	fi20000240	Stainless steel fan housing-820	1
44	fi20000720	Galvanised back plate-920	1
	fi20000710	Galvanised back plate-820	1
45	fi8000010a	S/steel boom manifold with 10 holes	2
46	fi80000110	Stirrup clamp for boom	8

Pos	Part No	Description	Qty
47	fi50000070	Fan hub cover	1
48	fi50000230	Fan hub cover O-ring	1
49	fi40000030	Fan clutch	1
50	fi40000290	Clutch spring	1
51	fieni11-920	Fan complete Items 47-65	1
	fieni11-820	Fan complete Items 47-65	1
52	fi5000016g	Fan hub	1
53	fi50000190	Fan blade-920	8
	fi50000180	Fan blade-820	8
54	fi50000240	Fan blade O-ring 3137	1
55	fi00010480	Fan blade bolt 8 x 55mm	8
56	fi00010350	Circlip E 40mm	1
57	fi50000320	Ring 48 x 40 x 5mm	2
58	fi00010400	Circlip 180mm	2
59	fi00102080	Bearing 6208z	2
60	fi50000270	Spacer 40mm	1
61	fi00012540	Seal 45 x 80 x 10mm	1
62	fi60000910	Lock pin 5 x 40mm	1
63	fi60000940	Nut MB24	1
64	fi00010270	Washer 24 x 44 x 4mm	1
65	fi00010050	Small key 10 x 8 x 40	1
66	fi30000250	Straightening vanes SV s/steel-920	1
	fi30000230	Straightening vanes SV s/steel-820	1
67	fi30000020	Straightening vane cover	1
68	fi30000170	Straightening vane bracket	12
69	fi00010970	Shaped washer	7
70	fi20001000	Shaped spacer-920	7
	fi20000990	Shaped spacer-820	7
71		Fibreglass cone-920	1
		Fibreglass cone-820	1
72	fi20001140	Bottom deflector s/steel-920	1
	fi20001120	Bottom deflector s/steel-820	1
73	fi20002000	Safety guard-920	1
	fi20000100	Safety guard-82	1
74	b267.612.177	Clamp 1/4" bsp	20
75	b75.0617.00	m75 anti drip nozzle body 1/4" bsp	20
	b75.605.46	Nozzle cap	20

720mm & 920mm Standard Fan Parts



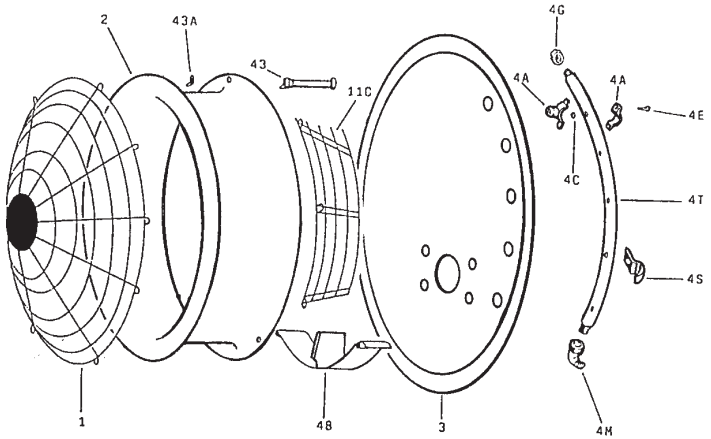
720mm & 920mm Standard Fan Parts List

Pos	Part No	Description	Qty
FAN HOUSING			
1	fi20000040	Galvanised protector mesh-720	1
	fi20000070	Galvanised protector mesh-920	1
2	fi20000170	S/steel fan housing-720x175mm	1
	fi20000250	S/steel fan housing-920x175mm	1
3	fi20000700	Galvanised back plate-720	1
	fi20000720	Galvanised back plate-920	1
4T	fi8000008A	S/steel boom manifold with 8 holes	2
	fi8000010A	S/steel boom manifold with 10 holes	2
4ACE	b267.612.177	Boom clamp 1/4" bsp-720	8
	b267.612.177	Boom clamp 1/4" bsp-920	10
4G	tfc12	Brass cap	2
4M	b163.604.13	1/2" brass nut & 90 degree elbow	2
4S	fi80000110	Stirrup clamp for boom-720	6
	fi80000110	Stirrup clamp for boom-920	8
43	fi20000980	Shaped spacer-720	7
	fi20001000	Shaped spacer-920	7
43A	fi00010970	Shaped washer	7
48	fi20001150	S/steel bottom deflector-720	1
	fi20001110	S/steel bottom deflector-920	1
52		Frame for gearbox & fan housing-720	1
	ht065	Frame for gearbox & fan housing-920	1
54		Fibreglass cone-720	1
		Fibreglass cone-920	1
110	fi20000110	Safety guard-720	1
	fi20002000	Safety guard-920	1
FAN			
7	fi50000300	Fan cover-720	1
	fi50000070	Fan cover-920	1
8	fi5000023A	Fan O-Ring-720	1
	fi50000230	Fan O-Ring-920	1
10	fi40000020	Clutch-720	1
	fi40000030	Clutch-920	1
11M	fi5000017g	Fan hub-720	1
	fi5000016g	Fan hub-920	1
11P	fi50000310	Fan blade-720	8
	fi50000190	Fan blade-920	8
11O	fi50000240	O-Ring 3137	8
11V	fi00010480	Bolt 8x55mm	8
12	fi00010380	Circlip 162mm-720	2
	fi00010400	Circlip 180mm-920	2
13	fi00012040	Bearing 6007z-720	2
	fi00012080	Bearing 6208z-920	2
14	fi50000260	Spacer 35mm-720	1
	fi50000270	Spacer 40mm-920	1
15	fi00012560	Seal 40x62x7mm-720	1
	fi00012540	Seal 45x80x10mm-920	1
61	fi40000290	Spring	2

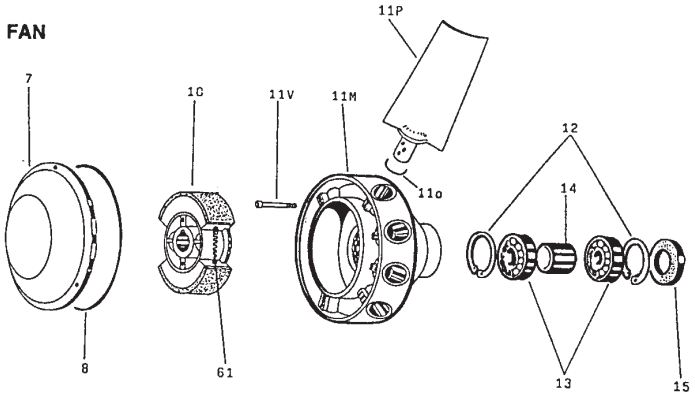
Pos	Part No	Description	Qty
GEARBOX			
16	fi6000021g	Round cover-720	1
	fi6000022g	Round cover-920	1
17	fi00012560	Seal 40x62x7mm-720	1
	fi00012590	Seal 45x65x10mm-920	1
18	fi00012090	Bearing 6208-720	1
	fi00012200	Bearing 6309-920	1
20	fi7000019g	High speed shaft z10-12 -720	1
	fi7000020g	High speed shaft z10-12 -920	1
	fi7000022g	Low speed shaft z11-13 -720	1
	fi7000021g	Low speed shaft z11-13 -920	1
21	fi00012150	Bearing 6305-720	1
	fi00012160	Bearing 6307 SKF-920	1
22	fi60000880	Oil drain plug 12x16	1
23	fi60000040	Gearbox housing-720	1
	fi60000030	Gearbox housing-920	1
26	fi00012180	Bearing 6307	2
27	fi70000420	Splining pivot-720	1
	fi70000440	Splining pivot-920	1
28	fi7000002g	High speed gear z47-49 -720	1
	fi7000006g	Low speed gear z46-48 -720	1
	fi7000011g	High speed gear z42-44 -920	1
	fi7000004g	Low speed gear z41-43 -920	1
29	fi00010400	Circlip 180mm	2
30	fi00012520	Seal 35x80x12mm	1
32	fi6000033g	Accessory lever-720	1
	fi6000034g	Accessory lever-920	1
33	fi00010320	Circlip E 10mm	1
34	fi60000550	Gasket-720	1
	fi60000560	Gasket-920	1
35	fi6000060n	Rectangular cover	1
	fi6000063n	Rectangular cover	1
37	fi60000750	S/steel ball 19/32"	1
38	fi60000850	Oil level plug 1/2"	1
39	fi00012500	Seal 18x30x7mm	1
40	fi60000700	Spring	1
41	fi6000041g	Aluminium lever	1
42	fi00010440	Roll pin 6x45mm	1
44	fi60000910	Pin 5x40mm	1
45	fi60000940	Nut MB24	1
46	fi00010040	Small key 8x7x40mm-720	1
	fi00010050	Small key 10x8x40mm-920	1
47	fi00010270	Washer 24x44x4mm	1
49	fi00011550	Circlip E 35mm-720	1
	fi00010350	Circlip E 40mm-920	1
50	fi50000280	Spacer ring 42x35x5mm-720	1
	fi50000320	Spacer ring 48x40x5mm-920	1
51	fi00010240	Washer 18x30x3mm	1
55	fi60000790	Tempered cube	1
99	fi00010350	Ring 40x50x2mm-720	2
	fi00000980	Ring 45x55x2mm-920	2
100	fi00010350	Circlip E 40mm	2
	fi00011560	Circlip E 45mm	2

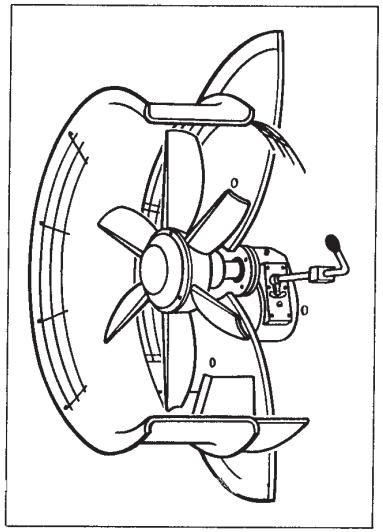
720 Single Speed Fan Parts

FAN HOUSING

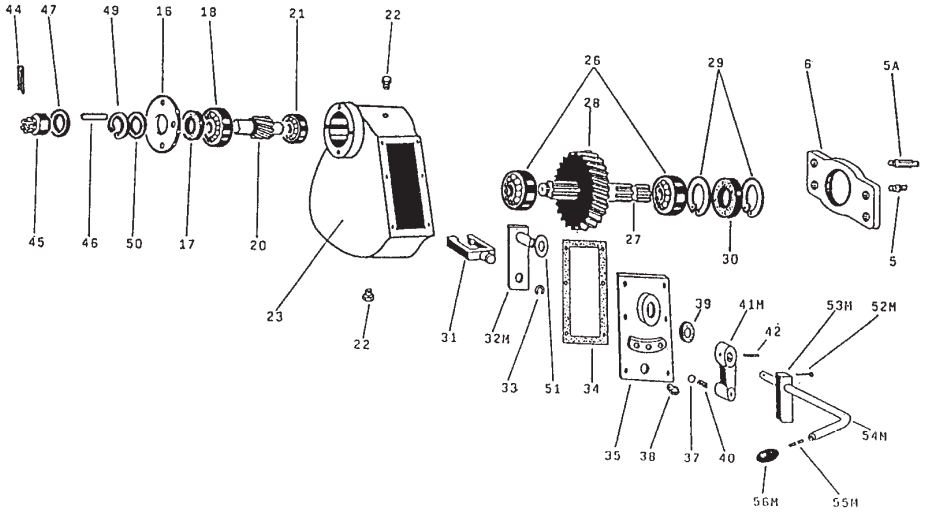


FAN





GEARBOX



720 Single Speed Fan Parts List

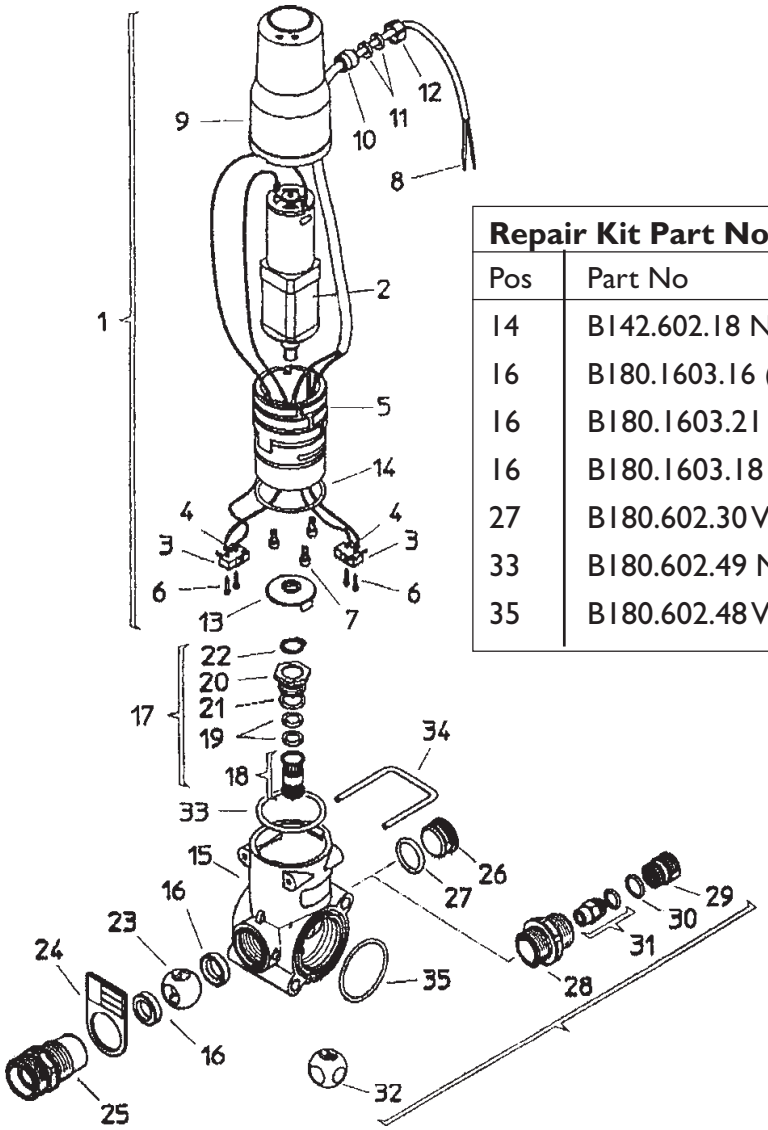
Pos	Part No	Description	Qty
FAN HOUSING			
1	fi20000040	Galvanised protector mesh	1
2	fi2000016g	Fan housing 720x200mm	1
	fi20000160	Galvanised fan housing 720x200mm	1
3	fi20000700	Galvanised back plate	1
4T		S/steel pipe with 8 holes	2
4A	fi80000270	1/4" F gas clamp	16
4C	fi80000300	O-Ring 109 Viton	16
4E	fi00010450	Screw 6x12mm	
4G	tfc12	Brass cap	2
4M	b163.604.13	1/2" brass nut & 90 degree elbow	2
4S	fi80000260	Galvanised stirrup clamp for boom	6
43	fi20000110	Shaped spacer	7
43A	fi00010970	Shaped washer	7
48	i20001150	S/steel bottom deflector	1
52		Frame for gearbox & fan housing	1
54		Fibreglass cone	1
110	fi20000110	Safety guard	1
FAN			
7	fi50000060	Fan cover	1
8	fi50000220	Fan O-Ring	1
10	fi40000020	Clutch	1
11	fi50000140	Fan	1
12	fi00012040	Circlip I 62mm	2
13	fi00012040	Bearing 6007z	2
14	fi50000260	Spacer 35mm	1
15	fi00012560	Seal 40x62x7mm	1
61	fi40000290	Spring	2
GEARBOX			
5	fi00010170	Stud 12x22mm	4
5A	fi00010180	Stud 12x53mm	4
6	fi60000190	Flange	1
16	fi6000021g	Round cover	1

Pos	Part No	Description	Qty
17	fi00012560	Seal 40x62x7mm	1
18	fi00012210	Bearing 30208	1
20	fi7000027g	Shaft	1
21	fi00012290	Bearing 30304	1
22	fi60000880	Oil drain plug 12x16	1
23	fi60000060	Gearbox housing	1
26	fi00012060	Bearing 6207	2
27	fi70004340	Splining pivot	1
28	fi70000070	Gear	1
29	fi00010390	Circlip I 72mm	2
30	fi00012510	Seal 35x72x10mm	1
31	fi60000250	Gearshift fork	1
32M	fi6000032g	Accessory lever	1
33	fi00010340	Circlip E 18mm	1
34	fi60000550	Gasket	1
35	fi6000060n	Rectangular cover	1
37	fi60000750	S/steel ball 19/32"	1
38	fi60000850	Oil level plug 1/2"	1
39	fi00012500	Seal 18x30x7mm	1
40	fi60000700	Spring	1
41M	fi6000040g	Aluminium lever	1
42	fi00010440	Roll pin 6x45mm	1
44	fi60000910	Pin 5x40mm	1
45	fi60000940	Nut MB24	1
46	fi00010040	Small key 8x7x40mm	1
47	fi00010270	Washer 24x44x4mm	1
49	fi00011550	Circlip E 35mm	1
50	fi50000280	Spacer ring	1
51	fi00010240	Washer 18x30x3mm	1
52M	fi00010010	Bolt 5x25mm	1
53M	fi60000770	Lever support	1
54M	fi60000690	Lever	1
55M	fi00010160	Stud 8x16mm	1
56M	fi60000800	Hand grip	1
100	fi00010350	Circlip E 40mm	1

Electro Mechanical Control Valves

Main On/Off (Dump) Valve

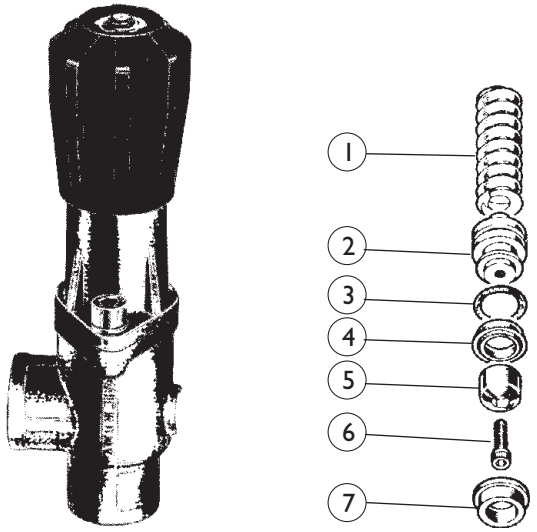
Part No B180.1910.9



Repair Kit Part No B10.302.31		
Pos	Part No	Qty
14	B142.602.18 NBR	1
16	B180.1603.16 (Ø 10.5)	2
16	B180.1603.21 (Ø 15.5)	2
16	B180.1603.18 (Ø 13)	2
27	B180.602.30 Viton	1
33	B180.602.49 NBR	1
35	B180.602.48 Viton	1

Pressure Relief Valve

Part No B410.1510.2

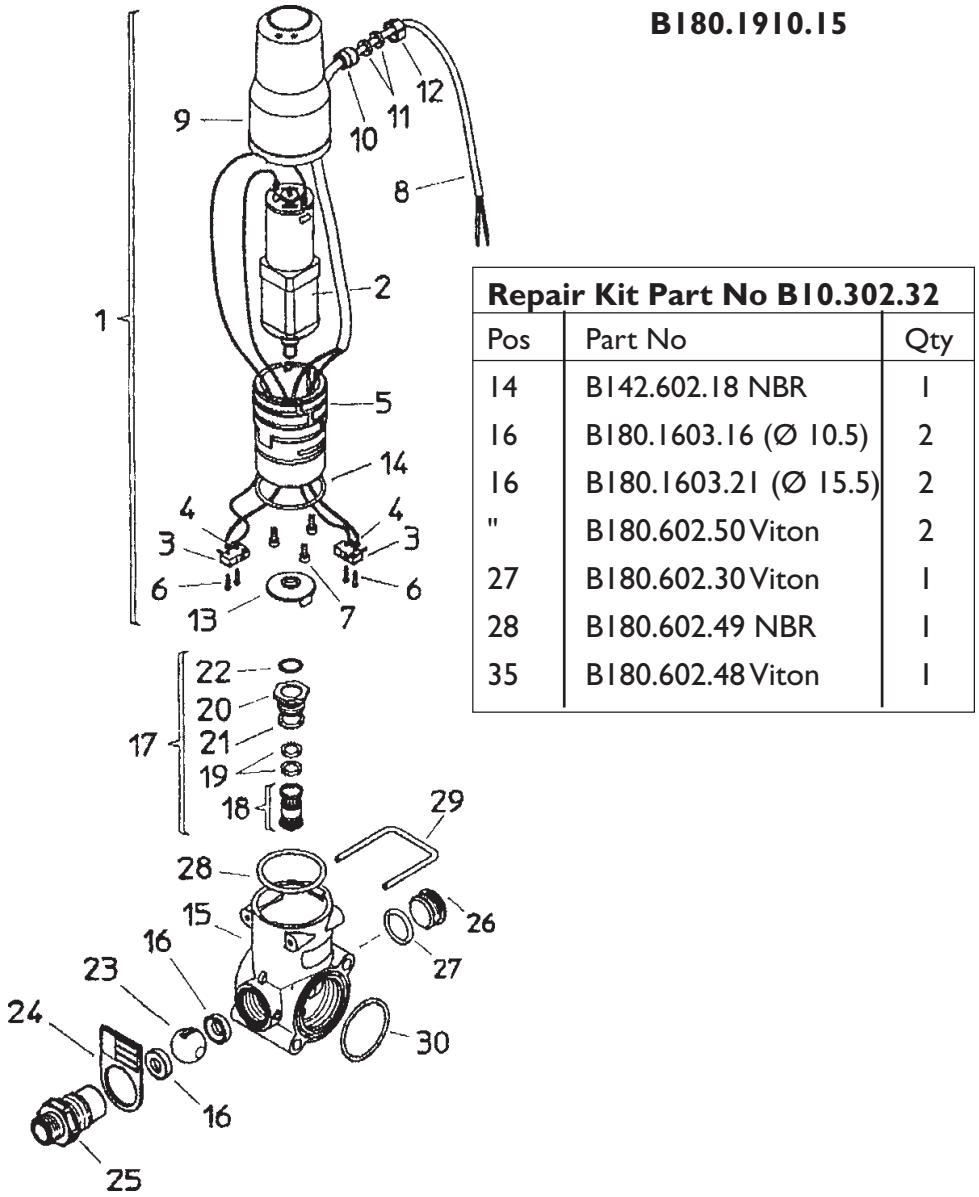


Parts List		
Pos	Part No	Qty
1	B170.1003.10	1
2	B170.1609.1	1
3	B170.602.25	1
4	B170.601.23	1
5	B170.202.7	1
6	B170.1902.17	1
7	B170.1603.1	1

Electro Mechanical Control Valves

Boom On/Off Valve

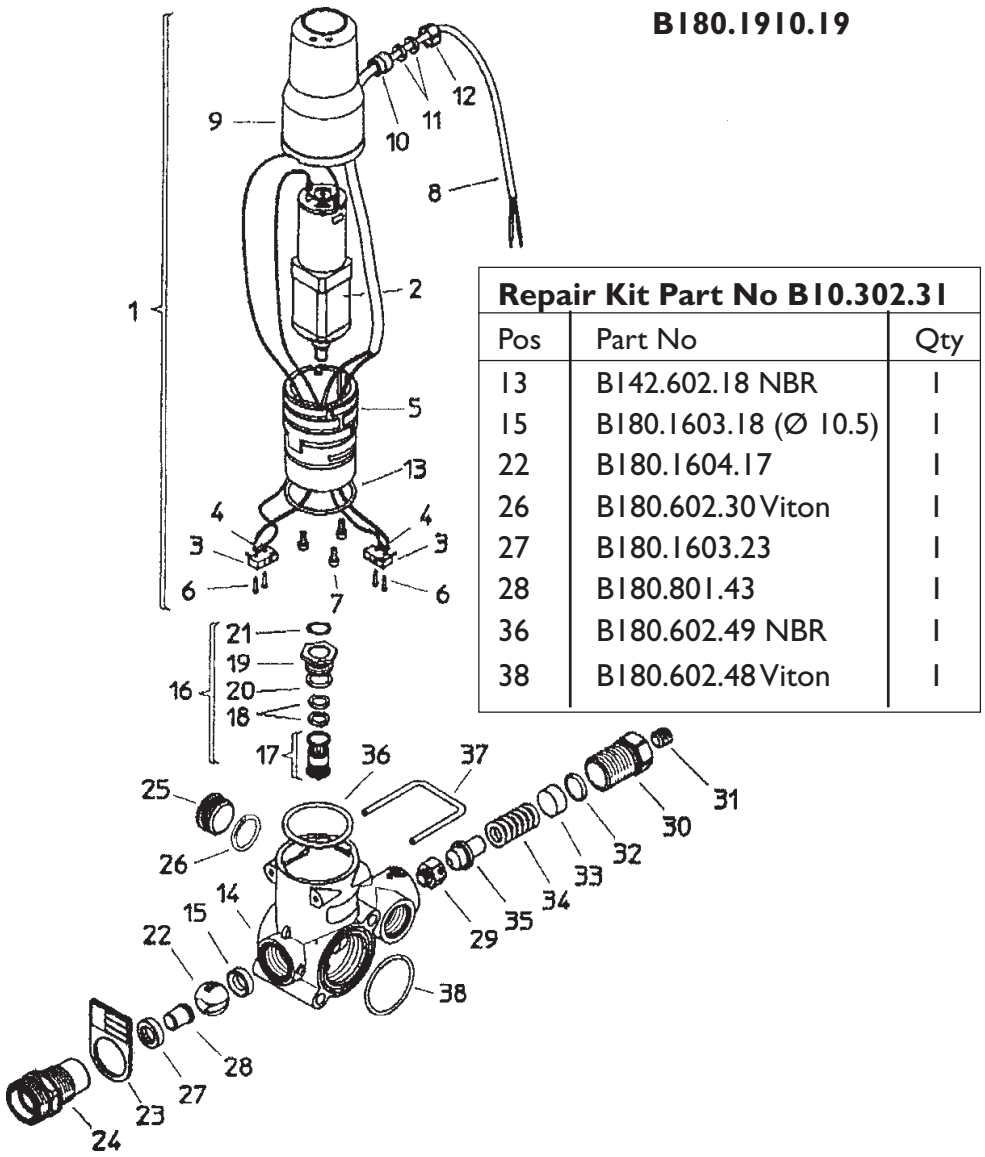
Part No
B180.1910.15



Repair Kit Part No B10.302.32		
Pos	Part No	Qty
14	B142.602.18 NBR	1
16	B180.1603.16 (Ø 10.5)	2
16	B180.1603.21 (Ø 15.5)	2
"	B180.602.50 Viton	2
27	B180.602.30 Viton	1
28	B180.602.49 NBR	1
35	B180.602.48 Viton	1

Pressure Regulating Valve

Part No
B180.1910.19

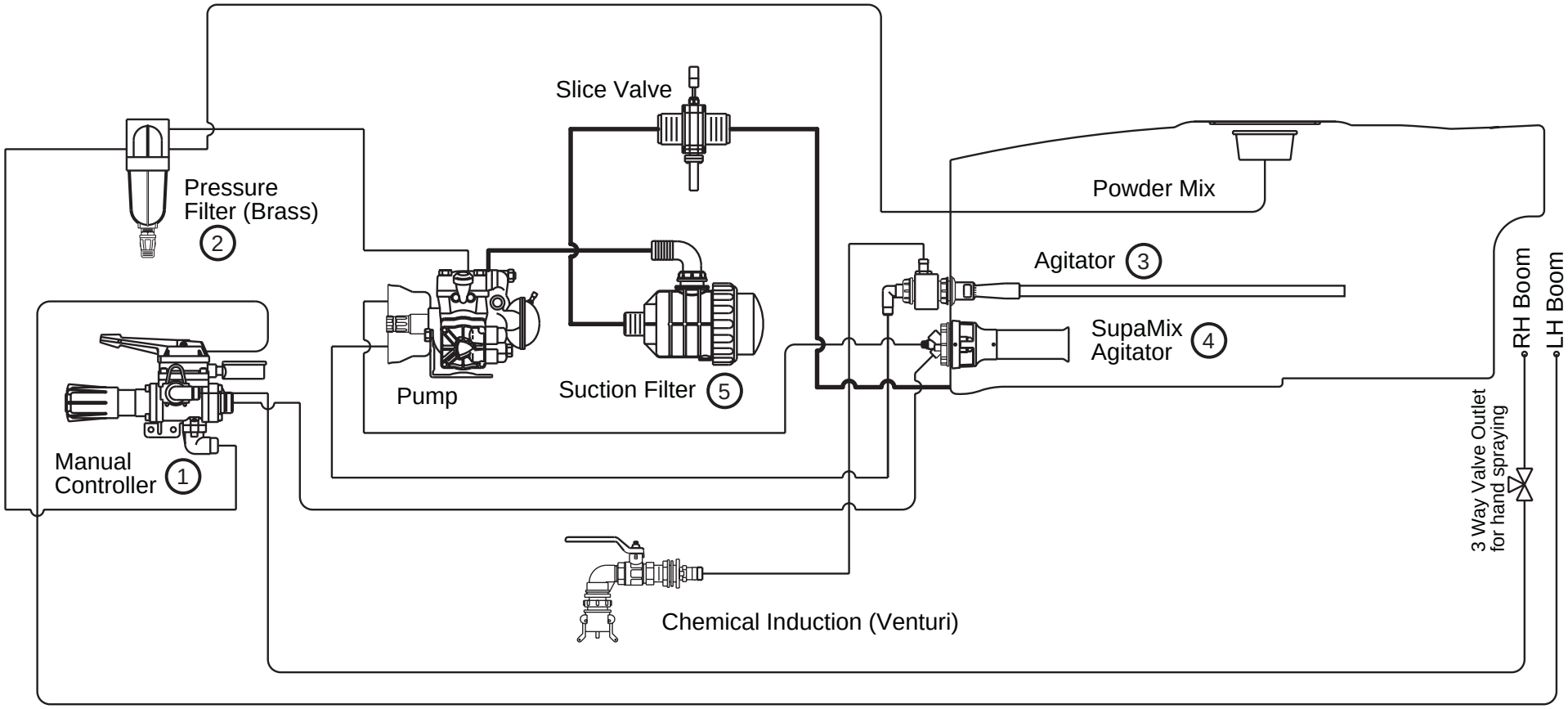


Repair Kit Part No B10.302.31		
Pos	Part No	Qty
13	B142.602.18 NBR	1
15	B180.1603.18 (Ø 10.5)	1
22	B180.1604.17	1
26	B180.602.30 Viton	1
27	B180.1603.23	1
28	B180.801.43	1
36	B180.602.49 NBR	1
38	B180.602.48 Viton	1

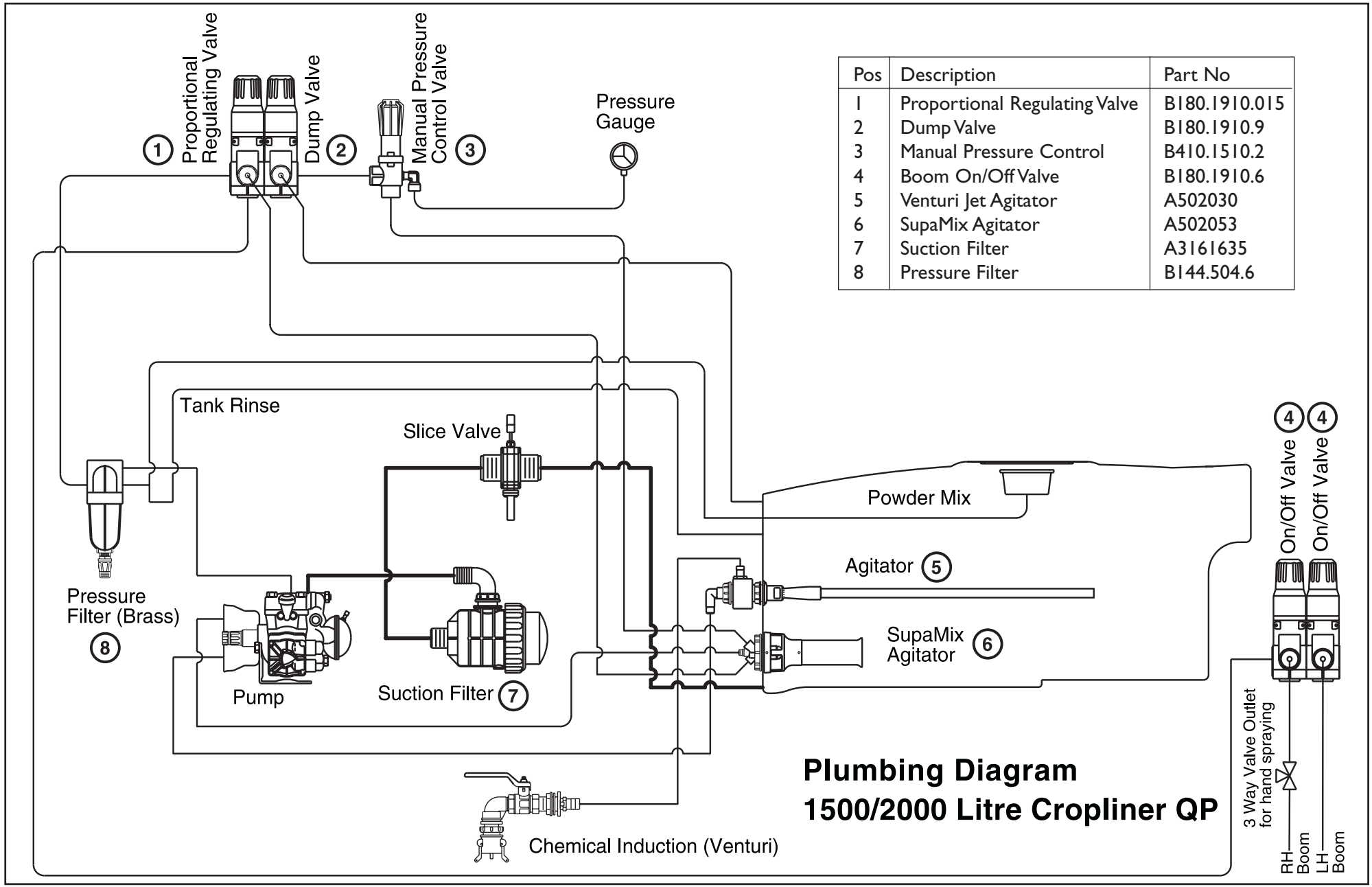
Plumbing Diagram with Manual By-Matic 50 Controller

Plumbing Diagram
1500/2000/3500 Litre Cropliner
with Manual Controller

Pos	Description	Part No
1	By-Matic 50 Controller	AR959
2	Pressure Filter	B144.504.6
3	Venturi Jet Agitator	A502030
4	SupaMix Agitator	A502053
5	Suction Filter	A3161635

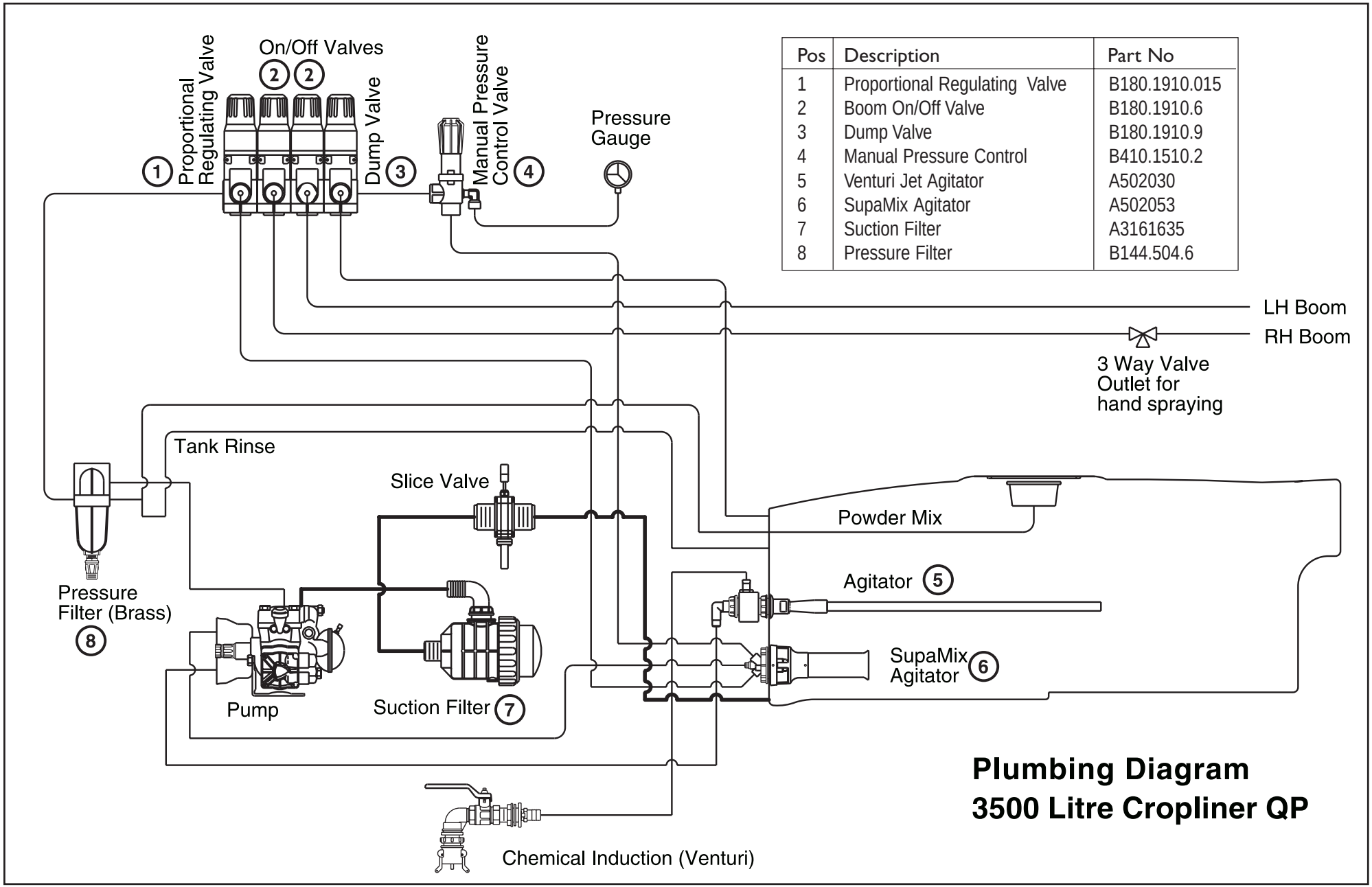


1500/2000 Plumbing Diagram with QP Controller



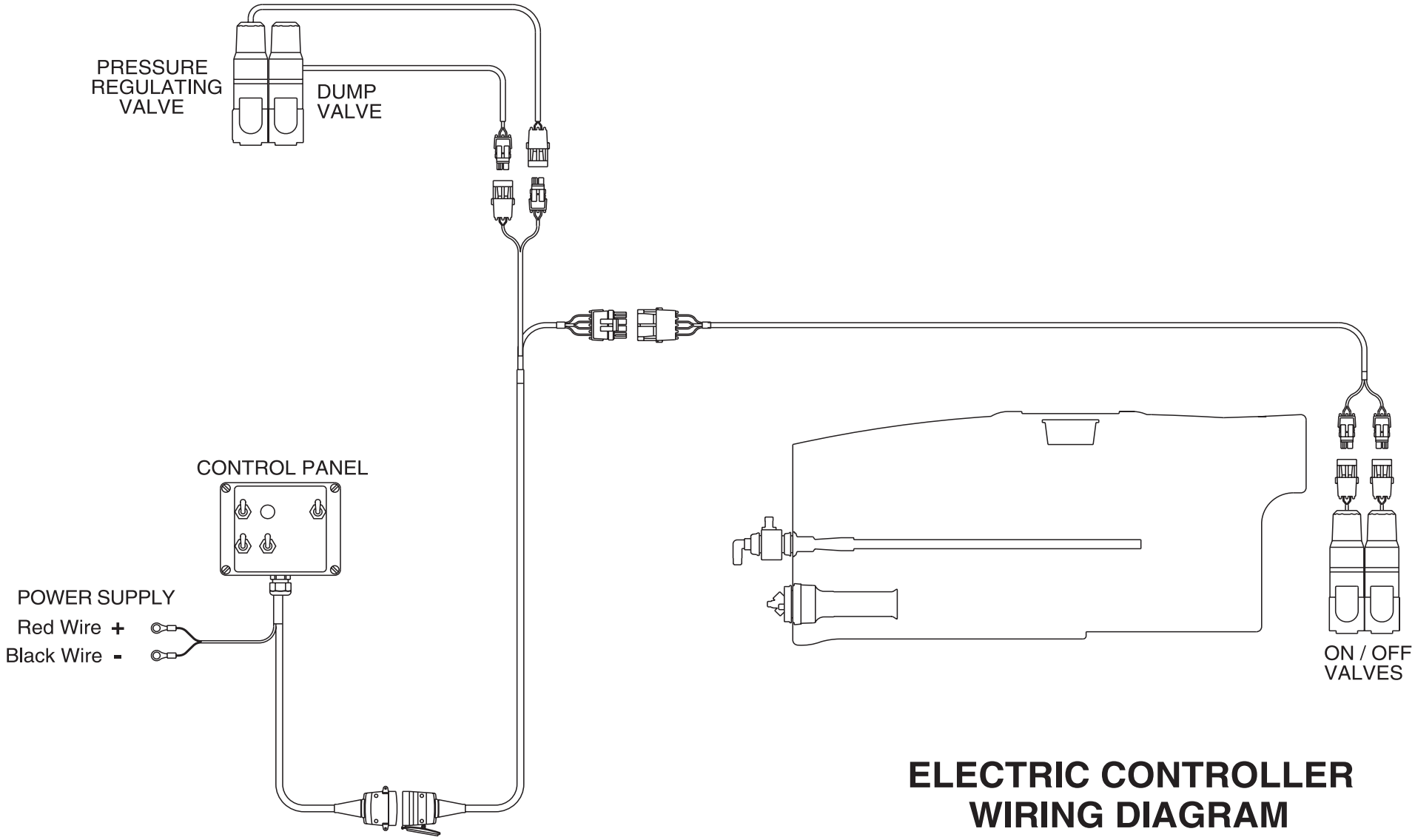
Pos	Description	Part No
1	Proportional Regulating Valve	B180.1910.015
2	Dump Valve	B180.1910.9
3	Manual Pressure Control	B410.1510.2
4	Boom On/Off Valve	B180.1910.6
5	Venturi Jet Agitator	A502030
6	SupaMix Agitator	A502053
7	Suction Filter	A3161635
8	Pressure Filter	B144.504.6

3500 Plumbing Diagram with QP Controller



Pos	Description	Part No
1	Proportional Regulating Valve	B180.1910.015
2	Boom On/Off Valve	B180.1910.6
3	Dump Valve	B180.1910.9
4	Manual Pressure Control	B410.1510.2
5	Venturi Jet Agitator	A502030
6	SupaMix Agitator	A502053
7	Suction Filter	A3161635
8	Pressure Filter	B144.504.6

Electrical Wiring Diagram - Electric Controller



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