



International Code of Conduct
on the Distribution and Use
of Pesticides

Guidelines on Minimum Requirements for
Agricultural Pesticide Application Equipment

Volume two

Vehicle Mounted and Trailed Sprayers



FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS

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This publication was developed in the IOMC context. The contents do not necessarily reflect the views or stated policies of individual IOMC Participating Organizations.

The Inter-Organisation Programme for the Sound Management of Chemicals (IOMC) was established in 1995 following recommendations made by the 1992 UN Conference on Environment and Development to strengthen co-operation and increase international co-ordination in the field of chemical safety. The participating organisations are FAO, ILO, OECD, UNEP, UNIDO, UNITAR and WHO. The World Bank and UNDP are observers. The purpose of the IOMC is to promote co-ordination of the policies and activities pursued by the Participating Organisations, jointly or separately, to achieve the sound management of chemicals in relation to human health and the environment.

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Guidelines on Minimum Requirements for Agricultural Pesticide Application Equipment

Background

Safety and quality standards for agricultural pesticide sprayers do not exist in all FAO member countries and existing international standards for this type of equipment are often inappropriate for many member countries. Since 1995 FAO-AGSE has worked on the formulation of guidelines to improve the safety and efficiency of the most commonly used types of spray equipment.

The FAO guidelines on standards are based on existing international, European and national standards and other published references. They also draw on the in-depth knowledge and experience of international sprayer standards of the experts assigned to the project and on the authors' experience of pesticide application in the developing world.

The first versions of the FAO guidelines on pesticide application equipment were approved for publication in May 1997 by; the FAO Panel of Experts on Pesticide Specifications, Registration Requirements, Application Standards and Prior Informed Consent; and the FAO Panel of Experts on Agricultural Engineering.

This publication is the first revision of these guidelines, which incorporate comments and suggestions received from member states and new international developments since 1997. There are two guidelines; the first covers minimum requirements and the second covers more precise standards and test procedures to determine compliance.

Minimum requirements

An important objective of the guidelines on minimum requirements is to assist FAO and other agencies to ensure that sprayers purchased are safe to users and to the environment as well as being efficient and durable in operation. Price will always play an important part in purchase decisions on equipment but even the cheapest sprayer models should meet minimum standards of safety and durability.

The FAO minimum requirements take into account sprayers that are already on the market, many of which already meet the requirements. The prime objective therefore is that member countries should adopt them immediately, to begin to eliminate substandard and unsafe sprayers from national markets and ultimately from the international scene.

The guidelines on minimum requirements are presented in separate volumes covering different categories of spray equipment, such as the principal types of portable (operator-carried) sprayers, including rotary atomizers, vehicle-mounted and trailed (tractor) sprayers and others.

Guidelines on standards and test procedures

The guidelines on standards are more demanding than the minimum requirements and provide more precise safety targets for spray equipment. They consist of detailed specifications and requirements, supported by test procedures to measure compliance with the FAO standard, for the major types of agricultural pesticide sprayers manufactured or used in FAO member countries. These standards reflect current manufacturing practice, other national and international standards and the practical reality in the field in member states.

The aim of both the minimum requirements and the standards guidelines is to provide manufacturers and governments with a practical and consistent quality assurance system. Each member country can then decide on the form and speed of introduction of the respective guidelines into national practice and into legislation where appropriate.

The entire series consists of the following other guidelines:

Guidelines on procedures for the registration, certification and testing of new pesticide application equipment;

These guidelines outline a further way by which governments can influence pesticide safety by controlling the quality of the pesticide application equipment manufactured in or imported into the country. By incorporating into national legislation, a requirement for manufacturers and importers to declare that application equipment meets standard of safety and durability, it should be possible to gradually reduce and eventually eliminate sub-standard equipment from the market.

Guidelines on the organization of schemes for testing and certification of agricultural pesticide sprayers in use

This publication covers the testing and certification of the sprayers currently applying pesticides on commercial farms. They address an urgent need in many countries to ensure that where pesticides are used in crop production, they are applied through equipment, which is safe and fully functional. The issue applies to both large, field crop and orchard sprayers as well as operator-carried equipment.

Guidelines on the organization and operation of training schemes and certification procedures for operators of pesticide application equipment.

These guidelines consider the training, testing and certification of those who actually operate pesticide application equipment. Even the most well designed and maintained sprayer can do immeasurable damage in the hands of an unskilled operator and the importance of these guidelines should not be underestimated.

A further two guidelines in the series cover application of pesticides using aircraft and field crop sprayers and tree and bush crop sprayers:

Guidelines on good practice for aerial application of pesticides;

Guidelines on good practice for ground application of pesticides.

These guidelines have been prepared to offer practical help and guidance to all those involved in using pesticides for food and fibre production or in public health programmes. They cover the main terrestrial and aerial spray application techniques.

Introduction

Volume two of the FAO guidelines on minimum requirements covers vehicle-mounted, trailed and self-propelled field crop, orchard and plantation sprayers. These types of sprayer fall into two distinct groups according to the height and architecture of the crop/target to be sprayed:

Boom sprayers

These sprayers apply the spray liquid through nozzles, which are attached to a horizontal structure (boom) and which are normally directed towards the ground. Boom sprayers are normally used to spray low-growing arable (field) crops and weeds. Some models incorporate a fan to produce an air stream to aid downward penetration of droplets into low-growing cereals and other crops.

Tree and bush crop sprayers

These machines are designed to treat taller crops and commonly incorporate a fan to create an air stream, which is directed sideways and upwards to propel the droplets into the crop canopy from nozzles mounted on a boom positioned in or beside the air-stream. Some models do not use an additional air stream but an arrangement of nozzles on the boom directed towards the target.

High pressure and drift

One of the primary sources of potential hazard from terrestrial vehicle sprayers is high pressure that can produce fine droplets, which are prone to drift and inhalation. High pressure can also increase hazard through component failure leading to major leakage of spray liquid. Therefore, a key criterion in sprayer design is the provision of systems for pressure control within the sprayer and at the nozzle. These guidelines specify the functional requirements for sprayers and the pressure limits recommended to minimize hazards without compromising spraying efficiency.

Using the guidelines on minimum requirements

For the purposes of determining these minimum requirements, sprayers are divided into several “component modules” (Figure 2). Within each module the functional requirements, especially in relation to safety, are defined and presented as a simple series of numbered clauses (sections).

The minimum requirements do not aim to provide precise quality requirements and test procedures. These issues are addressed in the companion guideline of this series: *Guidelines on standards for agricultural pesticide sprayers and related test procedures*. The aim of the guideline on minimum requirements is to provide a practical aid to assist purchasing and other agencies to avoid buying or approving sprayers with quality and design limitations, which could compromise operator and environmental safety.

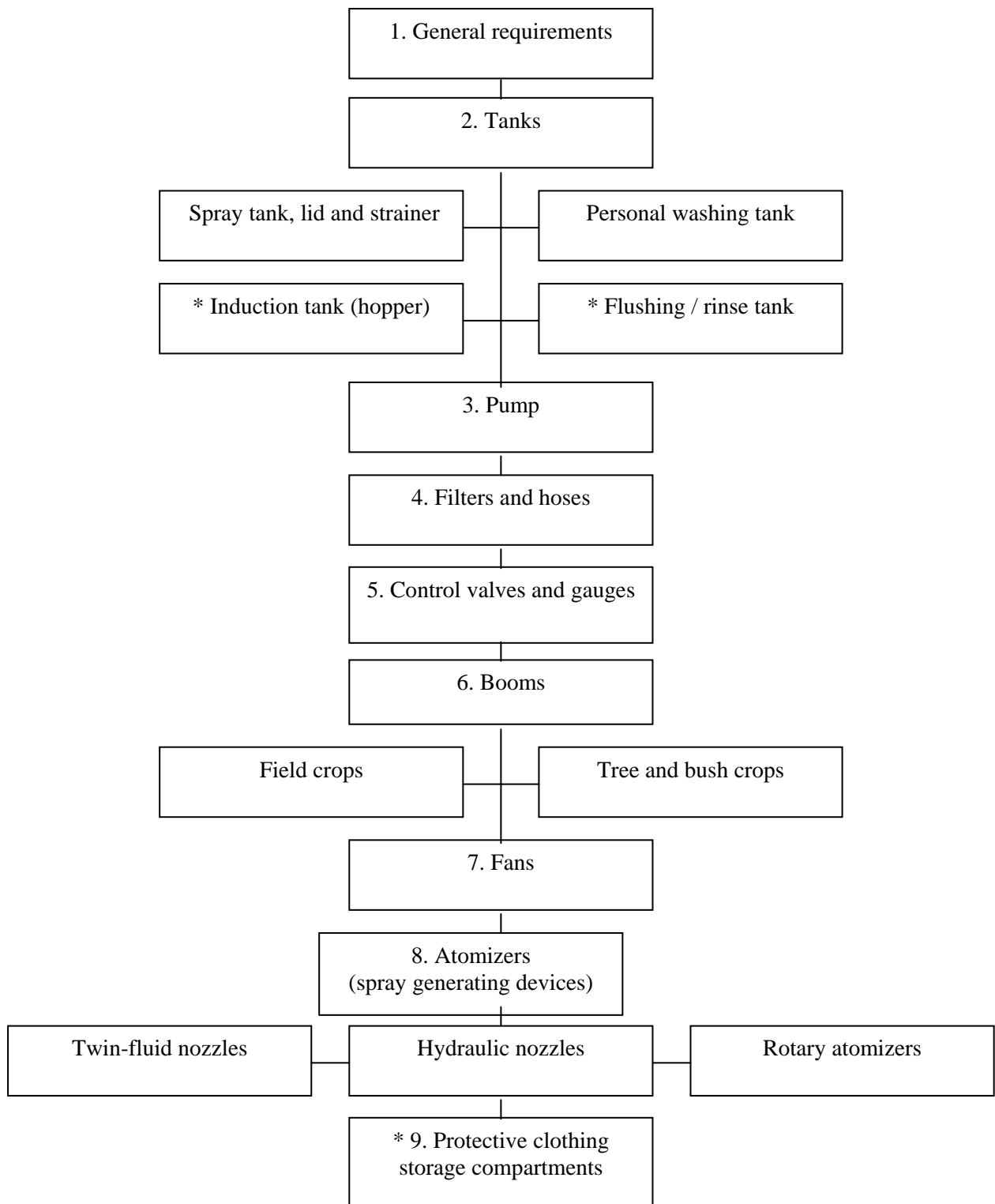
Format

The modular format used in this document was developed by the authors as the basis of a guide to assist FAO and other buying agencies in the selection of crop sprayers: *FAO Basic Guidelines for the Selection of Agricultural Pesticide Sprayers, June 1995*.

Each module relates to a major component or a functional group of components from which consistent specifications for complete spraying machines can be compiled. The various modules for vehicle-mounted and trailed sprayers, which are generally referred to as “tractor sprayers”, are shown in Figure 2.

The following requirements therefore apply to all terrestrial agricultural spraying equipment, which is operated in conjunction with a tractor, mounted on a purpose built chassis unit or within a multi-purpose agricultural/horticultural vehicle. Throughout this document, for convenience, these types of spraying equipment are referred to as “the sprayer”.

Figure 2
TRACTOR SPRAYER COMPONENT MODULES



* required for sprayers with tank volumes over 1000 litres

1. Module 1 - General Requirements

Sprayers should be safe, reliable and capable of working efficiently under practical field conditions.

They should be robustly constructed from strong, durable materials which will not obviously be prone to undue deterioration during field use, thereby adversely affecting safety and lowering efficiency due to corrosion, rust, distortion or premature wear.

To meet the FAO minimum standard, a sprayer should comply with the following requirements.

- 1.1. The sprayer unit should be securely attached to the vehicle system.
- 1.2. All shaft drives should be adequately guarded so that no moving parts are exposed.
- 1.3. Potential trapping points, which could cause physical injury e.g. created by the boom folding or height adjustment mechanism, should be fitted with guards. In positions where guards are not practical, the sprayer should be fitted with appropriate, clear warning signs.
- 1.4. All handles, grips or handholds should be at least 300 mm from any hinged joint.
- 1.5. Hydraulic oil connections should be via “snap-fit” connector systems. Ideally sprayers should be fitted with a closed transfer system, however, where filling of either water or chemical is manual, it should be possible for the operator to add the chemical or water to the tank either standing on the ground or on a purpose-built platform with a minimum floor area of 0.5 m².
- 1.6. Platforms, should be made from anti-slip flooring and have guardrails.
- 1.7. Reach distances should not exceed 1.0 m vertically from the ground or platform and there should be no obstructions around the fill area.
- 1.8. The filling system for the spray tank(s) should permit safe, easy filling at the manufacturer’s recommended maximum rate without overflowing or splashing.
- 1.9. The sprayer should not leak under working conditions at recommended pressures and flow rates.
- 1.10. The sprayer should be easy to clean thoroughly both inside and out. Rough surfaces and awkward recesses, should be avoided.
- 1.11. The outer surfaces of the sprayer should not trap or retain spray liquid.
- 1.12. There should be no sharp edges, abrasive areas or unnecessary projections, which could injure the operator.
- 1.13. Trailed sprayers, even when disconnected from the towing vehicle, should be stable and remain upright when positioned on a 15% (1 in 7) slope in any direction, irrespective of the amount of liquid in the tank(s).
- 1.14. Adjustments to the sprayer, routine maintenance, drainage and cleaning should be easily carried out without needing special tools (i.e. tools specifically designed for the sprayer).
- 1.15. The manufacturer should provide with the sprayer, a clear, simple, illustrated, instruction manual in English, French or Spanish and in an accepted commercial language in a specific market for which the sprayer is being evaluated.

- 1.16. The manual should contain procedures for:
- identification of all replacement parts, including appropriate “exploded diagrams”;
 - setting and calibration;
 - minimizing the need to dispose of dilute pesticide;
 - washing pesticide bottles via the induction hopper when fitted;
 - cleaning and safe disposal of any washings;
 - routine maintenance and storage;
 - safe, accurate field use.

It should provide information on:

- safe handling of undiluted agrochemicals, mixing chemicals and filling the tank;
- disposal of leftover spray liquid and empty pesticide containers;
- atomizer flow rates and spray quality (see Module 8);
- the nozzle sizes and operating pressures to be used in the sprayer (see Module 8);
- precautions to minimise the risk of operator and environmental contamination, especially through spray drift;
- induction hoppers where fitted (see Section 2.17).

- 1.17. The manual should also provide written assurance that:

- parts of the sprayer that come into constant direct contact with the spray liquid are made from non-absorbent materials, which are suitable for use with approved pesticide formulations;
- parts of the sprayer that are exposed routinely to direct sunlight, are made from materials, which do not unduly deteriorate.
- a practical system is in place to assist in the provision of replacement parts for a minimum of five years after its date of manufacture.

- 1.18. To facilitate the accurate identification of replacement parts, the sprayer should be clearly and durably marked to indicate; the manufacturer’s name and address and the sprayer name and model.

- 1.19. All controls should be clearly marked and within easy reach of the operator from the normal driving/spraying position.

2. Module 2 - Tanks

There are often several tanks, or similar structures fitted to a sprayer.

These include:

- the main spray tank(s) which contain the spraying water or diluted pesticide solution;

- a rinsing or flushing tank containing clean water to help wash out the inside of the tank and spray liquid circuits;
- a clean water tank for use by the operators for personal washing;
- an induction tank (hopper) to assist in the safe transfer of chemicals into the sprayer.

To comply with the FAO standard, a sprayer should be equipped with:

- a main spray tank(s);
- a clean water personal washing tank.

Sprayers with a spray tank (s) capacity of 1000 litres or more require:

- an induction hopper;
- a rinsing tank.

Spray tank(s), lid and strainer

- 2.1. Spray tank(s) should be mechanically durable.
- 2.2. Fill openings should be closed with tight-sealing lids that are securely attached to the tank.
- 2.3. Lids should be fitted with positive, mechanical closure systems, which enable them to be opened and closed with gloved hands. For this and for other checks, where gloves are recommended they should have a minimum thickness of 0.5 mm.
- 2.4. Fill openings greater than 400 mm in diameter or, if rectangular, greater than 400 mm x 300 mm, should be fitted with a grating, which cannot be removed without using tools.
- 2.5. Fill openings should be fitted with a strainer with a maximum mesh aperture size of 1.0 mm.
- 2.6. Strainers should be easy to remove and fit with gloved hands
- 2.7. Strainers should be close fitting and should not lift from their seating during filling.
- 2.8. Tanks should be clearly and durably marked with the nominal (manufacturer's recommended maximum) filling level, which should not exceed 95% of the total volume of the tank.
- 2.9. The sprayer should be fitted with a means of indicating the level of liquid in the spray tank(s), with a scale interval of no more than 20% of the nominal volume of the tank(s).
- 2.10. Liquid level indicator(s) should be clearly visible to the sprayer operator from the normal working (spraying and filling) positions.
- 2.11. Spray tanks should incorporate a safe and convenient system to enable the drained liquid to be collected or discharged for safe disposal.
- 2.12. The spray tank should be fitted with an agitation system except where the sprayer is designed to operate exclusively with control systems in which the diluent (water) and the concentrated pesticide are controlled separately.

Personal washing tank

- 2.13. The personal washing tank (the tank) and associated plumbing circuit should contain clean water only and should be fully independent of the main sprayer circuits, which contain chemical solution.
- 2.14. The tank should have a minimum volume of 15 litres.
- 2.15. The tank should be securely fixed to the sprayer.
- 2.16. The tank should be constructed from materials that will not rust or corrode thereby contaminating the water.

Induction hopper

- 2.17. Sprayers with tank capacities of 1000 litres or more must be fitted with an induction hopper that complies with this module.
- 2.18. An induction hopper is a conveniently located tank or similar container into which undiluted pesticide formulations can be safely poured or placed. Water is introduced into the hopper to dissolve or dilute the pesticide and to transfer it into the main liquid flow circuit of the sprayer.
- 2.19. Where the sprayer is supplied with an induction hopper, it is the responsibility of the sprayer manufacturer to ensure that it complies with the following requirements even though it is probable that this information will originate from the hopper manufacturer.

An induction hopper should satisfy the following requirements.

- 2.20. The hopper should efficiently handle all commonly used pesticide formulation, liquids, powders, granules, soluble sachets and bags. This assurance, together with recommended procedures for use, should be included in the sprayer manual.
- 2.21. The hopper should have a minimum working volume of 15 litres.
- 2.22. The hopper should be clearly and durably marked to show the recommended maximum filling level, which should be no more than 95% of the total volume of the hopper.
- 2.23. The hopper should be fitted with a lid, which is securely attached to the hopper.
- 2.24. The fill hole should have a minimum dimension of 250 mm.
- 2.25. The fill hole should be between 0.5 and 1.0 m from the ground.
- 2.26. There should be a minimum clearance zone (i.e. an area free from obstacles) of 500 mm around the hopper.
- 2.27. The hopper should include a device for cleaning original pesticide containers so that less than 0.01% of the original contents remain in the container. This assurance, together with a defined procedure, should be included in the sprayer manual.
- 2.28. Parts of the hopper that come into constant direct contact with the spray liquid should be made from non-absorbent materials, which are suitable for use with approved pesticide formulations. This assurance should be included in the sprayer manual.
- 2.29. Instructions related to the operation of the induction hopper, should be clearly and durably marked on the sprayer or hopper.

- 2.30. The sprayer manual should also include:
- details on how the hopper operates;
 - clear, simple, illustrated instructions on the safe and effective installation of the hopper on to the sprayer, which should not require special tools (i.e. tools specifically designed for the hopper);
 - instructions on operating flows, pressures, and any other specific requirements;
 - appropriate cleaning procedures.

Flushing/rinse tank

- 2.31. Sprayers with spray tank capacities of 1000 litres or more must be equipped with a flushing tank that complies with this module.
- 2.32. These tanks are required to provide clean water to clean the sprayer tanks and the plumbing circuits on the sprayer that contain pesticide solution.
- 2.33. The liquid circuits on the sprayer should be designed to ensure that it is not possible to use liquid from the flushing/rinse tank for personal washing.
- 2.34. The volume of the flushing/rinse tank should be a minimum of 10% of the volume of the main sprayer tank(s).

3. Module 3 - Pump

- 3.1. When operating at its recommended rotational speed, the pump should have sufficient capacity to supply the boom, fitted with the largest nozzle size and operated at 20% above the manufacturer's maximum recommended working pressure.
- 3.2. It should be possible to remove the pump from the sprayer without draining the tank(s).
- 3.3. The pump should be permanently marked with:
- the maximum flow rate and operating pressure;
 - the recommended and maximum rotational speed;
 - the name and address of the manufacturer;
 - a serial number.

4. Module 4 - Filters and Hoses

- 4.1. When the sprayer is fitted with a pump, which operates with valves, there should be a filter on the suction side of the pump with a maximum mesh aperture size of 0.5 mm.

- 4.2. The pressure feed line of the sprayer should be fitted with a filter with a maximum mesh aperture size of 0.3 mm.
- 4.3. Filters should be readily accessible for cleaning and maintenance.
- 4.4. Filters should be easy to clean without needing to empty the sprayer tank(s).
- 4.5. Hoses fitted to the sprayer should be durably marked to indicate their rated pressure, which should be equal to or greater than the maximum operating pressure of the sprayer, plus 20%.
- 4.6. Hoses should be positioned so that, in the event of leakage or bursting, the risk of operator contamination is minimized. They should not pass through the tractor/vehicle cab. When there is no cab, hoses close to the operator should be covered by secure guards to prevent operator contamination. (e.g. the hose could run)
- 4.7. through a larger diameter protective hose with a pressure rating at least equal to that of the spray hose).
- 4.8. Hoses used to fill the sprayer should be fitted with a strainer with a mesh size aperture not exceeding 1.0 mm.
- 4.9. Hoses should be fitted to the sprayer so that they are not bent sharply (kinked), which could reduce the effective bore of the hose.
- 4.10. Hose connections should be easily adjustable and removable using gloved hands without needing special tools (i.e. tools specifically designed for the sprayer) and should not leak when reconnected.

5. Module 5 - Control Valves and Gauges

- 5.1. All sprayers should be fitted with a pressure safety device to prevent the pressure in any part of the circuit exceeding the maximum operating pressure by more than 20%.
- 5.2. The pressure safety device should ensure that all vented liquid flows are discharged into the main tank.
- 5.3. The boom should be fitted with spray lines and valves so that the supply of liquid to each boom section can be controlled independently.
- 5.4. There should be a single master control valve for turning on/off the supply to all boom sections.
- 5.5. “Anti-drip” valves should be incorporated in the sprayer circuit to minimise the loss of spray liquid from nozzles once the liquid supply to a boom section has been turned off. The maximum leakage from a nozzle should not exceed 2 ml in a 5-minute period, commencing 8 seconds after the supply to the boom section has been switched off.
- 5.6. A fail-safe system should be incorporated into the sprayer to prevent back-flow by siphoning while the spray and rinse tanks are being filled.
- 5.7. Sprayers designed to operate with hydraulic pressure nozzles should be fitted with a pressure gauge, which is clearly visible to the operator from the driving position. In the case of an analogue dial, this should have a minimum diameter of:

- 63 mm if mounted within hand reach of the operator when in the position for spraying;
- 100 mm in all other cases.

Other forms of display, e.g. digital readouts, should be clearly visible from the operating position

- 5.8. The pressure gauge indicator should provide a stable reading.
- 5.9. The housing of pressure gauges should be isolated from the spray liquid so that, in the event of failure leading to leakage, the operator is not contaminated.

6. Module 6 - Booms

Field crops

- 6.1. Booms should be rigidly constructed so that all nozzles along a boom are supported at the same height.
- 6.2. A minimum range of height adjustment of one metre should be possible.
- 6.3. The mechanism for height adjustment should incorporate a fail-safe feature so that in the event of failure of the mechanism, the boom height will not change by more than 0.2 m.
- 6.4. Where a manually operated system for boom height adjustment is used, it should be of a self-arresting type.
- 6.5. For powered height adjustment systems the sprayer should be fitted with either:
 - an arresting (anti-fall) device, or
 - a stop that limits the boom to a minimum height of 0.5m above ground level.
- 6.6. Boom height settings of less than 0.5 m should only be possible by manually overriding the 0.5m stop control.
- 6.7. All height adjustment systems should be fitted with a locking device.
- 6.8. Booms more than 10 m wide should incorporate a mechanism, which will isolate the boom from the movements of the spray vehicle, i.e. they should be equipped with a boom suspension system.
- 6.9. The boom should also be isolated from the yawing movements of the vehicle. With the boom extended and the machine stationary, it should be possible to displace the boom tip by a horizontal distance of 20 mm for each 1m of boom width, without distorting the boom structure.
- 6.10. The boom should be fitted with a “break-back” device so that when the outer 10% width of either end of the boom strikes a solid obstacle when travelling forwards, the boom displaces i.e. “breaks back”, without mechanical damage to the boom structure or to any other part of the sprayer. After striking an obstacle, the boom should return to its original working position automatically and quickly.

This test should be conducted with the tractor travelling in a forward direction at a speed of 2.5 m per second.

- 6.11. When folded in transport positions, the boom sections should not:
 - obstruct access to or from the operator's driving or filling positions;
 - position nozzles above the access route to or from the operator's driving/spraying or filling positions, unless a shielding mechanism is installed to avoid spray liquid dripping onto the operator.
- 6.12. The sprayer should be fitted with a mechanism to lock the boom sections securely in the transport position.
- 6.13. To minimise the risk of contact with overhead power cables during the folding operation, no part of the sprayer or boom should at any time, extend to a height of more than 5.0 m above the ground.
- 6.14. Booms, which when folded extend to a height of more than 3.5 m above the ground, should be fitted with a warning sign pointing out the potential hazard from overhead cables. This sign should be easily understood and clearly visible to the operator from the working (driving/spraying) position.
- 6.15. The design of the boom should ensure protection of the nozzles from damage from contact with the ground.
- 6.16. Boom sprayers designed to operate with air-assistance are required to meet all the standard requirements in 6.1 to 6.15. In addition, manufacturers of this type of sprayer should include in the sprayer manual:
 - details of air speed settings for different operating conditions, including those when no air is needed;
 - specific maintenance requirements related to the air production and distribution systems.
- 6.17. When the sprayer is equipped with a fan to generate air, it should comply with the requirements in Module 7.

Tree and bush crops

This module section covers boom structures for air-assisted orchard and plantation sprayers.

- 6.18. The spray boom (delivery arc) should allow:
 - the spray liquid to each side of the sprayer, to be controlled independently;
 - nozzles of different sizes and blanks to be fitted to the boom.
- 6.19. The boom should be rigidly attached to the sprayer.
- 6.20. Where the boom is intended to operate in different positions in relation to the air stream, clear, detailed instructions should be included in the sprayer manual describing the settings for effective operation in different crop and weather conditions.

- 6.21. When the boom can be used without air assistance, detailed instructions should be included in the sprayer manual on how to set up the sprayer for effective operation for different crop targets and conditions.

7. Module 7 - Fans (for air-assisted spraying)

- 7.1. The drive to the fan unit should be capable of disconnection without affecting the mechanism for circulation and agitation of liquid in the sprayer.
- 7.2. The inlet to the fan should be designed and positioned so that debris is not drawn into the fan, even at the highest operational speed.
- 7.3. The lowest point of the fan inlet must be at least 25 cm above the ground.
- 7.4. The fan should be equipped with a permanent guard with a minimum mesh aperture size of 5 mm and a maximum size of 10 mm.
- 7.5. The noise level, when the sprayer is operated at the maximum airflow, should not exceed 85 dB at the operator's ear.

8. Module 8 - Atomizers (spray generating devices)

It is the responsibility of the sprayer manufacturer to comply with the following requirements for nozzles and rotary atomizers supplied with or recommended for the sprayer even though the information may originate from another manufacturer, who specialises in nozzles or rotary atomizers.

Hydraulic nozzles

- 8.1. The sprayer manufacturer should include in the sprayer manual, information on:
- nozzle flow rates at 2, 3 and 4 bar;
 - characteristic spray patterns and spray angles at 2, 3 and 4 bar;
 - recommended nozzles, nozzle positions, heights and spacing, to give the required spray volume distribution at the target;
 - a procedure for determining when nozzles are worn to 125% of their original flow rates and operating pressure(s), and should be replaced.
- 8.2. The sprayer manufacturer should provide assurance in the sprayer manual that nozzles supplied with or recommended for the sprayer are manufactured to international standards e.g. International Standards Organisation (ISO).
- 8.3. Output from any single nozzle or between nozzles with the same identity code i.e. which claim to have the same characteristics, should not differ by more than ± 10 percent from the specified output at any recommended pressure.
- 8.4. For flat fan nozzles, the nozzle support system should include a method of ensuring correct orientation of the nozzle within the holder.

Twin-fluid nozzles

These devices create a spray within a nozzle body via pressurized supplies of both liquid and air.

- 8.5. Sprayers fitted with twin fluid nozzles should be equipped with separate pressure control valves and gauges to control the liquid and air supplies respectively.
- 8.6. The sprayer manufacturer should include in the sprayer manual, information on:
 - the range of pressures and flow rates over which the nozzles are designed to operate;
 - the flow rates and spray quality that can be achieved with defined pressures of liquid and air to the nozzle;
 - specific maintenance requirements for the nozzles supplied or recommended;
 - specific operating instructions for the nozzles supplied or recommended.
- 8.7. Output from any single nozzle or between nozzles with the same identity code i.e. which claim to have the same characteristics, should not differ by more than ± 10 percent from the specified output at any recommended pressure.

Rotary atomizers

- 8.8. The sprayer manufacturer should provide in the sprayer manual, information on:
 - flow rates (measured with water);
 - characteristic drop sizes produced at the manufacturer's recommended restrictor flow rates and atomizer speeds;
 - details of specific operating speeds and settings for the principal targets and field conditions;
 - spacing of atomizers on the boom for different spray targets and conditions;
 - a method for checking the atomizers to determine when they should be replaced.
- 8.9. Output from a single rotary atomizer restrictor or between restrictors with the same identity code i.e. which claim to have the same characteristics, should not differ by more than ± 10 % from the nominal output.
- 8.10. The atomizers should be capable of 50 hours of operation at maximum operating speed without loss of performance or needing maintenance. The manufacturer should provide written assurance of this in the sprayer manual.

9. Module 9 - Protective Clothing Storage Compartments

- 9.1. Sprayers with tank capacities of 1000 litres or more, must be equipped with protective clothing storage compartments, which comply with this module.

- 9.2. The sprayer should be equipped with two compartments; one for clean clothes and the other for contaminated clothes.
- 9.3. The compartments should be located on the sprayer as far away as possible from the point of chemical loading.
- 9.4. The minimum internal dimensions of the compartments should be 450 mm x 450 mm x 300 mm.
- 9.5. The compartments should be clearly and durably marked:
 - stating their purpose, i.e. to store protective clothes: either “clean” or “contaminated”;
 - warning against the storage of chemicals in these compartments.