



WHO SPECIFICATIONS FOR VEHICLE-MOUNTED MOTORIZED
AEROSOL GENERATORS WITH GASEOUS ENERGY NOZZLE¹

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The 1963 meeting of the WHO Expert Committee on Insecticides resulted in the publication in 1964 of the first edition of Equipment for Vector Control which provided information on a wide variety of equipment that could be used for the dispersal of pesticides and gave detailed specifications for the sprayers and dusters considered most important for vector control operations.

A meeting of the WHO Expert Committee on Insecticides, convened in November 1970, strongly recommended the revision of Equipment for Vector Control to reflect the new knowledge available. Consequently, the second edition of Equipment for Vector Control was published in 1974. The second edition has been expanded to include a discussion of the principles of vector control by chemicals and to provide information on the use of aircraft.

In September 1976, a meeting of the WHO Expert Committee on Engineering Aspects of Vector Control Operations was held. This committee revised the specifications for hand-operated compression sprayers and recommended that WHO should produce interim specifications for motorized knapsack mistblowers and vehicle-mounted motorized aerosol generators.

In April 1989, a meeting of the WHO Expert Committee on Equipment for Vector Control was held. This committee revised the interim specifications for vehicle-mounted motorized aerosol generators with gaseous energy nozzle and recommended that WHO should incorporate the new modifications and produce these WHO specifications on the subject.

This document is designed to support collaborative work needed to establish the specifications for inclusion in the third edition of the WHO Manual on "Equipment for vector control", as well as for use in the purchase of insecticide application equipment. Other relevant documents on equipment include: WHO/VBC/89.970; WHO/VBC/89.971; WHO/VBC/89.973 and WHO/VBC/89.974.

¹ In the United States referred to also as Cold Foggers.

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INTRODUCTION

The vehicle-mounted motorized aerosol generator with gaseous energy nozzle using a high volume, low pressure compressor system, is suitable for ultra-low volume application of insecticides for vector control in urban and suburban areas having adequate access roads.

1. SPECIFICATIONS

1.1 Description

The aerosol generator shall have an engine-driven air compressor system to produce a flow or vortex of air into which the insecticide formulation is metered so that the liquid is sheared into droplets no larger than 25 μm VMD. The complete unit shall be robustly constructed for rugged field use, easily mounted on a flat-bed truck or trailer and so designed that it may be operated from the vehicle cab. The weight of a complete unit assembled for operation but not including the weight of fuel and insecticide formulation shall not exceed 250 kg.

1.2 Materials of construction

All materials used in construction shall be resistant to pesticides and other chemicals used in their formulations under a wide range of climatic conditions, to meet the performance criteria specified (see section 2.1).

1.3 Dimensions

The aerosol generator mounting frame shall not exceed 1 m x 0.75 m. The overall height shall not exceed 1 m unless agreed by the purchaser. If the tank provided to store the insecticide formulation is separate from the main frame it shall not exceed the overall height, nor a floor area of 0.25 m². Any separate control panel shall be no larger than 25 x 35 x 20 cm performance criteria specified (see section 2.1).

1.4 Mounting frames

The mounting frames to support the various components of the aerosol generator shall be robustly constructed so as to withstand prolonged and variable vibration caused by driving the vehicle along rough roads and be equipped with parts or devices to reduce transmission of vibration of the vehicle to components of the aerosol generator. The insecticide tank, fuel tank and solvent tank (see section 1.14) may be mounted on the same frame.

1.5 Engine

An internal combustion engine of at least 8.0 rated kW (10 hp) capacity to drive the air compressor shall be equipped with an electric starter and alternator. If specified by the purchaser, a pulley wheel, protected by a removable cover may be provided so that the engine can be started with a rope if the electric starter fails. A fuel tank of sufficient capacity to allow for not less than six hours continuous operation shall be

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provided. All components shall be easily accessible. A suitable strainer shall be provided at the inlet of the tank and an efficient filter in the supply line between the fuel tank and carburettor. A suitable fuel pump should be provided to maintain flow regardless of operating conditions. A suitable air filter shall be placed directly on the carburettor air intake. An engine identification plate securely fastened to the engine, shall be provided to show the make, model number, type and power/capacity.

The engine shall be silenced by a muffler which shall have a protective guard around it and be located away from the fuel tank to prevent the operator from injury and avoid fire hazard.

1.5.1 Performance

The engine shall successfully pass the performance tests described in section 2.2 with respect to the following criteria:

- maximum speed in rpm as described in section 2.2.1;
- fuel consumption in litres/hour at maximum speed as described in section 2.2.2;
- noise level at maximum speed in decibels described in section 2.2.3 shall not exceed 90 decibels (dB-A);
- durability without any operational problems after 50 hours as described in section 2.2.4.

1.6 Air compressor

A heavy duty air compressor shall be fitted so that its position relative to the engine can be easily adjusted to ensure that connecting belts, if provided, are correctly tensioned. A strong guard must be securely fitted to protect the operator. The air intake of the compressor shall be fitted with an air filter designed to retain particles of over 100 μm in diameter. The filter shall preferably be of the permanent type. The volume and pressure of the air emitted by the compressor shall produce the specified droplet sizes over the complete range of flow rates produced. Thus, the compressor shall deliver a minimum of 4.5 m^3 air per minute to the nozzle. A pressure gauge shall be mounted on the control panel to monitor air pressure or there shall be an automatic flow control system with cut-off valves.

1.7 Insecticide tank

1.7.1 General

The insecticide tank shall be fitted either directly to the mounting frame or to a separate frame fixed to the vehicle, so that the tank can be easily removed for refilling, if necessary, and cleaning. The tank shall be constructed of materials resistant to chemicals.

1.7.2 Capacity

The insecticide tank shall have a capacity of at least 25 litres to allow spraying for a minimum of one hour at maximum output with a metering device to show or measure the liquid content of the tank.

1.7.3 Filler hole

The tank shall be designed to allow rapid filling and complete emptying, and have an opening in the top of not less than 60 mm diameter.

1.8 Insecticide metering system

1.8.1 Cut-off valve

If liquid is displaced from the tank by means of air pressure, a valve shall be provided between the tank and the nozzle assembly to control the flow of insecticide liquid. A remote electronic on/off switch shall be included to provide from the vehicle cab continuous control of the insecticide flow. The cut-off valve should be so designed that all parts are readily accessible for cleaning and replacement.

1.8.2 Delivery hose

The delivery hose from spray tank to cut-off valve and nozzle shall be made of material resistant to chemical components of pesticide formulations. It shall be of adequate inside diameter to allow easy and continuous flow of the liquid pesticide formulation. The hose shall be tightly connected to the tank, without leakage, and readily removable to allow drainage of the spray tank.

1.8.3 Control system

At the option of the purchasing agency, a positive displacement pump shall be fitted to regulate the flow of the insecticide to the nozzle. The metering system shall provide a constant flow. Alternatively, a variable restrictor and flow meter may be fitted, in which case a thermometer shall be incorporated in the flow line to monitor the temperature of the insecticide near the flow meter. With this system, the manufacturer shall provide calibration charts for liquids of different viscosity¹ over a range of temperature (16-35°C). Electronic flow control devices may also be used.

A control panel shall be provided with a visual and/or audible display to indicate that the machine is functioning correctly including the flow rate, a switch for the flow control valve, an on/off switch for the engine, an air pressure gauge to indicate the pressure at the nozzle, and a light, with an on/off switch to illuminate the panel. At the option of the purchasing agency the control panel shall be capable of being mounted in the cab of the vehicle, behind the cab on the bed of the vehicle or on the mounting frame of the aerosol generator. In each case the control panel shall be so mounted that it can be operated by the driver or operator as required by the purchasing agency.

1.8.4 Metering system

The metering system shall be provided with a small solvent storage tank of at least 2.5 litres capacity and control system to allow insecticide to be flushed from the pump and nozzle(s) after each day's use.

1.9 Nozzle system

One or more vorticle nozzles shall be provided. It shall produce aerosol droplets with VMD less than 25 µm and a maximum output of at least up to 500 ml/minute. Droplets shall be projected from the nozzle for a distance of at least 4 m in still air. The angle of direction of the nozzle shall be adjustable through 180° horizontally and vertically to project the spray either upwards or downwards to the rear or sides of the vehicle.

¹ Equivalent to formulations of insecticides currently in use with this type of equipment.

1.10 Markings

The appropriate part of the aerosol generator shall be clearly and permanently marked with the following:

- (a) insecticide tank capacity in litres and with markings or a metering device to measure the liquid content of the tank;
- (b) fuel tank capacity in litres and with a measuring device as above;
- (c) quality of fuel to be used for the engine;
- (d) open and closed position of choke control on engine;
- (e) throttle settings;
- (f) open and closed position of switch of the insecticide flow on/off valve;
- (g) flow rate to the nozzle in ml/min;
- (h) engine specification (see section 1.5 above);
- (i) net weight of the complete unit.

All components on the control panel shall be clearly labelled in the language specified by the purchaser. (Note: Metric units shall be used throughout unless otherwise specified by the purchasing agency.)

1.11 Spare parts and tools

The manufacturer, unless otherwise specified by the purchaser, shall supply spare parts and tools required for routine replacement during normal use of the equipment over a period of one year. The cost of these spare parts and tools shall be included in the cost of the generator. A list of spare parts, illustrated and coded, shall be provided to the purchaser.

1.12 Operation and maintenance manual

An adequately illustrated "Manual on Vehicle-mounted Motorized Aerosol Generator - Maintenance and Repair"; in the language specified by the purchasing agency, shall be provided with each machine. The manual shall include complete instructions on the use, maintenance and cleaning of the equipment, give a list of all parts, and also give details of fitting the equipment to various vehicles. Those parts of the unit which are in contact with insecticides and may be affected by specific insecticide formulations shall be indicated in the manual. The instructions for the maintenance and repair of the engine and compressor shall be an integral part of the manual.

1.13 Optional extras

At the option of the purchasing agency, a separate flushing tank shall be fitted on the mounting frame or adjacent to the insecticide tank. This tank shall be provided with an air-tight lid and shall have a capacity of up to 10 litres. Connections to the flushing tank shall be arranged to allow the cleaning fluid to flush the insecticide completely from the pump, pipes, nozzle and fittings without dismantling.

2. TEST PROCEDURES

The test procedures recommended in this specification are not intended to exclude accepted equivalent methods that may be in use in different countries. However, in the event of disagreement, the procedures described herein shall govern. As far as possible, all tests shall be carried out with the complete unit without dismantling any components.

The vehicle-mounted aerosol generator under consideration shall be inspected to ensure that all components are present according to the specification, free from defects and undamaged during shipment. The generator shall be prepared for operation according to the manufacturer's instructions, operated for three hours and checked for safety and proper performance. If preliminary droplet size data does not meet the specification, the generator is not worthy of further testing.

2.1 Test for resistance of construction material to chemicals

To test non-metallic parts of the mistblower, which are in contact with insecticide formulations, the following solvent mixture shall be used:

40% kerosene (by volume)
20% toluene (by volume)
40% xylene (by volume)

The parts being tested shall be soaked in the mixture for 72 hours at an ambient temperature or 21°C (whichever is the highest). The parts shall then be allowed to dry in the air for a further 24 hours. After this exposure, the parts shall not deform and when they are reassembled they shall not leak and should function normally. Care shall be taken when handling this mixture as it is toxic and inflammable.

2.2 Engine performance tests

2.2.1 Engine speed

The engine shall be operated at maximum speed, as directed by the manufacturer, and the speed in revolutions per minute measured with a tachometer. All subsequent tests shall be conducted at the same throttle setting/engine speed.

2.2.2 Fuel consumption

Operate the engine until it stops because of shortage of fuel. A measured volume of fuel shall be placed in the fuel tank, and the insecticide tank filled with water. The engine shall be operated at maximum speed while applying water at the maximum flow rate, until the engine stops through shortage of fuel. The period over which the engine operates shall be measured, and then a similar volume of fuel added for a repeat test. The mean fuel consumption, expressed in litres/hour and the time the machine runs on a full fuel tank shall be calculated.

2.2.3 Noise level

The noise level shall be measured adjacent to the operator's ear when he is in his operating position. The noise level so measured shall not exceed 90 decibels (dB-A) for eight-hour exposure. In case the noise level could not be reduced to the acceptable level, the manufacturer shall provide the purchaser initially with suitable ear protectors appropriate to the noise spectrum produced by the engine.

2.2.4 Durability of engine

The aerosol generator shall be operated at the maximum flow rate for at least five hours per day until a total of 50-hour operation has been completed. The engine shall be stopped after each emptying of the fuel tank load and any difficulties in restarting and maintenance required shall be noted. Engine speed shall be checked after every five hours and the liquid discharge rate and fuel consumption after every 25 hours.

2.3 Nozzle performance test

2.3.1 Throughput

This shall be checked over the range of settings of the displacement pump or variable restrictor to determine the time (not less than one minute) to emit a known volume of liquid. Unless otherwise specified, odourless kerosene shall be the test liquid, with the viscosity and temperature recorded.

2.3.2 Horizontal throw

A suitable target such as kromekote cards or glossy photograph paper (75 mm x 50 mm) or glass slides coated with magnesium oxide or teflon shall be fixed vertically on pegs 30 cm above the ground in a series of ten rows of seven pegs spaced 1.5 m apart from each other and 0.75 m between the rows; the first row being five metres apart from the nozzle of the sprayer. The sprayer nozzle shall be held horizontally one metre above the ground and the target sprayed with a suitable liquid for five seconds. The horizontal throw and the width of air stream with entrained droplets shall be determined by recording the number of droplets/cm² on each target. Ambient temperature and relative humidity at the time of spraying shall be recorded. This test shall be carried out in still air and if not the wind speed should be noted. The wind direction should be from the sprayer along the line of targets.

2.3.3 Droplet size

Glass slides coated with magnesium oxide or teflon shall be placed horizontally on the floor in the sedimentation chamber not less than 0.5 m x 0.5 m x 0.5 m into which the aerosol is projected and allowed to settle for at least 15 minutes.¹ Ambient temperature, nozzle pressure and test liquid at the time of spraying shall be recorded. The droplet diameter is determined by a standard method. Alternatively, the coated slides are waved approximately 1 m to 2 m from the nozzle and the droplet sizes measured as mentioned above.² Other proven methods of droplet size determination may be used at the discretion of the Collaborating Centre. In particular advanced laser systems of measuring spray droplets in flight are available at some centres. Ideally the droplet size shall be within 8-20 µm VMD size range.

2.4 Field performance and durability test

The sprayer should successfully undergo a field trial for a period of 300 hours without a change in the specifications provided by the manufacturers and development of major and/or frequent breakdowns of any part(s) of the unit. The field trial shall be performed in accordance with the guidelines for field trials of ground space spraying equipment (WHO/VBC/85.912).

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¹ Non-volatile formulation is essential for teflon slides.

² A suitable method for measuring the droplet size of aerosols is described in the report of the WHO Expert Committee on Insecticides entitled Application and Dispersal of Pesticides, Wld Hlth Org. techn. Rep. Ser., 1971, No. 465, Annex I.

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