

# WHO aircraft disinsection methods and procedures





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# Contents

Acknowledgements .....	v
Abbreviations and acronyms .....	vi
Definitions .....	vii
1. Introduction .....	1
2. Aircraft disinsection products .....	3
3. Types of pesticide application and equipment .....	4
3.1 Guidance, standards and regulatory requirements .....	5
3.2 Aerosol application .....	5
3.3 Residual treatment .....	6
3.4 Personal protective equipment.....	6
4. Aircraft disinsection .....	7
4.1 Certification of aircraft disinsection .....	9
4.2 Residual treatment of cabin and cargo hold .....	10
4.3 Pre-embarkation cabin treatment .....	12
4.4 Pre-departure cabin treatment.....	14
4.5 Pre-departure cargo hold disinsection.....	16
4.6 On-arrival cabin and hold disinsection.....	20
5. Amounts of aerosol spray required for aircraft.....	23
5.1 General information.....	23
5.2 Commercial passenger aircraft .....	25
5.3 Small jets, regional and private aircraft (including private helicopters).....	25
5.4 Military aircraft .....	25
5.5 Freighters .....	26
6. Estimation of amounts of residual spray required for aircraft.....	27
6.1 Calculations for specific areas.....	27
6.2 Amounts of residual spray in aircraft .....	32
References.....	37

## ANNEXES

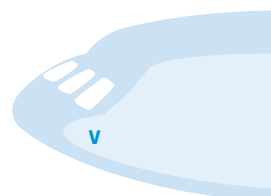
1. Examples of pre-embarkation cabin treatment by aircraft type .....	40
2. Examples of pre-departure cabin treatment by aircraft type .....	42
3. Amounts of aerosol spray required by aircraft type .....	44
4. ICAO Residual Aircraft Disinsection Certificate .....	53
5. ICAO Aircraft General Declaration.....	54

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# Abbreviations and acronyms

a.i.	active ingredient
AE	aerosol
EC	emulsifiable concentrate
ICAO	International Civil Aviation Organization
IHR	International Health Regulations (2005)
TC	technical concentration
VMD	volume median diameter (of droplets)
WHO	World Health Organization



# Definitions

**Aircraft disinsection:** A requirement to meet the International Health Regulations (2005) (IHR), which involves treatment of the cabin and cargo holds of an aircraft with insecticides specified by WHO to control insect vectors of human diseases.

**Aerosol:** A term used to indicate a space spray with droplets < 30 µm in diameter (volume median diameter), i.e. droplets with a low terminal velocity so that they remain airborne as long as possible (1).

**Volume median diameter (also referred to as the Dv50):** Half the volume of a spray contains droplets with a diameter less than the volume median diameter, and the other half have a diameter larger than the volume median diameter.

**Integrated vector management (2):** Rational decision-making process to optimize use of resources for vector control. As there is a strong risk that vectors will enter aircraft at airports with high vector populations, airlines should encourage airport management to organize vector surveillance and control within and in at least a 400-m perimeter of the airport (3). Well-implemented reduction of vector populations in and around airports will reduce the requirement for aircraft disinsection.

**Long-term treatment:** Disinsection that leaves a deposit that persists for much longer than one flight sector. Currently, the droplet size of permethrin 2% emulsifiable concentrate (EC) for residual disinsection treatment should be ≥ 50 µm. No more than 5% droplets should be < 30 µm at the specified operating pressure at the nozzle. This preparation provides an insecticidal deposit on all internal aircraft surfaces (cargo areas and/or passenger cabins)<sup>1</sup> that kills target insects that come into contact with the treated surface. Such deposits are intended to remain active for intervals of ≤ 8 weeks. See sections 3.3 and 4.2 for further information.

**Short-term treatment:** Aircraft disinsection treatments that last for one flight sector only. (See sections 4.3, 4.4 and 4.5 for further information.)

- **Pre-embarkation method:** Comprises aerosol spraying of aircraft cabins, in the absence of passengers, before embarkation. The treatment is effective for the duration of a single flight sector. In pre-embarkation cabin spraying, all areas of the aircraft cabin are sprayed, including the flight deck, open overhead and coat lockers and toilets.
- **Pre-departure method:** Replaces the previous “blocks-away” method and comprises aerosol spraying of the aircraft cabin after passenger embarkation but before the overhead lockers are closed and the aircraft is pushed back for departure. The treatment is effective for the duration of a single flight sector. All areas of the aircraft cabin are sprayed, including the flight deck, open overhead and coat lockers and toilets.
- **Pre-flight and top-of-descent methods:** These previously recommended methods have been replaced by pre-embarkation and pre-departure methods and are therefore no longer recommended by WHO.
- **Pre-departure cargo hold disinsection:** Treatment for aircraft cargo holds that were not treated by residual disinsection.
- **On-arrival disinsection:** For aircraft that were not disinfected before arrival or not disinfected correctly or as required as an additional treatment.

<sup>1</sup> Note: The flight deck, cockpit and crew rest areas are treated with a permethrin 2% aerosol.



# Introduction

This document replaces WHO's last formal publication on aircraft disinsection (4). It is a dynamic electronic document, which may be updated from time to time when new information is available. Links to other websites are provided for the users' convenience and do not constitute WHO's endorsement of the information or materials presented on such websites.

This document was prepared by WHO to describe the latest aircraft disinsection methods and procedures. Aircraft are disinsected to protect countries from the introduction of potential disease vectors and to help prevent the spread of pathogens borne by mosquitoes and other vectors. Each country should, in liaison with the departure country, assess the requirements for disinsection of arriving aircraft, taking into consideration the following risk assessment factors:

- region of the departure airport
  - ◇ known to have targeted vectors from local entomological information;
  - ◇ relevant season and climate of the targeted vector;
  - ◇ volume of flights.
- departing airport
  - ◇ vector surveillance for the presence or absence of targeted vectors;
  - ◇ routes to regions not endemic for the targeted vectors;
  - ◇ jetway, walkway, stairway or door to the aircraft closed when not in service;
  - ◇ can provide a designated parking position to isolate aircraft from vector threats.
- arrival airport
  - ◇ can provide designated parking position if arriving aircraft may be carrying infectious agents or vectors;
  - ◇ vector control programme implemented;
  - ◇ alternative airports in the region if diversion is necessary.
- aircraft operator
  - ◇ disinsection practices;
  - ◇ aircraft parking area enclosed (doors open if not enclosed);
  - ◇ can disinsect aircraft at non-base airports.

Aircraft may introduce insect vectors to locations in which they were not previously present. In addition, insect vectors may transmit infection to people in places served by aircraft (e.g. "airport malaria"). Mosquitoes act as vectors of pathogens that cause a number of serious diseases, such as malaria, dengue, Zika virus disease and yellow fever.

WHO's previous formal publication on aircraft disinsection was published in 1995 in the International Programme of Chemical Safety series (4). In 2000, the importance of disinsection of aircraft departing from airports in disease-endemic areas into non-endemic areas was discussed (5). The International Health Regulations (2005) (IHR) were adopted by the World Health Assembly in 2005 and came into force in 2007. The IHR establish global benchmark standards to prevent, protect against, control and provide a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks and that avoid unnecessary interference with international traffic and trade. The position of the IHR is that disinsection of aircraft is a necessary measure to help prevent the spread of vectors. The IHR

define disinsection as “the procedure whereby health measures are taken to control or kill the insect vectors of human disease present in baggage, cargo, containers, conveyances, goods and postal parcels” (IHR, Part I, article 1) (6) and state that it should “be carried out so as to avoid injury and, as far as possible, discomfort to persons ...” (IHR, Part IV, article 22, section 3).

The International Civil Aviation Organization (ICAO), which works to harmonize standards in civil aviation, including but not limited to aircraft and at airports, encourages Member States to complete the Airport Vector Control Register maintained by ICAO and emphasizes the importance of guidelines on vector surveillance and control in airports (7).

In 2016, WHO convened an expert group in response to the spread of Zika virus, which considered that disinsection would have little effect in preventing importation of the virus, as it is imported mainly by infected travellers and to a lesser extent by mosquito vectors (8). Some cases have been identified of dengue viruses carried by mosquitoes in aircraft. Even if the risk is very low, it nevertheless remains, and WHO considered it important to address the issue. Two documents provided WHO guidelines on efficacy testing (9) and risk assessment (10) of aircraft disinsection products. A WHO consultation in 2018 recognized that guidance on aircraft disinsection methods and procedures was required, with standard operating procedures for aircraft disinsection and training materials and tools (11). The present guideline addresses the first identified need.

## Scope

This document describes methods and procedures for effective disinsection, but it is not intended to cover all issues related to aircraft disinsection comprehensively. The regulatory aspects of approval of products for aircraft disinsection and occupational risk assessment, for example, are not within the scope of this document. The document addresses only the control of arthropods (mainly insect vectors of disease) inside the cabin and cargo hold of aircraft. Separate guidance is available for surveillance and control of vectors in and around airport premises (3). Although the prevention of importation of agricultural pests is beyond the scope of this document, many countries may require aircraft disinsection for this purpose.

The guidance given here is for use by the airline industry, airport authorities, national pesticide regulatory agencies, the pesticide industry, public health and pest control organizations, aviation authorities and other stakeholders.

# Aircraft disinsection products

The aircraft disinsection products to be used must meet national pesticide registration requirements, the product specifications contained in this document, national aviation policy, aircraft manufacturers' technical and safety requirements and standards and recommended practices of ICAO. A material safety data sheet should be made available by manufacturers to airlines or disinsection applicators for any pesticide products to be handled or applied for disinsection. Further guidance on pesticide risk reduction is available through the FAO/WHO Joint Meetings on Pesticide Management (12). A document on the safety of pyrethroids for public health (13) and on aircraft disinsection insecticides (10) are also available.

The active ingredients (a.i.'s) of pesticides and their end-use formulations that have been evaluated and recommended by WHO for aircraft disinsection are described below. Manufacturers of aircraft disinsection products may submit applications for WHO prequalification of specific product(s).<sup>1</sup> Upon assessment, new products containing these or other a.i.'s may be added to the list.

## *permethrin*

- permethrin (25:75) technical material (TC)
- permethrin emulsifiable concentrate (EC) at different concentrations to be diluted to permethrin 2% for residual treatment. A ready-to-use suspension containing permethrin 2% may be supplied for this purpose.

## *d-phenothrin and 1R-trans-phenothrin*

- d-phenothrin TC or 1R-trans-phenothrin TC
- d-phenothrin 2% aerosol (AE) or 1R-trans-phenothrin 2% AE

*Note:* 1R-trans-phenothrin TC has a higher ratio of the R-isomer than d-phenothrin TC and is more active.

## ***A combination formulation containing permethrin 2% and d-phenothrin 2% (or 1R-trans-phenothrin 2%)***

- An aerosol combination of permethrin 2% and d-phenothrin 2% (or 1R-trans-phenothrin 2%) with a single-shot vertical ejection nozzle<sup>2</sup> is the currently recommended aerosol for application in cargo holds where residual treatment with permethrin 2% EC has not been completed.
- Airlines may select the alternative of an aerosol containing d-phenothrin 2% or 1R-trans-phenothrin 2% with a single-shot vertical ejection nozzle in the following circumstances:
  - ◊ non-authorization of use or non-availability of a combination aerosol formulation in a spray can with final concentrations of permethrin 2% and d-phenothrin 2% (or 1R-trans-phenothrin); or
  - ◊ if there is a concern about use of a permethrin aerosol in the transport of live mammals.

The difference between permethrin and d-phenothrin (1R-trans-phenothrin) pyrethroids is principally in their residual effect: permethrin leaves a residual effect on surfaces, while d-phenothrin (or 1R-trans-phenothrin) primarily has a knock-down effect, with limited residual efficacy.

<sup>1</sup> For information on the process and data requirement for WHO evaluation and prequalification, manufacturers of aircraft disinsection products should contact WHO at <https://www.who.int/pq-vector-control/en/>.

<sup>2</sup> A multi-shot nozzle may also be used for treatment of small cargo and baggage holds, as described in section 5.3.

# Types of pesticide application and equipment

The types of pesticide application in passenger cabins, including toilet areas and the cargo hold, are aerosols and residual treatment of aircraft surfaces, while the flight deck, cockpit and crew rest areas are treated by aerosol application only.

## *Aerosol sprays*

Aerosol dispensers are used currently in the airline industry to treat all spaces accessible from the interior. The doors of overhead luggage racks should be closed only after space spraying has been completed. A specification for these dispensers was published by WHO as part of the specifications for equipment used in vector control (1), which state that they shall consist of a can and a valve or release mechanism, such that when the valve is actuated the entire contents will be discharged in the form of an aerosol without interruption and within a stated time.

## *Droplet spectrum*

Space treatments require that droplets < 30 µm (volume median diameter) remain airborne for a long time. For most vector species, airborne droplets should optimally measure 10–15 µm.

## *Discharge rate*

When a dispenser is operated according to the manufacturer's instructions, the rate of discharge should be  $1.0 \text{ g} \pm 0.2 \text{ g/s}$  at 27 °C.<sup>1</sup> The aerosol produced shall comply with the following physical requirements:

- ≤ 20% by weight (droplet size statistic: Dv80) of the aerosol shall consist of droplets of diameter > 30 µm;
- ≤ 1% by weight (droplet size statistic: Dv99) of the aerosol shall consist of droplets of diameter > 50 µm.

These requirements may not necessarily be met during discharge of the last 10% of the content of cans.

A droplet size with a volume median diameter < 30 µm is selected to produce a "space spray" that remains airborne, so that droplets are deposited on mosquitoes flying through the spray cloud. The dispensers are operated when the air-conditioning system is temporarily turned off; as soon as it is turned back on, these small droplets are removed from the air inside the passenger cabin, so that there is no residual spray in the cabin atmosphere. Hence, passengers are not expected to be exposed in pre-embarkation space spraying.

## Residual sprays

Residual sprays are an alternative method for use in empty aircraft, which provide a more persistent spray deposit, namely "residual treatment". A residual deposit requires a spray with a larger droplet size. It is recommended that, instead of the current high discharge rate of 30 mL of insecticide suspension/m<sup>2</sup> surface area with a hand compression sprayer fitted with a 1.5-bar control flow valve (or 40 mL/m<sup>2</sup> without a control flow valve), a very low volume of spray (< 10 mL/m<sup>2</sup>) is discharged, in which the volume median diameter of the droplets is ≥ 50 µm or a similar spectrum, and they are deposited evenly well, especially on horizontal

<sup>1</sup> If the manufacturers declare a discharge rate at a temperature other than 27 °C, they should also provide a declaration of the discharge rate at 27 °C.

surfaces in the aircraft cabin. No more than 5% droplets should be < 30 µm at the specified operating pressure at the nozzle.

**Note:** The use of “space spray aerosol dispensers” for residual spray deposition should be avoided, as the small droplets rebound or blow back from vertical surfaces and are deposited only on the floor.

## 3.1 Guidance, standards and regulatory requirements

### 3.1.1 Registration of products

The technical materials and formulations of pesticides, including spray cans, should adhere to the following requirements:

- manufacturer’s product specifications approved by a regulatory body or WHO;
- FAO/WHO guideline on good labelling practice;
- comply with regulations in the country of both flight departure and arrival;
- other international standards;<sup>1</sup>
- individual airlines might require additional testing of aircraft disinsection products to meet the aircraft manufacturer’s specifications;
- national regulations may require that aircraft disinsection products be registered or authorized for use.

### 3.1.2 Customer notification on disinsection requirements

At the time of flight booking, passengers and cargo customers should be notified that disinsection may be required on flights to and/or from their destination.

### 3.1.3 Storage and disposal of used cans

Airlines should follow national regulations on storage and disposal of used containers.

## 3.2 Aerosol application

The objective of aerosol treatment with d-phenothrin or 1*R*-*trans*-phenothrin of cabin airspace is to quickly knock down and kill any small flying insects that are present. Permethrin acts more slowly and is not only used to treat the cabin space but also to provide a fine residual coating on many internal surfaces. When insects come into contact with the treated surfaces, they are knocked down to the floor. Aerosol cans should have a discharge rate of 1 g/s (with a tolerance rate of 20%) and provide a droplet size according to the WHO specifications for equipment used in vector control (1). The propellant used in spray cans for disinsection of aircraft must be registered with the appropriate authority and must meet aviation and aircraft manufacturers’ technical and safety requirements for its use (i.e. not flammable). The spray rates for the cabin and the cargo holds are:

### *Cabin spraying*

Spraying should be at a rate of 35 g of formulation per 100 m<sup>3</sup> cabin space (or 10 g formulation per 28 m<sup>3</sup> (1000 ft<sup>3</sup>)), i.e. 0.7 g a.i. per 100 m<sup>3</sup> for a 2% aerosol formulation.

<sup>1</sup> Other standards cover disinsection procedures as required on international passenger flights: ICAO Annex 9 – *Facilitation* relevant standards and recommended practices (SARPs) are available at: <https://www.icao.int/Security/FAL/ANNEX9/Pages/Publications.aspx>

### *Cargo hold spray*

Spraying should be at a rate of 35 g of formulation per 100 m<sup>3</sup> (or 10 g of formulation per 28 m<sup>3</sup> (1000 ft<sup>3</sup>)), i.e. 1.4 g a.i. per 100 m<sup>3</sup>.

The requirements for the lower and upper cargo areas are as follows.

#### **Lower cargo holds**

A combination aerosol of permethrin 2% and d-phenothrin 2% (or 1*R*-trans-phenothrin 2%) in a spray can with a single-shot vertical ejection nozzle is the recommended aerosol for application in cargo holds in which residual treatment with permethrin 2% EC has not been completed.

In special circumstances,<sup>1</sup> the airline may select the alternative of an aerosol containing either d-phenothrin 2% or 1*R*-trans-phenothrin 2% with a single-shot vertical ejection nozzle.

#### **Upper cargo hold area of a freighter**

A combination aerosol in a spray can containing permethrin 2% and d-phenothrin 2% (or 1*R*-trans-phenothrin 2%) is the recommended aerosol for application in the upper cargo hold area of freighters. In special circumstances,<sup>3</sup> the airline may select the alternative of an aerosol containing either d-phenothrin 2% or 1*R*-trans-phenothrin 2% with either a single-shot vertical or a multi-shot ejection nozzle when residual treatment with permethrin 2% EC has not been completed.

## **3.3 Residual treatment**

Residual disinsection with permethrin 2% EC provides an insecticidal deposit on all internal aircraft surfaces (cargo areas and/or passenger cabins) to kill target insects that come into contact with the treated surface. Permethrin 2% EC deposits are intended to remain effective for intervals not exceeding 8 weeks. Residual spraying must be undertaken with either a compression sprayer or a mist sprayer according to WHO specifications for equipment used in vector control (1) that are suitable for applying permethrin 2% EC at a rate of 0.2 g a.i. per m<sup>2</sup> (with the aim of producing a flow rate of approximately 10 mL/m<sup>2</sup>). In areas such as the flight deck, cockpit and crew rest areas, an aerosol containing permethrin 2% is applied instead of residual treatment with permethrin 2% EC.

**Note:** Cabin and cargo hold floor surfaces are treated with permethrin 2% EC at a rate of 0.5 g a.i./m<sup>2</sup>. The aim is to spray the floor surfaces twice with 0.2 g a.i./m<sup>2</sup>, thus depositing a total of 0.4 g a.i./m<sup>2</sup>; however, as spray aimed at other surfaces may also be deposited from fall-out of larger droplets on the floor, especially along aisles, the maximum dose at floor level is estimated to be 0.5 g a.i./m<sup>2</sup>.

## **3.4 Personal protective equipment**

Effective personal protective equipment during disinsection and handling of pesticides reduces the exposure of spray operators. While general regulatory requirements, use of a tiered approach for pesticide risk reduction and provisions related to personal protective equipment and protective clothing are described in FAO/WHO guidance on personal protective equipment (14) the recommendations on the pesticide manufacturers' product label should be consulted in choosing the type of equipment essential for applying a specific pesticide formulation.

<sup>1</sup> Non-authorization or non-availability of the combination 2% permethrin aerosol and 2% d-phenothrin or 1*R*-trans-phenothrin aerosol; or concern about use of a permethrin aerosol in transport of live mammals.



# Aircraft disinsection

The methods and insecticides recommended in this document must meet the requirements of both the country in which treatment is applied and the country of arrival.

Tables 1–4 show recommended methods for disinsection of the aircraft cabin and cargo hold and the a.i.'s used. Products must be fit for purpose and contain the corresponding a.i. for each treatment type. Pre-flight and top-of-descent cabin treatment, which were previously recommended, have been replaced by the pre-embarkation and pre-departure methods, respectively.

**Table 1.** Approved pre-arrival aerosol methods

Option	Method	Area	Frequency	Passengers on board	Formulation	Technique
1	Pre-embarkation	Cabin	Per flight	No	Permethrin 2% aerosol	See section 4.3
2	Pre-departure	Cabin	Per flight	Yes	d-Phenothrin 2% or 1 <i>R</i> - <i>trans</i> -phenothrin 2% aerosol	See section 4.4
3	Pre-departure cargo holds <sup>a</sup>	Lower cargo holds	Per flight	Either	An aerosol containing permethrin 2% and d-phenothrin 2% (or 1 <i>R</i> - <i>trans</i> -phenothrin 2%) or an aerosol containing d-phenothrin 2% or 1 <i>R</i> - <i>trans</i> -phenothrin 2% <sup>b</sup>	See section 4.5
3a		Upper cargo area on freighters	Per flight	Either	A combination aerosol containing permethrin 2% and d-phenothrin 2% (or 1 <i>R</i> - <i>trans</i> -phenothrin 2%) or an aerosol containing d-phenothrin 2% or 1 <i>R</i> - <i>trans</i> -phenothrin <sup>b</sup>	See section 4.5

<sup>a</sup> Not required if the residual method has been completed.

<sup>b</sup> This method is used when residual treatment has not been completed and in special circumstances, such as non-authorization or non-availability of 2% permethrin aerosol and 2% d-phenothrin (or 1*R*-*trans*-phenothrin) aerosol, concern about transport of live mammals or for small aircraft with very small holds.

**Table 2.** Approved pre-arrival residual method

Option (cont'd from Table 1)	Method name	Area	Frequency	Passengers on board	Formulations	Technique
4	Residual long-term	Cabin or lower cargo holds, including upper cargo area of freighters	Every 8 weeks	No	Permethrin 2% EC	See section 4.2

**Table 3.** Selection of pre-arrival aircraft disinsection method

Flight type	Area	Options in Tables 2 and 3
Single sector or first sector on multi-sector flights	Cabin	1, 2, 4
Single sector or first sector on multi-sector flights	Cargo holds	3, 4
Multi-sector, second and subsequent flights	Cabin	1, 2, 4
Multi-sector, second and subsequent flights	Cargo holds	3, 4

**Table 4.** Approved on-arrival contingency method only

Option (cont'd from Table 2)	Method	Area	Frequency	Passengers on board	Formulations	Technique
5	On-arrival	Cabin	Per flight	Yes	d-Phenothrin 2% or 1 <i>R-trans</i> -phenothrin 2% aerosol	See section 4.6
6	On-arrival lower holds and for freighters; includes upper cargo area	Cargo	Per flight	No	A combination aerosol containing permethrin 2% and d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin); or an aerosol containing d-phenothrin 2% or 1 <i>R-trans</i> -phenothrin 2% <sup>a</sup>	See section 4.6

<sup>a</sup> Used when residual spraying has not been completed and in special circumstances such as non-authorization or non-availability of 2% permethrin aerosol or 2% d-phenothrin and 1*R-trans*-phenothrin aerosol, concern about transporting live mammals or for small aircraft with very small holds.

## 4.1 Certification of aircraft disinsection

Contracting States to ICAO are responsible for ensuring that ICAO Standards and Recommended Practices (SARPs) as per Annex 9 (Facilitation) are implemented by the relevant aviation stakeholders. Guidance is available in the ICAO facilitation manual (15); Annex 9 Chapter 2 Section D stipulates the specific Standards for aircraft disinsection.

The airline operator is responsible for ensuring that certification meets the arriving country requirements. This may include ensuring that a certificate detailing the cabin and cargo hold disinsection treatment has been completed by the relevant authorized agent<sup>1</sup> or the pilot in command. Certificates include the Aircraft General Declaration (Appendix 1 to ICAO Annex 9), the Certificate of Residual Disinsection (Appendix 4 to ICAO Annex 9) and any other certificates required by the destination country. When the aircraft has had both residual and aerosol disinsection treatments, both documents in Annex 9 should be completed. Copies of the ICAO Certificate of Residual Disinsection and the General Declaration (16) are provided in this document as Annex 4 and Annex 5, respectively.

When aerosol methods have been used, fully or partly used aerosol cans should remain on board for authorities to check if necessary, at the arrival destination.

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<sup>1</sup> An authorized agent is a person who represents an aircraft operator and who is authorized by or on behalf of the operator to act on formalities connected with the entry and clearance of the operator's aircraft, crew, passengers, cargo, mail, baggage or stores. When national law permits, a third party may be authorized to handle cargo on the aircraft.

## 4.2 Residual treatment of cabin and cargo hold

Residual treatment of the cabin should be performed in conjunction with cargo hold disinsection. Similarly, residual treatment of the cargo hold should be performed in conjunction with cabin disinsection.

Section 6 provides details for estimating the amount of residual spray necessary for each type of aircraft.

Any noncompliance with disinsection procedures at the departure airport should be reported to the intended first port before arrival.

The **general procedures for residual disinsection** are as follows:

Treatment must be at intervals < 8 weeks and completed at any time that the aircraft is available for long enough.

The formulation used for residual spraying is permethrin 2% EC.

Residual spraying must be undertaken with either a hand compression sprayer fitted with a 1.5-bar control flow valve or a mist sprayer that can discharge approximately 0.2 g a.i. of permethrin per m<sup>2</sup> (i.e. liquid volume of 10 mL/m<sup>2</sup>).

An aerosol formulation (permethrin 2% AE) should be used to treat the flight deck, cockpit and crew rest areas and any other areas in which use of an emulsion could damage the aircraft or be a safety concern.

Aircraft should be configured to ground service mode before spraying.

The procedure for residual aerosol disinsection of large areas remains to be confirmed.

The procedure for **residual treatment of cabins** is as follows:

The required dosage rate is 0.2 g a.i. of permethrin per m<sup>2</sup> on interior surfaces and 0.5 g a.i./m<sup>2</sup> on floors. Floors are treated twice at 0.2 g/m<sup>2</sup> dose, and spray aimed at other surfaces may be deposited by fall-out of larger droplets onto the floor, especially along aisles; therefore, the maximum dose at floor level is estimated to be 0.5 g/m<sup>2</sup>. The aim is to achieve an even pattern of close droplets on all surfaces and not necessarily to achieve total cover, and certainly not to produce run-off.

Prepare the aircraft by opening, clearing and cleaning all lockers, cupboards and storage units and closing all curtains and window blinds. Remove carpet covers if present.

Turn off the air-conditioning system, including any preconditioned air from a ground support unit. Recirculation fans may be left on if they are essential for operation of the aircraft but should be set at the lowest flow rate.

Spray all surfaces, including floors, ceilings, walls, lockers, curtains, toilets, galley floor and wall areas behind curtains. All doors and locker lids must be sprayed on both sides. Then, respray the floor areas only.

Spray carefully around permanently stored items such as loud-hailers, first aid kits, oxygen bottles and fire extinguishers.

**Do not spray** food preparation areas, bench tops, seats, mirrors, windows, medical equipment, separate crew rest areas or modules, bassinets, baby changing tables, toilet seats, electronic equipment or removable galley components, such as food trolleys. Any spray spilt onto these areas must be immediately wiped to remove any chemical deposit. Areas that will be in contact with food shall additionally be wiped with soap and water.

After spraying is completed and the spray has dried, the air-conditioning system and recirculation fans may be reactivated and run for at least 1 h to clear the air of the volatile components of the spray.

The procedure for **residual disinsection of cargo holds** is as follows:

The required dosage rate is 0.2 g of permethrin per m<sup>2</sup> for interior hold surfaces and 0.5 g of permethrin per m<sup>2</sup> on hold floors. To achieve 0.5 g of permethrin per m<sup>2</sup>, the floor must be sprayed twice at a rate of 0.2 g of permethrin per m<sup>2</sup> (the remaining 0.1 g comes from drift from higher surfaces).

The areas must be free of pallets, containers and any rubbish.

Spray compartment walls, including the inside of the door(s), ceilings, floors and both sides of dividing curtains. Pay particular attention to sidewall and floor cavities. Advise the crew that cargo hold spraying is about to commence. As it is not uncommon for cargo hold spray to set off smoke detectors, sensitive electronic equipment must not be directly sprayed, and the crew must be fully aware of the procedures before disinsection.

#### **4.2.1 Certification of residual treatment of cabin and cargo hold**

Contracting States to ICAO are responsible for ensuring that the relevant aviation stakeholders implement ICAO Standards and Recommended Practices (ICAO Annex 9). Guidance is available in the ICAO facilitation manual and the template of certification can be found in Appendix 4 to ICAO Annex 9 (Certificate of Residual Disinsection) (16).

When the aircraft has had both residual and aerosol disinsection treatments, both ICAO Annex 9 documents should be completed.

Copies of the ICAO aircraft disinsection residual certificate and the General Declaration are provided in this document as Annex 4 and Annex 5, respectively

#### **4.2.2 Residual top-up and fixture replacement procedures**

If an airline or its contractor wishes to change the cleaning products for aircraft cabins or holds, the airline should check with the manufacturer of the residual a.i. to ensure that there is no chemical incompatibility that would negate the effectiveness of the residual treatment.

Intensifying or increasing the frequency or method of cleaning or disinfecting large surface areas in aircraft may compromise the effectiveness of a residual insecticide. If this occurs, localized retreatment may be necessary more frequently, or an alternative aerosol application method utilized.

After a residual spray application, internal areas of aircraft < 1 m<sup>2</sup> that undergo additional or substantial cleaning, such as wall linings and carpets, should receive a supplementary “top-up” with an aerosol spray containing permethrin 2%.

The procedures for **top-up treatment and fixture replacement** are as follows:

The permethrin 2% aerosol must be directed at the cleaned surfaces and discharged approximately 30 cm away in a method that ensures that the droplets of spray cover all cleaned surfaces to achieve 0.2 g a.i./m<sup>2</sup> (for floor areas, 0.5 g a.i./m<sup>2</sup>).

Relatively minor interior cleaning and replacement of soiled items are considered negligible in the overall programme, and re-spraying is not required during turnaround; however, the areas should be treated at the first opportunity, to ensure compliance.

Residual spray should be reapplied when fixtures such as entire walls or large sections of carpet are replaced or received a deep clean.

Replacement fixtures may be treated off the aircraft but must be treated either on the same day or shortly after aircraft disinsection in order to comply with certification.

## 4.3 Pre-embarkation cabin treatment

Pre-embarkation cabin disinsection involves aerosol spraying of aircraft cabins before embarkation of passengers. The treatment lasts for the duration of the single flight sector. This method not only kills invertebrates that may be present in the cabin at the time of disinsection but also leaves a minimal but effective residue, which is likely to kill invertebrates that board between the time of disinsection and flight departure. Details for estimating the amounts of aerosol spray required for different types of aircraft are given in section 5.

Pre-embarkation cabin disinsection should be performed in conjunction with cargo hold disinsection, as specified in section 4.5. or section 4.2.

Examples of pre-embarkation cabin treatment for different types of aircraft are summarized in Annex 1. Pre-departure cabin disinsection should be performed in conjunction with cargo hold disinsection, as specified in section 4.5. or section 4.2.

### 4.3.1 Procedure

The aim of treatment is a short-term and not a long-term residual effect. It is designed to kill any mosquitoes that come aboard with the passengers. When surfaces are intensively cleaned or wiped, pre-embarkation treatment should be undertaken after disinsection has been completed and the surfaces have dried. The procedure is as follows:

For single-sector flights, the treatment should be carried out at the departing airport. For multi-stop flights, pre-embarkation treatment may be optional only at transit airports where all passengers disembark.

The treatment must be conducted after the aircraft has been fully catered, the service closed and before passengers board the aircraft. One main entry door per level may remain open for operational requirements. Spraying must be completed with an aerosol of permethrin 2% as the a.i. See Table 1 for more information on aerosol methods and the aerosol spray amounts listed in section 5 and Annex 3 for the amounts of spray required for each aircraft type.

During application of spray and for 5 min after completion of spraying, the aircraft's air-conditioning must be switched off. Recirculation fans may be left on if they are essential for operation of the aircraft but should be set at the lowest flow rate.

Overhead and sidewall lockers should be kept open during spraying.

Spray should be directed towards the open overhead lockers and ceiling to ensure that the spray does not fall on the face of the operator while he or she is walking along the aisle at a rate of not more than one step or one row of seats per second.

Spray all galleys, including those on lower levels, and the lift access.

Spray all toilets and coat lockers for 2 s each. Ensure that toilet seats and baby changing tables are up and not sprayed.

Spray all crew rest areas, avoiding bedding, and the flight deck for 3 s each. Spray must be directed away from aircraft equipment, officials and crew.

Any noncompliance with these procedures should be reported to the intended first port before arrival.

### 4.3.2 Certification of pre-embarkation cabin treatment

Contracting States to ICAO are responsible for ensuring implementation of the ICAO Standards and Recommended Practices as per Annex 9 by the relevant aviation stakeholders. Guidance is available in relevant extracts of the ICAO facilitation manual (16).

The airline operator is responsible for ensuring that certification meets the arriving country requirements.

When the aircraft has had both residual and aerosol disinsection treatments, both documents in Annex 9 of the ICAO Standards should be completed.

Copies of the ICAO aircraft disinsection residual certificate and the General Declaration are provided in this document as Annex 4 and Annex 5, respectively.

On arrival of the aircraft, authorities may require that all exterior doors and windows, including cargo hold doors, remain closed and be opened only once clearance has been granted.

## 4.4 Pre-departure cabin treatment

Pre-departure cabin disinsection involves aerosol spraying of the aircraft cabin after passenger embarkation but before the overhead lockers are closed and the aircraft is pushed back for departure. The treatment is effective for the duration of a single flight sector. In pre-departure cabin spraying, all areas of the aircraft cabin are sprayed, including the flight deck, open overhead and coat lockers and toilets. This method kills only invertebrates that are present in the cabin at the time of disinsection.

Details for estimating the amounts of aerosol spray required for different types of aircraft are given in section 5.

Examples of pre-departure cabin treatment for different types of aircraft are summarized in Annex 2. Pre-departure cabin disinsection should be performed in conjunction with cargo hold disinsection, as specified in section 4.5. or section 4.2.

The procedure for pre-departure cabin treatment is as follows:

This is an alternative to pre-embarkation treatment for single-sector flights and may be an option in transit airports for multi-stop flights.

The treatment is done after passengers have boarded and are seated and all service doors are closed.

The main entry door must be closed before commencement of cabin spraying.

Spraying must be completed with an aerosol of d-phenothrin 2% or 1*R-trans*-phenothrin 2% as the a.i. See Table 1 for more information on the aerosol, and section 5 and Annex 3 for the amount of spray required for each aircraft type.

During disinsection and for 5 min after completion of spraying, the aircraft's air-conditioning must be switched off or set to normal flow (not high flow) and the recirculation fans must be on.

Overhead and sidewall lockers are to be open during spraying.

Spray should be directed towards the open overhead lockers and ceiling, which will ensure that the spray does not fall on the face of the operator while he or she is walking along the aisle at a rate of not more than one step or one row of seats per second.

Spray all galleys, including those on lower levels, and the lift access.

Spray all toilets and coat lockers for 2 s each. Ensure that the toilet seats and baby changing tables are up and are not sprayed.

Spray all crew rest areas, avoiding the bedding, and the flight deck and cockpit for 3 s each. Direct the spray away from aircraft equipment, officers and crew.

Any non-compliance with procedures should be reported to the intended first port before arrival.

### *Optional step*

Before spraying, an in-flight announcement may be made to inform passengers about the impending disinsection according to the WHO procedure. The following text could be read:

“Ladies and gentlemen, to conform to health requirements, the aircraft cabin will now be sprayed with an insecticide. This procedure is recommended by the World Health Organization. The treatment is necessary to avoid introduction of insects at our destination airport that can be carriers of serious human diseases. Please remain seated and keep the aisles clear while spraying takes place. If you have a serious medical condition that could be affected by the spray, please press your call button to discuss this with your cabin crew. Thank you.”



#### ***4.4.1 Certification of pre-departure cabin treatment***

Contracting States to ICAO are responsible for ensuring implementation of the ICAO Standards and Recommended Practices as per Annex 9 by the relevant aviation stakeholders. Guidance is available in the ICAO facilitation manual (16).

The airline operator is responsible for ensuring that certification meets the arriving country requirements.

When the aircraft has had both residual and aerosol disinsection treatments, both documents in ICAO Standards Annex 9 should be completed.

Copies of the ICAO aircraft disinsection residual certificate and the General Declaration are provided in this document as Annex 4 and Annex 5, respectively.

On arrival of the aircraft, authorities may require that all exterior doors and windows, including cargo hold doors, remain closed and be opened only once permission has been granted.

## 4.5 Pre-departure cargo hold disinsection

The cargo holds of all aircraft that are required to perform disinsection must also be disinfected. If the cargo holds have been residually treated, the procedures described in this section do not apply. Pre-departure cargo hold disinsection must be performed in conjunction with cabin disinsection, as specified above.

Details for estimating the amount of aerosol spray required for different types of aircraft for pre-departure cargo hold disinsection are given in section 5.

### 4.5.1 Lower cargo hold

The procedure for pre-departure lower cargo hold treatment is as follows:

Spraying must be carried out manually at the last departure airport after all cargo has been loaded and just before the cargo hold door is closed.

Aerosols must be discharged into each cargo hold in such a manner as to ensure that all parts of the cargo hold have been disinfected.

Spraying must be completed with a single-shot aerosol can with a vertical ejection nozzle containing d-phenothrin 2% or 1*R-trans*-phenothrin 2% and permethrin 2% as the a.i.'s.

In special circumstances, such as transport of live animals or where permethrin-based products are not authorized or not available, a single-shot aerosol can with a vertical ejection nozzle containing either d-phenothrin 2% aerosol or 1*R-trans*-phenothrin aerosol alone may be used.

Advise the crew that the cargo hold is about to be sprayed. As it is not uncommon for cargo hold spray to set off smoke detectors, sensitive electronic equipment must not be directly sprayed, and the crew must be fully aware of the procedures before disinsection.

During disinsection and for 5 min after completion of spraying, the aircraft's air-conditioning must remain off. Recirculation fans may be left on if essential for operation of the aircraft but should be set to the lowest rate.

When the lower cargo door(s) are being closed, leave the door open just enough to place the aerosol(s) in a secure, upright position, and activate the lock-down nozzle(s).

Once the spray aerosol(s) appears to be functioning correctly, immediately close the hold door to complete disinsection. If either hold requires re-opening (except for the purpose of loading animals) or an aerosol malfunctions, the above steps must be repeated.

Full discharge of the aerosols takes 2 min, and the saturation period takes another 5 min.

Used aerosol containers should remain in the lower holds and should be retrieved by ground handlers at the destination airport. They should be accessible to the ground handlers.

If an airline chooses to remove aerosol containers before departure, the containers should be carried on board with the disinsection certificate. Allow 7 min after activation before retrieval. The door of the disinfected cargo hold must be opened only to the minimum necessary to retrieve used containers and then immediately closed to avoid recontamination.

Any non-compliance with procedures should be reported to the intended first port before arrival.

#### 4.5.2 Lower cargo hold when small mammals are to be loaded

The procedure for pre-flight disinsection of the lower cargo hold when small mammals are to be loaded is as follows:

Disinsection should be conducted before the mammals are loaded but after all other cargo. Consideration should be given to procedures of the International Air Transport Association for animals (Chapter 5) and the regulations of the World Organisation for Animal Health.

Spraying must be conducted manually at the last departure airport after all cargo has been loaded and just before the cargo hold doors are closed.

Aerosols must be discharged into each cargo hold in such a manner as to ensure that all parts of the hold are disinsected.

Spraying must be completed with a single-shot aerosol with a vertical ejection nozzle containing d-phenothrin 2%, or 1*R-trans*-phenothrin 2% and permethrin 2%.

In special circumstances, such as concern about transport of live animals or where permethrin-based products are not authorized/unavailable, a single shot aerosol with a vertical ejection nozzle containing d-phenothrin 2% AE or 1*R-trans*-phenothrin 2% AE alone may be used.

See Table 1 for more information on aerosols and the amounts of aerosol spray (section 5) required for each aircraft type.

Advise the crew that the cargo hold is about to be sprayed. As it is not uncommon for cargo hold spray to set off smoke detectors, sensitive electronic equipment must not be directly sprayed, and the crew must be fully aware of the procedures before disinsection.

During disinsection and for 5 min after completion of spraying, the aircraft's air-conditioning must remain off. Recirculation fans may be left on if they are essential for operation of the aircraft but should be set at the lowest flow rate.

When the lower cargo door(s) are being closed, leave just enough open to place the aerosol(s) in a secure, upright position, and activate the lock-down nozzle(s).

Once the spray aerosol(s) appears to be functioning correctly, immediately close the hold door to complete disinsection. If either hold requires re-opening (except for the purpose of loading animals) or an aerosol malfunctions, the above steps must be repeated.

Allow 7 min after activating aerosols before loading animals.

Used aerosol containers should remain in the lower holds and should be retrieved by ground handlers at the destination airport. They should be accessible to ground handlers.

If an airline chooses to remove aerosol containers before departure, the containers should be carried on board with the disinsection certificate. Allow 7 min after activation before retrieval. The door of the disinsected cargo hold must be opened only to the minimum necessary for retrieval of used containers and then immediately closed to avoid recontamination.

Open the hold only to load animals and close it immediately afterwards to avoid recontamination.

Any noncompliance with procedures should be reported to the intended first port before arrival.

### 4.5.3 Cargo hold for freighter aircraft

The pre-departure cargo hold procedure for freighter aircraft is as follows:

Spraying must be carried out manually at the last departure airport after all cargo has been loaded.

Non-essential personnel must have vacated the cabin and cargo areas before disinsection is begun.

#### **Cabin area**

See section 4.3 or 4.4.

#### **Upper cargo area**

For the upper cargo deck of a freighter, d-phenothrin 2% AE or 1*R-trans*-phenothrin 2% AE alone may be used instead of an aerosol product containing permethrin 2% and d-phenothrin 2% (or 1*R-trans*-phenothrin 2%).

Discharge the aerosols while walking away from the spray and vacate the area once spraying has been completed.

Spray should be discharged as high as possible and directed towards the centre of the aircraft ceiling by an operator walking at approximately one step per second.

If cargo prohibits access to certain parts of the aircraft:

- discharge the aerosol into the centre of aircraft, directed towards the ceiling above the top of the cargo, for the appropriate duration for the section of the aircraft that could not be accessed; or
- position the aerosols evenly throughout the aircraft on top of the cargo (applicable when using single shot aerosols only).

Once spraying is completed, allow at least 5 min for the spray to settle before departure.

#### **Lower cargo holds**

Spraying must be carried out manually at the last departure airport after all cargo has been loaded and just before the cargo hold door is closed.

Aerosols must be discharged into each cargo hold in such a manner as to ensure that all parts of the hold are disinsected.

Spraying must be completed with a single-shot aerosol can with a vertical ejection nozzle containing d-phenothrin 2%, or 1*R-trans*-phenothrin 2% and permethrin 2%.

In special circumstances, such as transport of live animals or where permethrin-based products are not authorized or not available, a single-shot aerosol can with a vertical ejection nozzle containing either d-phenothrin 2% or 1*R-trans*-phenothrin alone may be used.

See Table 1 for more information on aerosols and the amounts of aerosol spray (section 5) required for each aircraft type.

Advise the crew that the cargo hold is about to be sprayed. As it is not uncommon for cargo hold spray to set off smoke detectors, sensitive electronic equipment must not be directly sprayed, and the crew must be fully aware of the procedures before disinsection.

During disinsection and for 5 min after completion of spraying, the aircraft's air-conditioning must remain off. Recirculation fans may be left on if they are essential for operation of the aircraft but should be set at the lowest flow rate.

When the lower cargo door(s) are being closed, leave just enough open to place the aerosol(s) in a secure, upright position, and activate the lock-down nozzle(s).

Once the spray aerosol(s) appears to be functioning correctly, immediately close the hold door to complete disinsection. If either hold requires re-opening (except for the purpose of loading animals) or an aerosol malfunctions, the above steps must be repeated.

Full discharge of the aerosols takes 2 min, and saturation takes another 5 min.

Used aerosol containers should remain in the lower holds and should be retrieved by ground handlers at the destination airport. They should be accessible to ground handlers.

If an airline chooses to remove aerosol containers before departure, the containers should be carried on board with the disinsection certificate. Allow 7 min after activation before retrieval. The door of the disinsected cargo hold must be opened only to the minimum necessary for retrieval of used containers and then immediately closed to avoid recontamination.

Any non-compliance with procedures should be reported to the intended first port before arrival.

#### ***4.5.4 Certification of pre-departure cargo hold treatment***

Contracting States to ICAO are responsible for ensuring that ICAO Standards and Recommended Practices as per Annex 9 are implemented by the relevant aviation stakeholders. Guidance is available in the ICAO facilitation manual (16). The airline operator is responsible for ensuring that certification meets the arriving country requirements.

When the aircraft has had both residual and aerosol disinsection treatments, both ICAO Annex 9 documents should be completed.

Copies of the ICAO aircraft disinsection residual certificate and the General Declaration are provided in this document as Annex 4 and Annex 5, respectively.

On arrival of the aircraft, authorities may require that all exterior doors and windows, including cargo hold doors, remain closed and be opened only once permission has been granted.

## 4.6 On-arrival cabin and hold disinsection

Aerosol disinsection will be conducted on arrival if:

- the airline has not conducted one of the approved pre-arrival procedures (i.e. pre-embarkation, pre-departure, residual or the pre-departure hold spray);
- the authorities at the arrival airport are not satisfied that the operator has performed the chosen method correctly; or
- additional on-arrival treatment is required by the authorities at the arrival airport.

It is the responsibility of the authorized agent or the pilot in command of an aircraft to complete the ICAO General Declaration (Appendix 1 of Annex 9) and notify the relevant authorities at the arriving airport if disinsection has not been conducted. The notification must be made before arrival so that the local authority can meet the aircraft and supervise or perform on-arrival disinsection.

Details for estimating the amount of spray required for on-arrival cabin and cargo hold disinsection of different types of aircraft are given in section 5.

### 4.6.1 Passenger exemption

The authorities at the arrival airport may permit a passenger who has identified a medical condition that might be affected by on-arrival treatment, verbally or in writing, to disembark from the aircraft before such treatment, leaving their belongings on the aircraft. Such a procedure is used in Australia and New Zealand. Once the aircraft has undergone on-arrival disinsection treatment and all the other passengers have disembarked, exempted passengers may retrieve their belongings from the aircraft.

### 4.6.2 On-arrival cabin and hold procedures

On-arrival procedures for **cabin** spraying are as follows:

All exterior doors and windows must remain closed and may be opened only with directions from the authorities at the arrival airport.

Before spraying, an in-flight announcement should be made to inform passengers about disinsection according to the WHO procedure. The following text could be read:

“Ladies and gentlemen, to conform to health requirements, the aircraft cabin will now be sprayed with an insecticide. This procedure is recommended by the World Health Organization. The treatment is necessary to avoid introduction of insects at our destination airport that can be carriers of serious human diseases. Please remain seated, and keep the aisles clear while spraying takes place. If you have a serious medical condition that could be affected by the spray, please press your call button to discuss this with your cabin crew. Thank you.”

If a passenger has identified a serious medical condition that may be affected by spraying, the crew should inform the local authorities who meet the aircraft, who will advise whether there is a local procedure that would allow the passenger to disembark before spraying.

Spraying must be completed with an aerosol of d-phenothrin 2% or 1*R*-*trans*-phenothrin 2% as the a.i.

See Table 1 for more information on aerosols and the amounts of aerosol spray (section 5) required for each aircraft type.

Cabin crew should prepare the cabin for disinsection by opening all overhead lockers and requesting all passengers to remain seated.

During disinsection and for 5 min after completion of spraying, the aircraft’s air-conditioning must be switched off. Recirculation fans may be left on if they are essential for operation of the aircraft but should be set at the lowest flow rate.

Spray should be directed towards the open overhead lockers and ceiling to ensure that the spray does not fall on the face of the operator while he or she is walking along the aisle at a rate of not more than one step or one row of seats per second.

Spray all galleys, including those on lower levels, and the lift access.

Spray all toilets and lockers for 2 s each.

Spray all crew rest areas and the flight deck for 3 s each, with the spray directed away from aircraft equipment, officers and crew.

On completion of spraying, a 5-min saturation period must be observed before the air-conditioning is turned on and the airflow maximized. Passengers must remain seated during this time, until clearance to disembark is given by the local authority.

For freighters (aircraft with a cargo hold on the main deck), see below.

On-arrival procedures for **lower cargo hold** spraying are as follows:

Under no circumstances should a hold door be opened without approval from the local authority.

Aerosols must be discharged into each hold in such a manner as to ensure that all parts of the hold are disinfected.

Spraying must be completed with a single-shot aerosol with vertical ejection nozzle containing d-phenothrin 2% or 1*R-trans*-phenothrin 2% and permethrin 2% as the a.i.'s.

In special circumstances, such as transport of live animals or when permethrin-based products are not authorized or not available, a single-shot aerosol can with a vertical ejection nozzle containing either d-phenothrin 2% aerosol or 1*R-trans*-phenothrin aerosol alone may be used.

See Table 1 for more information on aerosols and the amounts of aerosol spray (section 5) required for each aircraft type.

Advise the crew that cargo hold spraying is about to commence. As it is not uncommon for cargo hold spray to set off smoke detectors, sensitive electronic equipment must not be directly sprayed, and the crew must be fully aware of the procedures before disinsection.

During disinsection and for 5 min after completion of spraying, the aircraft's air-conditioning must be switched off. Recirculation fans may be left on if they are essential for operation of the aircraft but should be set at the lowest flow rate.

Disinsection may be done manually by directing the spray into small pressure hatches where present or by placing aerosols inside the hold.

Open the hold door by no more than 30 cm, place the aerosols inside the hold in a secure upright position, and activate the lock-down nozzle(s).

Once the spray aerosol(s) appears to be functioning correctly, immediately close the hold door to complete disinsection.

Allow 2 min for the aerosols to fully discharge, and then wait a further 5 min for saturation.

Once the procedure has been carried out, the local authority will permit unloading of cargo.

On-arrival procedures for **freighter aircraft** spraying are as follows:

Under no circumstances should any aircraft door be opened without the approval of the local authority.

#### **Cabin area**

The main entry door must be closed before cabin spraying.

Before spraying, inform the crew about disinsection according to the WHO procedure.

During disinsection and for 5 min after completion of spraying, the aircraft's air-conditioning must be switched off. Recirculation fans may be left on if they are essential for operation of the aircraft but should be set at the lowest flow rate.

Spraying of the flight deck, galley, toilets and cabin areas must be completed with an aerosol containing d-phenothrin 2% or 1*R-trans*-phenothrin 2%.

See Table 1 for more information on aerosols and the amounts of aerosol spray (section 5) required for each aircraft type.

All overhead and sidewall lockers must be open during spraying.

Spray should be directed towards the open overhead lockers and ceiling by an operator walking at a rate of not more than one step per second.

Spray all toilets and coat lockers for 2 s each. Ensure that the toilet seat is up and not sprayed.

Spray all crew rest areas, avoiding bedding, and the flight deck for 3 s each. Spray must be directed away from aircraft equipment, officers and crew.

### **Upper cargo area**

For the upper cargo deck of a freighter, d-phenothrin 2% AE or 1*R-trans*-phenothrin 2% AE alone may be used instead of a product containing permethrin 2% and d-phenothrin 2% (or 1*R-trans*-phenothrin).

See Table 1 for more information on aerosols and the amounts of aerosol spray (section 5) required for each aircraft type.

When there is also a cargo hold on the main deck (freighter aircraft), this area should be sprayed through the passenger door only.

During disinsection and for 5 min after completion of spraying, the aircraft's air-conditioning must be switched off. Recirculation fans may be left on if they are essential for operation of the aircraft but should be set at the lowest flow rate.

Discharge aerosols by walking away from the spray and leave the area on completion of spraying.

Spray should be directed towards open overhead lockers and ceiling to ensure that it does not fall on the face of the operator while he or she is walking along the aisle at a rate of not more than one step or one row of seats per second.

If cargo prohibits access to certain parts of the aircraft, discharge the aerosol into the centre of aircraft, directed towards the ceiling above the top of the cargo, for the appropriate duration for the section of the aircraft that could not be accessed; or position the aerosols evenly throughout the aircraft on top of the cargo (note: this is applicable when using single shot aerosols only).

On completion of spraying, allow at least 5 min for the spray to settle before the local authority permits unloading of cargo.

### **Lower cargo holds**

All exterior doors and windows must remain closed and may be opened only in accordance with directions from the authorities at the arrival airport.

Advise the crew that cargo hold spraying is about to start. As it is not uncommon for cargo hold spray to set off smoke detectors, sensitive electronic equipment must not be directly sprayed, and the crew must be fully aware of the procedures before disinsection.

Spraying must be completed with a single-shot aerosol with a vertical ejection nozzle containing d-phenothrin 2% or 2% 1*R-trans*-phenothrin and permethrin 2%.

In special circumstances, such as transport of live animals or where permethrin-based products are not authorized for use or are not available, a single-shot aerosol with a vertical ejection nozzle containing d-phenothrin 2% aerosol or 1*R-trans*-phenothrin alone may be used.

See Table 1 for more information on aerosols and the amounts of aerosol spray (section 5) required for each aircraft type.

During disinsection and for 5 min after completion of spraying, the aircraft's air-conditioning must be switched off. Recirculation fans may be left on if they are essential for operation of the aircraft but should be set at the lowest flow rate.

The local authority will permit unloading of cargo once the procedure has been completed.



# Amounts of aerosol spray required for aircraft

## 5.1 General information

Please refer to section 4, aircraft disinsection treatment, to ensure the correct aerosol a.i.

The listing covers four aircraft types:

- commercial passenger aircraft;
- small jets, regional and private aircraft (including private helicopters);
- military aircraft; and
- freighter aircraft.

### 5.1.1 Aerosol spray in cabins

The rate of application of spray in cabins is based on 10 g of formulation/28 m<sup>3</sup> (1000 ft<sup>3</sup>) = 35 g/100 m<sup>3</sup> and is typically achieved by discharging aerosols when walking at a rate of one step or row of seats per second. Wide-bodied aircraft may require the operator to use up to two 100 g aerosol cans per aisle .

Spray is typically discharged at a rate of 1 g ± 0.2 g of aerosol/s; for example, a 100-g aerosol can take about 100 s to be fully discharged. Knowing the discharge rate can help the operator to achieve even coverage.

**Note:** For spraying on arrival, use the amounts listed under cabin pre-departure.

### 5.1.2 Aerosol spray in cargo holds

The rate of application of cargo hold spray is based on 10 g of formulation/28 m<sup>3</sup> (1000 ft<sup>3</sup>) = 35 g aerosol/100 m<sup>3</sup>.<sup>1</sup>

Spraying must be completed with a single-shot aerosol(s) with vertical ejection nozzles containing permethrin 2% and d-phenothrin 2% (or 2% 1*R-trans*-phenothrin). The airline may select the alternative of an aerosol containing d-phenothrin 2% or 1*R-trans*-phenothrin in a single-shot vertical ejection nozzle in special circumstances.<sup>2</sup>

### 5.1.3 Aircraft with very small cargo or baggage holds

These holds should be treated with a single-shot or multi-shot aerosol, containing:

- permethrin 2%, or
- a combination of permethrin 2% and d-phenothrin 2% (or 1*R-trans*-phenothrin 2%) or
- d-phenothrin 2% (or 1*R-trans*-phenothrin 2%) alone.

**Note:** The aerosol may activate the on-board smoke detectors.

<sup>1</sup> Some aerosol spray may be lost through the cargo door before it is closed. To achieve adequate coverage, some countries may stipulate larger amounts of aerosol spray.

<sup>2</sup> Non-authorization or non-availability of the combination aerosol containing permethrin 2% and d-phenothrin 2% (or 1*R-trans*-phenothrin 2%), or when there is concern about use of a permethrin aerosol when live mammals are being transported.

### 5.1.4 Rate and method of application

The amounts of spray depend on the aircraft model or use and are listed in Annex 3 of this document. If the aircraft model is not listed, use the aerosol spray amount calculator tool.

**Calculator for aerosol spray amount for aircraft disinsection**

Aircraft	Passenger or freighter	Main deck of aircraft			Forward cargo hold				Rear cargo hold				Bulk cargo hold				Total									
		Length (m)	Width (m)	Height (m)	Main deck of aircraft (m <sup>2</sup> )	Length (m)	Width (m)	Height (m)	Forward cargo hold (m <sup>3</sup> )	Amount of spray (g)	Length (m)	Width (m)	Height (m)	Rear cargo hold (m <sup>3</sup> )	Amount of spray (g)	Length (m)	Width (m)	Height (m)	Bulk cargo hold (m <sup>3</sup> )	Amount of spray (g)	Lower cargo holds and baggage holds (m <sup>3</sup> )	Amount of spray - main deck (g)	Amount of spray - cargo holds (g)			

## 5.2 Commercial passenger aircraft

Sample calculations for disinsection of commercial passenger aircraft are given in Annex 3.

## 5.3 Small jets, regional and private aircraft (including private helicopters)

Detailed estimates of the volumes of aerosol required are given in Annex 3. The aerosol spray delivery rate is  $1 \text{ g} \pm 0.2 \text{ g aerosol/s}$ .

For **small one- or two-seater aircraft not listed in Annex 3**, use the amounts of aerosol spray estimated for the volume required for the nearest type of listed aircraft.

For **helicopters and any non-listed aircraft flying or carried on board a vessel**, disinsection must be conducted at a rate of  $1 \text{ g} \pm 0.2 \text{ g aerosol}/2.8 \text{ m}^3$  (100 ft<sup>3</sup>) of internal space (equivalent to 1 s of discharge).

For **aircraft with very small cargo or baggage holds**, a single-shot or multi-shot aerosol should be used, containing:

- permethrin 2%, or
- a combination of permethrin 2% and d-phenothrin 2% (or 2% 1*R-trans*-phenothrin), or
- d-phenothrin 2% (or 1*R-trans*-phenothrin 2%) alone.

**Note:** The aerosol may activate the on-board smoke detectors.

When cargo holds can be accessed internally, they will have been accounted for in the amount of spray required for the cabin. The amounts have been rounded up to the nearest 5 g. Unless otherwise specified, the amount of spray required for external holds (number of seconds for which the aerosol is discharged) refers to the total number of “external access only” holds.

## 5.4 Military aircraft

Detailed estimates are given in Annex 3. The aerosol spray delivery rate is  $1 \text{ g} \pm 0.2 \text{ g aerosol/s}$ .

**One- or two-seat fast jet aircraft and combat helicopters** are usually exempt from disinsection because they contain sensitive electronic equipment and also because they are at low risk of carrying live mosquitoes.

For **helicopters and any non-listed aircraft flying or carried on board a vessel**, disinsection must be conducted at a rate of 1 g of spray (equivalent to 1 s of aerosol spraying) per  $2.8 \text{ m}^3$  (100 ft<sup>3</sup>) of internal space.

For **aircraft with very small cargo or baggage holds**, a single-shot or multi-shot aerosol should be used, containing:

- permethrin 2%, or
- a combination of permethrin 2% and d-phenothrin 2% (or 1*R-trans*-phenothrin 2%) or
- d-phenothrin 2% (or 1*R-trans*-phenothrin 2%) alone.

**Note:** The aerosol may activate on-board smoke detectors.

When holds can be accessed internally, they will have been included in the amount of spray required for the cabin. The amounts have been rounded up to the nearest 5 g. Unless otherwise specified, the amount of spray required for external holds (number of seconds for which aerosol is discharged) refers to the total number of “external access only” holds.

## 5.5 Freighters

Detailed calculations for the amounts of spray required are given in section 5. The rate of aerosol spray delivery is  $1 \text{ g} \pm 0.2 \text{ g}$  of aerosol/s. Depending on the disinsection method used, the aerosol should be:

- a combination of permethrin 2% and d-phenothrin 2% (or *1R-trans*-phenothrin 2%), or
- d-phenothrin 2% (or *1R-trans*-phenothrin 2%).

A single-shot or a multi-shot aerosol may be used for the galley, toilets and passenger compartment.

**Note:** The aerosol may activate the on-board smoke detectors.

To disinsect the upper cargo area on the main deck, spraying may be done with aerosols with a single-shot vertical ejection nozzle, containing either:

- d-phenothrin 2% or *1R-trans*-phenothrin or
- permethrin 2% and d-phenothrin 2% (or *1R-trans*-phenothrin 2%).

Discharge the aerosols by walking away from the spray and vacate the area on completion of spraying. Spray should be directed towards the open overhead lockers and ceiling to ensure that it does not fall on the face of the operator while he or she is walking along the aisle at a rate of not more than one step or one row of seats per second.

If cargo prohibits access to certain parts of the aircraft:

- discharge the aerosol into the centre of aircraft towards the ceiling above the cargo for the appropriate duration, or
- position the aerosols evenly throughout the aircraft on top of the cargo (note: this is applicable when using single shot aerosols only).

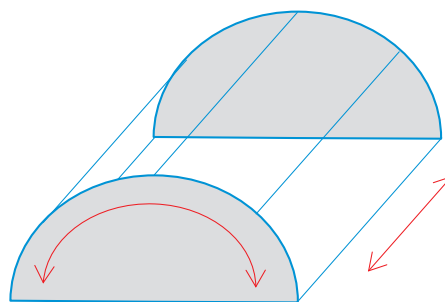
On completion of spraying, allow at least 5 min for the spray to settle before departure. As the amounts of spray depend on the configuration of the freighter, sprays should be applied by walking at a rate equivalent to one row or step per second.

# Estimation of amounts of residual spray required for aircraft

This section provides guidance on estimating the internal area of an aircraft so that the appropriate amount of product necessary for residual disinsection can be calculated for passenger cabins and cargo holds. For each aircraft type (model) in the fleet, all calculations should be completed and recorded in the operator's manual for use by staff conducting spraying.

Standards are available for calculating the amount of product required per square metre of area to be treated but not for calculating surface area, which has been left to organizations and individuals.

This can be derived from a simple initial measurement that can be made by someone with little practical knowledge of engineering or geometry and no access to expensive measuring devices. The estimate can be used as a baseline to compare current practices with either actual spray application measurements or alternative calculations that may be used. A visual of the roof, walls and cabin floor of the aircraft is shown below for ease of understanding of the measurements.



Visual of roof/wall and aircraft cabin floor

The estimates have allowed construction of a “near enough” estimated calculation that can be completed with documents on aircraft characteristics available from manufacturers, such as Airbus Aircraft Characteristics Documents (17) and Boeing Aircraft Characteristics Documents (18).

For examples of use of these documents, see below.

## 6.1 Calculations for specific areas

Calculations for estimating the areas that require spraying are as follows:

Cabin floor area = maximum width of the cabin floor × cabin length

Cabin walls and roof + “errata” (lockers, bulkheads, etc.) = [(maximum width of the cabin floor ×  $\pi \div 2$ ) × cabin length] × area errata ratio<sup>1</sup>

<sup>1</sup> Increase in the area calculation to account for additional surfaces such as bulkheads and lockers.

Cargo hold(s):

$$(\sqrt[3]{\text{Cargo hold}} \times \sqrt[3]{\text{Cargo hold}}) \times 6$$

This calculation is for converting the internal volume of the hold to its surface area.

### ***Compensation for under-spraying (volume errata ratio)<sup>1</sup>***

An additional 33% should be added to the results of the calculations to allow for any inconsistencies of spraying. These numbers are deduced from previous residual disinsection procedures documented in the *Report of the informal consultation on aircraft disinsection (4)*.

### ***Calculation and source***

This calculation is found in cross-sectional diagrams of interior arrangements (see example of calculation for Boeing 737-800 on page 30).

### ***Exclusions***

Any variation in width, such as of doorways, partitions or near flight deck or tail sections of an aircraft, is not considered in the calculations.

### ***Cabin length (door to door) (L)***

The cabin length measured from the front passenger or crew doors to the rear passenger or crew doors (inclusive).

### ***Calculation and source***

This calculation is derived from diagrams of the relative position of doors from the nose of the aircraft (see example of calculation for Boeing 737-800 on page 30).

Rear door distance – front door distance = cabin length.

### ***Exclusions***

The calculation may omit the small length between a door and the flight deck and the tail of the aircraft.

This calculation is valid only for aircraft in which doors are located at the extreme front and aft of the cabin. Other calculations may be required for double-decker planes such as the A380, in which the top deck does not follow this configuration and the calculation is made manually.

### ***Cabin walls and roof (height)***

A measurement that bisects the cabin wall and roof, running from the floor, up one wall and around onto the roof and lockers and then down again to the other side of the floor.

### ***Calculation and source***

This calculation is based on the cabin width to calculate the circumference of a semi-circle, an approximation of the actual length of the internal roof.

<sup>1</sup> An additional 33% added to the results of the calculations to allow for any inconsistencies in spraying.

## ***Area errata ratio***

The area errata ratio is an approximation of various additional surfaces as a proportion of the cabin wall and roof. The errata ratio is set at 2 and is multiplied by the total cabin wall and roof area, in effect doubling the cabin wall and roof area. For freighters, the value is set at 1, as there are no bulkheads, overhead lockers etc.

## ***Calculation and source***

The calculation is based on the additional area inside lockers, including each side. In addition, all aircraft have front and rear bulkheads and additional partitions throughout. A typical single-aisle aircraft has lockers on each side, whereas an aircraft with two aisles has an additional two banks of lockers. The area errata ratio reasonably accommodates these differences.

Area errata ratios cover the following:

*Lockers:* Typical lockers have a curvature inside with depths of approximately 400 mm and 500 mm.

*Locker walls:* The sides may be roughly approximated from the area of a semi-circle and multiplied by the length of the plane and average widths.

*Bulkheads:* The front and rear of the aircraft are calculated as semi-circles from the cabin width.

## ***Cargo holds (fore, aft and bulk)***

The total surface area of cargo holds in an aircraft is calculated by converting the cargo hold volume to surface area.

## ***Calculation and source***

Volume capacity can be found in tables of general characteristics. Each hold volume should be calculated separately (17, 18).

## ***Exclusions***

All calculations are based on usable capacity only. Some characteristics, such as water volume, may be stated. For consistency, these should not be used.

Some aircraft have variable cargo hold volumes because of optional auxiliary fuel tanks. It should be assumed that such optional tanks are not installed, i.e. the maximum cargo volume should be used.

Some characteristics may combine the total capacity of all holds. The section on loading combinations will provide a breakdown of how such loads are placed in holds. Additional calculation may be required, such as multiplying the total number of containers by their volume capacity (e.g. 22 LD3<sup>1</sup> containers at 4.5 m<sup>3</sup>). Although this gives a slightly smaller area, the difference is not significant at the scale being calculated.

## ***Freighters and double-decker commercial aircraft***

The area of freighters is calculated in exactly the same way as that of regular commercial craft. The only difference is that the area errata ratio is set at 1 because freighters do not have a lining, bulkheads or overhead compartments.

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<sup>1</sup> LD3 is an air container model.

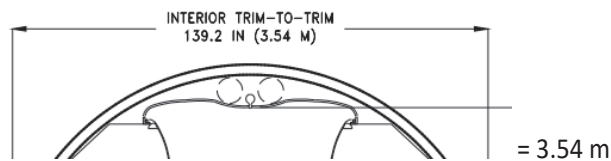
For double-decker commercial craft (747-400 and A380-800), the upper deck calculations should be added to the cabin floor area in m<sup>2</sup>. Additionally, the area errata ratio is set at 2.5, as there are two levels of overhead lockers, although the bulkhead and lining areas are similar to those of normal commercial aircraft such as Boeing 737-800.

Example of calculation – Boeing 737-800

### Source of data

Data on aircraft characteristics are available on manufacturers' websites.

### Cabin floor width (W)

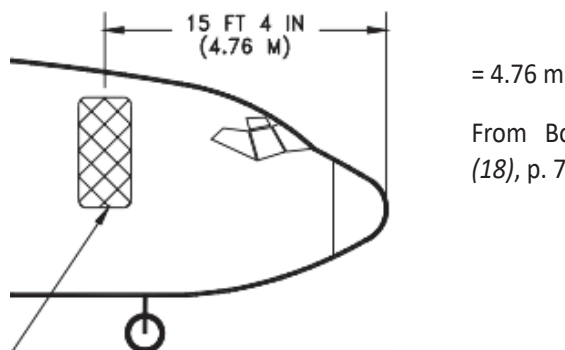


From Boeing Aircraft Characteristics Documents (18), p. 67.

### Cabin length (door to door) (L)

$$31.88 \text{ m} - 4.76 \text{ m} = 27.12 \text{ m}$$

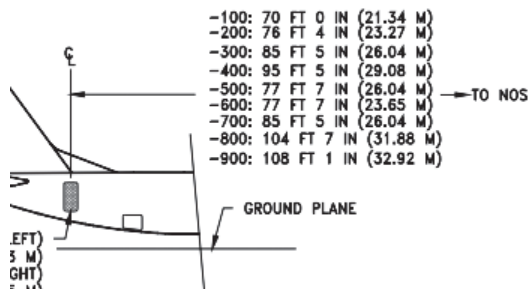
Front door from nose



= 4.76 m

From Boeing Aircraft Characteristics Documents (18), p. 77

Rear door from nose



= 31.88 m

From Boeing Aircraft Characteristics Documents (18), p. 78



## Cargo holds (forward (Fore), aft and bulk)

### Volume of cargo in Boeing aircraft

From Boeing Aircraft Characteristics Documents (18), p. 71

Airplane model	Aft cargo compartment			Capacity of bulk cargo		Notes	Calculation of volume for Boeing 737-800
	Bulk cargo	Capacity of auxiliary fuel tank	Capacity of auxiliary fuel tank compartment	Forward compartment	Total		
737-600	13.8 m <sup>3</sup> (488 ft <sup>3</sup> )	0	0	7.6 m <sup>3</sup> (268 ft <sup>3</sup> )	21.4 m <sup>3</sup> (756 ft <sup>3</sup> )	(1)	
737-700	16.9 m <sup>3</sup> (596 ft <sup>3</sup> )	0	0	11.5 m <sup>3</sup> (406 ft <sup>3</sup> )	28.4 m <sup>3</sup> (1002 ft <sup>3</sup> )	(1)	
<b>737-800</b>	<b>25.5 m<sup>3</sup></b> <b>(899 ft<sup>3</sup>)</b>	<b>0</b>	<b>0</b>	<b>19.6 m<sup>3</sup></b> <b>(692 ft<sup>3</sup>)</b>	<b>45.1 m<sup>3</sup></b> <b>(1591 ft<sup>3</sup>)</b>	<b>(1)</b>	<b>Fore = 19.6 m<sup>3</sup>;</b> <b>Aft = 25.5 m<sup>3</sup>;</b> <b>Bulk = included</b> <b>in aft (i.e. rear hold)</b>
737-900	28.7 m <sup>3</sup> (1012 ft <sup>3</sup> )	0	0	23.8 m <sup>3</sup> (840 ft <sup>3</sup> )	52.5 m <sup>3</sup> (1852 ft <sup>3</sup> )	(1)	
737-900ER	28.2 m <sup>3</sup> (996 ft <sup>3</sup> )	0	0	23.5 m <sup>3</sup> (830 ft <sup>3</sup> )	51.7 m <sup>3</sup> (1826 ft <sup>3</sup> )	(2)	
737-900ER	23.9 m <sup>3</sup> (843 ft <sup>3</sup> )	1968 L (520 gal)	4.3 m <sup>3</sup> (153 ft <sup>3</sup> )	23.5 m <sup>3</sup> (830 ft <sup>3</sup> )	47.7 m <sup>3</sup> (1673 ft <sup>3</sup> )	(3)	
737-900ER	21.4 m <sup>3</sup> (755 ft <sup>3</sup> )	3641 L (963 gal)	6.8 m <sup>3</sup> (241 ft <sup>3</sup> )	23.5 m <sup>3</sup> (830 ft <sup>3</sup> )	44.9 m <sup>3</sup> (1585 ft <sup>3</sup> )	(4)	

### Area calculations

Basic calculations from published data

#### Cabin floor

$$3.54 \text{ m} \times 27.12 \text{ m} = 96 \text{ m}^2$$

#### Cabin wall or roof plus area errata (lockers, bulkheads, etc.)

$$= (3.54 \times \pi \div 2) \times 27.12 \times 2 = 301.73 \text{ m}^2$$

## Cargo holds (fore, aft and bulk)

### Fore

$$= (\sqrt[3]{19.6} \times \sqrt[3]{19.6}) \times 6 = 43.6 \text{ m}^2$$

### Aft

$$= (\sqrt[3]{25.5} \times \sqrt[3]{25.5}) \times 6 = 52.0 \text{ m}^2$$

### All holds

$$43.6 \text{ m}^2 + 52.0 \text{ m}^2 = 95.6 \text{ m}^2$$

### *Amounts of disinsection spray (total mix)*

#### **Recommended dilutions to provide 2% emulsion of permethrin**

For example, when using a permethrin 50% EC formulation, mix one part of the 50% EC with 24 parts of water (42 mL permethrin 50% EC/1 L water) to obtain a permethrin 2% emulsion.

#### **Disinsection requirements:<sup>1</sup>**

Cabin wall ceiling or cargo holds = 10 mL permethrin per m<sup>2</sup>

Cabin floor = 20 mL permethrin per m<sup>2</sup>

**Cabin floor:** 20 mL × 96 m<sup>2</sup> = 1920 mL

**Cabin wall and roof + volume errata (lockers, bulkheads, etc):** 10 mL × 301.73<sup>2</sup> = 3017 mL

**Cargo holds (fore, aft and bulk):** 10 mL × 95.6 m<sup>2</sup> = 956 mL

**Total (including under-spray factor):** (1920 mL + 3017 mL + 956 mL) × 1.33 = 5.89 L × 1.33 = 7.84 L

## 6.2 Amounts of residual spray in aircraft

The following amounts of residual spray are those recommended for effective treatment when mixed and applied correctly.

<sup>1</sup> For this calculation and practical application, the floor is sprayed twice with 10 mL solution = 20 mL. The other 5 mL are for assumed drift from application on higher areas.

## 6.2.1 Commercial passenger aircraft

The calculations for the residual spray amounts for commercial aircraft are shown in the table below.

### Spray amounts, commercial passenger aircraft

Aircraft manufacturer and model	Cabin calculations											Cargo hold calculations						Number of litres per area (L)			Number of litres (L) for the whole aircraft
	No. of aisles	Front door measurement (m)	Rear door measurement (m)	Cabin length (m)	Cabin width (m)	Cabin floor (m <sup>2</sup> )	Wall + ceiling (m <sup>2</sup> )	Wall + ceiling (m <sup>2</sup> )	Wall and ceiling + bin and bulk (m <sup>2</sup> )	Forward (m <sup>3</sup> )	Area of forward hold (m <sup>2</sup> )	Aft (m <sup>3</sup> )	Bulkhead (m <sup>3</sup> )	Aft + bulkhead (m <sup>3</sup> )	Aft + bulkhead (m <sup>2</sup> )	Total cargo area (m <sup>2</sup> )	Cabin floor	Cabin ceiling, walls, bins + bulkheads	All lower cargo hold areas		
																				Cabin floor (m <sup>2</sup> )	
Airbus																					
A300-600	2			40.5	5.64	228.42	8.86	358.95	717.89	76.51	108.13	61.03	21.00	82.03	113.27	221.41	6.08	9.55	2.94	18.57	
A310-200	2			35.5	5.64	200.22	8.86	314.63	629.26	55.00	86.77	36.20	21.00	57.20	89.07	175.85	5.33	8.37	2.34	16.03	
A319-100/NEO	1	5.04	25.81	20.7	3.63	75.40	5.70	118.48	236.96	8.52	25.03	11.92	7.22	19.14	42.93	67.96	2.01	3.15	0.90	6.06	
A320-200	1	5.04	29.53	24.4	3.63	88.90	5.70	139.70	279.40	13.28	33.65	18.26	5.88	24.14	50.12	83.76	2.36	3.72	1.11	7.19	
A321-200	1	5.04	36.47	31.43	3.63	114.09	5.70	179.29	358.57	22.81	48.26	23.03	5.88	28.91	56.52	104.78	3.03	4.77	1.39	9.20	
A330-200/800	2	5.85	45.63	39.7	5.18	206.06	8.14	323.81	647.62	60.70	92.67	52.00	19.70	71.70	103.55	196.22	5.48	8.61	2.61	16.70	
A330-300/900	2	5.85	50.96	45.1	5.17	233.22	8.12	366.49	732.97	78.00	109.53	60.70	19.70	80.40	111.77	221.30	6.20	9.75	2.94	18.90	
A340-300	2	5.85	46.69	40.8	5.29	216.04	8.31	339.50	678.99	78.00	109.53	60.70	19.70	80.40	111.77	221.30	5.75	9.03	2.94	17.72	
A340-500	2	5.85	54.14	48.2	5.29	255.45	8.31	401.43	802.86	78.00	109.53	52.00	19.70	71.70	103.55	213.09	6.80	10.68	2.83	20.31	
A350-900	2	6.82	52.55	45.7	5.61	256.55	8.82	403.14	806.29	86.70	117.53	69.30	11.40	80.70	112.05	229.58	6.82	10.72	3.05	20.60	
A350-1000	2	6.82	59.53	52.7	5.61	295.70	8.82	464.68	929.35	104.00	132.69	86.70	11.40	98.10	127.62	260.31	7.87	12.36	3.46	23.69	
Boeing																					
727-200	1	4.60	24.78	20.18	3.56	71.84	5.59	112.89	225.79	15.50	37.30	8.80	7.40	16.20	38.41	75.71	1.91	3.00	1.01	5.92	
737-200	1	4.76	23.27	18.51	3.54	65.53	5.56	102.97	205.94	10.48	28.73	14.31	0.00	14.31	35.37	64.10	1.74	2.74	0.85	5.33	
737-800	1	4.76	31.88	27.12	3.54	96.00	5.56	150.86	301.73	19.60	43.62	25.50	0.00	25.50	51.98	95.60	2.55	4.01	1.27	7.84	

Aircraft manufacturer and model	Cabin calculations											Cargo hold calculations							Number of litres per area (L)			Number of litres (L) for the whole aircraft
	No. of aisles	Front door measurement (m)	Rear door measurement (m)	Cabin length (m)	Cabin width (m)	Cabin floor (m <sup>2</sup> )	Wall + ceiling (m <sup>2</sup> )	Wall + ceiling (m <sup>2</sup> )	Wall and ceiling + bin and bulk (m <sup>2</sup> )	Forward (m <sup>3</sup> )	Area of forward hold (m <sup>2</sup> )	Aft (m <sup>3</sup> )	Bulkhead (m <sup>3</sup> )	Aft + bulkhead (m <sup>3</sup> )	Aft + bulkhead (m <sup>2</sup> )	Total cargo area (m <sup>2</sup> )	Cabin floor	Cabin ceiling, walls, bins + bulkheads	All lower cargo hold areas			
																				2.65	4.17	
737-900	1	4.76	32.92	28.16	3.54	99.69	5.56	156.65	313.30	23.80	49.64	28.70	0.00	28.70	56.24	105.89	2.65	4.17	1.41	8.23		
757-200	2	5.05	38.23	33.18	3.54	177.46	5.56	184.58	369.15	25.50	51.98	25.50	0.00	25.50	51.98	103.96	4.72	4.91	1.38	11.01		
757-300	2	5.05	45.34	40.29	3.54	202.63	5.56	224.13	448.26	33.75	62.66	33.75	0.00	33.75	62.66	125.32	5.39	5.96	1.67	13.02		
767-200	2	5.70	36.12	30.42	4.72	143.58	7.42	225.63	451.26	40.78	71.09	33.98	12.18	46.16	77.21	148.29	3.82	6.00	1.97	11.79		
767-300	2	5.70	42.55	36.85	4.72	173.93	7.42	273.32	546.64	54.40	86.14	47.60	12.20	59.80	91.75	177.90	4.63	7.27	2.37	14.26		
767-400	2	5.70	48.95	43.25	4.72	204.14	7.42	320.79	641.58	61.90	93.89	61.90	12.20	74.10	105.85	199.74	5.43	8.53	2.66	16.62		
777-200	2	6.75	49.54	42.79	5.82	249.04	9.15	391.35	782.69	96.00	125.80	96.00	17.00	113.00	140.24	266.04	6.62	10.41	3.54	20.57		
777-300ER	2	6.74	59.67	52.93	5.82	308.05	9.15	484.08	968.17	106.50	134.81	106.50	0.00	106.50	134.81	269.62	8.19	12.88	3.59	24.66		
787-8	2	6.30	43.56	37.26	5.47	203.81	8.60	320.28	640.55	62.65	94.65	62.65	11.40	74.05	105.80	200.45	5.42	8.52	2.67	16.61		
787-9	2	6.30	49.66	43.36	5.47	237.18	8.60	372.71	745.42	80.50	111.86	80.50	11.40	91.90	122.19	234.05	6.31	9.91	3.11	19.34		
787-10	2	6.30	55.14	48.84	5.47	267.15	8.60	419.81	839.63	89.45	120.01	89.45	11.40	100.85	130.00	250.00	7.11	11.17	3.33	21.60		
Twin-level cabin area																						
747-400	2.00	0.00	57.00	57.00	6.13	409.41	9.63	549.07	1372.68	79.30	110.75	79.36	22.30	101.66	130.69	241.44	10.89	18.26	3.21	32.36		
747-800	2.00	0.00	60.08	60.08	6.13	428.29	9.63	578.74	1444.86	69.37	101.30	92.63	18.10	110.73	138.35	239.65	11.39	19.24	3.19	33.82		
A380-800	2.00	6.32	53.63	47.31	6.30	557.25	9.90	468.37	1170.92	131.00	154.76	107.80	17.30	125.10	150.08	304.84	14.82	15.57	4.05	34.45		

## 6.2.2 Freighter aircraft

The calculations for the residual spray amounts for freighter aircraft are shown in the table below.

### Spray amounts, freighter aircraft

Aircraft manufacturer and model	Cabin calculations										Cargo hold calculations							Number of litres per area (L)				Number of litres (L) for the whole aircraft
	No. of aisles	Front door measurement (m)	Rear door measurement (m)	Cabin length (m)	Cabin width (m)	Cabin floor (m <sup>2</sup> )	Wall + ceiling (m <sup>2</sup> )	Wall + ceiling (m <sup>2</sup> )	Wall and ceiling + bin and bulk (m <sup>2</sup> )	Forward (m <sup>3</sup> )	Area of forward hold (m <sup>2</sup> )	Aft (m <sup>3</sup> )	Bulkhead (m <sup>3</sup> )	Aft + bulkhead (m <sup>3</sup> )	Aft + bulkhead (m <sup>2</sup> )	Total cargo area (m <sup>2</sup> )	Cabin floor	Cabin ceiling, walls, bins + bulkheads	All lower cargo hold areas	Whole aircraft		
767-400F	2	5.70	48.95	43.25	4.72	204.14	7.42	320.79	320.79	61.90	93.89	61.90	12.20	74.10	105.85	199.74	5.43	4.27	2.66	12.35		
747-400F	NA	NA	NA	55.00	6.13	397.15	9.63	529.81	1324.52	58.76	90.69	71.64	15.00	86.64	117.48	208.17	10.56	17.62	2.77	30.95		
747-800F	NA	NA	NA	60.08	6.13	428.29	9.63	578.74	1446.86	69.37	101.30	96.63	14.7	111.33	138.85	240.15	11.39	19.24	3.19	33.83		
MD11/M1F	2	NA	46.51	46.51	5.74	266.97	9.02	419.52	419.52	72.48	104.30	72.48	14.44	86.92	117.73	222.04	7.10	5.58	2.95	15.63		

### 6.2.3 Aircraft residual spray amount calculator

To calculate the amount of residual spray required for aircraft that are not listed in sections 6.2.1 and 6.2.2, follow the guidance above, and use the aircraft residual amount calculator given below.

**Template for the calculation of spray amounts for residual disinsection of aircraft models not listed in the document**

	Type and Class			Cabin							Cargo area					Total volume required for treatment of				Volumes of product and water required						
	Aircraft type	Aircraft class	Number of aisles	Front door measurement (m)	Rear door measurement	Cabin length (m)	Cabin width (m)	Area of cabin floor (m <sup>2</sup> )	Area of walls and ceiling (m <sup>2</sup> )	Area of walls and ceiling (m <sup>2</sup> ) + Bin and Bulk (m <sup>2</sup> )	Forward hold (FWD)m <sup>3</sup>	FWD (m <sup>2</sup> )	Rear hold (AFT) m <sup>3</sup>	BLK m <sup>3</sup>	AFT + BLK m <sup>3</sup>	AFT + BLK (m <sup>2</sup> )	Total area of cargo (m <sup>2</sup> )	Cabin floor (L)	Cabin ceiling, walls, bins and bulk (L)	All lower cargo hold areas (L)	Whole aircraft (L)	Insecticide active ingredient concentration in the formulation (%)	Concentration of active ingredient required for end solution (%)	Volume of final product required to be sprayed (mL)	Amount of water required (mL)	
Template for calculations																										
Worked example for reference	A321	Commercial	1.00	5.04	36.47	31.43	3.63	114.09	5.70	179.15	358.30	22.81	48.26	23.03	5.88	28.91	56.52	104.78	3.03	4.77	1.39	9.194	50%	2%	367.7	8826.0

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# ANNEXES

# Annex 1. Examples of pre-embarkation cabin treatment by aircraft type

Use of various-sized aerosol cans is acceptable to achieve the same total.

## Boeing 747

A B747 requires 4 × 100 g aerosols containing permethrin 2% as the a.i.

Carry out all procedures as outlined in section 4.3.1.

Downstairs: two operators, each with two aerosols, starting at the rear of the aircraft and moving forward at a rate of not more than one step or one row of seats per second, with the spray directed towards the open overhead lockers.

Upstairs: one operator using the remaining spray from all four aerosols with all lockers open and moving at one step or one row of seats per second with two aerosols at a time.

The rear portion of the main cabin of a B747 Combi is a cargo area. This can be accessed via a door at the end of the main cabin. Carry out all procedures as outlined in section 4.5.3 and refer to Annex 3.

## Boeing 777 and Airbus A340-300

A B777 or A340-300 requires up to 3 × 100 g aerosol containing permethrin 2% as the a.i.

Carry out all procedures as outlined in section 4.3.1.

One operator with two aerosols starts at the rear of the aircraft and moves up one aisle and down the other, at a rate of not more than one step or one row of seats per second, directing the aerosols towards the open overhead lockers. When the two aerosols are empty, the remaining unsprayed aisle is sprayed up and back with the third aerosol.

## Boeing 737 and Airbus A320

A B737 or A320 requires up to 1 × 100 g aerosol containing permethrin 2% as the a.i..

Carry out all procedures as outlined in section 4.3.1.

One operator with one aerosol starts at the front the aircraft and moves down the aisle at a rate of not more than one step or one row of seats per second, with the spray directed towards the open overhead lockers on one side only. The other side is sprayed in the same manner when walking back.

## Airbus A380

An A380 requires 3 × 100 g on the main deck and 2 × 100 g on the upper deck, containing permethrin 2% as the a.i.

Carry out all procedures as outlined in section 4.3.1.

Main deck – 300 g:

One operator with two aerosols starts at the rear of the aircraft and moves up one aisle and down the other, at a rate of not more than one step or one row of seats per second, directing the aerosols towards the open overhead lockers. When the two aerosols are empty, the remaining unsprayed aisle is sprayed up and back with the third aerosol directed towards the open overhead lockers.

Upper deck with no suites – 200 g:

One operator with two aerosols starts at the rear of the aircraft and moves up one aisle and down the other, at a rate of not more than one step or one row of seats per second, directing the aerosols towards the open overhead lockers.

Upper deck with suites – 200 g:

One operator starts from the suite and takes two to three steps in and out of the bedroom, spraying at one step per second and then sprays the shower room and the living room, ensuring that any stowage compartments are open.

The operator then moves to the “apartments”, with one or two steps in from the aisle for each apartment to ensure adequate coverage at one step per second and ensuring that all stowage compartments are open during treatment.

The operator sprays the rest of the upper deck by moving down the left-hand aisle and up the other at a rate of not more than One step or one row of seats per second, directing the aerosols towards the open overhead stowage compartments.

#### **Small aircraft (corporate jets and other small aircraft)**

Small aircraft require less than 1 × 100 g aerosol containing permethrin 2% as the a.i.

Carry out procedures in section 4.3.1, except for the flight deck, which should be sprayed for 2 s, and the internally accessed baggage storage area, which should be sprayed for 4 s. The access door should be closed during treatment.

One operator with one aerosol sprays the flight deck, internally accessed baggage storage areas and toilet(s) and then sprays the cabin, moving from the rear of the aircraft and directing the spray high in the air towards the ceiling and wall areas at a rate of not more than one step or row of seats per second.

On completion of spraying, the operator should apply a short burst of spray while exiting the aircraft. The aircraft should remain closed for a full 5 min before it is opened, and air-conditioning and normal flight preparations are resumed.

The external door to the internally accessed baggage area shall be opened only after spraying is completed and for a short time while bags are loaded.

If there are any separate cargo holds with external access only, these should be sprayed after all cargo and luggage has been loaded. The amount is specified in section 5.

During spraying of cargo holds, ensure that the cargo hold doors are opened only just enough to introduce the aerosol can, to prevent spray from escaping to the exterior.

The cargo hold door should be closed immediately after spraying.

## Annex 2. Examples of pre-departure cabin treatment by aircraft type

Use of various sized aerosol cans is acceptable to achieve the same total.

### Boeing 747

A B747 requires 4 × 100 g aerosols containing d-phenothrin 2% or 1*R-trans*-phenothrin 2% as the a.i.

Carry out all procedures as outlined in section 4.4.

Downstairs: Two operators each with two aerosols starting at the rear of the aircraft and moving forward at a rate of not more than one step or one row of seats per second, the spray being directed towards the open overhead lockers.

Upstairs: One operator using the remaining spray from all four aerosols, with all lockers opened and moving at one step or row of seats per second with two aerosols at a time.

In a B747 Combi, the rear portion of the main cabin is a cargo area. This can be accessed via a door at the end of the main cabin. Carry out all procedures as outlined in section 4.5.3 and refer to Annex 3.

### Boeing 777/Airbus A340-300

A B777/A340-300 require 3 × 100 g aerosols containing d-phenothrin 2% or 1*R-trans*-phenothrin 2% as the a.i.

Carry out all procedures as outlined in section 4.4.

One operator with two aerosols starts at the rear of the aircraft and moves up one aisle and down the other, at a rate of one step or one row of seats per second, the spray being directed towards the open overhead lockers. When the two aerosols are empty, the remaining aisle is sprayed up and back with the third aerosol.

### Boeing 737/Airbus A320

A B737/A320 requires up to 1 × 100 g aerosol containing d-phenothrin 2% or 1*R-trans*-phenothrin 2% as the a.i.

Carry out all procedures as outlined in section 4.4.

One operator with one aerosol starts at the front the aircraft and moves down the aisle at a rate of not more than one step or one row of seats per second, the spray being directed towards the open overhead lockers on one side only. The other side is sprayed in the same manner while the operator walks back.

### Airbus A380

An A380 requires 3 × 100 g for the main deck and 2 × 100 g for the upper deck, containing d-phenothrin 2% or 1*R-trans*-phenothrin 2% as the a.i.

Carry out all procedures as outlined in section 4.4.

Main deck—300 g:

One operator with two aerosols starts at the rear of the aircraft and moves up one aisle and down the other, at a rate of not more than one step or one row of seats per second, directing the aerosols towards the open overhead lockers. When the two aerosols are empty, the remaining aisle is sprayed up and back with the third aerosol, the aerosol being directed towards the open overhead lockers.

Upper deck with no suites – 200 g:

One operator with two aerosols starts at the rear of the aircraft and moves up one aisle and down the other, at a rate of not more than one step or one row of seats per second, directing the aerosols towards the open overhead lockers.

Upper deck with suites – 200 g:

One operator starts from the suites and takes two to three steps in and out of the bedroom using the spray at one step per second and then proceeds to spraying the shower room and the living room, ensuring that any stowage compartments are open.

The operator then moves to the “apartments”, taking one or two steps in from the aisle for each apartment to ensure adequate coverage, taking one step per second and ensuring that all stowage compartments are open during treatment.

The operator will spray the rest of the upper deck by moving down the left-hand aisle and up the other at a rate of not more than one step or one row of seats per second, directing the aerosols towards the open overhead stowage compartments.

#### **Small aircraft (corporate jets and other small aircraft)**

Small aircraft require less than 1 × 100 g aerosol containing d-phenothrin 2% or 1*R*-*trans*-phenothrin 2% as the a.i.

Carry out the procedures in section 4.4, except for the flight deck, which is to be sprayed for 2 s, and any internally accessed baggage storage area, which is sprayed for 4 s. The access door is to be closed during treatment.

One operator with one aerosol sprays the flight deck, internal baggage storage areas and toilet(s) and then sprays the cabin, moving from the rear of the aircraft while directing the spray high in the air towards the ceiling and wall areas at a rate of not more than one step or row of seats per second.

Any separate external cargo holds should be sprayed with the amount specified in Annex 3 after all cargo and luggage has been loaded.

During spraying of cargo holds, ensure that the cargo hold doors are opened only just enough, in order to prevent spray from escaping to the exterior.

The cargo hold door should be closed immediately after spraying.

# Annex 3. Amounts of aerosol spray required by aircraft type

## A. Commercial passenger aircraft

Aircraft manufacturer and model	Cabin pre-embarkation: permethrin 2% (g)	Cabin pre-departure or on-arrival: d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin) (g)	Forward hold: d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) (g)	Aft hold: d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) (g)
<b>Airbus</b>				
A300-100/200	102	102	27	29
A300-600	207	207	27	29
A310-200	165	165	19	20
A318	41	41	3	6
A319	46	46	4	8
A320	52	52	5	10
A321	58	58	9	12
A330-200/800	126	126	30	33
A330-300/900	136	136	38	38
A340-200	126	126	30	33
A340-300	136	136	38	38
A340-500	177	177	38	34
A340-600	201	201	51	44
A350-900	170	170	40	39
A350-1000	170	170	49	45
A380	465	465	46	44
<b>Boeing</b>				
BBJ	65	65	4	2
BBJ2	80	80	10	6
Boeing 727-100	70	70	4	5
Boeing 727-200	85	85	7	8
Boeing 737-100	54	54	3	4
Boeing 737-200	59	59	4	5
Boeing 737-300	65	65	4	6
Boeing 737-400	73	73	6	8
Boeing 737-500	59	59	3	5
Boeing 737-600	59	59	3	5
Boeing 737-700	65	65	4	6

Aircraft manufacturer and model	Cabin pre-embarkation: permethrin 2% (g)	Cabin pre-departure or on-arrival: d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin) (g)	Forward hold: d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) (g)	Aft hold: d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) (g)
Boeing 737-800	80	80	7	9
Boeing 737-900	83	83	8	10
Boeing 737-1000	87	87	9	11
Boeing 747-100/200	321	321	19	22
Boeing 747-300	345	345	19	22
Boeing 747-400	344	344	28	36
Boeing 747-800	384	384	25	24
Boeing 747 SP	249	249	11	15
Boeing 757	115	115	6	11
Boeing 767-200/200ER	124	124	14	16
Boeing 767-300/300ER	146	146	19	21
Boeing 767-400ER	168	168	24	25
Boeing 777-200 ER/LR	246	246	28	28
Boeing 777-300 ER/LR	296	296	38	38
Boeing 777-900(X)	307	307	41	40
Boeing 787-800	204	204	25	23
Boeing 787-900	233	233	32	29
Boeing 787-1000	259	259	35	32
<b>Bombardier</b>				
CRJ 900	29	29	2	4
<b>British Aerospace</b>				
Bae146-100/200/300	47	47	4	4
	50	50	5a	5a
<b>Embraer</b>				
170 E-Jet	40	40	15	15
175 E-Jet	45	45	15	15
190 E-jet	50	50	20	20
195 E-jet	55	55	20	20
<b>Tupolev</b>				
TU-134	50	50	2	3
TU-154	95	95	3	4

Aircraft manufacturer and model	Cabin pre-embarkation: permethrin 2% (g)	Cabin pre-departure or on-arrival: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin) (g)	Forward hold: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) (g)	Aft hold: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) (g)	Separate bulk: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) (g)
<b>McDonnell Douglas</b>					
DC 8 – Series 60-70 <sup>b</sup>	–	137	–	–	–
DC9	–	68	7	5	–
DC10/MD10	8	200	25	21	8
MD11	–	224	28	27	–
MD81/82/88 <sup>c</sup>	4	60	5	4	4
MD83 <sup>c</sup>	3	60	4	3	3
MD87 <sup>c</sup>	3	55	3	4	3
MD90 <sup>c</sup>	4	56	4	3	4

## B. Small jets, regional and private aircraft (including private helicopters)

Aircraft manufacturer and model	Cabin pre-embarkation: permethrin 2% (g)	Cabin pre-departure or on-arrival: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin) (g)	Forward hold: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) (g)	Aft hold: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) (g)
<b>Bombardier</b>				
Challenger 300	10	10	5	5
Challenger 600	15	15	–	–
Challenger 601	15	15	–	–
Challenger 605	15	15	–	–
Challenger 850	25	25	–	–
Challenger 5000	25	25	–	–
CRJ 200	25	25	–	–
CRJ 700 (CL-6000)	24	24	1	4
Dash 8 (DHC-8) 100/200	15	15	–	–
Dash 8 (DHS-8) 300	20	20	–	–
Dash 8 (DHC-8) 400	32	32	1	4
Global 5000	25	25	–	–
Global Express	25	25	–	–
Learjet 24	5	5	–	–
Learjet 25	5	5	–	–
Learjet 31	5	5	–	–



Aircraft manufacturer and model	Cabin pre-embarkation: permethrin 2% (g)	Cabin pre-departure or on-arrival: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin) (g)	Forward hold: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) (g)	Aft hold: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) (g)
Learjet 35	5	5	–	–
Learjet 36	5	5	–	–
Learjet 40	10	10	3	3
Learjet 45	10	10	3	3
Learjet 55	5	5	2	2
Learjet 60	10	10	2	2
Learjet 85	10	10	–	–
<b>Cessna</b>				
Citation I	5	5	2	2
Citation II/SP	5	5	2	2
Citation V	5	5	2	2
Citation VI	5	5	3	3
Citation VII	5	5	3	3
Citation X	10	10	4	4
Citation Bravo	5	5	2	2
Citation CJ1	5	5	3	3
Citation CJ2	5	5	3	3
Citation CJ3	5	5	3	3
Citation CJ4	5	5	4	4
Citation S/II	5	5	2	2
Citation Encore	5	5	2	2
Citation Encore +	5	5	2	2
Citation Excel	5	5	2	2
Citation Jet	5	5	3	3
Citation Mustang	5	5	3	3
Citation Sovereign	10	10	5	5
Citation Ultra	5	5	3	3
Citation XLS	5	5	3	3
<b>Dassault</b>				
Falcon 7x	20	20	–	–
Falcon 10	5	5	2	2
Falcon 50	10	10	5	5
Falcon 100	5	5	2	2
Falcon 900	15	15	–	–
<b>Eclipse</b>				
Eclipse 400/500	5	5	2	2

Aircraft manufacturer and model	Cabin pre-embarkation: permethrin 2% (g)	Cabin pre-departure or on-arrival: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin) (g)	Forward hold: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) (g)	Aft hold: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) (g)
<b>Embraer</b>				
120	16	16	–	3
135	18	18	–	3
140	20	20	–	3
145	22	22	–	3
Legacy 450 (Emb-550)	13	13	–	2
Legacy 500	14	14	–	2
Legacy 600	23	23	–	2
Legacy Shuttle	22	22	–	3
Phenom 100/300	6	6	1	1
<b>Fokker</b>				
F27 Friendship	25	25	–	–
F28	41	41	3	2
F50	31	31	–	–
F60 – militarised F50	35	35	–	–
F70	43	43	3	2
F100	53	53	4	2
<b>Galaxy Aerospace</b>				
Galaxy	10	10	5	5
<b>Gulfstream</b>				
GII/GIII	15	15	–	–
GIV	20	20	–	2
GV	21	21	–	2
G100	5	5	–	1
G150	6	6	–	1
G200/250	11	11	–	1
G350/G450/ G500/ G550	21	21	–	2
G650	28	28	–	2
<b>Hawker Beechcraft</b>				
Beechcraft 1900	10	10	–	–
Beechcraft Premier I	5	5	3	3
Hawker 400	5	5	2	2
Hawker 750	10	10	2	2

Aircraft manufacturer and model	Cabin pre-embarkation: permethrin 2% (g)	Cabin pre-departure or on-arrival: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin) (g)	Forward hold: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) (g)	Aft hold: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) (g)
Hawker 800	10	10	2	2
Hawker 900XP	10	10	2	2
King Air	5	5	2d	2d
<b>Honda</b>				
Honda Jet	5	5	2	2
<b>Israel Aircraft Industries</b>				
Astra SP	5	5	3	3
Astra SPX	5	5	3	3
Westwind II	5	5	2	2
<b>Pilatus</b>				
PC – 12 NG	5	5	–	–

### C. Military aircraft<sup>e</sup>

Aircraft manufacturer and model	Cabin pre-embarkation: permethrin 2% (g)	Cabin pre-departure or on-arrival: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin) (g)	Forward hold: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) (g)	Aft hold: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) (g)
<b>Airbus</b>				
KC-30/A330 MRTT	212	212	30	33
A400M	120	120	–	–
<b>Boeing</b>				
Osprey	15	15	–	–
B-52 Stratofortress (bomber)	200	200	–	–
B757	100	100	6	11
C40 (B737-700)	70	70	4	5
KC B767	124	124	14	16
KC-135R Stratotanker	100	100	–	–
P-8A Poseidon	100	100	–	–
<b>Bombardier</b>				
Learjet C21	5	5	–	–

Aircraft manufacturer and model	Cabin pre-embarkation: permethrin 2% (g)	Cabin pre-departure or on-arrival: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin) (g)	Forward hold: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) (g)	Aft hold: d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R</i> -trans-phenothrin 2%) (g)
<b>EADS CASA/IPTNf</b>				
CASA CN235	20	20	–	–
<b>Embraer</b>				
145 AEW	25	25	–	–
C-99A (Transport 145)	25	25	–	–
E-99	25	25	–	–
P-99 (Maritime)	25	25	–	–
R-99	25	25	–	–
<b>Gulfstream</b>				
C-20 (A/D) Gulfstream III	15	15	–	–
C-20 (G) Gulfstream IV	20	20	–	–
C-37 Gulfstream V	20	20	–	–
<b>Hawker Beechcraft</b>				
C-12	5	5	1f	1f
<b>Ilyushin</b>				
IL-62	100	100	–	–
IL-96	274	274	32	25
IL-II 76	88	88	–	–
<b>Lockheed</b>				
C5 Galaxy	700g	700 g	–	–
C130 Hercules	60	60	–	–
MH60R	5	5	2	2
L-101 Tristar	–	200	19	15
P3 Orion	–	100	10h	10h
<b>McDonnell Douglas</b>				
C17 Globemaster	200	200	–	–
<b>Sikorsky</b>				
UH-60 Blackhawk	5	5	2	2
SH-60 Seahawk	5	5	2	2
<b>Northrop Grumman</b>				
E-2C Hawkeye	20	20	–	–
C-2 Greyhound	20	20	–	–
<b>Leonardo's Aircraft Division</b>				
Alenia C-27J Spartan	50	50	–	–

## D. Freighter aircraft

Aircraft manufacturer and model	Cabin pre-embarkation: permethrin 2% (g)	Cabin pre-departure or on-arrival: d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) (g)	Main deck cargo area: d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) (g)	Forward hold: d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) (g)	Aft hold: d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) (g)	Separate bulk: d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) (g)
<b>Airbus</b>						
A300-F4200	6	6	101	27	24	–
A300-F4600	4	4	191	27	29	–
A300-600ST Beluga	2	2	665	–	30	8
A310-200/300F	4	4	160	19	20	–
A330-200F	4	4	141	30	33	–
A330-300P2F	4	4	160	38	38	–
A330-700XL Beluga	2	2	780	–	38	8
<b>Antonov</b>						
Antonov 124	50	50	359	–	–	–
Antonov 225	50	50	431	–	–	–
<b>Boeing</b>						
Boeing 707-320C	4	4	80	9	9	–
Boeing 727-100	4	4	33	4	5	–
Boeing 727-200	4	4	47	7	8	–
Boeing 737	4	4	58	6	7	–
Boeing 747-100/200	33	33	176	19	22	–
Boeing 747-300/400	56	56	187	28	36	–
Boeing 747-800	66	66	245	25	24	–
Boeing 747 Combi	218i	218i	70	26	36	–
Boeing 747 LCF (Dream Lifter)	30	30	650	20	20	–
Boeing 757	4	4	66	11	13	–
Boeing 767	4	4	168	19	21	–
Boeing 777	4	4	170	38	38	–

Aircraft manufacturer and model	Cabin pre-embarkation: permethrin 2% (g)	Cabin pre-departure or on-arrival: d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) (g)	Main deck cargo area: d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) (g)	Forward hold: d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) (g)	Aft hold: d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) (g)	Separate bulk: d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) + permethrin 2%, or d-phenothrin 2% (or 1 <i>R-trans</i> -phenothrin 2%) (g)
Boeing 787	4	4	259	35	32	
KC 135	3	3	60	–	–	
<b>McDonnell Douglas</b>						
DC 8 – 60-70 series <sup>b</sup>	3	3	134	–	–	
DC 9	3	3	65	7	5	
MD11	4	4	220	28	27	
<b>Shorts</b>						
Belfast	4	4	110	–	–	

–, no spray requirements

<sup>a</sup> Electronic and equipment bay, hydraulics bay and adjacent to holds.

<sup>b</sup> Most have four belly holds. Spray at 12 g per hold.

<sup>c</sup> These aircraft typically have forward, centre and rear holds.

<sup>d</sup> Over wing lockers.

<sup>e</sup> All fighter jets are usually exempt from disinsection because they contain sensitive electronic equipment and are at low risk of carrying live mosquitoes.

<sup>f</sup> European Aeronautic Defence and Space Co./Construcciones Aeronauticas SA–Industri Pesawat Terbang Nusantara (Indonesian Aerospace).

<sup>g</sup> 600 g for main deck and 100 g for upper deck.

<sup>h</sup> Spray bomb bay via external hatch with 10 g of pre-spray.

<sup>i</sup> Passenger cabin.

# Annex 4. ICAO Residual Aircraft Disinsection Certificate

GOVERNMENT OF .....

**CERTIFICATE OF RESIDUAL DISINSECTION**

Interior surfaces, including cargo space, of this aircraft ..... were treated with an approved residual ..... (aircraft registration) disinsection product on ..... in accordance with the World Health Organization recommendations (WHO Weekly Epidemiological Record No. 7, 1985, p. 47; No. 12, 1985, p. 90; No. 45, 1985, pp. 345-346; and No. 44, 1987, pp. 335-336) and any amendments thereto.

The treatment must be renewed if cleaning or other operations remove a significant amount of the residual disinsection product, and in any case within 8 weeks of the above date.

Expiry date: .....

Signed: .....

Designation: .....

Date: .....

# Annex 5. ICAO Aircraft General Declaration

<b>GENERAL DECLARATION</b>		
<b>(Outward/Inward)</b>		
Operator .....		
Marks of Nationality and Registration..... Flight No. .... Date .....		
Departure from ..... Arrival at .....		
(Place) <span style="margin-left: 200px;">(Place)</span>		
<b>FLIGHT ROUTING</b>		
("Place" Column always to list origin, every en-route stop and destination)		
PLACE	NAMES OF CREW*	NUMBER OF PASSENGERS ON THIS STAGE**
		<i>Departure Place:</i>
		Embarking .....
		Through on same flight .....
		<i>Arrival Place:</i>
		Disembarking .....
		Through on same flight .....
<i>Declaration of Health</i>		For official use only
Name and seat number or function of persons on board with illnesses other than airsickness or the effects of accidents, who may be suffering from a communicable disease (a fever – temperature 38 °C/100 °F or greater – associated with one or more of the following signs or symptoms, e.g. appearing obviously unwell; persistent coughing; impaired breathing; persistent diarrhoea; persistent vomiting; skin rash; bruising or bleeding without previous injury; or confusion of recent onset, increases the likelihood that the person is suffering a communicable disease) as well as such cases of illness disembarked during a previous .stop .....		
Details of each disinsecting or sanitary treatment (place, date, time, method) during the flight. If no disinsecting has been carried out during the flight, give details of most recent disinsecting .....		
Signed, if required, with time and date ..... Crew member concerned		
I declare that all statements and particulars contained in this General Declaration, and in any supplementary forms required to be presented with this General Declaration, are complete, exact and true to the best of my knowledge and that all through passengers will continue/have continued on the flight.		
SIGNATURE ..... Authorized Agent or Pilot-in-command		

Size of document to be 210 mm × 297 mm (8 ¼ × 11 ¾ inches).

\* To be completed when required by the State.

\*\* Not to be completed when passenger manifests are presented and to be completed only when required by the State.







World Health  
Organization



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