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Operators have reported cases of aircraft infestation by rodents such as mice and rats, and reptiles such as snakes and lizards, causing discomfort and alarm amongst passengers and crew, but also potentially considerable damage to the aircraft. Their presence in an aircraft can lead in extreme cases to the aircraft being grounded, especially when electrical wiring damage has been discovered. Rats and mice seem to be attracted by the odours emitted by the insulation around the wires.

In-service experience has revealed that rodents and reptiles tend to board an aircraft through open doors and access panels, when it is parked for a relatively long period of time either in the hangar or on the apron, especially during the night when human activity is reduced. Also, they have been observed entering the aircraft during loading of catering trolleys and cargo.



*Fumigation of aircraft with
carbon dioxide CO₂*

Up to mid 1997, Airbus Industrie had provided operators with the possibility of fumigating infested aircraft with a methyl bromide based chemical agent, referred to as 'SOXAL-PESTIGAS' in the Aircraft Maintenance Manual (AMM).

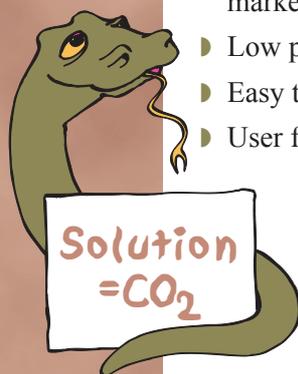
However, due to the continuing international process of banning toxic fumigation agents for civil use, and concerns about the usage and potential side effects of this agent, Airbus Industrie decided to withdraw it from the AMM.

Specifically, these concerns were focused upon:

- ▶ Residue of methyl bromide still traceable in some areas in the cabin and cargo compartments up to 36 hours after aircraft aeration;
- ▶ Accumulation of methyl bromide residues in the thermal-acoustic insulation blankets behind the linings of the cabin and cargo;
- ▶ Compatibility of methyl bromide based agents with sophisticated aircraft electronic equipment;
- ▶ Existence of chloroflourocarbons (CFC) in methyl-bromide agents, which are restricted in many countries by law, further to the Montreal protocol.

Airbus Industrie launched an investigation to identify another fumigation agent, possessing the following characteristics:

- ▶ Inert;
- ▶ Non toxic;
- ▶ Widely available in the world market;
- ▶ Low procurement cost;
- ▶ Easy to contain and transport;
- ▶ User friendly.



As a result, it has been determined that carbon dioxide (CO₂) can fulfil the above requirements, where the extermination of the rodents and reptiles would be achieved by means of asphyxiation.

CO₂ is already used in industry for protecting food stored in holds of ships and warehouses, and for protecting cultivated plants. In addition, the use of CO₂ for fumigation was of special interest since its procurement cost is lower than Nitrogen (N₂) and less of it is required.

In August 1999, Airbus Industrie conducted CO₂ fumigation tests in an A319 aircraft. The test readings were taken using probes placed in designated areas in the cabin, cockpit, avionics and cargo compartments measuring the CO₂ concentration at specified time intervals.

NOTE: no live animals of any kind were used in these fumigation tests.

The test results were positive, since CO₂ concentration reached approximately 90% of the aircraft volume, and scientifically it has been shown that the lethal dose to exterminate a rodent is approximately 60% of CO₂ with exposure of about six minutes. Therefore, Airbus Industrie decided to implement CO₂ and the associated fumigation procedure into the scheduled AMM revisions for each aircraft.

CO₂ Fumigation procedure

IMPORTANT: Operators are advised to consult AMM 12-21-12 for the specific aircraft fumigation procedure. The AMM for A319/A320/A321 was revised in May 2000 to incorporate fumigation procedure by CO₂ and for the A330/A340 in July 2000. The revision to the AMM for the A300/A300-600/A310 family is planned for the first quarter of 2001.

In addition, operators are advised to refer to SIL 12-007, revision 01, issued end of October 2000, since useful supplementary information is provided.

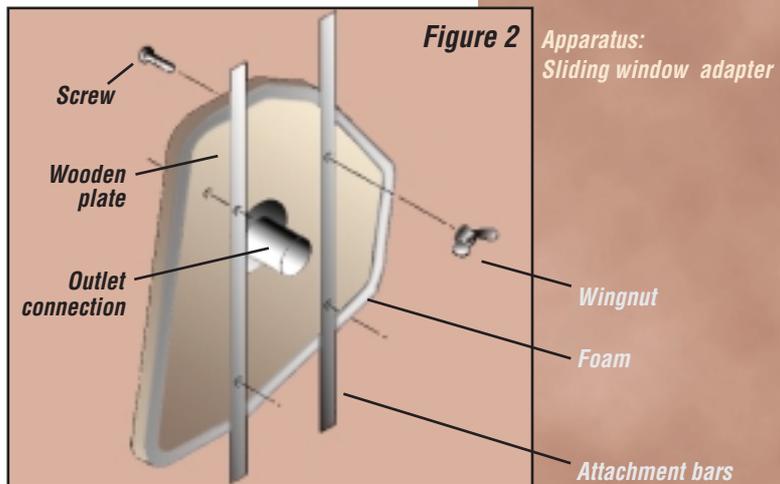
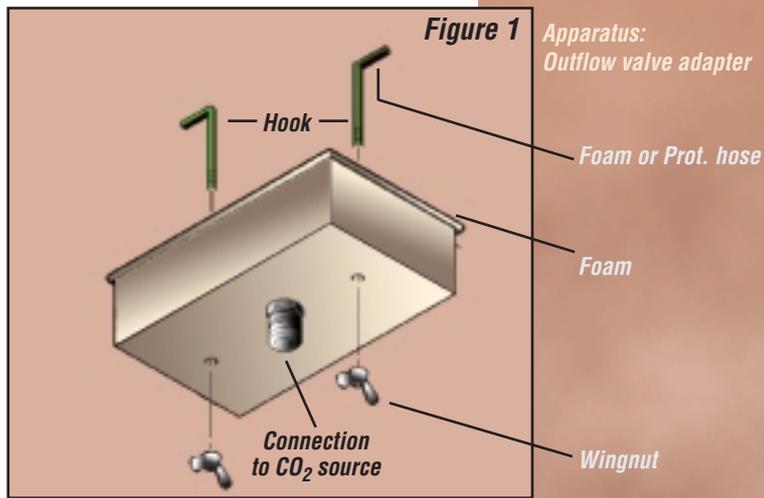
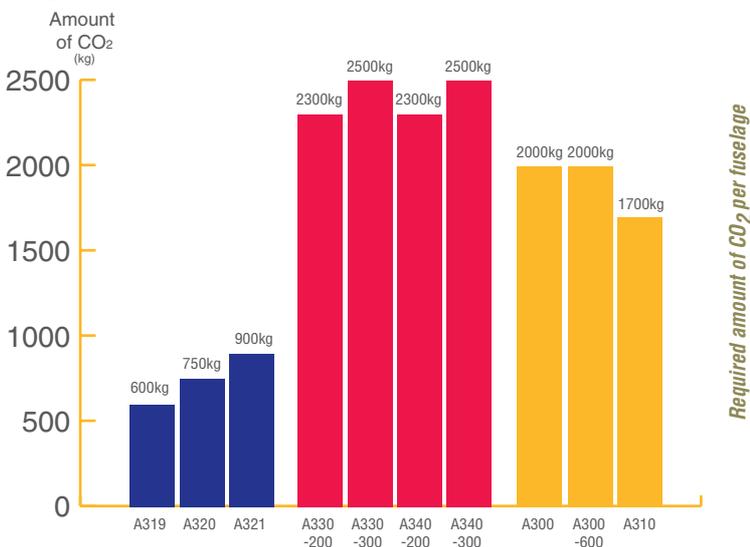
The fumigation procedure by CO₂ is the same for all of Airbus Industrie aircraft. A locally manufactured filling adaptor is installed over the outflow valve of the air-conditioning system and an outlet pipe installed at one of the cockpit sliding windows (see figures 1, 2 & 3).

When Airbus Industrie conducted the fumigation test, an average CO₂ mass flow rate of 3.6 kg/min was selected, corresponding to almost 2000 litres/min of CO₂, by adjusting the pressure to 8 bars at the CO₂ supply. In this case the filling time for an A319 was nearly three hours. Equipment is available, with a higher mass flow rate capability that would allow large aircraft to be filled in approximately the same time. The filling time is calculated using the required CO₂ mass specified in the table below for each type of aircraft fuselage and the mass flow rate selected. When the specified amount of CO₂ has been reached, the filling process stops.

Although the cargo compartments are nominally sealed from the cabin, cockpit and avionics compartments, it was demonstrated during the test that the cargo compartments are also filled with CO₂. This will occur through the cargo compartment drain lines (the leakage in/out is in fact calibrated for the purpose of assuring containment of fire extinguishant).

Usually, the CO₂ gas is contained under pressure in liquid form of about 150 Bars and at low temperatures. Heat exchangers and evaporators, (see photo →), are used to elevate the temperature of the gas prior to approximately 15°C on entering the fuselage.

The following table shows the amount of CO₂ required for each fuselage ↓



Heat exchangers and evaporators

CO₂ Fumigation procedure (cont'd)

The CO₂ enters the cabin through a locally manufactured simple adapter that is installed over the out-flow valve. To ensure that the CO₂ penetrates to the highest level in the cabin an outlet tube is fitted above the ceiling panel behind the cockpit, with the end placed at the highest position in the fuselage. The other end is taken out through a blank fitted in place of the sliding window in the cockpit (see figure 3c →). Thus as the level of CO₂ rises in the cabin it forces out the ambient air through the tube. After the CO₂ filling process, the aircraft should remain closed for half an hour for rodent extermination and 12 hours for reptile extermination.

General information

Using CO₂ and Insecticides

Fumigation using CO₂ is not totally effective against insects but very effective against rodents and reptiles. In case an operator needs to exterminate insects as well as rodents and reptiles then insecticide in association with fumigation should be used. First the internal section of the pressurised fuselage has to be sprayed with 'Baygon', (Material No. 14-004 or 14-004A), and then, the CO₂ fumigation procedure should be performed. Insects such as ticks are almost resistant to high concentrations of CO₂ gas since they can close their trachea and virtually stop their metabolism. Other insects such as cockroaches will lay their eggs prior to dying. CO₂ has no effect on the eggs, however 'Baygon' is effective against them.

In the case of reptiles, the fumigated aircraft has to be kept with all doors, hatches and drain ports closed and sealed for at least twelve hours. This is due to the fact that reptiles hibernate when under threat or lack of nutrition. They can reduce their heartbeat significantly as well as their rate of breathing.

Rodents are exterminated after being exposed to an environment

with 60% CO₂ content for six minutes.

The CO₂ has an anaesthetic effect after 20 seconds.

Penetration of the CO₂ into the thermal-acoustic insulation blankets behind the cabin and cargo linings, was measured at about 90% during the fumigation test.

Using Conventional Methods

If an operator wishes to use conventional traps (spring loaded or with adhesion) to catch rodents and or reptiles then the following technique should be used:

- ▶ Prior to placing the traps, remove all catering trolleys and the waste from the trash compactors, (if any), from the galleys, from the lavatory waste bins and from any other container which could contain any waste.
- ▶ Remove all soap bars and dispensers from the lavatories.
- ▶ Remove all cosmetic products from the lavatories.
- ▶ Place the traps in the cabin, in the aisles, below the seats, in the galley and lavatory areas, in the cockpit, in the avionics bay, in the cargo holds, and in the Flight Crew Rest Compartment, Lower Deck Mobile Crew Rest compartment and Lower Deck Lavatories, if any of these are installed.
- ▶ Close all aircraft doors and hatches for twelve hours with no human activity around the aircraft.

The main advantage of fumigating an aircraft by CO₂ over the use of conventional traps is that the result is definitive in a specified time frame.

IMPORTANT: Do not under any circumstances use poison capsules for rodents, since their later removal could be easily omitted by cleaning personnel, leaving them to be swallowed by child passengers.

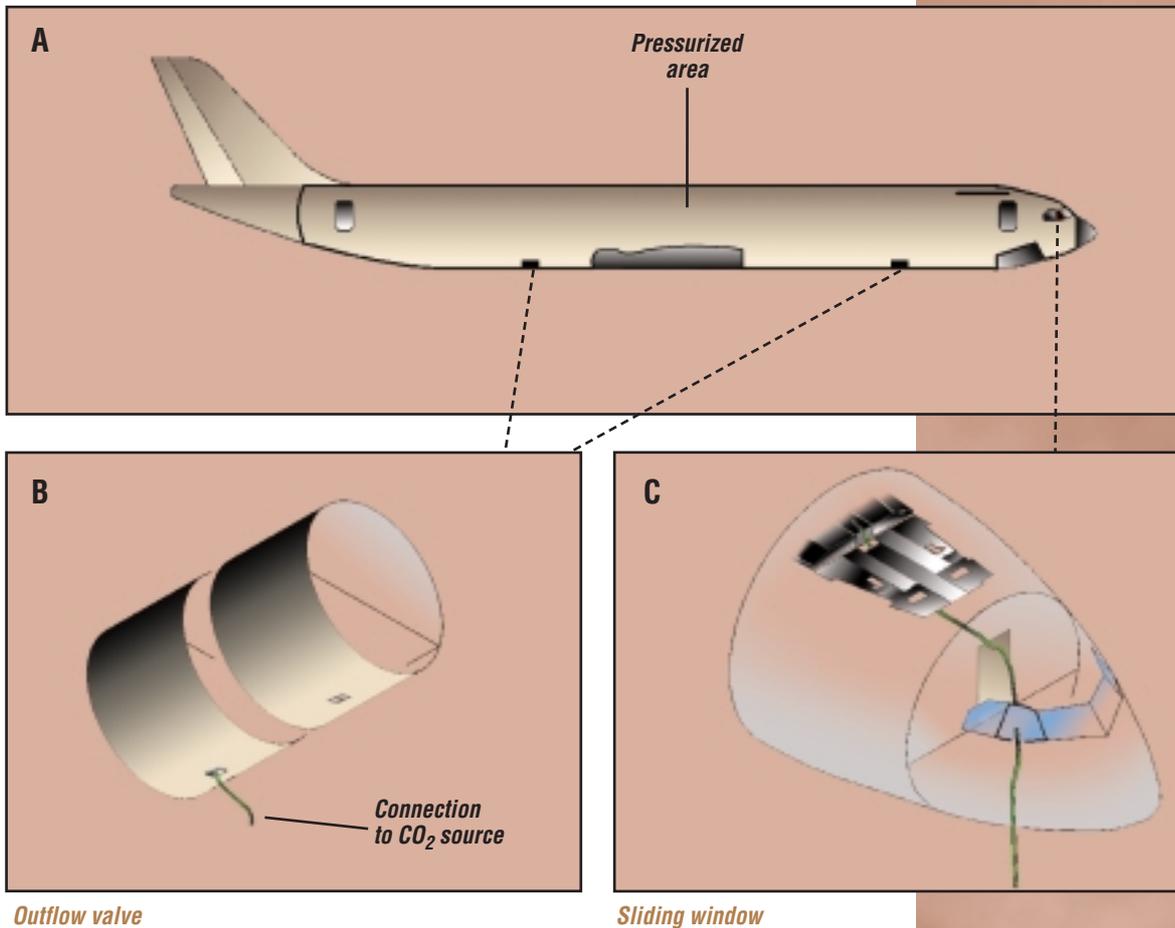
Do **not** under any circumstances use ultra-sonic animal repellent devices inside and/or near the aircraft.



CO₂ SUPPLIER

Airbus Industrie encourages operators wishing to use CO₂ for fumigation to use the method described in the AMM. They should contact and use local CO₂ suppliers and their associated equipment for performing the fumigation task. Airbus Industrie performed the fumigation test in association with Linde AG. (*see address below*) who supplied the gas and also the equipment.

Figure 3 Installation of apparatus



Conclusion

Airbus Industrie, being conscious of the difficulties faced by operators when pests board their aircraft, and with the gradual prohibition of toxic agents against them, has developed an effective, user friendly solution for the eradication of stowaway reptiles and rodents.

It uses products and materials that are in common use, and very simple to adapt to the aircraft.

Good hunting!

Contact person and address of supplier

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Note: LINDE AG has international distribution centres.