

A Code of Practice

For the Control of Bed Bug Infestations in Australia

4th Edition

March 2013



Stephen L. Doggett



A Code of Practice for the Control of Bed Bug Infestations in Australia

Fourth Edition (www.bedbug.org.au)

Stephen L. Doggett*

Principal Editor

Department of Medical Entomology,
Institute for Clinical Pathology & Medical Research,
Westmead Hospital, WESTMEAD NSW 2145, Australia.

*On behalf of the Bed Bug Code of Practice Working Party,
Australian Environmental Pest Managers Association,
GPO Box 4886, SYDNEY NSW 2001, Australia.

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1. PREFACE TO THE FOURTH EDITION

Bed bugs continue to be a major problem in the developed world including Australia, and management technology has evolved at a rapid pace, hence the need for an updated edition of the '*Code of Practice for the Control of Bed Bug Infestation in Australia*' (CoP). Up until recently in the modern bed bug resurgence, encounters with the insect were mainly in areas where people slept. However, bed bugs have had a broader societal impact with infestations occurring in shops, offices, hospitals, physician waiting rooms, public transport systems such as planes, trains and buses, and cinemas. You no longer need to stay in an infested bed to pick up bed bugs.

One of the major factors for the degree of the bed bug resurgence has been poor pest control and the failure of industry associations around the world to provide guidance to their members on 'best practice' in the management of modern insecticide resistant strains of bed bugs (Doggett *et al.* 2011). Thus it is encouraging to see the release recently of two major industry standards.

The '*European Code of Practice Bed Bug Management*' was initially developed from the third edition of the Australian CoP and has been adapted for the European market (Madge 2011). This has become a quality document such that the current edition of the CoP has cherry-picked the best from the European CoP. The organisation behind the European CoP, the Bed Bug Foundation (BBF), has joined forces with the Working Party for the Australian CoP, in an information co-sharing arrangement to better improve standards on bed bug management. The chair of the BBF, Oliver Madge, is especially acknowledged for his collaboration.

From the US, the '*NPMA BMP Bed Bugs Best Management Practices*' was released in 2011 (NPMA 2011). While more limited in detail and scope than the European Code, it is a welcome edition to the fight against bed bugs and does contain useful information that was used to enhance the Australian CoP.

As mentioned in the previous editions, bed bugs are an international problem and infestations can only be reduced in number worldwide if best practice management options are undertaken globally. The adoption and promotion of this CoP by other organizations and stakeholders, especially those in the pest management and accommodation industries, is welcomed.

Many of the updates within this version represent knowledge refinements and there are few major amendments or additions. One of the big trends in the US is the use of thermal heating to control bed bugs which is now included in this CoP (Section 17.1.4). If done properly thermal heat can result in the very quick eradication of infestations, unfortunately however, there has been a recent

series of fires resulting in the complete destruction of buildings with the use of heating and so such technology should only be employed by the most experienced. To help assist those in the accommodation industry and to minimise the impacts of bed bugs, the development of Proactive Management Plans is encouraged (Section 16.1). These plans should be part of an overall Bed Bug Management Policy and Procedural Guide; such a guide has been developed in Australia and is freely available from www.bedbug.org.au (Doggett 2011). Pest Managers are encouraged to produce an 'Eradication Declaration' report at the end of the treatment process and to list any impediments to a successful treatment (Section 19.1.2). There is also an update on new insecticides registered in Australia (Section 17.2.3). Of the new actives, amorphous silica (Diatomaceous Earth Dust) is likely to offer additional benefits to the Pest Manager.

Despite the market being flooded with bed bug management devices and products since the last edition of the CoP, very few have been verified as efficacious by an independent scientific body. Accordingly, the use of any management device not specifically supported in this CoP is not recommended.

The CoP is the culmination of the hard work of many and sincere thanks must be given to the CoP Working Party (listed in Appendix A), those who provide feedback, and to the individuals listed in the acknowledgements.

Stephen Doggett
March 2013

2. AIMS

The aims of the CoP are:

- i. To define **best practice** and outcomes through a CoP that encompasses an integrated pest management approach to the eradication of active bed bug infestations and the management of potential infestations,
- ii. To develop the CoP through **broad industry consultation**,
- iii. To provide **education** of stakeholders,
- iv. To **protect** stakeholders,
- v. To provide a **reference document** on which other more focused documents can be based.

The CoP endeavours to provide a reference document with broad acceptance by the pest management industry, which would be a guide to Pest Managers, the accommodation industry, service industries and professions and the general public on best practice in the control of active bed bug infestations, minimisation

of the spread of existing infestations and the prevention of possible future infestations.

The expected outcome from adherence to the CoP would be to minimise the impact of bed bug infestations wherever they occur. If improved control results from the CoP, then this should lead to a reduction in the rate of new infestations.

3. DOCUMENT ADMINISTRATION & REVIEW

This CoP was devised and is administered by a Working Party of the Australian Environmental Pest Managers Association (AEPMA), the national peak professional association for urban and commercial pest management in Australia. The appointment of the Working Party and ongoing administration and review of the CoP are conducted in accordance with guidelines agreed by the national board of AEPMA (Orton 2010).

Members of the Working Party, listed in Appendix A, include at least; one representative of AEPMA, one published scientist who is a recognised expert, one member of a University or Institute of Higher Education (which may or may not be the expert), one representative of an insecticide company and at least three licensed Pest Managers who are recognised as having experience in bed bug control. In addition, specific expertise required to devise and manage a best practice document is defined in the above mentioned guidelines .

The CoP is reviewed periodically to ensure that it incorporates the most recent advances in research and management technology in the control of bed bugs. Draft versions of each edition are made available for public comment and feedback is sought from various groups. This includes Pest Managers, pesticide manufacturers and suppliers, the accommodation industry and tourism bodies, environmental health managers and other health workers, researchers in tertiary institutions, and many other affected stakeholders. The feedback is used to develop the final release of each edition of the CoP.

Any version encompassing major changes is made available for public comment. Minor changes are undertaken at the discretion of the Working Party. All subsequent changes to the CoP are documented and made available on the bed bug CoP web site. The Department of Medical Entomology, Westmead Hospital, Bed Bug CoP web site (www.bedbug.org.au), should be checked for the latest version of the CoP.

Each edition of the CoP is valid for a maximum of eighteen months from the

date that appears on the front cover at which time it is reviewed to ensure currency. Only the current edition as displayed on the CoP bed bug web site is valid. Any suggestions that may improve the CoP can be sent to Stephen Doggett, Department of Medical Entomology, Westmead Hospital, Westmead NSW 2145, or email: Stephen.Doggett@swahs.health.nsw.gov.au.

4. LIMITATIONS OF THE CoP

Where possible the control and management strategies recommended herein are based on independent and peer reviewed scientific publications. However, due to the paucity of research in some areas since the recent bed bug resurgence, it has been necessary to initiate this CoP using the successful experiences of numerous Pest Managers and researchers. It should be noted that this CoP does not attempt to discuss every technology proposed for the control and management of bed bugs; only those where there is evidence of efficacy through common practice or via publications. If a product supported by the CoP is being promoted in a manner based on unsubstantiated claims, the company will be seen not to be promoting 'best practice' in bed bug management and the product may be removed from subsequent editions of the CoP.

As the bed bug situation is currently highly dynamic, it is envisaged that more insecticides and other management devices will become available, and scientific publications will be forthcoming. Thus it will be necessary to regularly review the CoP.

The CoP does not attempt to provide detailed background information on the biology and ecology of bed bugs. It is recognised that this is essential information and such knowledge will aid in the control and management of bed bug infestations. The biology of the pest will be the guiding principle for management practices. See Section 23 for references to bed bug biology.

5. SCOPE OF THIS CoP

The CoP will include currently identified effective control methodologies, which may be employed against bed bug infestations:

- To control active infestations,
- To minimise the spread of active infestations, and
- To minimise the risk of future infestations.

These control methodologies will include Integrated Pest Management (IPM) procedures as outlined in Section 11.

In describing control methodologies that may be employed, the following details will be included:

- Circumstances under which the measures should be used,
- Limitations and contra-indications of the measures,
- Required philosophies of Pest Managers, clients and the accommodation industry (Section 6),
- Required training of Pest Managers and clients (Section 7, 8),
- Customer relations (Section 8),
- Occupational health and safety (Section 9),
- How clients can find a Pest Manager appropriately trained in bed bug management (Section 10),
- Documentation of control methodologies (Section 16, 19).

The CoP is targeted towards any Australian individual, organisation (both government and non-government), or industry involved with the control and management of bed bugs, those who may be directly impacted by bed bugs, government organisations in the position of enforcing compliance, or those who are in a position where they could inadvertently spread bed bugs (e.g. second hand furniture sellers, linen contractors). This includes for example; Pest Managers, the hospitality industry including housekeeping staff, campervan hire industry, tourism operators, environmental health officers, charter boat operators, staff accommodation managers, housing organisations, landlords, property managers, transport operators, linen contractors, second hand furniture sellers and government.

6. REQUIRED PHILOSOPHIES

6.1. Pest Manager

For bed bug control the Pest Manager must realise that the normal practice of 'management' is not an option and that the client desires elimination.

The cryptic nature of bed bugs means that complete eradication with a single treatment is unlikely, especially in heavy infestations. The inspection process must be extremely thorough and may take considerable time, as all harbourages need to be identified and subsequently treated. Follow up inspections are always required and repeated treatments are usually necessary even in minor infestations. Ongoing surveillance during the control program is essential. Inadequate control often leads to a spreading of the infestation with inevitable

escalating control costs to the client, and potential loss of credibility and business for the Pest Manager. By aiming to achieve complete eradication, the risk of insecticide resistance will be reduced.

The Pest Manager should never undertake a bed bug treatment that does not conform to this CoP as a 'quick fix' solution. For example, the mattress should not be treated on one day and the remainder of the room on the next, as this can lead to dispersal of the insect even to adjoining rooms and units. The Pest Manager must attempt to eradicate the infestation with the first treatment. There should be a minimum of one follow up visit (or more with heavy infestations) and the final inspection should determine the success of the treatment.

The Pest Manager should integrate both non-chemical and chemical means of control and aim to minimise the risk of insecticide exposure to the public. Only those insecticides that are either currently registered or approved for use for bed bug control by the Australian Pesticides and Veterinary Medicines Authority (APVMA) must be used by the Pest Manager.

The Pest Manager must provide quality work as per 'best practice' defined in this CoP or warn the client that control will not be achieved. Where the client is unwilling to follow the recommendations of this CoP, the client must accept responsibility for this decision, and this fact must be documented by the Pest Manager, and signed by the client.

Bed bug control can only be achieved if the client fully cooperates with the Pest Manager. Cooperation may include preparing the room for treatment, to possible room closure. If the client is unwilling to cooperate with the Pest Manager, then a successful elimination may not be achieved. In this case the Pest Manager should consider not accepting the work, or include a preparation fee to the service.

6.2. The Client

The client can not solely rely on the Pest Manager for the prevention and control of bed bug infestations. For the Hotelier there is a responsibility to undertake preventative measures including, risk management, education of staff in bed bug management, ensuring that appropriate hygiene measures are implemented and maintained, ensuring that rooms are not bed bug 'friendly', and that other strategies are implemented to reduce the risk of potential infestations (Section 20). The Pest Manager will require the client to undertake certain activities during a control program. Without this cooperation, the treatment is likely to fail.

The client should not attempt to control an infestation prior to a site assessment by the Pest Manager. Such attempts can spread the infestation, increase the downtime of the premises, present a health and safety risk, and lead to an increase in control costs.

The client must realise that the control of bed bugs is expensive, especially in heavy infestations when rooms may be closed for extended periods. It is not the intention of the CoP to compromise any control activity on the basis of financial impact, no matter how costly. Rather the intention of this CoP is to provide current 'best practice' for the control of active infestations, the prevention of spreading active infestations, and the management of future potential infestations. However, research is encouraged to find the fastest control methods in an effort to minimise disruption and possible cost to the client.

6.3. Accommodation Industry

To reduce the risk of litigation and to minimise the potential for bed bugs, those in the sector of providing accommodation should attempt to demonstrate 'due diligence'. 'Due diligence' is the taking of all reasonable actions and care to prevent significant harm or undue risk to any party involved in an activity. For the accommodation industries, due diligence would involve risk minimisation strategies for potential bed bug infestations and ensuring that management strategies were promptly implemented once an infestation was detected. The development and implementation of a bed bug management policy and procedural guide based on best practice, which is subject to regular review, would assist in the demonstration of due diligence. A bed bug policy and procedural guide (Doggett 2011), which was developed from this CoP is freely available from www.bedbug.org.au.

7. TRAINING

7.1. Pest Managers

Pest Managers who undertake bed bug control should be specifically trained in bed bug identification, biology and management. Likewise, the Pest Manager should be trained in how to reduce the risk of acquiring and transporting bed bugs on themselves or their equipment when attending a bed bug infested site. This includes procedures for how equipment is brought in and taken out of infested sites, how infested beds and furnishings should be physically handled,

how infested items are properly disposed of, and how pest control equipment is stored in the vehicle after leaving an infestation.

This CoP should form the basis of any bed bug training program. Likewise, any bed bug training program being appraised for PestCPD compliance must ensure that this CoP forms the basis of the program. All training should be through RTOs or a PestCPD appraised activity.

Companies and Pest Managers who undertake bed bug management should review industry developments on a regular basis. It is preferable that only sales staff who have practical experience in bed bug management provide quotes on bed bug jobs, to avoid inaccurate costings.

The Working Party has developed an appraised one day course for the training of Pest Managers in bed bug management. The curriculum for this is based on the CoP. Pest Managers who successfully complete the course will be listed on the CoP web site, www.bedbug.org.au.

7.2. Accommodation/Housekeeping Staff

Housekeeping staff are in the position where they may recognise the signs of a bed bug infestation before the guests become aware of the problem. While this may not always happen, vigilance can prevent the bed bugs from becoming well established. Housekeeping staff should be trained in recognising the signs of bed bugs, including blood spotting on the sheets, mattresses and walls, and the bed bugs themselves, and routinely inspect the beds for signs of activity. Samples of bed bugs should be kept for future reference and training. Management could record bed bug indications via digital imagery. As housekeeping staff in Australia may not have English as the first language, staff information should be multi-lingual where appropriate. For the Hotelier, it is important to maintain records of staff training. Training should be undertaken by an appropriately skilled person. For hotels who use outside cleaning contractors, the Hotelier may consider establishing an in-house executive housekeeping position who would take responsibility for training and documentation.

It is often in the interest of the Pest Manager and their organisation to offer training to accommodation/housekeeping staff as a bed bug aware client can appreciate the difficulties involved in eradication and are more likely to cooperate.

Other staff who may have to deal with affected guests or those responsible for ensuring that control of infestations are undertaken, should also receive specific training in bed bugs. This may include front of house, managerial and

maintenance staff.

7.3. Publications

All industry publications (be they in pest management, accommodation or housekeeping journals) making recommendations on bed bug control should be in compliance with this CoP.

Industry publications should only be produced by recognised bed bug experts, and/or be externally refereed by a recognised bed bug expert. The referee/s should be included in the acknowledgement to show that the article has been reviewed by a recognised expert.

8. CUSTOMER RELATIONS & EDUCATION

8.1. Pest Managers

8.1.1. *Client Confidentiality*

In the past, bed bugs were largely associated with substandard housing. While this is no longer the case, for many the past association has developed into a stigma by which the client is embarrassed if an infestation occurs. For example, the Hotelier sees bed bugs as potentially impacting on their public image and they may lose clientele if in-house infestations became known. Thus the confidentiality of any bed bug infestation must be assured and must be written into the contract.

8.1.2. *Client Education*

To assist in the education of the client on bed bugs, the Pest Manager should consider providing the following;

- A copy of this CoP or details from where this can be downloaded (i.e. www.bedbug.org.au).
- Information on bed bugs and their biology (a fact sheet should be provided; one can be downloaded from www.bedbug.org.au), and clients should be informed that bed bugs are difficult to control due to their elusive nature.
- Information stating that there is no evidence that bed bugs transmit disease-causing organisms, although some people can develop allergic reactions. If the client has any medical issues, the Pest Manager must

never provide medical advice and suggest that they should consult a Medical Practitioner (or see articles: Doggett & Russell, 2009; Doggett *et al.*, 2012).

8.1.3. Professionalism

As noted above, bed bugs can give a hotel a poor public image. Thus all dealings with clients must be conducted in a professional manner. The infestation should not be discussed in a location where guests may overhear the conversation, and preferably only the management or housekeeping staff should be consulted. Treatments in common areas should be undertaken during times that would least inconvenience guests.

8.1.4. Warranties

A client accepting a Bed Bug Management Plan (Section 16) typically expects that elimination will be achieved. Accordingly where practical, the Pest Manager should offer a written service warranty. However, any contractual obligation should contain reference to client and Pest Manager responsibilities and limitations within the Bed Bug Management Plan. These would include the cooperation of the client during treatment as described in this CoP, circumstances encountered during the implementation of the plan, the quality of ongoing housekeeping, the nature of the room itself (whether or not it is 'bed bug friendly'; refer to Sections 20.6, 20.8 & 20.9), the level of ongoing maintenance (Section 20.7) and the potential risk of bed bug reintroduction (e.g. Section 20.11).

8.1.5. Insecticide Usage

It is required by Australian law that all insecticides must be used strictly according to the product label. Consideration should be given to using low odour insecticides. All relevant product label warnings should be discussed with the client prior to any insecticide application. If further information is required then the MSDS or the product manufacturer should be consulted.

8.2. Accommodation Industry

8.2.1. Guest Complaint

Procedural guidelines within the Bed Bug Management Policy (Section 20.2) should be followed if a guest lodges a complaint suggestive of bed bug involvement or if housekeeping staff find evidence of bed bugs;

- Any report of a possible bed bug infestation must be investigated and be recorded as an incident report. This is the responsibility of the Hotelier.

- Any guest complaining of bed bugs should be immediately moved to another room whenever possible; otherwise if the guest is bitten again, the hotel could increase the potential liability. Consideration should be given to assisting the guest in disinsecting their belongings (Section 17).
- Management should document within the incident report when the putative infestation was reported, the room number, if and where the bed bugs were observed, and the customer complaint (this may include such aspects as if bite marks were evident).
- If guests have a severe reaction to the bite, the Hotelier should encourage and assist the guest to seek medical assistance. The Hotelier must never provide any medical advice.
- The hotelier should demonstrate empathy with the guest by explaining that bed bugs are becoming increasingly common throughout the entire industry and that the hotel has strict policies and procedures in handling an infestation.
- The room should be inspected for bed bugs as soon as possible by appropriately trained staff or a Pest Manager. Inexperienced individuals may not readily detect an infestation if it is in a poorly accessible location such as behind a bed head. If the room can not be inspected on the same day, then it should be vacated until an inspection is undertaken. The inspection date and time must be documented, along with the date when the Pest Manager was contacted (ideally the same day), the dates the room was closed, when treatment was undertaken and when the Pest Manager declared the infestation eradicated.

9. OCCUPATIONAL HEALTH AND SAFETY

9.1. Pest Manager

All Pest Managers must comply with the relevant State occupational health and safety laws when mixing and applying insecticides. This includes wearing of the appropriate personal protective equipment, and storage and disposal of insecticides. For any insecticide selected for use, the label should be consulted for application rates and application directions, safety instructions, and if there are any use restrictions or requirements (for example, some products can not be applied to mattresses).

If power needs to be disconnected in a room (e.g. switch plates removed for inspection and insecticide application) then housekeeping staff should facilitate any electrically related procedures.

It is likely that in the majority of bed bug jobs that the Pest Manager will need to move beds and other heavy furnishings to gain access to bed bug harbourages. For this reason, it is suggested that housekeeping always assist the Pest Manager in gaining access to harbourage areas in preparation for inspection and treatment. However, this should only be undertaken with the Pest Manager in attendance.

Pest Managers should minimize the risk of exposure to bed bug allergens by only using vacuums fitted with HEPA filters (Section 17.1.3) and by wearing dust masks particularly in heavy infestations or dirty environments. Pest Managers should also undertake measures to minimise the risk of spreading bed bugs on their own belongings and clothing. It should be company policy that white clothing is worn, which enables bed bugs to be spotted more easily, and disposable overalls and shoes should be used which are placed into sealable plastic bags at the completion of treatment and labelled for disposal. Spare clothing should be carried and all worn clothing should be placed into sealable plastic bags, and subsequently laundered as described in Section 17.1.4. All equipment should be stored in sealable plastic containers.

9.2. Accommodation Industry

Those in the accommodation industry should not attempt to undertake insecticide treatments; only licensed Pest Managers have been trained in the safe handling and proper use of insecticides. Access to infested rooms should be restricted only to essential staff and preferably only those who have received training in how to conduct themselves in an infestation. This is to minimise the further possible transfer of bed bugs within the facility and to prevent staff spreading the infestation to their own homes.

10. CHOOSING A PEST MANAGER

Choosing a Pest Manager to undertake bed bug eradication can be a daunting prospect. Bed bugs are considered by many as the most difficult of all pests to control. Unfortunately some Pest Managers are not successful in treating these pests, which can cause the infestation to spread and dramatically increase overall eradication costs. The following suggestions can assist in selecting a reliable Pest Manager;

- Request from the Pest Manager a copy of their license and check to see it is current.
- The Pest Manager must abide by this Code of Practice and to use this

document as their principal guide in controlling the insect. This should be stated in the Bed Bug Management Plan.

- Ask others whom they have found successful in controlling bed bugs.
- Following the initial assessment, the Pest Manager should provide a Bed Bug Management Plan (Section 16). If the Pest Manager suggests undertaking just one treatment and makes the comment “see how you go after that”, then shop elsewhere.
- Request past Bed Bug Management Plans (Section 16) for similar situations (the Pest Manager must ensure names are removed for confidentiality).
- Enquire as to what warranty the company is willing to offer.
- Request information on the company’s response time.
- Check that the company has current insurance cover (both professional indemnity and public liability).
- The pricing of the job is usually a good indication of likely success. Bed bug control is very expensive and if the price is too good to be true, then it probably is.
- Request proof of specific training in bed bug management, such as attendance at bed bug courses where the course was conducted in accordance with the AEPMA approved curriculum developed by this CoP Working Party (see www.bedbug.org.au for trained Pest Managers). It is important that individuals rather than the company should have bed bug training.
- Ask the company for a list of current clients with contact details that have had a bed bug infestation successfully treated (although many may not allow their Pest Manager to pass this information on) and/or references.
- Ask the company if they belong to a professional association or are accredited. In Australia, the peak professional association is the Australian Environmental Pest Managers Association (www.aepma.com.au) and the accreditation body is PestCert Ltd (www.pestcert.com.au). Professional associations provide educational seminars to members through national conferences and regional meetings, and thus members are usually better trained. Members also are required to follow a professional code of conduct.

11. BED BUG CONTROL - AN OVERVIEW

Achieving elimination of a bed bug infestation requires:

- Proper identification of the pest (Section 12),
- A site assessment and a thorough inspection (Sections 13.1 & 14),
- Client co-operation (Section 13.2),

- The development of Bed Bug Management Plans (Section 16), which should include consideration of any high risk factors that can make control challenging (Section 16),
- Non chemical and chemical means of pest elimination (Section 17),
- Follow up inspections/re-treatments (Sections 18 & 19).

Risk minimisation procedures will then need to be implemented to reduce possible new infestations (Section 20).

12. IDENTIFICATION

12.1. Bed Bug Identification

Bed bugs (*Cimex* spp.) are insects that are wingless and dorsoventrally flattened. Adult bed bugs are a reddish brown, 5-6mm when unfed to almost 10mm when fully blood engorged. An unfed adult is not dissimilar in size and shape to that of an apple seed. There are five nymphal stages that have a similar body shape to the adults but start out translucent and cream in colour in the first instar (or 'stage'), becoming darker in the later instars. The size of the juveniles varies between 1-4mm depending on growth stage (Figure 1). Currently in Australia there are only two species of *Cimex*, which are both introduced; *Cimex hemipterus* (the Tropical bed bug) and *Cimex lectularius*, (the Common bed bug). The Tropical species occurs mainly north of the NSW/Qld border and the Common species to the south, with some overlap between northern NSW and southern Qld. The two species are taxonomically differentiated on the basis of the shape of the pronotum of the thorax; the Common species having a pronounced lateral extension of the pronotum and thus is much wider than that of the Tropical species (Figure 2).

12.2. Bed Bug Indications

Indications of a bed bug infestation include (Figures 3-6);

- Live or dead bed bugs, and cast skins. Live bed bugs will confirm that the infestation is currently active.
- Faecal spotting. This is digested blood defaecated by the bed bugs. It may be initially observed on the sheets, but will be commonly noticed along the mattress seams and beading, and other places where bed bugs hide. On light coloured surfaces individual faecal marks appear as small dark round spots, however the spotting may be in colour from cream, through grey to almost black. Generally the spotting will occur in

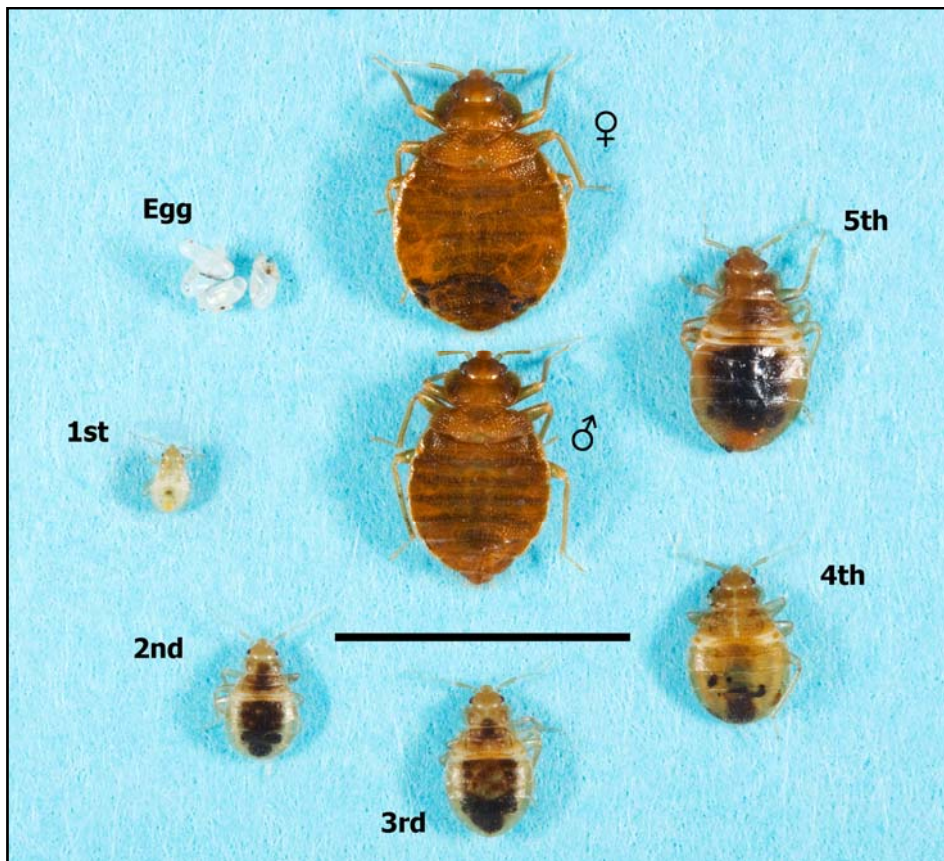


Figure 1. The various life stages of the Common bed bug, *Cimex lectularius*. The numbers represent the different instar stage. Bar = 5mm. ©2009, Stephen Doggett, Department of Medical Entomology, Westmead Hospital, Westmead.



Figure 2. Adult bed bugs. The Common species (*C. lectularius*) on the left has a lateral flange on the margin of the pronotum (arrow), making this structure wider than that of the Tropical species (*C. hempiterus*) on the right. ©2009, Stephen Doggett, Department of Medical Entomology, Westmead Hospital, Westmead.

groups and appear as splotches of dark marks (see Figures 3-5). Note that the faeces of nymphal cockroaches appear similar, however bed bug blood spotting tends to occur in groups as the insect by nature aggregates. Red blood coloured spots or smears on the sheets may occur which can be the result of bed bugs passing sera, or engorged bugs being squashed by movements of the sleeping host.

- Eggs (cream in colour with a slight bend, approx. 1mm, Figure 13), which tend to be laid in crevices in dark areas.
- A bed bug smell sometimes described as 'sickly sweet' but is akin to that of stink bugs. This is usually only noticed in heavy infestations, if close to the bugs or during the treatment process.

12.3. Diagnostic Confounders

It is important to realise that if a client is bitten by an unknown pest it may not necessarily be from a bed bug. Other common biting arthropods include; ticks, mites (bird, rat, chigger & various stored product mites), biting flies (mosquitoes, midges, stable flies, march flies), lice (especially head & pubic), fleas, wasps, bees, ants, and urticating caterpillars, to name but a few. There can also be non-entomological causes of bite-like reactions, which may include; environmental factors (fibres, dust, low humidity producing 'cable bug', plant hairs), medical conditions (skin pathogens and other infectious diseases, hormonal conditions such as 'formication', adverse reactions to medications, side effects of medications and/or drugs of addiction), and power of suggestion (if one person starts itching in a workplace, then others often follow). There can also be a delay in the appearance of a clinical reaction to a bed bug bite, even in the order of 9-14 days, and this can cause confusion as to the origin of the bites. For more information on the clinical consequences of bed bug bites, see Doggett and Russell (2009), and Doggett *et al.* (2012).

If bed bugs are not found in a possible infestation, then these other entomological causes need to be considered by the Pest Manager. Under no circumstance should the Pest Manager consider or advise on possible medical conditions.

With the recent focus on bed bugs in the media, many people find insects that are often mistakenly identified such as nymphal cockroaches. In any suspected infestation, it is important that the insect pest is properly identified by an appropriate Medical Entomology laboratory reference. A list of Medical Entomology laboratories with experience in bed bug identification is in Section 26.3.

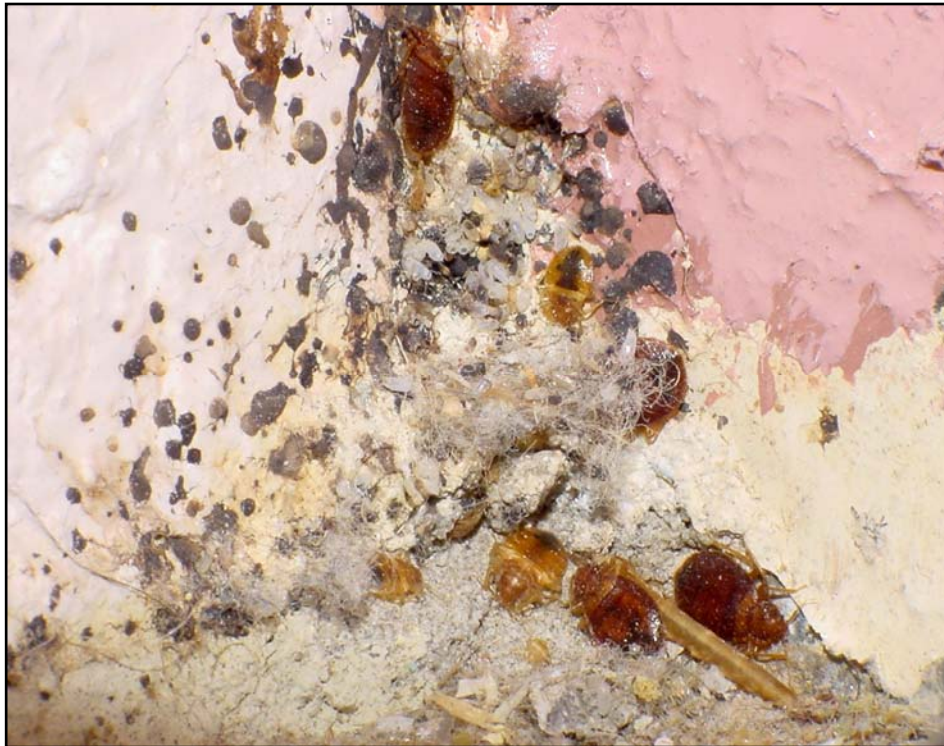


Figure 3. Bed bug adults, nymphs and eggs, along with blood spotting, at a wall/floor junction. ©2005 Department of Medical Entomology, Westmead Hospital.



Figure 4. Blood spotting on a mattress, which is typically grouped, indicating the gregarious nature of the insect. No bed bugs can be seen in this image. ©2005 Department of Medical Entomology, Westmead Hospital, Westmead.

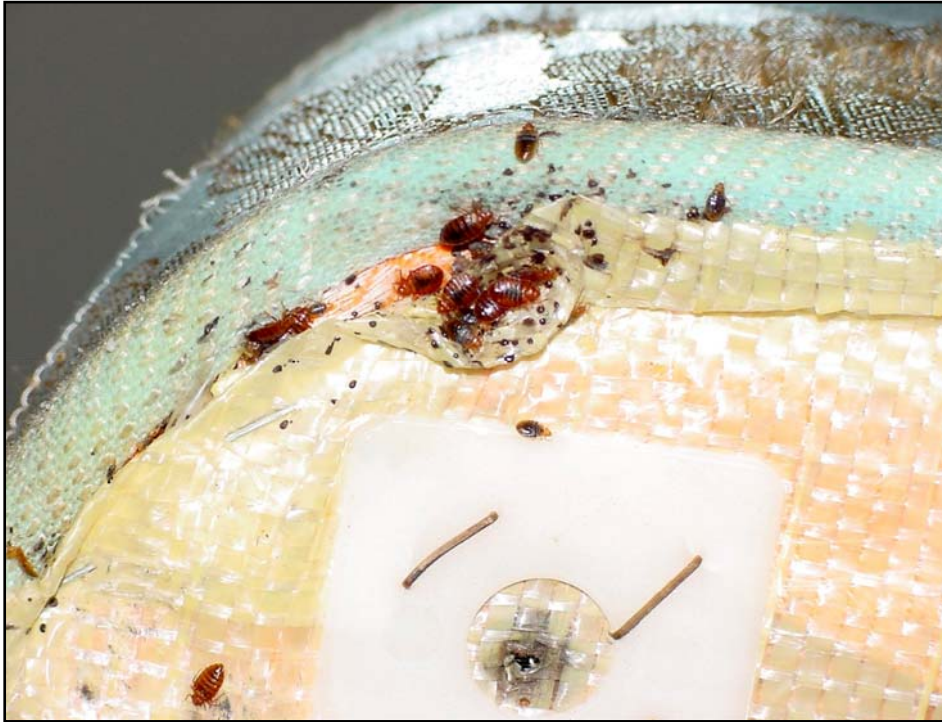


Figure 5. A massive bed bug infestation in an ensemble base. It is always necessary to remove the material covering the base in order to treat the infestation. ©2005 Department of Medical Entomology, Westmead Hospital, Westmead.



Figure 6. The 'straight edge' that holds the carpet in place. Numerous eggs and blood spotting are evident. ©2005 Department of Medical Entomology, Westmead Hospital, Westmead. For more bed bug related images see Doggett (2005).

13. PLANNING AND PREPARING FOR INSPECTIONS AND TREATMENTS

13.1. Pest Manager Preparation

It is extremely important that the Pest Manager explains the inspection processes in detail to the client and the Pest Manager should provide;

- Instructions that it will be necessary to inspect the bedroom, including looking through cupboards and drawers.
- Instructions that it will be necessary to remove bed heads, lift carpets and dismantle other items to access all bed bug harbourages.
- Instructions on any activities the client will be required to undertake prior to the inspection (see below).
- Advice to the client that follow up inspections after the initial inspection and treatment will be necessary.

13.1.1. *Pest Manager Equipment*

The Pest Manager may find the following useful for a bed bug inspection;

- A powerful torch.
- A 10x magnifying lens (to inspect for live bed bugs and eggs).
- Collection bottles (for gathering bed bugs for later confirmation of identity, sticky tape can also be used for gathering bugs).
- Fine tipped forceps (for picking up bed bugs).
- Screwdrivers and spanners for dismantling items.
- An inspection mirror.
- Plastic bags (large and small) to hold bottles, tape, infested items, etc.
- Notepad, for recording details of the infestation.
- Digital camera (for recording infested sites. The digital images or printouts can also be given to the client in a report or provided as part of an educational package, or used for in-house training for educating other pest management technicians).
- Checklists for a bed bug service (Appendix C & D).

13.2. Client Responsibilities & Preparation of Infested Sites

The client should not attempt to remove any item from the room before an inspection is undertaken by the Pest Manager, for the following reasons:

- The Pest Manager needs to gauge the true extent of the infestation,
- Disturbing the infestation may cause the bed bugs to disperse and,
- Removal of items to another location may spread the infestation.

In the process of, or immediately following the inspection and only upon the recommendation of the Pest Manager, all bed linen, curtains and clothing must be removed from the infested areas. It is essential to handle all such items as infectious; they must be bagged (and sealed) before removal from the room and labelled as being infested with bed bugs. They should then be washed in the hottest water possible (>55°C) and/or dried in a hot air clothes drier for at least 30 minutes. Alginate bags are preferable for infested linen, as the bags with the linen enclosed can be placed directly into the washing machine and the bags will dissolve. This reduces extra handling of infested linen and reduces potential cross contamination in laundry facilities. If alginate bags are used then it is imperative that these are stored dry and away from sources of moisture, otherwise the bag will breakdown before laundering. If alginate bags are not available then plastic bags should be used. Delicate items can be placed into a freezer after bagging (Section 17.1.6). If a linen contractor is used then all potentially infested linen must be kept isolated, labelled infested and have instructions to launder separately in hot water.

Likewise, all wardrobes, drawers and cupboards must be emptied and the contents treated as above. After clothing and materials have received the heat treatment, these should not be returned to wardrobes but kept sealed in plastic bags away from the infestation until eliminated.

Prior to treatment, the client must be advised to undertake the following:

- Cover up any fish tanks or preferably remove them from the room to be treated, after careful inspection by the Pest Manager for evidence of bed bugs.
- All occupants and pets must vacate the premises and/or area of treatment.
- For infested hotel rooms, the room must be kept unoccupied until the infestation is declared eradicated.
- If possible the client should provide the Pest Manager with a plan of the building so that the bed bug infestation/s can be recorded where detected. This is especially critical for hotels, as the Pest Manager will need to determine which adjoining rooms require inspection.
- To sign and date any Bed Bug Management Plan (Section 16) and return a copy to the Pest Manager.

14. INSPECTION PROCEDURES

14.1. Introduction

Bed bug infestations may be found in buildings, vehicles, boats, trains, buses and aircraft, and attention to detail will always be required. The main aim of the initial assessment is to develop the Bed Bug Management Plan (Section 16) and the aim of the inspection process is to detect every possible bed bug harbourage. One of the most common reasons for control failures is that inspections often fail to reveal all hiding places. A proper inspection is also necessary to anticipate the time required to undertake control, which is a prerequisite for accurate job costing.

14.2. The Inspection

14.2.1. Hotels

If a treatment is being undertaken in a hotel, then it is important that the housekeeping staff are interviewed to seek information on where guests have complained of bites and where staff may have seen bed bugs. Housekeeping staff are at the coalface and are more likely to have detailed knowledge about an infestation than the management. Such staff should also be questioned about laundering procedures and general housekeeping processes.

14.2.2. Residential

For treatments in homes, similar questions should be asked to determine areas where residents are being attacked. The Pest Manager should attempt to determine how the bugs were brought into the home; for example if the bugs were brought in via the occupant, then luggage storage areas need to be inspected and treated. The movements of the person/s affected by bed bugs need to be established; if they have slept in various areas within the home or away from the home then all of these need to be inspected and probably treated. Areas where dirty clothes and used linen are stored should be examined and the occupant questioned about any previous control attempts.

14.2.3. The Inspection Process

To avoid the risk of transferring bed bugs in equipment a minimum of items should be brought into the infested room. These items should be placed either on a previously inspected chair (with the clients permission and then on a plastic bag to protect the chair) or positioned in an open area away from walls, preferably on a plastic sheet. Equipment should never be placed onto beds, on

other furniture or next to walls. Likewise the Pest Manager should avoid prolonged contact with beds, curtains and other potentially infested materials.

Bed bugs have a very flat body shape and can hide in virtually any crack and crevice, preferring dark, isolated and protected areas. Bed bugs prefer wood, paper and fabric surfaces and so these materials should be paid special attention in the inspection process.

The mattress should be the first site inspected, and generally, bed bugs are more likely to be present in the darker areas near the wall. Close attention should be paid to:

- The seams, beading, under buttons, labels, and corner protectors if not previously removed.
- For an ensemble, the base is more likely to harbour the bugs than the top mattress. The edge of the material underneath the ensemble base is a favourite spot for bugs as well as any hollow plastic caster legs. It will be necessary to remove the material covering the base of the ensemble.
- For metal framed beds if wooden slats are present, these contain many cracks for bed bugs to hide in and lay their eggs. If the wooden slats are bolted to the bed frame, the bolts should be undone and the drilled holes inspected and treated. Bed bugs can also hide in coils of bed springs and inside hollow bed posts.

The areas around the bed should be investigated next, these include:

- The bed frame, bed head and bedside furniture.
- Bedside furniture, tables, etc, should be turned over and examined.
- The drawers in tables and cupboards should be removed and examined.
- If bed heads are attached to the wall, they should be removed after consulting maintenance staff.
- Other furniture in the room should be inspected, especially locations where luggage is placed, such as luggage racks. For these, close attention should be paid to the seams and buttons (if upholstered) and any wooden join (especially if constructed of chipboard).
- Other inspection sites include appliances such as telephones and audio visual equipment, books, power points and behind switch plates, underneath carpet edges and the straight edge that holds the carpet in place, underneath rugs, skirting boards, joins in floor boards and under floor boards, loose wall paper and paint, architraves, old nail and screw holes, ornaments, window casings and wall voids.
- Bed bugs may be found higher on the wall in wall hangings, picture frames, wall mirrors, Venetian and vertical blinds, curtains and curtain rods, books, behind electrical conduit, cracks and joins in the ceiling, under ceiling mouldings, smoke detectors and light fittings.

A room site plan should be used to indicate all locations of bed bug activity.

In any infestation, adjoining rooms and spaces, both either side and above and below, should be inspected.

Bed bugs are often found in lounges in common rooms of hotels and these should be examined. Housekeeping trolleys and laundry areas should also be inspected.

14.2.4. Bed Bug Detection Dogs

Bed bug infestations may be detected by the use of pest detection dogs. These have been used successfully for a number of years for termite detection and in the case of bed bugs, pest detection dogs can check a room for bed bugs more quickly than any human Pest Manager. Pest detection dogs are especially useful for detecting small infestations that are not always obvious and they can be employed in a proactive system of bed bug detection. If an infestation is detected early, control is easier and thus treatment success is more likely to be achieved. For the accommodation industry this means there is less chance of guests being bitten by bed bugs (and reduced litigation risk) and room closure time will be reduced. Detection dogs can also be used to check the success of the treatment. It is important to note that dogs are not always accurate and a recent investigation of bed bug detection dogs in the US found high levels of false indications and a failure to find bed bugs when present (Wang and Cooper 2011). Thus Pest Managers must confirm an infestation as indicated by the dog and examine those areas where the animal cannot access (e.g. high areas).

Not just any dog can be used as a detection dog. Dogs must be trained by an accredited facility and undergo regular retraining. Members of the US based association, the National Entomology Scent Detection Canine Association (NESDCA), suggests that a quality control system must be used daily as part of the process of regular assessing the accuracy of detection by the dogs. The National Pest Management Association of America (NPMA) has recently defined standards for the certification of bed bug detection dogs and their handlers (NPMA 2011).

At present in Australia there are very few dogs trained in bed bug detection.

15. HIGH RISK FACTORS

Certain risk factors at the site of the infestation can make the job extremely challenging and increase the likelihood of treatment failure. These risk factors

should be considered in the development of the Bed Bug Management Plan, especially in terms of the control limitations and in costing the job.

These include:

Bed Design; certain types of beds will always make bed bug control more challenging. Bed bugs will almost always get into ensemble bases, particularly underneath and between the staples of the base covering (Figure 7). Likewise plastic corner protectors provide an excellent harbourage. Even if the bed is made completely of metal, fittings such as metal springs provide ample bed bug habitat (Figure 8).

Metal springs are especially difficult to treat; using an aerosol or steam can result in bugs being blown out without being killed. It is necessary to flood the springs with insecticide or treat them with dry heat. Wooden bed slats (Figure 9) and the underneath of the material strip that often holds the slats in position both are favoured harbourage areas.

Room Integrity and Access; gaps, cracks and crevices around skirting boards (Figure 10), in the wall, along the cornice and other areas will provide harbourages for bed bugs and all of these sites will need to be assessed. In some cases, access for inspection can be very difficult, such as in hollow metal skirting fascia.

Room Construction; a room may be of sound construction yet the type of materials used can make bed bug control more challenging. In exposed brick work (Figure 11), bed bugs often harbour in and lay eggs along the mortar which necessitates time consuming treatment of all mortar work. In false walls, bed bugs often access behind the wall making treatment extremely problematic. In this case it may be necessary to remove the false wall.

Clutter; bed bug control in cluttered rooms is impossible unless the clutter is removed and either discarded or treated.

Bed Bug 'Friendly' Furnishings; certain construction materials make furnishings bed bug 'friendly'. Both chipboard (Figure 12) and wicker cane provide numerous harbourages and if present within an infestation, will make control more challenging.

Extent of the infestation; not surprising, a heavy bed bug infestation will be much harder to control than one where few bed bugs present. A heavy infestation will require multiple insecticide applications and frequent inspections and thus involves a lot of time.



Figure 7. Ensemble bases make great bed bug motels due to the large number of harbourages. Blood spotting can be seen in groups along the top, which is between the staples that hold the material that covers the underneath. ©2010 Department of Medical Entomology, Westmead Hospital, Westmead.

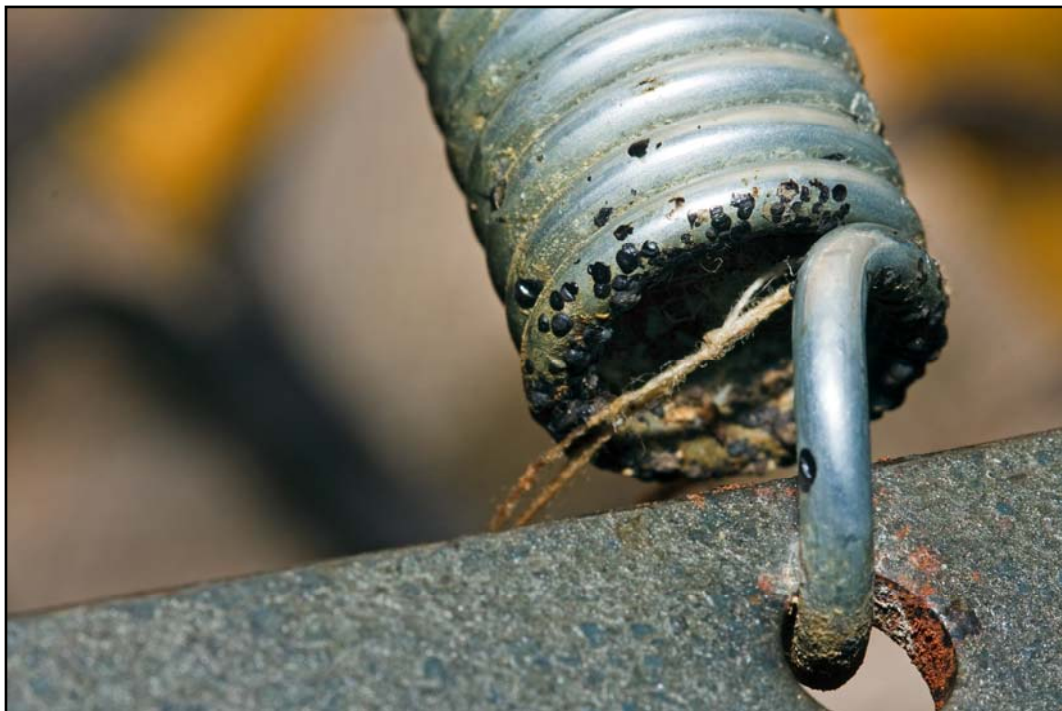


Figure 8. Metal bed springs make an excellent bed bug harbourage and are a challenge to treat. Extensive bed bug faecal spotting is evident. ©2010 Department of Medical Entomology, Westmead Hospital, Westmead.



Figure 9. Wooden bed slats provide numerous bed bug harbourages. ©2010 Department of Medical Entomology, Westmead Hospital, Westmead.



Figure 10. A large crack is present in the corner of the skirting and bed bug spotting is evident. Poor room integrity always makes bed bug control more challenging. ©2010 Department of Medical Entomology, Westmead Hospital, Westmead.



Figure 11. Exposed brick work is very challenging to treat for bed bugs and requires extensive spraying along all mortar lines. ©2010 Department of Medical Entomology, Westmead Hospital, Westmead.



Figure 12. Underneath a chest of drawers showing massive bed bug activity. Chipboard furniture is very bed bug 'friendly' and can be very problematical when bed heads are constructed of this material. ©2010 Department of Medical Entomology, Westmead Hospital, Westmead.

Access to adjoining properties; in multi-apartment dwellings, the Pest Manager should make every attempt to inspect all properties adjoining the infestation. However, in some cases residents refuse access. If privately owned then it may be impossible for any authority to force access, under these circumstances reinfestation is highly likely to occur.

Apartment complexes; control is often much more difficult in apartment complexes and multiple occupancy dwellings as the infestation may have originated from adjoining premises. Naturally the client is not willing to pay for control in a neighbour's property.

Residential properties; bed bug control is often made more difficult due to the fact that there tends to be more furniture and items within residential properties than hotel accommodation. This means that more items will need to go through a disinsection process.

Client co-operation; if a client does not consider that bed bug control is a co-operative venture between themselves and the Pest Manager then the possibility of failure increases. The Pest Manager must communicate with the client and inform them of their duties. This should be both verbally and via the Bed Bug Management Plan.

Previous use of household insecticides; most household insecticides contain synthetic pyrethroids (SPs) which are largely ineffectual and due to the excito-repellent nature of the chemical, often disperse an infestation. If the client has attempted to control the infestation with such products (especially insecticide 'bombs'), then usually the infestation will be far more diffused and spread throughout the property. Naturally control becomes more challenging.

16. BED BUG MANAGEMENT PLANS

16.1. Proactive Management Plan

Ideally a Bed Bug Proactive Management Plan for accommodation providers should be developed in collaboration with the contracted Pest Management company prior to any bed bug infestation. This plan should then become a part of an overall bed bug management policy and procedural guide for the accommodation provider (see www.bedbug.org.au for such a policy and procedural guide). The Proactive Management Plan should include:

- History of past bed bug activity and treatments (including insecticides used).
- Findings of the initial room inspections by the Pest Manager, which would include various risk factors relating to construction elements and

challenges to control (see Section 15).

- A review of current management practices that may influence potential bed bug risk, e.g. current housekeeping practices, documentation, training, etc.
- Responsibilities of the accommodation provider, including principal contacts.
- Floor plans, which can help determine which adjoining rooms will need inspection and monitoring in the advent of an infestation.
- The eradication processes by the Pest Manager, including response times, treatment regimens (including insecticides used), warranties and limitations of the treatment.
- Period of validity for the plan (which should be reviewed regularly).

The Bed Bug Proactive Management Plan should also include a review of both the real and potential financial impacts to the facility.

16.2. Eradication Management Plan

A Bed Bug Eradication Management Plan must be provided to the client for the treatment of all bed bug infestations by the Pest Manager, which can also serve as the service contract. This plan can be seen as a one off treatment regimen as opposed to a long-term proactive management plan. The plan sets out the pest control processes by detailing the work to be undertaken. It must be stated up front that the aim of the treatment is to achieve complete eradication of the infestation. Following an initial site assessment, the Bed Bug Eradication Management Plan should include:

- The findings of the initial assessment (e.g. where bed bugs were evident, the degree of the infestation, including photographs where possible).
- For commercial dwellings and/or managed facilities such as public housing, a review of past bed bug infestations in the building. It may be necessary to speak to staff and tenants in order to provide a complete history of bed bug activity.
- The treatment process. This would include; estimated treatment commencement date and a time frame for the treatment process, non-chemical means of control, insecticides to be used (and MSDSs as required), where the insecticides will be physically applied, times when the client needs to vacate the premise and can re-enter, any client duties prior to and post treatment (such as the placement of a mattress cover over insecticide treated mattresses).
- Realistic expectations of the treatment.
- The requirements for follow up inspections and treatments.
- That the Plan follows this CoP.
- Warranties, limitations and restrictions.

- Period of validity.
- The charge for the treatment.

In the plan, it must be stated that inspection of adjoining rooms (both vertically and horizontally) should be undertaken (even though this may not be possible in apartment complexes). The Bed Bug Eradication Management Plan should explain clearly the clients and organisation's responsibilities and include authorised signatures stating when each will carry out any recommendations made by the Pest Manager. For example, the Pest Manager should insist that Housekeeping help with the removal of carpets, bed heads, and other items, to protect the Pest Manager from liability claims of excessive damage. Where possible, a warranty on the service should be detailed in the Bed Bug Eradication Management Plan (Section 8.1.4).

17. TREATMENT PROCEDURES

17.1. Non-Chemical Control

17.1.1. Introduction

Non-chemical options should be considered largely as management tools only. Thus while they can be utilised to reduce the overall bed bug population, complete elimination of an infestation is unlikely unless insecticides are used.

17.1.2. Disposal of Infested Items

Reducing the overall biomass of a bed bug infestation can be achieved through discarding infested furnishing, although complete control will not be achieved. While the Pest Manager can recommend this option, it can be very expensive to the homeowner or Hotelier and not always necessary. The exceptions are mattresses that are torn; these are difficult to treat by insecticides and steam, and should be discarded. However they can be covered with an appropriate mattress encasement (Section 17.1.7), heat treated or fumigated. Any item to be removed must be sealed in plastic before removal, ensuring that all openings are securely taped shut. Such furnishings should be treated before discarding. To avoid others acquiring bed bugs from discarded infested items, the furniture should be destroyed or rendered unusable, for example mattresses and bases should be slashed. They should also be clearly labelled with obvious signs indicating that the items are infested with bed bugs and must be destroyed. Disposal of items should be co-ordinated with waste disposal collection.

17.1.3. Physical Removal

Bed bugs should be physically removed via vacuuming, or by sticky tape if numbers are small on mattresses. Always use a vacuum machine that has a disposable dust bag. A crevice nozzle can be used along carpet edges, bed frames, mattress seams and in ensemble bases, furniture, and other potential harbourages. Vacuuming cracks and crevices prior to insecticide treatment will not only remove the bugs but dirt as well, which will allow the chemicals to penetrate better and improve their effectiveness. After vacuuming is complete, the contents must be sealed within a plastic bag. This should then be destroyed by incineration if possible, rather than just being placed into the general rubbish. If incineration is not possible, then apply insecticide dust to the contents and seal in a plastic bag prior to disposal. Under no circumstances should an insecticide aerosol or spray be applied to an operating vacuum machine as this may cause an explosion and/or fire. The allergens from bed bugs are known to trigger asthmatic reactions and dispersal of the allergens can occur through vacuuming. Repeated exposure to the allergens can lead to a sensitisation thereby increasing the risk of possible adverse respiratory effects, thus it is important that a vacuum machine fitted with a HEPA filter is used to protect the health of the client and the Pest Manager.

It is important that the vacuum machine does not become the source for further infestations so it must be properly 'disinfected' following use and only be used for pest control. Vacuum units that have the base and all hoses composed of solid plastic can be readily sterilised in hot water. This should be done as soon as possible after use. When not in use the vacuum unit itself should be stored in a sealed bag.

The Pest Manager should be aware of the limitations of vacuuming. All previously vacuumed areas need to be treated with insecticides as bed bugs within crevices can hold on against the suction forces. The eggs themselves are glued in place when laid and resist removal via vacuum (Figure 13), meaning that other control measures must be subsequently applied.



Figure 13. Bed bugs eggs are glued down when laid, which means that they resist removal via vacuuming.

Stiff brushes are sometimes suggested for removing bed bug eggs, however they are not recommended as they can disperse the eggs and make control more difficult.

17.1.4. Heat

Bed bugs are very sensitive to heat and are rapidly killed when exposed to temperatures over 45°C. If heat is used for bed bug control it is important that the high temperatures are applied suddenly; a gradual rise in temperature may cause the bed bugs to disperse, thereby potentially spreading an infestation.

Laundering. As noted in Section 13.2, infested linen and clothing can be laundered in hot water followed by a hot tumble drying to kill any bed bugs. Studies from the United Kingdom (Naylor & Boase, 2010) have shown if the water is at 60°C, then every bed bug stage will be killed in the wash. However, a temperature of 40°C will not be lethal to all the eggs. In Australia, there are State plumbing codes for the temperature of hot water at the outlet. For example, in NSW the requirement for personal hygiene fixtures (such as hand basins, showers and baths) is that the water must be delivered at no more than 43°C in childcare centres, schools or nursing homes, or 50°C for other classes of building. This means that if such water is used to treat infested linen, it may not be hot enough to ensure a complete kill of all stages. Laundries and kitchen sinks do not need to comply with this regulation and the water should be around 60°C (unless mixed with cold water or a long way from the water heater) and will kill all stages. Clearly if hot water is to be relied on for bed bug disinsection, the temperature must be confirmed at or above 60°C.

For tumble drying, the Naylor and Boase investigations found that the dryer had to be operated on the 'hot' setting for 30 minutes for dry clothes to achieve a complete kill of all stages. If clothes are wet, then they should be left in the machine until completely dry.

Thermal Heating. large electric or gas driven heating units are increasingly being employed for bed bug control around the world. The most efficient are 'bubble treatments', where infested items are treated in a small contained area. Heat treating whole rooms is rarely successful without the use of insecticides as there are many harbourages that can protect the bed bugs, and control is especially difficult in heavily cluttered rooms. Ideally the airspace should be heated first before fans are switched on. Thermal control for bed bugs in large spaces requires a high level of skill; fans are required to distribute hot air evenly, multiple temperature monitoring devices are necessary to record heat changes and to ensure that the appropriate temperatures are reached. There have been a series of fires resulting in the complete destruction of dwellings caused by the inappropriate use of heating units; this method should only be undertaken by trained individuals.

Solar Heating. It is often claimed that bed bugs can be killed via heat by placing infested materials into black plastic bags and then into the sun. However, a scientific investigation has shown that this can be ineffective with large items

such as mattresses, which have a high thermal inertia (Doggett *et al.*, 2006). Since this method can not be relied upon to disinfest items it is not recommended within the CoP.

17.1.5. Steam

One practical method of exploiting heat is through the use of steam. The great advantage is that it will kill all bed bug stages including the eggs (most insecticides are non-ovicidal). A study from the United States (Meek 2003) has shown that a program that employs steam followed by insecticides provides better long-term control than with the use of insecticides alone. As steam is composed only of heated water, some clients favour this treatment over chemicals, particularly for their mattress and bed. However, control can not reliably be achieved with steam alone.

It is important to note that there are many different brands and types of steam machines on the market, however not all are appropriate; the unit must be able to produce steam of a low vapour flow and high temperature. It is best to use commercial units that employ 'dry steam', which allows for quicker drying times. *Note: 'dry steam' is a misnomer; items treated will still be damp and a fan or ventilation should be used to dry the room afterwards, otherwise mould growth could occur.* Steam machines that have a continual flow feature can be filled and remain operational without the downtime of some of the cheaper units, which must go through a cooling and reheating phase.

As with all equipment, the steam machine must be properly maintained and the operating temperatures should be regularly checked with the aid of an infrared thermometer. Immediately after steam treatment the surface should be recording at least a temperature of 70-80°C.

Steam flow rate must be kept to a minimum to avoid blowing bed bugs about (along with exuviae which may contain eggs and nymphs) and to reduce wetting. Likewise, single jet steam nozzles can blow bed bugs away. If such nozzles are used on mattresses then the nozzle should be always pointed towards the centre of the mattress where propelled bugs can be seen and re-steamed if still alive. Multiple jet steam heads produce a gentler flow rate, are thus less likely to blow bed bugs away and can treat larger areas over a shorter period. In comparison for example, with single jet nozzles it will be necessary to run the nozzle along both sides of edge beading, whereas a single pass with a multiple jet head placed over the beading will usually suffice. By placing a cloth over the steam head as in Figure 14, bed bugs will not be blown about by the jets and the treated surface becomes much hotter, which better facilitates the killing of all stages. However, heat penetration into the surface being treated will not be as great. Brush heads and brush fittings on steam machines should be

avoided as the stiff bristles can fling off eggs and bugs. It is important that the steam be applied directly to the bugs as even a thin layer of cloth may shield the insects.

To reduce the risk of blowing bed bugs about if a cloth is not used over the steam head, all areas destined for steam treatment should be vacuumed first.



Figure 14. Covering the steam head with cloth will ensure that bugs will not be blown about, yet the temperature will be high enough to kill the insects.

Like any tool, steam machines are only as effective as the operator. To achieve control, an intimate knowledge of the pest and its ecology are essential, inspections must be diligent and the treatment process must be meticulous. The instructions of the steam machine must be read thoroughly noting all safety instructions prior to use.

As the steam machines are operated with a low vapour flow rate it is necessary to place the nozzle *in direct contact* with the surface being treated; the temperature drops away rapidly from the nozzle and a separation of only a few centimetres will not be lethal to the bugs. The nozzle should be moved along at a rate of only 30cm per every 10-15 seconds.

The steam treatment should start with the mattress and be applied to the seams, under labels and handles, and both inside and out of an ensemble base. It will be necessary to remove the material base of the ensemble, which should be kept for the client to reattach after the infestation has been eradicated. Cushions of chairs and sofas should be treated next, paying particular attention to seams and buttons. Always check if the sofa is a sofa bed, and if so, treat the mattress as above. Carpet edges can also be treated with steam, along with the straight edge both above and below. After the completion of the steam treatment, any dead bugs should be removed via vacuuming, which will help facilitate the determination of treatment success.

As with any technology, steam has its limitations. Being water based, electrocution is a potential issue and thus power points and other electrical fittings should not be steam treated. Steam may damage heat and water sensitive materials, thus the Pest Manager should always test the item to be treated in a non-conspicuous area. Steam will raise the humidity in a room,

which can lead to mould growth leading to other potential health issues. Steam treatments are very time consuming. The greatest disadvantage is that steam is non-residual. Thus bugs that are not directly killed (and it is prudent to assume that a certain percentage will not be contacted) will not be exposed to any further control influence unless an insecticide is present. Thus it is always necessary to complete the control process by following up any steam treatment with a residual insecticide.

17.1.6. Cold

The alternative to extreme heat is extreme cold, i.e. freezing the bugs. This has the advantage that heat sensitive materials will not be damaged. While this method can often not be directly used by the Pest Manager, it can be recommended to the home owner and Hotelier for small items. Any item for freezing should be placed loosely into a bag, and as always, this must be done in the infested room prior to removal. The amount of time in the freezer would be dependent on the density and size of the item; the more dense and the larger the item, the longer the time in the freezer is required. If the freezer is operating at or around -20°C , then two hours at this temperature will kill all stages. However, for the average household freezer, studies have indicated that 10 hours will be required (Naylor & Boase, 2010). Dense items may take several days for the centre to cool sufficiently to kill the bugs and the longer an item is kept frozen, the more likely the bugs will be destroyed. Naylor and Boase suggest around 8 hours of freezing is required per 2.5kg of dry weight of laundry. Many modern freezers are of the 'frost-free' type and go through cycles of varying temperatures. As a result, bed bugs will require a much longer time in the freezer to be killed, even up to several days.

High pressure devices that employ various gases with the aim to freeze bed bugs are not endorsed within this CoP. This is for their propensity to non-lethally blow bed bugs about, with the potential to spread an infestation, increasing the risk of treatment failure (for a full discussion on this, see http://medent.usyd.edu.au/bedbug/cop_ed4_submissions.pdf).

17.1.7. Mattress Encasements

Seamless mattress covers provide fewer potential harbourage areas than mattresses, thus making them less susceptible to an infestation. The covers can also be readily removed for laundering thereby making control easier and being white makes bed bugs and their spotting easier to notice.

The benefits provided by mattress covers have been further extended with the recent development of specialised anti bed bug mattress encasements, which are now available in Australia. These encasements have incorporated an in built

membrane that is impervious to bed bugs; not only can bed bugs not penetrate these encasements, they are even unable to bite through the material.

Encasements may be used in two modes; to completely contain and hence inactivate an existing infestation in a mattress and ensemble base, or to prevent the mattress and base becoming infested in the first place.

In the containment mode, the infested mattress and ensemble base are encased for an extended period of time and in due course all the encased bugs will die of starvation. The obvious advantages of this system are that insecticide use is minimised and costs reduced as the infested mattress and base do not need to be discarded, even if damaged or heavily infested. As bed bugs can live for up to six months without feeding at 22°C, or even longer in cooler climates, the encasements must be left in place for much longer than this, as removal represents a reinfestation risk. Thus users need to be made aware that encasements should not be removed if being used for bed bug containment. In these circumstances, bed sanitation can be improved by covering the mattress encasement with a seamless mattress cover which can be regularly removed and hot washed and hot dried.

In the prevention mode, the encasements are used as a risk management tool to minimise the possibility of an infestation becoming established in new or uninfested mattresses and ensemble bases. The encasements have few seams meaning that there are few places where bed bugs can hide on the outer surface. If an infestation ensues, then the encasement can be sanitised via hot wash and dry cycles without affecting the integrity of the membrane. The encasement should be immediately replaced after laundering.

It is important to note that mattress encasements cannot by themselves stop bed bugs and should be used as part of an overall bed bug management program. For suppliers of mattress encasements see Appendix C.

The desirable features of mattress encasements include: small zipper teeth that stop juvenile bed bugs passing through, few seams and tightly stitched joins, an inbuilt bite-proof membrane, end zipper stops that prevent bed bug escape or entry, and anti-removal devices.

17.1.8. Vacating a Room

Leaving an infested room vacant for extended periods is not an option to control bed bugs as they can live for many months without a blood meal. Infested rooms must be treated as per this CoP.

17.1.9. *Bed Bug Traps/Barriers*

Over the last few years there have been a number of devices coming onto the marketplace claimed to capture or detect bed bugs (traps and monitors) or that aim to prevent the insects crawling onto beds (barriers). Neither will eliminate an infestation by themselves and must be used as part of an IPM program.

Many traps are active devices that attempt to catch host seeking bed bugs via the use of various attractants such as heat, humidity, carbon dioxide, and/or various other attractants. Historically within the literature there has been considerable debate on what attracts bed bugs to the host and over what distance, and much of this research is over 50 years old and requires updating. More recent research in the area of pheromones has been shown that most bed bug stages respond positively to an aggregation pheromone, however mated females respond negatively and are thus repelled. This is a major problem for any trap that employs pheromones as they may help to disperse an infestation. Arguably, any trap that employs an olfactory stimulant may inadvertently help to disperse bed bugs. For example, if the bed bugs are at the far range of the ability to detect the olfactory stimuli this may elicit a non-directional wandering response. However, it can also be argued that this probably happens when humans are present anyway. Most active traps either have a short life (<24hrs) and are disposable, or use consumables that only last overnight. These types of devices require regular replacement or continuing maintenance to function. There are very few traps that use attractants that can operate continually.

There are also passive traps that have no attractant and rely on bed bugs using the trap as a harbourage location. These types of traps aim to act as a longer term monitoring device.

A number of traps have attributes that may limit their use either due to their physical size or perceived occupational health and safety issues. Regarding physical issues, some traps are over 10cm tall, while most beds with casters in hotels have a clearance to the floor of around 6-8cm, which makes placement of the trap problematic. The trap can not be placed in an obvious location within a hotel room while in use, as the guest would not want to stay in a facility where there obviously is or has been bed bugs. The hotel also certainly does not want to risk their reputation by announcing that they have an infestation. For some hotels where the bed frame consists of sheets of timber nailed together, there is no space available at all underneath. In hotels with ensembles or solid bed bases, bed bug traps could only be employed while the room is closed during the treatment process.

Regarding occupational health and safety, a number of bed bug traps utilise mains power. Many in the accommodation industry may not want power cords under the bed for risk of fire or power cords around the room for risk of clients

tripping. Additionally, some traps have a canister of compressed carbon dioxide and again it is probable that many hotels would not want a high pressure gas cylinder within their rooms. Such devices may have insurance implications.

Currently the limitations of bed bug traps and how most effectively they can be employed are yet to be fully evaluated. Given this and the issues discussed above, the most likely scenarios of their use include:

- Non-commercial premises; in privately owned residences there are no reputation threats, although the occupational health and safety issues are still real. The traps could be used to monitor the success of treatment or to allay the fears of a homeowner that they have bed bugs.
- Traps could be used for monitoring while a room is closed during the treatment process to monitor the success of treatment.
- The passive traps could be used for long term monitoring in commercial premises.

As of January 2013, none of the traps have been tested and found efficacious in an independent scientific study. Thus presently, they are not recommended within this CoP.

Barriers, also referred to as 'intercepting devices', are simple passive units that aim to protect the sleeper by preventing bed bugs climbing beyond the bed legs. They are not dissimilar to the various techniques historically used to thwart bed bugs accessing the bed. Barriers are placed either underneath the bed legs/casters or on top of the casters of ensemble bases. Added to the barrier may be additional security devices to reduce the risk of the bed bugs gaining access to the sleeper including the inclusion of various dusts (insecticidal or talc) and/or sticky substances that entrap the insects. For barriers to be effective the bed must be kept away from the wall and valances and sheets must not touch the ground, otherwise bed bugs can then access the bed.

Many barrier devices are quite obvious and unlikely to be used in the commercial accommodation market for the same reasons relating to reputation threats as mentioned with traps. However, barriers can be a cost effective option in low income housing and homeless shelters. Despite barriers not having any attractant, some can trap bed bugs and could play a monitoring role. As these devices are based on old proven technology, they are likely to be effective.

The use of sticky tapes for the monitoring of bed bugs have been found ineffective (Doggett *et al.* 2011). Bed bugs tend to react negatively to gels and other sticky surfaces, and avoid capture.

The 'Climbup Interceptor' (www.insect-interceptor.com, Figures 15 & 16) is a

barrier that has been demonstrated efficacious in a scientific study as part of an IPM program (Wang *et al.* 2009). Like all barriers, this device aims to prevent bed bugs accessing the bed and thence the sleeping host. The success of this device does rely on the assumption that the bed has been cleared of any active infestation and that the legs of the bed are the only contact to the floor. The Climbup Interceptor is made of a smooth plastic that bed bugs find difficult to climb and it is further supplemented with the addition of a light dusting of talc, which does need refreshing from time to time, but this makes it even more difficult for the bed bugs to breach the device. The barrier is proving to be very useful in the US not only to prevent bed bugs crawling onto the bed, but also as a monitoring tool, as inspection is convenient and trapped bed bugs easily observed. Another advantage is that the device forces the bed to be kept away from the wall, which further isolates the bed ensuring that bed bugs can not access the host via the wall. There are a few disadvantages; beds with castors can no longer be easily rolled out for vacuuming once the device is installed, beds without bed heads can have issues as the pillows will fall down at the back, and valances and blankets can touch the ground and render them ineffective. These devices do require maintenance as a build up dirt and debris can render them less effective and the talc needs occasional replacing (see www.insect-interceptor.com/Precautionary_Statements.pdf for notes on maintenance). However, the advantages may outweigh the negatives and this device could prove to be a very effective tool particularly in low income housing.



Figure 15. The 'Climbup Interceptor' barrier.



Figure 16. The 'Climbup Interceptor' installed underneath a bed leg.

The BB Secure Ring is a very simple barrier that fits between the bed leg and the bed, and is constructed from an ultra smooth plastic which bed bugs can not climb over. In laboratory trials, the device was able to prevent access by bed bugs of all strains and stages (Doggett *et al.* 2011).

17.2. Chemical Control

17.2.1. Insecticide Application & Situational Choices

It is a requirement of Australian law that only those insecticides that are either currently registered or permitted for use by the APVMA for the control of bed bugs may be used. The label of the product must be consulted to ensure that it is currently registered and its use in the proposed situation is permitted. However, due to insecticide resistance of bed bugs in the field, registration of a product by the APVMA is not proof of efficacy as the APVMA does not require that efficacy data is provided on modern insecticide resistant bed bug strains.

The insecticide/s to be applied must be directed to the insects and all harbourage areas identified in the inspection process, in accordance with label instructions. In most infestations, the carpet and underlay should be peeled back for at least 30cm, and the straight edge treated underneath. Following the completion of treating the infested room, it may be advisable to treat the adjoining rooms even if no bed bugs were seen in the inspection.

The type of formulation selected for the treatment will be dependent on its usage patterns. For example dusts if applied in obvious areas in a hotel will be quickly vacuumed up and rendered ineffective. Dusts can be used in electrical areas while liquid formulations can be utilised in more obvious locations. Dusts can be applied to wall voids if the bugs are suspected of penetrating such areas. They can also be directed to the underneath of carpet edges and under straight edges. Currently there are several brands of dust registered for the control of bed bugs in Australia, although only four different active ingredients occur in the products that are currently available. These include amorphous silica (also known as Diatomaceous Earth Dust, trade name: Bed Bug Killer), bendiocarb (Ficam), and permethrin (many brands). Due to insecticide resistance, permethrin dust use should be avoided.

Aerosol insecticides have their use as quick killing agents. Products such as synergised pyrethroids act very effectively to knockdown and kill the bugs rapidly when applied directly to the insects *in situ* (although it is always best to vacuum first). With extension nozzles, the chemical can be very accurately applied to areas such as beading on mattresses, and cracks and crevices in furniture. For wall hangings and delicate or antique furniture, aerosols may be

more appropriate than other formulations, after vacuuming. Aerosols should never be used as space sprays for bed bug elimination; the fine droplets simply will not penetrate into the locations where the insects hide. As most contain pyrethroids, there is an associated excitatory flushing effect and by spraying into a space rather than harbourage areas, the bugs are likely to disperse and can spread an infestation. Despite being effective as topical killing agents, aerosols provide poor residual action against resistant bed bugs, which means that other formulations must be co-employed.

Like aerosols, the smoke generating insecticides (known as pyrotechnics) or total release insecticides ('bombs') are also unlikely to penetrate into harbourage areas and should never be used (Jones & Bryant, 2012)

For applying liquid formulations, fan sprays should be used along carpet edges and pin streams for cracks and crevices. Avoid using hollow cone sprays.

It is important to note that not all surfaces can be treated by all insecticides and so the label needs to be carefully consulted. For example, some of the carbamates and organophosphates cannot be used on mattresses. If mattresses are to be treated, there are often specific instructions for this use and it is advisable to recommend to the client that a non-porous cover be placed between the mattress and sheets. Insecticides on a mattress should be kept to a minimum to reduce human exposure and it is best to use vacuuming and steam first to remove and eliminate bed bugs on beds.

In the past, fumigants were widely used and there are those registered for bed bug control. However this is a highly specialised area and an appropriate specialist should be consulted.

17.2.2. Currently Registered Products

A list of currently registered products is in Appendix E. The main chemicals available to the Pest Manager including their formulations are in Table 1.

17.2.3. Insecticide Efficacy

Efficacy studies have been undertaken in Australia with registered insecticide groups via topical (i.e. directly applied to the insect) and residual application, using both liquid formulations and dusts (Doggett & Russell 2008; Lilly *et al.*, 2009a,b,c). The test animal used was an insecticide resistant modern strain of the Common bed bug (*C. lectularius*) sourced from Australian field infestations and thus the studies are relevant to present strains. For the registered liquid insecticide groups it was found in the topical investigations that the order of effectiveness from most to least was: OPs > synergised 4th generation SPs >

non-synergised SPs and carbamates > 3rd generation SPs > natural pyrethrins. In the study, the natural pyrethrins provided no control and the 3rd generation SPs (permethrin) virtually no control. The carbamate (bendiocarb) produced an equivalent level to that of the non-synergised SPs with around 60% control at ten days, while the synergised 4th generation SPs produced 95% control over an equivalent time. Only the OPs (diazinon and pirimiphos-methyl) provided 100% mortality within six hours.

Table 1. The various insecticidal active ingredients currently registered for bed bug control in Australia (as of the date of this publication).

Active Ingredient	Formulation/s	Insecticide Group	Mode of Action Group*
Amorphous Silica (Diatomaceous Earth Dust)	Dust	Silicates	Not listed
Bendiocarb	DP, WP	Carb	1A
Betacyfluthrin	SC	SP (4G)	3A
Cyfluthrin	AC, WP	SP (4G)	3A
Chlorfenapyr	SC	Arylpyrrole	13
Deltamethrin (some synergised with PBO)	SC	SP (4G)	3A
Diazinon	EC	OP	1B
Permethrin	DP, EC, WP	SP (3G)	3A
Pirimiphos-Methyl	EC	Organophosphate	1B
Propoxur	Aerosol	Carb	1A
Sulfuryl Fluoride	Fumigant	Miscellaneous	8C
Various aerosols containing synergised pyrethroids	Aerosol	SP (2,3,4G)	Mostly 3A

AC= Aqueous Concentrate, DP=Dustable Powder, EC= Emulsifiable Concentrate, SC=Suspension Concentrate, WP=Wettable Powder. PBO=Piperonyl Butoxide (synergist). Carb=Carbamate, OP=Organophosphate, SP=Synthetic Pyrethroid, G=Generation of Synthetic Pyrethroid (4th being the most modern and insecticidal). No Dichlorvos product is specifically registered for bed bug

The residual experiments produced somewhat similar trends to the topically applied insecticide trials in that 100% mortality was achieved within 24 hours with the OPs and even after 52 weeks of ageing the pirimiphos-methyl treated surface, 100% mortality was still being achieved. However, the remaining insecticide groups produced consistently poor results with no greater control than 50% mortality after ten days.

These research findings suggest the following:

- Where possible, the first choice of insecticide would be the OPs,
- Non-OP products cannot be relied on as a residual treatment to achieve complete control, rather the aim should be to directly treat the bed bugs,
- A synergised SP is preferable to a non-synergised SP.

However, the OPs and some carbamates (notably propoxur) have use limitations. They have an unpleasant odour which would be unacceptable to many clients, especially for accommodation providers. The OPs also contain various solvents that can cause staining on some surfaces, notably fabrics, which means that there are restricted use patterns. For example, the label for Actellic (primiphos-methyl) states "Do not apply to carpets, mats or soft furnishings", which means this product can not be used in the eradication of many bed bug infestations. Despite this, there are circumstances when the OPs may be used, for example in premises which remain unoccupied for some time such that the odour can dissipate.

The studies above did not measure repellency of the insecticides. It is known that the pyrethroids have an excito-repellency effect with various insects and investigations have shown that bed bugs are indeed repelled from pyrethroid treated surfaces (Romero *et al.* 2009) at sublethal doses. Arguably, this makes the pyrethroids less effective than the non-repellent insecticides in the field situation as if poorly applied, they can spread an infestation making control more difficult. The carbamates appear not to repel bed bugs and anecdotally appear more effective as a killing agent. Currently the only carbamates registered against bed bugs is bendiocarb and propoxur. Propoxur is present in the aerosol Battleaxe Pro, while bendiocarb is available as both dust and wettable powder formulations, and it should be noted that bendiocarb is not registered for use on mattresses.

In September 2011, amorphous silica, more commonly known as Diatomaceous Earth Dust (DED), was registered for bed bug control. DED is a slow acting compound taking up to 1-2 weeks for a complete kill with adult bed bugs, although is much quicker on the nymphal stages. It does however offer a number of advantages over other products; it is highly residual with an extremely long shelf life, dusted bed bugs can transfer the insecticide to other bugs thereby killing others indirectly, there is a low probability of resistance developing due to its physical mode of action, dose rate is not as critical compared with other products (under-dosing results in a longer time to achieve a complete kill), it has very low mammalian toxicity and is often recommended by environmental groups, and DED could be used in a prophylactic sense to minimise the risk of bed bugs establishing in otherwise uninfested rooms (Doggett & Russell 2008). Other management means should be used to quickly

reduce the biomass of infestations when DED is employed, however this product should prove highly beneficial in bed bug management.

In 2010, Phantom SC Insecticide was registered in the Australia for the control of bed bugs. Published efficacy data have demonstrated variable results; while two laboratory investigations have found that the product would slowly kill all bed bugs exposed, another found the product so ineffective that the treated bed bugs mated and laid eggs, with many of the hatching nymphs surviving. A third laboratory trial, from Australia, found that the product was unable to kill any bed bug strain, even those susceptible to the pyrethroids (Doggett *et al.* 2011). Two field investigations have also demonstrated poor efficacy; in one of the trials complete control was not achieved over five months despite repeated applications with the product (Doggett *et al.* 2012). In light of the generally variable published efficacy results, the use of Phantom SC Insecticide against bed bugs is not supported.

At the time of writing this CoP, there are no insect growth regulators (IGR'S) which are registered for bed bug control in Australia and thus their use can not be recommended.

17.2.4. Insecticide Reapplication

Most of the insecticides registered for bed bug control in Australia have little proven ovicidal effect and thus do not kill the eggs. Many products also provide poor residual control and thus may not kill newly emerged nymphs. To facilitate the kill of newly emerged nymphs, additional direct application treatments must be undertaken after the eggs have hatched. The duration of egg hatching, and thus the time to the additional treatments, will be dependent on the ambient temperature (Table 2) and at least one follow up visit must be made with an insecticidal application. If the infestation is heavy, further inspection and treatments will be needed.

Table 2. The development time (in days) to hatching at various temperatures for the eggs of *Cimex* spp. (after Usinger, 1966).

Species	Temperature (°C)				
	18	22	27	30	33
<i>Cimex lectularius</i> (Common bed bug)	20.9	12.1	5.3	4.4	4.1
<i>Cimex hemipterus</i> (Tropical bed bug)	25	13.2	5.9	4.6	4

17.2.5. Insecticide Resistance Strategies

Overseas investigations have reported a high degree of insecticide resistance in

bed bugs. One study in the USA found that field collected Common bed bugs were several thousand times more resistant to deltamethrin and lambda-cyhalothrin (both pyrethroids) than susceptible strains (Romero *et al.* 2007). Resistance to both the synthetic pyrethroid alphacypermethrin and the carbamate bendiocarb has been recorded in the Common bed bug in the United Kingdom (Boase *et al.* 2006), while the Tropical bed bug was found resistant to pyrethroids in Africa (Myamba *et al.* 2002). Investigations have also found high levels of resistance to the SPs and the Carbamates in Australia (Lilly *et al.* 2009c). Recent studies have also identified resistance to the OPs.

Currently, there are very few insecticides from different chemical groups registered for bed bug control in Australia and thus presently it is not possible to formulate an effective insecticide resistance strategy. The Pest Manager should however assist in reducing the further development of insecticide resistance by integrating non-chemical with chemical means of control, always following the application instructions on the product label when applying insecticides and by not relying solely on residual action of insecticides.

18. POST-TREATMENT PROCEDURES

18.1. Client

The client should be advised to undertake the following after each treatment:

- Occupants should be encouraged not to re-enter the treated area until after the chemical has completely dried. Refer to label instructions for re-entry period.
- The client should be requested not to vacuum floors and upholstered furniture for at least 12-14 days after final treatment.
- The room should be kept vacant until the Pest Manager declares the area free of bed bugs in a follow up visit.
- All past signs of the infestation should be removed, such as dead bugs and the blood spotting on walls and mattresses, to avoid future confusion.
- Proactive measures should be undertaken as outlined below.

19. POST ERADICATION PROCEDURES

19.1. Pest Manager

19.1.1. *Measurement of Success*

A successful treatment has been achieved when the infestation identified at the initial inspection has been eliminated. All adjoining rooms must be inspected; an infestation in these rooms may indicate a control failure.

Treatment success should also be based on assessing the level of client cooperation, along with follow up inspections and treatments. The Pest Manager should ensure that the client has followed all the recommendations prior, during and post treatment. The final inspection should be as detailed as the initial inspection, or even more so. All previously identified locations with bed bugs must be examined, cracks and crevices retreated with a knockdown agent and surrounding areas examined in case bugs have been flushed out by the insecticides. If live bed bugs are observed then a further treatment and subsequent inspection should be undertaken.

19.1.2. *Eradication Declaration*

At the completion of treatment the Pest Manager should add to the Bed Bug Eradication Plan:

- The date of eradication.
- Any variations in the Bed Bug Management Plan.
- Limitations or conditions experienced during the treatment, which could not be envisaged from the initial inspection (e.g. areas that could not be accessed). If these factors prevented successful eradication, then all actions to demonstrate that reasonable steps have been undertaken must be recorded.
- If heat was employed, include temperature readings and locations of sensors for whole rooms.
- Any client duties such as recommendations to minimise risks of further infestations (see next section).

20. REDUCING BED BUG RISKS

For practical reasons it is not possible to prevent bed bugs from entering a premise. Thus the following section attempts to discuss methods that may

reduce the risk of an infestation, and to minimise bed bug impacts if introduced. The ultimate key to reducing bed bug impacts is to 'detect early and act quickly'.

20.1. Bed Bug Population Dynamics

The dynamics of a bed bug infestation can be classified into four broad phases:

- I. **Introduction,**
- II. **Establishment,**
- III. **Growth, &**
- IV. **Spread.**

Thus bed bugs are first brought into a premise ('**Introduction**') and the population becomes entrenched ('**Establishment**'). Next the population expands in number ('**Growth**') and finally the infestation is passed onto new premises or to other areas or rooms within the same facility ('**Spread**'). It should be noted that this is a general path; bed bugs could spread soon after introduction even though the population has yet to substantially grow. To reduce the risk of bed bug infestations and their ultimate spread, an accommodation facility must attempt to undertake risk reduction strategies for each of these infestation phases.

Various strategies for each of the phases include:

Introduction; educating travellers on avoiding bed bugs (Section 20.3), the treatment of luggage suspected contaminated with bed bugs (Section 20.3.1 & 20.3.2), banning of second hand furniture (Section 20.4), and banning external bedding and linen (Section 20.5).

Establishment; making the room less suitable for bed bugs through appropriate room construction (Section 20.6) and maintenance (Section 20.7), the use of bed bug 'unfriendly' furniture (Section 20.6) and bed types (Section 20.8), the use of mattress encasements (Sections 17.1.7 & 20.9), employment of bed bug barriers (Section 17.1.9), appropriate hygiene measures (Section 20.10), and undertaking risk analysis of previous infestations (Section 20.11).

Growth; training of housekeepers in bed bug recognition (Section 7.2), informing tenants to encourage reporting (Section 20.12), ensuring that linen handling procedures are appropriate (Section 20.13), and proactive pest inspections (Section 20.14).

Spread; infested items should be quarantined, access to infested rooms should be limited, control measures should be implemented promptly, any items within an infested room should be bagged before removal (Section

17.1.2), any belongings of the tenant should be disinfected before relocated (Section 17), and items that are removed should be appropriately destroyed (Section 20.15).

No one method of risk reduction should be relied on, rather a multi-disciplinary approach undertaken as part of an integrated pest management program should be employed. Within an accommodation facility, the approach to prevention and control must be consistent and based on a Bed Bug Management Policy (Section 20.2).

20.2. Bed Bug Management Policy

As part of the risk management process, those in the accommodation industry should have a Bed Bug Management Policy. This policy should cover aspects including; staff training (Section 7.2), the documentation of putative and actual infestations (Sections 8.2.1 & 20.2.1), occupational health and safety (Section 9), the eradication processes (Sections 17-19) and minimising bed bug risks (Section 20). A Proactive Bed Bug Management Plan should be prepared in the event of an infestation (Section 16.1). Records of bed bug infestations should be kept to distinguish possible new infestations from potentially failed treatments. The policy should be reassessed regularly, updated and refined as for routine risk management reviews. Such a Bed Bug Management Policy now exists and can be downloaded from www.bedbug.org.au (Doggett, 2011).

20.2.1. Bed Bug Detection

The following procedures should be included within the Bed Bug Management Policy and implemented upon the detection of a bed bug infestation;

- If the guest has been moved to another room, then the second room should also be inspected and treated once the guest has vacated (again ensuring all above procedures are documented).
- In the event of a positive bed bug infestation, the Hotelier should provide information to the guest on how to prevent the establishment of bed bugs in their home.
- The Hotelier may wish to contact past guests that had stayed in the room over the previous month to inform of the bed bug infestation and the possibility that the infestation could have been transferred to their home, or other locations.
- The Hotelier should undertake those processes relevant under Section 13 'Planning and preparing for inspections and treatments'.

20.3. The Traveller

Bed bugs are often inadvertently brought home in conjunction with travelling, or transferred to other accommodation facilities. Reducing the risk of establishing bed bugs in the home involves;

- Minimising the possibility of bed bugs infesting luggage,
- A thorough inspection of the hotel mattress and room for bed bugs,
- Decontamination of luggage and clothing upon returning home.

Luggage is the prime means by which bed bugs are transferred from one location to the next and consideration should always be given to means of reducing the risk of bugs infesting the luggage. Prior to inspecting the mattress and bed for signs of bed bugs, luggage should be initially left outside, in the centre of the room where there are fewer harbourage areas, or on pre-inspected tables. Belongings should not be unpacked from luggage, and in turn, the luggage itself should be kept in plastic bags at all times as this may prevent bed bugs from entering the luggage. After leaving the room, the external plastic bag should be discarded. An alternative to plastic bags are BugZip luggage encasements (www.bugzip.com), which can stop bed bugs entering the luggage. BugZip also produce draw liners that can prevent bugs infesting clothing. Solid luggage, such as those made of polypropylene or ABS plastic, without external pockets may be more resilient to bed bug invasion than soft bags. However, soft material bags (unless of a nylon composition) may be laundered in hot water thereby killing any unwanted hitchhiking bed bugs.

The traveller must be aware of the possibility of their belongings becoming infested and consideration should be made to only including clothing that can be safely laundered or dried at high temperatures. Any items that can not be treated by extremes of high (or low) temperatures should be kept protected by being constantly sealed in zip lock disposable plastic bags. It is sometimes recommended that spraying luggage with synthetic pyrethroid insecticides (such as permethrin) may prevent bed bugs entering bags. However, this group of insecticides provides poor residual control against modern resistant bed bug strains and is thus unlikely to offer any real protection, and there is no evidence to suggest that this method is effective. Thus other methods of avoiding luggage becoming infested should be followed.

To minimise the risk of taking bed bugs home or transferring the bugs elsewhere, it is important for the traveller to check their hotel room on arrival for evidence of bed bugs, as described in Section 12.2. The edges of the mattress should be exposed, and the seams and beading of the mattress checked for the tell tale signs of bed bugs particularly in the darker areas where the bed meets the wall. It is advisable also to check the areas where luggage is placed. If there is evidence of bed bugs then a new room should be requested. If there are signs

of blood spotting, even if no live bed bugs are present, it would still be highly advisable to ask for another room as it is impossible to know how well the room has been treated and what stage of treatment it is in (such as between the initial treatment and subsequent inspections).

An inspection of the mattress and room may uncover no evidence of bed bugs, yet the possibility of an infestation can not be totally excluded. In new infestations or when numbers are low, the bugs can hide in less obvious locations such as in ensemble bases, which are hard to access for inspection. If the traveller experiences any bite-like reaction or has suspicions of bed bugs being present (such as blood spotting on the sheets), then it would be best to assume that luggage and clothing is infested and requires disinsection. On returning home, luggage should be kept isolated from the bedroom (such as in a garage). All clothing should be hot washed and/or dried on the hot cycle of a clothes dryer (see Section 17.1.4). Luggage can be disinfected by heating and/or freezing (Section 17.1.4 & 17.1.6). If there is any possibility an infestation may have been acquired, then a Pest Manager should be consulted.

It can take up to nine days or more for the bed bug bite to appear. If the traveller has stayed in multiple locations during this period, then it may be impossible to determine where the exposure occurred.

20.3.1. Luggage

Isolating luggage such as backpacks and other belongings separately from bedrooms in accommodation facilities may help in preventing the transmission of bed bugs but this practice presents obvious logistical problems in terms of storage and security of belongings. If the bags are to be stored elsewhere, this would have to be in metal lockers, which provide fewer harbourages and could be readily treated, otherwise the storage area could aid in the spreading of the bugs. As there is no current information on the benefit of such procedures they are not recommended within this CoP.

20.3.2. Inspecting Luggage for Bed Bugs

Inspecting luggage for bed bugs is probably not practical; the eggs are too small to be easily seen, can be laid in any small crack and crevices, and thus may not be visible. Inspection of client luggage by hoteliers may also violate privacy laws.

20.4. Second Hand Furniture

There are numerous reports of bed bugs being transmitted via second hand furniture. It is inadvisable to purchase or use any second hand mattresses, furniture or furnishings, unless the items can be confirmed bed bug free. Accommodation facilities should also limit the practice of transferring mattresses

and furniture from one location to another. If this becomes necessary, then the items need to be thoroughly inspected for bed bugs. No item should be transferred from a previously infested room.

For Second Hand Furniture Retailers, all mattresses and bed frames should be examined for signs of bed bugs by an appropriately trained inspector before being placed into the store for sale. Infested furniture should be treated as outlined in the CoP.

20.5. Guest Linen & Bedding

As the transmission of bed bugs is linked with bedding, guests should not be allowed to use their own sleeping bags and linen. Ideally, sleeping bags should not be permitted in the bedroom but sealed in a plastic bag and placed in a separate storage room. The Hotelier should explain to the client the need for this. All linen should be provided by and laundered by the accommodation facility or contractor. Laundering should be in hot water, preferably on a daily basis. For backpacking lodges, rooms should have multi-lingual signs requesting guests to use the linen provided.

20.6. Room Furnishings & Room Construction

For the other areas of the room, access for inspection and treatment, and reduction in harbourages should always be the overriding design philosophy for the bed bug unfriendly room. For example, fixed cupboards should be replaced with metal, removable shelves. While these are probably not as aesthetically pleasing, control would be easier as there are fewer places for bed bugs to hide. Many hotels use cane or wicker furniture, especially in seaside and tropical locations. Such furniture is very bed bug friendly, offering numerous harbourages. Likewise, so is open brickwork and sprayed concrete walls. Such walls should be rendered and heavily painted or covered with plasterboard ensuring all joints are well sealed. Carpeted floors provide more harbourages than solid tiles and carpet squares should be avoided. Solid tiles have the advantage of being easily cleaned via vacuuming or even washed with hot water (or steam). For situations of high risk, the solid plastic chairs would be preferable over cloth and wooden types.

20.7. Ongoing Maintenance

The main aim of ongoing maintenance for minimising the risk of bed bugs is the reduction of potential harbourages via sealing any cracks and crevices. Loose

wallpaper should be reglued, while paint should not be allowed to deteriorate to the extent that it is flaking from the wall. Decorative plates are often placed over wiring that penetrates into the walls and it is important that a sealant such as silicon is placed around the wiring. This is also true for any plumbing pipes.

20.8. Bed Design

Metal framed beds can limit the impact of bed bugs as they provide fewer harbourages and the bed bugs are averse to climbing smooth hard surfaces (unless starved for some time). Thus metal frames can help to contain an infestation; if the bugs fall off the bed, they are unlikely to climb back up and eventually die without a blood meal. Wooden beds offer numerous cracks and crevices for harbourages, and provide many footholds for the insect.

The inherent advantages of metal beds can be rendered ineffective if valances or bed linen are in constant contact with the floor or walls, or if curtains are touching the bed. Such contact will allow access for the bed bugs. Ideally, the metal bed frame should be constructed so that the feet of the legs splay out so that it is impossible to push the bed hard against the wall. To be most effective, the bed must be made like an island, isolated in the room.

Other bed designs are not so effective at containing an infestation. Ensemble beds contain many places for bed bugs to hide and lay their eggs. The base of this bed type is especially favourable to the insect; the material base cover limits inspection and the areas between the staples are a common bed bug haunt. If the caster legs are plastic, they will be hollow and provide further harbourages. The other problem with ensemble bases is that they can be pushed hard against the wall, enabling the bugs to spread via the wall and utilise other locations in the room as harbourages. Keeping beds away from the wall (more than a few centimetres) will minimise the risk of bed bugs climbing up the wall and onto the bed.

In hotels the bed head is usually a separate component to the mattress and bed base and is often firmly fixed to the wall. This makes inspection and treatment impossible unless the bed head can be completely removed from the wall (often they are nailed or even glued in place). If power points are attached to the bed head, this can make the inspection more time consuming as power will have to be turned off and electrical fitting disconnected and treated. Where such electrical wires penetrate the wall, this can be an access point by which the infestation can spread to adjoining units. Often the bed heads are made of laminated chipboard, which provides numerous harbourages. Such materials should be avoided in a room to limit bed bug infestations. Ideally in a bed bug unfriendly room, bed heads would not be used.

20.9. Mattress Design, Encasement and Treatment

As bed bugs often hide on the beading of mattress, those without beading, such as the solid rubber foam variety, may be less attractive to bed bugs as fewer harbourages are available. The alternative is to use a mattress encasement (Section 17.1.7) that can be easily removed for regular washing. If not prohibited to do so, all tags, labels and corner protectors should be removed from the mattress to limit harbourage areas.

Presently there are mattresses and mattress covers available pre-treated with insecticides and claiming to resist bed bug infestations. Laboratory tests evaluating permethrin impregnated fabrics against a resistant Australian bed bug strain have found these fabrics ineffectual (Doggett *et al.* 2011). The use of these products may even contribute to the development of further insecticide resistance (Davis *et al.* 2012). Until the Working Party has sighted data supporting efficacy of treated mattresses against modern insecticide resistant Australian bed bug strains, such mattresses are not recommended within the CoP.

20.10. Hygiene

A regular regimen of vacuuming all areas of a room, especially around skirtings and under lounges and sofas, can reduce the severity of a bed bug infestation, and limit the potential for spreading an infestation. The contents of the vacuum should be sealed and discarded (Section 17.1.3), and the vacuum, when not in use, should ideally be confined to the one location. For larger establishments, vacuums and cleaning trolleys should be confined to one floor or to a certain section of a floor. Bed bugs can be transferred via cleaning trolleys and isolating the trolleys to an area should help contain this possibility. A minimum of items should be brought into the room, for example cleaning trolleys should be left outside. Any crevices on the cleaning trolleys should be sealed with a caulking agent. Clutter in a room should be kept to a minimum.

20.11. Risk Assessment and Management

Those in the accommodation industry, who are seriously affected by bed bugs, should undertake a risk analysis of past infestations. Rooms afflicted should be analysed to see where the past guests have come from, whether they be from a local region or from overseas. If clear patterns emerge, then the high risk groups should be kept separately from the low risk groups. This may help to contain infestations to certain rooms and to a certain area of a facility.

20.11.1. Tracking Infestations

Hotels belonging to a chain should advise their head office of any infestation and the possibility of new infestations via guests transferring between hotels.

20.12. Notification by Tenants

In high density housing if bed bugs are problematic, management should encourage tenants to promptly notify if they suspect an infestation. Information signage can be placed on noticeboards and educational leaflets distributed to tenants.

20.13. Linen Handling

All used sheets and bedding should be sealed in plastic bags within the room before taken outside and placed into linen hoppers. For a known or suspected bed bug infestation, the bedding should be placed into alginate bags. Clean and used linen should be kept separate at all times; they should not be transported to and from rooms via the same trolleys. It may be advisable to colour code linen hoppers to distinguish between clean and used linen. If linen is washed by outside contractors, the dirty and clean linen should not be transported in the same vehicle. It is not uncommon for used linen to be placed in the corridor outside a room; this is a high risk practice for spreading bed bugs and should be avoided.

20.14. Pest Inspections

Ongoing pest inspections are essential to reduce the severity of infestations. Ideally this should be undertaken on a routine basis by housekeeping staff when linen is changed. The inspection date should be recorded even if no bugs are noticed. The frequency of inspections should be dictated by the number of past infestations and modified according to the rate of new infestations. Pest detection dogs may be used as a sensitive means of detecting early infestations (Section 14.2.4).

20.14.1. Preventative Insecticide Applications

The majority of the presently registered insecticides provide a very poor level of control against bed bugs when applied as a residual treatment, therefore their use as a preventative treatment is not advised in this code. Also, such ineffective use of insecticides can increase the probability of insecticide resistance developing, which is already a problem in bed bug management.

20.15. Destruction of Infested Items

When items are disposed of for control, it must be ensured that they are not sent to a recycling facility, unless the facility has processes and procedures in place to disinsect the items. It is preferable that they are sent to land fill or are incinerated. All beds and furniture must be clearly labelled as bed bug infested and rendered unusable before discarding, and sealed in plastic before removal from infested rooms.

21. SITUATIONAL CONTROL

21.1. Multiple Occupancy Residential Complexes

Like hotels, if bed bugs are detected in one dwelling within a multiple occupancy residential complex (such as apartments, units, flats, townhouses or villas), then the adjoining dwellings should also be inspected. However, there are big differences in management responsibilities between hotels and multiple occupancy residential complexes, which can pose many challenges for bed bug control. For example, a hotelier has complete control of the building, including housekeeping, and can readily undertake inspections and treatments in any room whenever necessary. This is not the case for multiple occupancy residential complexes and ensuring that an adjoining room is inspected can be very difficult.

It would be unprofessional and a breach of client confidentiality for the Pest Manager to contact the neighbouring premises without the consent (preferably written) of the client. The situation becomes difficult when the adjoining property is suspected as being the source of the infestation as reinfestation in the treated premise is likely to occur. All the Pest Manager can do in this case is to encourage the occupant to inform the Body Corporate or the Body Strata Manager that bed bugs have been found in the complex and that anyone who experiences bite type reactions should have their premises inspected by a licensed Pest Manager.

In some cases, an occupant's premise within a complex may become infested when an adjoining tenant fails to undertake control of their own bed bug infestation. In these situations, the occupant should inform the Body Corporate or the Body Strata Manager. If the problem remains unresolved it may be necessary to contact an Environmental Health Officer (sometimes known as a 'Health and Building Surveyor') within the local Council, the Public Health Unit and/or State Health Department.

In some states there are strict notification requirements for undertaking insecticidal treatments in common areas and the Pest Manager should check to see if such legislation applies in their respective state (for NSW, see: www.epa.nsw.gov.au/resources/pestmanagement.pdf). For example, under the NSW requirements, normally the residents must be informed five days prior to the treatment of common areas. However, as bed bugs are biting insects they are possibly exempt from this notification process under the 'Emergency Situation' provision. Despite this exemption, the Pest Manager must still put up notices on the site when the treatment is undertaken and must keep records to justify carrying out the treatment under the emergency conditions.

21.2. Rental Accommodation

A disturbing trend for people with bed bugs in rental accommodation is for the tenants to move to another property leaving an uncontrolled infestation behind. Subsequent tenants then often become involved in disputes with the landlord over who pays for the bed bug control. In such cases the following steps can be taken by the disputing parties:

- Ensure that the pest is properly identified as a bed bug.
- Have the premise inspected by a Pest Manager with experience in bed bug management. Ensure that the report lists the signs of bed bug activity and the extent of the infestation.
- For any disputes refer to the Tenancy Agreement.

21.3. Transport Industry

As bed bugs are transferred from one location to another mainly via luggage, there is a risk that the bugs could be passed from luggage to luggage in cargo holds, luggage trailers, car boots or other areas where luggage is placed, transported or stored. All such sites should be made bed bug 'unfriendly'; cracks and crevices should be kept to a minimum, surfaces should be metal (or tiled for floors) and carpet should be avoided.

21.3.1. *Bed Bugs on Aircraft*

There have been a number of reports from overseas of bed bugs infesting aircraft. In this situation control is more challenging as there are a limited number of insecticidal products approved for use on aircraft. It must be noted that a product that is registered by the APVMA may not necessarily be used on aircraft. The only active ingredient and formulation approved as a residual treatment is permethrin as an EC. As noted under Section 17.2.3 (Insecticide Efficacy), permethrin provides very poor control in both direct and residual

application. This means that there needs to be greater reliance on non-chemical means of control, including vacuuming and steam. In the US, heat treatment of whole planes has been undertaken.

The products that are approved for use on international aircraft are listed in: MQS and AQIS. 2010. **Schedule of aircraft disinsection procedures**. Version 2.1. *Australian Quarantine and Inspection Service, and the New Zealand Ministry of Agriculture Quarantine Service*. 42pp. This can be freely downloaded from: www.daff.gov.au/_data/assets/pdf_file/0005/111992/mqs-procedures.pdf

21.4. Extreme Bed Bug Infestations

A disturbing recent trend is the increasing number of bed bug infestations that are occurring amongst socially disadvantaged groups, particularly in public housing and homeless shelters. These infestations can be massive, involving thousands to even tens of thousands of bugs in a single dwelling. Usually the occupant does not have the economic capability to pay for control or sometimes even the cognitive awareness to know that bed bugs are present. In multistorey dwellings, these large infestations often only become evident after the adjoining units in turn become infested, which is almost inevitable. Units three stories above or below the prime source can become invaded, while the tenant in the main infestation can pass bed bugs to other units via their clothing, visitors, or shared items of furniture and appliances.

Once bed bugs are introduced in high density housing they can quickly become established and spread throughout the building. This makes ultimate control more difficult and expensive. If only one room is left untreated, than this can act as a reservoir for the reinfestation of the whole of the building. Thus management should be proactive and aim to identify and treat every infestation. Tenants must be encouraged to notify management of the suspicion of bed bugs and not to attempt to treat the insect themselves. Management should place notices of bed bugs with pictures of the insect and signs of an infestation onto communal boards and include information in tenant meetings. Councillors and carers should be notified of any bed bugs and encourage clients in the management of the insect. Tenants should not be allowed to bring discarded furniture or other items off the street. In all cases the rooms adjoining those to the infested premise should be inspected for bed bugs; failure to do so may result in the perpetuation of the infestation. Carers and other visitors often can take bed bugs home and in the event of an infestation, the carer's premise should also be inspected. Most importantly, management must rapidly respond to any putative bed bug incident.

Due to the high costs associated with these heavy infestations and the risk for

uncontrolled spreading of the infestation throughout multi-storey dwellings, the authority managing the building should bear the financial costs for eradication. They should also ensure that eradication is conducted as per this CoP.

The extreme infestation site often will have bed bugs virtually everywhere within the dwelling. Not only will the bed be heavily infested, but the bed bugs will be in books, CDs, pictures, wall hangings, clothing, cupboards and other furniture, lounges, whitegoods, appliances, telephone, under carpets, behind skirtings, in wall cavities, etc. Compounding the challenge of controlling such a large infestation in these homes is that they tend to be heavily cluttered, and bed bugs will be scattered throughout these belongings. Control thus becomes impossible unless the clutter is removed and discarded, or taken off site for fumigation or heat treatment. For the tenant, this clutter may be their lifelong belongings and any suggestions of disposal of such property must be undertaken with due sensitivity and in conjunction with the manager of the facility, with the possible assistance of social workers.

The decision to discard, fumigate or heat treat personal belongings must be undertaken on a case by case basis. Fumigating and heat treating belongings is a logistical challenge; items must be bagged on site, taken to the appropriate facility, the bags opened, the items treated, and post-treatment airing undertaken for fumigation. All belongings must be taken to a bed bug free storage area and only returned once the initial infestation is eradicated. Thus fumigation and heat treatment must be based on a logistical and financial assessment, and be sensitive to the tenant's situation.

In heavy infestations, the Pest Manager will require considerable cooperation from a number of parties to achieve control. This may include the owner or manager of the facility (such as public housing), contract cleaners, community health nurses, social and/or charitable workers to help relocate the tenant and provide assistance in removing and replacement of clothing and belongings, and maintenance workers to assist the Pest Manager in gaining access to areas for treatment and dismantling fixed items in the premise. It will be necessary that the tenant is relocated and that none of their belongings (including any clothing currently worn) should be permitted into the new premise.

It is advisable that the Pest Manager has a detailed Bed Bug Management Plan, which is provided to all parties (Section 16). Not only does this appear highly professional but it also protects the Pest Manager in the event that recommended procedures are not undertaken. If an Environmental Health Officer is called in to investigate the infestations, which is not an uncommon occurrence, then a Bed Bug Management Plan may well be requested.

In the Bed Bug Management Plan in extreme infestations the following aspects

are especially important:

- The proper handling and disposal of infested items.
- The handling of infested items to be kept for treatment via fumigation or heat treatment.
- Advice on minimising the risk of the tenant passing bed bugs onto any other premise.
- The need to remove carpets, wall paper, floorings, and other fixtures to gain access to harbourage areas for treatment.
- The need to remove skirtings, architraves and other solid fixtures to gain access to harbourages for treatment and wall voids for dusting.
- The treatment process, including non-chemical methods and a list of the actual insecticides employed and how they are used.
- The need for follow up inspections and treatments.
- The necessity to keep the unit unoccupied during the treatment period.
- The need to inspect, and if necessary, treat all adjoining units.
- Recommendations on reducing harbourage locations post treatment, e.g. sealing cracks and crevices.
- Other post treatment processes, such as housekeeping recommendations or other needed refurbishments.

Most importantly, the Bed Bug Management Plan must stress that bed bug eradication is a cooperative venture between the client, the Pest Manager and the other parties.

A behaviour common amongst these tenants is the tendency to collect items off the street that are intended for disposal, such as old furniture. These items may well have been discarded for the very reason of being infested with bed bugs. It thus becomes important for the manager of these facilities to attempt to change such behaviours and limit what can be brought into the dwelling, and this recommendation should be included in the Bed Bug Management Plan. If the tenant is under a carer or regularly visited by friends and family, then these people may have also inadvertently transported bed bugs to their own home. The Bed Bug Management Plan should recommend that the manager attempts to inform all of the tenant's contacts about the bed bug infestation and the possible need of undertaking an inspection in their respective homes.

The Pest Manager should be present when the contract cleaners arrive to discard belongings. The Pest Manager must then inform the cleaners on how the infested belongings are best handled, including any OH&S recommendations (such as the wearing of overalls and the use of gloves), to minimise the risk of spreading the bugs further.

Such large infestations represent a high risk to the Pest Manager as control equipment items brought into the dwelling can easily become infested. Likewise,

the bugs can get onto clothing and so the Pest Manager should be wary of their procedures, such as inadvertently leaning against objects.

The difficult task with these infestations is establishing when eradication is finally achieved. Only through repeated treatments and follow up inspections, including one at least some months after the initial course of treatments, can the Pest Manager be certain of success. Not surprisingly, such jobs are time consuming, involving numerous consultations, inspections, treatments and follow up visits. Thus the overall price must be commensurate with the labour input and may come to many thousands of dollars.

For more information on bed bug control in public housing and homeless shelters, see: Gangloff-Kaufmann and Pichler, "Guidelines for Prevention and Management of Bed Bugs in Shelters and Group Living Facilities":

www.nysipm.cornell.edu/publications/bb_guidelines/ and "The Bed Bug Resource Manual: A Guide to Preventing, Treating and Coping with Bed Bugs":
www.woodgreen.org/Temp/BedBugManualOct242008.pdf

22. DEFINITIONS

AEPMA – Australian Environmental Pest Managers Association.

Alginate Bags – Dissolvable laundry bags used for handling infectious bedding.

APVMA – Australian Pesticides and Veterinary Medicines Authority; the Federal authority responsible for insecticide registration.

BBF – The Bed Bug Foundation, the organisation who have developed the 'European Code of Practice Bed Bug Management'.

Bed bug/s – Either the Common bed bug (*Cimex lectularius*) or the Tropical Bed bug (*Cimex hemipterus*).

Bed Bug Elimination – The inspection and treatment have been undertaken according to the CoP and no living bed bugs were detected in the final inspection.

Bed Bug Friendly – Any item, material (e.g. wood, chipboard, cane, unsealed brick work, etc) or dwelling that contains numerous cracks and crevices, and provides a multitude of bed bug harbourages.

Best Practice – Utilising the most current and safe technologies, and procedures for the eradication of pests.

Client – An individual, business or organisation that employs a Pest Manager to undertake a bed bug treatment.

Control – In the context of this CoP, primarily implies the elimination of a bed bug infestation. In some contexts, control also includes bed bug management and prevention.

CoP – Code of Practice, i.e. this document.

Disinsection – The process of eliminating an insect infestation.

Due Diligance – Is the ability to prove beyond a reasonable doubt that everything possible was done to prevent a certain act from happening. For those in the accommodation sector, this would be to minimise the risk of bed bugs and ensuring that management strategies were promptly implemented once an infestation was detected. Having a bed bug policy and procedural guide in place, and following it, would assist in the demonstration of 'Due Diligence'.

Fumigation – The process of using a fumigant, which are gaseous insecticides. Due to the highly toxic nature of fumigants, they can only be used by Pest Managers with a fumigation licence. Fumigation is rarely undertaken for bed bug control at the site of the infestation.

Guest – In the context of this CoP, the term is used for any individual staying within any form of accommodation, excluding those privately owned (i.e.

homes, units).

Harbourages – Places where bed bugs hide.

Hotel – In the context of this CoP, this is a generic term used for any form of provided accommodation, excluding those privately owned (i.e. homes, units).

Hotelier – In the context of this CoP, any manager, administrator or owner of short-medium stay accommodation, for example, hotels, motels, guest houses, student lodgings, backpackers, caravans and cabins in caravan parks, B&Bs, landlords, etc., excluding those privately owned (i.e. homes, units).

Housekeepers – Includes staff responsible for hotel maintenance and cleaning.

ICPMR – The Institute for Clinical Pathology and Medical Research at Westmead Hospital, Westmead, NSW.

IPM – Integrated Pest Management is a multidisciplinary approach to pest management with the main aim being to maximise the control of insect infestations by the use of multiple methods. IPM is based on the proper identification of the pest, knowledge of the pest's ecology, non-chemical means of control and the judicious use of insecticides.

MSDS – Material Safety Data Sheet.

NPMA – The National Pest Management Association of America.

OPs – Organophosphate insecticides.

PestCert – The Australian accreditation body for Pest Managers (see www.pestcert.com.au for more information on PestCert).

PestCPD – *The system for recording Continuing Professional Development, administered by the AEPMA.*

Pest Manager – A person licensed to undertake pest management services under relevant State Legislation, and who undertakes a bed bug treatment. Note that this name varies across the country with the different State Legislative Acts.

Putative Infestation – A suspected infestation; i.e. the presence of bed bugs have not been confirmed.

Residual Application – The process of applying insecticide to a surface such that an insect will contact the insecticide when it walks on the treated surface.

RTO – Registered Training Organisation under the definition of the Australian Quality Training Framework (see www.dest.gov.au for more information).

Socially Disadvantaged – People who for whatever reason are unable to control their own circumstances.

SPs – Synthetic pyrethroid insecticides.

Topical Application – The process of applying insecticide directly at the insect (as opposed to 'residual application').

23. REFERENCES AND FURTHER READING

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24. ACKNOWLEDGMENTS

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- Mr Frank Meek, Orkin Pest Control (USA), for providing the service checklist templates used in Appendix C & D.
- Mr Oliver Madge, The Bed Bug Foundation, for allowing the use of aspects of the European Code of Practice, Bed Bug Management.

The Working Party wishes to acknowledge all those who took time to provide comments on all previous editions.

The Working Party commends companies who on their product labels, recommend the use of the The Bed Bug Code-of-Practice and an IPM approach in bed bug management.

25. APPENDIX A – The CoP Working Party

Name	Position	Affiliation (State)
Stephen Doggett (National Coordinator)	Medical Entomologist/ Senior Hospital Scientist	Dept of Medical Entomology ICPMR, Westmead Hospital (NSW)
Dr Chris Orton (Chair)	Entomologist – Urban and Commercial Pest Manage- ment, Senior Visiting Fellow UNSW	School of Biological Earth and Environmental Sciences, Fac- ulty of Science, University of New South Wales. (UNSW)
Gary Cochrane	Technical Services Manager	Amalgamated Pest Control (Qld)
David Gay	Pest Manager/Director President	WR Gay Pest Control (Vic) Australian Environmental Pest Managers Association
Keith Farrow	Training Manager	Rapid Training (NSW)
John Hall	Technical Manager	Bayer (Vic)
Garry Jones	Operations Manager	Ecolab Pty Ltd (NSW)
Brian Langenberg	Pest Manager/Director	Westate Pest Control (WA)
David Lilly	Technical Support Manager	Ecolab Pty Ltd (NSW)
Greg Mills	Pest Manager/Director	Allpest (WA)

25.1. Associate Members

Name	Position	Affiliation
Eric van Essen	Technical Manager	Ecolab Pest Elimination (New Zealand)
Oliver Madge	Senate Member	Bed Bug Foundation (UK)
Justin McBeath	Business Development Manager, Vector Control	Bayer (France)
Frank Meek	International Technical and Training Director	Orkin Pest Control (USA)
Richard Naylor	Senate Member	Bed Bug Foundation (UK)

26. APPENDIX B – Suppliers & Contacts

Products are listed in alphabetical order within categories.

26.1. Mattress Encasements

The following have undergone comprehensive laboratory testing and if used according to manufacturers instructions, bed bugs are unable to escape from the encasements. They also incorporate a membrane which is impervious to the bite of a bed bug.

'*Mattress Safe*' Encasements: Agserv Pty Ltd., 6/105 Derby St, Silverwater NSW 2128 Ph: 1800 55 44 45, Fax 02 9648 2262, www.agservaustralia.com, Email: safe@agservaustralia.com.

'*Protect-A-Bed*' Encasements: Protect A Bed® Snugfit Australia, 2 Simpson St, Moorabbin VIC 3189. Ph: 1300 857 123 or (03) 9551 7255, Fax: (03) 9551 7266. www.protectabed.com.au. Protect-A-Bed encasements are also available from Garrards, consult www.garrards.com.au for branch locations.

26.2. Miscellaneous

Alginate Bags: Confident Care, see www.confidentcare.com.au for state contacts.

'*BugZip*' luggage and clothing encasements: The Bed Protector, PO Box 2019, St Kilda West VIC 3182. Ph: 1300 760 646, Mob: 0419 777 776, Fax: (03) 9534 1892, www.bedbugbarrier.com.au (BugZip luggage and clothing encasements are also available from this supplier).

26.3. Medical Entomological Expertise

The following laboratory is the de facto national reference Medical Entomology laboratory for the identification of arthropods of medical importance:

The Department of Medical Entomology, ICPMR, Westmead Hospital, PO Box 533, Wentworthville, NSW, 2145. Ph: 02 9845 7265, www.medent.usyd.edu.au.

27. APPENDIX C – Bed Bug Service Checklist for the Client*

These should only be undertaken following the inspection and upon the advice of the Pest Manager. Note that all rooms adjoining the infested room will need to be inspected and possibly treated.

Customer Responsibilities

- Loosen carpet around the perimeter of the room (s) to be treated. Do not remove carpet from room unless instructed to do so.
- Remove any items that are mounted to the walls i.e. pictures, mirrors, light fixtures, but do not remove from the room as these need treatment.
- Loosen outlet and switch plate covers.
- Remove linen from bed and ensemble base. These should be bagged and hot washed.
- Remove items from closets, treat appropriately for bed bugs and bag.
- Do not remove any items of furniture from the room.
- Provide a building layout plan of the rooms to be treated.

For Commercial facilities

- Make housekeeping carts available for inspection and treatment.
- Make housekeeping rooms available for inspection and treatment.

After Treatment

- Replace all items removed from walls.
- Replace carpet on straight edge or glue back down.
- Re-assemble room for use.
- Keep room unoccupied until infestation is declared eliminated.

Company/Motel Name/Room no: _____

Signed: _____ **Date:** _____

*This checklist was kindly provided by Mr Frank Meek, Technical Manager, Orkin Pest Control, USA, and includes some modifications.

28. APPENDIX D – Bed Bug Service Checklist*

(Copy to be provided to client once completed)

Hotel Name: _____ Contact Name: _____

Contact Phone: _____ Fax: _____

Address: _____

Date Pest Manager Contacted by Company: _____

Date First Inspection: _____ Date First Treatment: _____

Date/s Follow up Treatments: _____

Date infestation eliminated: _____

Period of Warranty: _____

Pest Manager

- Refer to 'A Code of Practice for the Control of Bed Bug infestations in Australia – Fourth Edition'.
- Respond to calls for bed bug service within 24 hours by phone to schedule the service. Coordinate the service to coincide with preparations by the facility. The Pest Manager must be on site to direct the preparation. If necessary, preparation must be done on several rooms so it is possible to start service after the first room is prepared.

Information to client

- Bed bug service checklist provided.
- Recommended that rooms to be treated taken out of service until the infestation is eliminated.
- Bed bug fact sheets provided, along with details of insecticides.
- Bed Bug Management Plan and billing details provided (the Plan includes the schedule of treatment).
- Client advised that adjoining rooms are to be inspected/treated.

Customer responsibilities completed

- Carpet loosened at floor / wall junction around the perimeter of the rooms.
- All items attached to the walls removed (e.g. pictures, light fixtures, outlet covers, bed heads, etc.)
- Outlet and switch plate covers loosened.
- Linen removed from bed and ensemble base
- Items removed from closets.
- Housekeeping carts (if applicable) available for inspection and treatment.
- Housekeeping rooms (if applicable) available for inspection and treatment.

Pest Manager: _____

Sign: _____ **Date:** _____

Pest Manager Service Procedures

Room

nos: _____

Inspection

- Mattress/es (seams, beading, under buttons, labels and corner protectors if not previously removed).
- Ensemble base (material covering base removed, check hollow plastic caster legs).
- Bed frame (wooden slats, bed posts, etc).
- Bed head (if attached, remove from wall).
- Bedside furniture (including removing and checking drawers in tables and cupboards).
- Other furniture (e.g. luggage racks, especially along seams and buttons, wooden joins, especially if constructed of fibreboard).
- Electrical fittings and appliances.
- Underneath carpet edges and the straight edges (plus any other floor coverings, along with joins in floor boards).
- Wallpaper and paint (if loose).
- Architraves, wall hangings, picture frames, wall mirrors, Venetian and vertical blinds, curtains and curtain rods, books, behind electrical conduit, cracks and joins in the ceiling and ceiling mouldings.
- Lounges in common rooms of backpacker lodges.
- Housekeeping carts & rooms, linen & mattress storage rooms, laundry areas.
- Adjoining rooms, above & below.

Inspection Notes (include impediments to completing the inspection)

Non-chemical control - Vacuuming

- ❑ Use a vacuum cleaner with a disposable bag.
- ❑ Vacuum floors using crack and crevice tool along the base of the wall.
- ❑ Remove cloth cover from the bottom of the ensemble base. Save for re-attachment after service.
- ❑ Vacuum the seams and general surface area of the mattress and ensemble base. If sofa contains a fold out sofa bed, it must also be vacuumed and removed from the sofa for treatment.
- ❑ Vacuum the seams and general surface area of all cushions from sofa and chairs. Remove cushions from sofas and recliners. Turn sofas and chairs upside down and place in the middle of the room away from the walls.
- ❑ Remove vacuum cleaner bag, dust contents with insecticide, seal and dispose.
- ❑ Inspect folding luggage rack for evidence of insects, if found, treat the infestation.

Non-chemical control - Steam

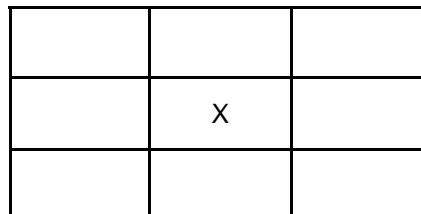
- ❑ Place nozzle directly onto the surface being treated. The nozzle should be moved along at a rate of only 30cm per every 10-15 seconds.
- ❑ Start treatment with the mattress applying steam to the seams, under labels and handles, and both inside and out of an ensemble base.
- ❑ Cushions of chairs and sofas should be treated, paying particular attention to seams and buttons.
- ❑ Check if the sofa is a sofa bed and if so treat the mattress as above.
- ❑ Treat carpet edges along with the straight edge both above and below and curtains.
- ❑ Do not apply steam to electrical fittings.

Chemical control

If steam is unavailable treat those areas described above with insecticide, ensuring that all products are used according the label directions.

- ❑ Apply insecticide to the floor wall junction and under the carpet and straight edge.
- ❑ Apply dust to the inside of all electrical junction boxes. (Light switches, outlets, television cable outlets.)
- ❑ Ensure that the cracks and crevices of the ensemble bases and framework of furniture are treated.
- ❑ Ensure items that will be re-attached to the wall are treated.
- ❑ Inspect guide tracks of closet doors for evidence of bed bugs. If insects are found in this area, have the maintenance staff pull the metal track up and treat. Have maintenance re-attach after treatment.
- ❑ Inspect and treat all rooms where housekeeping carts and extra mattresses or furniture are stored.

Rooms are to be treated in blocks in this general pattern.



X = infested room

All rooms that make contact with the infested room, both above and below, must be treated on the same service.

Notify customer to undertake the following if necessary

- ❑ Repair any loose wallpaper and baseboard covering.
- ❑ Repair any sources of moisture, such as leaky taps and air conditioner condensation lines and pans.
- ❑ After treatment, seal cracks and crevices.

- ❑ Re-attach material covering to ensemble base.
- ❑ Re-attach carpet to straight edge.
- ❑ Place a mattress cover on the mattress according to labelling instructions if treated with insecticides.

*This checklist was based upon a list kindly provided by Mr Frank Meek, Technical Manager, Orkin Pest Control, USA.

29. Appendix E – Pesticides registered by the APVMA for bed bug control as of 27/Feb/2013

Note this is for information only; the APVMA (www.apvma.gov.au) should be consulted for accuracy of information and to obtain a current list of registered products. This list does not distinguish between products available for the home user and the Pest Manager. The 'Approved Use' is as per instructions as described on the label, as appears on the Queensland Department of Primary Industries InfoPest web site. Access to this site was via the link direct from the APVMA site. The product label must be consulted prior to use to confirm the current approved use and for application rates and safety instructions. Note also that just because a product is registered does not necessarily mean that it is still available or that it is effective against modern insecticide resistant bed bug strains (**i.e. registration by the APVMA is not proof of efficacy**).

Product Code	Product	Active Ingredient/s	Formulation	Approved Use
31986	FICAM D INSECTICIDE DUST	Bendiocarb	Dust	Insect hiding places such as electrical areas, ceilings, wall cavities.
31988	FICAM W INSECTICIDE	Bendiocarb	WP	Bed frames, cracks & crevices, not bedding.
32254	DEFENDER HOME GARDEN READY FOR USE SPIDER COCKROACH & ANT INSECTICIDE	Permethrin	Liquid	Directly at insects, carpets, floor areas, under furniture, wardrobes, and skirtings.
32843	COOPEX RESIDUAL INSECTICIDE	Permethrin	WP	Not stated.
33210	COOPEX INSECTICIDAL DUSTING POWDER INDUSTRIAL STRENGTH	Permethrin	Dust	Bedsteads, bedsprings, mattresses, floor coverings, upholstered furniture, cracks in walls, behind torn wallpaper, joints in woodwork and other cracks and crevices that may provide harbours.
41698	COUNTRY DIAZINON 800 INSECTICIDE	Diazinon	LC	Spray should be applied under beds, along skirting boards and anywhere bed bugs may be able to shelter, as well as lightly to bedding.
45907	CRACKDOWN RESIDUAL INSECTICIDE	Pip but, deltamethrin, D-tetramethrin	SC	Cracks & crevices, bed frames.

46237	SOLFAC 50 EW PROFESSIONAL INSECTICIDE	Cyfluthrin	AC	Mattresses, clothing (wash before reuse), walls, cracks & crevices, skirting & bed frames.
46465	ACTELLIC 900SF SOLVENT FREE LIQUID INSECTICIDE	Pirimiphos-methyl	Liquid	Apply to run-off point.
46589	TARGET DUST TREATMENT FOR INSECT CONTROL	Permethrin	Dust	Bedsteads, mattresses, springs, floor coverings, upholstered furniture, cracks, torn wallpaper, joints in woodwork.
47105	PEA-BEU SURFACE SPRAY HOUSE-HOLD INSECTICIDE INSECT KILLER	Permethrin, tetramethrin	Aero	Not stated.
48234	COMMERCIAL INSECTICIDE ROACH TOX SURFACE SPRAY	Allethrin, permethrin	Aero	Not stated.
48570	OZTEC PERMETHRIN 10 INSECTICIDAL DUSTING POWDER	Permethrin	Dust	Not stated.
49084	BARMAC PERMETHRIN D PROFESSIONAL INSECTICIDE DUST	Permethrin	Dust	Bedroom furniture, mattresses, cracks & crevices, etc.
50007	BARMAC DIAZINON INSECTICIDE	Diazinon	EC	Spray should be applied under beds, along skirting boards and anywhere bed bugs may be able to shelter, as well as lightly to bedding.
50682	BLITZ INSECTICIDE	Pip but, deltamethrin, Tetramethrin	SC	Cracks & crevices, bed frames, adjacent walls.
51943	INSECTIGONE INSECTICIDE	Deltamethrin	SC	Not stated.
52336	DRAGNET DUST - INSECTICIDAL POWDER INDUSTRIAL STRENGTH	Permethrin	Dust	Bedsteads, mattresses, springs, floor coverings, upholstered furniture, cracks, torn wallpaper, joints in woodwork.
52365	DELTASHIELD 10 RESIDUAL INSECTICIDE	Deltamethrin	SC	Apply up to run off point.
52913	PERMEDUST INSECTICIDAL DUSTING POWDER INDUSTRIAL STRENGTH	Permethrin	Dust	Bedsteads, mattresses, springs, floor coverings, upholstered furniture, cracks, torn wallpaper, joints in woodwork.
53210	CREEPLY CRAWLEY PRODUCTS DELTA PRO 10 RESIDUAL INSECTICIDE	Deltamethrin	SC	Apply up to run off point.

53312	PRECLUDE INSECTICIDE	N-Octyl Bicycloheptene Dicarboximide, Pip But, pyrethrins	Aero	Mattresses, bed linen (wash linen and clothing before reuse), walls, cracks & crevices, skirting & bed frames.
53349	COUNTRY DELTAMETHRIN 10 RESIDUAL INSECTICIDE	Deltamethrin	EC	Apply up to run off point.
53534	DAVID GRAYS ANT AND TERMITE SPRAY	Permethrin, hydrocarbon solvent	EC	Spray in cracks and crevices and other insect harbours.
53625	FARMOZ PERMEX EC RESIDUAL INSECTICIDE	Permethrin, hydrocarbon solvent	EC	Spray in cracks and crevices and other insect harbours.
53632	DRAGNET HOUSEHOLD READY-TO-USE DUSTING POWDER	Permethrin	Dust	Not stated.
53794	DAVID GRAYS PERMETHRIN ANT DUST	Permethrin	Dust	Bedsteads, mattresses, springs, floor coverings, upholstered furniture, cracks, torn wallpaper, joints in woodwork.
53819	HEALTHGUARD EC MITICIDE	Benzalkonium Chloride/permethrin	EC	For use in industrial situations associated with the manufacture of polyurethane foam, fibre, textile and carpets products for the purpose of controlling bed bugs and dust mites on the treated articles.
54134	TEMPO RESIDUAL INSECTICIDE	Betacyfluthrin	SC	Bed frames, walls, cracks & crevices near beds.
54146	MORTEIN LOW IRRITANT SURFACE SPRAY KILLS COCKROACHES FAST	Permethrin, tetramethrin	Aero	Not stated.
54181	CHEMSPRAY HOME PEST CONTROL ANT, SPIDER & COCKROACH KILLER	Permethrin	EC	Spray infested carpets, floor areas, in cupboards and wardrobes, and around furniture, bookshelves and skirting boards. Do not apply to clothing or bed linen.
54192	MORTEIN HIGH PERFORMANCE SURFACE SPRAY KILLS COCKROACHES FAST	Imiprothrin, cypermethrin	Aero	Not stated.
54224	GARD & GROW ANT, SPIDER & COCKROACH SPRAY READY TO USE	Permethrin	Emulsion	Spray insect directly, carpet, floor areas, under furniture, in and around cupboards, wardrobes, skirting boards, not clothing.
54456	CISLIN WG RESIDUAL INSECTICIDE	Deltamethrin	Water Dispersible Granule	Bed frames, walls, skirting boards, cracks & crevices near beds.

54626	MORTEIN ODOURLESS SURFACE SPRAY KILLS COCKROACHES FAST	Imiprothrin, permethrin	Aero	Not stated.
54682	COUNTRY DELTRA RESIDUAL INSECTICIDE	Pip but, deltamethrin, D-tetramethrin	SC	Cracks & crevices, bed frames, adjacent walls.
54934	BLITZEM! INSECT KILLER CONCENTRATE	Permethrin, hydrocarbon solvent	EC	Spray at insects, carpets, floor areas and furniture. Avoid treated area for several hours. Spray in and around book shelves, cupboards, wardrobes, skirting boards. Do not apply to clothing or bed linen.
55091	COUNTRY PERMETHRIN 25:75 INSECTICIDAL DUSTING POWDER INDUSTRIAL STRENGTH	Permethrin	Dust	Bedsteads, mattresses, springs, floor coverings, upholstered furniture, cracks, torn wallpaper, joints in woodwork.
55137	HOVEX PERMETHRIN ANT KILLER	Permethrin	Dust	Bedsteads, mattresses, springs, floor coverings, upholstered furniture, cracks, torn wallpaper, joints in woodwork.
55217	MORTEIN EASY REACH SURFACE SPRAY KILLS COCKROACHES FAST	Imiprothrin, cypermethrin	Aero	Not stated.
55221	SUPERWAY DELTA-M RESIDUAL INSECTICIDE	Deltamethrin	SC	Apply up to run off point.
55329	TERMINANT ANT, TERMITE AND SPIDER SPRAY	Permethrin, hydrocarbon solvent	EC	Spray at insects, carpets, floor areas and furniture. Avoid treated area for several hours. Spray in and around book shelves, cupboards, wardrobes, skirting boards. Do not apply to clothing or bed linen.
55426	RICHGRO GARDEN PRODUCTS PERMETHRIN ANT KILLER FOR INDOOR AND OUTDOOR USE	Permethrin	Powder	Not stated.
55656	RENTOKIL CHEK-PEST RESIDUAL INSECTICIDE	Permethrin, hydrocarbon solvent	EC	Cracks & crevices, bed frames, adjacent walls, mattresses.
55787	LOW ODOUR GET-IT FLY SPRAY WATER-BASED INSECTICIDE SPRAY READY TO USE	Permethrin	Emulsion	Spray insect directly, carpet, floor areas, under furniture, in and around cupboards, wardrobes, skirting boards, not clothing.
55790	LOW ODOUR GET-IT BUG SPRAY HOME AND GARDEN SURFACE AND INSECTICIDE SPRAY READY TO USE	Permethrin	Emulsion	Spray insect directly, carpet, floor areas, under furniture, in and around cupboards, wardrobes, skirting boards, not clothing.

	K-O TAB WT RESIDUAL INSECTICIDE TABLET	Deltamethrin	Tablet	Bed frames and walls, cracks, crevices and skirting boards in the vicinity of the bed. Do not apply to bedding.
55992				
56496	KONK-EM-D READY TO USE INSECTICIDE SPRAY	Permethrin	EC	Not stated.
56576	BLACK & GOLD LOW IRRITANT SURFACE SPRAY CRAWLING INSECT KILLER	Permethrin, tetramethrin	Aero	Not stated.
56765	ASTRO ECOTECH PEST EXTERMINATOR, READY TO USE, COCKROACH, SPIDER & ANT KILLER	Permethrin	Emulsion	Spray insect directly, carpet, floor areas, under furniture, in and around cupboards, wardrobes, skirting boards, not clothing.
56840	FARMOZ PERMEX 100 RESIDUAL INSECTICIDE	Permethrin	EC	Apply up to run off, except for mattresses and carpets. Spray in cracks, crevices and other insect harbourages. When applying to mattresses and carpets apply an even thorough coverage.
57333	SUMITOMO BORAFUME FUMIGATOR	Cyphenothrin	Vapour releasing	Not stated.
58044	BARMAC DELTA FORCE INSECTICIDE	Deltamethrin	EC	Bed frames, walls, cracks & crevices near beds.
58267	FRANKLINS NO FRILLS SURFACE SPRAY HOUSEHOLD INSECTICIDE FOR CRAWLING INSECTS	Allethrin, permethrin	Aero	Not stated.
58423	TRADEWYNS DELTRA RESIDUAL INSECTICIDE	Pip but, deltamethrin, D-tetramethrin	SC	Treat cracks and crevices in bed frames and the adjacent walls.
58460	PROLONG FLY AND LITTER BEETLE INSECTICIDE	Cyfluthrin	WP	Fumigate all mattresses or clothing. Wash sheets and clothing before re-use. Apply Prolong to walls, cracks and crevices, skirting boards and bed frames.
58499	DELTATHOR PLUS INSECTICIDE	Pip but, deltamethrin, tetramethrin-R	SC	Cracks and crevices in bed frames and adjacent walls.
58505	DAVID GRAYS DIAZINON 800 INSECTICIDE	Diazinon	EC	Spray should be applied under beds, along skirting boards and anywhere bed bugs may be able to shelter, as well as lightly to bedding.
58600	BAYGON GERMICIDE CRAWLING INSECT SPRAY ANTIBACTERIAL	Imiprothrin, cypermethrin	Aero	Lightly spray mattresses, bed frames and skirting boards.

58630	BAYGON FAST KILL CRAWLING INSECT SPRAY	Imiprothrin, cypermethrin	Aero	Lightly spray mattresses, skirting boards and bed frames
58717	MORTEIN HIGH PERFORMANCE COCKROACH KILLER ODOURLESS	Cypermethrin, Imiprothrin	Aero	Not stated.
58723	DELTATHOR INSECTICIDE	Deltamethrin	SC	Cracks and crevices in bed frames and adjacent walls.
58783	ATLAS CRAWLING INSECT SURFACE SPRAY FOR HOME USE	Imiprothrin, permethrin	Aero	Not stated.
58904	BARMAC DELTA FORCE PLUS INSECTICIDE	Pip but, deltamethrin, D-tetramethrin	SC	Cracks and crevices in bed frames and adjacent walls.
59005	PERMETHOR INSECTICIDAL DUST	Permethrin	Dust	Bedsteads, bedsprings, mattresses, floor coverings, upholstered furniture, cracks in walls, behind torn wallpaper, joints in woodwork and other harbourages.
59345	PREMISE FOAM INSECTICIDE	Imidacloprid	Foaming Aero	Insert applicator hose directly into crack or crevice infested with pest insects. Foam should be injected until flow-back out of the harbourage starts to occur. The foam should temporarily fill the harbourage and engulf insects present during application.
59424	SOLFAC PRO RESIDUAL INSECTICIDE	Betacyfluthrin	SC	Apply to the bed-frame and walls, cracks, crevices and skirting boards in the vicinity of the bed.
59707	FARMOZ DIAZOL 800 INSECTICIDE	Diazinon	EC	Spray should be applied under beds, along skirting boards and anywhere bed bugs may be able to shelter, as well as lightly to bedding.
59710	ACTELLIC 900 SOLVENT FREE LIQUID INSECTICIDE	Pirimiphos-Methyl	Liquid	Apply thoroughly to all areas to be treated to run off point. Do not apply to carpets, mats or soft furnishings.
59750	KILLMASTER ZERO PEST STRIP	Dichlorvos	Impregnated Pest Strip	Note that this is not specifically registered for bed bug control, but could be used as it is registered for use on "other" insects. Items to be disinfested must be stored in plastic with the pest strip, and away from people.
59945	GARDEN PRO ANT KILLER	Permethrin	Dust	Apply powder to bedsteads, bed springs, mattresses, floor coverings, upholstered furniture, cracks in walls, behind torn wallpaper, joints in woodwork and other harbourages.

59952	PROFUME GAS FUMIGANT	Sulfuryl Fluoride	Fumigant	For the control of insects in buildings (commercial & residential), timber, construction materials, furnishings, shipping containers & vehicles (excluding aircraft). Situational use includes Dwellings (including mobile homes), Buildings, Furnishings (household effects). For use only by licensed fumigators trained under appropriate industry program
60325	MORTEIN DETTOL WITH GERM STOP COCKROACH KILLER	Cypermethrin, imiprothrin	Aero	Not stated.
60414	WOOLWORTHS HOME BRAND HOUSEHOLD INSECTICIDE	Permethrin, tetramethrin	Aero	Spray around bed, bed frame and other locations close to sleeping areas.
60634	SEARLES ANT, SPIDER & COCKROACH KILLER	Permethrin	EC	Spray directly when seen. Spray infested carpets, floor areas and under furniture, in and around cupboards, wardrobes, and skirting boards. Do not apply to clothing.
60644	RAID SURFACE SPRAY NATURALLY FRESH	Imiprothrin, cypermethrin	Aero	Not stated.
61012	SCARID 10 RESIDUAL INSECTICIDE	Deltamethrin	SC	Not stated.
61272	SURFACE SPRAY INSECT KILLER	Allethrin, permethrin	Aero	Lightly spray mattresses, bed frames and skirting boards.
61618	RICHGRO ANT, SPIDER & COCKROACH INSECTICIDE	Permethrin	EC	Spray directly when seen. Spray infested carpets, floor areas and under furniture, in and around cupboards, wardrobes, and skirting boards. Do not apply to clothing.
61751	DAVID GRAYS HIGH PERFORMANCE ROACH SURFACE SPRAY	Cypermethrin, imiprothrin	Aero	Lightly spray mattresses, bed frames and skirting boards.
61917	RICHGRO PERMETHRIN ANT, SPIDER AND ROACH KILLER	Permethrin	EC	Spray directly when seen. Spray infested carpets, floor areas and under furniture, in and around cupboards, wardrobes, and skirting boards. Do not apply to clothing.
62147	CISLIN 25 PROFESSIONAL INSECTICIDE	Deltamethrin	SC	Apply to the bed-frame and walls, cracks, crevices and skirting boards in the vicinity of the bed. May also be applied to the edges and seams of the mattress but do not treat the flat surfaces which people sleep on.

62664	CHAINDRITE PERMFORCE DUST INSECTICIDE	Permethrin	Dust	Apply powder to bedsteads, bed springs, mattresses, floor coverings, upholstered furniture, cracks in walls, behind torn wallpaper, joints in woodwork and other harbours.
62988	MORTEIN DO-IT-YOURSELF HIGH PERFORMANCE SURFACE SPRAY COCKROACH KILLER	Cypermethrin, imiprothrin	Aero	Not stated.
62989	MORTEIN DO-IT-YOURSELF ODOURLESS HIGH PERFORMANCE COCKROACH KILLER	Cypermethrin, imiprothrin	Aero	Not stated.
63064	COLES CRAWLING INSECT KILLER HIGH PERFORMANCE KILLS COCKROACHES FAST KILLS COCKROACHES FOR UP TO 6 MONTHS	Cypermethrin, imiprothrin	Aero	Not stated.
63129	CISLIN ULTRA RESIDUAL INSECTICIDE	Deltamethrin S-bioallethrin	SC	Not stated.
63337	ATLAS HIGH PERFORMANCE SURFACE SPRAY	Cypermethrin, imiprothrin	Aero	Not stated.
63575	PHANTOM INSECTICIDE	Chlorfenapyr	SC	Treat affected room by applying Phantom directly to bed bug activity as a spot treatment.
63593	AEROTHOR EXTRA STRENGTH CRAWLING INSECT SPRAY	Cypermethrin, imiprothrin	Aero	Spray areas where bed bugs hide such as bed frames, floors and skirting boards.
63610	BAYGON ANT KILL SURFACE SPRAY 2 IN 1	Cypermethrin, imiprothrin	Aero	Not stated.
63673	ENVIROMAX DELTAMETHRIN 10SC RESIDUAL INSECTICIDE	Deltamethrin	SC	Not stated.
63723	WOOLWORTHS HOME BRAND ANT KILLER	Permethrin	Dust	Apply powder to bedsteads, bed springs, mattresses, floor coverings, upholstered furniture, cracks in walls, behind torn wallpaper, joints in woodwork and other harbours.
63767	MORTEIN POWERGARD CRAWLING INSECT KILLER	Cypermethrin, imiprothrin	Aero	Not stated.

63772	MORTEIN POWERGARD CRAWLING INSECT KILLER EASY REACH	Cypermethrin, imiprothrin	Aero	Lightly spray bed frames and skirting boards.
63850	CHAINDRITE EXTRA STRENGTH CRAWLING INSECT SPRAY	Cypermethrin, imiprothrin	Aero	Spray areas where bed bugs hide such as bed frames, floors and skirting boards.
63941	DELFORCE RESIDUAL INSECTICIDE	Deltamethrin	SC	Not stated.
63984	BLACK & GOLD VALUE YOU CAN TRUST ANT KILLER	Permethrin	Dust	Apply powder to bedsteads, bedsprings, mattresses, floor coverings, upholstered furniture, cracks in wall, behind torn wallpaper, joins in woodwork and other harbourages.
64048	BEDLAM INSECTICIDE KILLS BED BUGS, LICE AND DUST MITES	Phenothrin-D	Aero	Apply as a spot treatment to cracks and crevices on and around baseboards, floorboards, bed frames, wall hangings, headboards, furniture, door and window frames, millwork and walls. Apply as a surface spray to carpet, mattresses, box springs, walls, furniture, bedding, floor and floor coverings, rugs, garments, luggage, closets, drapes and other window appointments.
64148	MAXUMPRO 125 SC INSECTICIDE	Betacyfluthrin	SC	Apply to the bed frame and walls, cracks, crevices and skirting boards in the vicinity of the bed.
64371	TEMPRID 75 RESIDUAL INSECTICIDE	Betacyfluthrin, Imidacloprid	SC	Treatment should be directed to all areas of infestation (e.g. the bed-frame and walls, cracks, crevices and skirting boards in the vicinity of the bed).
64517	TONIZONE AUSTRALIA'S OWN POW SURFACE SPRAY INSECTICIDE	D-Allethrin, permethrin	Aero	Spray directly at insects when they are visible.
64679	AMGROW PATROL ANT, SPIDER & COCKROACH KILLER	Permethrin	EC	Spray infested carpets, floor areas, in cupboards and wardrobes and around furniture, bookshelves and skirting boards. Do not apply to clothing or bed linen.
64937	RAID TESTED BY EXPERTS ANT KILLER FOR INDOOR AND OUTDOOR USE	Cypermethrin, imiprothrin	Aero	Not stated.
65067	RAID TESTED BY EXPERTS COCKROACH AND SPIDER KILLER INDOOR SURFACE SPRAY	Cypermethrin, imiprothrin	Aero	Not stated.
65084	KILLS UP TO 6 MONTHS WOOL-WORTHS SELECT EXTRA STRENGTH HIGH PERFORMANCE SURFACE SPRAY	Cypermethrin, imiprothrin	Aero	Not stated.

65131	IGA SIGNATURE SURFACE SPRAY LOW IRRITANT	Permethrin, tetramethrin	Aero	Spray around bed, bed frame and other locations close to sleeping areas.
65133	IGA SIGNATURE SURFACE SPRAY HIGH PERFORMANCE	Cypermethrin, imiprothrin	Aero	Lightly spray around bed, bed frame and other locations close to sleeping areas.
65290	BED BUG BARRIER BED BUG KILLER	Amorphous silica	Dust	Apply powder using the powder puffer or a powder duster to cracks and crevices, underneath edges of carpet, power points, wall sockets, behind skirting boards, in wall voids and other areas known to harbour bed bugs and in bed bug barrier devices
65387	DELTAPRO 25 PROFESSIONAL INSECTICIDE	Deltamethrin	SC	Apply to the bed-frame and walls, cracks, crevices and skirting boards in the vicinity of the bed. May also be applied to the edges and seams of the mattress but do not treat the flat surfaces which people sleep on.
65438	NO COCKROACH FUMIGATOR	Cyphenothrin	Vapour Releasing	Best results for use in rooms not exceeding 26m ² .
65439	NO BUGS FUMIGATOR	Cyphenothrin	Vapour Releasing	Best results for use in rooms not exceeding 26m ² .
65487	KDPC INSECTICIDAL DUST	Permethrin	Dust	Not stated.
65628	OZTEC PERMETHRIN 100 EC INSECTICIDE	Permethrin	EC	Not stated.
65697	BATTLEAXEPRO PROFESSIONAL CRACK & CREVICE AEROSOL	Pip but, propoxur tetramethrin	Aero	Lightly spray mattresses, bed frames and skirting boards.
65856	RAID MAX BAYGON ODOURLESS CRAWLING INSECT SURFACE SPRAY 2 IN 1	Imiprothrin, permethrin	Aero	Not stated.
65979	ATLAS PERMETHRIN ANT KILLER	Permethrin	Dust	Not stated.
65986	COLES PERMETHRIN ANT KILLER	Permethrin	Dust	Not stated.
66006	KILLS UP TO 6 MONTHS WOOLWORTHS SELECT HIGH PERFORMANCE SURFACE SPRAY	Cypermethrin, imiprothrin	Aero	Lightly spray around bed, bed frame and other locations close to sleeping areas.
66216	GALA SURFACE INSECT SPRAY	Cypermethrin, imiprothrin	Aero	Not stated.

66250	DELTA FORCE PRO SERIES HOUSEHOLD SURFACE INSECT SPRAY	Deltamethrin	EC	Apply to the bed-frame and walls, cracks, crevices and skirting boards in the vicinity of the bed.
66448	BEEBLEBETA 125 SC INSECTICIDE	Betacyfluthrin	SC	Not stated.
66483	PROLONG ULTRA FLY AND LITTER BEE-TLE INSECTICIDE	Betacyfluthrin	SC	Apply to the bed-frame and walls, cracks, crevices and skirting boards in the vicinity of the bed.
66498	HOVEX BED BUG & FLEA KILLER	Permethrin	Dust	Not stated.
66661	RENTOKIL INSECT-EX RESIDUAL INSECTICIDE	Permethrin	EC	Spray in cracks, crevices and other insect harbours.
66704	FARMAXE 125 SC INSECTICIDE	Betacyfluthrin	SC	Apply to the bed-frame and walls, cracks, crevices and skirting boards in the vicinity of the bed.
66805	FURY 120 EW GENERAL HOUSEHOLD IN-SECTICIDE	Alpha-cypermethrin /Bifenthrin	EC	Not stated.
67037	PROTECT-US PROFESSIONAL WATER-BASED INSECTICIDE	Deltamethrin	SC	Treat cracks and crevices in bed frames and adjacent walls.
67038	PROTECT-US EXTRA STRENGTH CRAWLING INSECT SPRAY	Cypermethrin, imiprothrin	Aero	Spray where bed bugs hide such as bed frames, floors and skirting boards.
67337	DESTROY PERMETHRIN ANT KILLER	Permethrin	Dust	Not stated.
67569	FARMSHEDPRO 25 PROFESSIONAL IN-SECTICIDE	Deltamethrin	SC	Apply to the bed-frame and walls, cracks, crevices and skirting boards in the vicinity of the bed. May also be applied to the edges and seams of the mattress but do not treat the flat surfaces which people sleep on.
67584	COLES CRAWLING INSECT SPRAY HIGH PERFORMANCE	Cypermethrin, imiprothrin	Aero	Not stated.
67693	ATLAS HIGH PERFORMANCE CRAWLING INSECT KILLER	Cypermethrin, imiprothrin	Aero	Not stated.
67694	COLES CRAWLING INSECT KILLER SPRAY HIGH PERFORMANCE	Cypermethrin, imiprothrin	Aero	Not stated.

67762	BLACK FLAG HIGH PERFORMANCE SURFACE SPRAY CRAWLING INSECT KILLER KILLS COCKROACHES FAST 3 MONTH BARRIER PROTECTION AGAINST COCKROACHES HOUSEHOLD PROTECTION	Cypermethrin, imiprothrin	Aero	Not stated.
67768	BLACK FLAG HIGH PERFORMANCE SURFACE SPRAY CRAWLING INSECT KILLER FAST DIRECT KILL 6 MONTH BARRIER PROTECTION	Cypermethrin, imiprothrin	Aero	Not stated.
67769	TERMATRIX TERMITES FOAM INSECTICIDE	Imidacloprid	Foam	Not stated.
67853	ATLAS HIGH PERFORMANCE CRAWLING INSECT SPRAY	Cypermethrin, imiprothrin	Aero	Not stated.
67870	COLES HIGH PERFORMANCE CRAWLING INSECT SPRAY	Cypermethrin, imiprothrin	Aero	Not stated.
67911	ATLAS HIGH PERFORMANCE COCKROACH AND SURFACE SPRAY	Cypermethrin, imiprothrin	Aero	Not stated.
67934	ATLAS CRAWLING INSECT SURFACE SPRAY ODOURLESS	Imiprothrin, permethrin	Aero	Not stated.



Approved for use upon mattresses

AC = Aqueous Concentrate

LC = Liquid Concentrate

Aero = Aerosol

SC = Suspension concentrate

EC = Emulsifiable Concentrate

WP = Wettable Powder

Not Stated = Approved use directions are not stated on the Infopest web site