UNIVERSITY OF MINNESOTA
Extension
SERVICE

CONTROL OF BED BUGS IN RESIDENCES

INFORMATION FOR PEST CONTROL COMPANIES

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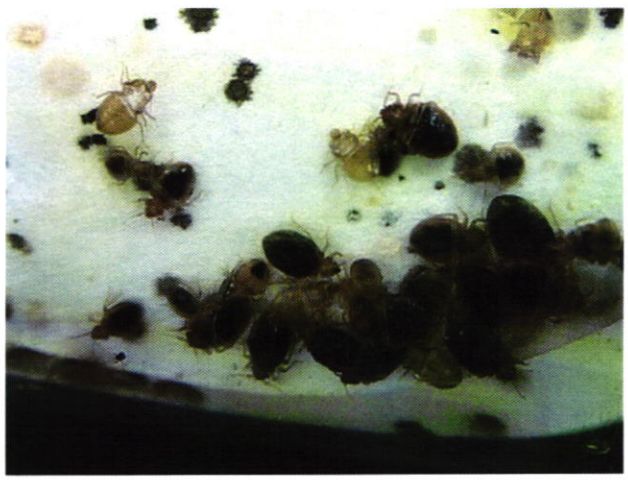
1. INTRODUCTION

Bed bugs have resurged to quickly become a very important pest of the 21st century, as they invade numerous urban areas including hostels, hotels and residences. Our society has had a "30-year vacation" from this pest, where bed bugs were almost removed from North America as a result of mass treatments with older types of insecticides (DDT, Chlordane, Lindane). However, the combination of re-introduction to society; increased travel of people; and improved treatment methods that specifically target other insect pests, bed bugs found ample opportunity in unprotected rooms. Because of their unique hiding behavior, because they can feed without detection, and because of their ability to spread, inspection and control methods against bed bugs must be far more thorough and extensive than previously encountered with other pests (such as cockroaches, ants and rodents).

Bed Bugs:
The pest of the 21st Century!



Bed bugs are in a group of parasites that live in the "nests" of their hosts, and the feeding behavior of these bugs makes them a particular problem. Associated with humans, the "nests" can include houses, hotels, hostels, tents and caves; essentially any protected area in close proximity to where people sleep or rest. By living in nests, they can feed when the host (person) is not likely to notice them, and then can hide to avoid detection. These pests bite people typically when they are sleeping, resting or sitting for long periods. Hungry bugs will move out from their hiding places, in search of exposed skin. Typically, the head and neck are prime feeding sites; however, bare arms, hands and legs may also be

bitten. In heavy infestations, these bugs may also move into folds of clothing or under sheets to find a feeding site. When searching for a place to feed, these bugs can move very quickly. Once an appropriate site is found, they feed for 2 – 5 minutes until full, and then move quickly away from the host. Unless people are carefully inspecting for bed bugs hiding in cracks and crevices, these pests can be easily overlooked. The combination of bed bugs' feeding behavior and their tendency to move away in search of hiding places, makes bed bugs an extremely difficult pest to control.

In addition to behavior that helps them go unnoticed, the bites inflicted by bed bugs can also go unnoticed, or can be mistaken for the bites of other pests. All people are not equally sensitive to bed bug bites, so while some victims break out in rashes from the bites, other people may not display symptoms. Even among people sleeping side by side, one person may show severe reactions while the other has no evidence of having been bitten at all. When a reaction does occur, the results of feeding can be mild (a simple red spot) to severe (rash or even hives).

With these feeding and hiding behaviors, bed bugs can produce a well established infestation that may be difficult to control!

Over time, people may develop a response to the bites, but it will depend on the person, the number of bugs, and the size of infestation. Peoples' reaction to insect bites is an immune response and will depend on the ability of their body to detect and respond to inflicted bites. Sometimes the immune system requires time to develop a response, resulting in the bites being detected only after multiple feedings. Cold medications containing antihistamines may reduce a person's response to insect bites. The reaction caused by feeding might be mistaken for other problems: fleas, mosquitoes and other biting insects, sensitization to detergents and soaps, and irritants (e.g., poison ivy) are some of the conditions victims of bed bugs thought they were dealing with. When feeding is not readily detected, it can permit an infestation to exist for quite a time before the person (or establishment) realizes they have an infestation.

Control of bed bugs in residential areas requires a very thorough process of:

- Identification and inspection;
- Non-chemical and chemical control methods; and
- Follow-up methods including regular inspections for new infestations.

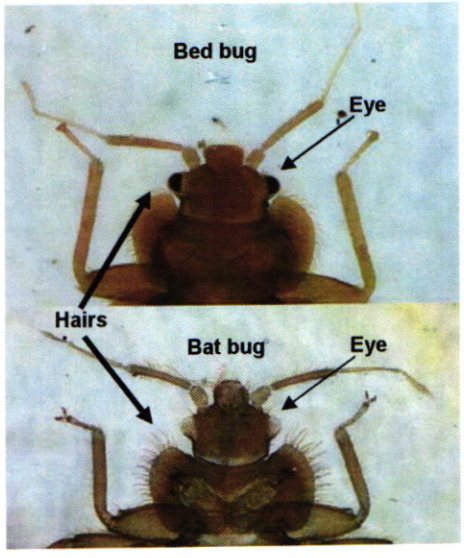
The methods below describe a system of ***eliminating*** the insects completely from a site. Without complete elimination and a system to quickly respond to new infestations, bed bug infestations will continue, and the site will pose a risk to becoming a reservoir site for other areas. Control methods for a single residence can take 4 hours to several days, depending on the extent of the infestation. In addition, after feeding some bed bugs may move farther away from the feeding site, to quieter areas (including smoke detectors or fire sprinklers). Therefore, all activities against this bug must be extensive and carefully done.

2. IDENTIFICATION

During an inspection or when you have received a sample, the first step is to make sure you are indeed dealing with bed bugs. Bed bugs are flattened, brown, wingless insect approximately ¼ to 3/8 inch long (5 – 9 mm). After the bug has taken a blood meal, it's color changes from brown to purplish-red. The size and shape also changes, making it appear like a different insect. Young bed bugs are nearly colorless and much smaller (1/16" or 1.6 mm), but resemble the adult in general shape. You may also find caste skins, empty shells of bugs as they grow. After a blood meal, bed bugs deposit fecal spots (composed of digested blood) in areas adjacent to the feeding site or back at their hiding places.

For comparison purposes, the "bed bug on a stick" is available from the University of Minnesota Extension Service to aid with identification, and training. They are available for pest control personnel and health inspectors and can be ordered online at www.ipmctoc.umn.edu.

Over the past few years bed bugs have been on the increase, but at the same time, bat bug complaints have also occurred. Bat bugs have very long hairs along the lateral edge of the pronotum (the plate just behind the head). These hairs will be long enough to project beyond the eye (or at least longer than the eye is wide). When in doubt, have a specialist examine the sample. Bat bugs live in attics (and eaves) associated with bats and birds. Inspection and control measures can move to areas where these animals may be found.



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3. INSPECTIONS


Bed bugs on a backpack

When a bed bug infestation is suspected, a very thorough inspection is required. You must be prepared to look for large and small bugs, fecal spotting, and cast skins. Often the first response is to head for the bed, but other locations can be just as important. Here are some important questions to ask:

1. Has someone in the family been on a trip that required luggage? Do they regularly carry other bags (backpacks, etc.) that they may place under (or beside) chairs or seats?
2. Where is luggage, (or baggage, backpacks, etc) typically placed when returning to the residence?
3. Where is the luggage stored after emptying?
4. Does the affected person sleep or rest for extended time on a couch (or another area) in the residence?
5. Where are dirty clothes and bed linens placed, or stored?
6. Does anyone else visit the residence with bags, a coat, or other items? (*This question has been important for seniors residences and apartments*)
7. Where has the person visited in the past 6 months – place or places where they may have sat or rested for a time period? (*This is a "long shot" question, but it has in the past revealed a key societal connection, and may be critical for prevention methods*).
8. What control measures were previously attempted?

Answers to the above questions will help determine the potential extent of the infestation and where inspections should ***start.*** Keep in mind, though, that these questions should not limit where you look! **While bed bugs are most commonly found in bedrooms, infestations can also occur in other rooms, including: bathrooms; living rooms; and laundry rooms.**

Necessary tools:

1. a quality flashlight,
2. thin blade spatula (a cake icing spatula is suitable),
3. screwdrivers and wrenches for dismantling items (e.g., the bed and cover plates to electrical receptacles)
4. 10x magnifying glass,
5. inspection mirror,
6. carpet adhesive,
7. garbage bags (for quickly containing infested items),
8. clear packing tape (for samples and sealing infested articles in bags),
9. staple gun with ¼" staples, and
10. a vacuum cleaner that can use filter bags.

Usually, there will be one (to several) primary infestation sites associated where people rest (sleep, sit for extended periods, etc.). Bed bugs are extremely flat and small (1/16th to 3/8 inch or 6 to 8 mm long) so the person inspecting must look along (and in) edges and cracks, folds and seams. Holes drilled in wooden elements for screws are important, as are labels. To give you an idea of the tight places bed bugs can fit into, bed bugs have been found along picture frames, between the glass and frame itself. Start at the places the person has identified as a resting site, and move out from this point.

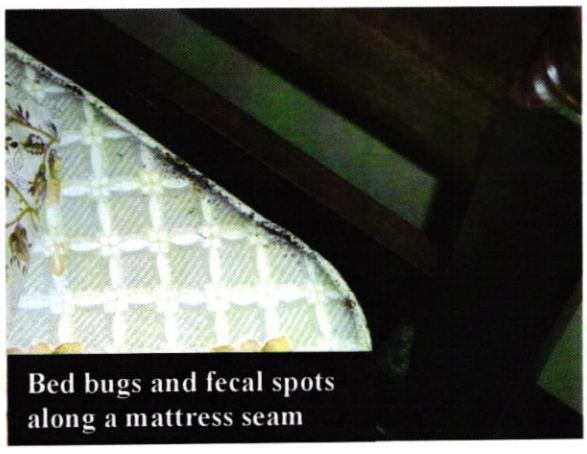
Inspections of the bed (or resting areas) have to be detailed, as this habitat is very complex. The bed consists of: linens; blankets; mattress; box spring; headboard and frame. Although the favored resting areas consist of the region near the head and shoulders of the person (mattress, box spring and behind the headboard) **do not** superficially inspect these areas and assume the job is done. Start with the linens concentrating on the folds and seams of sheets and blankets (particularly fitted sheets). As items are inspected, remove them from the bed and place them centrally on the floor. Remember, you are looking for bed bugs in a range of sizes, as well as fecal spotting and caste skins.

If at any time a bed bug is found: discontinue the in-depth inspection and initiate control activity (after discussing recommended course of action with the client, and obtaining approval from client). Do not continue with an in-depth inspection alone, as bed bugs may move from their hiding places once disturbed. At the very least, any bugs found during a continued inspection should be removed by vacuuming.

Needles and sharps hazard!
Be very careful of wood splinters, sharp metal fragments, and concealed items.
Look with your eyes and use the spatula only.
DO NOT use your hands!

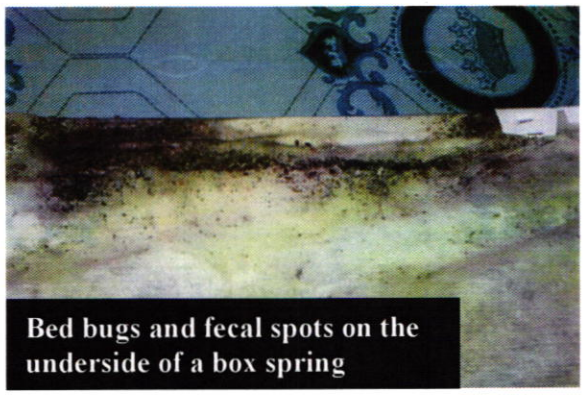
Next on the mattress:

1. Start with the piping (the edge reinforcement on the bed) and look along all stitching lines.
2. Look along the sides of the mattress, and then the field (top and bottom, again follow all stitch lines will help you methodically and quickly cover the mattress).
3. Finally, pay attention to any labels, tags, buttons or air screens that may be on the mattress.



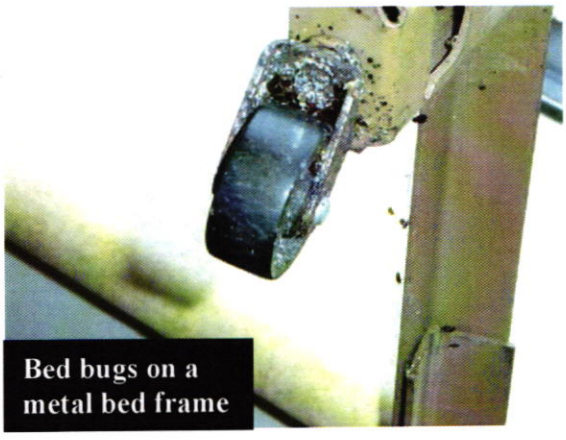
Bed bugs and fecal spots along a mattress seam

With the mattress out of the way, begin with the box spring:


Bed bugs and fecal spots on the underside of a box spring

1. Again begin with the edge, looking along stitch lines.
2. Look where the frame and boxspring contact - if you lift the box spring on edge quickly look along the frame before bed bugs have a chance to scatter.
3. Look under the plastic edge guards (best is to remove them for inspection and refasten with the staple gun).
4. Gradually remove the dust cover ("ticking") from the back of the box spring while looking under any folds and where the mattress fabric fastens to the frame. Obtain approval from owner for removing the dust cover.
5. Look in any depressions, countersunk screws and under any staples that are not flush with the frame.
6. Finally, inspect all joints, cracks and corners of the box spring's frame.

With the box spring clear, move to the frame:


Bed bugs on a metal bed frame

1. Starting with the frame rails, inspect along the rails and the following features: end caps, joints, welds, holes, seams, cracks, and countersunk areas (bed bugs will hide on metal and wood frames).
2. Inspect along any crossbracing, again paying attention to the above features.
3. Inspect the legs (don't forget the casters, if present).
4. Move to the head- and foot-boards, again look along all surfaces and pay attention to the features previously mentioned.

With the frame moved away, begin in the surrounding area:

1. Look in the area where the bed contacted the floor (carpeting depressions, or hardwood).
2. Move to the baseboards, inspecting top and bottom of the baseboard (including imperfections, cracks and crevices, peeling wallpaper and drywall cracks, in and under phone jacks and other plugs).

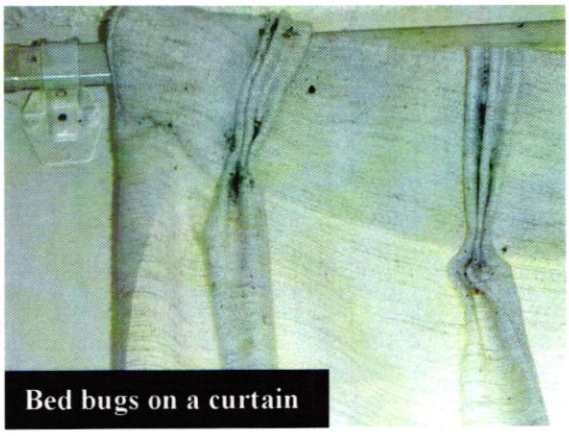
   If the baseboards are made of carpeting and are fastened to the wall with glue, carefully peel back the carpeting - inspecting the carpet and glue lines. Carpeting can later be replaced with adhesive, but use adhesive sparingly.

3. In the general area of the bed and along the baseboard, carpeting can be carefully lifted off the tack strip (or adhesive). You can inspect the baseboard, underside of the carpet and tack strip for bed bugs and feces.
4. Using the spatula, carefully "scoop" debris from under the baseboard. Angle the spatula so the leading edge rests on the floor and the trailing edge scrapes along the baseboard underside. This method will often crush bugs, so pay attention to blood spots or insect parts (you may have to send the parts to an entomologist for identification, as other insects might be present).

Having finished with the bed (or resting area), move out to the next item of furniture and begin the same methodical and thorough inspection.

For drawers and bedside tables: start with an exterior inspection (top, sides, bottom), then move to the drawers (remove them and begin with top, sides and bottom). Again, pay attention to: cracks and crevices, imperfections, joints, screws and corners.

For upholstered furniture, the same detailed search is required as mentioned with the bed. Do not overlook any detail and pay special attention to: zippers; skirting; fabric seams; and the crevices under the cushions.


Bed bugs on a curtain

Other items such as drapes, pictures, stuffed animals, and toys must be inspected also. Infested items should be contained in plastic bags.

For electronic items, such as phones, radios and TVs: inspect all holes, corners, cracks and edges. If possible: hold the item over an open plastic bag or light colored sheet; orient the item such that any ventilation holes are pointed down; and tap with the unit with the open part of your hand. Avoid hitting the item too hard. As an added precaution, a dust insecticide (Diatomaceous earth for crawling insects) can be applied carefully to ventilation holes. Do not attempt to coat all electronics with dust; you simply want to create a barrier between any bug harborages and the exit points from the item.

4. Control Procedures

Again, when using any insecticide, obey the label and follow all directions.

Furthermore, the control methods described herein assume that the commercial insecticides available will be used by licensed personnel from a Professional Pest Control Service Provider.

DO NOT substitute materials (unless the product is registered for bed bugs and appropriately describes the habitat receiving the application).

DO NOT use other pesticide products off-label (Pesticides meant for Garden or Agricultural use)

DO NOT use products that appear "homemade", "custom formulated", or were purchased from a non-licensed vendor.

The following control procedures represent "best practices" for controlling bed bugs. They were developed through the experience of myself and a number of professionals in the Pest Control Industry. These practices were developed in response to complaints about repeated control failures from attempts to control this pest using only insecticides. At this time, both non-chemical and chemical measures are required to control infestations, and any shortcuts or missed steps increase the risk of an infestation continuing.

Control practices must be done once bed bugs are found, and must be simultaneous with any further inspection of the area. With detection of an infested room, any further movement of infested furniture or infested items will increase the risk of bed bugs scattering from their hiding places. Furniture and items in the room should not be moved, or prepared for treatment purposes.

Work Efficiently

Control procedure against bed bugs requires much moving of furniture, equipment and other items. Plan how you treat the room so you only move each item once. This will save considerable time and effort. Designate a "clean area" and apply non-chemical and chemical measures to that area (see below). After setting up a clean area, all items receiving treatment can be placed into this clean area. As the clean area fills up, adjacent sections of the room will become available and you can expand the clean area to provide more room for treated items. Depending on the room and its contents, setting up a clean area three times usually provides enough space for all the contents.

Vacuuming

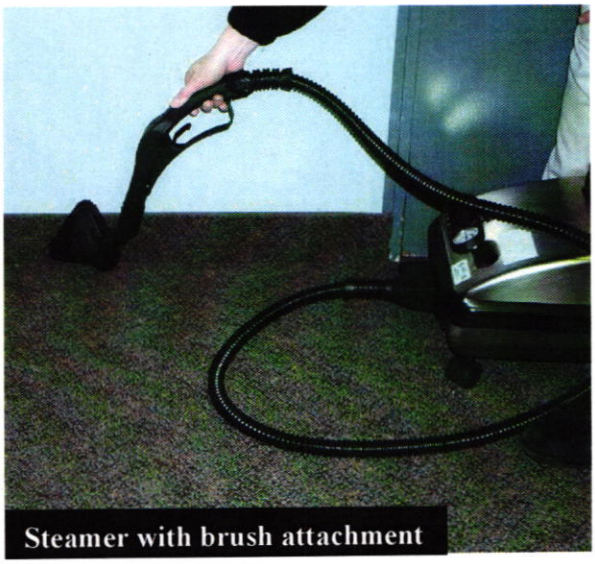
Having a vacuum present during inspections and control efforts helps to quickly capture and contain any bugs that are found (make sure you get a couple for identification purposes). Use a vacuum fitted with a collection bag so you can apply diatomaceous

earth (labeled for crawling insects) into a discarded bag and seal for disposal. Do not use a "wet/dry" vacuum unless it has a bag fitted to collect bugs and debris. During control procedures, use the vacuum to collect any bugs found, vacuum the clean area, and also vacuum the crevices around baseboards, electronic items, and receptacles.

Use a plastic (non-conducting) crevice tool to prevent electric shock.

Steam

Using steam is a very effective method of killing all stages of bed bugs. Delivered correctly, steam will contact bugs on the surface and those hidden inside stitch seams. However, steaming is very labor intensive, consuming most of your time (after the time required for inspections). Here are some key points to get the most out of this control method:



Steamer with brush attachment

1. Use a commercial unit with a capacity of at least 4 litres (or 1 gallon). Avoid smaller (non-commercial) units because of the amount of steam delivered and the need to frequently cool and refill. Two units are preferable at a large site so at least one unit is in constant operation.
2. A unit that has a steam volume control is preferable because "dry" steam will reduce the drying time, yet provide flexibility for use of different attachments.
3. Employ a unit with a floor (or upholstery) attachment. Steam should be concentrated enough to penetrate the fabric, but given enough area to so you don't have to follow each stitch line. A single hole nozzle provides a jet of steam that is too concentrated. Bed bugs hit by a concentrated jet of steam may be blown across the room, and may walk away.
4. Use a non-contact (infrared) thermometer to monitor your progress. Immediately after the steam brush has passed, the surface temperature should be 80° C (this temperature was determined by speed and the resulting lack of control failures – lower temperatures (60°C to 79°C) may also work, but remain untested). Temperatures that are too low will permit survival of bed bugs hidden in stitching; too high and surfaces could be damaged.

Always test the steam on a hidden area to confirm that treated fabric, dyes and wood finishes can withstand this temperature.

Apply steam to each item and object in the room as control procedures progress. Concentrate on areas and features that were mentioned in the inspection part of this fact sheet. Steam is particularly useful for carpeting, upholstery, the mattress / box spring, and deep cracks and crevices. Steam is useful for box springs because it can penetrate the fabric (and padding) and the many crevices that form during construction of a bed. Steam can also be useful on tubular steel frames, particularly when multiple holes are present.

Note that steam kills the bugs immediately, but does not provide important residual control necessary to ensure no bugs remain alive. As soon as the heat is removed, the area can be prone to re-infestation.

Also note that once finished, humidity will be rather high. To promote drying, a fan (dehumidifier or natural ventilation) should be used to prevent mold and mildew growth. Steam applications will prolong drying of insecticide applications, so reentry times by occupants should be adjusted accordingly.

After steam-treating each item, apply any additional treatments (where possible -- see below) and place item into the clean area (See the section about working efficiently).

Handling clothes and other washable items

Clothes and linens can be washed and dried to remove infestations. Linens and dirty clothes by the bed should be contained in sealed plastic bags until they can be washed. Washing and drying should be done at as high a temperature as possible, but temperatures should be limited to the fabric rating (check each label). Again, similar to steam temperatures, no information is available as to the minimum conditions required to kill all stages of bed bugs. Field experience has determined that even mild temperatures should suffice.


Bed bugs on socks

Dry cleaning may be required for articles that cannot be washed. To avoid having to report infested articles to a dry cleaning establishment, you may want to use a clothes dryer, where possible.

A common question asked is: "what about all of the clothes in the closet and drawers?" The answer to this will depend on the size and location of the infestation. A chest of drawers placed next to an infested bed should be suspect and handled appropriately. Similarly, the clothes in a closet where infested luggage was stored should also be suspect. This is where proper inspections are so important: to ensure areas can be

included or disregarded as possible sites of infestation. In trying to decide if adjacent areas should be receive treatments, some Pest Management Professionals consider an additional 20 ft "at-risk" zone beyond the infestation site.

Thermal Treatments

If items can be isolated and contained so that bed bugs cannot move away from the area, bugs can be controlled by **dry heat**, or by **freezing** infested articles. The key point of thermal treatments is to make sure the bugs are exposed to a **critical temperature** for a specified time, ***and*** to make sure that you consider the **insulative qualities** of the infested item. Temperatures may damage certain articles, so careful monitoring of surface and core temperatures is very important. Critical temperatures are necessary at the core (or inside) of the infested item.

Currently, research is being conducted to determine the most efficient conditions for killing bed bugs and not damaging materials. However, based on other insects, a 2 hour core exposure at 120°F (45°C) should be considered a minimum target temperature for heat treatments. Care should be taken to avoid conditions above 145°F (63 °C), as damage to certain items may occur. For freezing conditions, a minimum of 23°F (-5°C) must be held for at least 5 days. As you decrease the temperature, you will be able to shorten the time of exposure. If you wish to "flash freeze" articles (shorten the time of exposure, by using really low temperatures) the target temperature should be -15°F (-26°C); at this temperature the eggs instantly freeze. Again, these temperatures are based on initial studies and test specimens (live bed bugs contained in a vial) should be used to confirm a proper kill.

When conducting thermal treatments, the key is to minimize insulative qualities, allowing critical temperatures to quickly reach the core of each article. Piling cushions or clothes together increases the time for critical temperatures to reach the core. Keep stacked items to a minimum, and try to promote circulation of air around and between items. For heat treatments, articles can be placed within a storage structure, or in an old shipping container. Heat resistant tarps may be used as well. Equipment used for heating may include electric heaters (such as commercial "box-style" heaters). Fuel driven heaters (propane heaters) may be available, but precautions must be taken to avoid fires; these units must not be used indoors and must be properly ventilated. Also, care must be taken to avoid direct contact between the heater and the infested articles. For freeze treatments, chest freezers or commercial walk-in freezers may be available to reach -5oC or below.

Regardless of the method used, proper equipment for monitoring temperatures should be used. Thermocouples and electronic thermometers are available from scientific supply stores or heating and ventilation suppliers. Thermocouples are wires with a temperature sensor on the end. You can place several wires within infested articles to ensure critical temperatures are reached.

Mattress Covers

Mattress covers are recommended for areas prone to chronic infestations. Mattress covers prevent bed bugs from hiding in the complex habitat provided by the bed, and simplify control measures. When an infestation occurs, mattress covers can be replaced and the infested covers laundered for re-use. If insecticides are used (per label) to the mattress, covers can be used to contain this application and provide an additional barrier between the treated mattress and the person.

Insecticide Applications

Insecticides are a necessary component of controlling a bed bug infestation, because some of the infestation may be unavailable to the non-chemical methods and individual bugs can move away from main infestation site to quieter areas. Non-chemical methods may be used as the only method of control, but the time spent using these methods greatly increases, and there is a need to repeat procedures (including inspections) several times until the infestation is adequately controlled. Insecticides provide a valuable backup to finishing off any remaining and hidden bed bugs as they emerge from hiding in search of a blood meal.

The following are recommendations according to common sites of infestation. However, all insecticides must be used carefully, and according to label.

Applications against bed bugs will require several products (and formulations). The products are summarized in **Table 1**. Specific application sites and methods of application vary according to each label. Read and fully understand each label before using and be prepared with alternative (non-chemical) methods if you have a specific site that is not addressed by any of the labels or formulations. Based on experience, below are some additional recommendations to consider:

A. **Expect to use several formulations.** A review of common formulation advantages include:
   - **Emulsifiable Concentrate (EC)**– low visibility compared to wettable powders (etc), less expensive than aerosols
   - **Wettable powder, suspended concentrates, soluble packets, microencapsulated (WP, SC, WSP)** – better on porous /absorptive surfaces, fewer problems with varnish/ urethane surfaces.
   - **Microencapsulated (ME)** – similar to wettable powder, but the active ingredient is protected; providing for improved residual time.
   - **Aerosol (A) or Ready-to-use Spray (RTU)**– no mixing or additional sprayer equipment, when properly applied the spray tends to be "drier" than applications from a sprayer tank
   - **Dusts (D)** – Residual activity; best for voids, hidden areas, under carpet, inside hollow metal frames and electrical boxes / electronics

B. **To treat, or not to treat the bed:** Extreme care must be taken when treating mattresses. Some products are labeled for the mattress, while others are restricted

to the frame and non-sleeping surfaces. While some products mention treatment of "bedding", make sure the intention is for sleeping surfaces where people sleep and not restricted to pet or livestock bedding. Also, be careful of labels that mention mattresses, but restrict potential contact by children, the elderly, or hospital patients. If concerned about applying insecticides to the mattress, use steam treatments only, or consider the use of a mattress covers for the mattress and box spring after the application has dried.

C. **Caution with furniture:** Take care when using liquids on any upholstered or wood furniture. Apply on unseen areas to confirm the sprays are compatible with fabric and dyes. For wood furniture, some of the manufactured wood (aspenite, chipboard, MDF, plywood) may delaminate or expand when wet. Care must be taken to avoid excessive wetting; again, test on an unseen area. For wood furniture, some liquid products may damage varnished or waxed surfaces – avoid applications to the outer (highly visible) surfaces.

D. **Under carpet edges, baseboards:** An application of a dust insecticide is important to provide a barrier. In addition, a crack and crevice application of a spray, or spot applications will be important, but their use must be determined on a case-by-case basis.

E. **Electronics and electrical receptacle boxes:** To prevent electric shock and damage to electric equipment, only dusts should be applied. Avoid the over-use of dusts in electric equipment; and when possible, consider heat-treating appliances.

F. **Other equipment:** There are certain items that must be assessed on a case-by-case basis. Smoke detectors, fire sprinklers, and mercury-containing thermostats can cause extensive damage (cost, or special clean up operations) if not handled properly. These areas must be inspected with caution, and care must be taken if they are found to be infested. One suggested method of control is to use a cotton swab soaked with soapy water (not to electronics), or 70% isopropyl alcohol (avoid sparks). In heavy infestation, it may be wise to replace smoke detectors. The wetted cotton swab will help remove bed bugs and eggs.

5. FOLLOW UP INSPECTIONS

Approximately two weeks post inspection, another inspection of the premises is required to confirm that all bed bugs were eliminated. This inspection must be as thorough as the preliminary inspection (described above), and if bugs are found again, control procedures must be repeated. In my experience, cost control failures encountered were a result of missed hiding places. The presence of bed bugs in previously treated areas may be a result of these bugs moving from an untreated site (or sites) to areas closer to their food source. Attention to detail is critical for complete elimination and the follow up inspection is critical ensuring that bed bugs have not survived control procedures.

TABLE 1. AVAILABLE INSECTICIDES FOR USE AGAINST BED BUGS

This list is provided for planning purposes only, not a product endorsement.

DO NOT use this information as a substitute for compliance of label instructions on the container!
It is your responsibility as the applicator to read, understand, and follow all instructions stated on the label.

Active Ingredient	Product Name(s) [EPA REG. NO.]	Form*	Additional application notes relative to bed bugs
Chlorfenapyr	Phantom [241-392]	SC	• ***Bed bugs not mentioned on the label, but directions for cockroach and ant control provide applications in the same habitat where bed bugs hide.*** Available in Minnesota; confirm with other State Regulators before using. • Restricted to spot, and crack and crevice applications in areas specified by the label. • DO NOT for use for general surface applications, or for applications to the bed.
Cyfluthrin	Tempo SC Ultra [3125-498 / 432-1363] Tempo 20WP [432-1302] Tempo WP [432-1304] WSP [432-1377]	SC WP WP	• General surface treatments, but not the entire floor • Spot, crack and crevice applications • Avoid furniture surfaces with prolonged human contact
Cyfluthrin & pyrethrins	Intruder HPX [9444-183]	A	• Spot, crack and crevice applications
Deltamethrin	DeltaDust [432-772] Suspend SC [432-763] D-Force HPX [9444-217]	D SC A	• General surface, spot, crack and crevice applications - Exposed areas with **Delta Dust** must be vacuumed 4-6 hours after application - With **Suspend**, do not treat the whole floor and avoid furniture surfaces with prolonged human contact • Mattresses mentioned on label, emphasis on seams, tufts and folds
Diatomaceous earth or Silicon dioxide	Natural Guard Crawling Insect Control[7401-449] Safer Brand Ant& Crawling Insect Killer [59913-1-42697]	D D	• Crack and crevice applications • Mattresses mentioned on Natural Guard label, but not on current Safer label
Esfenvalerate	Onslaught [1021-1815]	ME	• Spot, crack and crevice applications
Hydroprene	Gentrol [2724-351]	EC	• General surface, spot, crack and crevice applications • May be tank-mixed with other insecticides- check the label for both insecticides and use the more restrictive application methods. • **Gentrol** interrupts bed bug development, but does not act as a contact insecticide. This product must be used in conjunction with other insecticides. • If your **Gentrol** label does not have bed bugs listed, make sure you are carrying the supplemental label.
Lambda cyhalothrin	Demand CS [100-1066]	ME	• General surface, spot, crack and crevice applications • Do not apply to mattresses • Avoid furniture surfaces where humans sit or contact

Active Ingredient	Product Name(s) [EPA REG. NO.]	Form*	Additional application notes relative to bed bugs
Permethrin	Prelude [100-997]	EC	• General surface, spot, crack and crevice applications • Finished wood surfaces may stain (personal experience), as with vinyl siding, label recommends **Demand CS**
Phenothrin with isopropanol with MGK264	Sterifab [397-13] Bedlam [1021-1767]	RTU A	• Sterifab: General surface application • Bedlam: mattresses mentioned on label - emphasis on seams, tufts and folds; spot applications elsewhere
2-Phenethylpropionate with PBO with pyrethrins	EcoPCO EC [67425-20] EcoPCO DX [67425-16]	EC D	• Crack and crevice applications • Mattresses mentioned on label
Pyrethrins and similar** with PBO	Kicker [432-1145] Prescription Treatment PI [499-444] CB-80,-123 Extra [9444-175, 9444-188] 565 Plus XLO [499-310]	EC A A A	• General surface, spot, crack and crevice applications • Contact insecticide only, not a residual • **Kicker** can be tanked mixed with residual insecticide or IGR • Mattresses mentioned on label - emphasis on seams, tufts and folds
Silica and pyrethrins	Drione [432-992] Tri-Die [499-385]	D D	• General surface, spot, crack and crevice applications • Mattresses mentioned on label - emphasis on seams, tufts and folds
Tralomethrin	Saga WP [432-755]	WP	• ***Bed bugs not directly mentioned on the label, but directions for flea control provide a general treatment application in the same habitat where bed bugs hide.*** Available in Minnesota; confirm with other State Regulators before using. • General surface, spot, crack and crevice applications
Fumigants: Suggested for exceptionally severe conditions, for certain types of vehicles, or with containerized materials. Not necessary for routine control procedures.			
Sufluryl fluoride	Vikane [62719-4]	Fumigant	• For use by licensed fumigators only, requires sealing the building • Be sure to check for State specific registration – Registered in several states, but currently not available in Mn
Methyl bromide	Brom-O-Gas [5785-4] Meth-O-gas [5785-41]	Fumigant	• Availability very limited, unlikely to be used except in cases of regulatory / quarantine action. For use by licensed fumigators only

*- **Form = Formulation:** Different formulations have advantages in different locations within the treatment area. See page 12. Like active ingredients, make sure you are using different formulations to achieve the best control possible.

**- Some actives similar to Pyrethrins and requiring PBO were grouped together. A few included were tetramethrin and D-trans-allethrin.

Please note: in Minnesota there are more products registered for use against bed bugs, than indicated on this list. Many of these products include private (over-the-counter or custom) labels, but contain the same active ingredients as listed above. Check with the label, to confirm that the product in question is registered against bed bugs and includes application measures (and locations) pertinent to the infestation site.

Other common restrictions:

1. Make sure all residues are dry before the room is re-used. Additional time may be required if furniture and upholstery was steamed prior to insecticide application.
2. Additional restrictions pertain to Hospitals, Senior Homes and Schools – often during application, or post application drying. Some labels do not allow product usage in these areas.
3. Low pressures must be used for all tank mixes.

Photo credits: 2nd instar larvae - Jeff Hahn, Department of Entomology, University of Minnesota Extension Service
Sites of infestation – Abell Pest Control, Inc. Etobicoke, Ontario, Canada

Additional technical review by Jay Bruesch - Plunkett's Pest Control (Fridley, Minnesota), Larry Rufledt & Todd Leyse - Adam's Pest Control, Inc. (Hamel, Minnesota) was much appreciated.