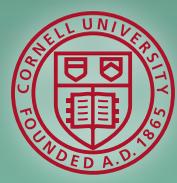
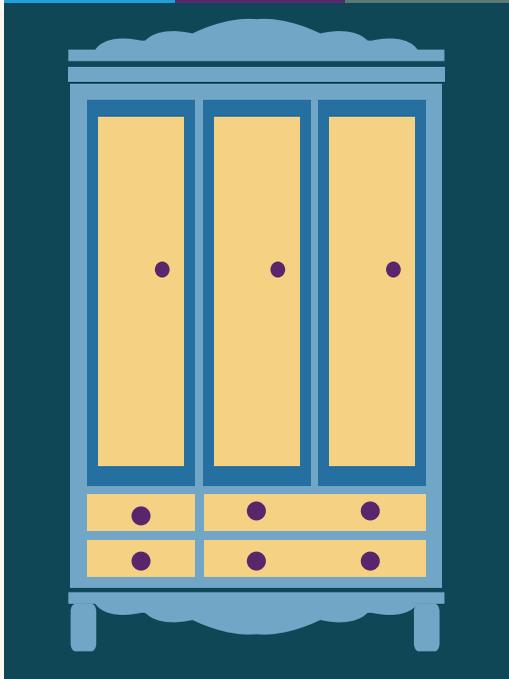


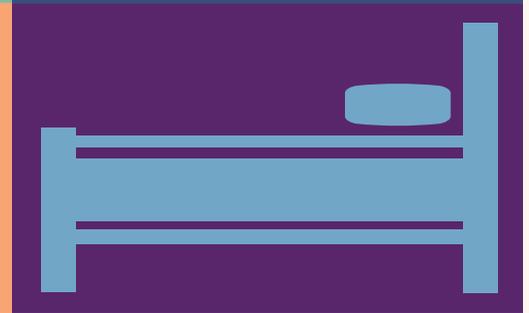
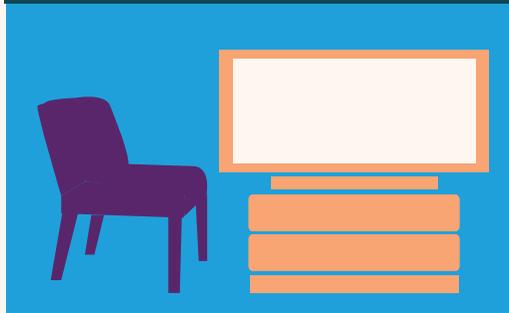
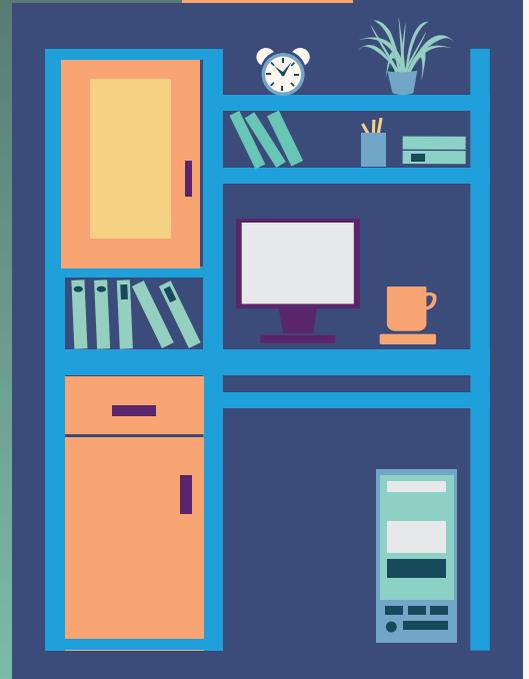


How to Get Bed Bugs Out of Your Belongings

Matthew Frye and Jody Gangloff-Kaufmann
New York State
Integrated Pest Management Program
Cornell University



Cornell Cooperative Extension



How to Get Bed Bugs Out of Your Belongings

Authors: Matthew Frye and Jody Gangloff-Kaufmann, New York State IPM Program, Cornell University

Reviewers: Amara Dunn, Debra Marvin, Lynn Braband, Joellen Lampman, New York State Integrated Pest Management Program; Gil Bloom, Standard Pest Management, Astoria, New York; and James Carpentier, New York State Department of Environmental Conservation.

Cover design : Karen English, New York State IPM Program, Cornell University

Produced and published by the New York State Integrated Pest Management Program, which is funded through Cornell University, Cornell Cooperative Extension, the New York State Department of Agriculture and Markets, the New York State Department of Environmental Conservation, and USDA-NIFA. Funding for this publication was provided by USDA-NIFA. We were further supported by \$770,000 in competitive federal funding through USDA-NIFA's Crop Protection and Pest Management Extension Implementation Program (grant no. 2014-70006-22505), along with numerous smaller grants secured by staff.

Cornell Cooperative Extension provides equal program and employment opportunities.

The information in this guide reflects the current authors' best effort to interpret a complex body of scientific research, experience and to translate this into practical management options. Following the guidance provided in this guide does not assure compliance with any applicable law, rule, regulation or standard. Trade names used herein are for convenience only.

Every effort has been made to provide correct, complete, and up-to-date pest management information for New York State at the time this publication was released for printing (February 2018).

Changes in pesticide registrations and regulations occurring after publication are available in Cornell Cooperative Extension county offices or from the Pesticide Management Education Program website (<http://pmep.cce.cornell.edu>). No endorsement of products is intended, nor is criticism of unnamed products implied.

Always check with the certifying agency before using a new product or material. This guide is not a substitute for pesticide labeling. Always read the product label before applying any pesticide.

Copyright New York State IPM Program and Cornell University. NYS IPM Publication No. 620. Published 2/2018 at <http://hdl.handle.net/1813/55760>.

TABLE OF CONTENTS

Introduction.....	2
Glossary.....	3
Part 1. List of household items that need to be disinfested	5
Part 2. Techniques for eliminating bed bugs from your things	32
1. Inspection of household items	32
Identify	32
Inspect.....	33
2. Isolation of items long enough to kill bed bugs	35
Encasements	36
Clear zippered plastic bags and sealable bins	39
Pitfall-style traps	40
Carpet tape barrier.....	42
3. Hand wash items	43
4. Vacuuming to get rid of bed bugs.....	45
Area vacuuming.....	45
Targeted vacuuming	45
5. Using heat to eliminate bed bugs	48
Clothes dryer	49
Clothes iron.....	50
Hair dryer.....	50
Space heaters	51
Using steam to eliminate bed bugs	53
Desiccant dusts.....	59
Freezing items to kill bed bugs	62
Liquid and aerosol insecticide sprays	63
Illegal, unsafe and ineffective practices	64
References	66

How to Get Bed Bugs Out of Your Belongings

INTRODUCTION:

The common bed bug has returned as a significant pest problem across the United States. Although first recognized in the tourism industry in the late 1990's, bed bug infestations are now a common issue for private residences. People dealing with an infestation can spread bed bugs to the homes of family and friends, to public places they visit, and to their work place. From there, bugs continue to relocate by hitchhiking on personal belongings.

We offer treatment recommendations to help you protect your home and belongings, and to stop the spread of bed bugs. This guidebook provides comprehensive instructions using methods currently available, and emphasizes techniques that do not rely on pesticide application. You may choose to hire a pest management professional and utilize their additional options for controlling bed bugs. But, you may still need to get bed bugs out of your personal belongings. This is a Do-it-Yourself guide that will help in either situation.

The document is divided into two sections:

[Part 1](#) is a list of household items that often need to be disinfested. For each item, a list of the techniques that can be employed from Part 2 are listed, as well as any special instructions for that item.

[Part 2](#) offers techniques for removing or eliminating bed bugs. For each technique there is a brief description, followed by a list of supplies you will need, "how to" instructions, special considerations, and advantages and disadvantages.

An important note before we get started. Elimination of bed bugs does not prevent a new infestation. People exposed to bed bugs in their daily lives, through work or travel, are always at risk of encountering bed bugs. Also, bed bugs can move between units in multiple-family dwellings and between rooms in a unit or home. They can move both ways for those who work in other peoples' homes (health aide, nanny, house-cleaners, etc.). The best approach is using preventative and proactive measures included here and in the NYS IPM factsheet, "How to Avoid Getting and Spreading Bed Bugs".

GLOSSARY

Box spring (foundation) – the foundation for a mattress, composed of a boxlike frame filled with springs and supports, covered in cloth. In this context, the box spring is a common hiding place for bed bugs.

Desiccate – to become thoroughly dried or dried up.

Ectoparasite – an organism that lives on the outside of another species, from which it obtains nutrients.

Encasement – a fully enclosed outer covering; in this context a fully enclosed and bed bug proof outer covering made of plastic or fabric that prevents bed bugs from going inside or getting out.

Exoskeleton – the waxy outer layer or skin of arthropods (insects, spiders, crustaceans, etc.) that support muscles and movement and protect soft tissues of the body.

Feces/fecal stains – waste matter discharged from the gut; in this case digested blood from the gut of a bed bug that often leaves behind tan or dark stains on surfaces. Bed bug feces can also appear flaky, like pepper.

Harborage – a place of shelter or a hiding spot.

Headboard (of bed) – a vertical board at the head of a bed, usually made of wood, wicker, plastic, metal or cloth. In this context, the headboard is a common hiding place for bed bugs.

HEPA (High Efficiency Particulate Air) – referring to a filter or filtered vacuum, is a filter composed of a mat of dense fibers designed to trap at least 99.97% of the smallest airborne particles, such as pollen and other asthma triggers.

Instar – an insect in any one of its stages of growth between molts and before the adult stage. Bed bugs have 5 nymphal instars.

Interceptor – a device that interrupts movement; in this case a device that halts the movement of bed bugs by trapping them alive in a well, and is designed to prevent escape. Also referred to in this guide as a pitfall trap.

Nymph – the young stage of an insect that undergoes incomplete metamorphosis (with no pupal stage).

Pesticide resistance - The ability of an organism to withstand the effects of a pesticide by becoming tolerant to its toxic effects by means of natural selection.

Pitfall trap – the generic term for a passive trapping device that allows insect entry into a pit and prevents escape. Also known as an interceptor in this guide.

Re-entry time – the time between a pesticide application and the point at which it is safe to enter the treated space, generally (but not officially) considered to be 4 hours for indoor liquid spray applications used for the treatment of bed bugs.

PART 1. LIST OF HOUSEHOLD ITEMS THAT NEED TO BE DISINFESTED

The following table lists broad categories of common household items and the recommended methods for eliminating bed bugs. Some methods work better than others; some take more time than others. No method is perfect, but when the right tool is used correctly it can bring success—often with less expense.

Later, in Part 2 of this document, we outline detailed, effective techniques to eliminate bed bugs from household items. Because pesticide products come and go, new laws can change what products are available, and bed bugs show some resistance to available pesticides, it is important to understand tactics that do not depend on them.

Physical methods such as heat, steam, vacuuming and isolation do not require registration with the U.S. EPA, are currently effective at managing bed bug populations, and are generally require less financial investment. Some techniques, however, do require an investment of time.



A laboratory colony of bed bugs. All life stages can be seen. (Photo A. T. Allen, NYSIPM Program).

HOUSEHOLD ITEMS LISTED ALPHABETICALLY. **BEST OPTIONS ARE IN BOLD.**

Air Conditioner - Window mount, through the wall and stand-alone tower

Recommended	Special Instructions
Inspection	If the AC unit has been in a room with a known bed bug infestation, check carefully for signs of activity (fecal stains, live bugs). Look for shed skins at the floor beneath the unit. Take the unit apart to see the filter, for example, and check the interior. This is not 100% foolproof. You will need to do more than just inspect, but inspection can confirm that the AC has bed bugs.
Isolation	Remove the unit from the window or wall and place inside a heavy-duty plastic bag. Seal the bag so it is airtight. Store the unit for six or more months.
Hand wash	Wash the exterior and the filter. Do not wash any electronic parts.
Vacuum	Vacuum the unit thoroughly to remove visible bed bugs. This will not eliminate bed bugs, but will reduce the chances of bed bugs crawling away into new places.
Heat	Hair dryer or space heater - With the unit unplugged, a hair dryer can be used to push heat inside the unit to kill or chase bed bugs out. Work in an enclosed space to avoid spreading bed bugs. Most electronic devices can withstand heat of up to 160°F. Check the owner's manual or call the manufacturer to confirm that the unit can withstand heat.

Not Recommended - Steam, Freeze, Desiccant dust

Animal bedding - Fabric beds for cats, dogs, ferrets, rabbits, etc.

Recommended	Special Instructions
Inspection	Look for fecal stains and live bugs. Check corners, folds, zippers and the bottom side.
Isolation	Store inside an airtight plastic bag or bin for six months.
Heat	Clothes dryer and space heater are best options. Wash after heat treatment. Use hair dryer if no clothes dryer is available.
Steam	Good for sanitizing animal bedding as well.

Not Recommended—Hand wash, Vacuum, Freeze, Desiccant dust

Animal Cages - Dog kennels, cages for birds, hamsters and other small animals

Recommended	Special Instructions
Inspection	Look in crevices and gaps, and under flooring. Bed bugs might hide in the bottom of bird cages and in small mammal cages.
Isolation	Store inside an airtight plastic bag or bin for six months.
Hand wash	Use a hose outside or a strong stream of water and soap in a bathtub or shower to wash the cage.
Vacuum	Pay attention to gaps, crevices, tubes and flooring.

Animal Cages (Cont'd)- Dog kennels, cages for birds, hamsters and other small animals

Recommended	Special Instructions
Heat	Hair dryer or space heater. A hair dryer can be used to flush bed bugs out of tubes or crevices.
Steam	Steam will be effective and will also disinfect.
Not Recommended - Freeze, Desiccant dust	

Appliances, Small - Alarm clock, radio, speakers, power tools, kitchen

Recommended	Special Instructions
Inspection	Look for fecal stains adjacent to crevices. Lift appliance and examine underside for bed bugs and feces.
Isolation	Store inside an airtight plastic bag or bin for six months.
Hand Wash	Unplug device, then wash the exterior and removable parts where possible. Do not wash any electronic parts.
Vacuum	Unplug item, then vacuum at gaps and crevices. Use caution to avoid damaging critical elements of the device.
Heat	Hair dryer or space heater. With the device unplugged, a hair dryer can be used to push heat inside the appliance to kill or chase bed bugs out. Perform this task outdoors, on a white sheet, or in a bathtub so wandering bed bugs can be killed. Most electronic devices can withstand some heat. Check the owner's manual or call the manufacturer to confirm that the unit can withstand heat.
Throw away	If the item is old and infestation is bad (bed bugs are visible on the appliance) just discard it.

Not Recommended - Steam, Freeze, Desiccant dust

Artwork - Paintings, photographs, posters, tapestry, wall quilts, sculpture

Recommended	Special Instructions
Inspection	Focus inspections on frames and the back of artwork and crevices of sculptures. Brackets and other wall mounting items may also harbor bed bugs.
Isolation	Store inside an airtight plastic bag or bin for six months.
Vacuum	Use crevice tool on back of item and frame. The brush tool may be used on the artwork itself if bugs or eggs are visible.
Heat	Hair dryer or space heater. Applicable for cotton-based tapestries, wall quilts and sculptures that will not be damaged by heat. This technique is not recommended for paintings or valuable photographs due to possible damage. Other artwork, frames and wall mounting items can be heated to high temperatures.

Artwork (Cont'd) - Paintings, photographs, posters, tapestry, wall quilts, sculpture

Recommended	Special Instructions
Freeze	Some companies offer Cryonite treatment, which is CO2 gas that freezes on contact. This is recommended for some artwork, but not oil paintings.

Not Recommended - Steam, Desiccant dust

Baby stroller and car seat

Recommended	Special Instructions
Inspection	Due to the numbers of hiding spots, inspection might be difficult but should be used to confirm that bed bugs are present and treatment is warranted.
Isolation	Place item in a large bag sealed to be airtight for six months.
Hand wash	Remove fabric parts and wash metal and plastic parts of the frame with hot soapy water.
Vacuum	Vacuuming first will reduce chances of spreading bed bugs. Use vacuum with hair dryer.
Heat	Clothes dryer, hair dryer or space heater. Remove fabric and upholstered parts and heat treat in a hot dryer. Use hair dryer to blow hot air into gaps, tubes and crevices, vacuuming any bugs as you go. A space heater will be very effective.

[Steam](#) **Get steam into all gaps, tubes and crevices.**

Not Recommended - Freeze, Desiccant dust

Backpack, handbag, or duffel bag - Any soft, durable luggage

Recommended	Special Instructions
Inspection	Look all over for bed bugs and fecal stains. This may be challenging due to seams, pockets and folds in the material.
Isolation	Store inside an airtight plastic bag or bin for six months.
Hand Wash	Use a scrub brush with hot soapy water and hang outside to dry.
Vacuum	Use the crevice or brush tool on seams. This technique may be used in combination with a hair dryer.
Heat	Clothes dryer, hair dryer, space heater. All forms of heat will kill bed bugs and their eggs on soft luggage.
Steam	Make sure to get steam into corners and folds.

Not Recommended - Freeze, Desiccant dust

Baskets - Woven, natural or synthetic materials

Recommended	Special Instructions
Inspection	Look all over for bed bugs and fecal stains. This may be challenging due to the number of crevices.
Isolation	Store inside an airtight plastic bag or bin for six months.
Hand Wash	This is better for synthetic materials. Wash with soap and water.
Vacuum	Vacuum with a brush attachment, but use another method to deal with eggs that may be glued in crevices (isolation or heat).
Heat	Hair dryer or space heater. Treat both inside and outside of basket thoroughly with hair dryer heat, making sure to get in all the nooks.
Steam	Make sure to dry baskets made of natural materials well before they mold.
Throw away	If the item is old or unimportant and infested, just discard.
Not Recommended - Freeze, Desiccant dust	

Bedding - Sheets, blankets, pillows, bed skirts, mattress covers, sleeping bags

Recommended	Special Instructions
Inspection	Look for black fecal stains on portions of bed skirts, mattress covers and sheets that fall on the side of the bed. Bloodstains from bite wounds may be found on the sleeping surface of sheets. If bed bugs have been confirmed from the home, this step is not necessary.
Isolation	Store inside an airtight plastic bag or bin for six months. Good option to keep items bed bug free after an intervention.
Heat	Clothes dryer, iron, space heater. The easiest and most effective way to treat bedding is the clothes dryer. However, caution is needed to prevent dispersing bugs when removing and transporting bedding. Items should be removed gently and sealed in a plastic bag for transport to a dryer. The area around the bed should be vacuumed immediately after, with bag/canister contents sealed and discarded outside the home. With bedding removed, you can also vacuum the mattress/box spring/bed frame to remove any live bed bugs, shed skins and possibly eggs.
Not Recommended - Hand wash, Vacuum, Steam, Freeze, Desiccant dust	

Bed frame - Wood, composite, metal or plastic, including headboard

Recommended	Special Instructions
Inspection	This is the most important step, and is described in detail on page 33.
Isolation	If the bed frame has been treated and is bed bug free, pitfall traps can be used to isolate the bed.

Bed frame (Cont'd) - Wood, composite, metal or plastic, including headboard

Recommended	Special Instructions
Hand Wash	If possible, bed frames can be dismantled to more effectively clean these spaces. This step should be combined with vacuuming to intercept live bed bugs. Read the section on hand washing for precautions about treating wood furniture.
Vacuum	Use of a vacuum alone may not be sufficient to remove bed bugs hiding in cracks and crevices. However, this technique can be combined with using a hair dryer.
Heat	Hair dryer or space heater. Blow hot air into cracks and crevices of bed frames to flush bed bugs, and use the crevice tool on a vacuum cleaner to pick them up. Space heating is effective for large furniture.
Steam	This treatment can damage wooden bed frames, and without proper drying times can cause metal frames to rust. Test steam treatments on a small part of the bed frame before selecting this technique.
Desiccant dust	See this section for specific instructions. Always read and follow the label instructions.
Freeze	Some companies offer Cryonite treatment, which is CO2 gas that freezes on contact. Freezing will not damage wood, mattresses, box springs or linens.

Blanket - See Bedding

Books - Paperback, hardcover, school notebooks, binders, etc.

Recommended	Special Instructions
Inspection	Bed bugs are most likely to be found in the protective cover or the book binding. Inspect suspect books over a white sheet or in the bathtub, with a vacuum ready and waiting.
Isolation	Store inside an airtight plastic bag or bin for six months.
Vacuum	Remove and vacuum protective covering and book binding.
Heat	Hair dryer or space heater. Remove protective covering and point hair dryer into binding; combine with vacuuming.

Not Recommended - Hand wash, Steam, Freeze, Desiccant dust

Book shelf - See Furniture, wood and metal

Boxes - Cardboard, storage.

Recommended	Special Instructions
Inspection	Inspection can be challenging due to the number of crevices/corrugations in the cardboard. It may be necessary to remove each item from filled boxes and treat them individually.
Isolation	If boxes are infested, individual items should be removed, treated appropriately and stored in airtight plastic bags or bins for six months.

Boxes (Cont'd) - Cardboard, storage.

Recommended	Special Instructions
Heat	Hair dryer and space heater. Use this technique in combination with the vacuum on the box, but more importantly on the individual items inside the box. Treat cracks and crevices with the heat, then vacuum bed bugs, shed skins and eggs if possible. During space heating boxes should be opened and items loose to ensure good heating.
Discard	If items can be stored in airtight plastic bags or bins, cardboard boxes should be discarded in an outdoor trash receptacle.

Not Recommended - Hand wash, Steam, Freeze, Desiccant dust

Box spring or foundation of bed

Recommended	Special Instructions
Inspection	Box spring inspections are difficult due to the many hiding places on the internal structure. The dust cover, the thin material on the bottom of the box spring, does not prevent bed bugs from entering the space.
Isolation	This is the best option. Use a bed bug proof encasement that fits well and is completely sealed.
Vacuum	Vacuum seams and gaps to remove visible bed bugs. This will not eliminate bed bugs, but can reduce the chances of bed bugs crawling away into new places.
Heat	Hair dryer or space heater. A hair dryer to heat up bugs and kill eggs can be used in combination with a vacuum, but may not be completely effective due to the large number of hiding places within a box spring. Space heating is effective for large furniture.
Steam	This treatment may not be completely effective due to the large number of hiding places within a box spring.
Desiccant dusts	See this section for specific instructions. Always read and follow the label instructions.

Not Recommended - Hand wash, Freeze

Brush, comb or other hair styling tools

Recommended	Special Instructions
Inspection	Hollow brushes may harbor bed bugs internally. Look for any parts of the brush that might allow bugs to enter a hollow space.
Isolation	Store inside an airtight plastic bag or bin for six months.
Hand Wash	Wood-handled tools can be washed with warm soapy water, while hard plastic tools can be washed or submersed in warm soapy water for several days to kill bed bugs.
Heat	Hair dryer or space heater. Systematically treat all sides of the item and internal areas to ensure a lethal temperature has been reached.

Not Recommended - Vacuum, Steam, Freeze, Desiccant dust

Broom, mop, duster and other cleaning tools

Recommended	Special Instructions
Inspection	Pay special attention to joints: for example, where the handle meets the broom head or the end of the handle used for hanging.
Hand Wash	Soapy water can be used on handles, but may not be effective or practical for other parts of the tool.
Vacuum	Use in combination with the Hair Dyer (see below)
Heat	Clothes dryer, hair dryer or space heater. Cotton wet mop heads can be heat-treated in a dryer. Over a white sheet or in the bathtub, apply hot air to broom and duster heads, using the vacuum to remove any bugs that emerge.

Not Recommended - Isolation, Steam, Freeze, Desiccant dust

Cameras - Digital or film, including video

Recommended	Special Instructions
Inspection	Camera bag should be inspected thoroughly inside and out.
Isolation	This is the best method for cameras. Keep camera and lenses isolated in a sealed Ziplock bag for six months in a warm place. Check corners of bag periodically for bed bug evidence. Desiccant packets may be added to prevent moisture buildup.
Vacuum	Micro attachments for vacuum cleaners may be used to remove visible bugs from cameras, but caution is needed to not damage the camera.
Heat	This technique may be used to remove bed bugs on a camera case, but is not recommended for the camera. Cameras can be professionally cleaned.

Not Recommended - Hand wash, Heat, Steam, Freeze, Desiccant dust

Cane or crutches - See Walker, cane and crutches

Car seat, baby or toddler - See Baby stroller and car seat

Cat furniture - Scratching post, tree and tower, rug or upholstery covered

Recommended	Special Instructions
Inspection	This step may be challenging for items made of cardboard or those covered in carpeting.
Vacuum	Use in combination with Hair Dryer.
Heat	Hair dryer or space heater. Use hair dryer to blow hot air into cracks and crevices of cat furniture to flush bed bugs, and use the crevice tool on a vacuum cleaner to suck them up.

Cat furniture (Cont'd) - Scratching post, tree and tower, rug or upholstery covered

Recommended	Special Instructions
Steam	This treatment can damage items made of cardboard, but can be appropriate for furniture covered in carpeting.

Not Recommended - Isolation, Freeze, Desiccant dust

CDs, DVDs and cases

Recommended	Special Instructions
Inspection	Pay special attention to space between the external plastic sleeve (with movie information) and the case. Bugs may also be located inside the case where the CD/DVD attaches, or in the information booklet.
Isolation	Store inside an airtight plastic bag or bin for six months.
Hand Wash	Discs themselves are unlikely to be infested with bed bugs, but can be wiped clean with a microfiber cloth. Cases can be rinsed with warm soap, water and any kind of sponge/rag. Note that water may damage paper displays, and it might not be possible to clean inside the external plastic sleeves of DVDs.
Vacuum	Most DVD cases can be opened wide, causing the external plastic sleeve to buckle outward. This will allow you to vacuum the back of the DVD case. For CD cases, remove the part of the case where the CD attaches to clean the space behind this part.
Heat	Hair dryer and space heater. Use a hair dryer in combination with a vacuum, especially to kill bed bugs eggs.

Not Recommended - Steam, Freeze, Desiccant dust

Cell phones and handheld game units - Small digital devices

Recommended	Special Instructions
Inspection	There are just a few openings on a cell phone or game unit. Look inside the headphone jack, charger port and speaker. Remove protective case and look in corners and crevices.
Isolation	Some devices can be lived without for a period of time. Store in an airtight plastic bag for 6 months.
Hand Wash	Use warm soapy water to wash the protective case ONLY.
Heat	Hair dryer. Turn the device off. Treat carefully with hair dryer. Most electronic devices can withstand some heat. Check the owner's manual or call the manufacturer to confirm that the unit can withstand heat. If applicable and safe, this technique can be combined with vacuuming to remove mobile bugs.

Not Recommended - Vacuum (alone), Steam, Freeze, Desiccant dust

Chair, wood - See Furniture, wood and metal

Clock, table or wall—See **Electronics. For grandfather clocks, see **Furniture**.**

Clothing - All washable clothes (for non-washable, use dry cleaning)

Recommended	Special Instructions
Inspection	Bed bugs can be found in any clothing fold, but are especially attracted to areas with human scents from sweat, such as socks and armpits on shirts.
Isolation	Store inside an airtight plastic bag or bin for six months to kill bed bugs. If items are treated by heat first, they can be isolated in bags or bins to prevent reinfestation.
Heat	Clothes dryer, iron, space heater See page 48 for detailed instructions.

Not Recommended - Hand wash or machine wash, Vacuum, Freeze, Steam, Desiccant dust

Coats - Wool, leather or items unable to be washed in water

Recommended	Special Instructions
Inspection	Look for bed bugs, eggs and evidence. This may be challenging due to dark colors, folds, pockets and seams. Treat if bed bugs or evidence is found.
Isolation	Store inside an airtight plastic bag or bin for six months.
Heat	Clothes dryer or space heater. Place in a warm (no more than 118°F) dryer for 90 minutes, being careful not to crowd the dryer. Most dry items made of wool or leather can be moderately heated without shrinkage or damage. Lower heat requires longer time for killing bed bugs.
Dry clean	Dry cleaning with standard solvents is recommended for any clothing that will not be washed, including wool and delicate items.

Not Recommended - Hand wash, Vacuum, Steam, Freeze, Desiccant dust

Computers and equipment - Laptop, desktop, keyboard, speakers, mouse, monitor

Recommended	Special Instructions
Inspection	Inspections are difficult for most computers/equipment due to the number of hiding spaces within the device. Warmth may lure bed bugs inside the device or machine.
Isolation	If you can live without a device or computer for a period of time, isolation is the best option. See multiple options in Isolation section, page 35.
Vacuum	Micro attachments for vacuum cleaners may be used to remove visible bugs, but caution is needed to not damage the item.
Heat	Hair dryer or space heater. Blow hot air into cracks and crevices to flush bed bugs, and use the vacuum cleaner to suck them up. Check the owner's manual or call the manufacturer to confirm that the unit can withstand heat.
Freeze	Cryonite treatment (CO ₂ gas) is recommended for computers and equipment.

Not Recommended - Hand wash, Steam, Desiccant dust

Console - See Furniture, wood and metal

CPAP - Continuous Positive Airway Pressure system (used by individuals with obstructive sleep apnea)

Recommended	Special Instructions
Inspection	Inspections are difficult due to the number of hiding spaces within the device, but it is worth looking for fecal stains and live bugs to confirm the need for treatment.
Hand Wash	Unplug device, then wash the exterior and removable parts where possible. Do not wash any electronic parts.
Vacuum	Use of a vacuum alone may not be sufficient to eliminate bed bugs, but used in combination with a hair dryer can reduce the number of mobile bed bugs.
Heat	Hair dryer or space heater. Blow hot air into cracks and crevices to flush bed bugs, and use the crevice tool on a vacuum cleaner to suck them up. Check the owner's manual or call the manufacturer to confirm that the unit can withstand heat.
Freeze	Some companies offer Cryonite treatment (CO ₂ gas). This is recommended for electronics, like a CPAP system.

Not Recommended - Isolation (impractical for a device needed daily), Steam, Desiccant dust

Crib, baby—Wood or plastic, including bassinet (for crib mattress see: **Mattress**)

Recommended	Special Instructions
Inspection	Determine where bed bugs are living, bedding, mattress and/or frame. If the crib has been treated and is bed bug free, pitfall traps can be used to isolate the bed. See page 32.
Isolation	If the crib has been treated and is bed bug free, pitfall traps can be used to isolate the bed. See page 38 for tips on isolation.
Hand Wash	When dealing with a hollow (metal) rod, submerge the rod in hot soapy water. Scrub if you see eggs.
Heat	Hair dryer or space heater. Use hair dryer to blow hot air into cracks and crevices to flush bed bugs, and use the crevice tool on a vacuum cleaner to suck them up.

Not Recommended - Vacuum, Steam (impractical), Freeze, Desiccant dust

Curtains and drapes - See Bedding for washable items. Dry clean non-washable, delicate and velvet items.

Curtain Rods - Hollow tube (metal) or solid wood

Recommended	Special Instructions
Inspection	Pay special attention to where curtain rods rest on the bracket, and where the bracket attaches to the wall. Bed bugs may also be found inside hollow curtain rods or at the joints where two halves of long rods meet.

Curtain Rods (Cont'd) - Hollow tube (metal) or solid wood

Recommended

Special Instructions

[Isolation](#)

Store inside an airtight plastic bag or bin for six months.

[Hand Wash](#)

When dealing with a hollow (metal) rod, submerge the rod in hot soapy water. Scrub if you see eggs.

[Heat](#)

Hair dryer or space heater. Use hair dryer to blow hot air into cracks and crevices to flush bed bugs, and use the crevice tool on a vacuum cleaner to suck them up.

Not Recommended - Vacuum, Steam (impractical), Freeze, Desiccant dust

Desk - See Furniture, wood and metal

Dishes - Plates, bowls, cups, silverware, mixing bowls, trays, bake ware, etc.

Recommended

Special Instructions

[Inspection](#)

Bed bugs are unlikely to be found in kitchens except in extreme infestations. In these settings, bugs can hide between stacked items and within folded edges of cookware.

[Isolation](#)

Store inside an airtight plastic bag or bin for six months.

[Hand Wash](#)

Hand wash or place in dishwasher on hottest setting.

[Heat](#)

Space heating will be sufficient to treat dishes for bed bugs, when being used for the whole house.

Not Recommended - Vacuum, Steam, Freeze, Desiccant dust

Documents - See Books or Paper and Files

Dog bedding - See Animal Bedding

Dog toys (also cat, bird and other animal toys) - Rope, balls, chew and plush toys

Recommended

Special Instructions

[Inspection](#)

Look at grooves, folds and inside any toys.

[Isolation](#)

Store inside an airtight plastic bag or bin for six months.

[Hand Wash](#)

Hard plastic toys can be cleaned with warm soapy water.

[Heat](#)

Clothes dryer, hair dryer, or space heater. Ropes, balls and stuffed toys can be easily heat-treated in a hot dryer with a dry towel for a buffer.

Throw away

If items are heavily infested or have lots of potential hiding places, disposal is recommended.

Not Recommended - Steam, Freeze, Desiccant dust

Drapes - See **Bedding and Linens** for washable items – Use dry cleaning for delicate or velvet items.

Electronics – Including television, home phone, cell phone, TV remote, game system, lamps/lights, laptops, radio, DVD player, clock, printers, cable box

Recommended	Special Instructions
Inspection	Bed bugs are drawn to heat. Warm electronics, especially, should be inspected.
Isolation	Store inside an airtight plastic bag or bin for six months.
Vacuum	Micro attachments for vacuum cleaners may be used to remove visible bugs. However, this technique may not be sufficient to remove bed bugs hiding within the device.
Heat	Hair dryer or space heater. Use the hair dryer to blow hot air into cracks and crevices to flush bed bugs, and use the vacuum cleaner to suck them up. Most electronics can withstand some heat. Check the owner’s manual or call the manufacturer to confirm that the unit can withstand heat.
Freeze	Some companies offer Cryonite treatment, which is CO2 gas that freezes on contact. This is recommended for electronics.

Not Recommended - Hand wash, Steam, Desiccant dust

Dresser - See **Furniture, wood and metal**

Drums - See **Instruments**

Entertainment Center - See **Furniture, wood and metal**

Furniture, wood and metal (not upholstered): Nightstand, dressers or wardrobes with clothing and personal items, kitchen/office or folding chairs, tables, consoles, book shelves, desks, entertainment centers

Recommended	Special Instructions
Inspection	Inspect joints and seams where two components attach. Bed bugs can also hide beneath laminate coatings on some furniture, especially when it peels away from the composite material. Remove all drawers and inspect corners/joints.
Isolation	To prevent spreading bed bugs, especially in storage furniture, place a white sheet under or in front of the furniture. Remove items and inspect/treat them as described in other sections of this document. Put clothing in a sealed plastic bag before moving, or treating items on the white sheet next to furniture. After all items have been removed, inspect/treat the furniture as described in other sections of this document.
Hand Wash	Be careful not to stain wood finishes with water.

Furniture, wood and metal (Cont'd): Nightstand, dressers or wardrobes with clothing and personal items, kitchen/office or folding chairs, tables, consoles, book shelves, desks, entertainment centers

Recommended	Special Instructions
-------------	----------------------

- | | |
|---------------------------------|---|
| Vacuum | Use of a vacuum alone may not be sufficient to remove bed bugs hiding in crack and crevices. However, this technique can be combined with using a hair dryer. |
| Heat | Hair dryer or space heater. Use a hair dryer to blow hot air into cracks and crevices to flush bed bugs, and use the crevice tool on a vacuum cleaner to suck them up. Space heating is a good option when done thoroughly or professionally. |
| Desiccant dusts | See this section for specific instructions. Always read and follow the label instructions. |

Not Recommended - Steam, Freeze

Furniture – Upholstered couches, sofas, recliners, cushions

Recommended	Special Instructions
-------------	----------------------

- | | |
|--------------------------------|---|
| Inspection | Look closely at buttons, folds and seams, especially those on the back of the couch and sides that are not disturbed by people when they sit. |
| Vacuum | Keeping the furniture in place, use the crack and crevice attachment to vacuum all seams on the furniture. Once you have vacuumed all visible areas of the furniture, remove cushions and pillows where applicable and vacuum each along seams. Vacuum areas beneath cushions and pillows. Finish by vacuuming the back and finally the bottom of furniture. If possible, follow vacuuming with a steam treatment to kill bed bug eggs. |
| Heat | Hair dryer or space heater. Use hair dryer to blow hot air into cracks and crevices to flush bed bugs, and use the crevice tool on a vacuum cleaner to suck them up. Space heating is a good option when done thoroughly or professionally. |
| Steam | This is a good option but some fabrics and leather can be damaged or discolored by steam. Test a small hidden area first. |
| Desiccant dust | See this section for specific instructions. Always read and follow the label instructions. |

Not Recommended - Hand wash, Freeze

Game unit, handheld - See Electronics

Guitar - See Instruments

Handbags - See Leather items

Heater—See Air conditioner

Instrument - String, brass, woodwind, percussion, etc.

Recommended	Special Instructions
-------------	----------------------

Isolation **Isolation of the delicate instrument in an airtight bag and in a warm place is the most effective and safest option for the instrument.**

All other treatments All other treatments (vacuum, wash, heat, steam, freeze) will be inadequate or damaging to instruments. While, this guide does not make pesticide recommendations for bed bugs, the most effective and non-damaging way to treat an instrument is by fumigation. Fumigants are toxic gases used by a specially trained person in an enclosed space for pest control. Contact a professional pest management company to find out more about fumigation services.

Not Recommended - Hand wash, Vacuum, Heat, Steam, Freeze, Desiccant dust

Instrument case

Recommended	Special Instructions
-------------	----------------------

Inspection Pay special attention to straps, buckles and edges where two halves of hard cases meet. Cases may not seal tightly, allowing bugs to get inside the case, so inspection may also require removal of formed padding that supports the instrument.

Isolation **Store inside an airtight plastic bag or bin for six months.**

Hand Wash Hard cases can be washed on the exterior with warm, soapy water. Use a brush to treat textured items such as buckles and straps. After washing, use a towel to remove excess liquid from the case and allow time to air dry.

Vacuum Use the brush attachment to vacuum exterior portions of soft and hard cases. The crack and crevice attachment can be used on interior portions of the case. Use of a vacuum alone may not be sufficient to remove bed bugs, however, this technique can be combined with using a hair dryer. [This should be done over a white sheet, outdoors or in the bathtub]

Heat Hair dryer or space heater. Use hair dryer to blow hot air into cracks and crevices to flush bed bugs, and use the crevice tool on a vacuum cleaner to suck them up. [This should be done over a white sheet, outdoors or in the bathtub].

Steam This option can be used on the exterior of hard and soft cases, but may not be effective on the interior due to the thickness of padding or the presence of voids under padding. Make sure the case is dry before putting the instrument inside.

Not Recommended - Freeze, Desiccant dust

Ironing board

Recommended	Special Instructions
-------------	----------------------

Inspection Consider hollow portions of legs, caps that cover the feet and areas under the fabric padding and cover.

Ironing board (Cont'd)

Recommended	Special Instructions
Hand Wash	Metal/plastic portions of the ironing board can be washed with warm soapy water using a scrub brush or use a hose outdoors. After washing, use a towel to remove excess liquid and allow time to air dry.
Vacuum	Use the brush attachment to vacuum metal/plastic portions of the ironing board. This technique can be combined with using a hair dryer.
Heat	Clothes dryer, hair dryer, space heater. The fabric and padding on top of the ironing board can be removed and placed in a hot dryer to heat treat for bed bugs. Use a hair dryer to blow hot air into cracks and crevices to flush bed bugs, and use the crevice tool on a vacuum cleaner to pick them up. A space heater will treat an ironing board effectively.

Not Recommended - Steam, Freeze, Desiccant dust

Jewelry box - Wood plastic or metal

Recommended	Special Instructions
Inspection	Look closely at the groove that holds rings and small storage pockets.
Isolation	Store inside an airtight plastic bag or bin for six months.
Hand Wash	This option is ideal for the exterior of the box, but is not recommended for internal, plush parts.
Vacuum	Depending on the size of the box, a brush, crevice or micro attachments can be used to remove bugs from a jewelry box. This technique can be combined with using a hair dryer.
Heat	Hair dryer or space heater. Use the hair dryer to blow hot air into cracks and crevices to flush bed bugs, and use the crevice tool or micro attachments on a vacuum cleaner to pick them up.

Not Recommended - Steam, Freeze, Desiccant dust

Kitchen Appliances – See Appliances, small or Refrigerator

Keyboard - See Computers and Equipment

Lamp - Table top or floor

Recommended	Special Instructions
Inspection	Bed bugs can be found inside the lampshade or on the bottom of the fixture between felt/fabric and the structural parts of the lamp.
Isolation	Store inside an airtight plastic bag or bin for six months.

Lamp (Cont'd) - Table top or floor

Recommended	Special Instructions
Hand Wash	As with other electronics, unplug before washing. This technique may not be sufficient to eliminate a problem if bugs can hide inside the device.
Vacuum	Use the brush attachment to vacuum the lampshade. Treat the rest of the lamp as an Electronic.
Heat	A space heater will treat appliances, such as lamps, effectively.

Not Recommended - Steam, Freeze, Desiccant dust

Laptop - See Computers and equipment

Laundry basket - Wicker, plastic or metal

Recommended	Special Instructions
Isolation	Store inside an airtight plastic bag for six months.
Hand Wash	Place basket in bathtub partially filled with warm, soapy water. Use scrub brush to clean all surfaces. After washing, use a towel to remove excess liquid and allow time
Vacuum	Use a brush attachment to vacuum all surfaces of the basket. This technique may be used in combination with a hair dryer to kill bed bug eggs.
Heat	Hair dryer or space heater. Systematically treat both the inside and outside of the basket so that both sides of the item are heated sufficiently.

Not Recommended - Steam, Freeze, Desiccant dust

Leather items - Coats, handbags, briefcases

Recommended	Special Instructions
Inspection	Look in folds and pockets.
Isolation	Store inside an airtight plastic bag or bin for six months.
Vacuum	Use a brush attachment to vacuum all surfaces.
Heat	Clothes dryer, hair dryer and space heater

Not Recommended - Hand wash, Steam, Freeze, Desiccant dust

Litter box - Plastic pan, lid and self-cleaning units

Recommended	Special Instructions
Inspection	Check under the lip of the rim.
Isolation	Store inside an airtight plastic bag for six months.
Hand Wash	Place empty litter box pan in bathtub partially filled with warm, soapy water. Use scrub brush to clean all surfaces. Motor units in self-cleaning boxes cannot be treated with water.
Heat	Hair dryer or space heater. Systematically treat both the inside and outside of the box to so that both sides of the item are heated sufficiently, including the motor on self-cleaning boxes. Most electronic devices can withstand some heat. Check with the manufacturer.

Not Recommended - Vacuum, Freeze, Desiccant dust

Luggage - All hard shell and nylon hard-frame

Recommended	Special Instructions
Inspection	Focus inspection on piping, seams and pocket folds. If luggage was kept open, bed bugs may also be under linings inside the luggage.
Isolation	Store inside an airtight plastic bag or bin for six months.
Vacuum	Use the crevice tool to vacuum all parts of the luggage. This technique can be used in combination with the hair dryer to flush bed bugs.
Heat	Hair dryer and space heater. Use in-room hair dryer to heat seams and folds before packing and leaving.
Steam	Be sure luggage is dry before closing and storing.

Not Recommended - Hand wash, Desiccant dust

Mattress - All types

Recommended	Special Instructions
Inspection	This is a critical step. See pages 35-36 for instructions.
Isolation	Mattress encasements and pitfall traps are the best options.
Vacuum	Use the crevice tool to vacuum live bed bugs and eggs from mattresses.
Heat	Hair dryer or space heater. Run the hair dryer along seams and piping, and between folds to kill bed bugs and eggs. A space heater is effective for large furniture.
Steam	Steam piping and seams where bed bugs and eggs are found. Slow and thorough treatments are most effective.

Not Recommended - Hand wash, Freeze, Desiccant dust

Medical equipment - Small electronic or battery, digital, including defibrillator, EKG monitor, insulin pump

Recommended	Special Instructions
Inspection	Check inside battery compartment and gaps and crevices. Inspection may be hindered if equipment cannot be opened, except by a service technician.
Isolation	If possible, store inside an airtight plastic bag or bin for six months.
Vacuum	Micro attachments for vacuum cleaners may be used to remove visible bugs, but caution is needed to not damage the item. This technique may be used in combination with a hair dryer.
Heat	Hair dryer. Use the hair dryer to blow hot air into cracks and crevices to flush bed bugs, and use the crevice tool on a vacuum cleaner to suck them up. Most electronic devices can withstand some heat. Check the owner's manual or call the manufacturer to confirm that the unit can withstand heat.
Freeze	Some companies offer Cryonite treatment, which is CO2 gas that freezes on contact. This is recommended for electronics.

Not Recommended - Hand wash, Steam, Desiccant dust

Mop - See Broom, mop, dusters and other cleaning tools

Musical instruments - See Instruments

Nightstand - See Furniture, wood or metal

Pantry – Food items in pantry or kitchen cabinets

Recommended	Special Instructions
Inspection	Confirm the presence of bed bugs.
Throw away	Throw away any infested items that are not airtight/sealed and may contain bed bugs.

Not Recommended - Isolation, Hand wash, Vacuum, Heat, Steam, Desiccant dust

Paper and Files - Magazines, newspapers, paper files

Recommended	Special Instructions
Inspection	You may need to look at every single page for fecal stains, eggs and live bugs.
Isolation	Store inside an airtight plastic bag or bin for six months.
Heat	Space Heater. Good option if space heating technique is being used for other items.
Throw Away	Depending on value and necessity of items, infested paper and files can be thrown out.

Not Recommended - Hand wash, Vacuum, Steam, Freeze, Desiccant dust

Phone - landline or house phone - See **Electronics**

Photographs - See **Artwork**

Piano – Wood and strings

Recommended	Special Instructions
-------------	----------------------

Inspection	Confirm the presence of bed bugs.
----------------------------	-----------------------------------

Isolation	Move to an offsite storage unit.
---------------------------	---

All other treatments All other treatments (vacuum, wash, heat, steam, freeze) will be inadequate or damaging to a wooden piano. While, this guide does not make pesticide recommendations for bed bugs, the most effective and non-damaging way to treat a piano is by fumigation. Fumigants are toxic gases used by a specially trained person in an enclosed space for pest control. Contact a professional pest management company to find out more about fumigation services.

Not Recommended - Hand wash, Vacuum, Heat, Steam, Freeze, Desiccant dust

Picture frames - Frames for art, photographs, posters and mirrors, religious items

Recommended	Special Instructions
-------------	----------------------

Inspection	Pay attention to corners, gaps and hooks.
----------------------------	---

Isolation	Store inside an airtight plastic bag or bin for six months.
---------------------------	--

Hand Wash	Take care not to damage wood finishes.
---------------------------	--

Vacuum	Use crevice tool or micro attachments for frames.
------------------------	---

Heat	Hair dryer. Blow hot air into cracks and crevices to flush bed bugs, and use the crevice tool on a vacuum cleaner to suck them up. Good option if space heating technique is being used for other items.
----------------------	--

Not Recommended - Steam, Freeze, Desiccant dust

Pillows - See **Bedding**

Plants - Houseplants

Recommended	Special Instructions
-------------	----------------------

Inspection	Bed bugs will not be in the soil on a houseplant, but might crawl on the leaves or stems. They will hide around the pot or container that holds the plant. Look all around and underneath a potted plant for bed bugs.
----------------------------	---

Isolation	Place the plant outside, away from the home or in the garden if the weather is appropriately warm. Bed bugs will not survive outdoors. If concern is too great, discard the plant.
---------------------------	--

Plants (Cont'd) - Houseplants

Recommended	Special Instructions
-------------	----------------------

Hand Wash	Use a mild soap (not dish detergent) to wash the leaves and stems of houseplants if bed bugs are on the foliage. Pots can be placed in a bathtub or sink and washed thoroughly in hot soapy water.
---------------------------	--

Not Recommended - Vacuum, Heat, Steam, Freeze, Desiccant dust

Photo albums - Paper and cardboard with printed photos

Recommended	Special Instructions
-------------	----------------------

Inspection	Pay attention to the binding, especially.
----------------------------	---

Isolation	This is the best option. Store inside an airtight plastic bag or bin for six months.
---------------------------	---

Heat	Consider how valuable or delicate the photographs are before using space heating technique. Delicate items might be damaged.
----------------------	--

Not Recommended - Hand wash, Steam, Freeze, Desiccant Dust

Photographs - See Artwork

Posters - See Artwork

Pots and Pans— See Dishes

Printer - See Electronics

Prosthetics

Recommended	Special Instructions
-------------	----------------------

Inspection	Consult manufacturer if this needs to be taken apart for inspection.
----------------------------	--

Hand Wash	Refer to instructions on how to properly wash prosthetics.
---------------------------	---

Vacuum	The item may need to be taken apart to reach inside spaces.
------------------------	---

Heat	Blow hot air into cracks and crevices to flush bed bugs, and use the crevice tool on a vacuum cleaner to suck them up. Refer to manufacturer to verify if heating is safe.
----------------------	--

Not Recommended - Isolation (not feasible), Steam, Freeze, Desiccant dust

Radio - See Appliances, small or Electronics

Records, vinyl (Record player - See Appliances or Electronics)

Recommended	Special Instructions
-------------	----------------------

Inspection	Look inside the paper/cardboard jacket for bed bugs.
----------------------------	--

Records, vinyl (Record player - See Appliances or Electronics)

Recommended	Special Instructions
-------------	----------------------

Isolation	Store inside an airtight plastic bag or bin for six months.
---------------------------	---

Heat	The record jacket may be heated using a hair dryer, iron or space heater. However, the vinyl record could be damaged by heat and should not be treated using this method.
----------------------	---

Not Recommended - Hand wash, Vacuum, Steam, Freeze, Desiccant dust

Refrigerator

Recommended	Special Instructions
-------------	----------------------

Inspection	Look closely at the seal/gasket on the refrigerator and freezer doors for bed bug evidence or live bed bugs.
----------------------------	--

Hand Wash	Use a cotton swap or toothbrush to scrub the grooves of the seal/gasket on the refrigerator and freezer door.
---------------------------	---

Vacuum	Use the crevice tool to vacuum the filter and motor of the refrigerator.
------------------------	--

Heat	Hair dryer or space heater. Use the hair dryer to blow hot air into cracks and crevices to flush bed bugs, and use the crevice tool on a vacuum cleaner to suck them up.
----------------------	---

Not Recommended - Isolation, Steam, Freeze, Desiccant dust

Remote control - TV, cable, game console, garage opener, car key dogle

Recommended	Special Instructions
-------------	----------------------

Inspection	Check inside the battery compartment.
----------------------------	---------------------------------------

Isolation	Store inside an airtight plastic bag or bin for six months. Remote controls can still be used if placed inside a clear Ziplock bag.
---------------------------	---

Heat	Hair dryer and space heater. Most electronic devices can withstand some heat. Check the owner's manual or call the manufacturer to confirm that the unit can withstand heat.
----------------------	---

Not Recommended - Hand wash, Steam, Freeze, Desiccant dust

Rugs - Small area rugs

Recommended	Special Instructions
-------------	----------------------

Inspection	Look closely at rug edges and tag.
----------------------------	------------------------------------

Isolation	Store inside an airtight plastic bag or bin for six months.
---------------------------	---

Vacuum	Use the beater brush to pick up stray bed bugs. Vacuum both sides.
------------------------	--

Rugs (Cont'd) - Small area rugs

Recommended	Special Instructions
-------------	----------------------

Heat	Clothes dryer, hair dryer, space heater. Follow instructions for clothes drying.
----------------------	--

Not Recommended - Hand wash, Steam, Freeze, Desiccant dust

Rugs - Large area (wall-to-wall carpeting should be treated as part of the structure)

Recommended	Special Instructions
-------------	----------------------

Inspection	Look closely at rug edges, where the tag attaches and where furniture and walls are in contact with the rug.
----------------------------	--

Isolation	Have the rug wrapped and placed in professional storage.
---------------------------	--

Vacuum	Vacuum the surface and edges well. This may not be very helpful if there are eggs on parts of the rug. If that is suspected, combine vacuuming with steam.
------------------------	--

Heat	A space heater will treat an unrolled rug effectively. If the rug is rolled up heating will be difficult.
----------------------	---

Steam	A good option to kill bed bugs and their eggs, while cleaning the carpet. Do not use a standard rug steamer. See page 58-59 for more information about the right machine.
-----------------------	---

Not Recommended - Hand wash, Freeze, Desiccant dust

Scale - For weight monitoring - See Appliances or Electronics

Shoes – Boots, heels, sneakers, tennis shoes, sport shoes, sandals

Recommended	Special Instructions
-------------	----------------------

Inspection	Look closely at overlapping shoe material, laces and zippers.
----------------------------	---

Isolation	Store inside an airtight plastic bag or bin for six months.
---------------------------	---

Hand Wash	Soles can be washed by hand, but suede and other delicate materials can be damaged by soapy water.
---------------------------	--

Vacuum	Use if bed bugs are visible on the shoes.
------------------------	---

Heat	Clothes dryer, hair dryer, space heater. Place in mesh bag and hang on the inside of the dryer door. Close the door and let the dryer run without other items inside. Use a hair dryer to heat shoes quickly, but do so in an enclosed space to contain bed bugs.
----------------------	---

Not Recommended - Steam, Freeze, Desiccant dusts

Shoes – including fancy, boots, heels, sneakers, tennis shoes, sport shoes

Recommended	Special Instructions
-------------	----------------------

Inspection	Look closely at overlapping shoe material, laces and zippers.
------------	---

Shoes – including fancy, boots, heels, sneakers, tennis shoes, sport shoes (Cont'd)

Recommended	Special Instructions
Isolation	Store inside an airtight plastic bag or bin for six months.
Hand Wash	Soles can be washed by hand, but suede and other delicate materials can be damaged by soapy water.
Vacuum	Use if bed bugs are visible on the shoes.
Heat	Clothes dryer, hair dryer, space heater. Place in mesh bag and hang on the inside of the dryer door. Close the door and let the dryer run without other items inside. Use a hair dryer to heat shoes quickly, but do so in an enclosed space to contain bed bugs.

Not Recommended - Steam, Freeze, Desiccant dusts

Shower curtain - See **Bedding** for washable items

Sports equipment - Balls, baseball gloves, pads, gear, not including uniforms

Recommended	Special Instructions
Inspection	Inspections will vary depending on the type of equipment. Remember to look for fecal stains, exoskeletons, eggs and live bed bugs at or near cracks and crevices
Isolation	Store inside an airtight plastic bag or bin for six months.
Hand Wash	Many items can be washed with hot, soapy water. Check tag to verify that soapy water will not damage item.
Vacuum	Pay attention to folds, gaps and other hiding spots.
Heat	Clothes dryer, hair dryer or space heater. In a clothes dryer, place in mesh bag and hang on the inside of the dryer door. Close the door and let the dryer run without other items inside. Direct hair dryer treatments to areas where bugs are found.

Not Recommended - Steam, Freeze, Desiccant dust

Space heater - See **Air Conditioner**

Table, wood - See **Furniture, wood or metal**

Television - See **Electronics**

Telephone—See **Electronics**

Tools (power) - See **Appliances, small. Hand tools - See Utensils**

Toys - Hard plastic, metal or wood

Recommended	Special Instructions
Inspection	If the room is infested, it may not be necessary to inspect all toys.

Toys - Hard plastic, metal or wood (Cont'd)

Recommended	Special Instructions
Isolation	Store inside an airtight plastic bag or bin for six months.
Hand Wash	Read the section on hand washing for precautions about treating wood.
Vacuum	Do not attempt to vacuum small items.
Heat	Space heating and targeted treatments with the hair dryer to areas where bed bugs are found.

Not Recommended - Steam, Freeze, Desiccant dust

Toys - Soft, plush or stuffed animals

Recommended	Special Instructions
Inspection	Look for live bugs, eggs and fecal stains, especially in folds of material.
Isolation	Store inside an airtight plastic bag or bin for six months.
Vacuum	This can be useful for removing stray bed bugs, but not for removing eggs.
Heat	Clothes dryer, hair dryer or space heater. Soft toys can be tumbled or placed in a mesh bag and hung inside the dryer door. Remember to remove batteries and/or mechanical parts if possible. Space heating and targeted treatments with the hair dryer to areas where bed bugs are found can also be used effectively.

[Steam](#) If steam is being used for other items, steam will kill bed bugs and eggs on plush toys.

Not Recommended - Hand wash, Freeze, Desiccant dust

Toys - Board games, paper coloring books, cardboard boxes for games, cards

Recommended	Special Instructions
Inspection	Look between layers and along edges, especially on wood and cardboard items.
Isolation	Store inside an airtight plastic bag or bin for six months.
Heat	Space Heating is effective and targeted treatments with the hair dryer can be used on items where bed bugs are found. Use the hair dryer in an enclosed space to avoid the accidental spread of bed bugs.

Not Recommended - Hand wash, Vacuum, Steam, Freeze, Desiccant dust

Undergarments— see Clothing

Utensils - Silverware, cooking tools

Recommended

Special Instructions

[Inspection](#)

Check the drawer or place where utensils are stored for bed bug activity and signs.

[Isolation](#)

Store inside an airtight plastic bag or bin for six months.

[Hand Wash](#)

Hand wash or place in a dishwasher with a hot cycle.

[Heat](#)

Space Heating if technique is being used for other items.

Not Recommended - Vacuum, Steam, Freeze, Desiccant dust

Vacuum cleaner - Vacuum contaminated by being in an area with bed bugs, not through use in control of bed bugs.

Recommended

Special Instructions

[Inspection](#)

For vacuum cleaners with a bag, remove the bag to inspect for bed bugs. Note that bugs can infest the hose and other parts of the vacuum that might be difficult to inspect.

[Isolation](#)

Store inside an airtight plastic bag for six months. This can be done for individual parts of the vacuum such as the hose and attachments.

[Hand Wash](#)

Hose, attachments, dirt container and synthetic filter can be hand washed in hot, soapy water.

[Heat](#)

Hair dryer can be used to clean the brush attachment; space heating to treat whole vacuum. Most electronic devices can withstand heat of up to 160°F. Check the owner's manual or call the manufacturer to confirm that the unit can withstand heat.

Not Recommended - Vacuum, Steam, Desiccant dust

Video tapes and film

Recommended

Special Instructions

[Inspection](#)

May be difficult to inspect inside a video tape. Check outside for evidence of bed bugs.

[Isolation](#)

Store inside an airtight plastic bag or bin for six months.

Not Recommended - Hand wash, Vacuum, Steam, Heat, Freeze, Desiccant dust

Walker, cane and crutches

Recommended

Special Instructions

[Inspection](#)

Look closely at hollow metal items that can contain bed bugs. Remove arm cushions, handgrips and tips (bottom) to inspect for bed bugs.

[Isolation](#)

Store inside an airtight plastic bag for six months.

[Hand Wash](#)

Great option for removing live bugs and eggs, as well as fecal stains.

Walker, cane and crutches (Cont'd)

Recommended

Special Instructions

[Heat](#)

Space heating and targeted treatments with the hair dryer to areas where bed bugs are found can be used.

Not Recommended - Vacuum, Steam, Desiccant dust

Wallpaper—Rips, tears, loose edges

Recommended

Special Instructions

[Inspection](#)

Look closely at edges of wallpaper that have peeled and folded for evidence of bed bugs. **Peeled edges can be glued down to eliminate bed bug harborage

[Vacuum](#)

Vacuuming may be part of a larger household effort to eliminate bed bugs. Targeting peeling wallpaper while vacuuming other objects is a good approach.

[Heat](#)

Space heating and targeted treatments with the hair dryer can effectively treat areas where bed bugs are found.

Not Recommended - Isolation, Steam, Desiccant dust

Wardrobe - See Furniture, wood or metal

Wheelchair and scooter

Recommended

Special Instructions *Treat these at the same time that the unit is being treated to avoid possible immediate reinfestation..

[Inspection](#)

Determine what parts of the wheelchair have bed bugs and treat them as described in other sections. Look under removable cushions and at their zippers. Look under all flaps.

[Hand Wash](#)

Some parts can be hand washed but be careful around electronic components.

[Vacuum](#)

Vacuum first to eliminate live bed bugs.

[Heat](#)

Space Heating and targeted treatments with the hair dryer to areas where bed bugs are found can be used. Most electronic devices can withstand heat of up to 160°F. Check the owner's manual or call the manufacturer to confirm that the unit can withstand heat

[Steam](#)

This option is ideal for most wheelchairs, including mechanized chairs that have watertight motor housing.

Not Recommended - Isolation, Freeze, Desiccant dust

Yoga mat—Rubber or plastic

Recommended	Special Instructions
Inspection	Lay the mat out flat and check edges.
Isolation	Store inside an airtight plastic bag or bin for six months.
Hand Wash	Wash mat in a bathtub in case of stray bed bugs.
Vacuum	May be useful to pick up stray bed bugs but will not remove bed bug eggs.
Heat	All types of heat (hair dryer, clothes dryer, and space heater) are effective. The best option for both mat and case is to treat items in a clothes dryer.

Not Recommended—Freeze, Desiccant dust

PART 2. TECHNIQUES FOR ELIMINATING BED BUGS FROM YOUR BELONGINGS

1. INSPECTION OF HOUSEHOLD ITEMS

Everything you own can be inspected.

Thorough inspection of your furniture and belongings is the first and most important step. Bed bugs are not everywhere, but if you find them in your home, they could be anywhere. Bed bugs can move around on their own or they can be moved by people and their belongings. If not treated, over time they will spread out. If you find bed bugs in your home or work space, you should thoroughly inspect as many items as you can for bugs. Bed bugs are visible at all life stages, however a magnifying glass can make it easier to spot them. They tend to stay close to your sleeping and sitting areas, whether that is a bed, a couch or a chair.

What You Need for Inspection:

- A bright flashlight: an LED type is brightest and works best
- A reader's magnifying glass (\$10 – at any pharmacy)
- Crevice tools: Any flat, flexible and long item, such as a cake icing spatula, a plastic card cut into a long triangle or a firm business card for use in probing gaps in furniture and other items.
- Lint roller to remove live bed bugs
- Clean pill bottle or Ziploc baggie for specimen.

HOW TO INSPECT FOR BED BUGS

A. **Identify:** It is important to know what bed bugs look like at all stages. Adults are easiest to find because they are the largest (a bit larger than a sesame seed) and dark reddish-brown. Nymphs vary in size; the smallest (youngest) are the size of a poppy seed (Fig. 1). Nymphs are lighter in color, but most have a dark spot in the belly, indicating they have had a blood meal (Fig. 2). Eggs are tiny, bean-shaped, white and about the length of a comma on this page. At that size, they are rarely the first evidence to be found because they are so small.

Fact:

Bed bugs glue their eggs in place when laid. To have bed bug eggs on furniture and items that do not leave the house, you must also have an adult female bed bug that is laying eggs. This is a sign of infestation.



Fig. 1. Adult and first instar nymph bed bugs next to sesame and poppy seeds.

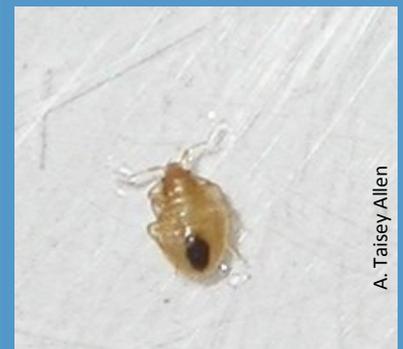


Fig. 2. A dark spot in the belly of this small bed bug indicates it has already fed, but is ready to feed again.

A. Taisey Allen

A key indicator of bed bug activity is the presence of fecal stains and shed skins (Fig. 3). Many things can cause black specs on a mattress/box spring/head board, so dampen the stain with a moist paper towel. If the smear turns a rusty brown color, it could be bed bug feces.

B. **Inspect:** If you suspect bed bug activity, begin your inspection at the most likely site of infestation - the bed or sleeping area. The box spring, headboard and mattress are the top three hiding spots for bed bugs.

i. **Box Spring:** Inspection of the box spring can be difficult when it cannot be easily moved off the frame, but the network of wood and springs inside is the perfect bed bug hiding place. If the box spring can be moved, prop it against a wall and remove the thin cloth on the underside (the dust cover). Using a bright flashlight inspect the seams and outer covering for live bugs and signs of bed bug activity. Bed bugs can also hide under staples. Another option to this difficult inspection is to completely encase the box spring in a bed bug-proof cover. See the "[Isolation](#)" section for more information. You will need two people.

ii. **Headboard and Bed Frame:** Whether constructed of wood, metal or plastic, headboards and bed frames provide plenty of hiding spots. Adults and nymphs will hide in gaps the thickness of a credit card. To inspect these areas and flush bed bugs out, use a "crevice tool", such as a thin spatula, screwdriver tip, or part of a business/credit card (Fig. 4) . Use a bright flashlight to inspect all screw holes (Fig. 5), and slide the crevice device through the length of all gaps, corners and cracks to flush out bed bugs (Fig. 6, next page).

iii. **Mattress:** Examine the entire surface of the mattress—top, sides and bottom. Pay special attention to the seams, piping and pillow top around the edge. Lift the pillow top edge up and look at both sides of the seam (Fig. 7, next page). Don't forget to look beneath the mattress labels or tags. If you can safely move or slide the mattress off the box spring or bed frame, lean it against a wall to enable inspection of the underside. You may wish to have a vacuum on hand to catch and remove any fleeing bed bugs. See "[Vacuuming](#)" for details on how to vacuum without infesting your machine.

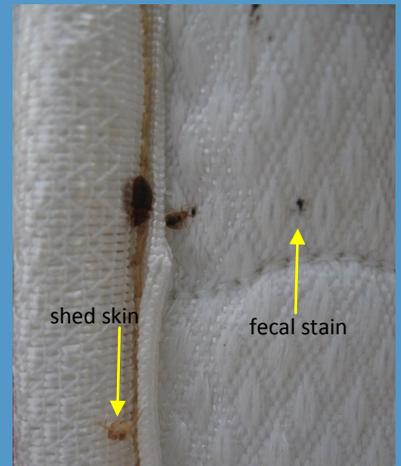


Fig. 3. Fecal stains and shed skin will usually be found in places where bed bugs are hiding. This is also where bed bug eggs will be deposited.



Fig. 4. Simple inspection tools include a magnifier, LED light, screwdriver and crevice tool.



Fig. 5. Bed bugs hide and cluster in a screw hole under a chair.

iii. **Bed Linens:** Look at your linens (sheets, pillow covers, blankets), especially the seams. Take pillowcases off the pillows and inspect both items. Focus on seams and folds. See techniques listed below for "[Isolation](#)" and "[Heat Treatment](#)" if pillowcases are infested with bugs. Pillows can be treated in the dryer.

C. Lint rollers, especially the extra sticky type, can be used to inspect items and remove bed bugs. For example, when returning from travel, use a lint roller on your suitcase to inspect for and remove bugs that are hiding in seams. Social workers, visiting nurses or people who work in the homes of other people can use lint rollers on clothing, backpacks or bags and other gear that might have picked up bed bugs. Figure 8 shows how lint rollers can be used on mattress seams. Roll the sticky surface over areas in question. Look closely for trapped bed bugs. Peel off and fold the sticky layer over itself to encase bed bugs, and throw it away.

CONSIDER THIS

- Pest management professionals have little time to spend on inspection, and usually do not inspect belongings other than furniture. Once bed bugs are found, treatment of the home will begin, but professional treatment does not work well for smaller household items. Pest managers often recommend that customers self-treat or throw away belongings because many things are difficult to treat. Inspection helps you determine which items do and do not need treatment. This can save money and the heartbreak of throwing away important or irreplaceable things. Inspection can help you prevent the spread of bed bugs into other rooms, homes or the workplace. Details on how to remove or kill bed bugs on a list of personal belongings are in the sections that follow.
- After inspection, if an item is free of bed bugs or correctly treated, it is very important to keep that item away from bed bugs. Place clean items in sealed plastic bags or bins until the whole bed bug infestation is eliminated. See the "[Isolation](#)" section for more details.



Fig. 6. Any thin, strong and flexible piece of plastic can work as a crevice tool. A credit card may be too thick for some furniture gaps.



Fig. 7. Inspection of folds on pillow top mattress.



Fig. 8. Use a lint roller to inspect a mattress.



Fig. 9. Bed bugs will often hide under the plastic corner protector of the box spring.

ADVANTAGES AND DISADVANTAGES OF INSPECTION

- **Advantages:** Inspection is the very first and most important step in bed bug control, and allows you and your pest manager to avoid wasting time on unnecessary treatments. Inspection also helps narrow down the location and extent of the infestation. Inspection helps you save your belongings, rather than discarding valuable items and replacing expensive things. Inspection and isolation of belongings in airtight bags or containers is a very low cost method of bed bug control. See the "[Isolation](#)" section for additional information.
- **Disadvantages:** Inspection takes time. Bed bugs are flat and fit into narrow spaces, so thorough inspection of hiding spots is needed, which can be time consuming. Inspection, itself, does not kill bed bugs; so other controls must also be used.

2. EFFECTIVE ISOLATION OF YOUR BELONGINGS

Isolation is an inexpensive way to fight bed bugs.

Although bed bugs can live for a surprisingly long time without a liquid meal, isolation from a food source can be used to starve, desiccate (dehydrate), and therefore kill, bed bugs with minimal effort. Isolation techniques include installing encasements on mattresses and box springs, placing items in airtight zippered plastic bags or sealable plastic bins, or using pitfall traps/interceptor devices.

All bed bug life stages, except eggs, are susceptible to desiccation, but newly hatched, first instar nymphs are believed to be most vulnerable. First instar nymphs do not have a thick cuticle (waxy insect skin) like adults and may not have had their first blood meal. This is important because blood meals feed **and** hydrate bed bugs.

The length of time required for bed bugs to die from starvation or desiccation depends on several factors, the time since its last blood meal, temperature, humidity, and the setting (laboratory versus field).



Fig. 10. Various life stages of bed bugs (left to right) and various stages of feeding (top to bottom) can make correct identification confusing.



Fig. 11. Bed bugs do not have "nests" but will gather in groups in good hiding spots.

Did you know? Bed bugs will die faster in warm, dry places compared with cool, damp

In general, *warmer temperatures increase metabolic activity and result in quicker death for bed bugs*. When studied in the laboratory, bed bugs survived 3 to 10 months at 70°F (near room temperature). In non-lab settings, recent research conducted in apartment buildings demonstrated that adult bed bugs can survive at least 4.5 months after their last blood meal, and unfed nymphs may survive just as long. In these settings, bed bugs can prolong their lives by hiding in cracks and crevices. However, effective isolation methods may increase desiccation and result in quicker death.

What You Need for Isolating Your Things

- Mattress and box spring encasements
- Clear zippered plastic bags or sealable bins (airtight)
- Duct tape or other strong wide tape
- Pitfall style bed bug traps
- Carpet tape – 2 sided, very sticky

HOW TO ISOLATE YOUR BELONGINGS

A. **Use Encasements:** Throwing out a lightly infested mattress or box spring can be an expensive mistake. In fact, discarding the bed (or other furniture) does not eliminate bed bugs. Hasty attempts to remove furniture and sleep in a different location or replace furniture can actually spread bed bugs to other areas in the home. As a result, newly purchased furniture can quickly become infested. This should be avoided.

There are many encasement brands available for purchase, and they differ in quality and effectiveness. See “[Consider This](#)” below for traits of a good encasement. The following steps are general recommendations; directions on the encasement package should be followed. After you have selected a brand, follow the procedures below:

- Measure the depth (height) of the bare mattress without bedding or pads (Fig. 12). Buy the correct size encasement.
- Vacuum the mattress and box spring (Fig. 13) according to the instructions in “[Vacuuming](#)”. This will remove any bed bugs and reduce allergens.



Fig. 12. Measure the depth (height) of your mattress.

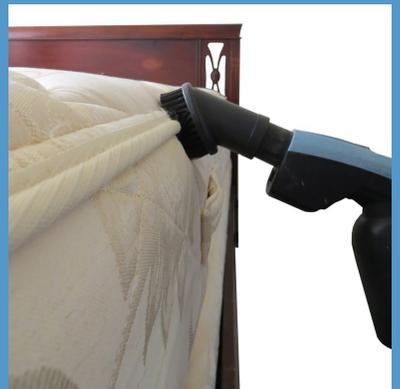


Fig. 13. Vacuum with a brush attachment and use a scrubbing motion to dislodge bed bugs.

It may be necessary to have two people to install mattress and box spring encasements to avoid injury

- Enlist the help of a friend. To avoid injury or damage it is recommended that two people install an encasement.
- With two people, one on either side of the mattress, slide mattress off the box spring so that the foot of the mattress touches the floor.
- Grab the sides of the mattress and stand it up on the foot end, resting it against the wall.
- Starting at the top of the mattress fit the encasement on one corner, then the other (Fig. 14).
- Verify that the seams are aligned, and pull the encasement down over the length of the mattress slowly and evenly.
- With the encasement still open, follow the same procedure for the box spring.
- Place box spring back on bed frame – DO NOT drag box spring or mattress across floor once encasement is installed. This could result in a tear or damage to the zipper.
- Secure encasement by closing the zipper (Fig. 15). Most encasements have a special feature on the zipper that that protects it from infestation (Fig. 16). Seal the zipper as instructed on the product directions.
- Follow the same procedure for the mattress by placing it on the box spring and closing the zipper.
- Precaution: You may want to install felt strips or duct tape on the encasement and the bed frame where the mattress or box spring sit on the frame, to avoid rips.

Seal the rips in any encasement with duct tape, which is sticky enough to last and comes in a variety of colors, including white.

Some people may feel compelled to remove and wash the encasement. But opening and removing it from the bed can lead to reinfestation of bed bugs.

Leave the encasements on!

Encasements are also available for luggage (as inside liners or to protect the whole item), sofas and pillows.



Fig. 14. Stand the mattress on end and slide the encasement over the mattress.



Fig. 15. Zip the encasement closed.



Fig. 16. Encasement zipper with hook to prevent opening.

CONSIDER THIS

- Several encasement brands are available on the internet or in bedding stores. Consider the following traits when buying an encasement:
 - * **Color** - It should be white or light colored to make bed bugs and their fecal stains easy to see.
 - * **Size** - It should be the right size (twin, queen, king) for your mattress, box spring and pillow (Fig. 17).
 - * **Fit** - It should have a snug fit on your mattress or box spring but not so tight that it could rip apart. Too much loose fabric can create folds that provide harborage for bed bugs (Fig. 18), reducing its effectiveness.
 - * **Zipper** - The zipper should have a protective mechanism that eliminates seams or folds and prevents bed bug entry and escape.
 - * **Rip-Resistant** - The material must be strong and tear resistant. Stretchy fabric encasements are less likely to rip than vinyl and are more comfortable to sleep on. Vinyl will rip, eventually, but can be a cheaper first line of defense. Keep the duct tape handy. Padding (duct tape or cloth) on the corners will help protect the encasement and reduce tearing caused by friction with the bed frame.
 - * **Escape-Proof** - There should be no openings large enough to permit bed bugs entering or escaping.
 - * **Bite-Proof** - Some encasements have been tested and shown to be “bite proof”, which means bed bugs cannot stick their tiny mouthparts through the material to feed on sleeping hosts. This is not an issue for box spring encasements, and likely not a concern for most mattress encasements since bed sheets also increase thickness and protection to sleeping hosts.
 - * **Insecticidal**: Some encasements are pre-treated with permethrin – a pesticide that binds to fabric and kill pests that encounter it. This treatment has been deemed safe, and has been used for decades to protect individuals in the armed forces. However, this cannot be used alone to fight bed bugs. Some have shown resistance to pesticides like permethrin, so treated encasements are not always effective.



Fig. 17. Properly installed, well-fitting mattress encasements.



Fig. 18. Bed bugs will cluster and hide in the folds of a loose mattress encasement. Make sure yours fits.

Once the encasement is installed, it is important that you DO NOT REMOVE IT.

ADVANTAGES AND DISADVANTAGES OF ENCASEMENTS

- **Advantages:** Encasements offer protection, whether you are dealing with an active infestation or being proactive.
 - * Encase and isolate bed bugs: Mattress and pillow encasements enclose bed bugs inside so they cannot feed on a sleeping person. The fabric weave and zipper protectors are designed to prevent bed bug escape, therefore putting an end to feeding and growth. Thus, the mattress and pillow do not need to be replaced.
 - * Eliminate harborage: Encasements are designed to eliminate the seams, piping, or other features of mattresses and box springs used for harborage.
 - * Help inspections: White encasements provide contrast when inspecting for bed bugs, including fecal stains and live bed bugs (Fig. 19). Cast skins and nymphs are translucent yellow and may be difficult to see, as are the white eggs. Use a bright flashlight when inspecting.
 - **Disadvantage:** While most encasements are effective at preventing feeding and can save a mattress and box spring, some products may tear as a result of friction against the bed frame or other sharp objects. Any tear in the encasement makes the product ineffective.
- B. Use Clear Zippered Plastic Bags and Sealable Bins:** Just like encasements, these supplies can be used to protect personal items or as an isolation method to kill bugs by desiccation and starvation.
- **Protection:** For people that work where bed bug introductions may occur, or for workers that visit homes as a part of their job, personal belongings should be isolated before and after use. This includes coats, bags, laptop computers, tablets, binders, clipboards and medical equipment brought into a client's home. Items should be kept in the bin or bag when not in use (Fig. 20 and Fig. 21). This precaution can limit the chances of personal items serving as bed bug transportation.
 - **Kill bugs on infested items:** If a particular item is infested, place it in a large, airtight plastic bag or plastic bin with a lid and store it in a warm, dry location. Warmer



Fig. 19. Bed bug fecal stains are easy to identify on a white mattress encasement.



Fig. 20. Storage bins can be used to isolate belongings.



Fig. 21. Items can be protected in a sealed plastic bag when at work, visiting or at home. At work, place personal items in a safe place, such as a drawer.

temperatures speed starvation and desiccation, reducing the average time of five months usually necessary to kill bed bugs. If the bin is not airtight, carefully seal around the lid edge with duct tape. After a month or so, thoroughly inspect bags, bins and stored items for bed bugs, which may have crawled off into corners.

CONSIDER THIS

- For isolation to be effective, the bag or bin must provide a secure, airtight seal that will not provide escape for a tiny bed bug nymph. First instar nymphs are about the size of a poppy seed, but very flat, and capable of squeezing through the smallest gaps. Duct tape around the lid will ensure that no bed bugs escape. Clear bags/containers are preferred because they allow for inspection of items. If bed bugs are present, they may be observed in the corners of bags as they attempt to escape.

ADVANTAGES AND DISADVANTAGES OF PLASTIC BAGS & SEALABLE CONTAINERS

- Advantage: This technique can prevent bed bugs from hitchhiking on personal items and moving into living spaces for people who visit homes for a living, work in areas where bed bug introductions are likely, or for those who travel.
- Disadvantage: This technique requires months of isolation for bed bugs to die. Many items are used daily and cannot be left in complete isolation for five months or more. Make sure to inspect those items and keep them away from bed bug infestations.

C. **Pitfall-Style Traps:** These devices were initially created to protect beds and furniture from wandering bed bugs by placing the furniture legs in the middle of the trap (Fig. 25). In an attempt to access a host, bed bugs crawl up the roughened exterior of the trap and fall into the smooth-surfaced pit that they cannot escape. Although they can hide and survive for several months in cracks and crevices, pitfall traps expose bugs to circulating air, and faster death by starvation and dehydration. New research has shown that bed bugs move throughout the environment



Fig. 22. This laptop is protected in a sealed plastic bag.



Fig. 23. A laptop or tablet can be taken out and used safely, then returned to the bag. This prevents bed bugs from infesting electronics and can be used in many ways.



Fig. 24. The well of this pitfall trap is smooth and dusted with talc. The outer wall is rough to allow bed bugs to climb up.



Fig. 25. A pitfall style bed bug trap placed under a furniture leg.

more than previously thought, so placing traps around living areas or work spaces can lead to faster detection (Fig. 26). Furthermore, it has been shown that when trap devices are placed under furniture legs and along walls throughout the living space, traps can eliminate small populations of bed bugs in multifamily housing.

CONSIDER THIS

- **Pitfall-Style Traps:** Pitfall trap technology continues to change. While the original traps had a smooth inner-surface, they were lined with a talc powder to decrease friction and keep bugs inside the smooth well. For this design, traps that are dusty or need to be cleaned of bed bugs require a new coating of talc, which can be applied using a sock filled with talc powder (not insecticide dust) or a cotton ball (Fig. 27). These traps often have an inner and outer well, which provides useful information during an inspection. If bugs are found in the inner well (where the furniture leg sits), it suggests that the furniture is infested. If bugs are found in the outer well, this means that bugs are approaching the bed from another part of the room.

Pitfall-style traps that do not require talc powder are now available (Figs. 28 and 29). However, some of these traps have only a single well with a smooth surface. Those are efficient at monitoring and eliminating small bed bug infestations, but provide less information about where bugs are coming from (the bed or elsewhere in the room). Black traps are more discreet, but trapped bugs are more difficult to see. Another type of pitfall trap includes a pheromone lure to attract bed bugs. While no published research is available to date, scientific trials have shown that non-baited traps are equally or more effective than baited traps (and less expensive).

Finally, researchers have shown that dark colors are more attractive to the bugs than light-colors, which may influence your trap selection. For all traps types (except those that incorporate a lure) traps may be cleaned with a *vacuum* using the technique described in the section below.

Did you know that pitfall traps like the ones pictured can eliminate a small bed bug infestation?



Fig. 26. A pitfall trap placed in the bedroom under a table.



Fig. 27. Dusting a bed bug trap with talc powder using a cotton ball.



Fig. 28. Some brands of bed bug traps do not require talc powder. Look at the details before buying traps.

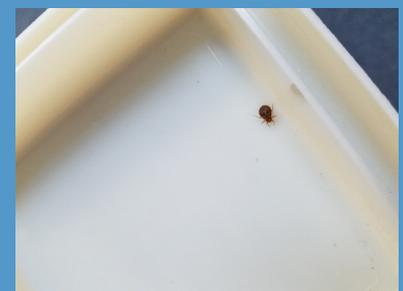


Fig. 29. Bed bug trap with an adult bed bug.

ADVANTAGES AND DISADVANTAGES OF PITFALL TRAPS

- Advantage: Once used only to intercept bugs as they crawled up furniture legs, traps may be more effective than other methods (human inspection or scent-detecting dogs) for early detection. Traps are always present and active, whereas inspectors and dogs are short-term visitors. Interceptors require no bait or pheromone, do not break down over time, and can be reused over and over again.

Research has also shown that they can be used to eliminate small populations of bed bugs in multi-family housing, and when used in combination with other actions, can prevent bites while sleeping.

Pitfall traps can be used both to isolate a piece of furniture and as a monitoring device near furniture (Fig. 30).

- Disadvantage: Because they are placed on the floor behind or under furniture, the smooth-surfaced wells that prevent bed bugs from climbing out can be filled with dust, debris and other insects (Fig. 32). As a result, bugs can crawl out of the smooth-surfaced well. If traps are not checked and cleaned regularly, they may become ineffective. Further, some devices become ineffective when heavy furniture causes them to crack. Look for heavy-duty traps if needed.

- D. **Carpet Tape Barrier** – Bed bugs avoid crossing sticky surfaces, so it is unlikely that they will be caught on sticky traps. Use this to your advantage by placing strong, two-sided carpet tape on bed legs and elsewhere to prevent bed bug movement. Carpet tape is very strong two-sided tape that can be placed on bed legs and many other places to stop bed bugs from traveling across that spot. Carpet tape can be used as a barrier to protect a variety of items. For example, carpet tape around the legs of a baby’s crib can provide good protection as long as blankets do not touch the floor. Examine the tape frequently to make sure the surface is still sticky and not full of dust or hair.



Fig. 30. A pitfall trap placed along the wall for bed bug monitoring.



Fig. 31. Place all four bed legs in the center of a bed bug pitfall trap to isolate the bed and monitor for bed bug activity.



Fig. 32. This bed bug trap should be cleaned and dusted with talc to be effective again.

3. HAND WASH ITEMS

Washing with detergent immobilizes and removes bed bugs, using common household materials.

For many things around the home, a simple soap and water wash can be the solution. Soaps can break down the waxy exoskeleton, or outer covering of bed bug bodies. Soap helps drown bed bugs by breaking the surface tension of water. Further, scrubbing an area where bed bugs are present can squish bugs that attempt to escape. This treatment effectively removes shed skins and bed bug feces. Consider this technique for hard items that would not absorb water, such as wood, plastic, metal and glass furniture, picture frames, toys, dishes and knickknacks. A complete inventory of home items is listed in Part I.

HOW TO HAND WASH ITEMS

What You Need for Hand Washing:

- Gloves: optional
- Bucket and sudsy soap (dish detergent, liquid soap, or anything sudsy)
- Scrubbers: a toothbrush or scrub brush
- White cloths to wipe and towels to dry the area

- A. Soak a rag or cloth in the bucket of hot, soapy water, wring it out and wipe surfaces of furniture, floors, walls and infested items (Fig. 33). If you pick up live bed bugs, rinse them off in the bucket of soapy water. The soap will help drown bed bugs.
- B. Use a scrub brush (Fig. 34) or a toothbrush to clean in cracks and crevices. Dip the brush into hot, sudsy water and scrub the area thoroughly.
- C. Dump used water into the toilet, rather than the sink, and flush to eliminate any bed bugs.

CONSIDER THIS

To guard against damage, test your treatment method and cleaning solution on a small portion of the infested item. For example, some wood finishes can be damaged by exposure to water (Fig. 35, next page).

Tip:

Washing furniture, floors and walls will erase bed bug evidence and provide a clean slate for monitoring for new bed bug activity. It also reduces aller-



Fig. 33. Scrub crevices thoroughly to remove bed bugs and eggs.



Fig. 34. Scrub brushes with long bristles are great for washing deep into crevices where bed bugs hide.

- Watch for escaping bed bugs when using this method. Sudsy water will partly disable bed bugs, making them easier to capture and discard. Make sure any captured bugs go into the soapy water or squish bugs you see.
- Consider washing items, such as toys, small plastic or metal furniture, laundry baskets and other water-safe things in a bathtub or the shower stall. Bed bugs that are washed off can be rinsed down the drain.
- If possible, wash larger items outside with a hose or bucket of soapy water. A strong stream of water from a hose may dislodge bed bugs and those that end up on the ground outside will quickly perish from exposure or predation. Bed bugs left outside will not come back into the house. Use this method for folding chairs, sports equipment, larger toys and large metal or plastic furniture.
- Although it may seem logical to place items into a washing machine to wash bed bugs away, they can sometimes survive a wash cycle if the water is not hot enough. Items that can be laundered (linens, clothes, rugs, pillows and stuffed animals) should be heat treated in a hot dryer before being laundered. This ensures enough heat to kill all stages of bed bugs. See the "[Heat](#)" section for more information about heat treatment.

ADVANTAGES AND DISADVANTAGES

- Advantages: Washing items is a low cost method of eliminating bed bugs on many hard surfaces and washable items. It removes insect exoskeletons and feces, which may contribute to allergens. Using this technique can prevent unnecessary pesticide exposure and can reduce the number of belongings you must throw away.

Disadvantages: Some items cannot be washed, so consider other treatments for books, important papers or files, photographs, artwork, electronics and fabric on furniture. Be careful with certain types of furniture constructed of pressboard or particle board (composite wood made from wood shavings and glue). They may be damaged by even small amounts of water. Some finishes on wood furniture develop water stains from water exposure. Always test a small area of any item before using soap and water!



Fig. 35. Pressboard and laminate furniture can suffer permanent damage from water exposure.



Fig. 36. Soapy water and a brush are ideal for straps and buckles on an instrument case and other water-safe things with lots of hiding spots.

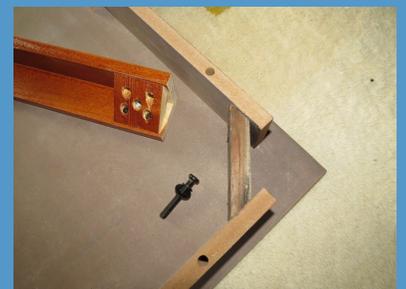


Fig. 37. Where possible, take furniture apart for thorough cleaning.

4. VACUUMING TO GET RID OF BED BUGS

An inexpensive and important strategy to remove bed bugs and their debris.

Vacuuming is an effective way to remove bed bugs and their debris (shed exoskeletons, feces, eggs), which may trigger allergic reactions and asthma. For bed bug removal, professional pest managers use dedicated vacuums containing HEPA (High Efficiency Particulate Air) filters that prevent dust and other particles from escaping into the air. A home vacuum can be easily modified to eliminate clusters of bed bugs, their shed skins and eggs without contaminating the vacuum. Vacuuming is best used at the beginning of treatment, when bed bugs are hiding, or are intentionally flushed from a crack or crevice. Once disturbed, bed bugs usually move to new hiding spots and can be hard to find.

What You Need for Vacuuming:

- Any kind of vacuum, except a small hand held unit (they are generally too weak for the job)
- Vacuum attachments, including brush and crack and crevice tool (the one with the narrow opening at the end)
- Panty hose or knee high stockings
- Rubber band

A. **Area Vacuuming:** Recent research has shown that bed bugs constantly move within an environment. All stages of bed bugs (except eggs) are mobile, and pregnant females are the most active and disperse the furthest. With this in mind, regular vacuuming of carpets can catch bed bugs on the move.

To avoid infestations inside the vacuum, remove the bag or canister immediately after using and discard the contents outside of the home in a sealed plastic bag.

B. **Targeted Vacuuming:** Vacuum in specific areas to pick up clusters of bed bugs, shed skins and eggs. Use the vacuum hose and the crack and crevice attachment.



Fig. 38. A Philips brand HEPA vacuum, one of many that are affordable and easy to get.



Fig. 39. If you cannot buy a HEPA vacuum, you can buy HEPA-filtered vacuum bags.

Fact:

Bed bug nymphs have been observed hiding in shed skins from larger bugs. Bed bugs also roam. Vacuuming regularly is a sure way to remove these shed skins, nymphs and roamers.

- i. Prepare Your Vacuum: Before you begin, take steps to prevent infestation in your vacuum. Use a knee high stocking in the hose end to collect all vacuumed debris. When vacuuming is done, this can be removed, tied off and discarded.
 - Place closed end of stocking inside the vacuum (Fig. 40) and carefully place the open end of the stocking cuff around the hose opening (Fig. 41). Use a rubber band to secure.
 - Gently insert the crack and crevice tool into the hose end, securing the stocking in place (Fig. 42). You are ready to vacuum, (see below).
 - Once you have finished vacuuming, carefully remove the crack and crevice tool, swiftly but gently remove the stocking and tie off the end to prevent any bugs from escaping (Fig. 43).
 - Promptly seal the stocking in a zippered plastic bag before taking it outside to discard. Dispose of the stocking in an outdoor garbage container.
 - If you use a vacuum cleaner *without the stocking technique* the machine may have living bed bugs inside, even after discarding the bag or cleaning the canister. To prevent their release back into the home, store the vacuum cleaner and all its parts inside a large plastic bag, and seal it until next use.
- ii. Target Your Vacuuming: Vacuum all areas where bed bugs might be found. This includes gaps/cracks/crevices in furniture (headboard, night stand, dresser, electronics, and knickknacks), seams of mattresses, box springs and upholstered furniture, where the wall and ceiling meet, where the wall and floor meet and floor/ceiling molding. Use a crevice tool to flush bugs from their hiding place and then suck them up (Fig. 44).

All vacuums have filters that protect the motor from dust and debris. Bed bugs should never make it to the filter in a vacuum that uses bags. However, in a bagless vacuum the filter could collect live bed bugs. Many of these filters can be washed by hand. Some are made of folded paper and cannot be washed. Consider inspection and heat treatment (hair dryer) to assure that no living bed bugs persist on these filters.



Fig. 40. Stocking in the hose end.



Fig. 41. Roll the cuff down.



Fig. 42. Add the crevice tool.



Fig. 43. Remove, tie and discard.

CONSIDER THIS

- Vacuuming should be done regularly (3x week).
- Most vacuums come equipped with multiple attachment types, including wand or hose extenders. The crack and crevice tools focus more suction power to a small opening. Micro (smaller) vacuum attachments (Fig. 45) may be available to concentrate the suction in small areas
- While the brush attachment can be used to dislodge eggs from surfaces, bugs and eggs can also get caught between the bristles, or can be flung during the act of brushing. If you use a brush attachment, clean it after each use. Wash the attachment, especially the bristles, in very hot soapy water, rinse and dry. Store it in isolation (Fig. 46) until next use.

ADVANTAGES AND DISADVANTAGES OF VACUUMING

- Advantages:
 - * Quick removal of live/dead bed bugs and their debris;
 - * Reduce the need for multiple insecticide applications;
 - * Improve insecticide treatments;
 - * Provide a clean slate for inspections.
- Disadvantages:
 - * Live bed bugs may persist inside a vacuum if precautions, such as the stocking technique, are not taken. As a result, dedicated vacuums that are used for bed bug work can actually spread bed bugs to new locations. Avoid this problem by using the proper precautions listed in "How To".
 - * Not every home or building has access to a vacuum cleaner.
 - * Small handheld vacuum cleaners built for cleaning up dust are often too weak to use for bed bug control.



Fig. 44. Use a spatula or paint scraper as a crevice tool for flushing out bed bugs.



Fig. 45. Micro-vacuum attachments can be used on electronics and gaps and crevices in items.



Fig. 46. Sealed plastic bags can be used to isolate vacuum attachments between uses.



Fig 47. Clutter inhibits pest management for any kind of pest.

5. USING HEAT TO ELIMINATE BED BUGS

Heat is the one treatment bed bugs are not resistant to. Used safely, heat kills all life stages quickly.

Bed bugs, like many other arthropods, are unable to withstand high, dry temperatures. This information has been used to develop techniques to rid personal belongings of bed bugs using common household items, such as the clothes dryer, hair dryer and iron. Although special equipment and expertise is needed to treat entire rooms or houses, individuals can use heat or create heat chambers to kill bed bugs on smaller items. All four strategies will be described.

Killing bed bugs with heat depends on two factors: temperature and time. The higher the temperature, the less time is needed to kill bugs. At lower temperatures, more time will be needed.

Temperature vs. time needed to kill bed bugs

Temperature	Time Needed	
	Adults	Eggs
113°F	90 minutes	8 hours
118°F	2 minutes	90 minutes
122°F	0 minutes	0 minutes

Current research suggests that 122°F is immediately lethal to bed bugs, killing them within one minute of exposure. The eggs are slightly more resilient and require exposure to 122°F, so to be safe, aim for a temperature of 125°F and use the instructions below. Your choice of technique will depend on the types and size of items you wish to treat.

Did you know?

Dry heat is a technique that can kill bed bugs, ticks, cockroaches and other pests.



Fig. 48. Temperature and time go hand-in-hand: Higher temperatures lead to quicker drying times.

Desiccation is a technical term used to describe extreme drying.

Desiccation is lethal for bed bugs.

What You Need for Heat Treatments:

Dryer Method

- Clothes dryer
- Meat thermometer
- 3 dry towels for testing dryer temperature
- Mesh laundry bag

Clothes Iron

- Clothes iron in good condition
- Towel

Hair Dryer Method

- Hair dryer with a warm enough setting to kill bed bugs

- Meat thermometer

Heat Chamber—Space heating

- Space heaters
- Box fans
- Insulating foam boards (as large as 8'x4')
- Remote thermometers

HOW TO USE HEAT TO KILL BED BUGS

A. **Clothes Dryer:** Many fabric, leather and wool items can be cleared of bed bugs by placing items into a dryer that can heat above 125°F. Washing items first is not recommended because this increases the time needed to bring the items to the proper heat and may even spread bed bugs. Washer water temperatures are usually *not enough* to kill bed bugs.

i. **Test the dryer for the right level of heat:**

- Place 3 dry towels into the dryer (Fig. 49).
- Set the dryer on high for 20 minutes.
- Open the hot dryer quickly, place a meat thermometer in the center of the towels and close the door.
- After five minutes, check the thermometer (Fig. 50). Temperatures of over 125°F are recommended to kill bed bugs using this technique.
- If the temperature is below 125°F, increase the heat level or the length of time in the dryer. Two hours at 115° F will be enough to kill bed bug and their eggs.



Fig. 49. Place already dry towels into the dryer and set on temperature you intend to test. Run for 20 minutes.



Fig. 50. After 20 minutes of dry heat open the dryer door and place meat thermometer in the center of the towels. Wait 5 minutes and check the temperature. Over 125°F? Good.



Important!

Dry items first! Do not wash first. Washing items does not kill bed bugs and will increase the time needed for dry-

- If 115°F is not possible, use a different dryer or a commercial Laundromat.

ii. Using the Dryer:

- If the dryer achieves the target temperature of 125°F, place infested items into the dryer using the same heat and time settings. This kills and removes bed bugs from your belongings. *Do not* over fill the dryer. Ensure items are tumbling! All items must reach the target temperature to achieve control.
- Items that you do not wish to tumble, such as shoes, can be placed inside a mesh laundry bag closed inside the door (Fig. 51 and Fig. 52). This exposes the item to heat and warm air circulation, but not the tumbling.

B. **Clothes Iron:** Some infested clothing items should not be tumble dried. For these items, place a towel over the item and use your iron's highest steam setting to treat seams and other areas where bed bugs and eggs may be found (Fig. 53). To guard against damage, always test a small portion of the item. This technique can be applied to fabric, leather and wool, as well as important documents, wallpaper and window blinds, etc.

C. **Hair Dryer:** Forced air from a hair dryer (**never a heat gun**) can reach temperatures that are lethal to bed bugs, and can be used to treat infested cracks and crevices. Hair dryers are a good option when dryers and irons are not practical. This includes treating luggage, headboards, plastic furniture and other hard items. If the item is small enough to be moved (luggage, plastic furniture), use the hair dryer in a dry bath tub or on top of a white sheet, in case bed bugs are blown off. This precaution allows easy observation. Bed bugs are no longer a threat if they fall off outdoors.

ii. Test the hair dryer for the right level of heat:

- Turn on the hair dryer, preferably on the low speed, high heat setting

Place a meat thermometer approximately 2 inches from the end of the dryer (Fig. 54, next page).



Fig. 51. Place shoes into a mesh laundry bag and hang the bag on the inside of the door.



Fig. 52. Close the dryer door with the bag hanging inside.



Fig. 53. A hot iron and towel can be used to kill bed bug in clothing and linens.

- After one minute, check the thermometer. Temperatures over 140°F are recommended to kill bed bugs using this technique (Fig. 55).

ii. *Treat an infested item:*

- Using a low speed, high heat setting, turn on the hair dryer.
- Slowly direct hot air along the item’s cracks and crevices (Fig. 56). Lift seams and pocket flaps during the process for better access. Keep in mind that the slower you proceed with this treatment, the better.
- Keep an eye out for escaping bugs. They can be squished, vacuumed or picked up with a lint roller.

D. **Space Heater:** Professional pest management companies use expensive equipment capable of sustaining the high temperatures needed to heat entire rooms. Due to the cost of equipment and required expertise, these treatments are not feasible for non-professionals. Attempts to raise the internal temperature of the living space without professional assistance will not reach critical temperatures, and will create a dangerous situation. **DO NOT try to heat your own home!!**

Whole room treatments by individuals are not advised. However, heat chambers offer an alternative solution to treat medium or small items inside an enclosed area.

Heat chambers can either be purchased as “Portable Heat Chambers”, or made in a Do-It-Yourself fashion. For a discussion on several commonly available Portable Heat Chambers, see References for this chapter at the end of the book. Original instructions on how to make your own heat chamber can be found in the Reference section (Pereira, et al. 2009) but are also described here.

- Small Capacity heat chambers operate on the same premise as large capacity treatments. See below for more details.
- Large Capacity
 - Portable Heat Chambers: Portable heat chambers are available for purchase. Kits include the container to enclose items and the equipment to heat the space. Figure 57 shows a smaller portable heat chamber used for luggage and small items.



Fig. 54. Testing the temperature of a hair dryer is easy.



Fig. 55. Aim for temperatures above 140F. Hair dryers often get much hotter than that.



Fig. 56. When treating a piece of luggage move the hair dryer slowly to allow heat build-up.



Fig. 57. A portable heat chamber that can fit a piece of luggage can be useful for treating smaller household items. They can cost under \$200.

Some portable chambers are best suited for situations where large items cannot or should not be moved from their current location. Examples might include furniture in a college dormitory or senior housing location.

Other portable chambers are made for luggage and smaller heat-tolerant home items. They can be purchased for \$200-500.

See this article for more information: <http://www.pctonline.com/article/pct1214-bed-bug-diy-control-techniques/> (Hit Ctrl and link at same time)

- **DIY Heat Chambers:** Do-It-Yourself chambers offer a cheaper alternative to large portable heat treatments. The concept is the same: build a self-contained space around bed bug infested items and raise the internal temperature past the thermal death point (122°F). Depending on the location, heat chambers may be permanent or temporary.

- Temporary chambers are made with sheets of rigid polystyrene insulation that form a box around infested items, such as beds and other furniture. Researchers evaluating this technique used the following supplies:

- * Six polystyrene sheets: 8 foot by 4 foot by 2 inch thick
- * 2 inch wide masking tape
- * 2 remote indoor/outdoor thermometers
- * 2 box fans
- * 2 oil-filled space heaters (reduced risk of fire)
- * A comforter or thick blanket, that can be placed in the dryer, to cover hard floors
- * A white sheet to cover carpeted floors
- * Surge protectors and extension cords as needed

The procedure includes the following steps:

1. Place items in a central area on top of a comforter, thick blanket or sheet larger than the heating space. Make sure that the items are positioned to fit inside the 8 by 8 foot (and 4 foot tall) chamber.
2. Place one space heater next to furniture, but not touching. Place the second space heater in the diagonal corner (opposite ends of the chamber). Try to use separate electrical circuits to avoid tripping a fuse.

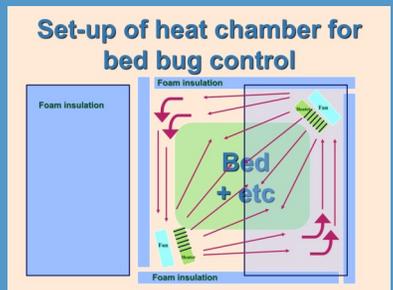


Fig. 58. The basic setup for a DIY heat chamber. Univ. of Florida.



Univ. of Florida
Fig. 59. Place furniture and things in the center and build a Styrofoam box around the pile.



Univ. of Florida
Fig. 60. Fans and heaters are turned on inside before box is put together. Completed box is sealed with tape. This must be monitored.

To see a slide set with images that demonstrate the trials and errors of creating a heat chamber, see this [slide set from the University of Florida](#).

3. Place box fan facing away from the heater so it will blow hot air through the space. Set up both fans so that the motion of the air will be clockwise within the chamber.
4. Place remote thermometers inside or under materials to be treated. It is important that these are not in exposed areas, but rather in hard to reach places where bed bugs tend to hide.
5. Turn on the heaters, box fans and thermometers.
6. Create a cube around the items using the foam board and fasten them at the seams with masking tape. Start with the four walls, then add the roof. All joints should be sealed to prevent escape of warm air.
7. Allow the chamber to heat to 125°F based on readings from both thermometers. This may take several hours. Allow the temperature to hold for a minute or more.
8. Turn off equipment and take apart the cube.
9. The one disadvantage of this less expensive alternative is the reduced portability of the chamber. Large (8' x 4') polystyrene boards can be difficult to transport, move up and down stairways and they present a storage challenge.

Dedicated space: Facilities with a high turnover in occupants may wish to invest in a dedicated area used for heat treatments. Homeless shelters, public housing, apartment buildings, hospitals and college dormitories are places where items can be treated on-site upon arrival as part of an intake procedure. In these settings, an individual room, storage closet, basement accessory room or even a shipping container (Fig. 61 and 62) or box truck (Fig. 63) can be fitted with materials described above to create a permanent heat chamber. This approach can save a lot of money and time in the long run.

CONSIDER THIS

- *Achieving Lethal Temperatures:* Although the air inside may be over 122°F, crowding too many items in a clothes dryer or heat chamber will obstruct hot air and result in control failure.

Colleges, shelters, hospitals, nursing homes, and hotels are sites with high turnover and risk of bed bug introductions.

Managers of these sites should consider buying supplies for building heat chambers.



Fig. 61. This commercial storage container was set up to be a bed bug heat chamber by the operators of a group home. Inside, they heat treat furniture and other items on a regular basis using donated commercial heaters.



Fig. 62. This is the inside of the commercial storage container that was set up to be a bed bug heat chamber.

- **Solarization Does Not Work:** Solarization is a heat treatment using sunlight to heat materials under black plastic sheeting (Fig. 64). While this technique is often suggested, researchers in Australia have demonstrated that it does not eliminate bed bugs from infested items. Bed bugs survive by finding a cool spot that does not reach lethal temperatures.
- **Other treatments:** It has been shown that hot washing clothing can kill all stages of bed bugs and eggs if the wash cycle maintains 140°F for 90 minutes. Washing machines in the United States may not reach the required temperature. Hot tumble-drying requires less time and energy investment, therefore drying is preferred treatment.

ADVANTAGES AND DISADVANTAGES

- Advantages:
 - * **No Residual** - Dry heat does not require pesticides. Therefore, there is no concern over chemical residues on surfaces and there is no re-entry time after the treatment is complete.
 - * **No Resistance** - To date, there is no documented bed bug resistance to heat treatments.
- Disadvantages:
 - * **Risk of fire:** Using space heaters in a confined space has risks. Use heaters that have auto shut-off if tipped over.
 - * **Damage to Items:** High temperatures can damage personal items, especially objects made of wood, hard plastic and electronics. Careful consideration of the infested item is needed to determine if it will withstand the treatment. Consult with the item's manufacturer to determine if high temperatures are safe.
 - * **No Residual:** While heat can be immediately lethal to bed bugs, there is no residual activity from these treatments. Thus, an infestation can be eliminated one day, but new bugs can enter and start feeding and reproducing once the treatment is done. For whole room or home treatments, this is a disadvantage of heat treatments, which already have a high price tag.



Fig. 63. Some companies use large heaters and fans inside box trucks for bed bug treatments. M. Overline, Aardvark Pest Management.



Fig. 64. Heating things in a black plastic bag in the sun does not work. You also risk mistaking your belongings for trash.

Important!

Turning up the heat in your home will NOT kill bed bugs. Adding the heat of the oven is dangerous. Neither can provide enough heat to kill bed bugs. Only specialized equipment can do that job.

6. USING STEAM TO ELIMINATE BED BUGS

Commercial steam cleaning machines can achieve the lethal temperatures needed to kill bed bugs. Dry heat of 122°F is immediately lethal to bed bugs (desiccation), but due to moisture and quick evaporation steam must bring the surface temperature to within a range of 160°F – 180°F to kill bed bugs. Dry steam (low moisture) is preferable but such outputs are only available with commercial steam machines designed for deep cleaning. If you are choosing a steamer for bed bug control, be sure to confirm that the steam output temperature is high enough for the job.

Compared to dry heat's ability to penetrate cracks and crevices within an enclosed space, use of steam is a targeted approach requiring more precision, time and effort to be effective. Nevertheless, steam is an important tool in the IPM toolbox for managing bed bugs, on mattresses, box springs, rugs and plush furniture, such as sofas.

THINGS TO KNOW ABOUT STEAM MACHINES

Steam machines come in a variety of forms and functionalities. The steam machine market expanded greatly after it was recognized that steam can be used for bed bug treatments. But device performance may vary based on the model.

Some desirable qualities in a steam machine include:

- **“For Commercial Use”:** Most steam machines built for commercial use reach temperatures of 200°F or more, instantly killing bed bugs. Using methods described in the “Heat- Hair Dryer” section, test the steam machine to make sure temperatures reach at least 160-180°F.
- **Length of continuous steam:** The ability to produce steam over a long period of time is important. Less expensive machines may reach the lethal temperature but operate for a short period of time, forcing the user to stop frequently. This may be OK for an individual or for a few items, but pest management professionals should seek machines with greater continuous steams times (45 minutes).
- **Large water capacity:** Steam machines vary in the amount of water they can carry. Higher capacity means fewer re-fills. A one-gallon tank is recommended for DIY home use.

Best Option:

Steam is the best option for plush furniture and upholstered items. For a demonstration of the use of steam see: [“Using Steamers to Kill Bed Bugs” by the University of Minnesota](#)



Fig. 65. Choose a steamer carefully, making sure it generates enough heat to kill bed bugs.

Pest management professionals should consider steamers with high water capacity and a continuous-flow feature, so fresh water can be added while the machine is in operation.

- **Steam volume control:** Some machines offer steam volume control to limit the amount of moisture. This helps to protect items that can retain or be damaged by excess moisture. Look for machines featuring low vapor flow and high temperatures.
- **Multiple attachments:** Like vacuum cleaners, steam machines often come equipped with various attachments for specific jobs (Fig. 66). A flat square or triangle-shaped upholstery attachment (Fig. 67) should be included for treating furniture. Look for a carpet attachment and a crack-and-crevice tool. Place a small towel over the steam head to reduce air pressure (avoid blowing bed bugs around) and to increase heat development.

Avoid steam machines designed for clothing, carpet steamers, non-portable units or poorly made brands. For the greatest efficiency use the correct tool for the job.

What You Need to Use Steam:

- Commercial steam machine for cleaning
- Meat thermometer to measure temperature output
- Multiple attachments for different sizes and shapes of harborage
- Hand towel or cotton cloth

HOW TO USE STEAM

It is generally accepted that longer treatment time is better. “Slow and Steady” is the rule for steam treatments. One study found that 10 to 30 seconds per foot was sufficient to kill all stages of bed bugs and their eggs on upholstered furniture.

- A. First, use a meat thermometer to first measure the steam machine’s temperature output. Aim for a temperature of over 160°F.
- B. Prepare the steam machine as described in the product guide (fill water, plug in device, allow to warm, etc.).



Fig. 66. Various attachments can help you apply steam to different types of furniture and materials.



Fig. 67. An upholstery attachment for a steam cleaner can .



Fig. 68. Steam the material at 10-30 seconds per foot, or until the material reaches 160F.

- C. Attach appropriate nozzle to the device (generally the triangular-shaped upholstery nozzle)
- D. Test a small portion of the item to identify any risks of damage from the treatment and determine if steam is an option (See Consider This below).
- E. Slowly (10-30 seconds per foot) move the applicator over the area. If infested, as you suspect, there will be live bugs, feces, and eggs in the furniture's cracks and crevices—ideal bed bug harborage. Keep in mind that steam dissipates and cools the further it gets from the applicator, so keep the nozzle within ¼ inch of the infested item, or in direct contact. If live bugs are present, direct contact may cause them to disperse, so you might consider vacuuming to remove live bugs before a steam treatment.
- F. Allow the treated area to dry. Remove dead bugs and eggs with a vacuum. If treating a mattress or box spring, consider using an encasement only after it has dried to avoid the development of mold.

CONSIDER THIS

- **Sensitive Items:** The combination of heat and moisture has been shown to damage certain items, so steam is not a viable option for many infested items. Before performing a treatment, perform a test on an inconspicuous area for the following and similar items:
 - * Leather/suede
 - * Acrylic
 - * Vinyl
 - * Linen, silk
 - * Painted surfaces
 - * Finished wood
 - * Laminated wood
 - * Simulated wood veneers
 - * Plastic
 - * Wallpaper and other glued surfaces
- **Attachment or Nozzle Type:** As described above, various attachments or nozzles will be included with most steam machines. In general, the upholstery attachment (triangle-shaped) is used to concentrate steam in a smaller area.



Fig. 69. Steam treatment of a fabric sofa takes time but can be very effective.

Do not use steam treatments directly on electrical outlets, lighting or appliances that are plugged in.

The carpet attachment is often too big and requires slower treatment time.

- A benefit of the upholstery nozzle is that it tends to regulate the steam pressure. Too much pressure can blow bed bugs off without killing them so take note when using steam, and adjust accordingly.
- Penetration. Unlike dry heat that is able to penetrate cracks and crevices, steam at lethal temperatures is thought to have low penetration. Specifically, steam can penetrate $2 \frac{3}{8}$ inch (6 centimeters) into a crack/crevice, and less than one inch beneath fabric surface.
- Professional Use. A quality steam machine can be expensive, and is not a tool commonly employed by individuals. However, organizations and businesses may wish to invest in a steam machine if they are constantly faced with bed bug introductions. Hospitals, group homes, shelters, universities/colleges, and others can use steam machines to treat commonly infested items or areas.

ADVANTAGES AND DISADVANTAGES OF STEAM

- Advantage: Pesticides are not always effective against bed bug eggs, and usually require two treatments. Steam and other high temperature treatments, however, kill all life stages, including eggs, in a single treatment. Furthermore, because pesticides are not used, there is no concern about chemical residues on surfaces. To date, there is no documented resistance to steam treatments.
- Disadvantages:
 - * Possible damage to items: (see **Consider This** above)
 - * Moisture damage to items: Development of mold if wet items are encased or covered in bed sheets
 - * No residual: like dry heat, steam provides control for a moment in time that does not last after the treatment is completed
 - * Equipment issues: One study demonstrated that the duration of treatment can reduce the output of the steam machine. As a result, the temperature generated and the ability to kill bed bugs was diminished with longer use.



Fig. 70. The triangular upholstery nozzle can be wrapped in a cotton cloth to help build up heat. Photo by R. Cooper.

Office bed bugs:

Introductions to offices are common, but often create a panic. Steam can be used by office staff or cleaners to treat chairs, desks and other things that might have been exposed. This option does not require a license the way pesticide applications do.

7. DESICCANT DUSTS

Insects and other arthropods (ticks, mites, spiders, etc.) have an exoskeleton, the hard, outer surface that provides the shape of the insect. A waxy layer, called the cuticle, serves as a barrier to prevent water loss. Without the cuticle, insects and other arthropods rapidly lose water from their bodies and die.

Desiccant dusts have long been used in pest management. They work by either scratching or abrading the exoskeleton, or by absorbing the waxy cuticle layer. The outcome is the same in both cases – the insect loses its ability to retain water and dies from desiccation or water loss.

Diatomaceous earth and silica gel are two types of desiccant dusts used against bed bugs. These products are non-toxic dusts, and do not contain active ingredients such as pyrethroids or neonicotinoids, two common pesticides.

Diatomaceous earth is the fossilized remains of algae (called diatoms). It is a naturally occurring mineral, like talcum powder. When an insect crawls over diatomaceous earth, it scratches the insect cuticle and makes the insect vulnerable to desiccation. Silica gel, on the other hand, is a synthetic, fluffy white powder that is made from silica (the name is misleading – it is a powder and not a gel). Silica gel sticks to and adsorbs the waxy cuticle of the exoskeleton. The outcome is the same: the insect dies slowly from desiccation.

What You Need to Use Dusts:

- Silica gel (preferably) or diatomaceous earth
- Applicators: soft bristle paint brush, cosmetic brush, feather duster or something similar

HOW TO USE DESICCANT DUSTS

- Read all label instructions prior to using a desiccant dust. Label instructions might include recommendations for personal protective equipment (gloves, mask, eye protection), and will provide details about suitable application methods.
- Dust applications should be thin coats of the material that create a light film and/or are barely perceptible.

Fact:

Boric acid is not a desiccant dust, and has little to no effect on bed bugs.



Fig 71. A bed bug, like many other insects, has a waxy coating on the surface of the body that protects it from dehydration.



Fig. 72. Use a makeup brush or soft paint brush to apply dusts to crevices in furniture. Place dust in a small bowl for easy access.

- DO NOT OVERAPPLY! When treating furniture, the bed frame, carpet edges, etc., a soft bristled paintbrush or a cosmetic brush (Fig. 73) may be used to apply a very thin coat to cracks and crevices (Fig. 74).
- Remember that these materials work by affecting the insect exoskeleton – essentially requiring that the insect crawl through it. Applying desiccant dusts to open areas will not force bed bugs into complete contact with the material, and may not affect their survival. Instead, apply dusts to cracks and crevices where bugs will press against two or more surfaces, exposing themselves to the material.
- Common areas of dust application include cracks and crevices of floor molding, bed frames, couches/sofas, electrical outlets or other areas where insects or their evidence is visible. Some products can be used directly on box springs and mattresses – with applications focused on areas of bed bug activity such as the seams/folds of the mattress and the underside of the box spring [read the label for specific instruction].

CONSIDER THIS

- There is some evidence that silica gels perform better than diatomaceous earth. This is partially because of the way the products work: silica gels adhere to the exoskeleton and adsorb the cuticle layer, whereas diatomaceous earth scratches the cuticle. It is important to note that juvenile stages of bed bugs may be able to overcome both products when harborages are sufficiently humid, if they are recently fed (blood is high in moisture), or if they molt soon after exposure to the dusts.
- Desiccant dusts will clump in high humidity or excessive moisture. Clumped dusts will not adhere to the insect's exoskeleton to cause desiccation. High humidity may also reduce the effect of dusts because desiccation is less likely.
- Apply desiccant dusts in a thin layer (Fig. 74), as indicated on the label. Large amounts of desiccant dusts may be repellent to bed bugs, and are likely to be less effective.
- Compared to synthetic insecticides, desiccant dusts are a safer alternative when used according to the label.



Fig. 73. Using a makeup brush to apply dust to furniture can be time consuming but effective.

Fact:

Diatomaceous earth is a naturally occurring mineral. Silica gel dust, used often by professionals, is a synthetic material. Both are desiccants used to combat bed bugs.



Fig. 74. A thin, fine coating of dust is all that is needed to battle bed bugs.

ADVANTAGES AND DISADVANTAGES OF DESICCANT DUSTS

- Advantages:
 - * Silica gels can also be mixed with water and used as a spray formulation. Instructions on the label should be followed to avoid clogging applicator tips on spray equipment.
 - * When applied in dry areas and according to label instructions, desiccant dusts will have a much longer residual activity than most liquid insecticides. The physical properties of the dusts do not change over time and will abrade or absorb the exoskeleton, whereas chemical insecticides can decay over time in response to light, moisture and bacteria.
 - * Dusts picked up by one insect can be transferred to others in a harborage. This horizontal transfer can increase impact of desiccants.
 - * Research has highlighted cost savings for multi-unit buildings when connecting walls are proactively treated with desiccant dusts.
 - * In some situations desiccant dusts can be applied with minimal home preparation.
 - * Based on their demonstrated safety, desiccant dusts have a broad application label and can be used in a variety of sites and locations.
- Disadvantages:
 - * Depending on the surface of application, residue left by desiccant dusts can leave a white powdery residue. However, this powder can easily be cleaned with a wet paper towel, duster or vacuum. Label instructions should be consulted for cleaning up excess product.
 - * According to the label, desiccant dusts should be applied in a manner that leaves behind a thin coating of product. This can be achieved in a variety of ways, but in many cases special equipment is utilized, such as automated dusters.



Fig. 75. Do not apply dusts in heavy piles. It is ineffective and wastes material. Apply in a thin coating.



Fig. 76. Make sure bed bugs appear on the label.

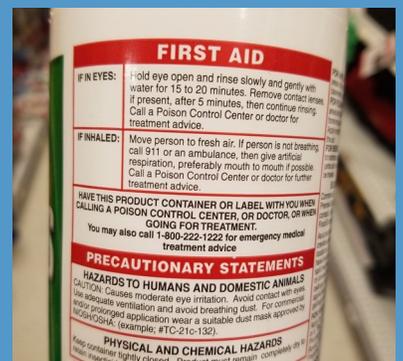


Fig. 77. READ THE LABEL before using any pesticide product. Follow directions. The label is Federal Law.

8. FREEZING ITEMS TO KILL BED BUGS

When bed bugs first returned as a pest in the United States, the use of cold temperatures and freezing were explored as treatments. However, unlike the immediately lethal effects of heat and steam, freezing requires sustained exposure at very low temperatures to affect bed bugs. **Some researchers suggest that freezing is inconsistently effective and may not kill all bed bugs all of the time. For this reason, freezing is not a reliable option for getting bed bugs out of personal items.**

Professional freeze treatments through the application of liquid carbon dioxide or liquid nitrogen, are available and appropriate for some situations. However, research on container (freezer) freezing has shown that sustained temperatures of 0°F, the temperature of most household freezers, are needed for 4 or more days to kill all stages of bed bugs and their eggs. While lower temperatures will kill faster (two days at -4°F; immediately lethal at -6 to -22.5°F), these temperatures are not practical for most situations and higher temperatures are not guaranteed to work. For example, a well-known scientist pulled a container of bed bugs out of a household freezer that had been frozen for five years. One of the bed bugs recovered and became active after 5 years!

Interestingly, research has shown that the feeding status of bed bugs does not affect their ability to survive the cold. In other words, bed bugs that had recently eaten were just as susceptible to freezing as those that were starved. This has also been observed with pesticides, although bed bugs that are able to feed after pesticide exposure had an improved survival rate.

A challenge in freezing is that current conditions may influence an insect's ability to survive. For instance, if the ambient temperature is already low, freezing is less likely to be effective. Furthermore, bed bugs are capable of rapid cold hardening, such that exposure to cold temperatures (one hour at 32°F) increases the ability of bed bugs to survive at 6.8°F and 3.2°F.

The bottom line: We do not recommend freezing in a household freezer to treat items for bed bugs. It is not guaranteed to work. Professional freeze treatments are available for certain situations.

ADVANTAGES AND DISADVANTAGES

- Advantages:
 - * Professional treatments that use liquid carbon dioxide or liquid nitrogen can often be used on surfaces that would be damaged by high heat, including toys, plastics, books.
 - * Carbon dioxide snow produces less moisture compared to steam, which might make this applicable for items such as electronics.

- Disadvantages:
 - * Unlike steam and heat, cold treatments that rely on liquid carbon dioxide or liquid nitrogen do not penetrate into pleats and seams of mattress. Therefore, this treatment technique necessitates direct contact with the target insects.
 - * The velocity of 'snow' from liquid carbon dioxide/nitrogen treatments is capable of blowing bed bugs off of the substrate before a lethal exposure to the cold temperature.
 - * Anecdotal evidence suggests that some bed bugs are able to recover from cold treatments, and that even direct contact with freezing temperatures may not be sufficient to kill the insects, but rather immobilizes them.
 - * Like other similar treatments, the use of liquid carbon dioxide/nitrogen is time consuming because all cracks and crevices must be treated.

9. LIQUID AND AEROSOL INSECTICIDE SPRAYS

Insecticide sprays are widely available tools for bed bug management. Most people think of these products first. While many over-the-counter pesticides can help manage bed bugs, the type of product and the way it is applied can affect the success of a treatment. This is especially true with bed bugs, which are secretive insects that hide in cracks and crevices. To be an expert in bed bug management requires an understanding of pest biology, and the time to do a thorough, targeted treatment in areas where bed bugs hide.

In this guide, we do not recommend do-it-yourself insecticide sprays for managing bed bugs on household items.

Why? The most effective pest management strategy for pests like bed bugs, mice, cockroaches and others is Integrated Pest Management (IPM). IPM uses a combination of tools (inspection, isolation, sanitation, physical removal, mechanical control, etc.) to fight pests. This strategy reduces risks to human health (fewer toxins, lower allergens), to the environment, and lowers the economic impact on families dealing with bed bugs (no need to throw out and replace belongings).

These justifications sound good, but there are additional reasons to use IPM.

- Pesticides, alone, often may not resolve the issue. Bed bug hiding spots are sometimes inaccessible or missed by the applicator, bed bugs spread from one apartment to another depending on the pesticides used, and many pesticides have short residuals (meaning they do not last long on surfaces).

- People affected by bed bugs still need to treat household items that could have bed bugs, because pesticides are inappropriate treatments for many things, such as clothing.
- Pesticide resistance in bed bugs is a well-known problem and is difficult to detect unless pesticide treatments are not working.
- If you hire a professional pest management company to treat the home (walls, floors, voids), these guidelines can be used to avoid throwing away your belongings.

For any and all pesticide use, it is critical that you read and follow the product label. Not only do label instructions represent federal law (and failure to follow them is thus a violation of the law), but the specifications for use are designed to maximize their efficacy. Using more than the label rate may be dangerous and could reduce product efficacy. More is not better. Read the label.

10. ILLEGAL, UNSAFE AND INEFFECTIVE PRACTICES

When dealing with bed bugs, some may think “desperate times call for desperate measures.” There is no doubt that dealing with bed bugs can cause physical discomfort, anxiety, stress, depression, isolation, financial burdens and other personal and relationship problems. But dealing with bed bugs in an inappropriate way can actually be more harmful to you, your family and your property. It is not worth these risks. Chronic and acute exposure to some pesticides can have long-term impacts on human health. The careless use of rubbing alcohol, gasoline and total release foggers has caused fires and explosions. Even pesticides, like total release foggers, can cause bed bugs to spread further.

While misinformation on the Internet about techniques that “work” for bed bug control can be dangerous, so too can certain techniques that require special training, and should therefore only be attempted by the professional pest management industry. For a quick reference, our colleagues at Rutgers University have created a concise, informative document that lists and describes the effective and in-effective techniques for managing bed bugs: Wang, C & R Cooper. 2015. Cost-Effective and Money-Wasting Bed Bug Control Methods. Rutgers University, Cooperative Extension Fact Sheet 1251. 4pp.

URL: <https://njaes.rutgers.edu/pubs/fs1251/>

Some techniques that are illegal, ineffective, or unsafe for use by untrained individuals against bed bugs include:

- Bug Bombs (Total Release Foggers): These have been proven ineffective against bed bugs (www.pctonline.com/article/pct1012-ineffective-foggers-bed-bugs/)



Fig. 78. Residents of a one bedroom apartment used as many as 60 total release foggers to kill bed bugs. This was both dangerous and unsuccessful.

- Dry ice: From EPA, December 2014 (www.epa.gov/managing-pests-schools/bed-bugs-schools-webinar-report): Solid carbon dioxide (also known as dry ice) should not be used to control bed bugs. This use is not registered by EPA, therefore, it has not been evaluated for safety or efficacy. Dry ice can cause serious burns and, when used in enclosed spaces, has caused asphyxia (suffocation).
- “Fumigation” with pest strips: From CDC, January 2014 (www.cdc.gov/mmwr/preview/mmwrhtml/mm6302a5.htm?s_cid=mm6302a5_w): From 2000 to 2013, a total of 31 (30 possible and one probable) cases of acute dichlorvos (also known as DDVP) pest strip-related illness were identified in the United States (24 cases) and Canada (seven)... A total of 20 (65%) of the 31 cases involved label violations, mostly use of dichlorvos pest strips in areas occupied by persons ≥ 4 hours/day. For the remaining 11 cases, information was not sufficient to determine if usage of dichlorvos pest strips resulted in a label violation. Contributing factors other than using strips in occupied areas included excessive application (two cases), placing strips in sealed bags to treat infested items (four), lack of skin protection (e.g., gloves or prompt skin washing) (four), placing strips in closets and pantries (three), cutting and tearing strips into smaller pieces (three), and using a heater and fan to accelerate vapor dissemination from strips (three).
- Ultrasonic Devices are not effective against bed bugs or any other insects.
- Herbal sprays, rubbing alcohol, and most over the counter products are not known to be effective unless directly applied to a visible bug – but why not squish it?
- Ozone has been suggested as a technique that will kill bed bugs. However, field evaluations by pest professionals have failed to demonstrate any measurable control on bed bug infestations, while risks of using this molecule in homes have not been thoroughly studied and ozone may be dangerous.
- It may be tempting to “cook” items inside a microwave oven to get rid of bed bugs. This method has not been shown to work and may be dangerous if the items have metal components. A microwave can also melt items you might not expect and can easily set some things on fire. Do not treat your belongings in a microwave oven.

References for Isolation

- Cooper, R, C. Wang & N Singh. 2015. Mark-release-recapture reveals extensive movement of bed bugs (*Cimex lectularius* L.) within and between apartments. PLoS ONE 10(9): e0136462
- Cooper, R, C. Wang & N Singh. 2015. Effects of various interventions, including mass trapping with passive pitfall traps, on low-level bed bug populations in apartments. Journal of Economic Entomology 109(2): 762-769.
- Doggett, SL, MJ Geary & RC Russell. 2006. Encasing mattresses in black plastic will not provide thermal control of bed bugs, *Cimex* spp. (Hemiptera: Cimicidae). Journal of Economic Entomology 99(6): 2132-2135.
- Jones, SC, JL Bryant, FS Sivakoff. 2015. Sublethal effects of *ActiveGuard* exposure on feeding behavior and fecundity of the bed bug (Hemiptera: Cimicidae). Journal of Medical Entomology 52(3): 413-418.
- Kells, SA & MJ Goblirsch. 2011. Temperature and time requirements for controlling bed bugs (*Cimex lectularius*) under commercial heat treatment conditions. Insects 2: 412-422.
- McNeill, CA, RM Pereira, PG Koehler, SA McNeill, & RW Baldwin. 2016. Behavioral responses of nymph and adult *Cimex lectularius* (Hemiptera: Cimicidae) to colored harborages. Journal of Medical Entomology 53(4): 760-769.
- Singh, N, C Wang & R Cooper. 2015. Vision and mechanoreception in bed bug, *Cimex lectularius* L. behavior. PLoS ONE 10(3): e0118855.
- Wang, C, K Saltzmann, A Gondhalekar, T Gibb & G Bennett. 2014. Building-wide bed bug management. Pest Control Technology 42(3): www.pctonline.com/article/pct0314-building-wide-bed-bug-programs/
- Wang, C, N Singh, C Zha, & R Cooper. 2016. Bed bugs: prevalence in low-income communities, resident's reactions, and implementation of a low-cost inspection protocol. Journal of Medical Entomology 53: 639-646.
- Vail, K, & JG Chandler. 2017. Bed bug (Hemiptera: Cimicidae) detection in low-income, high-rise apartments using for or fewer passive monitors. Journal of Economic Entomology. doi: 10.1093/jee/tox053

References for Vacuuming

- Bérenger, J.M., L. Almeras, H. Leulmi, & P. Parola. 2015. A high-performance vacuum cleaner for bed bug sampling: a useful tool for medical entomology. Journal of Medical Entomology 52(3): 513-515.
- Brazell, C. 2015. Investigating realistic control options. Pest Control Technology 43(9): 40 42-44.
- Kraft, S. & L. Pinto. 2016. Should you be vacuuming for bed bugs? Pest Control Technology 44(6). URL: www.pctonline.com/article/should-you-be--vacuuming-for-bed--bugs/
- Sheperdigian, M. 2016. Helping the bed bug-afflicted. Pest Management Professional 84(5): 80.
- Shindelar, A., & S. Kells. 2011. Vacuuming to capture bed bugs. University of Minnesota Extension. 1pp. URL: www.bedbugs.umn.edu/sites/bedbugs.umn.edu/files/y2014m05d23_vacuuming.pdf

References for Using Heat to Manage Bed Bugs

- Benoit, JB. 2011. Stress tolerance of bed bugs: a review of factors that cause trauma to *Cimex lectularius* and *C. hemipterus*. Insects 2: 151-172.
- Doggett, SL, MJ Geary & RC Russell. 2006. Encasing mattresses in black plastic will not provide thermal control of bed bugs, *Cimex* spp. (Hemiptera: Cimicidae). Journal of Economic Entomology 99(6): 2132-2135.
- Hottel, B, R Pereira & P Koehler. 2014. Helping those in need. Pest Control Technology 42(12): 92-93.
- How, Y-F, & C-Y Lee. 2010. Effects of temperature and humidity on the survival and water loss of *Cimex hemipterus* (Hemiptera: Cimicidae). Journal of Medical Entomology 47(6): 987-995.

References for Using Heat to Manage Bed Bugs, Continued.

- Kells, SA & MJ Goblirsch. 2011. Temperature and time requirements for controlling bed bugs (*Cimex lectularius*) under commercial heat treatment conditions. *Insects* 2: 412-422.
- Louden, C. 2017. Rapid killing of bed bugs (*Cimex lectularius* L.) on surfaces using heat: application to luggage. *Pest Management Science* 73: 64-70.
- Naylor, RA & CJ Boase. 2010. Practical solutions for treating laundry infested with *Cimex lectularius* (Hemiptera: Cimicidae). *Journal of Economic Entomology* 103(1): 136-139.
- Pereira, RM, PG Koehler, M Pfiester & W Walker. 2009. Lethal effects of heat and use of localized heat treatment for control of bed bug infestations. *Journal of Economic Entomology* 102(3): 1182-1188.
- Potter, MF, A Romero, KF Haynes & E Hardebeck. 2007. Killing them softly: battling bed bugs in sensitive places. *Pest Control Technology* 35(1): 24-5,27,29,30,32.
- Quarles, W. 2015. New IPM methods for bed bugs. *IPM Practitioner* 34(7/8): 1-9.
- Rukke, BA, A Aak & KS Edgar. 2015. Mortality, temporary sterilization and maternal effects of sublethal heat in bed bugs. *PLoS ONE* 10(5): e0127555
- Stedfast, ML, & DM Miller. 2015. Turning up the heat. *Pest Control Technology* 43(6): 94,96,98-100,114.
- Wang, C, & R Cooper. 2016. Research Update: Portable Heat Chambers. *Pest Control Technology* 44(3).

References for Using Steam to Eliminate Bed Bugs

- Kells, SA. 2006. Nonchemical control for bed bugs. *American Entomologist* 52(2): 109-110.
- Shindelar, A. and S. Kells. 2011. Using Steamers to Kill Bed Bugs. UMN https://www.bedbugs.umn.edu/sites/bedbugs.umn.edu/files/y2014m05d27_using_steamers_to_kill_bed_bugs.pdf
- Puckett, RT, DL McDonald & RE Gold. 2013. Comparison of multiple steam treatment durations for control of bed bugs (*Cimex lectularius* L.). *Pest Management Science* 69: 1061-1065.
- White, J. 2009. How to use a steamer to treat bed bugs. https://youtu.be/f_tTehoyOng. Accessed July 2016.
- White, J. 2012. BBTV #34 - Effectiveness of steamers on bed bugs. <https://youtu.be/vHdHOFrbv34>. Accessed July 2016.

Purdue Extension Video on Steaming an Electric Wheelchair:

<https://www.youtube.com/watch?v=Q3VIyrjg8Lc>

References for Freezing Items to Kill Bed Bugs

- Benoit, JB, G Lopez-Martinez, NM Teets, SA Phillips, & DL Denlinger. 2009. Responses of the bed bug, *Cimex lectularius*, to temperature extremes and dehydration: levels of tolerance, rapid cold hardening and expression of heat shock proteins. *Medical and Veterinary Entomology* 23: 418-425.
- Benoit, JB. 2011. Stress tolerance of bed bugs: a review of factors that cause trauma to *Cimex lectularius* and *C. hemipterus*. *Insects* 2: 151-172.
- Choe, D-H, & K Campbell. 2014. Effect of feeding status on mortality response of adult bed bugs (Hemiptera: Cimicidae) to some insecticide products. *Journal of Economic Entomology* 107(3): 1206-1215.
- How, Y-F, & C-Y Lee. 2010. Effects of temperature and humidity on the survival and water loss of *Cimex hemipterus* (Hemiptera: Cimicidae). *Journal of Medical Entomology* 47(6): 987-995.
- Koganemaru, R, & DM Miller. 2013. The bed bug problem: past, present and future control methods. *Pesticide Biochemistry and Physiology* 106: 177-189.
- Naylor, RA & CJ Boase. 2010. Practical solutions for treating laundry infested with *Cimex lectularius* (Hemiptera: Cimicidae). *Journal of Economic Entomology* 103(1): 136-139.

References for Freezing Items to Kill Bed Bugs, Continued.

- Olson, JF, M Eaton, SA Kells, V Morin & C Wang. 2013. Cold tolerance of bed bugs and practical recommendations for control. *Journal of Economic Entomology* 106(6): 2433-2441.
- Potter, MF, A Romero, KF Haynes & E Hardebeck. 2007. Killing them softly: battling bed bugs in sensitive places. *Pest Control Technology* 35(1): 24-5,27,29,30,32.
- Rukke, BA, M Hage, & A Aak. 2016. Mortality, fecundity and development among bed bugs (*Cimex lectularius*) exposed to prolonged, intermediate cold stress. *Pest Management Science* 73(5): 838-843.
- Singh, N, C Wang, & R Cooper. 2015. Post treatment feeding affects mortality of bed bugs (Hemiptera: Cimicidae) exposed to insecticides. *Journal of Economic Entomology* 109(1): 273-283.
- White, J. 2012. Killing bed bugs: steam vs. Cryonite. <https://youtu.be/vHDHOFrbv34>. Accessed July 2016.

References for Desiccant Dusts

- Akhtar, Y, & MB Isman. 2013. Horizontal transfer of diatomaceous earth and botanical insecticides in the common bed bug, *Cimex lectularius* L.; Hemiptera: Cimicidae. *PLoS ONE* 8(9): e75626.
- Akhtar, Y, & MB Isman. 2016. Efficacy of diatomaceous earth and a DE-aerosol formulation against the common bed bug, *Cimex lectularius* Linnaeus in the laboratory. *Journal of Pest Science* 89: 1013-1021.
- Brazell, C. 2015. Investigating realistic control options. *Pest Control Technology* 43(9): 40 42-44.
- Potter, MF, KF Haynes, C Christensen, TJ Neary, C Turner, L Washbur. 2013. Diatomaceous earth: where do bed bugs stand when the dust settles? *Pest Control Technology* 41(12): www.pctonline.com/article/pct1213-diatomaceous-earth-study/
- Potter, MF, KF Haynes, JR Gordon, L Washburn, M Washburn, & T Hardin. 2014. Silica gel: a better bed bug desiccant. *Pest Control Technology* 42(8). www.pctonline.com/article/pct0814-silica-gel-research-bed-bugs/
- Romero, A, MF Potter, & KF Haynes. 2009. Bed bugs: Are dusts the bed bug bullet? *Pest Management Professional* 77(5): 22, 23, 26, 28, 30.
- Stedfast, ML, & DM Miller. 2014. Development and evaluation of a proactive bed bug (Hemiptera: Cimicidae) suppression program for low-income multi-unit housing facilities. *Journal of Integrated Pest Management* 5(3): E1-E7.
- Wang, C, T Gibb, & GW Bennett. 2009. Evaluation of two least toxic integrated pest management programs for managing bed bugs (Heteroptera: Cimicidae) with discussion of a bed bug intercepting device. *Journal of Medical Entomology* 46(3): 566-571.
- Wang, C, K Saltzmann, G Bennett, & T Gibb. 2012. Comparison of three bed bug management strategies in a low-income apartment building. *Insects* 3(2): 402-409.
- Wang, C, K Saltzmann, A Gondhalekar, T Gibb & G Bennett. 2014. Building-wide bed bug management. *Pest Control Technology* 42(3): www.pctonline.com/article/pct0314-building-wide-bed-bug-programs/

General Reference

- National Center for Healthy Housing. (2010) What's working for bed bug control in multifamily housing: reconciling best practices with research and the realities of implementation. Columbia, MD: NCHH; http://www.nchh.org/Portals/0/Contents/bedbug_report.pdf
- Doggett, S., D. Miller, C-Y Lee. 2018. *Advances in the Biology and Management of Modern Bed Bugs*. John Wiley and Sons, Hoboken, NJ.