



Bed Bug Heat Treatments – What you need to know!

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Introduction

Not all bed bug heat systems are equally effective! This fact is very important to know when looking to hire a company to eliminate a bed bug infestation. The ability of a heating system to successfully get every crack and crevice in a home up to bed bug lethal temperature is very dependent on: 1. the heat system itself, 2. the size of the structure to be treated, 3. the amount of time (hours) that the active heating is to take place, 4. the amount of air movement (using fans) in the heated location, and (most important) 5. the focused attention of a trained heat treatment technician.

Many heat treatment companies will claim that the number of BTUs the heater(s) produces (British Thermals Units: energy needed to increase the temperature of one pound of water by 1⁰ F) is the key factor for successful bed bug elimination. While this may make intuitive sense at first, researchers have found although some systems (propane) produce a very high number of BTUs, the placement of the actual heater(s) and the methods used to transport the heat from the system to individual rooms (e. g. mylar tubing) may reduce the heated air temperature significantly prior to its arrival at the target location. Therefore, rooms that are located at a distance from the heat generating equipment may take much longer to reach bed bug lethal temperature (if they reach it at all) and may require a longer hold time. Therefore, in a multi-story home, it may be advantageous to hire a company that uses a heat system with multiple heaters, so that they can be placed directly into individual rooms.

Unfortunately, since the bed bug resurgence, many homeowners and apartment owners have paid for heat treatments only to be disappointed with the results. This is due to the fact that many people believe that heat treatment is a “once and done”

method of bed bug elimination. They do not understand that the heat system used, and how it is monitored by the technician can make a significant difference in the efficacy of the treatment. In addition, both the clients, and even many heat treatment technicians believe that all heat treatments can be completed in relatively short (four hour) time frame, regardless of the size of the home. Needless to say, this is not the case (Figure 1).



Figure 1. How long might it take to get this infested bible up to 122° F? (Dini Miller Virginia Cooperative Extension)

Also, it is very important for customers to be aware that Virginia companies who only do heat treatments are not required to be certified pest management professionals (because they do not apply pesticides), therefore, they may not have any bed bug knowledge at all. In fact, it has been observed that a technician may even misidentify an insect found in the home as bed bug, when it is actually something else (a German cockroach egg case). Therefore, it is very important for anyone who is considering a bed bug heat treatment, to know what to ask for from the heat

company prior to paying for a treatment that may fail to eliminate the pest.

Before paying for any kind of bed bug heat treatment it is important that you understand how the heat system works, how the temperatures of the hard-to-heat locations are going to be monitored, and what type of documentation that you, the customer, will receive after the treatment, indicating that the heat treatment was successful. It is even recommended that you be present during the heat treatment so that you are able to observe the technician's activities during the process (is he/she entering the home every 15 minutes to take temperatures and move equipment around or are they sleeping in the truck?).

Assessing the Situation

Before hiring any heat treatment or pest management company to address a bed bug infestation, it is wise to assess the situation yourself. First and foremost, assess the relative size of the infestation. Are there only two bed bugs that have been seen in the home, or 2,000? Are the bed bugs found in only one room, or are they spread throughout the home? Are they concentrated on certain pieces of furniture, or are they also aggregating on baseboards, and ceiling/wall junctions? Next, evaluate the size of the home. This is done by quantifying the cubic footage. Remember that bed bugs can be located in aggregations on the ceiling as well as the floor, so the square footage of the home does not provide enough information about the home size. Cubic footage is essential for assessing the size of each floor.

In addition to the size of the infestation and the structure, some other factors that need to be assessed when considering a heat treatment include:

- Is this a two-story apartment?
- Are the bed bugs located on both floors?
- Will the heaters need to treat the top floor and then be moved or redirected to heat the bottom floor?
- How many infested rooms are on each floor?
- Will the heat need to be directed into three different upstairs bedrooms, a bathroom, and multiple closets?
- Is there a bedroom downstairs?
- Is the living room and dining room one large continuous space?
- Any bed bug evidence in the kitchen or bathrooms?

- Is there a basement?
- Does the apartment unit have emergency sprinklers?

Bed bugs can infest a variety of structures so assessing the ability of a heat treatment to effectively eliminate an infestation in a particular location is important. Is the structure a single family home, a dorm room, an apartment unit, a double-wide trailer, or a cafeteria in an assisted living facility? Bed bugs are known to escape into cooler cracks and crevices during a heat treatment, so heat treatment may not be advantageous in certain environments. For example, dormitories or group living facilities may have drop ceilings that provide the bed bugs with cool refuge areas during the treatment. Trailer homes contain spaces between the exterior sheathing and the interior drywall surfaces, and if these spaces are accessible to the bed bugs, and it is cool outside, the heat treatment may be futile. Therefore, it is very important to assess the potential for bed bug elimination in particular structures prior to paying for heat treatment.

Thermal Death Point for Bed Bugs and Eggs

It is very important to know, that the thermal death point for bed bug adults and nymphs is 118° F degrees, but the thermal death point for bed bug eggs is 122° F. While bed bugs can be killed when exposed to slightly lower temperatures, (112°- 115° F), they have to consistently be exposed to these temperatures for a number of hours in order for death to occur. Bed bug exposure to lethal temperature is very important to consider when you know that many bugs will hide in cracks and crevices. Therefore, these cracks and crevices must reach 122° F for the heat treatment to be effective. Many heat treatment technicians aim to get the ambient temperature up to 135° F and then leave the heaters in place for four to five hours. They do this under the assumption that the multiple hour treatment will allow all cracks and crevices to get up to bed bug lethal temperature. However, it is very important to keep in mind that ambient temperature (the temperature of the heated air in the home) is not relevant! Bed bugs are not flying in the air, and the ambient temperature is no predictor of the temperature at floor-wall junctions, or the spaces underneath baseboards. So, it is very important that efforts are made throughout the heat treatment to ensure that all hard-to-heat cracks and crevices are reaching 122° F. Several studies have shown that unless the technician is measuring the

temperature in specific areas and adjusting his/her equipment to address hard-to-heat locations, these areas may never make it up to bed bug lethal temperature during the course of a 4–5-hour treatment. In fact, the technician will have to measure temperatures and rearrange the heaters and fans frequently to make sure that all the hard-to-heat locations are reaching lethal temperature. See Figure 2 showing the average time it takes for certain areas in the home to reach lethal temperature. Also, understand that some of these locations (*floor wall junctions; utility closet floors, under bags of clothes etc.) never actually reached lethal temperature during the treatment period.

Heat Treatment Preparation

Fortunately, the home preparation required by most pest management companies for bed bug heat treatment is not overly excessive. While some companies may claim that household clutter will hinder heat treatment efficacy, certain studies have shown that while it may take longer for a cluttered environment to get all cracks and crevices up to bed

bug lethal temperature, the clutter does not necessarily hinder the efficacy of a good heat system. In fact, a room full of “stuff” many actually hold the heat more effectively. In a large empty space, heat tends to rise and dissipate quickly. However, in an environment with a larger percentage of furniture and belonging, those belonging tend to soak up the heat and hold it in place longer. Therefore, there is a better chance of killing bed bugs hiding in cluttered rooms, provided that the clutter is moved around frequently so that floors and walls can reach lethal temperature, and the heat system is left in the room long enough to get all cracks and crevices in the clutter items up to lethal temperature. Therefore, clutter removal should not be required as part of heat treatment preparation. (Note: The technician will need to move items around frequently to increase air flow, so do not expect everything to be put back into its original place after treatment).

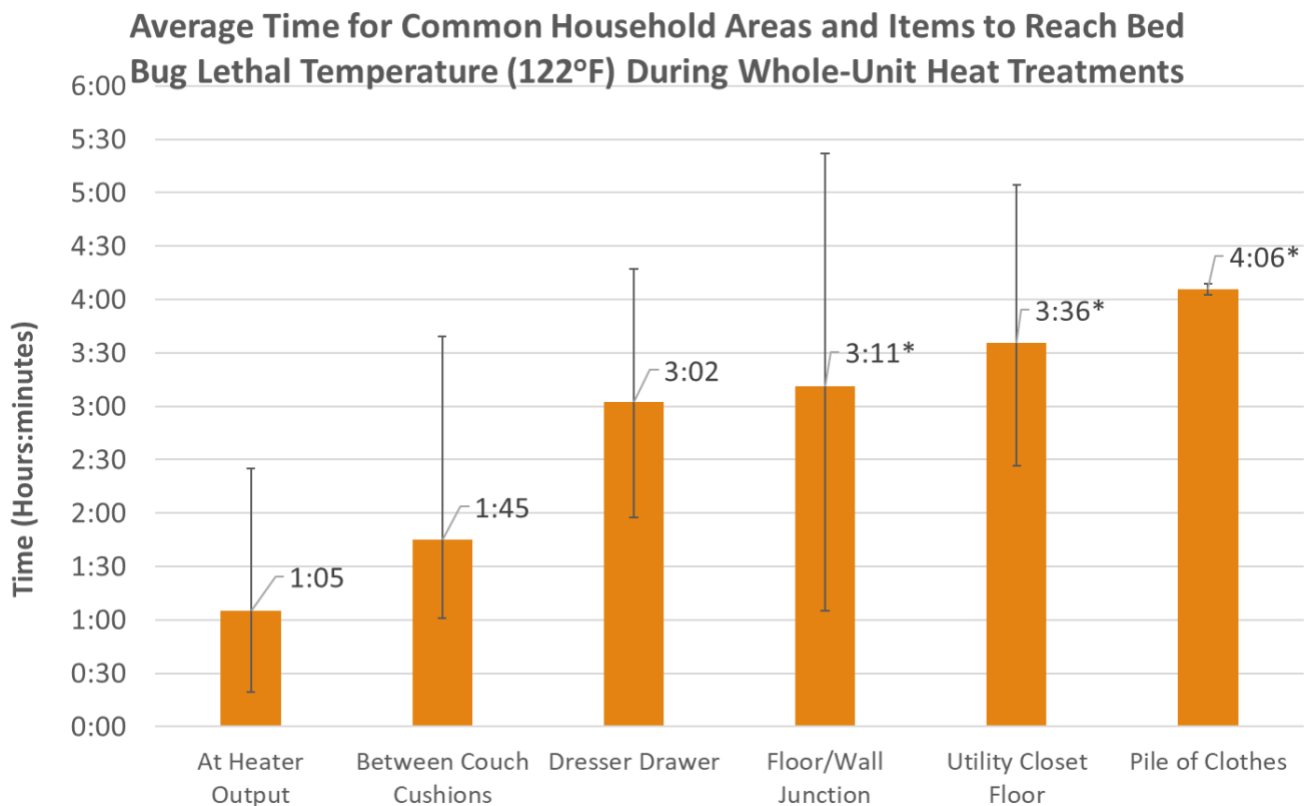


Figure 2. Range of time it takes for certain locations, and items, to reach bed bug thermal death point (Dini Miller, Virginia Cooperative Extension).



Figure 3. Heating a cluttered apartment (Dini Miller Virginia Cooperative Extension)

What is required is the removal of items that can be damaged by the heat. All houseplants, pets, candles, lipstick, and combustibles (aerosol cans and cigarette lighters) should be removed from the inside of the home. Heat treatment preparation instructions will also frequently recommend that electronics be disconnected from outlets and that televisions be removed or wrapped in blankets prior to treatment. In addition, all non-refrigerated produce, medications, stringed instruments, family heirlooms, and photographs are typically suggested to be removed to avoid any potential heat damage. A list of the items that must be removed should be provided by the heat treatment company prior to the treatment date so that the customer can prepare.

Which Heat System Works Best?

This is a very common question when customers find out that not all heat systems work equally well. In a recent study at Virginia Tech, three different heat systems were evaluated in highly cluttered apartment units (5 apartments were treated using each system) where groups of sentinel bed bugs (eggs, nymphs, and adults) were hidden in hard-to-heat locations prior to the heat treatment. A total of twelve heat sensors were also placed in hard-to-heat locations throughout each apartment. These sensors produced an electronic readout on an outdoor computer screen that allowed researchers to observe how many heat sensors actually reached bed bug lethal temperature

during the heat treatment process. The sentinel bed bugs allowed researchers to determine the ability of the individual heat systems to eliminate different bed bug life stages that were placed in hard-to-heat locations.

Table 1 lists the three different heat systems evaluated, their energy sources, the BTUs, cost, and equipment components. The heat technicians responsible for the set up and monitoring of each heat system worked for different companies and therefore, had different set-up and monitoring procedures for each system. Also, note that the Temp-Air Heat System was the only system that uses remote monitoring as part of the heat treatment process, so the technicians were watching their own sensors during the Temp-Air treatments.

Table 1. Properties of 3 commercial heat systems evaluated for efficacy.

<i>System Properties</i>	Green Tech Titan 800	Temp-Air System + remote monitors	Heat Assault
<i>Heat Source</i>	Propane	Electric	Heated Glycol
<i>Reported BTUs</i>	~990,000	~24,880 per heater; 4 heaters ~99,520	~600,000
<i>Equipment</i>	1 heater 1 mylar tube (divided) 2 fans	4 portable heaters 5 power cables 1 power distribution box 12 fans	5-10 radiators 10-14 hoses 2-4 supply and return manifolds
<i>System Cost</i>	~\$11,000	~\$154,000	~\$87,000

Todd, D. 2022. Master's Thesis (unpublished).

Heat Treatment Supplements

Because we cannot expect even the best heat treatment to always be 100% successful, it makes sense to ask your (certified pest management) technician to apply a residual insecticide after the heat treatment is completed. It is recommended that

these residual applications be placed in those locations that were hard to heat. These locations may include floor wall-junctions; voids behind drywall; the floors inside closets; inside electrical wall sockets; and any spaces where clothing items had been stacked. The most effective residual product to apply would be silica aerogel (Cimexa Dust) or some other desiccant dust (a diatomaceous earth product) that is non-toxic to humans and animals and will have long term residual activity. Desiccant dusts are known to kill bed bugs by absorbing their external wax layer so that they die of desiccation. This type of supplementary application will allow you have some residual in place to kill any bed bugs that might have survived the heat treatment.

Documentation of Heat Treatment Success

Something that any customer should require from their heat treatment company is documentation that the treatment was a successful in eliminating the bed bug infestation. In other words, we ask the technicians for documentation that all locations in the home got up to bed bug lethal temperature because that is what they were being paid for. The technician should be able to provide photographs of the number of bed bugs in particular locations, and then photographs of those same locations after treatment. In addition, your pest management company needs to provide a follow-up inspection within a week to make sure that all bed bug aggregation locations are empty; that no live bed bugs have been seen; and that no one in the home has experienced any bites.

Be aware of specific factors that contribute to an effective heat treatment process:

1. Most heat treatment companies will provide the resident with a list of tasks to be completed in preparation for the heat treatment. These tasks will focus on removing materials that have the potential to be damaged by the heat (aerosol cans, televisions, etc.). These instructions must be followed very carefully.
2. Pre-treatment preparation lists may also include specific locations where clutter needs to be removed in order to promote heat circulation (e.g. under beds). Some companies may even require that the resident move furniture, stand mattresses against the wall, remove couch cushions etc. However, it is important to keep in mind that many of these instructions are intended

for the convenience of the heat treatment technician only, and do not necessarily contribute to the heat treatment success. In fact, it has been observed that extreme cleaning, and clutter movement right before heat treatment has the potential to scatter the bed bugs into new locations. While this may not completely protect them from the heat, it may make them somewhat less accessible. Therefore, minimal preparation is becoming the new standard for heat treatments, where only locations that need to be cleared to increase heated airflow must be cleared of boxes and other items prior to heat treatment implementation.

3. Experienced heat treaters have found that leaving furniture in place, and simply opening all closet doors, cabinet doors, and furniture drawers in bedrooms and living rooms, during the initial heating process to be advantageous. Basically, while waiting for the heaters to actually increase the temperature in the room, we want to make all cracks and crevices accessible. These locations will heat up gradually, but if all locations are “open” they can be exposed to the heated air. All of these locations will need to be monitored throughout the initial heating process to make sure that the insides of cupboards, book shelves, dresser drawers etc. are getting up to bed bug lethal temperature.
4. When the ambient temperature inside the heated room reaches ~135° F, the temperatures of the floor/wall junctions and ceiling/wall junctions need to be measured to see if they are reaching 122° F. If the temperatures indicate that these spaces have reached bed bug lethal temperature, it is now time to unstack the mattresses, and stand them up on end. Be sure to lean them against a wall with as little wall contact as possible. Similarly, couch cushions and pillows should be suddenly removed from the furniture and stood on their narrow edges so that there is airflow along both sides of each cushion. Lounge chairs and recliners should have their backs and leg rests extended to expose any bed bugs hidden in the chair components. Other furniture items should also be inspected and “flipped” if necessary, to suddenly expose any bed bug hiding in their cushions, drawers, or cracks. By waiting for the room to reach 135°F and then suddenly exposing any hidden bed bugs, you greatly increase the chance of achieving bed bug elimination. The bed bug will have no time to escape the heat exposure. This is also very

important for exposing eggs that might be in protected locations deep within the furniture.

5. A common feature in human homes is that they contain a lot of “stuff”. Therefore, it is very important to be aware that floors and walls that have storage boxes, or bags of clothing placed on top of or against them will never reach lethal temperature. It is essential that stacked boxes and bags be moved away from walls and off of floors so that these areas can be heated properly. If these boxes and bags are all in a room that is used for storage (the room has never had human occupancy) and the bed bug infestation level in the home is low, this may not be an issue. However, if the home has a high level of infestation and is highly cluttered with boxes and bags, these items will need to be emptied while the heat treatment is process so that any bed bugs hiding inside the boxes or bags are exposed to the heat while the floors and walls beneath or behind these boxes and bags also get proper exposure.
6. Again, technician focus on the heat treatment process is essential to make sure that any locations that are not reaching lethal temperature are addressed. The technician may have to continuously reposition the heaters, fans, or mylar tubing every 20 minutes in individual rooms to make sure that all furniture items; floor/wall junctions; ceiling/wall junctions; storage closets; clothes closets; chests of drawers; toilet seats; and piles of toys, shoes, books and magazines get up to bed bug lethal temperature. This will require almost constant attention on the part of the technician during the heating process.
7. After the treatment is complete it would also be advantageous for the heat technician to make a residual application of a desiccant dust formulation so that a product with long lasting activity is present in case there are any surviving bed bugs or eggs after treatment. It is for this reason (and bed bug knowledge on the part of the technician) that it is best to hire a certified pest management company to conduct bed bug heat treatments rather than a heat treatment company that cannot legally apply pesticides.

Summary

Heat treatments do work! However, it is important to note that it is very common have a few bed bug survivors after a heat treatment. This is not a simple “once and done” methodology of bed bug elimination. While the heat treatment may eliminate a large number of the bed bugs, it is always possible to have a few survivors due to the complexity of the

treated environment (architecture), the size of the location, the heating capacity of the system used, and heat treatment technician’s knowledge and attention. Unfortunately, any bed bugs that are found alive after a heat treatment has been conducted, are typically blamed on the resident bringing them back in. This needs to change.

Today, heat treatments range in cost from \$500.00 to \$5000.00 depending on the size of the home and the number of technicians needed to set up and monitor the treatment. Because of this cost, it is essential that the customer knows exactly what their company is doing, and that they get some documentation that the treatment had the potential to achieve bed bug elimination. Otherwise, you run the risk of paying an untrained person \$900.00 to put heaters in the home, and simply remove them several hours later with no documentation of bed bug elimination.



Figure 4. Heated glycol being pumped into Heat Assault radiators inside the apartment (Dini Miller Virginia Cooperative Extension)



Figure 5. Researchers were monitoring indoor temperatures during a GreenTech propane heat treatment (Dini Miller Virginia Cooperative Extension)



Figure 6. Setting up the TempAir system equipment in preparation for heat treatment (Dini Miller Virginia Cooperative Extension).

Additional Resources

For additional information about bed bug prevention methods, please visit the following resources:

- Virginia Department of Agriculture and Consumer Services, Bed Bug Fact Sheets, <https://www.vdacs.virginia.gov/pesticide-bedbug-fact-sheets.shtml>.
- Environmental Protection Agency, Bed Bugs: Get Them Out and Keep Them Out, <https://www.epa.gov/bedbugs>.



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