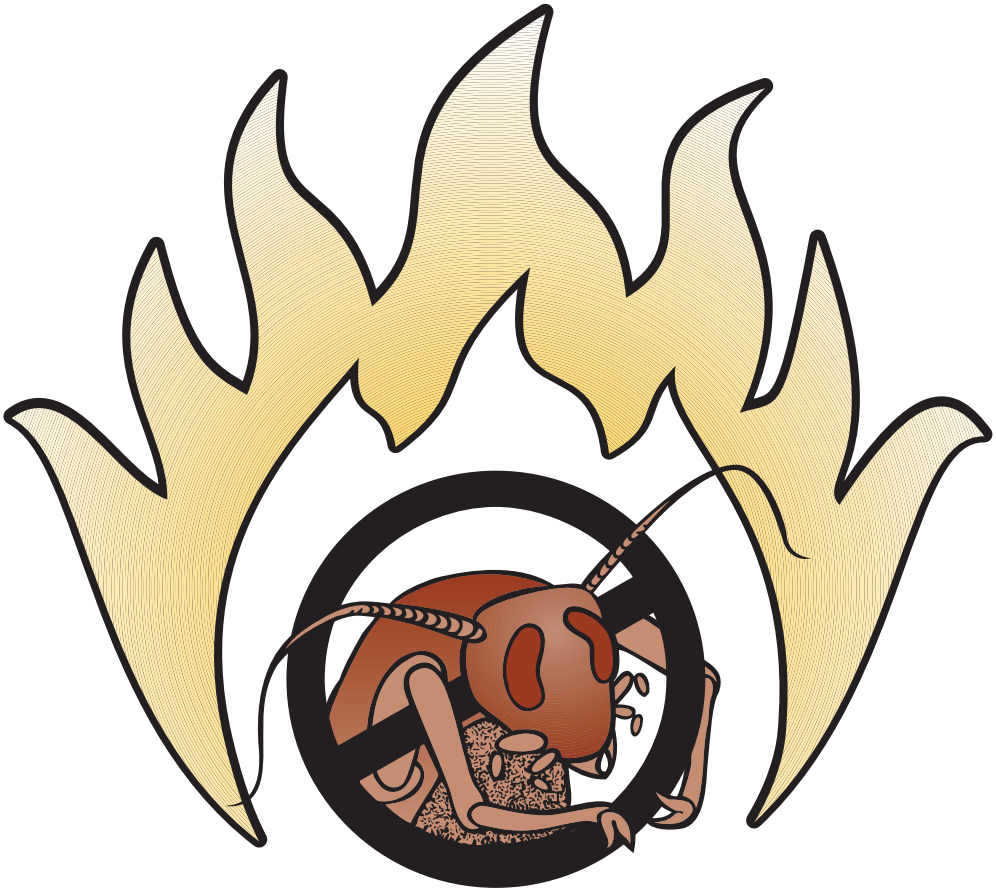
USACHPPM

SUPPLEMENT TO
USACHPPM TECHNICAL GUIDE No. 208

Precision Targeting of Heat for German Cockroach Control in Food Service Facilities



United States Army Center for Health Promotion
and Preventive Medicine

Readiness Thru Health

Approved for Public Release; Distribution Unlimited.

USACHPPM is the proponent of this supplement. Users are invited to send comments and suggested improvements on a DA Form 2028 (Recommended Changes To Publications and Blank Forms) directly to Commander, U.S. Army Center for Health Promotion and Preventive Medicine, ATTN: MCHB-DC-OEN, 5158 Blackhawk Road, Aberdeen Proving Ground, MD 21010-5403.

Precision Targeting of Heat for German Cockroach Control in Food Service Facilities

Supplement to USACHPPM Technical Guide No. 208

Prepared for:
U.S. Army Environmental Center
ATTN: SFIM-AEC-ECN
Aberdeen Proving Ground, Maryland 21010-5410

Prepared by:
U.S. Army Center for Health Promotion and Preventive Medicine
Entomological Sciences Program
ATTN: MCHB-TS-OEN
Aberdeen Proving Ground, Maryland 21010-5403

May 1999

CONTENTS

Chapter 1 – Introduction

Chapter 2 – Execution of a Precision Targeted Thermal Control

Appendices

Precision Targeting of Heat for German Cockroach Control in Food Service Facilities
Supplement to USACHPPM Technical Guide No. 208

Chapter 1

Introduction

1-1. Purpose. The purpose of this Supplement to USACHPPM Technical Guide (TG) 208 (***Procedures for Thermal Control of Cockroaches in Army Food Service Facilities***) is to provide guidance, identify equipment, and describe procedures on how pest management personnel can conduct small-area thermal control for German cockroaches in a Government dining facility.

1-2. Equipment and Materials. Appendix A gives a partial list and brief description of the equipment and materials required to conduct cockroach surveillance and produce population contours so that control can be precision targeted.

1-3. References.

a. Zeichner, B. C., A. L. Hoch, and D. F. Wood, Jr. Heat and IPM for Cockroach Control. *The IPM Practitioner*, Vol. XX, February 1998.

b. Brenner, R. J., D. A. Focks, R. T. Arbogast, D. K. Weaver, and D. Shuman. Practical Use of Spatial Analysis in Precision Targeting for Integrated Pest Management. *American Entomologist*. pp79-101, 1998.

1-4. Special Terms. Special terms not mentioned in USACHPPM TG 208 can be found in Appendix B.

1-5. Technical Support. Technical support can be obtained from Commander, USACHPPM, ATTN: MCHB-TS-OEN/Entomological Sciences Program, 5158 Blackhawk Road, Aberdeen Proving Ground, MD 21010-5403; or DSN 584-3613, commercial (410) 436-3613; or facsimile to DSN 584-2037 or commercial (410) 436-2037.

1-6. Background and Rational. The thermal cockroach control methodology was developed as an alternative to traditional insecticide applications for chronic cockroach infestations with high levels of resistance to insecticides in food service facilities. In addition, this methodology will assist the military's efforts to reduce the amount of pesticides being applied to the working environment. Moreover, the applications of residual insecticides have failed to keep cockroach

infestations at acceptable levels in some troop dining facilities. The thermal control program, in which the entire dining facilities were heat treated, has provided excellent control results (Zeichner et. al., 1998). Nevertheless, heat treating large areas requires significant upfront investments in heating and temperature monitoring equipment; requires a lot of coordination among various installation organizations; is very labor intensive and disruptive to the normal functioning of a dining facility. Therefore, it was decided that, for heat treatments to be more acceptable to the managers of dining facilities, the thermal control process needed to be scaled back and target only focal points (precision targeting) of high cockroach populations in equipment and/or limited areas of a kitchen or food serving area.

1-7. Small Area or Equipment Heat Treatment.

a. Typically, cockroach infestations in dining facilities exhibit clump distributions, with larger populations occupying a limited number of preferred harborages. Commonly infested areas and equipment include the mop and storage closets, staff office(s), bathrooms equipped with metal storage lockers, adjoining pot and pan washrooms, dishwasher room and equipment, soda/ice cream machines, storage rooms, large refrigerators, and portable food warming units.

b. In addition, building structures such as short walls located in the kitchen area that house multiple gas/water/steam pipes and electrical plug-ins connecting various kitchen equipment (e.g., steam kettles, stoves/ovens), serve as preferred cockroach harborage sites (**Figure 1)**. Frequently, the wall openings for these types of items are not adequately sealed (caulked) and provide easy access to wall voids for cockroaches.

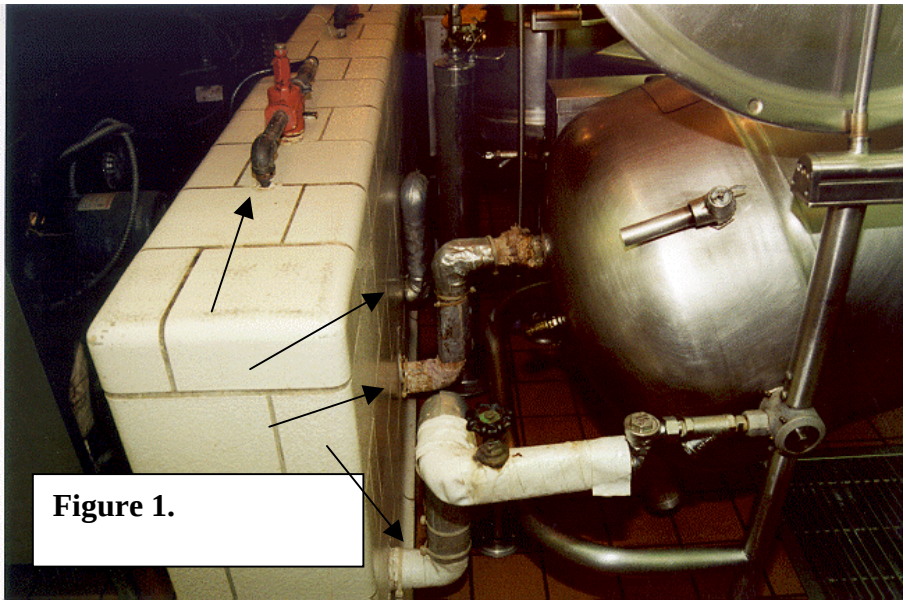
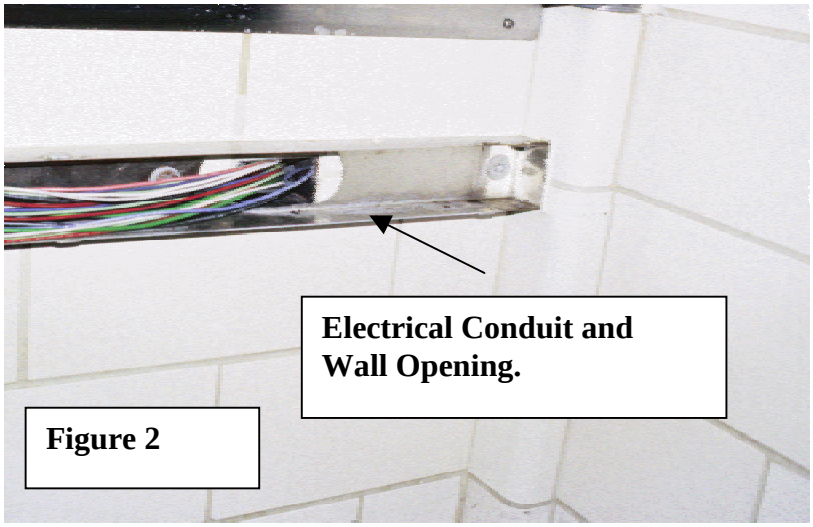
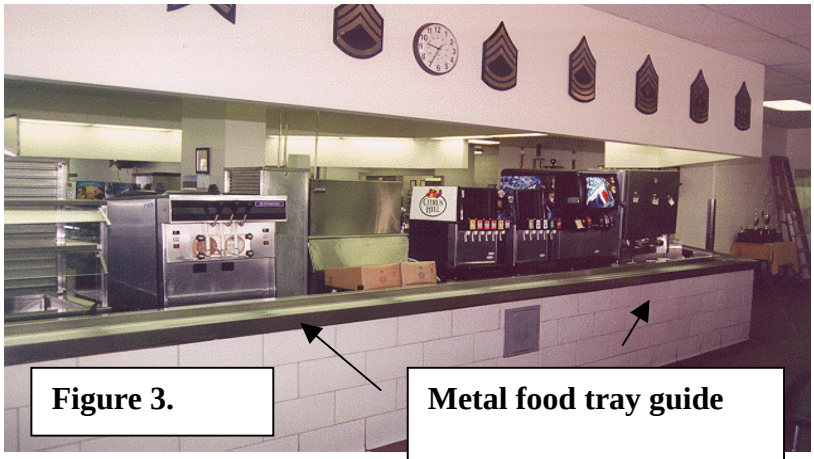


Figure 1.

c. We have also found that wall-mounted electrical conduits provide excellent concealed harborages for large populations of cockroaches and provide openings to harborage sites within the wall(s) (**Figure 2**). Large populations of cockroaches have also been found living within cinderblock walls located beneath stainless steel tray guides on serving lines that have not been sealed adequately (**Figure 3**).





d. Controlling cockroaches within the exposed, metal electrical conduits with heat is easy since the metal heats up rapidly resulting in the death of a majority of cockroaches in this harborage. However, a portion of the cockroaches associated with this type of harborage escape into the wall voids where they are protected from lethal temperatures. Controlling cockroaches harboring in wall voids with heat is not practical and alternative control methods (such as thoroughly sealing the walls and/or dusting voids with boric acid) are required.

e. When conducting this type of control procedure, it is critical that the model of heater selected has the proper heating, safety, and air handling features necessary to conduct small area heat treatments (refer to **Appendix A** for recommended heater specifications). In small area heat treatments of less than 8,000 cubic feet, only one heater is required (**Figure 4**). Enclosing the infested equipment(s) or other cockroach harborage site(s) to be heat treated can be easily accomplished by tenting the equipment and/or area with 3-5 mm plastic sheeting. In some instances, it may be easier to partition off small side rooms (e.g., pot and pan wash area, small offices, small storage or equipment room, and restrooms) rather than tent the cockroach infested equipment or items contained in small rooms. As with large area heat treatments, a number of building designs and safety issues need to be considered when performing small-area heat treatments. Special attention is required to close off any air vents that will allow hot air to escape the area being heated. Any items which may be damaged or present a safety hazard should either be removed or protected, such as pressurized cylinders connected to a fire extinguisher system (**Figure 5**).

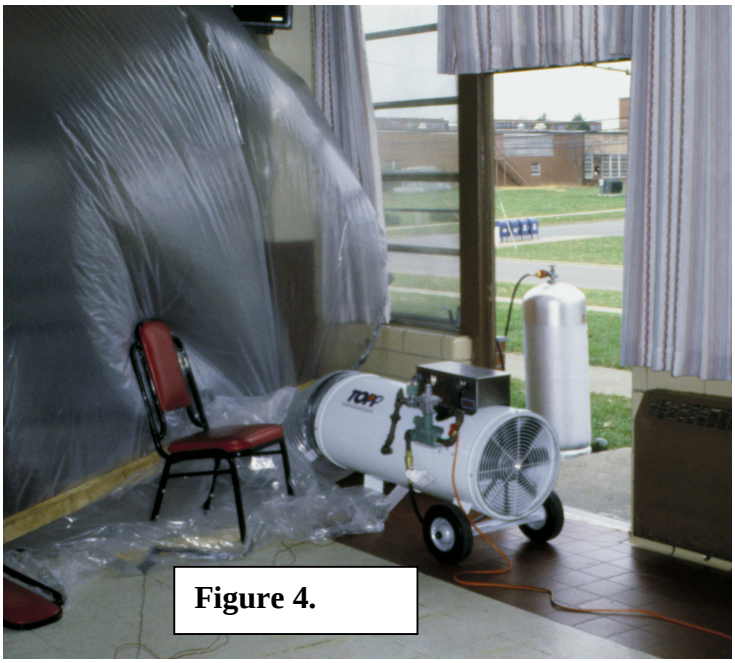


Figure 4.

f. In addition, any fire protection system within the treatment area, especially in partitioned small rooms, should be disarmed and the fire sprinkler heads insulated. For a more complete discussion of these safety precautions, TG 208, Chapter 2, "Conduct of a Thermal Control Treatment," should be consulted. One major advantage to tenting is that heat-sensitive items can easily be excluded from the tented (heated) area, thus simplifying thermal treatment preparations.

Figure 5.

1-8. Spatial Analysis and Precision Targeting.

a. A major challenge in pest management efforts is achieving satisfactory pest control, while at the same time, minimizing control expenditures, reducing the impact of pesticides on the environment, and safeguarding human health. With the current emphasis on good environmental stewardship, these goals are not only receiving increased emphasis by pest control management but are also being mandated by federal regulatory requirements. All too often, the criteria for conducting cockroach pest control in a dining facility was based on a routine treatment schedule and/or inadequate pest surveillance information. To maximize control, the pest control technicians would routinely treat an entire dining facility for cockroaches with little consideration for the fact that cockroach populations are traditionally clumped in distribution with a significant portion of the facility having no or little cockroach activity. In fact, it is not uncommon to find approximately 80% of the cockroach population in less than 40% of the facility. Thusly, areas with no cockroaches were receiving the same amount of pesticide and control effort as those foci which were heavily infested. As a result, an excess of pesticides was being applied with minimal gain in real cockroach control. Moreover, due to the manner in which information about cockroach infestations and control was being documented and reported, it was not possible for pest management coordinators to easily evaluate and compare different control strategies. Therefore, the effectiveness of pest intervention was most often measured by the number of pest complaints received.

With today's computer technology and specialized/customized software programs, the pest control technician (PCT) is capable of transforming **comprehensive cockroach surveillance data** into 2-dimensional spatial distribution maps (spatial analysis) that show the location of cockroach infestations within a dining facility (precision targeting). The software program is capable of interpolating the spatial distribution data and population data into cockroach population contour maps (Figure 6). However, to capture the analytic power of this technology, it requires that pest surveillance data be collected in a comprehensive, systematic, and accurate manner. For a cockroach survey to be comprehensive, the survey (sticky traps or visual inspections) needs to be conducted at several points through out the **entire** facility--or the main area of concern--with the location of each observation being systematically documented. Accuracy of information is crucial in order to make comparative analysis of pre and post control treatment success. The ability to identify and document each observation site allows for replication of standardized survey techniques and comparison of cockroach population trends over time.

The application of precision targeting techniques permits the PCT to develop an accurate assessment of a facility's infestation and formulate control strategies which would make the greatest possible impact on the cockroach infestation while at the same time reducing the amount of pesticides required to treat the infestation. By identifying only those areas where cockroaches are active, the pest control coordinator can minimize labor and pesticide use while maximizing

pest control efforts. The analyzed data serves as a historical document which can be readily accessed by pest control personnel to evaluate future control measures and evaluate/compare different control strategies.

b. As a result of using the spatial analysis procedure to evaluate a dining facility, we were able to identify three areas with high populations of cockroaches where control measures should be taken: the dishwasher room, a serving line, and behind a sink in the pot and pan room (**Figure 6).** The post-thermal treatment graph (lower graph) indicates that the cockroaches behind the sink in the pot and pan room were eliminated, whereas the cockroach infestations in the serving line and dishwasher room were greatly reduced, but not eliminated. In both of these areas it was found that at least a portion of the cockroach population had access to openings in cinderblock wall voids. The lack of complete cockroach control highlights the importance of thoroughly caulking the area to be heat treated prior to thermal control efforts and the added benefit of spraying the area with an Insect Growth Regulator (IGR, Gentrol®) prior to and following a thermal treatment. Treatment with an IGR affects the immature cockroaches (the stage most likely to survive the heat treatment) and prevents them from developing into adults.

POPULATION CONTOURS

BEFORE AND
7 - 9 DAYS AFTER

SELECTIVE THERMAL CONTROL OF POT AND PAN WASHING ROOM, DISHWASHER, AND SERVING LINE

HEATED AREA

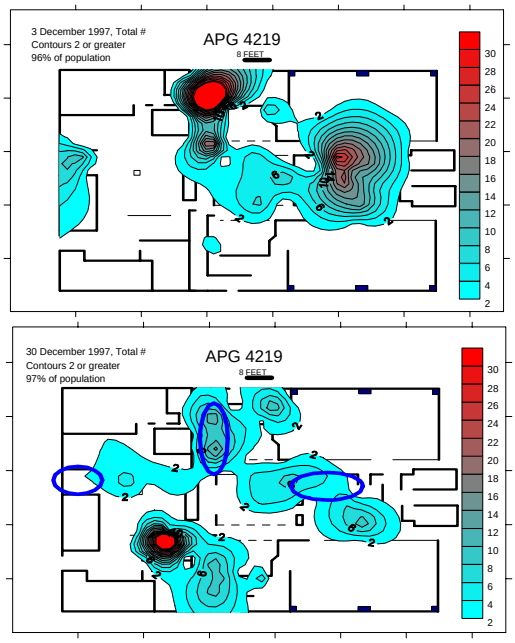


Figure 6

®Gentrol is a registered trademark of Zoecon Corporation, A Sandoz Company, Dallas, Texas.

1-9. Safety Precautions. One of the main advantages of controlling focal cockroach populations is that a number of the safety issues addressed in the USACHPPM TG 208 for whole building or kitchen areas will not be problems when conducting small area or equipment heat treatments for cockroaches. However, it is advisable to review those sections in TG 208 for a more complete discussion of major safety concerns. Nevertheless, some major safety precautions discussed in TG 208 will also be addressed in this Supplement due to their importance.

a. Carbon Monoxide Poisoning. Carbon monoxide poisoning is a potential problem whenever combustible fuels are burned in a closed facility and deserves extra precaution. When feasible, pest control personnel should open some windows and/or doors to ensure adequate ventilation of any accumulation of combustible fumes or gases. Carbon monoxide is a colorless, odorless gas, and may be fatal at high concentrations. All heating equipment used in the USACHPPM heat treatment trials have had safety features that will stop the combustion of fuel if the unit should malfunction (i.e., improper fuel combustion). However, it is essential for the personnel conducting the heat treatment to be knowledgeable of and recognize the symptoms of carbon monoxide poisoning. The symptoms include dizziness, headaches, and increased heart rate. If for any reason persons within the treatment areas experience any of these symptoms, they should be evacuated from the area immediately and the heater(s) shut off. After servicing the heater, the heating equipment then must be checked with special carbon monoxide detection equipment before it is returned to service.

b. Propane. Propane is highly explosive and any gas leaks in a heat treatment process are a major concern and must be tested for and corrected prior to any attempt to operate the heater(s). Propane is heavier than air and if a gas leak is present, the propane will flow to the floor (or downstairs), spread like water, and slowly fill lower areas. If propane tanks are to be used inside a building, it should only be in a well-ventilated area, and only after the tanks have been properly tested for leaks by using a combustible gas leak detector or a leak detector solution**.**

Propane gas tanks should never be stored in a facility prior to or after a thermal treatment. The pressure regulators and valves must meet the manufacturer's specifications for the equipment being used. Do not use a wrench or pliers to close the valve; it must be closed leak-tight by hand.

- Never refill a smaller tank from a larger tank (e.g., using a 200-pound tank to fill a 100-pound tank). Serious, possibly explosive, damage to the smaller tank can result.

- Never use tanks or equipment that are defective.

- Move

propane tanks only when a valve protection cover is in place.

- Never lift the propane tank by the valve.
- Never expose the propane tank to the direct heat of the thermal treatment; it could become over pressurized and leak propane.
- Never leave tanks in an unsecured location.
- Never use a vertical tank in a horizontal position, liquid propane rather than propane gas will flow to the heater and not burn properly.
- Never use pipe-joint compound to stop leaking connectors; it could clog the gas hoses and valves, use Teflon® tape instead.

®Teflon is a registered trademark of E.I. DuPont de Nemours and Co., Inc., Wilmington, Delaware.

Chapter 2

Execution of a Precision Targeted Thermal Control Treatment

2-1. Evaluating the Facility to be Thermally Treated.

a. **Structural Considerations**. If it is determined that a small room (e.g., mop/storage closet) of the dining facility requires heat treatment for cockroach control, the precautions and procedures outlined in TG 208 concerning a whole room treatment should be referenced.

b. **Natural Gas Lines.** If natural gas lines are located within the area to be heat treated, then steps should be taken to ensure that the gas to the lines has been shut off. Occasionally gas valves within the building may leak slightly even after being shut off; therefore, facility gas supply may have to be shut off outside the building. A combustible gas detector should always be used to check all gas lines in the areas before conducting a heat treatment.

c. **Plumbing Problems**. Water pooling on the floor from leaking water pipes, equipment, and faulty drains will hamper thermal control preparation and results. The excess moisture functions to cool the immediate floor surface allowing some cockroaches that congregate near or on the wet area to survive the heat treatment. Floor drains should be functional so that any cockroaches seeking harborage in the drains can be washed away with hot water. If possible, the caps for floor drains should be removed and wrapped with aluminum foil and replaced prior to a thermal treatment. This will help to prevent the accumulation of cockroaches in these cooler areas.

d. **Flooring Condition and Type**. Based on observations of conducting thermal treatments to whole dining facilities, it is possible to damage ceramic tile floors (lifting and/or breaking of small sections of tile) which have been exposed to excess water leaks or have loosened with time. TG 208 describes in detail what procedures should be conducted when evaluating ceramic tile flooring for possible damage due to exposure to high temperatures. Problems will not occur with ceramic flooring that is in good, sound condition. In addition, problems are not anticipated with any other types of flooring (e.g., carpeting, vinyl style tile) exposed in the heating trials conducted.

e. **Size or Volume of the Area to be Treated**. In order to determine the number or size of heater required for a heat treatment, the total volume (cubic feet) of the area to be treated needs to be calculated. At least one 400,000 BTU heater should be used for each 6,000-8,000 cubic feet of space. Normally, one heater will be sufficient to accomplish any focal thermal treatment for cockroaches.

2-2. Fire Suppression Systems. The pest control operator should be aware of any fire suppression system in the area where thermal control is to be used; however, most focal heat treatments will be confined to tarped equipment or small areas that should not activate the fire suppression system. If there is any concern for temperature buildup in a particular area of the dining facility, the heat can be directed out of the treated area using exhaust ducts. In the event that a fire suppression system is installed in a small room or area to be treated, the system needs to be deactivated and/or protected as described in Chapter 2 of TG 208. The fire department must be informed of any thermal treatment scheduled for a government dining facility.

2-3. Cockroach Surveillance. Prior to any pest intervention for cockroach control, the pest controllers must have current and adequate surveillance data to plan and execute the control measures. Any effort to control pests without supportive surveillance information is highly discouraged. Normally, the military's preventive medicine personnel conduct routine pest (cockroaches and rodents) surveys in all military dining and food handling facilities, and it is usually through these surveys that cockroach problems are noted and documented. Once a particular dining facility has been identified as having a cockroach problem and control measures are required, it is up to the pest control personnel to select the control procedures to be used. Pretreatment cockroach surveys will need to be accomplished prior to performing any thermal treatment with one survey being conducted no more than one week prior to the scheduled heat treatment. The number and location of sticky survey traps to be set depends on the size of the area potentially infested with cockroaches. To have adequate sample data to develop accurate spatial contour maps required for precision targeting, plan on about one sticky trap per 100 square feet. Ideally, the traps should be placed out when the facility is closed for a 24 hour period. Trap data should be recorded prior to any disturbance of the traps by normal dining facility activities. However, if this is not possible then the traps should be set out following the noon clean-up time (or after the evening meal) and picked up early the following morning. A post-treatment cockroach survey, identical to the pretreatment survey, should be conducted within 7 to 10 days to determine the level of control achieved and provide data for the spatial analysis contour maps. Comprehensive cockroach surveillance of a dining facility (or any building) will provide the information needed to determine if cockroach control is needed, the distribution and location of cockroach infestations, and measure of control achieved following control treatments.

2-4. Pretreatment and Posttreatment Applications of Gentrol. Prior to a thermal treatment, applying an insect growth regulator, in accordance with the label, produces a band of insect growth regulator which nymphs will contact while departing harborage areas during the heat treatment. A thorough application of IGR to "touch points" where any piece of equipment comes into contact with the floor, as well as all cracks and crevices, is important, since these are the areas where nymphs typically survive the thermal treatment. Since, Gentrol is stable to 140ºF, it is a good choice for this process. It should be applied early enough in advance so that it can dry thoroughly prior to the application of heat, otherwise the heat will cause it to dissipate into the

air. A second application of the IGR to the control areas and immediate surrounding area should be applied following teardown of the thermal equipment and tenting materials. Thus far, there has been no evidence of insect growth regulator resistance identified in cockroaches.

2-5. Placement of Thermocouples. In focal heat treatments, few thermocouples (four to eight) are required. The number and placement of these temperature sensors will be based to a larger extent on the size of area to be treated, the number of potential cockroach harborages, and the amount of potentially heat-sensitive equipment in the area. At a minimum, thermocouples should be placed in the entrance duct for hot air to measure the heater output, next to the floor approximately half way through the tented run, and in the exhaust duct to measure the temperature of the exiting air. Thermocouples should also be placed in the interior of equipment being heat treated. All areas within the enclosure to be heated should reach a minimum temperature of 115ºF for 45 minutes or more. The location of the thermocouples should be recorded on a data sheet for future reference.

2-6. Setup of the Area and Equipment to be Heated.

a. Following management's decision to perform a limited area heat treatment, it is necessary to enclose or seal off the area and/or equipment in such a manner as to minimize the space that needs to be heated and contain the hot air. Heavy-duty (4-6mm) clear plastic sheeting is recommended as a tenting material to enclose the area and/or equipment to be heated (**Figure 7**). The size of the plastic sheeting should be large enough to cover the equipment or seal off the area without having to be spliced. Splicing large sheets of plastic is cumbersome and serves as a trouble spot for possible separation during heating and filling (or ballooning) with air. If the plastic sheeting needs to be spliced, a high-temperature tape (e.g., Pacto® tape) is recommended for this purpose. Most masking and duct tapes lose their adhesive bond when heated.

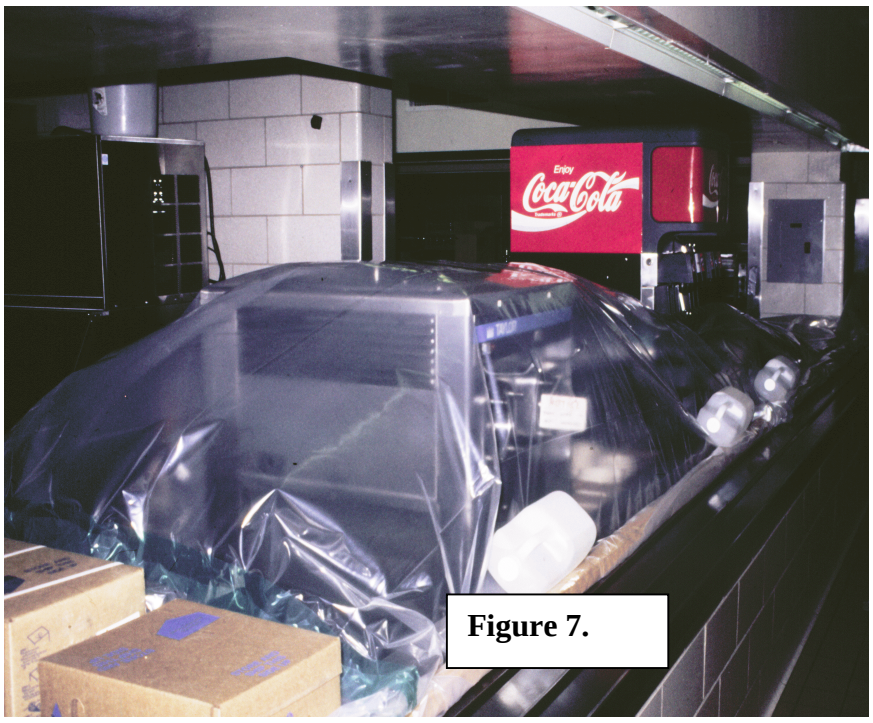


Figure 7.

®Pacto is a registered trademark of the Pacto Corporation, Bristol, Rhode Island.

b. The use of plastic sheeting to enclose an area offers the flexibility of enclosing all of or part of a piece of equipment depending on the extent of cockroach infestation, presence of heat sensitive components and/or amount of plastic sheeting available for the treatment. During the heat treatment of the serving line (**Figure 7**), a hole was cut in the plastic sheeting to allow the upper section of a soft drink machine to protrude beyond the opening so that the plastic sheeting would not have to be spliced due to the added height of the soft drink machine. Since the soft drink machine was new, there wasn't a concern for cockroaches harboraging in the section not exposed to heat.

c. The margins or edges of the enclosure must be held in place to keep the hot air contained and prevent the cockroaches from seeking refuge outside the area being heated. In our studies we used "water snakes" to secure the edges of the plastic sheeting to the floor (**Figure 8**).

d. Water snakes can be purchased at any swimming pool retail store. They are economical, easy to store and transport, and conform to the contour of the floor. Water can be added to the water tubes prior to being used and they can be emptied following use. In addition, duct tape can be used to secure difficult areas; however, this method is sometimes unreliable if the surface has a dirt or grease buildup. In some instances the edging of plastic sheeting can be held in place by sawed lumber (2 by 2 inches, 4-to 8-foot lengths) with gallon jugs of water serving as added weight. (See Figure 7).

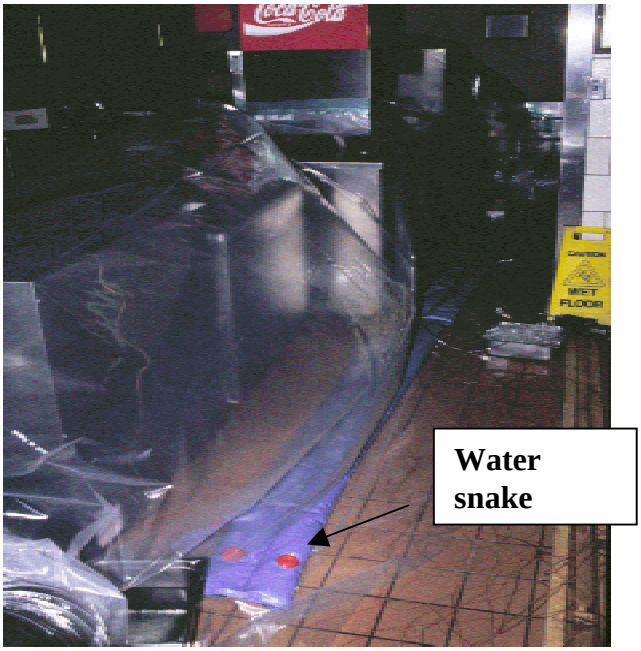


Figure 8.

e. Due to the heat gradient in the enclosure, it is normally hotter towards the top of the enclosure than near the floor area; therefore, cockroaches will tend to migrate to the floor where the temperature is cooler and attempt to escape underneath the edges of the plastic sheeting. In order to contain and collect those cockroaches trying escape, it is necessary to develop a sticky barrier that can be placed on the interior edge of the floor and plastic-sheeting interface (**Figure 9**).

f. One way of constructing a sticky barrier is to place double sticky tape to the intersurface of a J-channel (plastic molding designed for home vinyl siding installation) purchased at any hardware/construction merchant. The materials for building the barrier are inexpensive, light, and flexible enough to conform to an uneven floor surface.

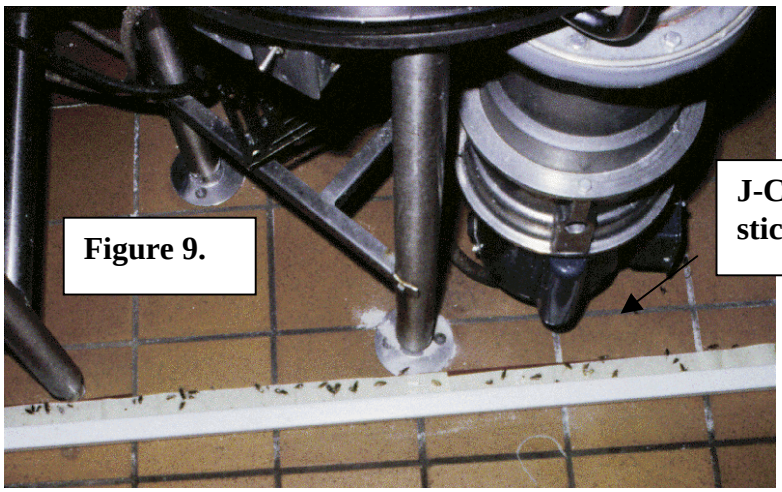


Figure 9.

2-7. Cockroach Behavior During the Heating Process.

a. Within a relatively short period of time (30 to 60 minutes) after initiating the heating process, cockroaches will start exiting their harborages as the metal in the equipment and/or building structure begins to heat. At first their movement will appear to be somewhat erratic; however, as the air temperature within the interior of the enclosure and solid surfaces becomes hotter, a majority of the cockroach movement will be to the cooler regions of the floor.

b. As the metal surfaces of equipment reach 115ºF and above, personnel should start noting cockroaches beginning to die on the exposed metal surfaces. At this time, those cockroaches capable of escaping the increasingly hotter harborages will seek refuge on the floor in the more protected corners of the area, underneath larger equipment, and at the junction between the plastic sheeting and floor. Cockroaches are capable of detecting relatively small differences in temperature and air movement and will seek the least hostile environment. With experience, pest control personnel will be able to anticipate the most likely areas for cockroaches to congregate.

c. It is recommended that at various intervals throughout the heating process the pockets of cockroaches should be vacuumed up and eliminated from the area being treated.

d. The removal process will facilitate the overall control of cockroaches within the treated area and reduce the number of cockroaches that may have to be handled at the end of the treatment period (3-4 hours) as the heat treatment materials are being removed. The vacuuming process should be completed prior to final removal of the plastic tent sheeting and sticky J-channel barriers. In addition, all larger equipment compartments (i.e., electrical motor, compressor housing) that are accessible should be checked for viable cockroaches since the motors and compressors are slower to take on heat and are located in semiprotected locations. Vacuuming of these areas is recommended to remove any dead or surviving cockroaches.

e. It is strongly recommended that the vacuum sweeper used during the cockroach treatment have a high efficiency particulate air (HEPA) filter to prevent cockroach allergens being passed through the equipment into the air. However, extra precautions must be taken when removing live/dead cockroaches and extra debris in the presence of water, as water will ruin the HEPA filtering capability of a vacuum sweeper.

2-8. Setup of Heater(s), Ducts, and Propane Tanks.

a. Paragraph 2-3b of TG 208 should be reviewed for information concerning the setup and use of heating equipment.

b. In summary, thermal treatment equipment should be setup so that the heater and attached duct can be positioned to facilitate a direct flow of heated air into the enclosed area, to accommodate the secure placement of the gas tank(s), and to minimize area congestion for personnel. An exhaust duct should be located at the far end of the enclosed (or tented) area to ensure that the hot air is channeled through the entire area before being exhausted into the room or outside.

c. After connecting all gas connectors and hoses, it is highly recommended that a combustible gas detector be used to check for possible gas leaks. Soap solutions applied to gas connectors have been used to detect leaks but are not as effective as using a gas detector. Since the propane gas tank(s) is being used inside a closed facility, it is imperative that no gas leaks occur. Gas tank(s) should be secured to prevent it (them) from being accidentally turned over and should be well ventilated.

d. After checking that the heater is properly positioned and connected, the heater can be turned on so that the fan is functioning, followed by ignition of the gas burner. The gas regulator on the heater should be partially closed so that the temperature generated is not excessive. After ignition, the gas regulator valve can be gradually opened until the heater reaches a steady output temperature of 150ºF. In confined spaces as with this type of heat treatment, where equipment is very close to the heater output, heater temperature output should not exceed 150ºF due to the potential of damaging floor tiles and temperature-sensitive plastic equipment parts.

2-9. Monitoring Equipment, Selection and Setup.

a. There are a number of companies that produce excellent data loggers for measuring and storing temperature data. Data loggers range in price from a few hundred to several thousand dollars. When selecting a data logger for thermal treatment, it is recommended that it have at least 8 to 12 channels for reading temperatures, be capable of giving real time temperature readouts either on a tape and/or visually, and have data storage capability.

b. It is important that the pest control personnel have some form of a permanent record of the heat treatment. A permanent record not only helps to evaluate the success or failure of a heat treatment but also serves as a document to protect the pest control applicators from liability claims if equipment or the facility is claimed to have been damaged. In addition, it is highly recommended that a gas-monitoring device capable of reading combustible gases and carbon monoxide be available on the day of the scheduled treatment. Along with checking the heater, valves, gas lines and tank, the gas monitor should be used to check any gas line passing through the area or any piece of equipment that has been shut off so that a thermal treatment could be conducted.

c. The TOPP SAFE-HEAT® Model 400, used in our studies is designed to produce air that is safe to breathe; however, it is always possible that any piece of combustible equipment could malfunction. It is recommended by the American Conference of Governmental Industrial Hygienist that a person not be exposed to carbon monoxide levels above 25 ppm for more than 8 hours. The amount of available oxygen in the heat treatment area should be at or above 21.5 percent. If any combustibles are detectable in the area, the heat treatment should be stopped immediately until the problem has been resolved. For additional safety, one or more windows or doors should be opened to allow ventilation of the facility.

d. To safeguard it, the monitoring equipment should be strategically placed in a secure location outside the area being heat treated. The data logger should be readily accessible to personnel for monitoring temperatures within the treatment area.

2-10. Removal or Insulation of Heat-Sensitive Equipment. If there is any question concerning the ability of a piece of equipment to withstand the heat treatment, it should either be removed from the area or protected by insulation. One or more thermocouples should be placed on the exterior surfaces of the equipment being insulated. By monitoring the temperature of the thermocouple(s) attached to heat sensitive equipment, one can easily determine if the temperature of the heater should be lowered or disconnected. To date, the only piece of equipment that has been damaged during the more than 20 heat treatments of dining facilities has been the foam insulation of the doors on a Jordan® refrigerator. Nevertheless, cash registers, computers, and compressed gas containers are routinely removed from the enclosed area to be heated to prevent any potential damage to high dollar equipment or danger to personnel. In any case, whether the equipment or any other material is insulated and left in the heated area or removed prior to the thermal treatment, it should be checked for live cockroaches prior to leaving the facility.

®TOPP SAFE-HEAT is a registered trademark of TOPP Construction Services, Inc., Media, Pennsylvania.

®Jordan is a registered trademark of Jordan Commercial Refrigerator Company, Philadelphia, Pennsylvania.

2-11. Thermal Treatment Completion and Teardown.

a. After the coolest areas of the thermal treatment have reached 115ºF for 45 minutes (typically 3-4 hours) or more and no further movement of cockroaches is noted, the heater can be shut off and the treatment can be discontinued.

b. The process of vacuuming should still be continued to remove any surviving cockroaches found on the floor or on equipment compressors. Extra care must be exercised when removing the sticky barriers and/or weights holding the plastic sheeting in place so that any surviving cockroaches in these areas can be collected by the vacuuming process. All heat treatment equipment and materials should be removed from the site and all dining facility property returned to its original position and reconnected prior to leaving the area. A second application of insect growth regulator is recommended to be applied to the area in accordance to the label directions to kill any cockroaches that survived the thermal treatment. The heat forces a majority of the cockroaches to become active and leave their normal daytime harborages. With the increased activity, the surviving cockroaches have a greater chance of coming in contact with the growth regulator, further reducing any remaining cockroach population. In addition, it is recommended that cockroach gel baits and/or a boric acid liquid bait (their attractiveness should be enhanced due to the dehydrated condition of the cockroaches surviving heat treatment) be applied posttreatment to kill survivors and prevent reinfestation. Posttreatment cockroach surveillance is an important part of any cockroach control effort. The surveillance demonstrates the efficacy of the control effort and identifies areas where additional control effort should be directed if the facility experiences a resurgence of cockroach activity.

Appendix A

Equipment and Materials

1. Pacto Tape No. D5033; High Temperature tape; Pacto Corporation, P.O. Box 1200, Bristol, RI 02809-0995.

2. Dr. Moss's Liquid Bait System, Liquid Boric Acid Bait, J.T. Eaton & Co., Inc.

3. SAFE-HEAT Model 400, TOPP Construction Services, Inc., P.O.; Equipment Specifications: Propane, 400,000 BTU/Hour, 4000 Cubic Feet/Minute (CFM).

4. Li'l Hummer Backpack Vacuum, Miracle Marketing Corp., P.O. Box 520125, Salt Lake City, UT 84152-0125.

5. Portable Modular Datalogger, 8 channels, PC compatible, approximate cost $1,100 to 1,500.

Appendix B

Special Terms

1. **Precision Targeting:** a process where computerized spatial analyses are preformed to determine the spatial relationship of an insect population within a defined area and to quantify the number of insects within that spatial relationship.

2. **Short wall:** as referred to in this report, a partial wall structure which does not extend to the ceiling and is commonly found in the kitchen of dining facilities. It serves to enclose natural gas lines to stoves, ovens, and steam kettles; and also functions as the support structure for electrical wiring and outlets.

Local Reproduction is
Authorized and Encouraged

May 1999

USACHPPM
Readiness thru Health

USACHPPM TG NO. 208
SUPPLEMENT