

# WOOD- DESTROYING ORGANISMS

⇒ APPLICATOR TRAINING MANUAL ⇐

*First Edition*

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First Edition

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UNIVERSITY of FLORIDA

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# 1 Introduction to WDOs and Non-WDOs In Florida

**T**HIS MANUAL contains basic information useful to anyone interested in learning more about the management of wood-destroying organisms, or WDOs. WDOs include termites, beetles and wood-decay fungi that must be controlled to protect the structure and its contents. It is important for pest management professionals to differentiate WDOs from other organisms and conditions that are considered non-WDOs, such as bees, ants or physical damage that might be mistaken as wood-destroying organisms (Chapter 1).

Florida is very specific on the definition of a wood-destroying organism. A “wood-destroying organism” means an arthropod or fungus that damages and can reinfest seasoned wood in a structure, namely termites, powderpost beetles, old house borers, and wood-decay fungi. For that reason, the biologies and identifications of WDOs are presented in this manual (Chapters 2–5).

Wood is an important structural material and is extensively used in Florida homes and buildings. In order to prevent and control WDOs, it is important to understand how the organisms enter and infest buildings. Therefore, the building terminology and construction process is presented (Chapter 6). It is common to inspect buildings for WDOs, and the rules and regulations of doing a WDO inspection need to be understood as well as the conducive conditions that permit WDO infestations (Chapter 7).

WDO treatments can be applied either to prevent an infestation or to control an existing infestation. The correct placement of these treatments is an important consideration and depends on the type of treatment being applied. There are soil treatments, bait treatments, and wood treatments to protect wood in structures (Chapter 8). Of course, any time pesticides are used, they must be applied in a way to protect the environment (Chapter 9).

Equipment to apply treatments has been developed to make application easier for the professional. Various types of pumps, nozzles and specialized tools are available to make application safe and effective (Chapter 10). The correct amount and placement of treatments often involves calibration of equipment before treatment and calculation of treatment amounts (Chapter 11).

Termiticide labels are the law, and the label must be interpreted correctly by the pest management professional. Therefore, an explanation of common terminology on termiticide labels is explained (Chapter 12). WDOs are regulated under Florida Statutes Chapter 482 by the Florida Department of Agriculture and Consumer Services (FDACS). Pest management professionals need to understand the specific requirements of the law and the rules implemented by FDACS (Chapter 13). In addition, contracts for WDOs are also regulated by law and FDACS rules (Chapter 14).

This manual benefits the applicator and the general public. By learning how to handle and apply termiticides correctly, applicators will be able to protect structures, themselves, others and the environment.

## List of WDOs and non-WDOs in Florida

### WDOs



Eastern subterranean termite



Formosan subterranean termite



West Indian powderpost termite



Western drywood termite



Southern dampwood termite



Coneheaded termite

#### 1. Subterranean termites — Rhinotermitidae

- a. Eastern subterranean termite — *Reticulitermes flavipes*
- b. Southern subterranean termite — *Reticulitermes virginicus*
- c. Light southern subterranean termite — *Reticulitermes hageni*
- d. Florida “dampwood” termite — *Prorhinotermes simplex*
- e. West Indian subterranean termite — *Heterotermes* sp.
- f. Formosan subterranean termite — *Coptotermes formosanus*
- g. Asian subterranean termite — *Coptotermes gestroi*
- h. Florida darkwinged subterranean termite — *Amitermes floridensis*

#### 2. Drywood/powderpost termites — Kalotermitidae

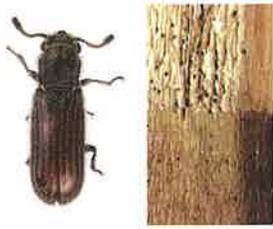
- a. *Calcaritermes nearcticus* (no common name)
- b. West Indian powderpost termite — *Cryptotermes brevis*
- c. *Cryptotermes cavifrons* (no common name)
- d. *Incisitermes milleri* (no common name)
- e. Western drywood termite — *Incisitermes minor*
- f. *Incisitermes schwartzi* (no common name)
- g. Southeastern drywood termite — *Incisitermes snyderi*
- h. *Kalotermes approximates* (no common name)

#### 3. Dampwood termites — Kalotermitidae

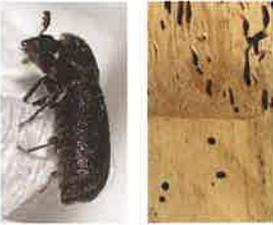
- a. Southern dampwood termite — *Neotermes castaneus*
- b. *Neotermes luykxi* (no common name)
- c. *Neotermes jouteli* (no common name)

#### 4. Arboreal/subterranean termite — Termitidae

- a. Conehead termite (aka tree termite) — *Nasutitermes corniger*



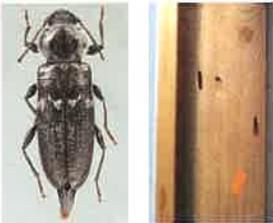
True powderpost beetle



False powderpost beetle



Deathwatch beetle



Longhorned wood borer



Brown rot



Soft rot



White rot



Water-conducting rot

## WDOs, continued

### 5. Wood-boring beetles — Coleoptera

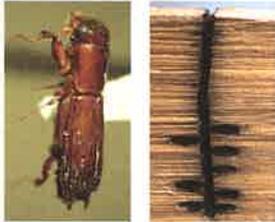
- a. True powderpost beetles — Bostrichidae, Lyctinae
  - i. Brown Lyctus beetle — *Lyctus brunneus*
  - ii. Linear Lyctus beetle — *Lyctus linearis*
  - iii. Southern Lyctus beetle — *Lyctus planicollis*
- b. False powderpost beetles — Bostrichidae, Bostrichinae
  - i. Oriental wood borer — *Heterobostrychus aequalis*
  - ii. Bamboo borer — *Dinoderus minutus*
  - iii. Lead cable borer — *Sobicia declivis*
- c. Deathwatch beetles — Anobiidae
  - i. Anobiid powderpost beetle — *Euvrilletta peltata*
  - ii. Deathwatch beetle — *Xestobium rufovillosum*
  - iii. Eastern deathwatch beetle — *Hemicoelus carinatus*
  - iv. Furniture beetle — *Anobium punctatum*
- d. Longhorned wood borers — Cerambycidae
  - i. Old house borer — *Hylotrupes bajulus*
  - ii. Flat oak borer — *Smodicum cucuhiforme*
  - iii. New house borer — *Arhopalus productus*

### 6. Wood-decay fungi

- a. Brown rots
  - i. True dry rot — *Serpula lacrymans*
  - ii. Mine fungus — *Fibroporia vaillantii*
  - iii. Cellar fungus — *Coniophora puteana*
- b. Soft rots (no other common names)
  - i. *Chaetomium* spp.
  - ii. *Ceratocystis* spp.
  - iii. *Kretzschmaria deusta*
- c. White rot
  - i. *Phanerochaete chrysosporium* (no common name)
- d. Water-conducting rot
  - i. *Meruliporia incrassata* — previously *Poria incrassata*



Bark beetle, damage



Ambrosia beetle, damage



Metallic wood borer, damage



Carpenter ant, damage



Acrobat ant



Carpenter bee, exit hole



Booklice



Shipworms, damage

## Non-WDOs

### 1. Bark beetles — Curculionidae, Scolytidinae

### 2. Ambrosia beetles — Curculionidae, Platypodinae

### 3. Metallic wood borers — Buprestidae

### 4. Formicidae

- a. Carpenter ants — *Camponotus* spp.
- b. Acrobat ants — *Crematogaster* spp.

### 5. Apidae

- a. Carpenter bees — *Xylocopa* spp.
- b. Sweat bees — Halictidae
- c. Mason bees — Megachilidae

### 6. Booklice — Psocoptera

### 7. Shipworms — Mollusca, Bivalvia, Teredinidae

- a. *Teredo navalis* — naval shipworm

### 8. Nonwood-destroying fungi

- a. Blue stain or sapstain fungi — *Ceratocystis* spp., *Ophiostoma* spp.
- b. Toxic mold
  - i. Black mold — *Stachybotrys chartarum*
- c. Mildew — *Cladosporium* spp.
- d. Surface molds — many species

### 9. Physical damage

- a. Nail holes
- b. Saw cuts
- c. Water and urine stains



Blue stain or sapstain fungi



Black mold



Mildew



Nail holes



Saw cuts



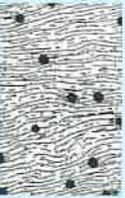
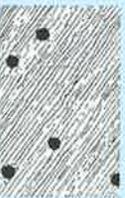
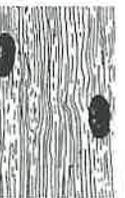
Water / urine stains

## Key to Insect Damage by Wood-Infesting Pests

1. In processed wood; numerous small holes less than  $\frac{3}{8}$  inch in diameter. If the piece is split open, many frass-filled tunnels can be seen, most of them running with the grain.
  - ..... Powderpost beetles
  - Exit holes  $\frac{1}{16}$  to  $\frac{1}{8}$  inch in diameter. More advanced galleries running across the grain. Frass consists in part of distinct elongate or bun-shaped pellets, as well as fine yellowish-white powder. In hardwoods and softwoods
    - ..... Family Anobiidae — Furniture beetles and deathwatch beetles
    - Exit holes vary from  $\frac{1}{16}$  to  $\frac{5}{16}$  inch in diameter. Occasional tunnels go across the grain but mostly with the grain. Fine or coarse frass that tends to stick together; few if any pellets. In hardwoods such as ash, oak and hickory; sometimes in softwoods
      - ..... Family Bostrichidae; subfamily Bostrichinae — False powderpost beetles
      - Exit holes  $\frac{1}{32}$  to  $\frac{1}{8}$  inch in diameter in newer or poorly seasoned hardwood lumber. (Common in poorly seasoned lumber.) Frass in tunnels is loose and powdery and contains no pellets.
        - ..... Family Bostrichidae; subfamily Lyctinae — True powderpost beetles
2. In either processed wood or rough timber, occasional exit holes, round or elliptical,  $\frac{1}{4}$  to  $\frac{3}{8}$  inch in diameter. Irregular and rather extensive tunnels in the sapwood with usually coarse, packed frass.
  - ..... Family Cerambycidae — Longhorned beetles
  - Usually heavy damage of this sort in finished softwood. Often the only external evidence of damage is one or two oval exit holes.
    - ..... Oldhouse borer
3. In rough, bark-covered wood, small exit holes about  $\frac{1}{8}$  inch in diameter. Inner side of bark and surface of wood itself “engraved” with galleries (old damage; will not reinfest dried wood; no control required).
  - ..... Family Curculionidae; subfamily Scolytinae — Bark beetles
4. Pinholes and slender galleries in sapwood, frequently of southern yellow pine. The burrows and area around them stained dark by the action of fungi (old damage, will not reinfest dried wood; no control required).
  - ..... Family Curculionidae; subfamilies Scolytinae and Platypodinae — Ambrosia beetles

5. No openings (or very few, and these are usually sealed over). Extensive galleries run lengthwise, usually in the springwood, and are packed with a hard, masticlike frass. May infest many old cellulose objects near or in contact with the soil.  
..... Order Blattodea (Isoptera); family Rhinotermitidae — Subterranean termites
6. Distinct, round openings to outside of wood; when split open, it reveals very thorough excavation. Galleries contain considerable amounts of coarse, hard sandlike frass, each pellet having rounded ends and six longitudinal depressions. No masticlike frass or very fine powder.  
..... Order Blattodea (Isoptera); family Kalotermitidae — Drywood termites
7. Timbers with extensive galleries that are sandpaper smooth, often with rounded edges, and contain no frass. Coarse sawdust may be found near damage.  
..... Order Hymenoptera; family Formicidae; genus *Camponotus* — Carpenter ants
8. Wood with  $\frac{3}{8}$  to  $\frac{1}{2}$ -inch round entry holes on side, edge or end, leading into long tunnels (3 to 24 inches). Holes turn at right angles, and tunnels run with the grain of the wood.  
..... Order Hymenoptera; family Apidae; genus *Xylocopa* — Carpenter bees

# Wood-Destroying Beetle Damage Identification Chart

BEETLE NAME	HOLE SIZE	WOOD MOST COMMONLY FOUND IN	APPEARANCE OF GALLERIES AND FRASS	CONSUME WOOD	LENGTH OF LIFE CYCLE	COMMON NAME(S)	ADULT	LARVA
<b>Lyctus</b>	Round holes $\frac{1}{32}$ " to $\frac{1}{8}$ " 	New hardwoods and bamboo	Round galleries. Fine, loosely packed, powderlike frass 	No	1 year or less	True powderpost beetles	Adult length $\frac{1}{4}$ " 	Mature larva $\frac{1}{4}$ " Spiracle on 8th segment larger 
<b>Anobiid</b>	Round holes $\frac{1}{16}$ " to $\frac{1}{8}$ " 	Hardwoods and softwoods Usually 10 years or older	Round galleries. Frass consists of powder plus oval pellets stuck together in clumps 	Yes Pellets	1-3 years	Furniture or deathwatch beetles	Adult length $\frac{1}{4}$ " 	Mature larva $\frac{1}{2}$ " 
<b>Bostrichid</b>	Round holes $\frac{1}{16}$ " to $\frac{3}{16}$ " 	Hardwoods, softwoods, and bamboo	Galleries variable. Tightly packed, fine to coarse frass with few pellets 	No	~1 year	False powderpost beetles	Adult length $\frac{3}{8}$ " 	Mature larva $\frac{3}{8}$ " 
<b>Cerambycid</b>	Oval holes $\frac{1}{4}$ " to $\frac{3}{8}$ " 	New softwood only	Round galleries with ridge marks. Tightly packed, coarse frass with small pellets 	Yes Pellets	3-10 years	Old house borer	Adult length $\frac{5}{8}$ " 	Mature larva $1\frac{1}{2}$ " 



# 2 Termites

## The Biology of Termites

**T**HE OLD order Isoptera, consisting entirely of termites, is now only used as an infraorder with the Order Blattodea. Because termites evolved from subsocial wood-feeding cockroaches, both of these insect groups are now classified in the Order Blattodea.

More than 2,000 termite species live throughout the world, but only about 50 occur in the United States. In nature, termites are considered to be beneficial insects because they help to convert dead wood and other cellulose material to soil. Termites are considered pests, however, when they feed on wooden structures and destroy cellulose-derived goods.

Termites found in the United States are generally grouped into four major groups:

- Drywood termites (Figure 1) live within dried wood, do not forage in soil, and derive all the water they need from the wood. They are economically important in Florida.
- Dampwood termites (Figure 2) nest within wood with high levels of moisture, do not forage in soil, and usually do not cause any economically important damage in Florida.
- Subterranean termites (Figure 3) normally nest in soil, forage in soil and sometimes above ground, and usually require constant contact with soil to obtain water. Some species can survive in certain conditions away from soil, as long as a source of moisture is available. More than 3,000 species were described, and less than 200 are structural or crop pests.
- Higher termites (Figure 4) have a wide variety of locations where they nest and forage. One native species, the Florida darkwinged termite, *Amitermes floridensis*, is considered a subterranean termite. A nonnative species, the conehead termite, *Nasutitermes corniger*, is considered a tree termite.



Figure 1. Drywood termites *Kalotermes approximatus*.



Figure 2. Dampwood termites *Neotermes jouteli*.

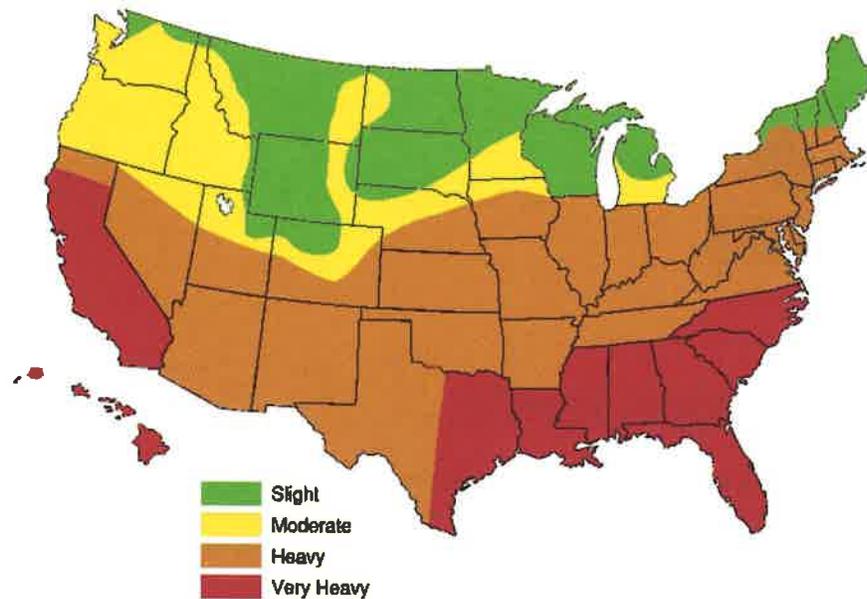


Figure 3. Subterranean termite king and queen, *Reticulitermes hageni*.



Figure 4 (left). *Nasutitermes corniger* in their nest in a tree. This species is classified as higher termites.

Figure 5. Termite distribution in the United States. Termites occupy all states except Alaska.



Source: Malis

## Termite Distribution

Termites have been found in every state except Alaska (Figure 5). Their distribution is determined by their nesting habits, which protect them from their surrounding environment and regulate their temperature extremes.

The most common and widely distributed type of termites found in Florida are the subterranean termites. Subterranean termites are also the most common and widely distributed type of termite in North America. Subterranean termites nest and forage in soil because they are reliant on soil moisture in order to survive, and soil also protects the colony from temperature extremes. Nonsubterranean termites — dampwood termites, drywood termites, and conehead termites — usually nest and forage above ground and are exposed to temperature extremes in their environment. As a result, drywood, dampwood and conehead termites in nature do not survive the cold temperatures of winter. For this reason, these nonsubterranean termites are usually found in the southern United States and for some, just in South Florida.

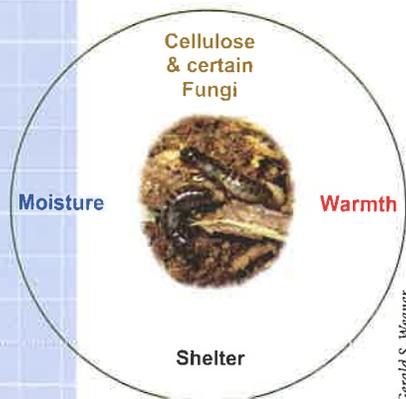


Figure 6. Environmental conditions required for termite survival.

Gerald S. Wegner

## The Termite and Its Environment

Termites require specific environmental conditions to survive (Figure 6). For subterranean termites, moist soil or other moist environments provide these conditions. Moisture is critical to termite survival because all castes except the swarmers are soft bodied insects that lose water rapidly upon exposure to dry air. Thus, an available moisture source is critical to termites. One of the reasons subterranean termites construct shelter tubes when they pass over exposed areas is to protect themselves from moisture loss. Subterranean termites must maintain contact with the soil unless they have a constant above-ground source of moisture.

On occasion, free-standing shelter tubes (drop tubes) will be built straight down from the infested wood toward the ground if they are in a protected area, such as a crawl space under a house (Figure 7). Likewise, free-standing exploratory shelter tubes may be erected upward from soil where termites may be seeking additional sources of wood/cellulose (Figure 8). This usually occurs after a colony has become well established and feeding has progressed some distance from the initial shelter tube. In this way, the colony can obtain the necessary moisture without having to travel great distances.

The retention of moisture is not the only important factor associated with water in the life of the termite. The warm, moist conditions that prevail within the closed system of the nest provide an ideal site for the growth of microorganisms.

The termite system is an extremely delicate, well-balanced system. Maintaining the proper levels of temperature and moisture is essential to the survival of the colony. The type of soil also has a great effect on the ability of subterranean termites to flourish. They generally prefer sandy soil over clay soil, though they will survive in many types of soil. In contrast to the subterranean termites, drywood termites do not need soil contact for moisture. They obtain their moisture directly from the wood where they live, on which they feed. Also, they have developed behaviors that protect them from desiccation or drying out.

## The Termite Life Cycle

Termites develop by gradual metamorphosis from eggs that are laid by reproductives. Larvae hatch from the eggs and undergo several molts through which individuals develop into the various castes. There is great variation in the development cycles among different termite species.

Termite development is complex, with a variety of developmental options available to this social insect. These complexities are highlighted by the termite life cycle (Figure 9). Subterranean, drywood and dampwood termites have colony structure and life cycles similar to the generalized one described here. For instance, like subterranean termites, drywood colonies are composed of workers/pseudergates, soldiers and reproductives. The ultimate caste, or life form, of an immature termite is not determined at the egg stage. Each newly hatched termite can develop into any one of a number of castes.

As illustrated in this life cycle, the termite life cycle has completely different terminology from other insects. An egg is laid by a queen termite. The eggs hatch into white immatures or first instar larvae. The white immature does not have a strong exoskeleton, so it is immobile and cared for by others in the colony. After the first molt, the white immatures become second and, later, third instar larvae. With most insects that undergo gradual metamorphosis, eggs hatch directly into nymphs. However, in termites, nymphs are a later developmental pathway for individuals destined to be reproductives rather than workers or soldiers.



Gerald S. Wegner



Dan Hollings

Figures 7 and 8. Subterranean termite mud shelter tubes may be built downward (top photo) or upward (bottom photo).

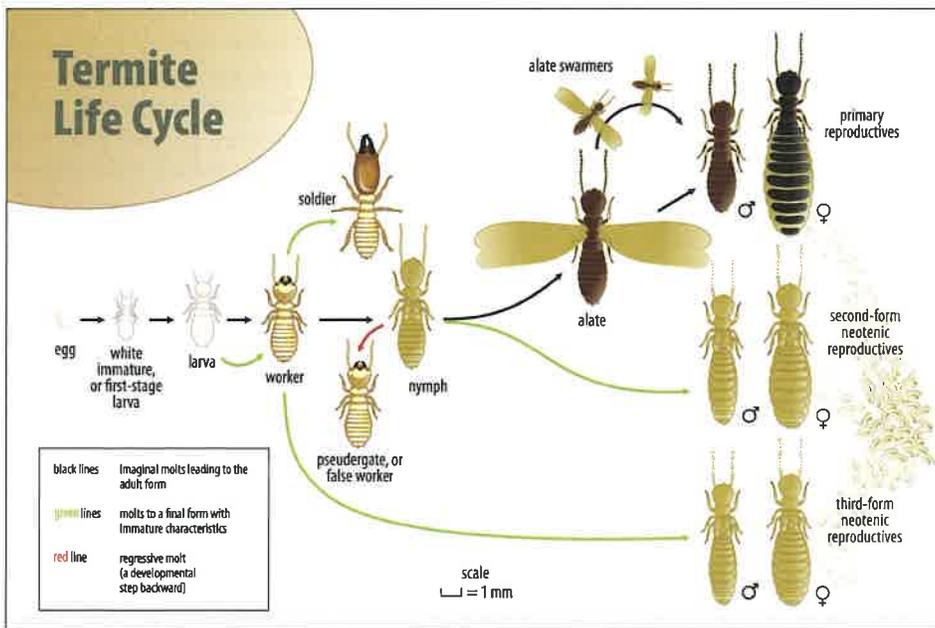


Figure 9. Generalized termite life cycle. Termite life cycles may not contain all phases included here.

Adapted from University of Georgia "Subterranean Termite Life Cycle"

### Comparison of termite soldier heads

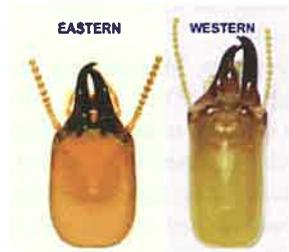


Figure 10. Subterranean termite species heads.



Figure 11. Phragmotic head.



Figure 12. Nasutiform head.

Biodiversity Institute of Ontario



Figure 13. Eastern subterranean nymph with prominent wing buds.



Figure 14. Eastern subterranean termite dealate primary reproductives, male below left and female above right.



Figure 15. Subterranean termite supplemental reproductives: apterous neotenics developing from workers.



Figure 16. Subterranean termite supplemental reproductives: A pair of brachypterous neotenics, which develop from nymphs, encircle workers in the photo at left. Note the presence of wing pads, seen in the closeup photo at right.

Entomology Department,  
The Ohio State University

The third instar larva is a functional worker, and workers can be either male or female. The worker can remain a worker for its entire life span of up to four years. In fact, it can undergo numerous molts, shedding its cuticle or “skin,” without developing into another caste.

Worker termites can molt into presoldiers, then subsequently to soldiers. The soldier can no longer molt and is considered a final caste, with various species modifications for defense. These modifications vary depending on the termite species. Three of these species modifications include:

- a large head and mandibles for defense (Figure 10),
- a phragmotic head to plug entrances to the colony and prevent attacking ants from entering (Figure 11), and
- a nasutiform head modified to squirt defensive secretions onto attacking insects and other arthropods (Figure 12).

Worker termites can also molt into nymphs that are destined to become reproductive insects. Nymphs differ from workers in that they have external wing buds on an elongated thorax and have an elongated abdomen (Figure 13). Large numbers of nymphs are seen in termite colonies in certain seasons. For subterranean termites, nymphs usually start appearing in colonies during late summer and early fall. In most subterranean termite colonies, larvae can molt into workers, soldiers, or reproductives; workers can change into soldiers, nymphs, or supplementary (neotenic) reproductives; and nymphs that have begun developing wing buds may actually lose them with additional molts and return to the worker stage. Such workers are called pseudergates, which means “false workers.” All these changes are chemically regulated within the colony, depending on its needs.

Nymphs molt several times and eventually develop into sexually mature, fully winged adult male or female alates, or winged reproductives. The alates leave the nest and swarm, usually in the spring or summer. During and after swarming, most alates are consumed by predators or die from inhospitable conditions. The survivors quickly shed their wings, which detach along lines of weakness. At this point they become known as dealates. Each surviving dealate female pairs up with a surviving dealate male (Figure 14). Together they find a suitable place to start a colony, and become the queen and king termites for the new colony.

A colony may contain several types of supplemental, or neotenic, reproductives. Secondary or second-form reproductives, also known as brachypterous neotenics, develop from nymphs and are characterized by the presence of small wing buds and setose (hairy) bodies (Figure 15). Tertiary or third-form reproductives, or apterous neotenics, develop from workers and lack wing buds (Figure 16). These brachypterous and apterous neotenics are nymphs that did not leave the colony to find a mate, but stayed in the colony as supplemental reproductives. They are capable of mating and producing eggs and more offspring for the colony.

The developmental flexibility of the termite life cycle plays a key role in their ability to disperse and establish new, functional colonies when infested materials are transported to new locations. Additionally, neotenic reproductives may bud off and develop their own colonies inside buildings, but only if adequate moisture is available inside the structure.

# Termite Colonies and Castes

TERMITES, like other social insects, are characterized by:

- cooperation in the rearing of young,
- sharing of resources (i.e., food, water and shelter),
- overlapping of generations (i.e., eggs are laid year-round), and
- division of labor, characterized by the presence of one or more castes, or life forms.

Termites are insects that live in loosely associated societies called colonies. The colony is a collection of individuals that cooperate in the rearing of young and that share resources, e.g., food and shelter. Some scientists view the termite colony not as a collection of individuals but as a single living entity whose parts, i.e., individual termites, work together toward the survival and reproduction of the whole colony.

Termite colonies start with two adults — the queen and king — but the majority of the population is soon composed of male and female immatures (Figure 17). Colony structure in subterranean termites is not like other social insects. In general, most social insects, i.e., social bees, wasps and ants, have a colony structure where the majority of members are females concentrated in a single, centralized, immobile nest from which workers forage in search of food and water. Subterranean termite social groups are composed of both males and females and have a mobile nest site usually located near food, most often some form of dead wood that they excavate and inhabit. Drywood termites differ from subterranean termites in that their colony nest site is immobile because they live entirely within a piece of wood, their food source. Once the food source is used up, the colony dies after a final swarm.

Termite colonies have a caste structure with a division of labor among the various types of individuals. Castes vary considerably among the various species and are considered the adult form of termite. Termites have a caste system of organization, so that individuals have physical adaptations to best accomplish the different tasks in the termite colony. The proportion of each caste is regulated by a variety of environmental factors as well as the presence or absence of caste-regulating pheromones, which are biochemical compounds produced by the termites themselves. Three distinct castes are recognized for termites: reproductive caste, soldier caste, and worker caste.

The primary reproductive caste is composed of alates, or swarmers (Figure 18). Alates have two pairs of long, narrow wings of equal size, thus fitting the descriptive name of the old order of classification to which termites belong — Isoptera. “Iso-” means equal, and “-ptera” means wing.

Alate subterranean termites have fully functional wings and compound eyes, and their pigmented, dark skin, or cuticle, can better tolerate water loss than the aforementioned immature forms.

Unfortunately, alate termites are sometimes mistaken for flying, or alate, ants. A winged termite can be easily distinguished from a winged ant by the following characteristics (Figure 19):

- winged termites have straight to slightly curved, beaded antennae, while winged ants have distinctly elbowed antennae,
- winged termites lack a pinched “waist,” while winged ants have a distinct constriction between body regions, and
- winged termites have two pairs of equal size wings, while winged ants have two pairs of wings, but the front pair is larger than the hind pair.

Worker termites (Figure 20), the most numerous caste, are physically and sexually immature males and females. These wingless, white insects are typically the first termites seen when an active shelter tube, infested log, or piece of infested structural wood is breached. Workers are blind and probably only detect changes in light intensity. They mature within a few months and may live up to four years.



Figure 17. *Reticulitermes hageni* eggs, white immatures, and larvae.



Figure 18. The primary reproductive caste is composed of winged termites known as alates or swarmers.

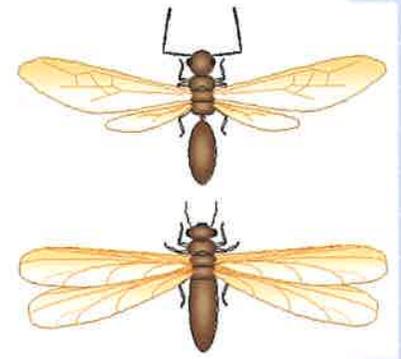


Figure 19. Comparison of ant alate (above) and primary reproductive termite.



Figure 20. Eastern subterranean termite workers.

They are called workers because they perform most of the labor associated with colony maintenance. Workers destroy wood because they consume it. Worker termites are involved in numerous tasks such as locating and colonizing food resources; excavating, repairing and building galleries and shelter tubes; feeding, grooming and caring for young termites, reproductives and soldiers; and participating in colony defense.

The soldier caste protects the colony from its enemies. Soldiers' heads are modified for various forms of defense (Figure 21). Subterranean termite soldiers and some drywood termite soldiers have large, quite hard, reddish-brown heads with much larger mandibles than are found in the other castes. The large head houses muscles that are used to close the mandibles around the heads and abdomens of attacking insects in order to remove their body parts. Because soldiers are not capable of feeding themselves, workers provide them with regurgitated food. Like workers, soldiers mature within a few months and may live two to three years.

Soldier termites are physically and sexually immature males and females whose primary function is colony defense. Soldier termites are wingless, blind, and soft-bodied except for their head capsule, which is highly sclerotized. In native subterranean termites, *Reticulitermes* species, soldiers typically comprise 1–2 percent of the termites present in a colony, and Formosan subterranean termite soldiers comprise 10–15 percent of the population.

Termites also have other forms of soldiers. Some of the drywood termites have hardened, or phragmotic, heads with small mandibles, such as *Cryptotermes brevis* (Figure 22). These heads are used to block the entrance to the nest. Other termite soldiers are nasutiform (coneheaded). These heads are designed to spray defensive chemicals onto ants and other animals that attack the colony (Figure 23).



Figure 21. Eastern subterranean termite soldier.



Figure 22. Some drywood termite soldiers have phragmotic heads with small mandibles.



Figure 23. Coneheaded termite soldiers can spray chemicals onto enemies.

## Colony Formation (Swarming)

The sudden, dramatic appearance of alate termites is commonly referred to as swarming (Figure 24). When swarming occurs indoors, it is often one of the first signs of a structural infestation (Figure 25). Termites swarm in an attempt to initiate new colonies at new locations. The success rate of colony establishment via swarming is extremely low, because most alates die soon after swarming. Alates commonly succumb to desiccation, predation and other environmental factors. Swarming occurs mainly when outdoor temperatures are warm, and usually only by mature colonies. In warm sections of infested structures termites may swarm during the winter, although this is not common. Figure 26 illustrates flight seasons of three *Reticulitermes* species in Florida.



Figure 24. Swarming termites.

A termite swarm is a dispersal flight that contains both male and female reproductives. As the termites land on the ground or trees after a short, fluttering flight, their wings break off. Females and males pair off and begin excavating a new nest. Subterranean termites usually burrow under trees or decaying wood, or in soil that is in contact with wood. They rarely use crevices in trees to initiate a colony. Drywood termites will squeeze into a crack or crevice in wood. Many termites in a swarm never find a mate or a home-site. Others are eaten by predators such as birds, reptiles, amphibians, spiders or insects.

Once a pair finds a suitable site and seals themselves in, they will mate and the female (queen) will begin egg laying. The first batch will be small, usually six to 12 eggs. Once these first-generation larvae hatch, they begin to eat cellulose, molt, and develop into nymphs, which enlarge the colony area. As the number of nymphs increases, the queen will lay increasingly larger numbers of eggs.

Reproductive forms usually will not be produced in the first year. It usually takes two to three years for a newly established colony to begin doing serious damage to structural wood. As the colony grows, the secondary reproductives also begin to lay eggs to supplement those laid by the queen. There is not just one central nest containing one queen. Secondary reproductives may be found throughout the colony.

Another way colonies may be formed is by budding from a well established colony. Budding occurs when a number of individuals, including one or more supplemental reproductives, leave the colony and start a new one.



Figure 25. Swarming indoors is a first sign of termite infestation.

## Communication in the Colony

Among social insects, communication is needed to maintain efficient social integration and division of labor. The most basic means of communication among termites is chemical (pheromone) communication. In fact, each colony develops its own characteristic odor. Any intruder, be it a termite from another colony, an ant, or any other natural enemy, is instantly recognized as foreign when it enters the colony. An alarm pheromone secreted by the colony triggers the soldier termites to attack and kill the intruder. The intruder is then walled off from the colony with fecal matter. If a breach in the termite gallery occurs, it is immediately patched by the workers.

Sound is another means of communication. Termite soldiers and workers bang their heads rapidly on the surface of their mud tunnels or wood galleries when the colony is disturbed. The vibration of the surrounding surface is perceived by others in the colony and they, too, take up the banging activity. Like the alarm pheromones, this activity serves to mobilize the colony defenses.

One of the primary means of communication is trophallaxis, which is the mutual exchange of nutrients and the transfer of food between colony members. Trophallaxis permits the efficient use of nutrients within the colony, enhances recognition of colony members, distributes chemicals involved in caste regulation, and transfers cellulose-digesting protozoans. Termites exchange food from both the mouth and the hind gut. When termites shed their cuticle ("skin") during molting, they also lose their hind gut contents, including the protozoans they need for digesting wood. To get a new supply, they must feed from the hind gut of other colony members. The feeding of the queens and soldiers by the workers is also a form of trophallaxis.

Worker termites forage continuously for new sources of food. They also forage randomly in many locations throughout their foraging territory, looking for food. When a foraging termite worker finds a source of food, it recruits others to the food source by laying a chemical (pheromone) trail. The more foragers that find the food and return with it to the colony, the more intense the pheromone trail becomes.

As the food source is depleted and the foragers no longer deposit the pheromone, the trail deteriorates and eventually is abandoned. Stone or concrete building foundations are temporary obstacles to termites. If a crack  $\frac{1}{2}$  inch wide develops in these founda-

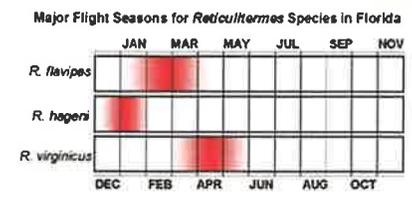


Figure 26. Flight seasons of three *Reticulitermes* species in Florida.

tions, termites can enter and move into the wood above unless there is some other barrier. Remember, if distances are short, termites can build shelter tubes across foundations to reach wood. So cracks in concrete, continuous openings in building blocks, utility openings such as plumbing routed through the concrete, expansion joints, and wood below soil level offer the best and easiest access for termites.

The proportion of the castes in the colony is also regulated chemically. For example, soldiers and reproductives produce chemicals that are distributed to other colony members by trophallaxis. The chemicals inhibit the production of additional soldiers and reproductives. Termites may react to a high level of soldier-produced chemical by killing some of the soldiers. Thus, the needs of the colony are met, and the proper balance of the various castes is maintained.

In most subterranean termite colonies, larvae can molt into workers, soldiers, or reproductives; workers can change into soldiers, nymphs, or supplementary (neotenic) reproductives; and nymphs that have begun developing wing buds may actually lose them with additional molts and return to the worker stage. Such workers are called pseudergates, which means “false workers.” All these changes are chemically regulated within the colony, depending on its needs.

## Termite Necessities for Survival

For cockroaches, survival is dependent on food, water and harborage. For termites, survival is very similar, but dependent on food, water and warmth.

Food of subterranean termites consists of anything made of or containing cellulose. Subterranean termites feed primarily on dead wood and wood by-products, and only under unusual circumstances will they feed on other living or dead plant tissue. However, in their search for food, termites can tunnel into and damage a variety of noncellulose materials such as rigid foam-board insulation and sheetrock (Figures 27 and 28).

Termites prefer to feed on soft, spring-growth wood rather than hardwoods and woods rich in natural chemical protectants. Redwood, cypress and juniper are less preferred by termites, but no wood is completely immune to attack.

In general, termites prefer cellulose that is easy to obtain. For example, in laboratory studies they prefer, in descending order: loose cellulose fibers > paper > cardboard > softwood blocks > hardwood blocks. In the field, preference for a particular cellulose resource is likely determined by its availability, size, texture, and the nutritional demands of the termite colony.

As termites break off wood fibers, they swallow the small fibers, which then undergo complete digestion by protozoans, bacteria and enzymes in the termite hindgut. The association of termites and fungi is quite complex. There is some evidence that termites prefer wood that has been attacked by certain wood-destroying fungi. Other fungi may deter termite feeding. Wood-destroying fungi often take advantage of the same moist conditions favored by termites. Thus, termites and wood-destroying fungi are sometimes found together in structural infestations.

**Moisture** is the most important factor limiting subterranean termite activity and distribution in the environment. In suburban areas where irrigation occurs regularly and soil moisture is not limited, subterranean termite colonies are thought to be more active. Termites are “thin-skinned” insects with a membranous cuticle that quickly dries out when exposed to the desiccating effects of wind or dry air. Subterranean termites require a constant supply of moisture, whereas drywood termites can survive within dry wood with no exterior source of moisture.

The gallery system that termites excavate within soil and wood allows for near complete saturation of the air inside. The wood and the soil act like a sponge, holding onto the water and helping to maintain high humidity in areas where the termites live and feed. Such high humidity helps minimize cuticular (“skin”) water loss. Subterranean termites can transport moisture and soil to above-ground feeding sites. In exposed areas, termites travel within shelter tubes (Figures 29 and 30). Shelter tubes are constructed

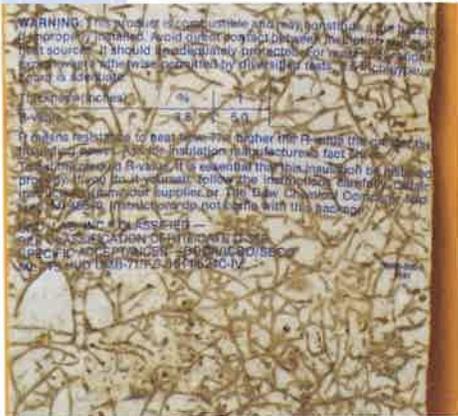


Figure 27. Subterranean termite excavation damage to rigid foam board.



Figure 28. Subterranean termite excavation damage to sheetrock.

by termite workers and are composed of particles of soil, wood, and other debris held together with glue-like fecal material, saliva, and other secretions.

Although rather uncommon, subterranean termites can survive and form functional colonies in above ground locations without maintaining contact with the soil if sufficient moisture is available. Sources of moisture include water pooled on the roof, water trapped behind the external siding or veneer of buildings, water in stopped-up gutters, and water resulting from leaky plumbing or air conditioning units.

**Temperature** has a strong influence on daily and seasonal fluctuations in termite activity. Subterranean termites will not forage for food when soil temperatures are either too hot or too cold. They adjust their activity to seek suitable temperatures and will migrate deeper in the soil when surface temperatures are unsuitable. Foraging termites can also detect temperature gradients in the soil, and under extremely hot conditions seek out thermal “shadows” cast by vegetation, and presumably structures.

When temperatures near the soil surface are too hot and the soil becomes dry, termite foraging may be significantly reduced. In climates where winter temperatures are extremely cold, termite foraging is limited due to nearly frozen or frozen topsoil. Little is known about termite foraging behavior during the winter. However, eastern subterranean termites have been observed moving and foraging slowly in bait stations in soil covered by snow in northern climates (Figure 31). It has also been observed that termites can remain active in cold weather if the structure they are infesting is heated.

## Termite Digestive System and Wood Consumption

Most animals are not able to convert cellulose into a nutritious source of energy. Termites are able to utilize cellulose in wood as a source of nutrition due to a variety of specific adaptations in their digestive system (Figure 32). Termites start eating wood by biting of slivers with their mandibles and swallowing the particles. The slivers go down the esophagus into the proventriculus where the wood is mixed with salivary secretions that contain some digestive enzymes. Alongside the esophagus, besides the salivary glands, are water sacs, where termites can carry water from moisture in soil to dry wood and the wood particles that are ingested. Termites can regurgitate such liquids to regulate the humidity throughout the nest.

The salivary secretions from the esophagus start the digestive process. The proventriculus is a muscular sac with cutting ridges that grind the wood slivers into a pulp while thoroughly mixing in digestive enzymes. The wood pulp then passes into the midgut, which incorporates more enzymes to break down the wood pulp further.

The partially broken-down wood then passes from the midgut into the hindgut, which in subterranean termites is expanded into a fermentation chamber. The fermentation chamber has protozoa and bacteria specially adapted for cellulose digestion. The protozoa, for instance, ingest the particles of cellulose and break them down into sugars. Termites harbor specific kinds of protozoa and bacteria in their digestive tracts to convert cellulose into substances that termites can utilize in their nutrition. Without these symbiotic microorganisms, the subterranean termite could not digest the wood it consumes. The higher termites do not utilize these microorganisms. Some higher termites in the Old World use fungal gardens to help digest cellulose to usable nutrition.

The protozoa and bacteria in termites are not found anywhere but the hindgut fermentation chamber. They are passed from termite to termite by proctodeal trophallaxis, which is the ingestion of feces from another termite. This process of proctodeal trophallaxis is a very important part of termite survival. Termites hatching from eggs must obtain these digestive organisms or they would die of starvation. This requirement for symbionts is why tent fumigations are effective even if drywood termite egg stages survive treatment.

Termite keys with identifying characteristics of soldier caste and winged reproductives appear on the next two pages, followed by several pages of detailed descriptions of more than 20 termite species.



Gerald S. Wegner



Gerald S. Wegner

Figures 29 and 30.  
Subterranean termite shelter tubes on exposed surfaces.



Kyle Inboden

Figure 31. Eastern subterranean termites foraging in a bait station in soil covered by snow.

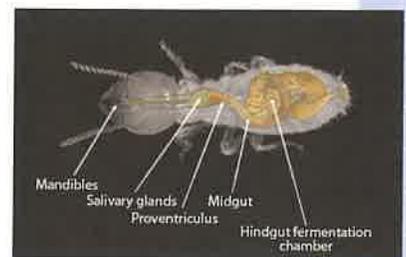
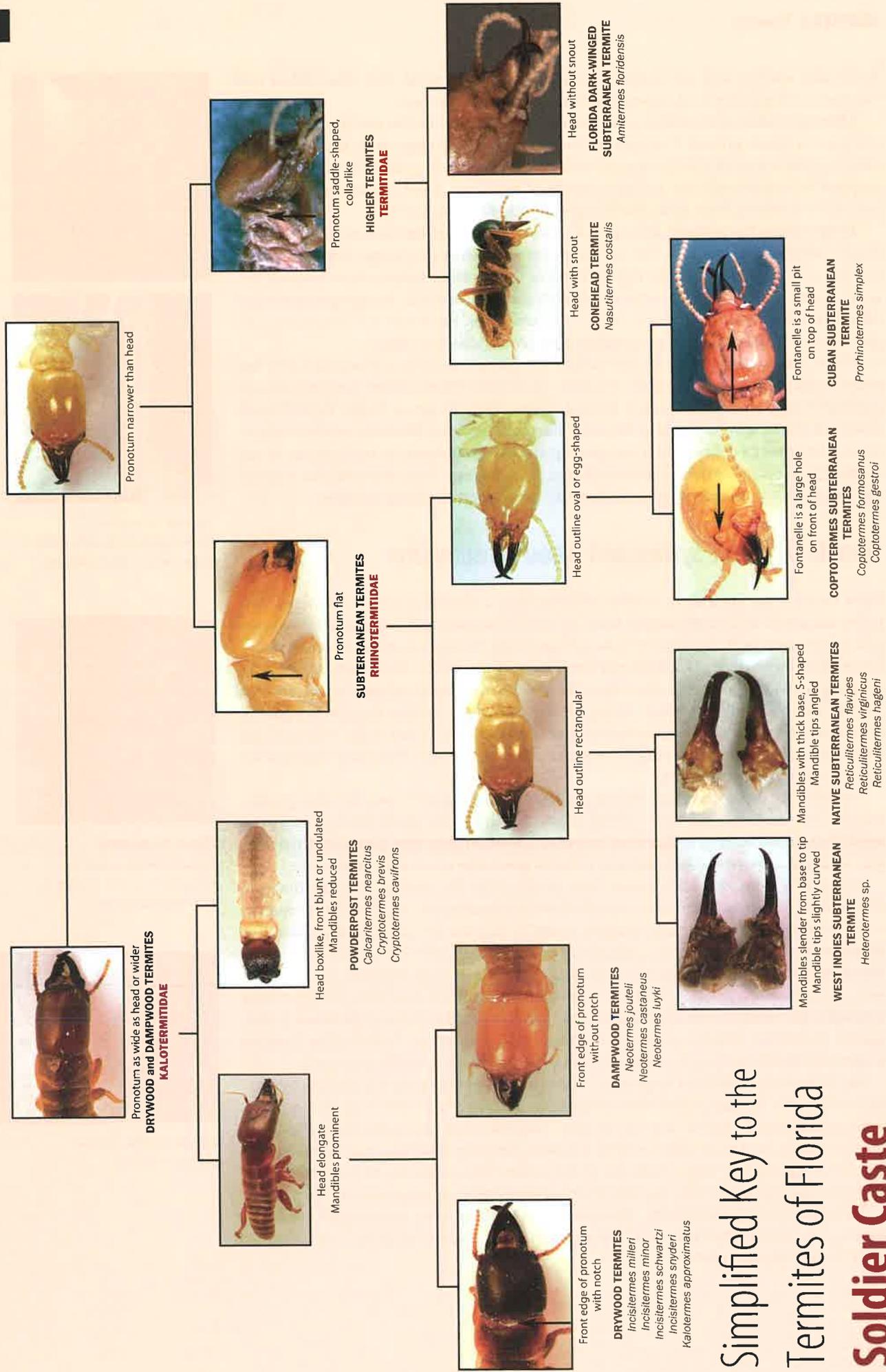
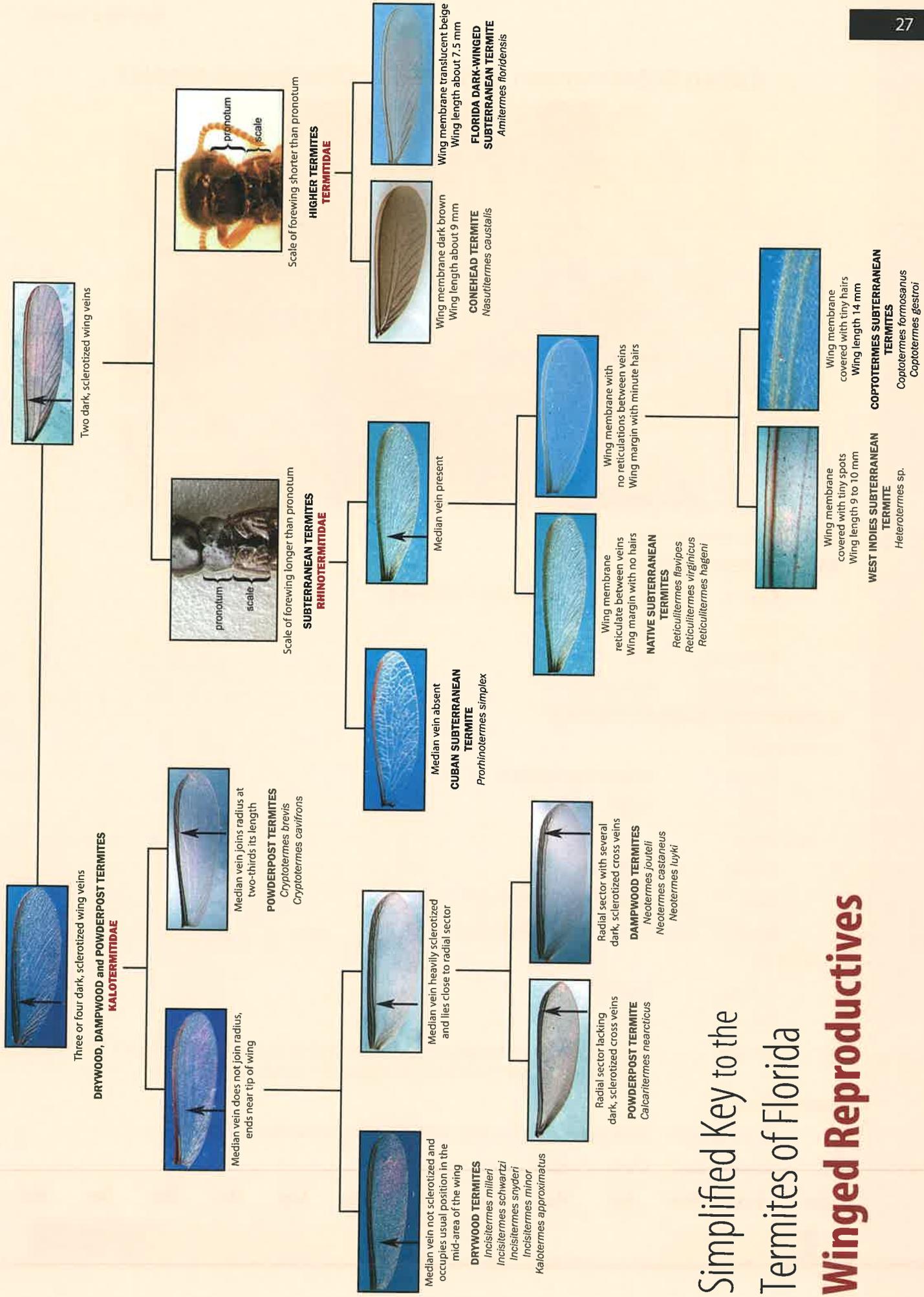


Figure 32. The termite digestive system.



# Simplified Key to the Termites of Florida

## Soldier Caste



# Simplified Key to the Termites of Florida

## Winged Reproductives





## Asian Subterranean Termite, *Coptotermes gestroi*



*Coptotermes formosanus*



*Coptotermes gestroi*

**FAMILY:** Rhinotermitidae

### WHERE DOES IT OCCUR?

Region:	Southeast Florida, Caribbean, South America
Nest:	Soil; aerial nests in structures
Foraging:	Soil
Damage:	Wood, insulation

### IDENTIFYING CHARACTERISTICS

#### WORKER

Color:	Light
Size:	Small

#### SOLDIER

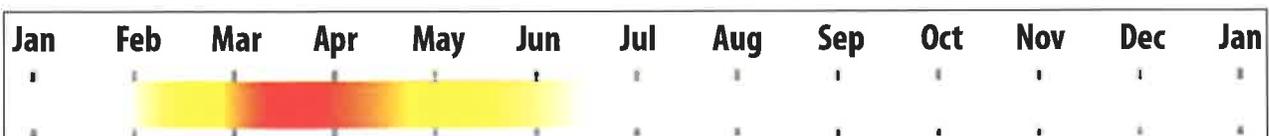
Color:	Yellowish
Size:	Small
Head:	Oval; fontanelle in front with one pair of setae alongside

#### ALATE

Color:	Dark brown
Size:	Large
Wings:	Clear, hairy, with two dark veins

### SWARMING

Time of year:	February to July
Time of day:	Dusk to midnight when there is high humidity



## West Indian Subterranean Termite, *Heterotermes caribeus*



**FAMILY:** Rhinotermitidae

### WHERE DOES IT OCCUR?

Region:	South Florida, West Indies
Nest:	Soil
Foraging:	Soil
Damage:	Structures

### IDENTIFYING CHARACTERISTICS

#### WORKER

Color:	Yellowish, clear
Size:	Small

#### SOLDIER

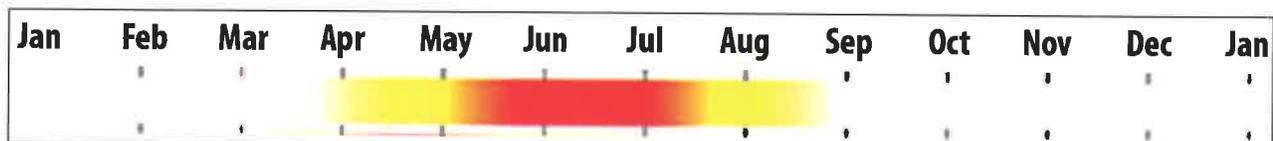
Color:	Yellowish orange
Size:	Small
Head:	Rectangular to oval, with slender, black mandibles curved near the tip

#### ALATE

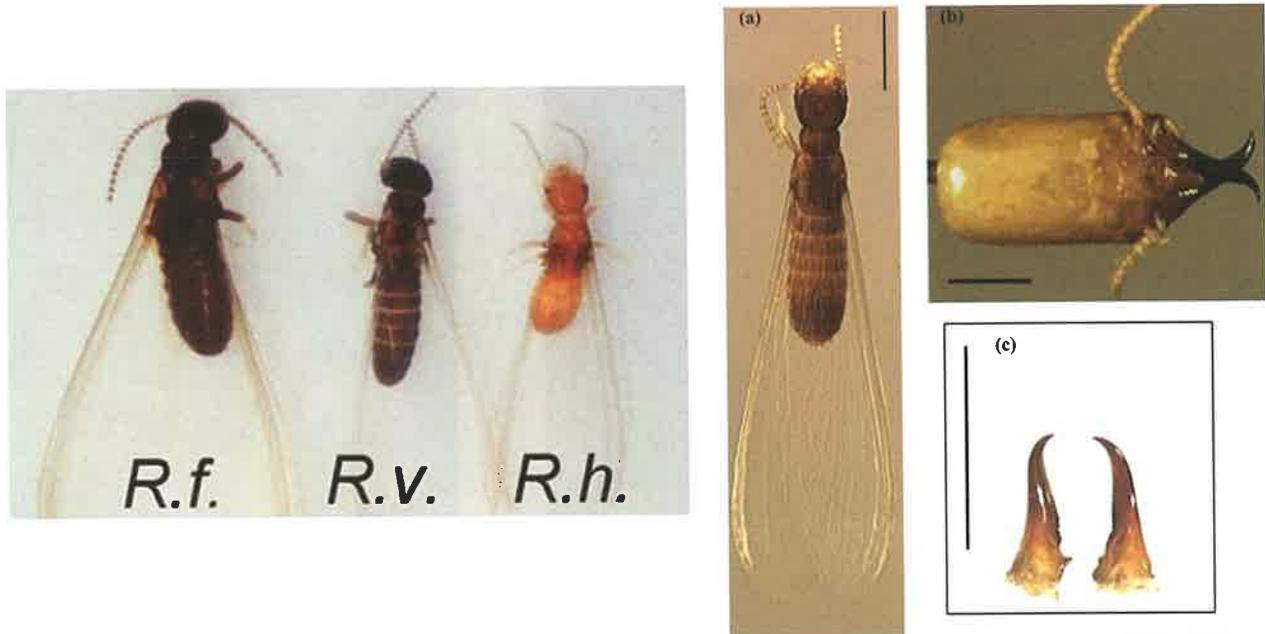
Color:	Pale yellow-brown to orange-brown
Size:	Small
Wings:	Narrow, clear, with two dark veins; smooth and opaque, with hairs on fringes

### SWARMING

Time of year:	Summer
Time of day:	Evenings



## Subterranean Termite, *Reticulitermes nelsonae*



**FAMILY:** Rhinotermitidae

### WHERE DOES IT OCCUR?

Region: Southeastern Florida  
 Nest: Soil  
 Foraging: Soil  
 Damage: Structural wood

### IDENTIFYING CHARACTERISTICS

#### WORKER

Color: Yellowish, clear  
 Size: Very small

#### SOLDIER

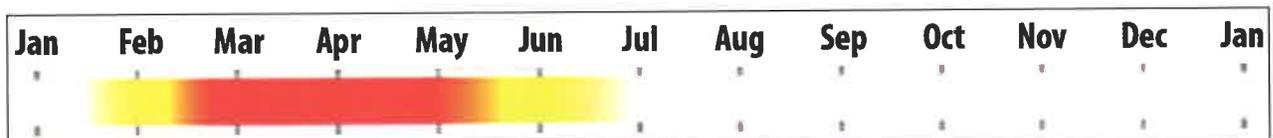
Color: Body light yellowish to white; head yellowish with dark mandibles  
 Size: Large  
 Head: Rectangular, with dark brown to black mandibles that cross

#### ALATE

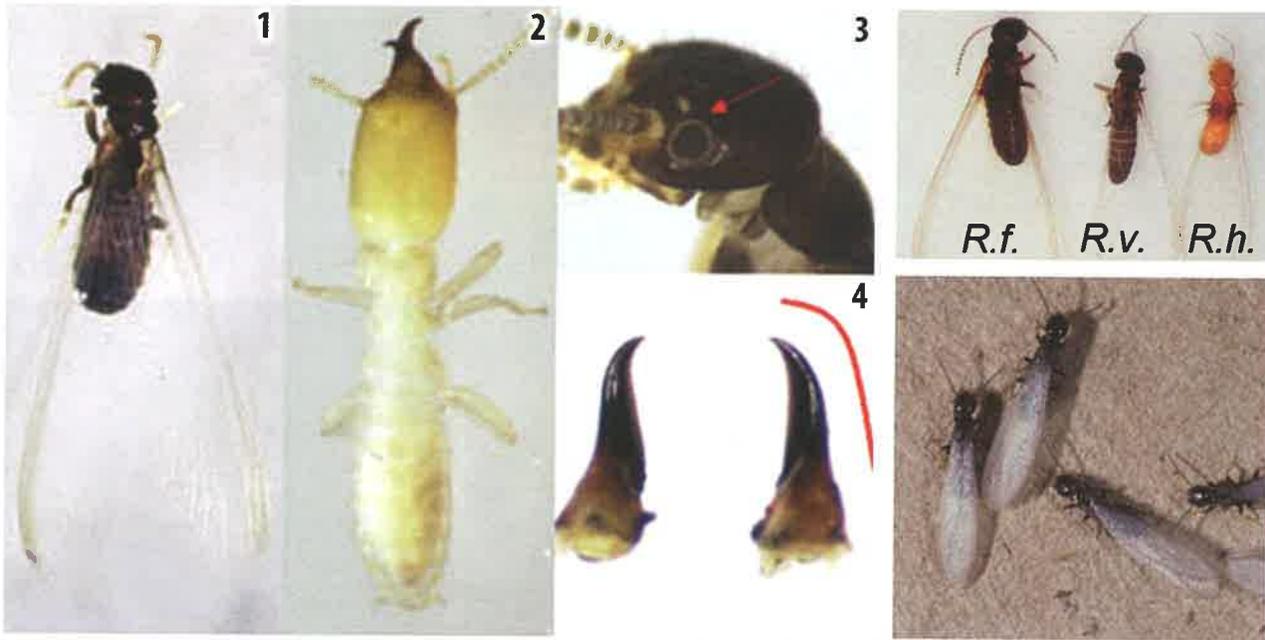
Color: Pale brown  
 Size: Small  
 Wings: Clear

### SWARMING

Time of year: February to May  
 Time of day: Daytime



## Dark Southern Subterranean Termite, *Reticulitermes virginicus*



**FAMILY:** Rhinotermitidae

### WHERE DOES IT OCCUR?

Region:	All Florida
Nest:	Soil
Foraging:	Soil
Damage:	Structural wood

### IDENTIFYING CHARACTERISTICS

#### WORKER

Color:	White, transparent
Size:	Small

#### SOLDIER (2)

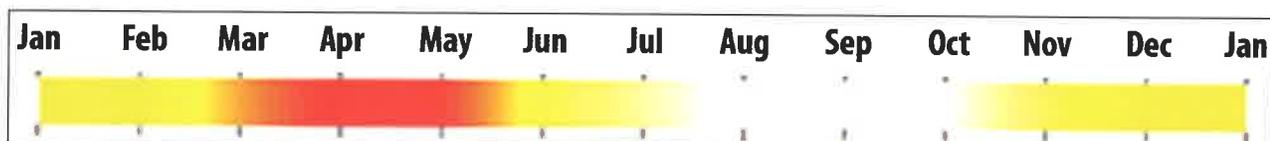
Color:	Clear white
Size:	Small
Head:	Rectangular head with right mandible with distinct inward curvature (4)

#### ALATE (1)

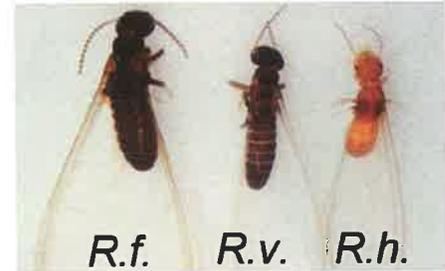
Color:	Dark brown to black
Size:	Small
Wings:	Clear

### SWARMING

Time of year:	March to May
Time of day:	Midday



## Light Southern Subterranean Termite, *Reticulitermes hageni*



**FAMILY:** Rhinotermitidae

### WHERE DOES IT OCCUR?

Region:	All Florida
Nest:	Soil
Foraging:	Soil
Damage:	Not common in structures

### IDENTIFYING CHARACTERISTICS

#### WORKER

Color:	White, transparent
Size:	Small

#### SOLDIER

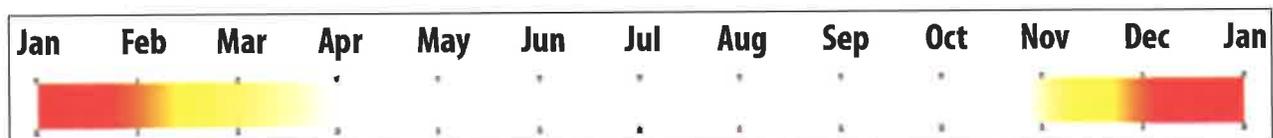
Color:	Light tan
Size:	Small
Head:	Rectangular head with right mandible less curved than left mandible

#### ALATE

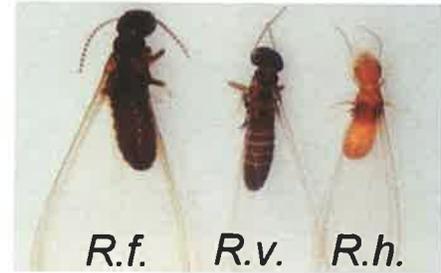
Color:	Light yellowish brown
Size:	Small
Wings:	Pigmented

### SWARMING

Time of year:	December to April
Time of day:	Midday



## Eastern Subterranean Termite, *Reticulitermes flavipes*



**FAMILY:** Rhinotermitidae

**WHERE DOES IT OCCUR?**

- Region: All Florida
- Nest: Soil
- Foraging: Soil
- Damage: Wood, insulation

**IDENTIFYING CHARACTERISTICS**

**WORKER**

- Color: Clear external cuticle
- Size: Small

**SOLDIER**

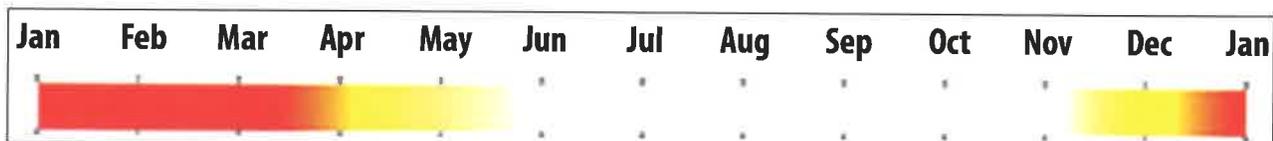
- Color: Off-white
- Size: Large
- Head: Rectangular, orange

**ALATE**

- Color: Dark brown to black
- Size: Large
- Wings: Brownish gray with two dark veins at forefront

**SWARMING**

- Time of year: November through April
- Time of day: Morning





## Conehead Termite, *Nasutitermes corniger*



**FAMILY:** Termitidae

### WHERE DOES IT OCCUR?

Region: Limited South Florida, Caribbean  
 Nest: Trees, soil  
 Foraging: Soil; soil surface  
 Damage: Wood, insulation, trees

### IDENTIFYING CHARACTERISTICS

#### WORKER

Color: Dark  
 Size: Small

#### SOLDIER

Color: Dark  
 Size: Small  
 Head: Teardrop shape, dark, no mandibles

#### ALATE

Color: Black  
 Size: Large  
 Wings: Shiny, blackish

### SWARMING

Time of year: April to May  
 Time of day: Daytime









## Western Drywood Termite, *Incisitermes minor*



**FAMILY:** Kalotermitidae

**WHERE DOES IT OCCUR?**

- Region: Entire Florida
- Nest: Dry wood
- Foraging: Inside dry wood
- Damage: Dry wood; wooden objects

**IDENTIFYING CHARACTERISTICS**

**WORKER**

- Color: Creamy white
- Size: Large

**SOLDIER**

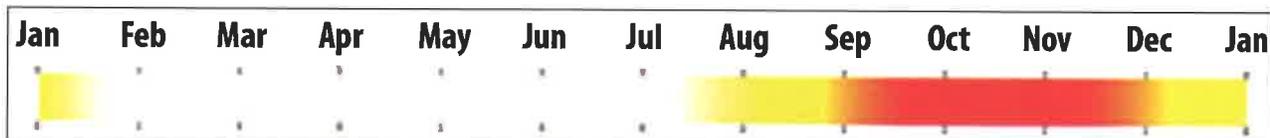
- Color: Yellowish tan
- Size: Large
- Head: Reddish brown; black mandibles with large teeth, third antennal segment

**ALATE**

- Color: Red thorax and head, with brown abdomen
- Size: Large
- Wings: Dark black; sclerotized veins

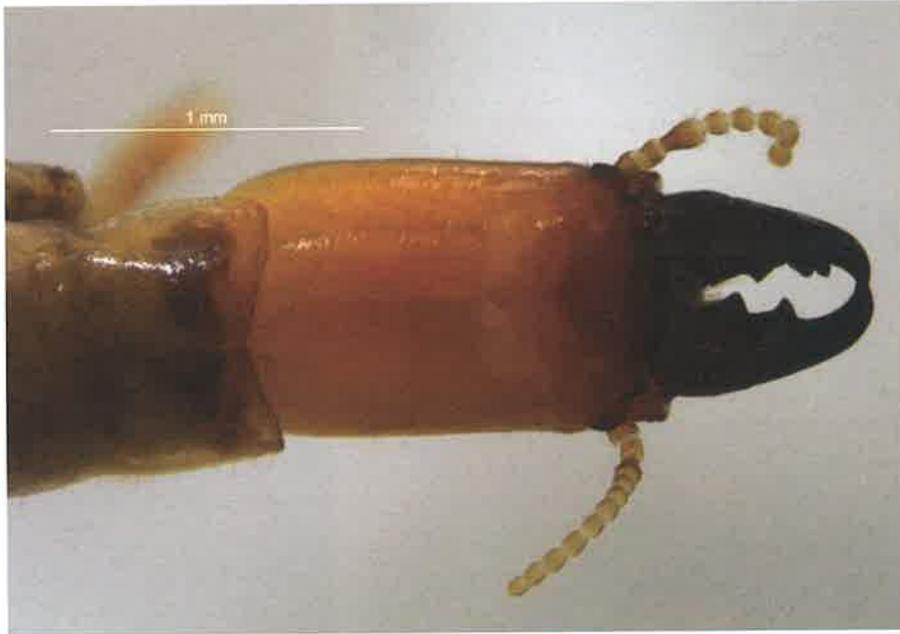
**SWARMING**

- Time of year: September to November
- Time of day: Midday





## Drywood Termite, *Incisitermes milleri*



**FAMILY:** Kalotermitidae

**WHERE DOES IT OCCUR?**

- Region: Florida Keys
- Nest: Dry wood
- Foraging: Inside dry wood
- Damage: Probably not significant

**IDENTIFYING CHARACTERISTICS**

**WORKER**

- Color: Cream to yellowish
- Size: Large

**SOLDIER**

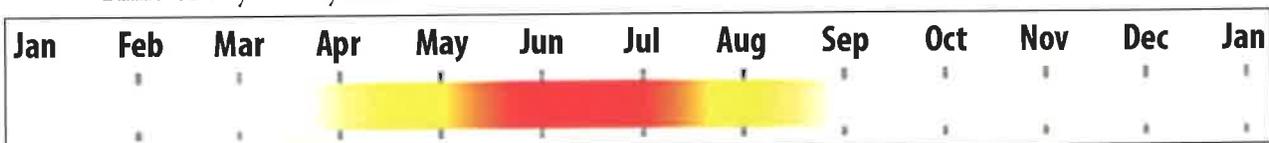
- Color: Yellowish tan
- Size: Large
- Head: Long; reddish brown; black mandibles with large teeth; third antennal segment

**ALATE**

- Color: Dark brown
- Size: Small
- Wings: Tan membrane with brown veins

**SWARMING**

- Time of year: May to July
- Time of day: Daytime



## Drywood Termite, *Incisitermes schwarzi*



**FAMILY:** Kalotermitidae

### WHERE DOES IT OCCUR?

- Region: Southern tip of Florida  
 Nest: Dry wood  
 Foraging: Inside dry wood  
 Damage: Rare in structural dry wood

### IDENTIFYING CHARACTERISTICS

#### WORKER

- Color: Cream to yellowish  
 Size: Large

#### SOLDIER

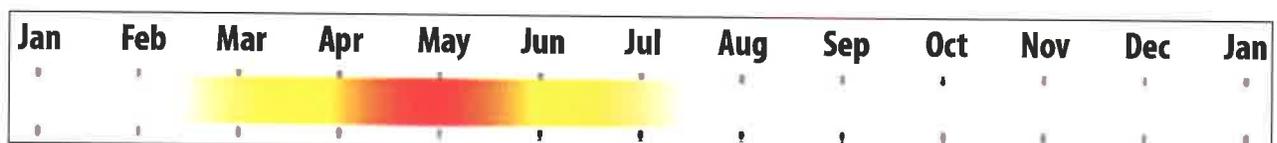
- Color: Yellowish tan  
 Size: Large  
 Head: Reddish brown with black mandibles

#### ALATE

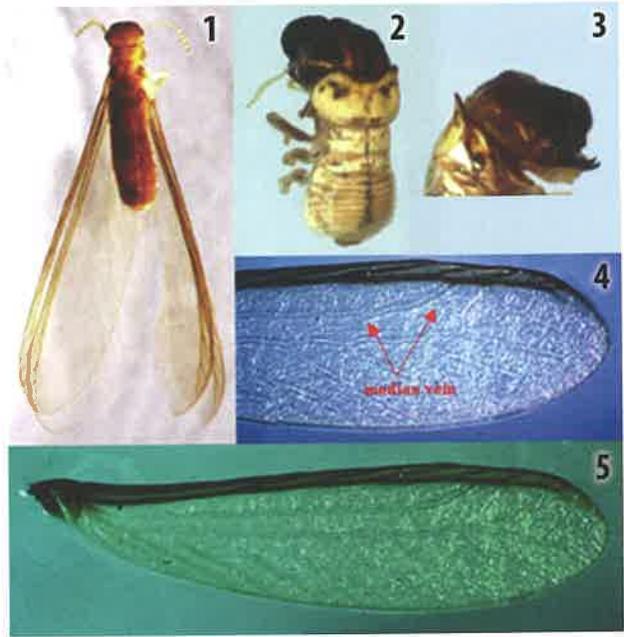
- Color: Medium brown  
 Size: Large  
 Wings: Tan membrane with brown veins

### SWARMING

- Time of year: All months except in winter  
 Time of day: Evening or night



## West Indian Powderpost Termite, *Cryptotermes brevis*



**FAMILY:** Kalotermitidae

**WHERE DOES IT OCCUR?**

- Region: Entire Florida; coastal Southeast United States
- Nest: Dry wood
- Foraging: Inside dry wood
- Damage: Structural wood and furniture

**IDENTIFYING CHARACTERISTICS**

**WORKER**

- Color: Whitish tan
- Size: Large

**SOLDIER (2)**

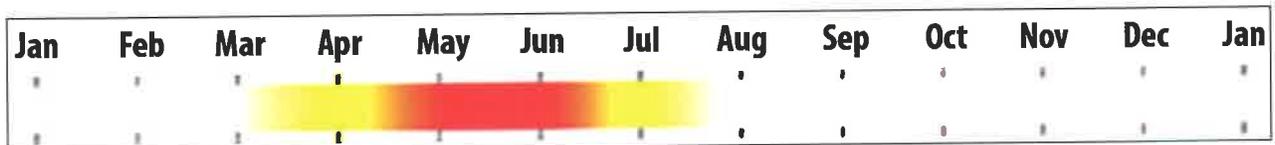
- Color: Whitish tan
- Size: Large
- Head (3): Distinct short head; reduced mandibles with rough, bumpy surface

**ALATE (1)**

- Color: Dull brown to gray
- Size: Large
- Wings (4, 5): Clear, brownish with brown veins

**SWARMING**

- Time of year: April to July
- Time of day: Near sunrise or after sunset



## Tropical Smooth-Headed Drywood Termite, *Cryptotermes cavifrons*



**FAMILY:** Kalotermitidae

### WHERE DOES IT OCCUR?

Region: Peninsular Florida  
 Nest: Dry wood  
 Foraging: Inside dry wood  
 Damage: Uncommon structural pest

### IDENTIFYING CHARACTERISTICS

#### WORKER

Color: Whitish tan  
 Size: Small

#### SOLDIER

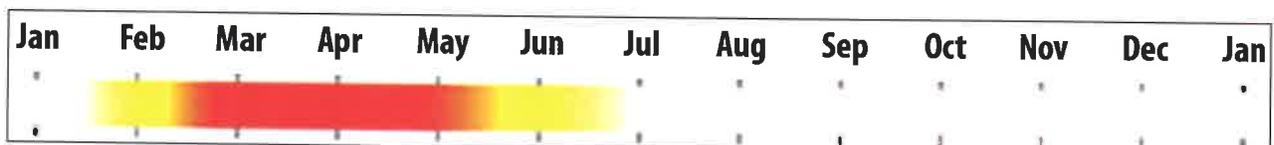
Color: Whitish tan  
 Size: Smaller than *Cryptotermes brevis*  
 Head: Smooth, brown, rectangular; black mandibles with large cavity in front

#### ALATE

Color: Pale yellowish brown to red  
 Size: Large  
 Wings: Dark with pale three dark veins at forefront

### SWARMING

Time of year: Year-round, especially in spring  
 Time of day: Evenings



## Drywood Termite, *Calcaritermes nearcticus*



**FAMILY:** Kalotermitidae

### WHERE DOES IT OCCUR?

Region:	Central to northeastern Florida, southeastern Georgia
Nest:	Dry wood
Foraging:	Inside dry wood
Damage:	Rare in structures

### IDENTIFYING CHARACTERISTICS

#### WORKER

Color:	Light brown
Size:	Small

#### SOLDIER

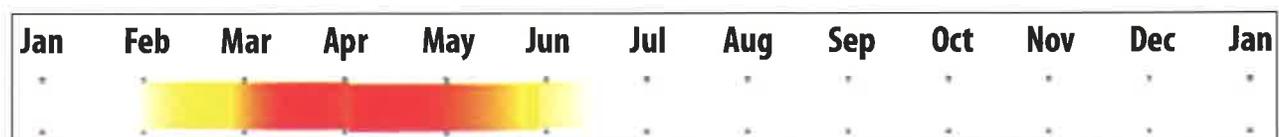
Color:	Light brown
Size:	Small
Head:	Cylindrical, smooth, light brown posterior, and black anterior end

#### ALATE

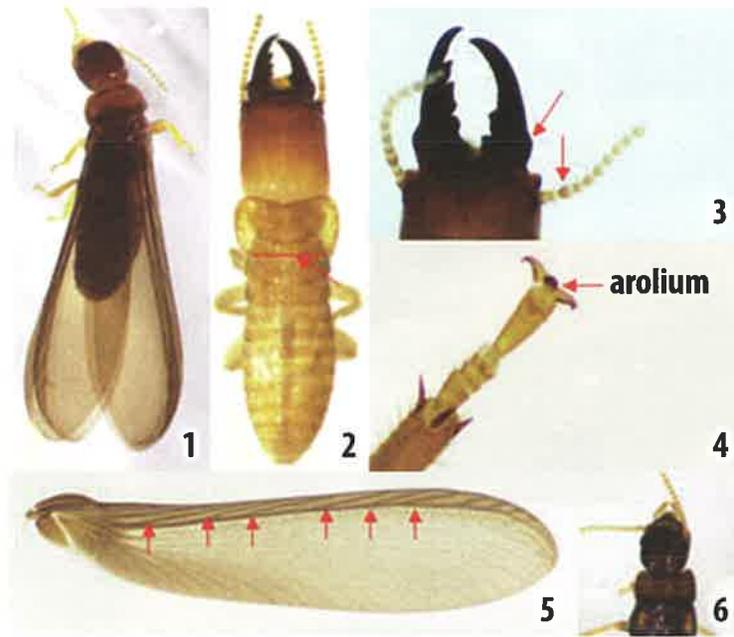
Color:	Dark brown
Size:	Small
Wings:	Blackish with pimples, with dark vein in middle of the wing

### SWARMING

Time of year:	March to May
Time of day:	Midday



## Dark Southern Drywood Termite, *Kalotermes approximatus*



**FAMILY:** Kalotermitidae

### WHERE DOES IT OCCUR?

Region: Central, western and northern Florida  
 Nest: Dry wood  
 Foraging: Inside dry wood  
 Damage: Rare in structures

### IDENTIFYING CHARACTERISTICS

#### WORKER (6)

Color: Light cream to yellowish  
 Size: Small

#### SOLDIER (2)

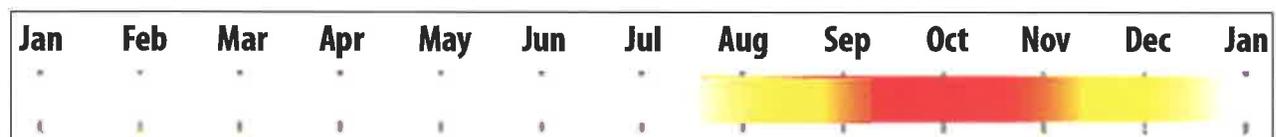
Color: Yellowish brown  
 Size: Small  
 Head: Rectangular; strong black mandibles with humps on outside margins (3)

#### ALATE (1)

Color: Dark reddish brown to black  
 Size: Small  
 Wings: Blackish with black veins; several cross veins in forewing (5)

### SWARMING

Time of year: September to November  
 Time of day: Daytime



# 3 Wood-Boring Beetles

**T**HIS CHAPTER will tell you how to recognize the beetles and the damage caused by the most common and important beetles that attack seasoned wood, as well as how this damage can be distinguished from that caused by organisms that attack unseasoned wood.

Many pest control operators do not identify the various families of wood-destroying beetles and, as a result, do not select the proper control measures. The beetles can be identified sufficiently for control if the PCO knows the families of beetles that attack wood, the type of wood under attack, and the damage caused by each. It is a lot like mathematics; it needs to be done step by step.

The first step is to recognize that beetles have been damaging the wood. The damage is usually not detected until adults emerge by making exit holes in the wood surface. Beetle damage, then, can be distinguished from that of other wood-destroying organisms by the presence of small round or oval holes, and by the meandering, powder-filled larval tunnels in the wood.

The next step is to remember the four major families of beetles that can reinfest seasoned wood. The acronym ALBO (Anobiid, Lyctid, Bostrichid, and Old house borer) may help in memorizing the family names of the wood infesting beetles. Occurrence, severity of damage, and type of wood attacked vary by family. It is important, therefore, to identify the beetle family before determining control measures.

Some families of beetles attack only softwoods, others attack only hardwoods, and still others attack both softwoods and hardwoods. The beetles in some families severely damage seasoned wood and are difficult to control. Those in other families cause less damage and are less difficult to get rid of. However, control of severe infestations of any wood-destroying beetles may be difficult.

Family/Subfamily	Common Name	Suggested Pronunciation
Anobiidae	Furniture/Deathwatch beetles	An-oh- <b>bee</b> -i-dee
Bostrichidae	Bostrichids	Bos- <b>trick</b> -i-dee
Lyctinae	True powderpost beetles	<b>Lick</b> -ti-nee
Bostrichinae	False powderpost beetles	Bos- <b>trick</b> -i-nee
Cerambycidae	Longhorned beetles	Ser-am- <b>biss</b> -i-dee

Many types of beetles attack dying trees, cut logs and stacked firewood. Adults may later emerge from such wood in use or in storage. These beetles cannot reinfest dry wood and do not require control. However, beetle damage in the wood of a living tree, log, or finished product will remain and does not go away. Activity — presence of feeding larvae—should be determined before attempting control. Sometimes PCOs have unnecessarily applied treatments for an inactive infestation of seasoned wood pests or for beetles that cannot infest seasoned wood.

Figure 1. Mass of very fine, powderlike material from powderpost beetles.



Hearth.com

## Wood Inspection

BETTER LARVAE and adults are seldom seen. Therefore, it is important to be able to identify beetle families by examining the wood itself. The acronym TOW-A-TOP helps in identification. TOW refers to type of wood damaged, either softwood or hardwood. A stands for age of wood, either old or new (the time that has elapsed since the lumber was manufactured). Wood less than 10 years old should be considered as new wood. TOP refers to the type of product damaged—a manufactured article, such as a piece of furniture, finished flooring (including laminates), paneling, structural timbers, subflooring, or siding.

To identify the beetle family, a PCO must be able to distinguish hardwoods from softwoods. The designation of a wood as hardwood or softwood has nothing to do with the hardness of the wood. Hardwood comes from broad-leaved trees, most of which shed their leaves each year. Examples include oak, ash, maple, walnut, hickory and mahogany. Softwood comes from coniferous species which have narrow leaves or needles that are usually retained for several years. Examples include pine, cedar and cypress. Hardwoods have large pores and no resin ducts; they often have more distinctive grain patterns than softwoods and often contain light-colored sapwood and dark heartwood. Softwoods have horizontal and vertical resin ducts and no pores. Douglas fir and southern pines, two of the most common species used for framing lumber, have light-colored early wood, or spring wood, and dark late wood, or summer wood.

Wood Type	Foliage Type	Wood Structure	Grain Pattern
Hardwood	Broad leaf/deciduous	Large pores	Light sapwood/dark heartwood
Softwood	Needles/not deciduous	Resin ducts	Light spring wood/dark summer wood

Type of Damaged Wood	Beetles
New softwood	Old house borer, Bostrichids sometimes
New hardwood and bamboo	Lyctids, Bostrichids
Old softwood and hardwood	Anobiids

The type of product use for the wood is often an important clue to the type of wood. For example, most buildings have structural timbers made of softwood. In the Southeast, where beetle damage is prevalent, sills, joists, subflooring, and wall studs are southern pine in most buildings constructed before the advent of metal components. In old buildings, most millwork, finished flooring, and old furniture are hardwood, but in newer buildings, some of these may be softwood. Furniture often contains both softwoods and hardwoods. New furniture that contains particle board, composition board, plastic laminates, or veneer is not usually attacked by beetles. However, true powderpost beetles have been observed emerging from lauan plywood flooring that had become infested while warehoused.

## Powderpost Beetles

The term powderpost beetle, used in the broad sense, applies to any of the wood-boring species of three closely related groups (Bostrichidae, Lyctidae and Anobiidae) within the superfamily Bostrichoidea. Recently, these groups have been reclassified. The Bostrichidae have the traditional family Lyctidae now as a subfamily, Lyctinae, along with the Bostrichinae. For ease of usage, this chapter will use the old family names for the groups of wood-infesting beetles. The common name, powderpost beetle, is appropriate because the larvae of these beetles reduce timbers internally to a mass of very fine, powderlike material (Figure 1). The adults do very little actual damage to wood, serving primarily a reproductive function.

### Anobiids

Anobiid powderpost beetles are elongate-oval and have the head deflected downward from the pronotum of the thorax, which is noticeable from a side view under magnification (Figure 2). The beetles are 4 to 6 mm (about  $\frac{1}{8}$  to  $\frac{1}{4}$  inch) long and develop in softwood or hardwood in structures. They are very common in subflooring of buildings. The beetles lay their eggs in cracks or on the surface of the wood. The larvae bore into the wood and feed on it. Adult beetles emerge from the wood by boring circular emergence holes about 2 to 3 mm ( $\frac{1}{16}$  to  $\frac{1}{8}$  inch) in diameter (Figure 3).

Anobiids are unique among beetles frequently attacking seasoned wood because individual species feed on both softwood and hardwood. The most common species in England is the furniture beetle, *Anobium punctatum*. The Anobiid deathwatch beetle, *Euvrilletta peltata*, is most frequently found in softwoods in homes in the southeastern United States. Both species probably prefer hardwoods. Diffuse porous hardwoods such as maple, beech, magnolia, and yellow poplar are very susceptible to anobiid attacks.

Anobiid larvae feeding in softwood produce a combination of fine yellowish-white powder and numerous ellipsoidal pellets, which gives the loosely packed frass a gritty feel. Frass from hardwood is finer, more tightly packed, and contains fewer pellets.

Infestations usually begin in crawl spaces or areas where wood is near the ground. Although anobiids attack freshly seasoned wood in the laboratory, their damage is usually detected in homes older than 10 years, because infestations develop slowly. Wood is often reinfested by the females, which lay relatively few eggs. Also, many of the young larvae may die, and the life cycle in some woods may be five years or longer. Under favorable conditions the cycle may be one or two years. Available moisture greatly influences development. Adult beetles are only active at night and are numerous only in April, May and June on the Gulf Coast and slightly later farther north. These habits cause infestations to be overlooked until damage becomes widespread.

The age and activity of infestations should be determined before control measures are selected. Anobiid infestations sometimes die out without treatment. Large amounts of fresh, fluffy-looking frass indicate active feeding larvae. If some surfaces of the crawl space timbers contain 30 or more exit holes per square foot, or some pin-sized parasite exit holes, the infestation should be considered well established. Severe, widespread damage may occur when moisture is plentiful and when the beetles are feeding in fast-grown pine



Figure 2. Anobiid powderpost beetle viewed from the side (left) and from above (right).



Figure 3. Anobiid larval and adult damage to wood that has only been infested for a few years.

sapwood typical of newer construction. In such cases the infestation probably has spread upward into the walls.

When active infestations are found in 15- to 30-year-old buildings, both hardwood and softwood materials should be carefully inspected to determine the extent of damage. These inspections are especially important for buildings on poorly drained sites or in warm, humid climates. Exit holes indicate that adult beetles have emerged and that they will continue to emerge each year unless controlled. Reinfestation occurs each year, and wood with holes probably contains the offspring of several generations of beetles. Larvae from the same generation develop at different rates and may emerge as adult beetles in different years. Feeding by larvae and attempted emergence of adults may continue for several years after control.

Thoroughly spraying wood surfaces in the crawl space with recommended insecticides prevents emergence and reinfestation if the infestation is confined to the crawl space. Because it is difficult to determine if beetles have entered the walls, it is advisable to limit the moisture supply beneath infested buildings. This will reduce the likelihood of additional upward spreading, by limiting feeding and reinfestation in the walls. Increasing the rate of ventilation in crawl spaces will help to reduce the relative humidity of the structural wood therein. Cover the soil with 6 mil polyethylene plastic or roll roofing when treating most beetle infestations. Fumigation may be the only choice for severe, widespread infestations. However, it is important to have annual inspections of crawl spaces and early detection of anobiid infestations.

#### **Anobiid Beetles in an Old House — A Case Study**

A beetle infestation was discovered in a 25-year-old house as a pest control firm was inspecting it for subterranean termite damage. Small circular holes and piles of powder were found all over the southern pine timbers in the crawl space. The owners were sold a spray treatment for beetles. All of the wood surfaces in the crawl space were treated. During the next year the owners noticed holes in the wallpaper in their dining room. The holes were in a line down the wall, an indication that beetles were emerging from a wall stud. At the next inspection the owners showed the service man this damage, but he informed them that their beetle contract guarantee was only for the subfloor timbers.

Further investigation and inquiry revealed that the wall studs in the house were repurposed yellow poplar studs from an old barn that had been torn down. Examination of the dining room furniture showed that all of the chairs and the table had fresh beetle exit holes and powder present. The technician said that fumigation was the only effective solution. The owners were an old, retired couple and couldn't afford to fumigate, so the infestation was not controlled.

Due to the financial status of the owners, there was not much the technician could do in his second visit. If he had been familiar with anobiid beetles, however, he would not have misled the owners into thinking the initial controls were adequate. The spray treatment did little more than reduce the beetle population. Probably most of the damage likely to occur in the crawl space had already been done.

With widespread severe infestations of these beetles in the crawl space, the upper parts of the house should have been inspected. Although infestations usually originate in the crawl space, the beetles often spread upward into the walls and even into furniture if the home is on a poorly drained site or in a warm, humid region. It is important to remember that these beetles feed on both softwoods and hardwoods.

The infestation spread upward in the case described. The wall studs probably were not infested prior to construction. In a very favorable wood like yellow poplar, the beetles' life cycle may only be one year. Even inside the walls of this house it was probably three years or less. The owners would surely have noticed damage inside the home before 25 years had passed. Anobiid infestations detected early in the crawl space can be controlled with thorough surface treatments of approved insecticides. With a widespread infestation hidden in the walls, however, fumigation is the only solution.



Figure 4. Lyctid larval damage and adult exit holes in wood that has been infested for several years.

Gerald S. Wiegner

### Lyctinae (Lyctids)

The larvae of Lyctid powderpost beetles develop and feed in hardwood. They usually infest furniture, flooring, paneling and molding. The beetles are elongate with nearly parallel-sided wing covers (elytra) and have a keystone-shaped pronotum (front thoracic segment). They lay their eggs in tiny pits on the surface of wood. The larvae are C-shaped grubs that feed and pupate in the wood. Adults chew out of the wood, leaving circular emergence holes about 1 to 2 mm ( $\frac{1}{32}$  to  $\frac{1}{16}$  inch) in diameter. Adult beetles are brown and are 3 to 5 mm (about  $\frac{1}{8}$  to  $\frac{3}{16}$  inch) long. The antennae have two-segmented clubs.

Lyctids only damage hardwood articles, mostly products manufactured from sapwood. Numerous 1 to 2 mm ( $\frac{1}{32}$  to  $\frac{1}{16}$  inch) diameter round exit holes and fine, talcum-like powder (frass) are characteristic damage signs (Figure 6). The hardwoods attacked must contain a minimum of about 3% starch and must have vessels or pores large enough for the female to lay her eggs in them. Because of these habits, lyctid attacks are usually found in new homes in products such as finished flooring, door or window frames, moldings, and occasionally furniture. Adverse conditions may lengthen the life cycle from one to four years, but infestations rarely occur in wood older than 10 years. Almost always the infestation occurs because the wood contains eggs or larvae when it is placed in the home. New sapwood is most severely damaged because it contains more starch than heartwood and because it loses starch with age. The relatively short life cycle, high initial populations, and high survival of offspring often result in rapid and extensive damage. Such damage in exposed areas within the home is detected readily.

For lyctid control, only hardwood products need to be treated. If the infestation is small, removal and replacement of infested products may be most practical. Spraying, brushing, or mopping successive small areas with recommended insecticides may suffice. Only large, poorly accessible infestations warrant fumigation of the entire building.

#### Lyctids in New Houses — A Case Study

The owners had just moved into their new slab-on-grade house. They felt confident their major lifetime investment would be secure against insect damage because they wisely had the soil treated for subterranean termite control before the slab was poured. After about one year of residence, the owners noticed some “sawdust” and several small circular holes in their living room floor. They had just renewed their termite control service contract and decided that they should contact the same pest control firm for assistance.



Figure 5. Lyctid powderpost beetle viewed from the side (left) and from above (right).

Figure 6. Powderlike frass of lyctid larvae recently expelled from adult exit holes in oak flooring.



Gerald S. Wegner

The pest control technician informed the owners that they had an infestation of powderpost beetles and that their termite contract guarantee did not cover beetle damage. The technician also said the entire hardwood living room floor was in danger of being turned into “powder” and that control was necessary. When the owners asked if the beetles would eat the softwood framing of the house too, the serviceman replied, “I don’t know, we’ll just have to wait and see. Some beetles feed on softwood, others on hardwood, while some beetles feed on wood of both types.”

The owners agreed to have the house fumigated. There seemed to be little choice. But there was a choice. If the service man had been familiar with the habits of wood-destroying beetles, he would have known that the insects most probably responsible were lyctids or true powderpost beetles. These beetles are usually found in manufactured products in relatively new homes. Often they are introduced as eggs or larvae in improperly dried wood or wood that has been stored for a while. They damage only hardwoods with pores large enough to receive their eggs. The damage is most severe in woods with high starch content and is usually confined to the sapwood. Thus, the owners had no reason to worry about the softwood framework of their house.

Depending upon the extent of the infestation, several control measures were possible. If only a few boards were infested, control could have been achieved by removing and replacing infested boards. Putting shut existing beetle exit holes is desirable because it permits detection of new exit holes made after treatment, which may indicate incomplete control. Fumigation for beetles in this or similar situations is necessary only if the infestation is very large, causing removal and replacement to be too expensive.



Figure 7. Bostrichid powderpost beetle viewed from the side (left) and from above (right).

### Bostrichids

Adult bostrichids have parallel-sided wing covers (elytra), similar to lyctid beetles, and have the head deflected downward from the pronotum like anobiid beetles. However, they often have rough texturing on the front of the pronotum and sometimes on the rear margins of the elytra (Figure 7). The larvae of bostrichid beetles live and feed in wood. They can attack both hardwood and softwood, including bamboo, wicker and weaving material of baskets. The beetles bore into the wood to lay eggs. The larvae eat and pupate in the wood. Adult beetles are 3 to 6 mm (about  $\frac{1}{8}$  to  $\frac{1}{4}$  inch) long. To emerge, they bore round exit holes greater than 3 mm ( $\frac{1}{8}$  inch) in diameter.

Bostrichids are similar to lyctids in habits and usually occur in similar situations. Most species feed only on starchy hardwoods or bamboo, but some other species may attack

softwoods. Many species require bark for egg-laying and do not reinfest wood in homes. Bostrichids have coarser, more tightly packed frass and somewhat larger exit holes than lyctids. In general, the same control procedures apply to both bostrichids and lyctids.

### Cerambycids

Longhorned beetles are large ( $\frac{1}{2}$  to 3 inches long), conspicuous beetles with long, thin antennae that may be longer than their bodies. They usually lay their eggs on unseasoned, rough-sawn timbers or logs. The larvae, called roundheaded borers (Figure 8), feed in the wood, boring large, oval holes as they move through it. Infestation usually takes place before the timber is used in structures. The larvae of some species take more than one year to complete their development, so they may still be feeding in the wood after it becomes part of a structure. Damage is usually limited to pine sapwood and can be recognized by the ripples on the surface of the galleries.

The adult beetle will not lay eggs for reinfestation on this type of wood, so control is rarely needed. However, the exception to this is a species known as the old house borer, *Hylotrupes bajulus*. Old house borers attack timbers in a building, so they are the only longhorned beetles requiring control measures.

### Old House Borer

Adult beetles are 15 to 25 mm (about  $\frac{2}{3}$  to 1 inch) long, flattened and grayish-brown to black (Figure 9). The pronotum of the thorax (area behind the head) has two shiny black spots on it and there are two white patches on the wing covers (elytra). The larvae spend two to 10 years feeding on sapwood of pine, fir, spruce and other softwoods. Adults emerging from infested wood bore oval emergence holes that are 6 mm to 15 mm long.

Old house borers only attack softwoods. Pine sapwood is frequently damaged, but spruce and Douglas fir may also be attacked. Old house borers prefer recently seasoned wood and usually cause damage in recently constructed homes, particularly log homes. However, infestations may continue for 10 or more years. Again, the beetles are usually brought into the home as eggs or larvae in lumber or logs. Usually infestations are limited to a few boards. Adjoining sound boards may be infested by boring larvae. Larvae become large and cause extensive damage. They usually feed in hidden areas such as the structural framework of buildings, or deep within logs, despite curing and superficial treatment with wood preservatives and stains. Depending upon conditions, damage may not be detected until adults emerge three to 10 years after construction. Both the adult exit holes and the feeding tunnels of large larvae are oval and about 7 mm ( $\frac{1}{4}$  inch) in diameter (Figure 9). Walls of galleries are rippled and galleries near the surface cause lighter colored streaks to appear on the wood surface. The frass is a coarse, tightly packed powder.

Old house borer control should be directed to softwoods only. The method selected should be based on the extent of the infestation. Fumigation is required when the beetles are numerous and widespread, and when thick wood structural elements are present, as in log homes. Spraying or applying a bodied emulsion to damaged timbers may control small exposed infestations.

### Old House Borers in Basement Ceiling Joists — A Case Study

The owner was working in the basement of his four-year-old house when he heard some rasping or scraping noises. He finally located their source in the southern pine ceiling joists. He also noticed five or six oval holes about  $\frac{1}{4}$  inch in diameter in some of the joists. Concerned, he called the pest control firm that had his house under a termite contract.

The technician examined the damage and told the owner he had old house borers or “powderpost beetles.” The service man wouldn’t spray the wood with insecticide because of fear of contaminating food stored in the basement. Instead he spread a mayonnaise-type insecticidal compound near both ends of the damaged joists. He said the compound would repel the adult beetles and would kill the young ones feeding in the wood near it.



Unknown

Figure 8. A typical roundheaded borer – the larval form of longhorned (cerambycid) beetles.



Figure 9. Old house borer adult viewed from the side (left) and from above (right).



USDA Forest Service

Figure 10. Old house borer exit hole between adult (on left) and larva (on right).



Bigwood.org

Figure 11. Wood previously infested with ambrosia beetles and stained with ambrosia fungi.

As time passed, the owner continued to hear scraping noises and noticed a few more holes. He couldn't get the service man to come back and re-treat his house. The owner became more and more worried because some areas of the joists were heavily tunneled and the noises were still present.

Although the technician should have just said old house borers, his diagnosis of the insect responsible for the damage was correct. He failed, however, to recognize the seriousness of the situation, and the control measures he took were ineffective. The owner should have been told that the large larvae of old house borers are capable of causing very extensive damage as they feed in the wood for three to four years or longer. He should also have been told that the adults would infest only softwood. Thus, softwood timbers were endangered, but hardwood flooring and millwork were not.

The behavior of the beetles is far different from that which their name suggests. They prefer to attack recently seasoned wood, and they are usually found in new homes. Infestations are often "built into homes" by using lumber that contains eggs or small larvae. When infested timbers are exposed, spraying the wood surfaces with insecticide is recommended for control. In view of the threat to the house in question, moving of foodstuffs in danger of contamination was certainly justified. Treating the ends of the joists would only have killed larvae feeding in that area. Old house borers are usually hidden inside structural framework of houses, and widespread infestations usually can only be controlled by fumigation.

## Sources of Beetle Damage Confusion

Although bostrichids rarely occur in new softwoods, their smaller round exit holes would distinguish their damage from the  $\frac{1}{4}$  inch oval holes of old house borers. However, many longhorned borers make oval holes similar to those of old house borers in softwood. Fresh damage by longhorned borers, however, is only found in very new buildings and is seldom extensive. Old house borer frass is tightly packed powder, whereas the frass of the other beetles is loose, fibrous shavings.

In general, bostrichid damage to new hardwoods is so similar to that of lyctids that further identification is not needed for control. Lyctid frass is loosely packed and so fine that it feels like talcum powder, while bostrichid frass is coarser and tightly packed. Most bostrichid exit holes are usually larger than those of lyctids. The flat oak borer, *Smodicum cucujiforme*, is a small (10 mm or  $\frac{3}{8}$  inch), yellowish-brown longhorned beetle that occasionally attacks flooring or paneling, and will reinfest seasoned wood. It should be controlled in the same manner as lyctids or bostrichids.

Damage of several other insects may be confused with that of Anobiids. Ambrosia beetles (family Curculionidae: subfamilies Scolytinae and Platypodinae) comprise several species that attack drying wood, usually logs, and may bore deeply into the wood. When a log is sawn into lumber, the tunnels will be intersected and appear to be at an angle to the wood surface. Ambrosia beetle tunnels are somewhat smaller than anobiid exit holes, and they usually have red-, purple- or black-stained walls due to the introduction of ambrosia fungi by these beetles (Figure 11). Anobiid exit holes are usually perpendicular to the wood surface, i.e., come straight out of the wood. Occasionally, ambrosia beetle tunnels will branch or have short tunnels perpendicular to another long tunnel. Anobiid tunnels do not. Ambrosia beetles do not reinfest dry wood, although they may emerge from wood one to two years after it is cut. No control is necessary.

Occasionally, strips of bark (wane) will be on the lumber. Sometimes beetle damage is present in the bark or adjacent wood. Bark beetle damage can be distinguished from anobiid damage by the exit holes in bark, the winding galleries immediately beneath the bark, and the powder in the tunnels in the wood. Some of this powder will usually be reddish brown like the bark. Again, no control is necessary because reinfestation does not occur.

# 4 Wood-Decay Fungi

**W**OOD-DECAY fungi (singular—fungus) are a group of several species of plant-like organisms in Kingdom Fungi that are able to destroy wood. Fungi need the high moisture and humidity conditions that are common in Florida. Wood-decay fungi feed on living or dead wood for nutrition because, unlike green plants, they cannot make their own food from photosynthesis. Some fungal forms, e.g., individual yeast cells, are so small they can be seen only with a microscope. Other forms are large enough to see, such as mushrooms, which are quite large.

Fungal fruiting bodies produce spores similar to seeds, which are spread by wind and water. Spores can be present and infest wood when it is being cut, processed or used. When wood is infected with fungal spores, the fungus germinates, forming threadlike filaments known as hyphae (singular—hypha). As these hyphae grow, they develop into a fibrous, branching, rootlike mass of fungus referred to as a mycelium. Hyphae can spread through the wood from the point of infection. For wood-decay fungi, hyphae are commonly found within the wood but also can grow on the surface.

Wood-decay fungi that destroy wood have certain requirements:

- Favorable temperatures: usually between 50° and 100°F. However, the optimum is usually 70° to 85°F.
- Adequate moisture: fungi usually cannot degrade wood with moisture content below 20 percent. However, wood moisture content of about 30 percent is needed for serious damage.
- Adequate oxygen: Fungi cannot live in wood that is completely saturated with water because of poor oxygen exchange with air in the atmosphere.
- Suitable food source: wet wood is an ideal food source. Wood decay fungi are often found in close association with subterranean termites because they often bring water from the soil to moisten wood.

Damage by fungi and subterranean termites commonly occur together. Fungi may cause damage alone or may also indicate the presence of termites; therefore, it is important to recognize the common fungi that attack wood and distinguish them from termites and termite damage. There are three major types of fungi that attack wood. These are the surface fungi, the staining fungi, and the decay fungi.

Some fungi attack wood only when it is in the log stage and cannot damage or continue damaging after the wood is milled, cured and installed into a structure or building. No control is necessary for these fungi. However, it is important to differentiate them from the types that do require control measures.

## Surface Fungi

Molds and mildews are surface fungi: They grow primarily on sapwood from coniferous and deciduous tree species. Wood that is covered with surface fungi has a powdery appearance or surface discoloration. These fungi do not destroy wood. They grow in the



US Forestry Service

Figure 1. Staining fungi



Wikimedia Commons / Mates II

Figure 2. Cubical brown rot



Wikimedia Commons / Stern

Figure 3. White rot



University of Minnesota

Figure 4. Soft rot

sugar storage cells of sapwood, do not destroy the wood cell walls where cellulose provides the strength of wood, and do not reduce the structural strength of the wood.

Treatment of wood attacked by surface fungi and installed in a structure is not required. Surface fungi are just indicators of high humidity and moisture conditions. Their presence indicates that the wood has absorbed excessive water and could be attacked by wood-destroying fungi. Surface fungi do not infest dry wood, but wood attacked by surface fungi is more permeable to moisture and can lead to further wood decay fungi problems.

## Staining Fungi

Blue staining fungi (*Ophiostoma* spp.): Staining fungi also attack the surface of sapwood from various hardwoods and softwoods. They differ from the surface fungi in that their hyphae grow into the outer layers of sapwood. The staining fungi cause a gray to bluish stain in the wood that cannot be removed (Figure 1). They enter wood cells and use the contents as a primary food source. They do not cause destroy the structural integrity of wood, but they can allow serious decay fungi to enter and cause serious damage. The presence of staining fungi also indicates that wood has absorbed an excessive amount of water. Staining fungi may be introduced to wood by ambrosia beetles (Family Curculionidae: Subfamilies Platypodinae and Scolytinae) before trees are cut and milled.

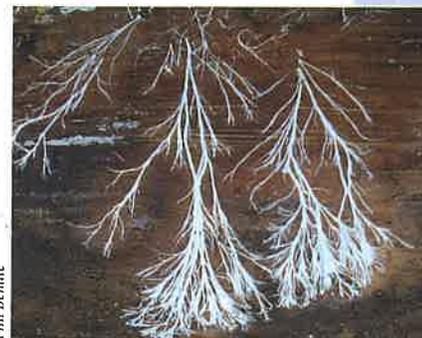
## Wood-Decay Fungi

Wood-decay fungi actually utilize and digest the structural portion of the wood (cell walls) to satisfy their nutritive needs. Destruction of the wood cell walls results in a loss of structural integrity, making the wood less suitable for construction purposes or renders it completely unfit if decay is advanced. Wood decay fungi can attack both the sapwood and heartwood. Enzymes secreted by the fungi break down cell walls which are composed of cellulose, hemicellulose and lignin so they can be readily assimilated and utilized.

Some types of decay fungi include:

- **Cubical brown rot (*Serpula lacrymans*), mine fungus, (*Fibroporia vaillantii*), and cellar fungus (*Coniophora puteana*):** These fungi cause the wood to break into small cubes with cracks running perpendicular to the grain (Figure 2). This cracking condition happens when wood changes in moisture content from wet to dry. As the wood dries, it becomes brittle as it shrinks. The wood becomes brown and crumbly and strength decreases rapidly. Eventually all the cellulose is decomposed, and lignin is left behind, giving it a dark-brown appearance. The infested wood becomes brittle and can be crushed into a powder.
- **White rot, *Phanerochaete chrysosporium*:** Fungi that cause white rot attack not only cellulose but also lignin. Destruction of the lignin causes a whitish, bleached, stringy appearance to the wood (Figure 3). The wood texture is spongy with little strength. White rot is common in crawl spaces that are consistently wet. Shrinkage is usually not associated as a characteristic of this type of rot.
- **Soft rot, *Chaetomium* spp., *Ceratocystis* spp., and *Kretzschmaria deusta*:** Soft rot fungi attack the wood from the surface inward and cause cavities to form (Figure 4). They generally are found in situations where the wood is too wet to be attacked by other decay fungi. This type of rot might be expected in cooling towers, pulpwood chips, marine habitats and in wood contacting the soil. This rot is less destructive than white rot.

- **Water-conducting fungus, *Meruliporia incrassate*:** This is a type of brown rot fungi and is often referred to as dry rot. This fungus has specialized structures called rhizomorphs that conduct water from wet soil to wood. Rhizomorphs begin to appear from the wood and connect the infested wood to the soil (Figure 5). They are dirty white at first and become brown or black as they age. Rhizomorphs are usually  $\frac{1}{4}$  to 1 inch in diameter. They allow this fungus to attack wood that is too dry to be attacked by other wood decay fungi. This fungus can have rhizomorphs up to 25 feet and conduct water from moist soil to wood. This fungus is known to destroy large areas of wood in one to two years. Mycelial fans that are papery and whitish-yellow are often present.



Phil Bendle

Figure 5. Water-conducting fungus

## Other Fungal Growth Affecting Wood

Several other fungi attack wood before it reaches the lumber stage. Pecky rot (Figure 6) and pock rot are two of these fungi. They may damage the wood, do not develop after the wood is cut and installed inside a building. Also, there are some bacteria that can grow in wood with high moisture content. They are not destructive but can cause sour odors.

## Control

All wood-destroying fungi have certain basic requirements that include a food source, favorable temperature and adequate oxygen and moisture. If any of these requirements are not present, fungal growth does not occur. The most practical method of controlling wood decay fungi in structures is to prevent the accumulation of high wood moisture.

Methods of moisture control include:

1. Preventing wood-to-soil contact
2. Installing moisture barriers
3. Providing adequate ventilation
4. Improving drainage around the building
5. Applying chemical preservatives
6. Painting or sealing wood

The following checklist can be used as a guide in helping avoid problems with decay fungi and/or termites.

## Checklist for Decay Problems

1. **Flowerbeds next to house:** Soil should not touch wood siding.
2. **Soil grading:** Wood should be at least 3 inches above adjacent finish grade for framing members, 6 inches above finish grade for siding.
3. **Lawn sprinklers / irrigation systems:** Persistent wetting of exterior wood creates high decay hazard.
4. **Wood junctions:** Decay often occurs where boards or beams are jointed together, end-to-end. Also, the ends of boards or beams absorb water much more rapidly than the sides do. Metal caps help prevent decay.
5. **Ends of exposed beams:** Cracks that open as wood dries out permit rain to soak into the wood. Exposed beams should be treated with preservative. When the preservative is thoroughly dry, ends should be capped with a metal shield.
6. **Roof overhang:** A wide overhang moves water runoff away from exterior walls.
7. **Roof dormers and chimney:** Flashing must be used where dormers extend from gable roofing.



Gerald S. Wegner

Figure 6. Pockets in milled cedar resulting from pecky rot infection of the tree prior to cutting.

8. **Roof construction and contours:** Water should flow completely off the roof and away from house; otherwise, wooden members are wetted continually. Flashing is needed where roof sections abut at different angles.
9. **Roof edge and drip edging:** If shingles don't extend enough beyond the fascia board, water that curls under the shingles will drain over the wood elements at the roof edge. Metal edging extends the drip line away from the roof to clear the wood roofing, fascia board and soffits.
10. **Splashing rain:** Rain from the roof that falls onto a hard surface like a patio can splash. Install rain gutters with downspouts that direct the drainage away from the house.
11. **Porch areas:** Porch surface must slope away from house to avoid water collection.
12. **Wooden posts:** Be sure posts do not touch the porch surface. Direct water to flow away from posts.
13. **Plumbing leaks:** Prevent spillage behind washing machine. Stop leaks beneath sinks, at top of built-in tub, and in shower.
14. **Condensation underneath house:** Some houses need a vapor barrier between the ground and the house.
15. **Water collecting under house:** Fill holes and channel water away from house (e.g., with installation of French drainage system).
16. **Indoor humidity issues:** Operate dehumidifiers in those areas of the structure where humidity persists after structural issues have been corrected.

# 5 Other WDO-like Organisms

A NUMBER of arthropod species found in Florida qualify as WDO-like organisms in that they are known to cause superficial damage to wood, either before trees are milled into lumber or post-construction. In most cases the damage created does not pose a significant threat to the structural integrity of the wood in question. Certain ants, bees and other insects may excavate limited cavities in wood in which to rear their young, but do not utilize wood as a food source. Often the condition of the wood, having been exposed to moisture and fungal decay, is conducive to excavation by these organisms or has already become structurally compromised.

## Bark Beetles

Bark beetles are in the subfamily Scolytinae and are now in the family Curculionidae (weevils). They feed and develop within the cambium layer just under the bark of trees. They are widespread, common and frequently abundant in the landscape but are not able to infest seasoned wood in houses. Bark beetles are found in trees that are under stress or in the process of dying. They are also common in firewood cut from recently dead or cut trees.

Bark beetle attack of trees, logs or firewood is recognized by powdery, sawdustlike frass created as the beetles chew and tunnel under the bark. Small, buckshot-sized emergence holes indicate past bark beetle activity as most of the holes are made when the beetles emerge from infested wood. Small winding tunnels or galleries less than  $\frac{1}{8}$  inch wide under the loose bark show where bark beetles were feeding and where larvae emerged from eggs (Figure 1).



*Figure 1. Bark beetle evidence on the surface of sapwood beneath the bark on a tree trunk.*



Figure 2. *Ips* species, a bark beetle.

Bark beetles are small, 2–3 mm ( $\frac{1}{16}$  to  $\frac{1}{8}$  inch) in length, cylindrical, brown to black beetles (Figure 2). Adults typically appear in the spring and females deposit eggs in galleries just under the bark. The eggs hatch into small, white legless larvae with brown heads. The larvae tunnel under the bark as they eat and grow, producing winding tunnels between the bark and the sap wood of the tree. New adults emerge through small round exit holes in the bark. There may be two or three generations of beetles produced each season and dying trees, logs or firewood may contain hundreds of individuals.

Bark beetles attack green logs and firewood for one or two seasons following cutting but do not attack cured wood or lumber. Bark beetles that emerge inside the house can be annoying and a source of anxiety. However, they are never a threat to people, furniture or the house structure. All firewood brought indoors in autumn and winter should either be burned or moved back outdoors before springtime in order to avoid insect pests from emerging indoors. Spraying infested firewood is of no practical benefit and is not advised.

#### Bark Beetle Damage — A Case Study

A technician was inspecting the crawl space of a 20-year-old house treated for termites two years previously by his firm. He noticed a few small, circular holes near and in some bark on several joists. He told the owner, a widow, that she had “powderpost beetles” and that if her house was not treated, extensive damage could occur. Alarmed, she borrowed the money and had the treatment done.

Careful examination, including probing into the wood for frass-filled tunnels, would have indicated that the tunnels were not extensive. Some of the powder in the tunnels was the same color as the bark. If the technician had been familiar with such damage he would have recognized this as the work of bark beetles. Probably the damage occurred as the logs were drying, before the lumber was cut. No control was necessary.



Figure 3. *Ambrosia* beetle gallery. Notice the dark wood staining.

## Ambrosia Beetles

As mentioned earlier, ambrosia beetles are in the subfamilies Scolytinae and Platypodinae in the family Curculionidae (weevils). They attack stressed, dying or dead trees, and are not able to attack seasoned, dry wood in structures. Adult ambrosia beetles are generally small, reddish brown to nearly black, cylindrical beetles measuring 3 to 5 mm (about  $\frac{1}{8}$  to  $\frac{3}{16}$  inch) long. Larvae are small, white, legless grubs similar to bark beetle larvae. The host wood is usually conifers.

Ambrosia beetle damage occurs to wood before it is installed in a house. The beetles attack weakened, dying, and recently cut or killed trees. They can attack freshly cut lumber and lumber in decks before it is dried, and they can cause pinhole defects and dark staining in the outer wood. Galleries are formed in the sapwood or heartwood and damage the wood. Because ambrosia beetles tunnel into the wood, they are considered wood borers rather than bark beetles in this guide.

Adults introduce ambrosia fungi that stain the wood (Figure 3), sometimes lowering its value, although some people find the staining to be of artistic value. Ambrosia beetles feed on the fungus rather than the wood. The most obvious sign of an ambrosia beetle attack is the fine, white boring dust that accumulates at the base of the tree and in the bark crevices.

Adults bore straight into the tree, creating perfectly round, small-diameter holes. If the bark is removed, the entrance points of adult ambrosia beetles and galleries are distinctive and are often surrounded by a red-, purple-, dark brown or black fungal stain. Damage caused by ambrosia beetles can vary greatly among locales. In some areas, aggressive control programs are required to reduce economic damage to wood products.

### Ambrosia Beetles in Floor Joists — A Case Study

After inspecting the crawl-space timbers of a 30-year-old house, a technician told the owners they had “powderpost beetles.” Small circular holes were present in several of the southern pine joists. The owners paid for a spray treatment.

Careful examination showed the tunnels were empty, the walls of many of the holes were stained, and the tunnels were at an angle to the wood surface, which suggested they were in the log when it was sawn. All of these characteristics suggested the damage had been done by ambrosia beetles. These beetles usually attack trees as they are drying. Ambrosia beetles cannot reinfest dry lumber, although they may survive for a year or two in wood that is drying. Thus, no control was needed.

## Ants

Ants of the genus *Camponotus* often nest in wood. Carpenter ants of some species are large, reaching lengths of 13 to 15 mm (about ½ to ⅔ inch) long. The nests are usually in hollows of old tree trunks, logs and stumps, and may be associated with wood decay or termite damage in a house. The Florida carpenter ant (Figure 4) is red and black.

Carpenter ants may construct their nests in hollow trees, logs, stumps, posts, porch pillars, hollow doors, and other timbers used in homes. The ants do not consume the wood but simply hollow it out to form cavities for the nest. They are usually attracted to damp, decaying wood, but once the nest is started, they will also excavate sound wood as they enlarge the nest. It is often quite common to find them nesting in existing voids that require no excavation; occasionally they start in an existing void and enlarge it as their need dictates. The presence of carpenter ants suggests the potential for damage to wood.

## Carpenter Bees

Carpenter bees, *Xylocopa* species (Figure 5), are 20 to 35 mm (¾ to 1½ inch) long. They closely resemble bumble bees, except the abdomen of a carpenter bee is a shiny metallic greenish- or bluish-black, whereas the abdomen of a bumble bee is very hairy. Also, carpenter bees have a noticeably wider head than bumble bees, to accommodate the muscles that work the mandibles. These insects sometimes build their nests in solid wood such as weather boarding, railings, supports and trim of buildings. Their nests are in the form of tunnels 3–24 inches deep, running with the grain of the wood. The entrance hole is 11 to 12 mm (about ¾ inch) in diameter. The holes are very clean and appear as though they were made by a drill. Damage to wood is seldom extensive.

The eastern carpenter bee, *Xylocopa virginica*, resembles a bumblebee in that it is robust and black with some markings of yellow hair (setae). The dorsal surface of the abdomen lacks the yellow hair markings of bumblebees and is mostly devoid of any hair. The southern carpenter bee, *Xylocopa micans*, is roughly the same size but is darker, with more of a metallic blue or green sheen to the cuticle.

These bees are considered pests of wood because they excavate tunnels in soft-wood as sites for producing their brood (Figure 6). Common nesting sites are posts, fence railings, porch support posts, wall siding, eaves, wooden shingles, windowsills, doors, and wooden porch furniture.



Figure 4. Florida carpenter ant worker.



Figure 5. The eastern carpenter bee, *Xylocopa virginica* (top) and southern carpenter bee, *Xylocopa micans* (bottom) occur in Florida.



Figure 6. Eastern carpenter bee galleries in pine fascia board; larvae and pupae are visible in the developmental cells at left.



# 6 Foundations, Framing, and Terminology

**W**OOD-DESTROYING INSECTS enter structures through small gaps and cracks between elements of construction. In most cases, these insects are associated with moisture and water in some way. For instance, subterranean termites usually live in the soil for moisture, build tunnels and enter buildings at predictable places based on the construction elements. Termites can then carry and deposit water on dry wood in order to consume and live in it. Wood-decay fungi can destroy wood where moisture accumulates in buildings due to roof leaks, poor aeration of crawl spaces, plumbing leaks, and other sources of water.

In most cases, areas of high risk for structural pests can be found based on the type of construction. Also, after inspecting for wood-destroying organisms, the structure should be drawn/diagrammed, and the areas where these organisms occur need to be indicated. This graph is important to determine where treatments should be placed and also to document the extent of infestation before treatment. Construction elements should be correctly identified and labeled according to various areas of a house: the foundation type, wall framing, window and door framing, and attic and roof structures.

**1. Foundation terms.** Concrete slabs are common foundation/floor systems in many parts of the world, particularly in warmer climates with soils that are stable, i.e., not expansive or otherwise active. Typically, from the ground up, building a concrete slab consists of 4 inches of sand, gravel, or crushed stone; a layer of 6 mil polyethylene used as a vapor barrier, with seams overlapping a minimum of 6 inches; a layer of wire mesh, usually #10 wire welded in 6-inch squares (6×6–10/10), which is embedded in the concrete; and 4 inches of 3,000 psi concrete.

**a. Monolithic slab** (Figure 1). The slab and the footer for this foundation type are both poured at the same time. The footer, at the perimeter of the slab and under any load-bearing walls, is a thicker area of concrete than the floor area. The footer portion of the slab is usually reinforced with steel called rebar. The footer is set up and poured at the same time as the slab. This is done by digging the footer and forming the outside edge, typically with lumber held in place with stakes and bracing until the concrete cures.

**b. Supported slab** (Figure 2). The slab and foundation are constructed at separate times. The footer/foundation wall is poured or constructed first. A common type of construction would be a concrete footer with concrete block foundation wall laid later on top of the footer. The concrete slab floor is poured later and is supported by the foundation wall and extends to the edge of the slab. In the middle it rests directly on the ground. A cold joint is usually visible at the top and on the side of the outside foundation wall.

**c. Partially supported slab** (Figure 3). Similar to the supported slab, a partially supported slab is poured with the outside edges of the concrete block being the form for the concrete when it is poured. The inner edge of the concrete block supports the slab. As a result, the slab does not extend to the outer edge of the foundation wall. At doorways, a cold joint or crack may be visible between the floor slab and the foundation slab.

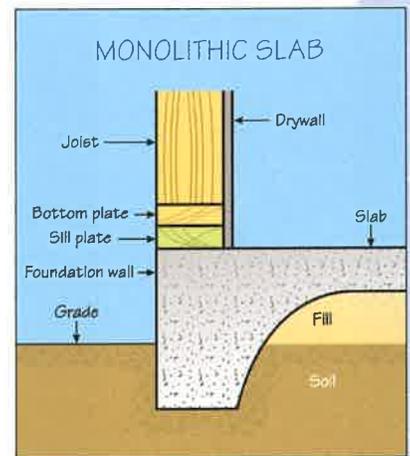


Figure 1. Monolithic slab foundation.

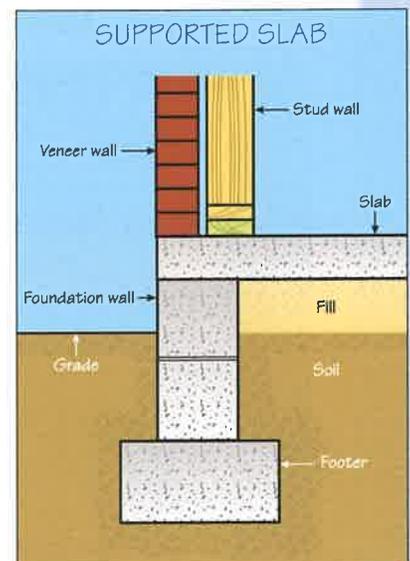


Figure 2. Supported slab foundation.

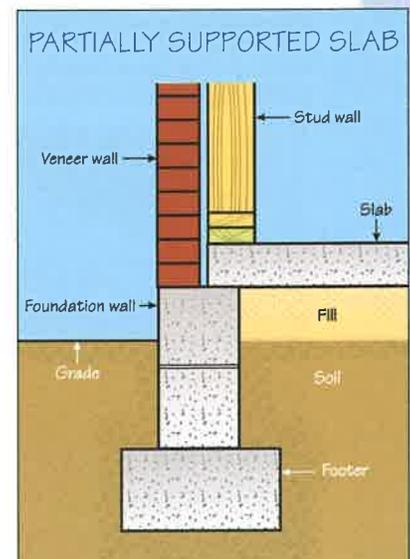


Figure 3. Partially supported slab foundation.

Figure 4. Floating slab foundation.

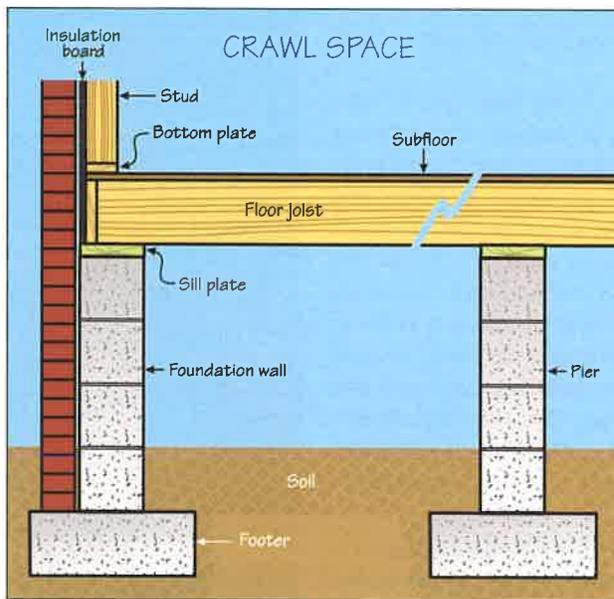
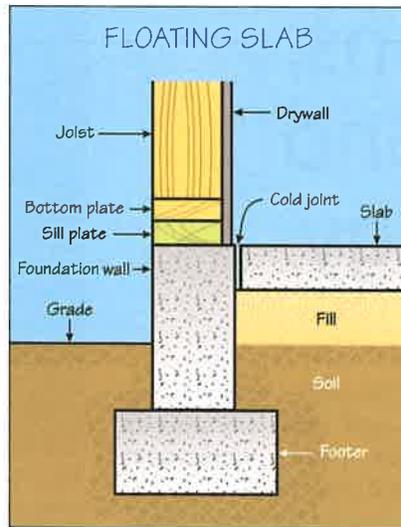


Figure 5. Crawlspace foundation, including pier and post interior load-bearing elements.



Figure 6. Stem wall of concrete block.

- d. **Floating slab** (Figure 4). A floating slab “floats” on the soil, with a deeper stem wall or concrete foundation wall around the edge holding it in place. Similar to the supported slab, the footer and the foundation wall are poured/constructed first, and then the concrete floor slab is poured so the inside wall of the foundation is the form. Floating slabs have cold joints just inside the perimeter walls of the building.
- e. **Crawl space** (Figure 5). Wood posts or concrete piers are set into the ground and bear the weight of the building. Foundation beams are attached to the piers and transfer the building weight to the piers. In many cases the perimeter of the building has a foundation wall, and the interior of the building is supported with piers forming a crawl space under the structure.
- f. **Stem wall** (Figure 6). Also a term for the outside foundation wall. It is usually constructed of concrete block, although it could also be formed from poured concrete.
- g. **Cold joint** (Figures 7 and 8). A gap or crack between two concrete pours. It can be caused by an interruption or delay in the concreting operations or just where two concrete slabs are next to each other — for instance, a sidewalk next to a house or a garage floor poured at a separate time. It occurs when the first batch of concrete has set before the next batch is poured.



Figure 7. Cold joint between concrete slab sections.



Figure 8. Cold joint between concrete slab sections.

- h. **Weep hole** (Figure 9). A small opening that allows water to drain from behind masonry on the exterior of a building. It is usually located at the bottom of a masonry wall to provide drainage. It also is an access point for termites and other insects into the structure.
- i. **Under-building ventilation** (Figure 10). Moisture from the soil can condense on unventilated space and destroy construction materials. Codes require at least 1 square foot of vent opening per 150 square feet of space or a vapor barrier placed on the soil surface under the building. Ventilation is important for crawl space and basement construction types.
- j. **Plumbing and utility penetrations** (Figure 11). With a slab foundation, any plumbing or electrical that runs under a home must be put in before the concrete is poured, since these utilities run in the dirt, not within the actual concrete. These utilities require digging a trench in the fill to bury the pipes and conduit in the soil. Utility access into the house is then from vertical pipes that will penetrate the slab. These are common areas where termites enter buildings. Affected areas include the shower pan, bathtub, toilet, sink, gas and electrical wiring.



Figure 9. Weep hole in exterior brick veneer.

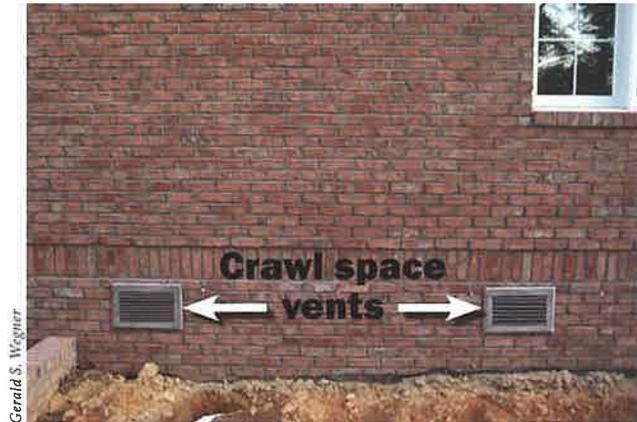


Figure 10. Under-building ventilation.

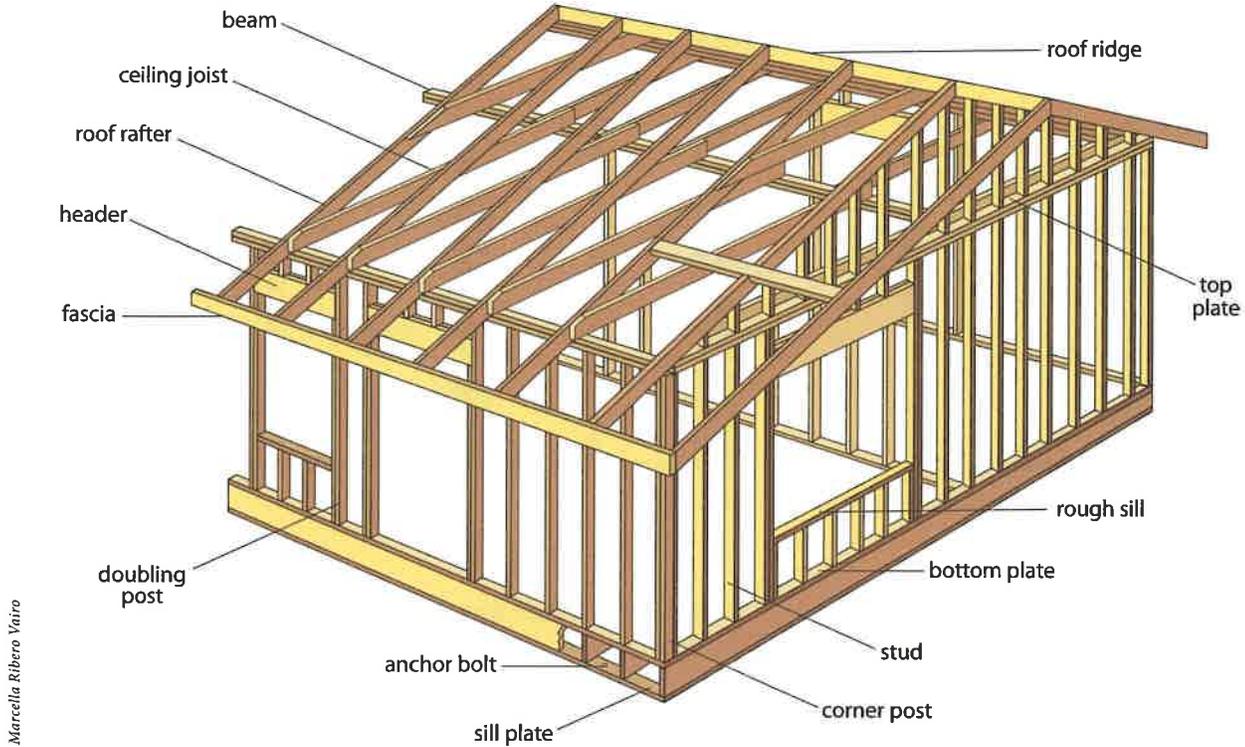


Figure 11. Plumbing and utility penetrations in a slab foundation.

2. **Framing terms.** Frame construction is the most common method for building residences and commercial buildings. Framing is used to erect walls, ceilings and attics in most houses and is usually made from wood (Figure 12), although metal framing elements (Figure 13) have become more popular, particularly in the South, where termite pressure is greater. Wood framing elements are food for termites, while the foundation types mentioned previously merely provide access for WDOs.

a. **Framing terms** (Figures 12 and 13)

- i. **Stud.** Vertical framing lumber or metal component in a building's wall, with a smaller cross section than a post. A stud is the fundamental element in building framing and is usually a 2×4 or 2×6 in cross dimension. Studs form walls and may be load-bearing and carry vertical structural loads, or they could be nonload-bearing such as in partition walls, which only separate spaces. In commercial buildings, studs are usually galvanized steel rather than lumber.
- ii. **Beam.** A long piece of heavy, often squared, timber suitable for use supporting heavy elements of construction, like upper floors or roofs. A stud is usually one piece of lumber, while a beam is often multiple pieces of lumber nailed together side by side. Beams are usually for horizontal support in structures, and posts are for vertical support.
- iii. **Sill plate.** The bottom horizontal member of a wall or building to which framing is attached. Sill plates usually come in sizes of 2×4, 2×6, 2×8, and 2×10 inches. In wood framing, the sill plate is made of pressure-treated lumber and is anchored to the foundation, often with J-bolts to keep the building from coming off the foundation during a severe storm. Building codes require that the bottom of the sill plate be kept 6 to 8 inches above the finished grade to hinder termites and to prevent the sill plate from rotting. The sill plate contacts the concrete foundation, and all wood contacting concrete must be pressure treated (AWPA U1).
- iv. **AWPA U1.** American Wood Protection Association standard for pressure-treated wood used for construction.
- v. **Bottom plate.** The members at the bottom of a wall at the foundation upon which some considerable weight is framed above. It is usually a second lower wall plate (above the sill plate) to which the wall studs are nailed and is the bottom of the wall section when assembled as a rectangular assembly. The bottom plate does not have to be pressure-treated.
- vi. **Top plate.** Upper wall plate, which is fastened along the top of the wall studs before the wall is lifted into position and on which the platform of the next story or the ceiling and roof assembly rest and are attached.
- vii. **Corner post.** A main vertical support in a structure similar to a column or pillar. The term post generally refers to a timber but could actually be made from several studs nailed together. A multiple-stud post made up of at least three studs, or the equivalent, is generally used at exterior corners and intersections to secure a good tie between adjoining walls and to provide nailing support for the interior finish and exterior sheathing.
- viii. **Doubling post.** Corners and intersections of walls must be framed with at least two studs. Also, doors and windows usually have a doubling post. Where the two studs meet, there is a crack and crevice that subterranean termites prefer to use for moving from the soil to construction elements in the building.



Marcella Ribero Vairo

Figure 12. House construction framing terminology showing traditional wood elements.



Gerald S. Wegner

Figure 13. House interior framing showing metal components.

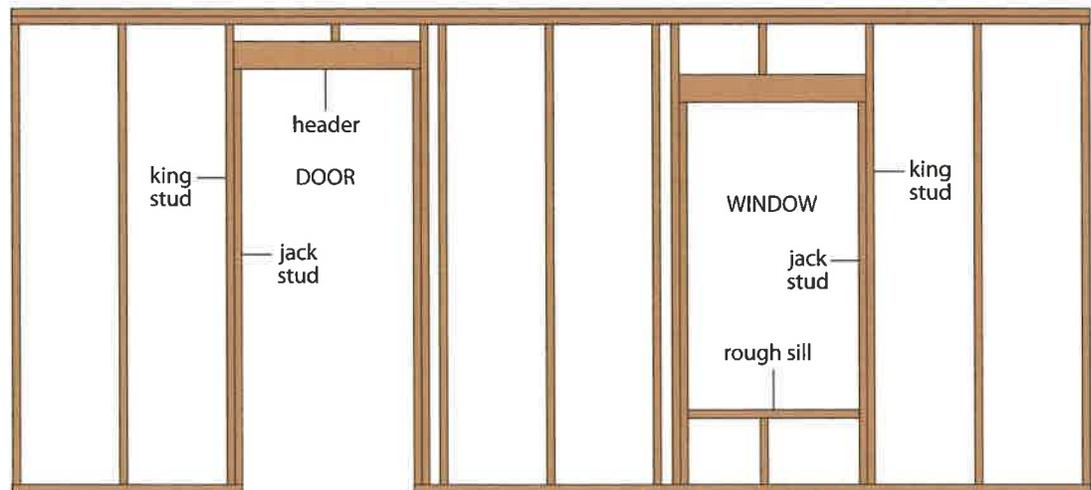


Figure 14. Window and door framing terminology.

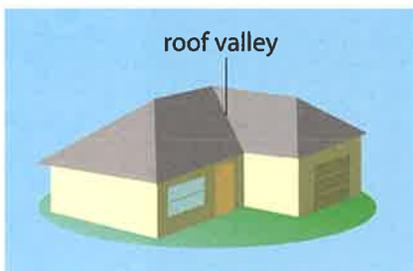
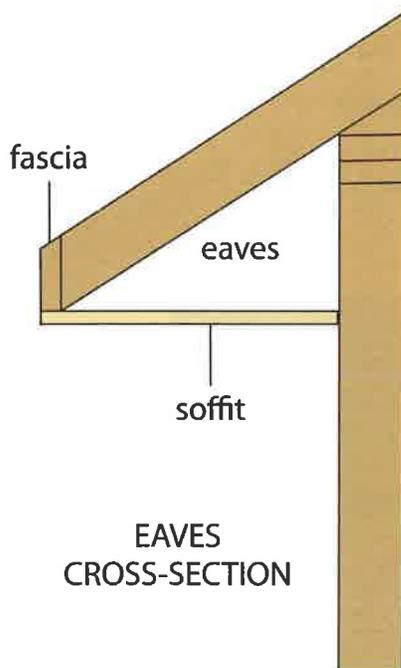


Figure 15. Attic and roofing terminology.

#### b. Window and door framing (Figure 14)

- i. Header. Large openings in the wall are made for windows and doors. When the opening is greater in width than the stud spacing — and most windows are wider than 24 inches — then a header must be inserted to carry the load of the interrupted stud(s). A header is a beam sized to support the load above the opening it spans.
- ii. Jack and king stud. A header is supported by a jack stud at each end and next to it is the king stud that extends to the top of the header. Jack studs, sometimes called trimmers, fit under each end of a header, and they transfer the load that the header carries down to the bottom plate and the sill plate beneath.
- iii. Rough sill. A horizontal member laid across the bottom of an unfinished opening to act as a base during construction of a window frame.

#### c. Attic and roofing terms (Figures 12 and 15)

- i. Roof ridge. The horizontal top area where two sloped roof areas meet.
- ii. Roof rafter, or top chord. One of a series of sloped structural members (beams) that extend from the ridge or hip to the wall plate, downslope perimeter, or eaves, and that are designed to support the roof deck and its associated loads.
- iii. Roof valley. Valleys are created where two roof slopes meet. Valleys are especially vulnerable to leakage because the combined runoff from both roof slopes is concentrated in the valley and the roof-covering materials are interrupted by the change in roof direction.
- iv. Ceiling joist, or bottom chord. One of a series of horizontal supporting members that run between foundations, walls, or beams to support a ceiling.

- v. Eaves. The edges of the roof that overhang the face of a wall and, normally, project beyond the side of a building. The eaves form an overhang to throw water clear of the walls.
- vi. Fascia. The horizontal “fascia board” that caps the end of rafters outside a building and may be used to hold the rain gutter.
- vii. Soffit. The material forming a ceiling from the top of an exterior house wall to the outer edge of the roof.
- viii. Roof pitch. A measure of the steepness of a roof. Roofs may be functionally flat or “pitched.” The roof’s pitch is its vertical rise divided by its horizontal span.
- ix. Attic ventilation. Proper ventilation of the attic is needed to remove moisture and prevent WDOs from destroying the structural materials. Usually there are eave vents to allow cool air to enter the attic space and ridge vents to allow hot air to escape. All vents need to be properly screened to keep insects and other organisms from entering.

### 3. Roofing types (Figure 16)

- a. Flat. A flat roof is a roof that is almost level. These roofs are common in more arid regions of the country. However, they are used extensively on commercial buildings. Water usually drains off roofs slowly, and many times there are pools of water on flat roofs. Also, there is usually little attic space, so it is not possible to inspect thoroughly with this roof design.
- b. Gable. Generally triangular portion of a wall between the edges of intersecting roof pitches. Water intrusion can occur at the peaks and eaves of this type of roof.
- c. Cross-gabled. Two or more gable roof lines that run perpendicular to each other. The roof valleys and peaks are places where water intrusion is common. Also the eaves are good places to inspect.
- d. Hip. A type of roof where all sides slope downward to the walls. Eaves completely surround this type of roof. This has similar problems to the gable roof.
- e. Cross-hipped. Two intersecting hip sections that run perpendicular to each other.

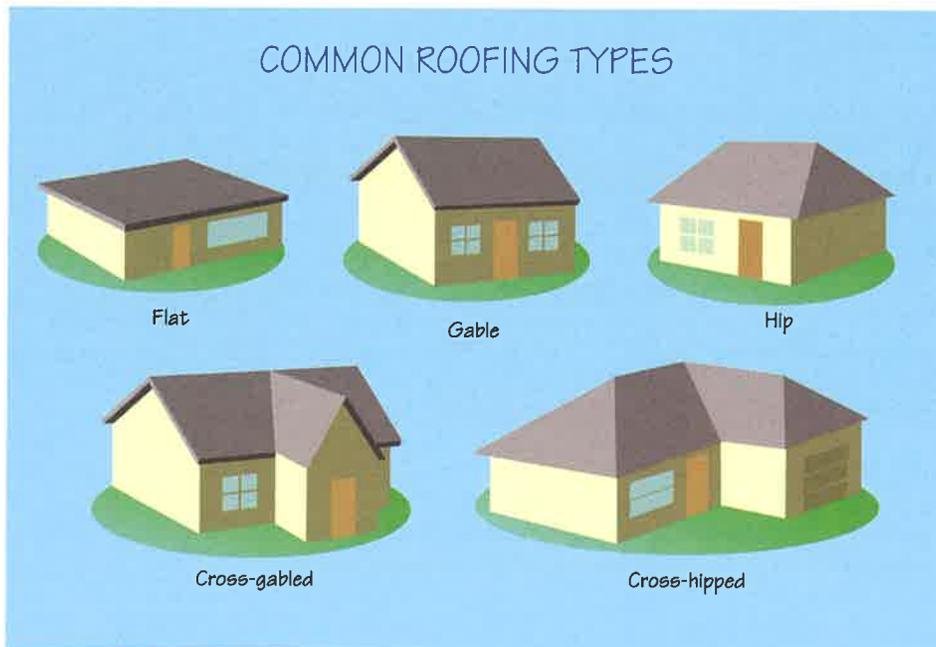


Figure 16. Common roofing types.

## House Building Schedule

### Preconstruction

- Have lot surveyed. Mark corners, building lines, and elevation requirements.
- Obtain building permit. Post the permit at the job site.

### Week 1–2: Foundation

- Dig footings. Have footings pass inspection.
- Pour concrete footings. If crawlspace foundation, lay concrete block. If concrete slab foundation, install forms for slab.
- Rough-in plumbing. Have plumbing pass inspection. Rough-in electrical conduit, if needed.
- Install rebar.
- **Soil termiticide treatment #1: Horizontal and interior vertical treatment and utility penetrations.**
- Install vapor barrier. Have foundation pass inspection.
- Pour concrete slab.

### Week 3–4: Framing

- Framing and dried in with all doors and windows in place.
- **Wood termiticide treatment #1: Treat all framing and concrete slab (where there is no wood framing).**

### Week 5–6: Mechanicals

- Rough-in plumbing, HVAC, and electric. Install roofing.
- Have plumbing, electrical and HVAC pass inspection.
- Have framing pass inspection. Have exterior finish pass inspection.
- **Wood termiticide treatment #2: Treat all framing changes.**
- Insulate walls.

### Week 7–8: Siding, Miscellaneous

- Hang and finish wallboard. Screw down wood subfloors. Install exterior finish.
- Have public utility run gas line. Dig underground electric service trench.
- Have trench pass inspection.
- Do exterior cleanup of scrap and all trash. Rough-grade lot.

### Week 9–10: Trim, Miscellaneous

- Install trim.
- Install forms for additional concrete slabs (walks, porch, driveway and patio).
- If steps for porch, dig a footing for support.
- **Soil Termiticide treatment #2: Vertical treatment under slabs adjacent to building.**
- Pour concrete for additional slabs.

### Week 11–12: Paint, Miscellaneous

Paint prime coat. Finish paint. Install garage door. Install gutters.

### Week 13–14: Cabinets, Miscellaneous

- Install cabinets. Install countertops. Install wood and tile flooring.
- **Optional wood termiticide treatment #3. Protect floor cabinets.**

### Week 15–16: Mechanical Finals

- Have plumbing, electric and HVAC pass inspection.
- Trim final. Landscape final. Install mirrors, glass and hardware. Insulate attic.
- **Soil termiticide treatment #3: Exterior perimeter vertical treatment.**

### Week 17–18: Final

- Install carpet. Paint touchup. Have building pass final inspection.
- Final clean.
- **Install termite bait stations (if option chosen).**



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Figure 17. Construction site preparation.



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Figure 18. Construction site preparation.

## Understanding the Building Construction Process and WDOs

WDOs are intimately associated with the building. WDO inspections and control procedures require a thorough knowledge of the process of building a structure. There are several important steps in construction of a building — site selection and preparation, footers and foundation walls, ground floor and slab preparation, walls and framing, trusses and roof, exterior surfaces and sealing the structure, interior finishing, and exterior grading and landscaping.

**1. Site selection and preparation.** In many instances the builder starts by clearing land of trees, underbrush, and unwanted structures, followed by excavation and grading of the site (Figures 17 and 18). As a result of clearing, there is a lot of cellulose debris composed of logs, branches, leaves and sometimes construction wood. Also noncellulose debris is created, which includes rocks, soil and sometimes concrete and asphalt if the site has been used for buildings or roads previously.

Site preparation debris needs to be removed to a landfill, which some builders avoid because it is the most expensive way to dispose of debris. The other options are to either burn or bury it. Because of no-burn ordinances in many counties, burning of waste is usually not allowed. If the builder decides to bury debris, the cellulose waste needs to be located away from the site of any building. The cellulose in the ground is a food source for termites and wood decay. As the waste decomposes the land will sink, leaving a depression. If this depression is under the structure, the foundation could sink, causing structural problems.

Excavation, grading, and leveling is accomplished to level the site and to slope the ground away from the structure. Grading of land means to cut dirt from a high spot and fill in a low spot. When grading and leveling, dirt is removed from high points and placed in low places, making a level area. This is known by excavating contractors as a “cut and fill” type of grading. Grading also prepares the building site so water drains in a predictable way and prevents future erosion and undermining of the footers and foundation wall. Water that accumulates next to the foundation can attract termites and promote wood decay.

**2. Foundation.** A foundation is the portion of the building that transfers the weight of the structure to the soil. It is composed of the footer and the foundation wall. Foundations are started by digging a trench in the ground to subsoil, which is more solid than the topsoil that is used to grow plants. Once graded, the soil is prepared for the footers and foundation wall (Figures 19 and 20).



Gerald S. Wegner

Figure 19. Residential foundation preparation.



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Figure 20. Commercial foundation preparation.

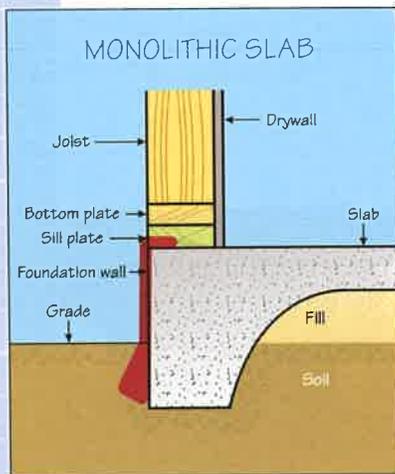


Figure 21. Typical termite access (marked in red) in a monolithic slab.

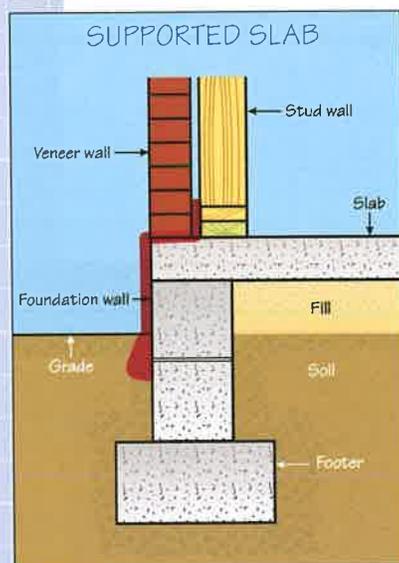


Figure 22. Typical termite access (marked in red) in a supported slab.

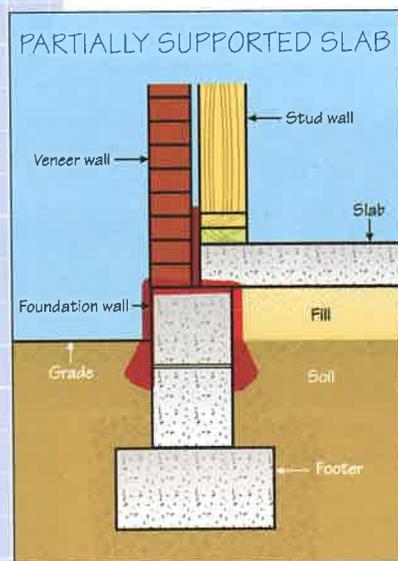


Figure 23. Typical termite access (in red) in a partially supported slab.

Footers are an important part of foundation construction. They are typically made of concrete with rebar reinforcement, making reinforced concrete. The purpose of footers is to support the foundation wall and prevent settling. Footers are especially important in areas with troublesome soils. The dimensions of footers also depend on the size and type of structure that will be built. Placement of footers is crucial to provide the proper support for the foundation and ultimately the structure. For typical soils, a common 16- or 20-inch-wide footer can more than handle the relatively low weight of an ordinary house. On the other hand, if the building is on soft clay soil or if there's a soft zone under part of the foundation, a wider footer may be necessary. A footer that performs well in good soil may not do so well in soft soil. Outright failure does not happen often, but it is common to see excessive settling when soil bearing capacity is low, and that settling can result in stress or settling cracks.

If the whole house settles slowly and evenly, some additional settling is no problem, but if settling is uneven (differential settlement), there could be damage and cracking of the foundation or flooring. A frame house with wood siding and drywall interiors can probably handle up to  $\frac{1}{2}$  inch of differential foundation movement, but even  $\frac{1}{4}$  inch of uneven settling is enough to cause cracks in hard materials, like masonry, tile or plaster. Unusual situations cause the most trouble. When the footing is laid out off-center so the wall misses its bearing point when there is a soft zone, or when the footer is undersized, the builder should probably stop and call an engineer. However, in most cases, the builder will keep the job moving and ignore the problem because nobody will see it. Settling will usually occur later, and then the structure will crack. Cracks that result from settling of the footers allow termites and sometimes water to have hidden and unexpected access into a structure through cracks in foundations and walls.

There are several types of foundations commonly used in most buildings, and the most common type is a concrete slab foundation. Each type of foundation allows termite access at different locations. The types of concrete slab foundations are monolithic slab, supported slab, and floating slab. In addition, there are basement foundations and crawl space foundations.

- a. **Monolithic slab** (Figure 21). Debris from framing is often left behind and can serve as a food source for termites.
- b. **Supported slab** (Figure 22). A cold joint that is usually visible at the top of and on the side of the outside foundation wall allows termite access.
- c. **Partially supported slab** (Figure 23). At doorways, a cold joint or crack may be visible between the floor slab and the foundation slab. This crack extends to areas under walls and allows for hidden termite access to wall framing.
- d. **Floating slab** (Figure 24). Floating slabs have cold joints just inside the perimeter walls of the building that allow termites hidden access to wall framing.
- e. **Crawl space** (Figure 25). Depending on the type of pier used in the foundation, termites can either tunnel on the surface of the pier or tube up the hidden interior portions of the pier. When crawl spaces are moist, termites can build tubes directly from the soil vertically to the foundation beams.

3. **Ground floor and slab preparation.** Before pouring the concrete slab, builders will install plumbing, electrical, rebar, and vapor barriers under the slab (Figure 26). Plumbing is one of the rough-in elements of construction and is generally hidden by the finished elements such as walls, floors and roofs (Figure 27). It can also run under sidewalks, stoops, patios and decks. During the initial building of a home that has a concrete slab foundation and basement level, any plumbing or electrical that runs under the home must be put in before the concrete is poured, since these utilities run in the dirt, not within the actual concrete. These utilities require digging a trench in the fill to bury the pipes and conduit in the soil. Access into the house is then from vertical pipes that will penetrate the slab. Termites usually like to tunnel alongside buried utility points because it is easier for them to follow the loose soil next to a pipe or conduit than to randomly tunnel in the soil.

on the outside. The foam must have plywood at corners and other critical positions. Garage posts at the sides of the garage doors are often set directly over an expansion joint and are key infestation points for termites. The expansion joint may or may not have been treated with termiticide, depending on whether the contractor called in the PMP for an additional treatment.

5. **Trusses and roof.** The roofing, when performing properly, prevents moisture from entering the structure. Roof decking is the main support and is covered with felt as a layer of moisture proofing. However, toeholds are nailed to the decking and could allow moisture in. Gables are very nice but require proper flashing to be moisture proof (Figure 14).
6. **Exterior surfaces and sealing the structure.** Roof shingles are installed. Fascia along the edges can be painted wood, plastic or aluminum. We often see the use of metal as porch support, with cement poured over the metal. Walkways are poured sometimes next to the slab. What's under the porch floor should be an automatic question you ask yourself. Is it dirt or gravel fill, hollow, unfinished basement, or finished room? Inspection will help answer these questions.
7. **Interior finishing.** When the outside is finished, there is more construction inside. Pipes installed through the foundation are routed throughout the structure (Figure 27). Bath traps may or may not have access openings finished into adjacent frame walls. Interior walls may be covered with furring strips and expansion joints may have wood associated with finished flooring attached over them.
8. **Exterior grading and landscaping.** Soon the structure is complete. Grading and landscaping signal the timing for the final termite treatment during the "pretreat" process. How many termite treatment trips should be made?
  - a. Prior to footer being poured and prior to basement and garage slab pour: one or two treatments.
  - b. Treatments prior to patio-capping and pouring of attached slabs, i.e., driveways and walkways. These are the ones most skipped. Is it a wonder why these are frequent spots where termites are found? Garage door posts and front door and patio door thresholds are often attacked from below due to missed treatment opportunities.
  - c. The final trip comes when the final grade and landscaping are complete (Figure 29).



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Figure 29. The final pre-treat application should be made when the final grade is complete.

### 9. Florida building code and WDOs

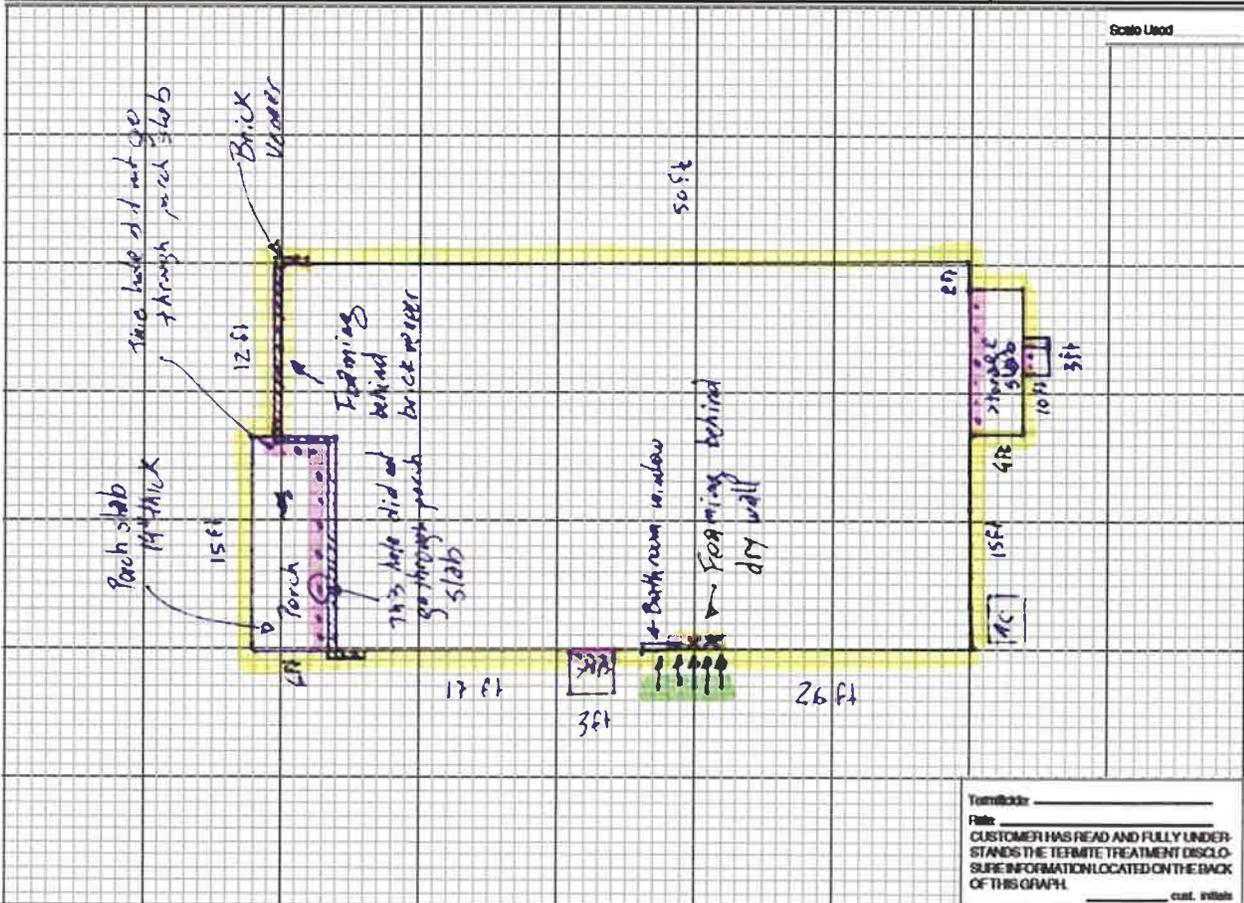
- a. Florida building code Section R318 requires termite protection in new construction to be provided by registered termiticides or other approved methods. Section R318 requires certain practices to protect residences from termites.
  - i. **Certificate of compliance**—a document issued by a licensed pest control company certifying a complete treatment was done in accordance with the building code and the rules and laws established by FDACS.
  - ii. **Approved pesticides for termites, i.e., “termiticides”**
    1. Soil-applied pesticides
    2. Baiting systems
    3. Pesticides applied to wood
  - iii. **Soil-applied termiticides requirements**
    1. Application after all excavating, backfilling and compaction
    2. Disturbed areas retreated
    3. Protected from dilution by rainfall after application
    4. Removal of concrete overpour and spilled mortar around exterior perimeter
    5. Application under adjoining concrete, such as sidewalks and patios, within 1 foot of exterior foundation wall
  - iv. **Bait system requirements**
    1. Contract assuring installation, maintenance, and monitoring of the bait system.
    2. If monitoring is needed for the baiting system, the installation of monitors is considered installation of the bait system.
  - v. **Structural requirements**
    1. Pipe penetration of slabs — pipe wraps made of noncellulose materials
    2. Brick or stone veneers required to be supported by a concrete ledge poured integrally with the foundation.
    3. Water from roof and condensate lines discharged at least 1 foot from foundation.
    4. Gutters required on eaves less than 6 inches wide.
    5. Cellulose materials such as wood, paper or cardboard removed from cells (voids) in masonry units and from under the building area and within 1 foot of the structure.
    6. Graded site to provide water drainage away from building.
    7. Clearance of exterior coverings to provide at least 6 inches of inspection space around exterior foundation walls.
    8. Foam or plastic insulation on exterior foundation and walls required to be at least 6 inches above grade.
    9. Preservative treated wood (AWPA U1)

### 10. Graphing WDO infestations and damage for a structure (Figures 30–31)

- a. Termite inspections done in preparation for a treatment should include a foundation diagram that shows you details of where there is activity/damage by termites and other wood-damaging insects.
- b. The drawing should be coded to show locations for
  - i. Subterranean termites
  - ii. Formosan termites
  - iii. Drywood termites
  - iv. Powderpost beetles
  - v. Wood-decay fungi
  - vi. Moisture damage
  - vii. Earth-to-wood contact
  - viii. Stucco-to-ground contact (no inspection gap)
  - ix. Potential hidden damage
  - x. Live activity
  - xi. Visible damage
  - xii. Evidence of previous treatment

Customer \_\_\_\_\_ Phone \_\_\_\_\_ Date \_\_\_\_\_  
 Address \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

General Inspection	<b>FOUNDATION/SLAB</b>		<b>EXTERIOR WALL CONSTRUCTION</b>		<b>EXTERIOR FINISH</b>		Linear Feet around structure _____
	<input type="checkbox"/> Slab on Grade/Monolithic	<input type="checkbox"/> Basement	<input type="checkbox"/> Concrete Block	<input type="checkbox"/> Other _____	<input type="checkbox"/> None	<input type="checkbox"/> Stucco	Square footage house & garage _____
Pest Control Inspection	<input type="checkbox"/> Floating or Supported Slab	<input type="checkbox"/> Manufactured / Mobile Home	<input type="checkbox"/> Wood Frame		<input type="checkbox"/> Brick	<input type="checkbox"/> Wood	
	<input type="checkbox"/> Crawlspace	<input type="checkbox"/> # of Piers _____	<input type="checkbox"/> Metal Frame		<input type="checkbox"/> Stone	<input type="checkbox"/> Vinyl/Alum	
Termite Inspection	<b>ROACHES</b>		<b>ANTS</b>		<b>OTHER</b>		<b>KEY SYMBOLS</b>
	Signs of Infestation		Signs of Infestation		Signs of Infestation		
	American	<input type="checkbox"/> Yes <input type="checkbox"/> No	Argentine	<input type="checkbox"/> Yes <input type="checkbox"/> No	Crickets	<input type="checkbox"/> Yes <input type="checkbox"/> No	ST Subterranean termites
	Australian	<input type="checkbox"/> Yes <input type="checkbox"/> No	Pavement	<input type="checkbox"/> Yes <input type="checkbox"/> No	Fleas	<input type="checkbox"/> Yes <input type="checkbox"/> No	FST Formosan termites
	Florida Woods	<input type="checkbox"/> Yes <input type="checkbox"/> No	Carpenter	<input type="checkbox"/> Yes <input type="checkbox"/> No	Mice	<input type="checkbox"/> Yes <input type="checkbox"/> No	DWT Drywood termites
	German	<input type="checkbox"/> Yes <input type="checkbox"/> No	Pharaoh	<input type="checkbox"/> Yes <input type="checkbox"/> No	Rats	<input type="checkbox"/> Yes <input type="checkbox"/> No	PPB Powderpost beetles
	Asian	<input type="checkbox"/> Yes <input type="checkbox"/> No	Crazy	<input type="checkbox"/> Yes <input type="checkbox"/> No	Silverfish	<input type="checkbox"/> Yes <input type="checkbox"/> No	WDF Wood-decaying fungi
	Brown Banded	<input type="checkbox"/> Yes <input type="checkbox"/> No	Ghost	<input type="checkbox"/> Yes <input type="checkbox"/> No	Spiders	<input type="checkbox"/> Yes <input type="checkbox"/> No	MD Moisture damage
	Oriental	<input type="checkbox"/> Yes <input type="checkbox"/> No	Fire	<input type="checkbox"/> Yes <input type="checkbox"/> No			E/W Earth to wood contact
							SAQ Stucco-to-ground
							PHD Possible hidden damage
							L Babe symbol indicates live activity
							X Visible damage
	<b>INFESTATION STATUS:</b> <input type="checkbox"/> Preventive (no observed evidence) <input type="checkbox"/> Presumptive (affected wood but no live termites) <input type="checkbox"/> Existing (affected wood and live termites)						
	Area Signs of Infestation		Infestation Comments	Area Signs of Infestation		Infestation Comments	
	Exterior Walls	<input type="checkbox"/> Yes <input type="checkbox"/> No	_____	Finished Floor	<input type="checkbox"/> Yes <input type="checkbox"/> No	_____	
	Attic	<input type="checkbox"/> Yes <input type="checkbox"/> No	_____	Sub Floor	<input type="checkbox"/> Yes <input type="checkbox"/> No	_____	
	Floor Joists	<input type="checkbox"/> Yes <input type="checkbox"/> No	_____	Interior Trim	<input type="checkbox"/> Yes <input type="checkbox"/> No	_____	
	Framing	<input type="checkbox"/> Yes <input type="checkbox"/> No	_____	Door Frames	<input type="checkbox"/> Yes <input type="checkbox"/> No	_____	
	Drywall	<input type="checkbox"/> Yes <input type="checkbox"/> No	_____	Window Frames	<input type="checkbox"/> Yes <input type="checkbox"/> No	_____	



If visible evidence of active or previous termite infestation or damage is noted by the technician during the inspection of your property, it should be evaluated by a licensed building contractor of customer's choice, because it is highly probable customer could have hidden damage in the structure. **YOUR COMPANY NAME** IS NOT RESPONSIBLE FOR PRE-EXISTING DAMAGE. This graph is based on visible evidence of readily accessible areas and does not make any attempt to reveal damage which may be present. No attempt to remove insulation, carpeting, drywall, etc. to search for hidden damage was made. For each infestation status there is always the potential for hidden damage.

Technician's Name (print) \_\_\_\_\_ Technician's No. # \_\_\_\_\_  
 Technician Signature \_\_\_\_\_ Customer Acknowledgment \_\_\_\_\_

Figure 30. Example of a WDO and general pest corrective treatment site assessment form with hand-drawn site assessment diagram indicating locations of termite evidence to document inspection and prepare for a corrective treatment..

Diagram of Structure(s) and Proposed Area(s) To Be Treated					

**KEY TO DIAGRAM SYMBOLS**

Conducive Condition for Termites.....C  
 Evidence of Infestation.....E  
 Evidence of Active Infestation.....A  
 Evidence of Previous Infestation.....P  
 Evidence of Subterranean Termites...S  
 Evidence of Formosan Termites.....F  
 Evidence of Wood Boring Beetles....W  
 Area to be Drilled.....X  
 Area to be Trenched.....O  
 Area to be Rodded.....R  
 Area Bait Station to be Applied.....BS  
 Area Barrier to be Applied.....BT

Area of Present Termite Activity:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Location to be Treated:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**TYPE OF CONSTRUCTION:**

<b>FOUNDATION:</b> <input type="checkbox"/> Slab <input type="checkbox"/> Pier and Beam Pier Type: _____ <input type="checkbox"/> Basement <input type="checkbox"/> Other: _____	<b>SIDING:</b> <input type="checkbox"/> Wood <input type="checkbox"/> Brick <input type="checkbox"/> Stone <input type="checkbox"/> Plaster <input type="checkbox"/> Other: _____	<b>ROOF:</b> <input type="checkbox"/> Composition <input type="checkbox"/> Wood Shingle <input type="checkbox"/> Metal <input type="checkbox"/> Tile <input type="checkbox"/> Other: _____	<b>PRIMARY USE:</b> <input type="checkbox"/> Residence <input type="checkbox"/> Public Building <input type="checkbox"/> Commercial <input type="checkbox"/> Industrial <input type="checkbox"/> Other: _____	<b>INACCESSIBLE / OBSTRUCTED AREAS:</b> <input type="checkbox"/> _____ <input type="checkbox"/> _____ <input type="checkbox"/> _____ <input type="checkbox"/> _____
---	--	---	--	---

**PROPOSED TREATMENT SPECIFICATIONS:**

Type of treatment:  Partial  Spot  Baiting System  Physical Barrier: \_\_\_\_\_ sq ft Approximate perimeter measurement of structure to be treated: \_\_\_\_\_

A label of \_\_\_\_\_ is attached. The concentration of liquid termiticide (if any) to be applied: \_\_\_\_\_ % Approx. number of baiting systems (if any) \_\_\_\_\_

**DEFINITIONS OF TREATMENT:**

A subterranean termite treatment may be a partial treatment or spot treatment using termiticide, approved physical barriers or a baiting system. These types of treatments are defined as follows:

**Partial Treatment:** This technique allows a wide variety of treatment strategies but is more involved than a spot treatment (see definition below). Ex: treatment of some or all of the perimeter, bath traps, expansion joints, stress cracks, portions of framing, walls and bait locations.

**Pier and Beam:** Generally defined as the treatment of the outer perimeter including porches, patios and treatment of the attached garage. In the crawl space, treatment would include any soil to structure contacts as well as removal of any wood debris on the ground.

**Slab Construction:** Generally defined as treatment of the perimeter and all known slab penetrations as well as any known expansion joints or stress cracks.

**Spot Treatment:** Any treatment which concerns a limited, defined area less than ten (10) linear or square feet that is intended to protect a specific location or "spot". Often there are adjacent areas that are susceptible to termite infestation, which are not treated.

**Baiting Systems:** This type of treatment may include interior and/or perimeter placement of monitoring or baiting systems along with routine inspection intervals. The baiting technique may include one or more baiting locations as prescribed by the product label and instructions.

**Barriers:** If a physical device is used, the square footage of the physical device must be recorded and a diagram describing the installation will be provided.

Figure 31. Example of a corrective treatment site assessment form for termites and other WDOs.

# Florida Building Code

## SECTION R317

### PROTECTION OF WOOD AND WOOD BASED PRODUCTS AGAINST DECAY

#### R317.1 Location required.

Protection of wood and wood based products from decay shall be provided in the following locations by the use of naturally durable wood or wood that is preservative-treated in accordance with AWPA U1 for the species, product, preservative and end use. Preservatives shall be listed in Section 4 of AWPA U1. 1. Wood joists or the bottom of a wood structural floor when closer than 18 inches (457 mm) or wood girders when closer than 12 inches (305 mm) to the exposed ground in crawl spaces or unexcavated area located within the periphery of the building foundation. 2. All wood framing members that rest on concrete or masonry exterior foundation walls and are less than 8 inches (203 mm) from the exposed ground. 3. Sills and sleepers on a concrete or masonry slab that is in direct contact with the ground unless separated from such slab by an impervious moisture barrier. 4. The ends of wood girders entering exterior masonry or concrete walls having clearances of less than ½ inch (12.7 mm) on tops, sides and ends. 5. Wood siding, sheathing and wall framing on the exterior of a building having a clearance of less than 6 inches (152 mm) from the ground or less than 2 inches (51 mm) measured vertically from concrete steps, porch slabs, patio slabs, and similar horizontal surfaces exposed to the weather. 6. Wood structural members supporting moisture-permeable floors or roofs that are exposed to the weather, such as concrete or masonry slabs, unless separated from such floors or roofs by an impervious moisture barrier. 7. Wood furring strips or other wood framing members attached directly to the interior of exterior masonry walls or concrete walls below grade except where an approved vapor retarder is applied between the wall and the furring strips or framing members.

#### R317.1.1 Field treatment.

Field-cut ends, notches and drilled holes of preservative-treated wood shall be treated in the field in accordance with AWPA M4.

#### R317.1.2 Ground contact.

All wood in contact with the ground, embedded in concrete in direct contact with the ground or embedded in concrete exposed to the weather that supports permanent structures intended for human occupancy shall be approved pressure-preservative-treated wood suitable for ground contact use, except untreated wood may be used where entirely below groundwater level or continuously submerged in fresh water.

#### R317.1.3 Geographical areas.

In geographical areas where experience has demonstrated a specific need, approved naturally durable or pressure-preservative-treated wood shall be used for those portions of wood members that form the structural supports of buildings, balconies, porches or

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similar permanent building appurtenances when those members are exposed to the weather without adequate protection from a roof, eave, overhang or other covering that would prevent moisture or water accumulation on the surface or at joints between members. Depending on local experience, such members may include: 1. Horizontal members such as girders, joists and decking. 2. Vertical members such as posts, poles and columns. 3. Both horizontal and vertical members.

#### R317.1.4 Wood columns.

Wood columns shall be approved wood of natural decay resistance or approved pressure-preservative-treated wood.

##### Exceptions:

1. Columns exposed to the weather or in basements when supported by concrete piers or metal pedestals projecting 1 inch (25.4 mm) above a concrete floor or 6 inches (152 mm) above exposed earth and the earth is covered by an approved impervious moisture barrier.
2. Columns in enclosed crawl spaces or unexcavated areas located within the periphery of the building when supported by a concrete pier or metal pedestal at a height more than 8 inches (203 mm) from exposed earth and the earth is covered by an impervious moisture barrier.

#### R317.1.5 Exposed glued-laminated timbers.

The portions of glued-laminated timbers that form the structural supports of a building or other structure and are exposed to weather and not properly protected by a roof, eave or similar covering shall be pressure treated with preservative, or be manufactured from naturally durable or preservative-treated wood.

#### R317.2 Quality mark.

Lumber and plywood required to be pressure-preservative-treated in accordance with Section R318. 1 shall bear the quality mark of an approved inspection agency that maintains continuing supervision, testing and inspection over the quality of the product and that has been approved by an accreditation body that complies with the requirements of the American Lumber Standard Committee treated wood program.

##### R317.2.1 Required information.

The required quality mark on each piece of pressure-preservative-treated lumber or plywood shall contain the following information: 1. Identification of the treating plant. 2. Type of preservative. 3. The minimum preservative retention. 4. End use for which the product was treated. 5. Standard to which the product was treated. 6. Identity of the approved inspection agency. 7. The designation "Dry," if applicable.

##### Exception:

Quality marks on lumber less than 1 inch (25.4 mm) nominal thickness, or lumber less than nominal 1 inch by 5 inches (25.4 mm by 127 mm) or 2 inches by 4 inches (51 mm by 102 mm) or lumber 36 inches (914 mm) or less in length shall be applied by stamping

the faces of exterior pieces or by end labeling not less than 25 percent of the pieces of a bundled unit.

### R317.3 Fasteners and connectors in contact with preservative-treated and fire-retardant-treated wood.

Fasteners, including nuts and washers, and connectors in contact with preservative-treated wood and fire-retardant-treated wood shall be in accordance with this section. The coating weights for zinc-coated fasteners shall be in accordance with ASTM A 153.

#### R317.3.1 Fasteners for preservative-treated wood.

Fasteners, including nuts and washers, for preservative-treated wood shall be of hot-dipped, zinc-coated galvanized steel, stainless steel, silicon bronze or copper. Coating types and weights for connectors in contact with preservative-treated wood shall be in accordance with the connector manufacturer's recommendations. In the absence of manufacturer's recommendations, a minimum of ASTM A 653 type G185 zinc-coated galvanized steel, or equivalent, shall be used.

#### Exceptions:

1. One-half-inch-diameter (12.7 mm) or greater steel bolts. 2. Fasteners other than nails and timber rivets shall be permitted to be of mechanically deposited zinc-coated steel with coating weights in accordance with ASTM B 695, Class 55 minimum. 3. Plain carbon steel fasteners in SBX/DOT and zinc borate preservative-treated wood in an interior, dry environment shall be permitted.

#### R317.3.2 Fastenings for wood foundations.

Fastenings, including nuts and washers, for wood foundations shall be as required in AF&PA PWF.

#### R317.3.3 Fasteners for fire-retardant-treated wood used in exterior applications or wet or damp locations.

Fasteners, including nuts and washers, for fire-retardant-treated wood used in exterior applications or wet or damp locations shall be of hot-dipped, zinc-coated galvanized steel, stainless steel, silicon bronze or copper. Fasteners other than nails and timber rivets shall be permitted to be of mechanically deposited zinc-coated steel with coating weights in accordance with ASTM B 695, Class 55 minimum.

#### R317.3.4 Fasteners for fire-retardant-treated wood used in interior applications.

Fasteners, including nuts and washers, for fire-retardant-treated wood used in interior locations shall be in accordance with the manufacturer's recommendations. In the absence of the manufacturer's recommendations, Section R317.3.3 shall apply.

### R317.4 Wood/plastic composites.

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Wood/plastic composites used in exterior deck boards, stair treads, handrails and guardrail systems shall bear a label indicating the required performance levels and demonstrating compliance with the provisions of ASTM D 7032.

#### R317.4.1 Labeling.

Deck boards and stair treads shall bear a label that indicates compliance to ASTM D 7032 and includes the allowable load and maximum allowable span. Handrails and guardrail systems or their packaging shall bear a label that indicates compliance to ASTM D 7032 and includes the maximum allowable span.

#### R317.4.2 Installation.

Wood/plastic composites shall be installed in accordance with the manufacturer's instructions.

## SECTION R318 PROTECTION AGAINST TERMITES

### R318.1 Termite Protection.

Termite protection shall be provided by registered termiticides, including soil applied pesticides, baiting systems, and pesticides applied to wood, or other approved methods of termite protection labeled for use as a preventative treatment to new construction. See Section 202, REGISTERED TERMITICIDE. Upon completion of the application of the termite protective treatment, a Certificate of Compliance shall be issued to the building department by the licensed pest control company that contains the following statement: "The building has received a complete treatment for the prevention of subterranean termites. Treatment is in accordance with rules and laws established by the Florida Department of Agriculture and Consumer Services."

#### R318.1.1

If soil treatment is used for subterranean termite prevention, the initial chemical soil treatment inside the foundation perimeter shall be done after all excavation, backfilling and compaction is complete.

#### R318.1.2

If soil treatment is used for subterranean termite prevention, soil area disturbed after initial chemical soil treatment shall be retreated with a chemical soil treatment, including spaces boxed or formed.

#### R318.1.3

If soil treatment is used for subterranean termite prevention, space in concrete floors boxed out or formed for the subsequent installation of plumbing traps, drains or any other purpose shall be created by using plastic or metal permanently placed forms of sufficient depth to eliminate any planned soil disturbance after initial chemical soil treatment.

#### R318.1.4

If soil treatment is used for subterranean termite prevention, chemically treated soil shall be protected with a minimum 6 mil vapor retarder to protect against rainfall dilution. If rainfall occurs before vapor retarder placement, retreatment is required. Any work, including placement of reinforcing steel, done after chemical treatment until the concrete floor is poured, shall be done in such manner as to avoid penetrating or disturbing treated soil.

#### R318.1.5

If soil treatment is used for subterranean termite prevention, concrete overpour or mortar accumulated along the exterior foundation perimeter shall be removed prior to exterior chemical soil treatment to enhance vertical penetration of the chemicals.

#### R318.1.6

If soil treatment is used for subterranean termite prevention, chemical soil treatments shall also be applied under all exterior concrete or grade within 1 foot (305 mm) of the primary structure sidewalls. Also, a vertical chemical barrier shall be applied promptly after construction is completed, including initial landscaping and irrigation/sprinkler installation. Any soil disturbed after the chemical vertical barrier is applied shall be promptly retreated.

#### R318.1.7

If a registered termiticide formulated and registered as a bait system is used for subterranean termite prevention, Section R318.1.1 through Section R318.1.6 do not apply; however, a signed contract assuring the installation, maintenance and monitoring of the baiting system that is in compliance with the requirements of Chapter 482, Florida Statutes, shall be provided to the building official prior to the pouring of the slab, and the system must be installed prior to final building approval.

If the baiting system directions for use require a monitoring phase prior to installation of the pesticide active ingredient, the installation of the monitoring phase components shall be deemed to constitute installation of the system.

#### R318.1.8

If a registered termiticide formulated and registered as a wood treatment is used for subterranean termite prevention, Sections R318.1.1 through R318.1.6 do not apply. Application of the wood treatment termiticide shall be as required by label directions for use, and must be completed prior to final building approval.

#### R318.2 Penetration.

Protective sleeves around piping penetrating concrete slab-on-grade floors shall not be of cellulose-containing materials. If soil treatment is used for subterranean termite protection, the sleeve shall have a maximum wall thickness of 0.010 inch (0.25 mm), and be sealed within the slab using a noncorrosive clamping device to eliminate the annular space between the pipe and the sleeve. No termiticides shall be applied inside the sleeve.

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### R318.3 Cleaning.

Cells and cavities in masonry units and air gaps between brick, stone or masonry veneers and the structure shall be cleaned of all nonpreservative-treated or non-naturally durable wood, or other cellulose-containing material prior to concrete placement.

#### Exception:

Inorganic material manufactured for closing cells in foundation concrete masonry unit construction or clean earth fill placed in concrete masonry unit voids below slab level before termite treatment is performed.

### R318.4 Concrete bearing ledge.

Brick, stone or other veneer shall be supported by a concrete bearing ledge at least equal to the total thickness of the brick, stone or other veneer which is poured integrally with the concrete foundation. No supplemental concrete foundation pours which will create a hidden cold joint shall be used without supplemental treatment in the foundation unless there is an approved physical barrier. An approved physical barrier shall also be installed from below the wall sill plate or first block course horizontally to embed in a mortar joint. If masonry veneer extends below grade, a termite protective treatment must be applied to the cavity created between the veneer and the foundation, in lieu of a physical barrier.

#### Exception:

Veneer supported by a structural member secured to the foundation sidewall in accordance with ACI 530/ASCE 5/TMS 402, provided at least a 6 inch (152 mm) clear inspection space of the foundation sidewall exterior exists between the veneer and the top of any soil, sod, mulch or other organic landscaping component, deck, apron, porch, walk or any other work immediately adjacent to or adjoining the structure.

### R318.5 Protection against decay and termites.

Condensate lines, irrigation/sprinkler system risers for spray heads, and roof downspouts shall discharge at least 1 foot (305 mm) away from the structure sidewall, whether by underground piping, tail extensions or splash blocks. Gutters with downspouts are required on all buildings with eaves of less than 6 inches (152 mm) horizontal projection except for gable end rakes or on a roof above another roof.

### R318.6 Preparation of building site and removal of debris.

#### R318.6.1

All building sites shall be graded to provide drainage under all portions of the building not occupied by basements.

### R318.6.2

The foundation and the area encompassed within 1 foot (305 mm) therein shall have all vegetation, stumps, dead roots, cardboard, trash and foreign material removed and the fill material shall be free of vegetation and foreign material. The fill shall be compacted to assure adequate support of the foundation.

### R318.6.3

After all work is completed, loose wood and debris shall be completely removed from under the building and within 1 foot (305 mm) thereof. All wood forms and supports shall be completely removed. This includes, but is not limited to: wooden grade stakes, forms, contraction spacers, tub trap boxes, plumbing supports, bracing, shoring, forms or other cellulose-containing material placed in any location where such materials are not clearly visible and readily removable prior to completion of the work. Wood shall not be stored in contact with the ground under any building.

### R318.7 Inspection for termites.

In order to provide for inspection for termite infestation, clearance between exterior wall coverings and final earth grade on the exterior of a building shall not be less than 6 inches (152 mm).

#### Exceptions:

1. Paint or decorative cementitious finish less than  $\frac{3}{8}$  inch (17.1 mm) thick adhered directly to the masonry foundation sidewall.
2. Access or vehicle ramps which rise to the interior finish floor elevation for the width of such ramps only.
3. A 4-inch (102 mm) inspection space above patio and garage slabs and entry areas.
4. If the patio has been soil treated for termites, the finish elevation may match the building interior finish floor elevations on masonry construction only.
5. Masonry veneers constructed in accordance with Section R318.4.

### R318.8 Foam plastic protection.

In areas where the probability of termite infestation is “very heavy,” as indicated in Figure R301.2(6), extruded and expanded polystyrene, polyisocyanurate and other foam plastics shall not be installed on the exterior face or under interior or exterior foundation walls or slab foundations located below grade. The clearance between foam plastics installed above grade and exposed earth shall be at least 6 inches (152 mm).

#### Exceptions:

1. Buildings where the structural members of walls, floors, ceilings and roofs are entirely of noncombustible materials or pressure-preservative-treated wood.
2. When in addition to the requirements of Section R318.1, an approved method of protecting the foam plastic and structure from subterranean termite damage is used.
3. On the interior side of basement walls.

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## SECTION R408

### UNDER-FLOOR SPACE

#### R408.1 Ventilation.

The under-floor space between the bottom of the floor joists and the earth under any building (except space occupied by a basement) shall have ventilation openings through foundation walls or exterior walls. The minimum net area of ventilation openings shall not be less than 1 square foot (0.0929 m<sup>2</sup>) for each 150 square feet (14 m<sup>2</sup>) of under-floor space area, unless the ground surface is covered by a Class 1 vapor retarder material. When a Class 1 vapor retarder material is used, the minimum net area of ventilation openings shall not be less than 1 square foot (0.0929 m<sup>2</sup>) for each 1,500 square feet (140 m<sup>2</sup>) of under-floor space area. One such ventilating opening shall be within 3 feet (914 mm) of each corner of the building.

#### R408.2 Openings for under-floor ventilation.

The minimum net area of ventilation openings shall not be less than 1 square foot (0.0929 m<sup>2</sup>) for each 150 square feet (14 m<sup>2</sup>) of under-floor area. One ventilation opening shall be within 3 feet (915 mm) of each corner of the building. Ventilation openings shall be covered for their height and width with any of the following materials provided that the least dimension of the covering shall not exceed ¼ inch (6.4 mm):

1. Perforated sheet metal plates not less than 0.070 inch (1.8 mm) thick.
2. Expanded sheet metal plates not less than 0.047 inch (1.2 mm) thick.
3. Cast-iron grill or grating.
4. Extruded load-bearing brick vents.
5. Hardware cloth of 0.035 inch (0.89 mm) wire or heavier.
6. Corrosion-resistant wire mesh, with the least dimension being ⅜ inch (3.2 mm) thick.

#### Exception:

The total area of ventilation openings shall be permitted to be reduced to ¼<sub>1,500</sub> of the under-floor area where the ground surface is covered with an approved Class I vapor retarder material and the required openings are placed to provide cross ventilation of the space. The installation of operable louvers shall not be prohibited.

#### R408.3 Unvented crawl space.

Ventilation openings in under-floor spaces specified in Sections R408.1 and R408.2 shall not be required where:

1. Exposed earth is covered with a continuous Class I vapor retarder. Joints of the vapor retarder shall overlap by 6 inches (152 mm) and shall be sealed or taped. The edges of the vapor retarder shall extend at least 6 inches (152 mm) up the stem wall and shall be attached and sealed to the stem wall or insulation; and
2. One of the following is provided for the under-floor space:
  - 2.1. Continuously operated mechanical exhaust ventilation at a rate equal to 1 cubic foot per minute (0.47 L/s) for each 50 square feet (4.7 m<sup>2</sup>) of crawl space floor area,

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including an air pathway to the common area (such as a duct or transfer grille), and perimeter walls insulated in accordance with Section R402.2.10 of the Florida Building Code, Energy Conservation;

2.2. Conditioned air supply sized to deliver at a rate equal to 1 cubic foot per minute (0.47 L/s) for each 50 square feet (4.7 m<sup>2</sup>) of under-floor area, including a return air pathway to the common area (such as a duct or transfer grille), and perimeter walls insulated in accordance with Section R402.2.10 of the Florida Building Code, Energy Conservation;

2.3. Plenum in existing structures complying with Section M1601.5, if under-floor space is used as a plenum.

#### R408.4 Access.

Access shall be provided to all under-floor spaces. Access openings through the floor shall be a minimum of 18 inches by 24 inches (457 mm by 610 mm). Openings through a perimeter wall shall be not less than 16 inches by 24 inches (407 mm by 610 mm). When any portion of the through-wall access is below grade, an areaway not less than 16 inches by 24 inches (407 mm by 610 mm) shall be provided. The bottom of the areaway shall be below the threshold of the access opening. Through wall access openings shall not be located under a door to the residence. See Section M1305.1.4 for access requirements where mechanical equipment is located under floors.

#### R408.5 Removal of debris.

The under-floor grade shall be cleaned of all vegetation and organic material. All wood forms used for placing concrete shall be removed before a building is occupied or used for any purpose. All construction materials shall be removed before a building is occupied or used for any purpose.

#### R408.6 Finished grade.

The finished grade of under-floor surface may be located at the bottom of the footings; however, where there is evidence that the groundwater table can rise to within 6 inches (152 mm) of the finished floor at the building perimeter or where there is evidence that the surface water does not readily drain from the building site, the grade in the under-floor space shall be as high as the outside finished grade, unless an approved drainage system is provided.

#### R408.7 Flood resistance.

For buildings located in flood hazard areas as established in Table R301.2(1):

1. Walls enclosing the under-floor space shall be provided with flood openings in accordance with Section R322.2.2.
2. The finished ground level of the under-floor space shall be equal to or higher than the outside finished ground level on at least one side.

#### Exception:

Under-floor spaces that meet the requirements of FEMA/FIA TB 11-1.

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# 7 WDO Inspections and Inspection Reports

**W**DO INSPECTIONS are visual inspections by a pest management inspector licensed and trained to identify live wood-destroying organisms, their damage, and evidence of infestation. Real estate transactions do not always require a WDO inspection. However, an inspection is often requested when buildings are bought or sold. The FDACS and Florida Law (Chapter 482 FS) requires all WDO inspections to use FDACS Form 13645 (Wood-Destroying Organism Inspections Report).

A WDO inspection identifies WDO situations only if they are visible and accessible at the time of the inspection. The report form does not require inspection of areas that are enclosed or inaccessible. For instance, enclosed or inaccessible areas may be those concealed by wall coverings, floor coverings, furniture, equipment, stored articles, or insulation. Also, any portion of the structure that would require removing or defacing any part of the structure is exempt from a required inspection. Crawl spaces and attics need to be inspected if the entrance is not blocked or is not too small for the inspector to access. The WDO inspection requirements under Florida law do not require a company to guarantee or warrant their inspection. It is only considered an opinion about infestation.

A WDO inspection is usually requested by real estate professionals, mortgage lenders, and homeowners as part of a real estate transaction. For these real estate transactions, the FDACS Form 13645 must be issued to the person or company requesting the inspection. A WDO inspection for real estate transactions should not be confused with annual inspections as part of a termite contract.

There are two types of inspections requested before many real estate transactions: a WDO inspection and a structural home inspection. The WDO inspection is to determine infestations, evidence, and damage caused by WDOs. A structural home inspection determines the condition of the electrical, HVAC and plumbing in the structure. Structural home inspectors cannot legally perform WDO inspections unless they are a licensed pest control company and properly trained to perform a WDO inspection. FDACS issues a special pest control identification card with the "Termites and Other Wood-Destroying Organisms" endorsement identified on the card.



*Figure 1. WDO inspections and structural home inspections occur before real estate transactions.*

## Completing a Wood-Destroying Organism Inspection Report 13645

This inspection report is required when an inspection for wood-destroying organisms is made by a licensee for the purposes of a real estate transaction and either a fee is charged for the inspection or a written report is requested by the customer. The inspection shall be made in accordance with good industry practice and standards as established by rule, and must include inspection for all wood-destroying organisms. The report must be made on the form prescribed by the Department and furnished by the licensee also a

copy of the report must be retained by the licensee for not less than three years. The report must include:

The licensee's name, date of the inspection, address of the structure inspected, any visible accessible areas not inspected and the reasons for not inspecting them, areas of the structure that were inaccessible, any visible evidence of previous treatments for, or infestations of, wood-destroying organisms (termites, powder post beetles, old house borers, and wood-decay fungi), the identity of any wood-destroying organisms present and any visible damage caused, a statement that a notice of inspection has been affixed to the property, and the location of the notice. The notice must be at least 3" × 5" and made of material that will last at least three years. It is a violation for anyone other than the property owner to remove the notice.

If any pest control treatment is provided at the time of the inspection, it also must provide the name of the wood-destroying organisms for which the treatment was made. This treatment would also require the issuance of a contract. The report does not constitute a guarantee of the absence of wood-destroying organisms or damage therefrom, or other evidence, unless the report specifically states therein the extent of such guarantee. The report must state that neither the inspector or licensee has any financial interest in the property inspected or is associated in any way in the transaction with any party to the transaction other than for inspection purposes.

A licensee must meet the minimum financial responsibility in the form of errors and omissions liability insurance or bond in an amount of not less than \$500,000 in the aggregate and \$250,000 per occurrence, or demonstrate that the licensee has equity or net worth of not less than \$500,000.

There are two documents that can give you guidance on completing the 13645 inspection report: *Guidelines for Use and Completion of Form 13645-Wood Destroying Organism Inspection Report* from the Department of Agriculture, and a baseline practices document developed in cooperation with UF/IFAS, the pest control industry, and the US Department of Agriculture. The baseline practices document can be found online at [http://www.flase.org/pdf/industry\\_baseline\\_final\\_10-07.pdf](http://www.flase.org/pdf/industry_baseline_final_10-07.pdf)

## Practices for Performing WDO Inspections for 13645 Report

It should be understood that the purpose of the Form 13645 inspection is to communicate the condition of the structure regarding the presence of WDOs at the time the inspection was performed. The report thus becomes a "snapshot in time" and provides no data as to the conditions of the structure before the inspection was made, or afterward. It is important to note that industry-wide acceptance of these good industry practice standards should not impact the majority of pest control companies that provide adequate WDO inspection services.

Licensees and certified operators in charge should ensure that they obtain wood-destroying organism identification cards only for persons who possess adequate knowledge of wood-destroying organisms based on appropriate validation by the licensee or certified operator in charge and that the individual has the ability to perform wood-destroying organism inspections. Additionally, the licensee and certified operator in charge should provide the training, tools and equipment necessary to perform an inspection in accordance with these good industry practices.

## Regulatory Requirements

Inspection for wood-destroying organisms is regulated as a pest control activity under the Florida Structural Pest Control Act, Chapter 482, Florida Statutes. Section 482.226 requires that when an inspection for wood-destroying organisms is conducted for the

purposes of a real estate transaction and either a fee is charged or a written report is requested, that a person qualified under Chapter 482 FS issue the report. Details about Section 482.226 are provided below.

Section 482.226 also includes requirements as to what the report must include [482.226 (2) FS], and a requirement that a notice of the inspection be posted in the access area to the attic or crawl or other accessible area of the structure inspected [482.226 (4) FS]. Licensees who perform wood destroying organism inspections for real estate transactions are required to have a minimum of \$50,000 in insurance coverage (or a bond) for professional liability for errors and omissions, or demonstrate an equity or net worth of no less than \$ 100,000 [482.226 (6) FS].

The report must include at a minimum [482.226 (2)(a) FS]:

1. The licensee's name.
2. The date of the inspection.
3. The address of the structure inspected.
4. Any visible, accessible areas not inspected and the reasons for not inspecting them.
5. The areas of the structure that were inaccessible.
6. Any visible evidence of previous treatments for, or infestations of, wood-destroying organisms.
7. The identity of any wood-destroying organisms observed or discovered and any visible damage caused.
8. A statement that a notice of the inspection has been affixed to the property in accordance and a statement of the location of the notice.

The inspection report must also include a statement certifying that neither the inspector nor the licensee by whom the inspection is made has any financial interest in the property inspected or is associated in any way in the transaction with any party to the transaction other than for inspection purposes [482.226 (2)(d) FS].

In addition, if treatment is made to the structure at the time of the inspection, the report must include information on the name of each WDO for which treatment was provided at the time of the inspection, the name of the pesticide used, and the conditions and terms associated with that treatment [482.226 (2)(b) FS]. A contract must be issued.

An inspection report does not constitute a guarantee of the absence of wood-destroying organisms or damage unless the report specifically states the extent of such guarantee [482.226 (2)(c) FS].

The Department has adopted a rule [Chapter 5E-14.142 (2)(c), Florida Administrative Code] that specifies Form 13645 (rev. 05/08) must be used to report any inspection conducted under Chapter 482.226 (1) FS. Form 13645 includes all of the information required under Section 482.226(2)(a) FS and the statements required in Section 482.226(2) (b), (c), and (d) FS.

The rule also states the general standards that must be met when conducting an inspection. These include:

- ▶ inspection of all areas accessible by normal means, except those areas that are enclosed or inaccessible, areas concealed by wall coverings, floor coverings, furniture, equipment, stored articles, insulation, or any portion of the structure in which inspection would necessitate removing or defacing any part of the structure,
- ▶ that the inspection be visual but that it may include probing and sounding of structural members as deemed necessary by the inspector, based upon a preliminary finding of visual evidence of infestation or damage, and
- ▶ that the inspection shall include an examination for visual evidence of wood-decaying fungi and damage caused by wood-decaying fungi.

Section (3) of 5E-14.142 (2)(c) states that wood-decaying fungi are fungi that can cause damage to wood, such as those that produce white rot, brown rot, poria and cubical rot, but not surface molds that do not cause damage to sound wood.



Stock photo

*Figure 2. The Form 13645 report is used to communicate the presence of WDOs only at the time the inspection is performed.*

Damage and deterioration in structures caused by exposure to water and sunlight are not reportable on a WDO 13645 report.

Examples of the above include delamination of wood veneer materials, water stains, peeling, separation and other breakdown of cellulose materials (i.e., particle board and masonite siding) where wood decay fungi are not present.

## Definitions Pertaining to WDO Inspections

For purposes of performing a wood-destroying organism's inspection for a real estate transaction, the following definitions shall apply:

1. **Attic access** — a visible and unobstructed opening, scuttle or ladder installed specifically for physical entry into the attic area of a structure.
2. **Accessible area** — an area of a structure to which the person performing the inspection can either gain physical entry in order to identify and/or determine the presence of wood-destroying organisms.
3. **Access panel** — a visible and unobstructed removable cover, plate or panel installed specifically for the purposes of conducting a visual inspection of the interior of a wall or void.
4. **Damage (caused by WDOs)** — any degradation or deterioration of wood, cellulose, or noncellulose components of a structure through the activity of WDOs. Damage is not limited to wooden structural members. Examples of damage include insect consumption of cellulose materials (galleries and mining), or WDO-created holes (adult emergence holes, kickout holes, swarm holes) in any structural material. Additionally, the deterioration of any cellulose material by the presence of wood-decay fungi creates damage. Areas of a structure that may have been obscured by paint or patching materials but that can still be identified by the inspector as WDO damage must be reported as damage.
5. **Defacement to property** — when the inspection process causes damage or creates unsightliness to the structure being inspected, whether it be intentional or accidental.
6. **Evidence** — visible signs of wood-destroying organisms other than damage or live activity, the presence of which indicates possible infestation. Examples of evidence include termite wings, dead insects, drywood termite fecal pellets, powderpost beetle frass, oldhouse borer frass, subterranean mud shelter tubes, and carton material. Areas of a structure that may have been obscured by paint or patching materials but that can still be identified by the inspector as WDO evidence must be reported as evidence.
7. **Good industry practice** — performance of wood-destroying organisms inspections in keeping with guidance set forth in this document (2006), developed by the structural pest control industry in cooperation with the Florida Department of Agriculture and Consumer Services.
8. **Inaccessible area** — any area of a structure that is not accessible including, but not necessarily limited to, those areas that are enclosed or concealed by wall coverings, floor coverings, furniture, equipment, stored articles, insulation, or any portion of the structure in which inspection would necessitate removing or defacing any part of the structure, or cannot be inspected due to the area's height, width, or safety concerns.
9. **Live** — the detection and observation of living immature or adult wood-destroying insects and active wood-decay fungi.
10. **Multi-unit structure** — after 5E-14.102(9), F.A.C. A structure, consisting of one or more stories, composed of functionally distinct units, such as stores, offices, apartments, town houses, and condominiums, in which units share a common wall of wood or metal studs or single masonry walls, including fire walls.

11. **Normal means** — inspection of visible and accessible areas performed following the guidance in this document.
12. **Probing** — the act of penetrating through the surface of a suspected area to determine the type of WDO present/probing will cause some degree of “defacement to the property.” Defacing property shall be strictly limited to that which is required to determine the type of WDO damage/evidence present.
13. **Sounding** — the noninvasive act of tapping on suspected areas of the structure with a tool in order to detect possible evidence of a WDO that may not be visible.
14. **Structure** — For the purpose of a WDO inspection report, this means any type of edifice or building together with the land thereunder, the contents thereof, and any patio or terrace thereof, including attached decks, and the portion of any fence touching or adjoining a structure on the designated property. The following might not be considered structures for the purpose of a WDO. You must disclose what structures you inspected on the property:

- ▶ Vehicles
- ▶ Transport trailers
- ▶ Boats
- ▶ Treehouses
- ▶ Detached pumphouses
- ▶ Pet houses
- ▶ Play houses
- ▶ Detached storage sheds constructed entirely of metal or plastic
- ▶ Transportable storage units
- ▶ Docks

*Note: The definition of structure is defined in Chapter 482.021(27), F.S. For the purposes of a WDO inspection, the definition of structure is as set forth above.*

15. **Substructure** — a shallow space below the living/occupied areas of at least a partially basementless structure normally enclosed by the foundation walls.
16. **Substructure access** — a visible and unobstructed removable cover or opening that provides for physical entry beneath a structure.
17. **Tools** — see Tools and Equipment section below for the list of required tools.
18. **Treatment** — is any method or device or the application of any substance routinely performed by a Pest Control Company for the purposes of preventing, controlling, eradicating, mitigating, diminishing, or curtailing a WDO in, on or under a structure.
19. **Visible** — Can be seen by the person performing the inspection at the time of the inspection without the need for visual enhancement other than illumination.



City-data.com

*Figure 3. Termite inspections may include probing as deemed necessary by the inspector.*

## Tools and Equipment Under Baseline Practices

Minimum tools and equipment that must be available are:

1. Flashlights or portable lights sufficient to illuminate areas which need to be illuminated during inspection.
2. Ladder sufficient for inspector to safely reach up to 8 feet to access interior attic openings.
3. Slotted head and Phillips-head screw drivers.
4. Inspection notices as required by Chapter 482 FS.
5. Hand lens or magnifying device with sufficient power to distinguish and identify wings, pellets and frass of a WDO. This device can be available at the office.
6. Measuring device or tape measure.

# Baseline Inspection Procedures

## Attic Inspections

### General

Attic inspections must provide for the following clearance for inspection purposes.

### Height to Access Opening

The maximum (without a pull-down ladder or staircase) should be 8 feet. No furniture, debris, permanent fixtures, shelving, appliances, household or stored items are to be under or around the opening/access area that hinders safe access. Opening or access area to attic must be specifically designed for the function of accessing the attics. Dropped ceiling panels are not to be considered as an access opening. There must be sufficient room to safely place and utilize a ladder (if necessary to gain access) without causing damage to the home or items in the area of the attic access. If any of these conditions exist, that particular attic access is considered inaccessible for the purposes of this inspection.

### Attic Access Opening

The opening should be a minimum of 20" × 20".

### INTERIOR SPACE OF ATTIC:

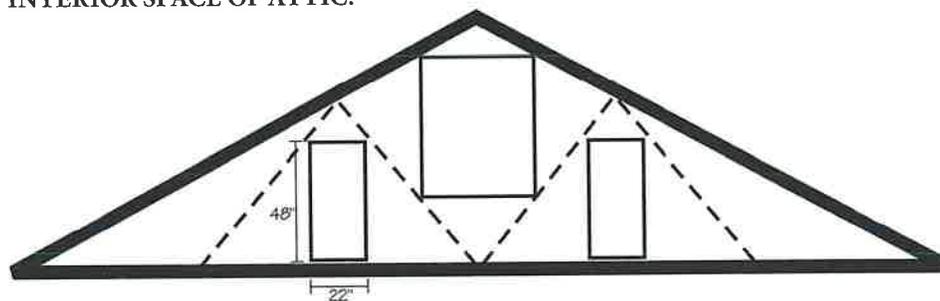


Figure 5. Cross section of attic space.

Attics will be inspected whenever there is an opening through the truss webbing (passageways) with dimensions of at least 48" in height and 22" in width as shown in Figure 5. Inspections of truss tails and soffit areas should be included to the extent they are accessible under the conditions existing in the interior attic space at the time of the inspection. Areas of the attic space may be considered inaccessible for inspection purposes if traversal of the interior attic space is obstructed by insulation which conceals the ceiling joists and no other means of traversal exists. Areas to be inspected that are concealed or blocked by insulation, HVAC equipment, electrical or other utility lines, stored items, pipe and chimney chases are considered inaccessible.

### Specific Areas

- ▶ Inspect all visible wood members for signs of WDOs
- ▶ Look for evidence on top of insulation, in spider webs, or on any visible surface in the attic.

However, those areas that are not completely accessible but can be observed and the WDOs identified by the use of a lighting device should be reported.



Figure 4. Attics must be inspected if the entrance is not blocked or too small for the inspector to access.

Gerald S. Wegner

## Inspecting the Exterior of the Structure

### General

WDO inspectors must familiarize themselves with the structure(s) to be inspected. The inspection of each structure shall include all sides of the building exterior and shall be limited to the first level, ground floor up to a height of 10 feet, with the exception of areas above the 10-foot level that can be visually identified by the naked eye as evidence or damage by WDOs may be reported. An inspection of the exterior will not require use of a ladder or necessitate the inspector entering onto the roof.

Areas of the exterior perimeter of the structure may be considered inaccessible if obstructed by structural or landscaping features such as, but not necessarily limited to:

- ▶ Attached sheds, decks, fences and other structures or attachments
- ▶ Shrubbery and ornamental plantings
- ▶ Mulch and/or ground cover
- ▶ Stored items and debris

Visual evidence or damage of WDOs that cannot be verified, accessed or confirmed may be reported in the comments section of the WDO Report Form, 13645.

The inspection will be visual but may include probing and sounding of structural members as deemed necessary by the inspector, based upon a preliminary finding of visual evidence of infestation or damage [5E-14.142(2)(c)2].

### Specific Areas

Examples of areas to inspect that may lead to the presence of WDOs include the following:

- ▶ Wood/soil contact
- ▶ Planter boxes
- ▶ Siding
- ▶ Fences (must be inspected at the point of attachment to the structure if accessible)
- ▶ Exterior doors
- ▶ Windows, door frames and shutters
- ▶ Window wells
- ▶ Balconies accessible by normal means
- ▶ Fascia and soffit
- ▶ Decks (attached or contiguous with the structure must be inspected if accessible)
- ▶ Lattice work and skirting around mobile homes and crawl spaces
- ▶ Chimneys
- ▶ Porches

## Inspecting the Interior of the Structure

### General

It is suggested that inspectors perform a general overview of the structure to familiarize themselves with the general layout of the structure to be inspected.

Evidence of and damage caused by WDOs in living areas is often hidden by furniture, floor coverings and interior finish and trim. Inspectors need to concentrate their efforts in those areas most likely to present visible evidence of WDOs.



Wikimedia Commons / Public domain

*Figure 6. Windows are one area that must be inspected for the presence of WDOs.*

The inspection will be visual but may include probing and sounding of structural members, as well as moisture readings (Figure 7) of wood and sheetrock elements, as deemed necessary by the inspector, based upon a preliminary finding of visual evidence of infestation or damage [5E-14.142(2)(c)2].

## Specific Areas

### General interior of rooms

- ▶ Areas obstructed by items such as furniture, wall coverings/hangings, floor coverings (rugs and mats), blinds and draperies (cornice and valance), stored items (boxes, containers and clothing), plants, or other household items will be considered inaccessible
- ▶ Interior inspections are performed from the floor level of each room inspected.
- ▶ General signs of infestation for the specific areas listed below include insect exit holes, frass, fecal pellets, mud tubes, termite wings, blistering, and wood-decay
- ▶ Evidence of and/or damage caused by WDOs may come in the form of wings, frass, fecal pellets, mud tubes, galleries, and termite exit holes
- ▶ An exit hole caused by a WDO is both evidence and damage.

### Access Panels

Open and/or remove readily accessible access panels, and inspect the accessible area for evidence or activity of WDOs and/or damage such as termite wings, mud tubes and galleries. Access panels may include areas that are not specifically related to plumbing.

### Doors and Windows

Inspect window and door frames for evidence of or damage caused by wood-destroying organisms. Wood-decay fungi problems are common in frames due to water intrusion. Frames are also subject to subterranean termite infestation because of their close proximity to the ground and moisture. It is suggested the inspector also look for evidence in spider webs, door and window tracks.

### Interior Walls

Visually inspect wall surfaces for waviness, blistering, slightly raised areas and peeling. If termites have been working inside the wall, they sometimes consume the paper between the gypsum and the paint, and this area may crumble when pressed.

### Baseboards and Trim

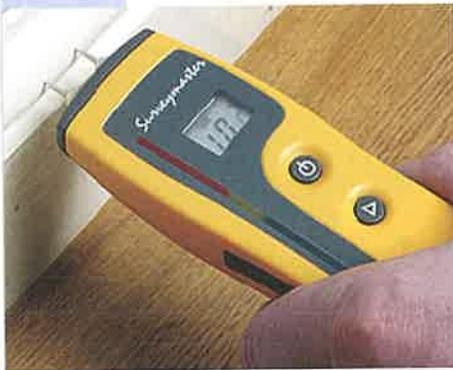
Emphasis should be placed on the inspection of all accessible baseboards and trim due to the propensity for infestation of these areas. When visible evidence or damage is present in this area, sounding and probing are recommended to ascertain the type of WDO present.

### Wood Flooring

Inspect accessible wood flooring for WDO evidence and damage. Special attention should be given to flooring adjacent to entry areas, plumbing penetrations, HVAC registers, areas of obvious buckling in the floor, fireplaces and staircases. Wood floors at ground level may indicate the presence of a substructure crawl space (see substructure crawl space).

### Cabinets

Inspect accessible areas of kitchen, bathroom and other cabinets, particularly those that contain sinks and pipes. Also check built in bookcases and alcoves.



Damp-meter-direct.co.uk



ToolExperts.com

Figure 7. Moisture meters.

## Substructure Inspections

### General

Substructure areas will be inspected whenever there is an entryway to the area that has an opening of at least 16" in height and 24" in width. Substructure areas that are blocked by plumbing, ductwork or other items may be excluded from the inspection. Additionally, areas that are less than 24" from the bottom of the floor joists to the ground are not required to be physically entered. However, those areas that cannot be physically entered into yet can be observed by use of a lighting device should be inspected visually to the extent possible. Investigation should be made to ascertain if an interior entryway exists for crawl space areas that do not have an exterior entryway. (See definitions of "Accessible Area" and "Access Panel" for inspecting areas where full accessibility is limited).

### Safety Concerns

Safety concerns rendering a substructure or portions thereof inaccessible include but may not be limited to items such as:

- ▶ Sewage waste
- ▶ Broken glass
- ▶ Unprotected electric lines
- ▶ Biting arthropods
- ▶ Vermin or other animals
- ▶ Plenum space

Portions of a substructure may be deemed inaccessible due to a safety concern. However, this does not automatically render the entire substructure inaccessible unless no other path to traverse the remaining structure exists. Any and all portions that are accessible are to be inspected and findings reported.

## Visible Evidence of Previous Treatment

The following items may be indicators of treatment for termites and other WDOs. Items that cannot be positively confirmed as a treatment for WDOs by a copy of a contract or warranty may be reported in the comment section of the report form.

### Look Inside For

- ▶ Treatment notices
- ▶ Drill holes along expansion joints or stress cracks found in garage and interior areas
- ▶ Drill holes near plumbing penetrations.
- ▶ Above ground termite bait stations.
- ▶ Dye on exposed wood studs and sheathing in garage or unfinished rooms.
- ▶ Drill holes in exposed surfaces (usually in a line or pattern). Drywood termite spot treatments

### Look In Attic For

- ▶ Treatment notices at or near access opening
- ▶ Evidence of previous treatment such as:
  - o Drill holes related to WDO treatments
  - o Dye on exposed wood rafters, joists or sheathing

### Look In Substructure For

- ▶ Treatment notices on or near crawl door
- ▶ Evidence of previous treatment such as:
  - Drill holes in block foundation walls and/or block piers
  - Evidence of trenching adjacent to foundation walls, piers or pier footings
  - Dye on exposed wood sills, floor joists, or flooring
  - Drill holes in exposed wood related to WDO treatments
  - Moisture barrier related to the control of wood-decay fungi
  - Baiting systems for termites



Gerald S. Wegner

Figure 8. Termite drill holes.

### Look Outside For

- ▶ Drill holes in foundation walls from horizontal drilling (supported or floating slabs)
- ▶ Drill holes along any attached slab such as patio, air conditioner slab, or walkway-expansion joints (Figure 8)
- ▶ Evidence of trenching along foundation perimeter
- ▶ Baiting systems for termites
- ▶ Clearly identifiable termite treatment port for injection under the slab

## Inspecting Multi-Unit Structures

When a WDO inspection is requested for an entire multi-unit structure, the inspection will be performed in accordance with recommended standards set forth in this document. When a WDO inspection is requested for less than an entire multi-unit structure and the unit being inspected is at ground level, that unit shall receive an exterior and interior inspection; any unit above the ground level shall receive an interior inspection. When an attic space exists and is accessible from within the unit being inspected the attic is to be included in the inspection. When inspecting a unit above the ground floor that has a balcony or porch, the visible and accessible areas are to be inspected without the use of a ladder.

When a WDO inspection is performed on an individual unit or portion of a multi-unit structure or a multi-unit dwelling as defined in Chapter 5E-14.102(9)&(11), FAC, it shall be identified on the wood-destroying organism's inspection report (Form 13645) that the inspection is specific to those unit(s) or portion(s) identified on the report form.

## Wood-Destroying Organisms Inspection Report, Form 13645

Proper documentation of the pest-conducive conditions observed in and around the structures being inspected is an essential responsibility of the pest management professional. Therefore, those who perform such inspections are well-advised to familiarize themselves with the state-approved documentation form that follows.



Florida Department of Agriculture and Consumer Services  
Division of Agricultural Environmental Services

**WOOD-DESTROYING ORGANISMS INSPECTION REPORT**

ADAM H. PUTNAM  
COMMISSIONER

Rule 5E-14.142, F.A.C.  
Telephone Number (850) 617-7996

**SECTION 1 – GENERAL INFORMATION**

Inspection Company: \_\_\_\_\_  
 Inspection Company Name: \_\_\_\_\_ Business License Number: \_\_\_\_\_  
 Company Address: \_\_\_\_\_ Phone Number: \_\_\_\_\_  
 Company City, State and Zip Code: \_\_\_\_\_ Date of Inspection: \_\_\_\_\_  
 Inspector's Name and Identification Card Number: \_\_\_\_\_  
Print Name ID Card No.  
 Address of Property Inspected: \_\_\_\_\_  
 Structure(s) on Property Inspected: \_\_\_\_\_  
 Inspection and Report requested by: \_\_\_\_\_  
Name and Contact Information  
 Report Sent to Requestor and to: \_\_\_\_\_  
Name and Contact Information if different from above

**SECTION 2 – INSPECTION FINDINGS – CONSUMERS SHOULD READ THIS SECTION CAREFULLY**

**THIS REPORT IS MADE ON THE BASIS OF WHAT WAS VISIBLE AND READILY ACCESSIBLE AT THE TIME OF INSPECTION AND DOES NOT CONSTITUTE A GUARANTEE OF THE ABSENCE OF WOOD-DESTROYING ORGANISMS (WDOs) OR DAMAGE OR OTHER EVIDENCE UNLESS THIS REPORT SPECIFICALLY STATES HEREIN THE EXTENT OF SUCH GUARANTEE.**  
 This report does not cover areas such as, but not limited to, those that are enclosed or inaccessible, areas concealed by wall-coverings, floor coverings, furniture, equipment, stored articles, insulation or any portion of the structure in which inspection would necessitate removing or defacing any part of the structure.  
 This property was not inspected for any fungi other than wood-decaying fungi, and no opinion on health related effects or indoor air quality is provided or rendered by this report. Individuals licensed to perform pest control are not required, authorized or licensed to inspect or report for any fungi other than wood-destroying fungi, nor to report or comment on health or indoor air quality issues related to any fungi. Persons concerned about these issues should consult with a certified industrial hygienist or other person trained and qualified to render such opinions. **A wood-destroying organism (WDO) means an arthropod or plant life which damages and can reinfest seasoned wood in a structure, namely, termites, powder post beetles, old house borers, and wood-decaying fungi.**

**NOTE: This is NOT a structural damage report. It should be understood that there may be damage, including possible hidden damage present. FURTHER INVESTIGATION BY QUALIFIED EXPERTS OF THE BUILDING TRADE SHOULD BE MADE TO DETERMINE THE STRUCTURAL SOUNDNESS OF THE PROPERTY.**

**Based on a visual inspection of accessible areas, the following findings were observed:**  
 (See Page 2, Section 3 to determine which areas of the inspected structure(s) may have been inaccessible.)

A.  NO visible signs of WDO(s) (live, evidence or damage) observed.

B.  VISIBLE evidence of WDO(s) was observed as follows:

1. LIVE WDO(s): \_\_\_\_\_  
(Common Name of Organism and Location – use additional page, if needed)

2. EVIDENCE of WDO(s) (dead wood-destroying insects or insect parts, frass, shelter tubes, exit holes, or other evidence): \_\_\_\_\_  
(Common Name, Description and Location – Describe evidence – use additional page, if needed)

3. DAMAGE caused by WDO(s) was observed and noted as follows: \_\_\_\_\_  
(Common Name, Description and Location of all visible damage – Describe damage – use additional page, if needed)

**CONTINUED ON PAGE TWO**

**SECTION 3 – OBSTRUCTIONS AND INACCESSIBLE AREAS:** The following areas of the structure(s) inspected were obstructed or inaccessible. NO INFORMATION on the status of wood-destroying organisms or damage from wood-destroying organisms in these areas is provided in this report.

In addition to those areas described in consumer information on Page 1, Section 2; the following specific areas were not visible and/or accessible for inspection. The descriptions and reasons for inaccessibility are stated below:

- Attic      **SPECIFIC AREAS:** \_\_\_\_\_  
    **REASON:** \_\_\_\_\_
  
- Interior      **SPECIFIC AREAS:** \_\_\_\_\_  
    **REASON:** \_\_\_\_\_
  
- Exterior      **SPECIFIC AREAS:** \_\_\_\_\_  
    **REASON:** \_\_\_\_\_
  
- Crawlspace      **SPECIFIC AREAS:** \_\_\_\_\_  
    **REASON:** \_\_\_\_\_
  
- Other:      **SPECIFIC AREAS:** \_\_\_\_\_  
    **REASON:** \_\_\_\_\_

**SECTION 4 – NOTICE OF INSPECTION AND TREATMENT INFORMATION**

**EVIDENCE** of previous treatment observed:  Yes  No    If Yes, the structure exhibits evidence of previous treatment. List what was observed: \_\_\_\_\_  
(State what visible evidence was observed to suggest possible previous treatment – use additional page, if needed)

**NOTE:** The inspecting company can give no assurances with regard to work done by other companies. The company that performed the treatment should be contacted for information on treatment history and any warranty or service agreement which may be in place.

A Notice of Inspection has been affixed to the structure at: \_\_\_\_\_  
(State the location)

This Company has treated the structure(s) at the time of inspection  Yes  No  
 If Yes: Common name of organism treated: \_\_\_\_\_  
(Common name of organism)  
 Name of Pesticide Used: \_\_\_\_\_ Terms and Conditions of Treatment: \_\_\_\_\_  
 Method of treatment:  Whole structure  Spot treatment: \_\_\_\_\_  
 Specify Treatment Notice Location: \_\_\_\_\_

**SECTION 5 – COMMENTS AND FINANCIAL DISCLOSURE**

Comments: \_\_\_\_\_  
(Use additional pages, if necessary)

Neither the company (licensee) nor the inspector has any financial interest in the property inspected or is associated in any way in the transaction or with any party to the transaction other than for inspection purposes.

Signature of Licensee or Agent: \_\_\_\_\_ Date: \_\_\_\_\_  
 Address of Property Inspected: \_\_\_\_\_ Inspection Date: \_\_\_\_\_

# Guidelines for Use and Completion of the Form 13645, Wood-Destroying Organisms Inspection Report

## General Information: Chapter 482.226, Florida Statutes, and Chapter 5E-14.142(2)(c), Florida Administrative Code

1. Whenever an inspection for wood-destroying organisms is made for purposes of a real estate transaction and either a fee is charged for the inspection or a written report is requested by the customer, it must be reported using Form 13645.
2. The licensee must inspect for all wood-destroying organisms as defined in Chapter 482.021(27), F.S. This also includes wood-decaying fungi.
3. A copy of the Form 13645 shall be retained by the licensee for not less than 3 years.
4. When a Wood-Destroying Inspection Report is issued on Form 13645, a notice of inspection shall be posted on the inspected property at a place designated in the report.
5. The Form 13645 report is not required to be guaranteed by the licensee nor is it required to be good for any set period of time. However, it is required that the report accurately reflect the condition of the property relative to wood-destroying organisms at the time the inspection was performed.
6. Persons performing wood-destroying organism inspections are required to have been issued a pest control identification card designating them as having received special training to perform such inspections or be a Florida certified operator in the category of "Termite and Other Wood-Destroying Organisms."
7. Neither the company (licensee) nor the inspector can have any financial interest in the property inspected nor can they be associated in any way in the transaction or be party to the transaction other than for inspection purposes (see Section 5 below for additional information).
8. It is necessary that a pest control company be licensed in the category of "Termites and Other Wood-Destroying Organisms Pest Control" in order to issue a written wood-destroying organism inspection report. The category of "Fumigation" does not entitle a licensee to issue Form 13645 reports.
9. Section 482.226(6), F.S., requires any licensee that performs Form 13645 inspections to have error and omission (professional liability) insurance coverage in the amount of \$500,000 aggregate and \$250,000 per occurrence or demonstrate net worth exceeding \$500,000.

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Rev 07/2014

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**Rev 07/2014**

10. The party requesting the inspection must be provided a copy of the Form 13645 report.
11. The inspection shall be performed in accordance with “Good industry practice” per Chapter 482.226(1), F.S. The document entitled “Baseline Practices for Performing 13645 WDO Inspections” describes the minimum good industry practice for 13645 WDO Inspections and has been endorsed by all State of Florida pest control associations. The document can be found at the Department’s website [www.flaes.org](http://www.flaes.org).

## COMPLETING THE FORM 13645

### Section 1 — General Information

1. **Inspection Company Name:** Business name as registered with the Department.
2. **Business License Number:** State-issued Inspection Company business license number.
3. **Company Address:** Licensed Inspection Company business location address.
4. **Phone Number:** Telephone number at the licensed business location.
5. **Date of Inspection:** Actual date the inspection was performed.
6. **Inspector’s Name and Identification Card Number:** Full name of inspector and WDO identification card number.
7. **Address of the Property Inspected:** Physical address of the property where the inspection was performed.
8. **Structure(s) on Property Inspected:** Identify the type of structure(s) that were inspected at the address indicated above. Example: House and detached garage.
9. **Inspection and Report Requested By:** Full name of person (seller or buyer) and their company contact information, i.e., phone or fax number.
10. **Report Sent To:** Name and contact information if different from information set forth in item No. 9.

### Section 2 — Inspection Findings

The first part of this section provides an explanation of what the report entails and what areas it covers. It is stated in a manner that should be understood by the reader as to what the report is and what it is not. The definition of “Wood-Destroying Organism” is set forth as it is defined in Chapter 482, F.S.

Based on a visual inspection the following findings were observed:

- A.  No visible evidence of WDO was observed.  
 If this box is checked, proceed to Section 3

B. Visible evidence of WDO was observed as follows:

1. Live WDO:

The actual live organism itself must be seen by the inspector in order to check this box. Example: Subterranean termites. Location: Tub trap area in hallway bathroom.

2. Evidence of WDO

This item is for reporting evidence of wood-destroying organisms that does not qualify as damage or as a live organism.

Examples:

- (A) Subterranean termite wings. Location: Family room floor in front of sliding glass doors.
- (B) Drywood termite pellets. Location: Kitchen cabinet above sink.
- (C) Powderpost beetle frass. Location: Floor joists at east end of substructure near access way.
- (D) Subterranean termite exit holes. Location: North wall of master bedroom

*\* Note: Exit holes caused by a WDO should be reported as evidence and damage*

3. Damage caused by WDO was observed and noted as follows.

Any and all wood-destroying organism damage should be reported. Whether extensive or minor, it is damage. It is not required to report the degree of damage but you are expected to report all damage observed in the visible accessible areas of a structure. If a damaged area appears insignificant it is better to report it than to overlook it. Any workings within a structural member by a wood-destroying organism would create a certain degree of damage, e.g., powderpost beetle emergence holes, subterranean termite galleries, wood decay, etc.

Example: Wood decay. Location: Subflooring underneath master bedroom bathroom.

The location of any damage and other reportable evidence required by the items above must be adequately described in sufficient detail so that the average person reading the report is able to readily understand where the findings are and, if so desired, could personally locate and observe the reported conditions.

## Section 3 — Obstructions and Inaccessible Areas

The purpose of this section is to make it clear to the reader of the report that areas of the structure normally inspected as part of a wood-destroying organism inspection were not inspected due to obstructions or inaccessibility, and the stated reason for the inaccessibility.

An unchecked box in this section indicates that the area was inspected and considered accessible by normal means.

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The following examples pertain to each of the areas listed:

- Attic Area. Reason: Entire attic area inaccessible due to A/C duct work and other conduit-blocking entry access in garage ceiling.
- Interior Areas. Reason: Utility room next to kitchen was inaccessible due to door being locked and key not available.
- Exterior Areas. Reason: Lower half of wood sided exterior wall at rear northeast corner of house not accessible due to stacked firewood.
- Crawlspace Foundation. Reason: Entire substructure crawlspace area inaccessible due to entryway in foundation being only 12 inches high.
- Other — Interior of garage. Reason: Entire garage area obstructed by storage of household goods/boxes

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Rev 07/2014

## Section 4 — Notice of Inspection and Treatment Information

### **Evidence of previous treatment observed:**

Any signs of a past wood-destroying organism treatment must be reported.

Examples:

- (A) Patched drill holes observed in foundation block indicating that a subterranean termite treatment has been performed.
- (B) Treatment notice in attic indicating a fumigation was performed.
- (C) Subterranean termite bait stations present around structure foundation perimeter.

**A Notice of Inspection has been affixed to the structure at:** Chapter 482, F.S., directs that whenever a wood-destroying organism inspection is made for purposes of issuing a 13645 report and/or whenever a treatment is performed for wood-destroying organisms, the licensee shall post notice of such inspection or treatment immediately adjacent to the access to the attic or crawlspace or other readily accessible area of the property inspected. Chapter 482.226, F.S., describes the information required on the notice as well as the minimum size. In all cases where a form 13645 is being issued, a notice of inspection must be posted at the structure being inspected. The location of the notice(s) must be reported in this item on the form.

**This company has treated the structure at time of inspection:** If any treatment for wood-destroying organisms is performed at or about the same time the inspection is performed, then it must be indicated in this item by stating what organism was treated. Additionally, a copy of the wood-destroying organism contract covering the treatment that was performed must be attached to the inspection report.

**If Yes:** Common name of organism treated: State the common name of the WDO for which treatment was performed.

**Name of pesticide used:** A copy of the WDO contract should be attached to the inspection report to comply with this item. In this space, state “See Attached Contract.”

**Method of treatment:**

If the inspecting company treats the property at or near the time of inspection, it must be indicated here whether the treatment included the whole (complete, entire) structure or whether it was only a spot (partial, limited) treatment to the structure.

## Section 5 — Comments and Financial Disclosure

**COMMENTS:** The purpose of the comments area is to allow for reporting additional information that may be necessary for better explanation or clarification of any of the items reported in Section 2 — Inspection Findings of the form.

If additional space is needed to fully report on any item, use additional sheet(s). If further reporting is done other than on page 1 or 2, it is suggested that it be noted in some manner in the pertinent section of the form.

The following statement appears near the bottom of Form 13645, “Neither the licensee nor the inspector has any financial interest in the structure(s) inspected or is associated in any way in the transaction with any party other than for inspection purposes.”

Chapter 482, F.S., requires that this statement appear on the form. This precludes the issuance of a Wood-Destroying Inspection Report on any structure(s) in which the inspector or licensee (to whom the pest control business license is issued) has any financial or business interests in the structure(s) or with any party to the transaction of the structures(s). Any association with the structure(s) or parties to the transaction should be strictly for inspection purposes only.

The final portion of the form is for the signature of the licensee or authorized agent.

The date of signature may or may not be the same as the inspection date.

The Department encourages the signature of the person performing the inspection when possible.

**Text on this page is from  
Instructions for Form 13545  
Rev 07/2014**

## Conducive Conditions

CONDUCTIVE CONDITIONS are conditions in, on, under, or around the structure that could contribute to infestations of termites or wood-decay fungi. These conditions include excessive moisture, wood in contact with the structure that is also in contact with soil, roof leaks, mulch and/or soil piled up around the structure, shrubs and trees planted too close to the structure, firewood piles stacked against the structure, soil grade sloping toward the structure, cracks in the slabs, grade stakes left in the slab, cellulose material buried adjacent to the structure, foam block construction, form boards left in place, stucco below grade, exterior access obstructed, and slab penetrations.

The following photos illustrate a selection of conditions that are conducive to termite infestations or growth of wood-decay fungi.

*Figure 9. Stucco below grade with dirt-filled planters abutting the foundation allow direct hidden access for termites. This also creates a moisture condition conducive to wood-decay fungi and subterranean termite infestations and prevents a thorough inspection of the structure exterior.*



*Figure 10. Wooden structural member in direct contact with the soil allows subterranean termites direct unseen access to the structure and is against the Florida Building Code.*





*Figure 11. Rigid foam board construction allows subterranean termites direct and unseen access to the structure. Although it is efficient from an insulation standpoint, it does not take into account the treatment of subterranean termite infestations.*



*Figure 12. Planted earthmound foundation covering is aesthetically pleasing from a “green” perspective. However, soil in constant contact with the exterior walls can lead to subterranean termite infestations above the foundation level and can cause a weakening of the structural elements due to moisture retained in the foundation walls.*



D.R. Supp

*Figure 13. Wood form boards left in place after the pouring of the slab can lead to subterranean termite infestations within the foundation of the structure.*



*Figure 14. Dense vegetation and improper soil grade allow moisture to accumulate, creating a conducive condition for wood-decay fungi, subterranean termites, and other pests.*



*Figure 15. Dense vegetation abutting the exterior foundation inhibits a thorough inspection and soil treatment around the structure exterior.*



*Figure 16. Soil erosion at a downspout washes the treated soil away from the structure, creating a zone of untreated soil, which can allow subterranean termites direct access through untreated soil. It also allows excessive moisture to be in contact with the foundation of the structure, which can cause structural defects.*



*Figure 17. Improperly installed or deformed flashing allows precipitation to soak into wooden roofing components, making them vulnerable to attack by wood-decay fungi and subterranean termites.*



*Figure 18. The location of the structure, and in some cases the grade of the landscape, may create flooding of the crawlspace, creating conducive conditions for the infestation of wood-decay fungi and subterranean termites. This condition can also lead to defects in the structure if not corrected.*



*Figure 19. Improperly installed flashing can direct precipitation against the structure, allowing intrusion into the stucco-covered walls and creating a conducive condition for wood-decay fungi and subterranean termite infestations.*



*Figure 20. Even a properly installed “termite shield” does not necessarily offer protection from subterranean termite infestations.*



# 8 Treatments

**S**OME OF the most important tools in an IPM program for wood-destroying organisms are insecticides, and pest management professionals need to select the correct termiticide/insecticide tools in order to successfully manage these pests in the urban environment. Termiticide/insecticide choices used to be quite simple when there were only one or two chemical classes, or groups of insecticides, as choices. Now there is a wide variety of choices, each with its own advantages and disadvantages. This chapter of the WDO manual is designed to provide the basic information on these insecticides so that these products can be most effectively and safely selected and used.

Termiticide/insecticides can be classified as either repellent or nonrepellent based on termite behavior when they encounter treated soil. Repellent termiticides are basically a barrier treatment to prevent termites from foraging into a structure. They kill termites if they are applied directly to the insect during application.

However, termiticides applied as a residual soil treatment results in termiticide adhering to soil particles. Termites will not pick up a soil particle treated with even very low levels of termiticide. As a result, termites will not penetrate into soil treated with a repellent termiticide, and they do not die from contact with treated soil.

Treatments with nonrepellent termiticides need to be thorough, or termites may find gaps in treatment. Nonrepellent termiticides allow a termite to forage and tunnel into the termiticide treatment and contact the treated soil. As a result, termites die as they tunnel into the treated zone around and under buildings.



*Figure 1. Pest control operator applying a termiticide soil treatment.*

Chemical Class/Group	Mode of Action	Target Site	Primary Use/ Route of Entry
<b>Insecticides that Target the Insect Nervous System</b>			
Pyrethrins/Pyrethroids	Sodium Channel Modulation	Axon of Nerve	Contact
Oxadiazines	Sodium Channel Blockage	Axon of Nerve	Oral
Semicarbazones	Sodium Channel Blockage	Axon of Nerve	Contact & Oral
OPs/Carbamates	Acetylcholinesterase Inhibition	Nerve Synapse	Contact
Neonicotinoids	Acetylcholine Receptor Stimulation	Nerve Post-synapse	Contact & Oral
Spinosyns	Acetylcholine Receptor Stimulation	Nerve Post-synapse	Oral
Phenylpyrazoles	GABA Receptor Blockage	Nerve Post-synapse	Contact & Oral
Avermectins	Glutamate Receptor Stimulation	Nerve Post-synapse	Oral
<b>Insecticides that Do Not Target the Insect Nervous System</b>			
Diamides	Muscle Stimulation	Muscular Calcium Channel	Oral
Juvenile Hormone Analogs	Mimic Juvenile Hormone Action	JH Degradative Enzymes/Receptor	Contact & Oral
Chitin Synthesis Inhibitors	Block Chitin Formation	Exoskeleton	Oral
Amidinohydrazones	Inhibit Energy Production	Mitochondria Within Cells	Oral
Pyrroles	Inhibit Energy Production	Mitochondria Within Cells	Contact
Fumigant (sulfuryl fluoride)	Inhibit Energy Production	Citric Acid / Glycolysis Cycles in Cells	Inhalation
Borates	Nonspecific Metabolic Disruption	Cells	Oral
Dehydrating Dusts (Dessicants)	Absorption of Cuticular Wax Layer	Exoskeleton	Contact

Table 1. Mode of action, target site, and primary route of entry of various insecticide classes used in urban and structural pest management.

## INSECTICIDES THAT DO NOT AFFECT THE NERVOUS SYSTEM

### INSECT GROWTH REGULATORS

- > **Juvenile hormone analog**
- > **Chitin synthesis inhibitors**

### OTHERS

- > **Borates**
- > **Energy inhibitors**
- > **Dehydrating / desiccant dusts**

## The Ways Termiticides/Insecticides Kill Insects<sup>1</sup>: Mode of Action

INSECTICIDES have chemical structures that allow them to be grouped into classes based on the similarity of their chemistries. All members in a termiticide/insecticide class have similar characteristics. The chemical structure of an insecticide generally defines its target site and its mode of action at that target site. Insecticidal target site is defined as the physical location within a pest where the insecticide acts. Mode of action is defined as what an insecticide does at its target site. In other words, an insecticide's mode of action is the way in which it disrupts something at its target site. Table 1 lists several insecticides and their modes of action, target sites, and routes of entry.

### Termiticide/Insecticides That Target the Insect Nervous System

Many termiticide/insecticides target the nervous system. Only a few insecticides, such as the insect growth regulators and some other insecticides, do not affect the nervous system. These insecticides are discussed later in the chapter.

To understand the mode of action of insecticides that target the insect nervous system, it is important to have a basic understanding of how the nervous system operates. In insects, the nervous system is composed of a series of highly specialized, interconnected cells along which travel electrical charges called impulses. Impulses are driven by the movement of electrically charged sodium, potassium, and chloride ions into and out of nerve cells. The uninterrupted transmission of impulses along this series of cells is required for a nervous system to function properly. In insects, prolonged or irreversible disruption of a normal-functioning nervous system will result in death.

<sup>1</sup> This section is modified from *Insecticide Basics for the Pest Management Professional*, Daniel R. Suiter and Michael E. Scharf, University of Georgia Extension and University of Florida, January 2015

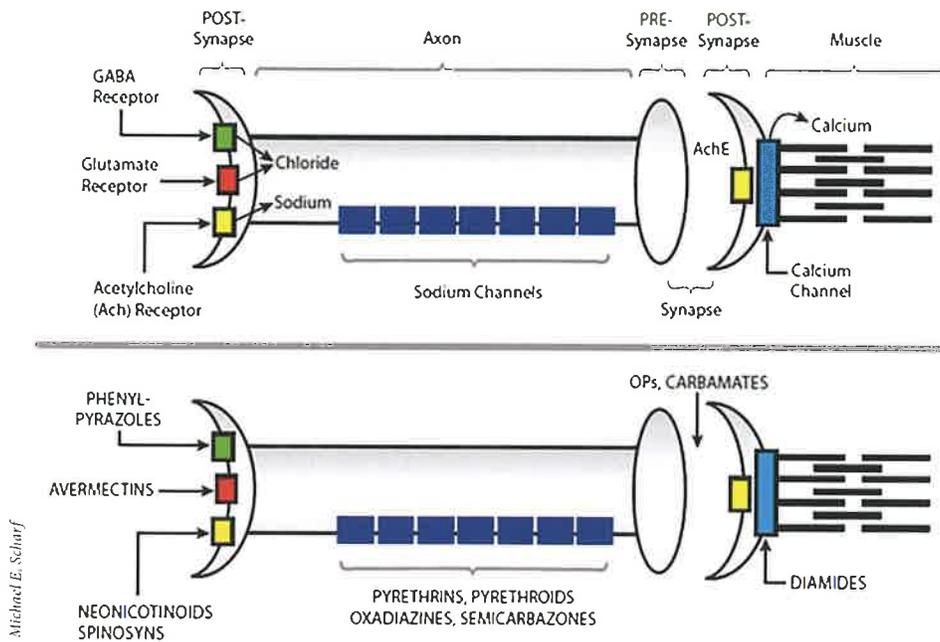


Figure 2. Neurological target site of various insecticide classes used by the urban and structural pest management industry.

Insecticides that target the insect nervous system can be subdivided based on their specific target site within the nervous system. Specific neurological target sites include sodium and chloride channels and various components of the acetylcholine system. Insecticides that do not target the nervous system can also be subdivided by target site and mode of action, and include: muscular calcium channel disruptors, insect growth regulators, inhibitors of energy production and nonspecific cellular disruptors, and insecticides that act via desiccation of the exoskeleton.

Based on these subdivisions, the following section describes the mode of action of important insecticides used in urban and structural pest management.

### Neurological Target Site: Sodium Channels

#### PYRETHROIDS — Figures 3 and 4

*The representative active ingredients of this class are bifenthrin, permethrin and cypermethrin.* Pyrethrins are the basis for pyrethroid chemistry. They have been known for more than 100 years to have insecticidal properties and are the individual insecticidal components of pyrethrum, an extract of chrysanthemum flowers.

Pyrethrins are not very stable. They decompose rapidly at high temperatures and when exposed directly to sunlight or ultraviolet light. As a result, pyrethrins lose their insecticidal properties quickly and are not acceptable as residual termiticides for long-term structural protection.

Because pyrethrins have such limited residual activity, manufacturers modified their original molecular structure and synthesized an entire new class of more stable, pyrethrinlike insecticides called pyrethroids — pyrethr-, which refers to the pyrethrins,



Manufacturer photos

Figure 3. Some pyrethroid termiticide/insecticide products: Demon Max, Dragnet SFR, and Permethrin SFR.



Figure 4. A pyrethroid termiticide/insecticide product: Bifen XTS.

and -oid, meaning like. Examples of pyrethroid termiticides commonly used by the pest management industry include bifenthrin, permethrin and cypermethrin.

Pyrethroids, like pyrethrins, disrupt normal nerve function in a region of the nerve cell known as the axon (i.e., the target site). Their mode of action is to inhibit the on/off switch of nerve cells, called sodium channels, by delaying the rate at which they close, or turn off. This mode of action results in uncontrolled, uninterrupted nerve firing, which results in a convulsing insect that exhibits tremors and shaking and quickly dies.

Pyrethroids are toxic to many hymenoptera (ants, bees and wasps) and most aquatic animals, especially fish. Pyrethroids are not very water soluble, a trait considered beneficial because it limits their movement in water (runoff) and soil. They still have limited stability in sunlight. However, when placed in the soil under a house and away from sunlight, pyrethroid residuals can last for years.

Pyrethroids are highly repellent to termites, and result in little termite mortality regardless of concentration in the soil. Termites encountering a pyrethroid soil treatment will turn away and continue foraging. Therefore, pyrethroid soil treatments need to be thorough, because repelled termites will use untreated gaps in treatments to gain access to treated buildings. Pyrethroid soil treatments do not reduce termite populations in soil surrounding the structure. Therefore, termites continue to tunnel and forage.

#### NEONICOTINOIDS — Figure 5

*The representative active ingredients of this class are imidacloprid and thiamethoxam.* Neonicotinoids, aka chloronicotinyls and “neonics,” are synthetic materials modeled after the natural, plant-produced insecticide nicotine. They target the insect nervous system by binding to the ACh (acetylcholine) receptor on the post-synapse nerve cell. Under normal conditions, ACh binds to this receptor for only milliseconds ( $\frac{1}{1,000}$  of a second) at a time, resulting in short, controlled nerve stimulation. The neonicotinoids bind to the ACh receptor for very long periods of minutes or more. This mode of action results in nerve hyperstimulation. Insects poisoned with a neonicotinoid insecticide exhibit symptoms of tremors.

Neonicotinoid insecticides are nonrepellent. Termites do not detect neonicotinoid products, like imidacloprid, on soil particles. They tunnel freely into treated soil resulting in primary kill. The termites pick up the soil particles and can remove them back into existing tunnels. This transfer results in secondary mortality of termites that did not directly contact the treatment. As a result of this primary and secondary kill, soil treatment with neonicotinoid insecticides results in a reduction in termite populations



Figure 5. Some neonicotinoid termiticide/insecticides — Dominion 21, Premise 75 in a bag, and Premise in a bottle.

around the treated structure. Neonicotinoid insecticides are soluble in water. When applied under a building, neonicotinoids have been shown to last at least five years, but applications to the perimeter of buildings that have exposure to rainfall have resulted in less residual.

## Neurological Target Site: Chloride Channels

### PHENYLPYRAZOLE — Figure 6

*The representative active ingredient of this class is fipronil.* Fipronil was discovered in 1987. It received its first registration as a termiticide in 1999. Fipronil acts on the insect nervous system by binding to and blocking the GABA (gamma aminobutyric acid) receptor on the post-synapse nerve cell. This blockage prevents GABA from binding to the receptor site, which then prevents the influx of chloride ions into the post-synapse nerve cell. Because chloride ions limit and balance the electrical activity within nerve cells, blocking chloride influx leads to rapid, uncontrolled nerve firing throughout the nervous system. Fipronil-treated insects exhibit tremors and shaking similar to that seen in pyrethrin- and pyrethroid-treated insects.

Phenylpyrazole insecticides are nonrepellent. Termites do not detect phenylpyrazole products, like fipronil, on soil particles. They tunnel freely into treated soil, resulting in primary kill. The termites pick up the soil particles and can remove them back into existing tunnels. This transfer results in secondary mortality of termites that did not directly contact the treatment. As a result of this primary and secondary kill, soil treatment with phenylpyrazole insecticides results in a reduction in termite populations around the treated structure.

Phenylpyrazole insecticides are not soluble in water. When applied under a building, they have been shown to last at least eight years, and applications to the perimeter of buildings can result in termite mortality up to 15 feet away. As a result, new application methods for fipronil have focused on treating just the exterior perimeter and limited interior treatments to utility penetrations of slab construction.

### COMBINATIONS OF PHENYLPYRAZOLES AND NEONICOTINOIDS — Figure 7

Combination spray products are usually mixtures of active ingredients from chemical groups with different modes of action, such as imidacloprid and fipronil. These products combine two nonrepellent (phenylpyrazole and neonicotinoid) active ingredients in termiticides/insecticide products.



Manufacturer photos

Figure 6. Some phenylpyrazole products: Taurus SC and Termidor.



Manufacturer photos

Figure 7. A phenylpyrazole and neonicotinoid combination spray product: Fuse.

## Termiticide/Insecticides That Do Not Target the Insect Nervous System

### Muscular Calcium Channel Toxins

#### DIAMIDE — Figure 8

*The representative active ingredient of this class is chlorantraniliprole.* The diamide insecticides are technically not neurotoxins. However, they act on the ryanodine receptors (under direct control of the nervous system) that regulate muscular calcium channels. Diamides bind to and stimulate muscular calcium channels, causing uncontrolled calcium release and resultant muscle contractions (Figure 1). Insects with early stages of diamide poisoning appear rigid or have “contractile” paralysis. In later stages of poisoning, symptoms are very similar to those of inhibitory neurotoxins like oxadiazines, semicarbazones and avermectins.

The diamide chlorantraniliprole, which is formulated into termiticide Altriset, is the first termiticide/insecticide classified as reduced risk by EPA. It is a nonrepellent termiticide. Termites tunnel into the treated soil and die days to weeks later due to muscle paralysis and weakness. It has been shown to provide five years of structural protection.



Figure 8. A diamide product: Altriset.

### Insect Growth Regulators

Insect growth regulators, or IGRs, used by the pest management industry include juvenile hormone analogs and chitin synthesis inhibitors. However, the chitin synthesis inhibitors are the only group used as termiticides/insecticides. IGRs do not act on the nervous system. They are insecticides that disrupt critical physiological functions associated with normal insect growth, development, and reproduction (egg production).

IGRs are typically not acutely toxic to adult insects. Adult insects exposed to IGRs usually suffer no adverse consequences, and typically live a normal lifespan. Because they target unique biochemical pathways found only in insects and related arthropods, IGR-containing products generally have low mammalian toxicity (i.e., large LD50 values). However, like all pesticides, IGRs should be handled safely and applied with a great deal of care and consideration for nontarget organisms. For example, the developmental physiology of many aquatic invertebrates is similar to that of insects. Because of this, aquatic arthropods are susceptible to some IGRs.

#### CHITIN SYNTHESIS INHIBITORS — Figures 9 and 10

*The representative active ingredients of this class are diflubenzuron, hexaflumuron, noviflumuron and novaluron.* The category of insect growth regulators used for termite control is the chitin synthesis inhibitors (CSIs). Chitin is a critical chemical component found in arthropod exoskeleton. As part of the process of molting, chitin is synthesized and incorporated into the insect’s new exoskeleton. The mode of action for chitin synthesis inhibitors is to block an important enzyme, called chitin synthase, which is directly responsible for the conversion of certain chemicals into chitin. In the absence of this enzyme, chitin cannot be synthesized. The prevention of chitin synthesis is fatal for the affected insect, which dies while attempting to molt.

Chitin synthesis inhibitors used by the structural pest management industry in termiticide bait products and systems include diflubenzuron, hexaflumuron, noviflumuron and novaluron. The subterranean termite worker caste is a continually molting immature form that makes up the majority of the social group. Workers cooperate to help maintain group stability and to keep social groups alive and viable. Termite baits that contain chitin synthesis inhibiting insecticides block chitin formation in molting termites exposed to the active ingredient.



Figure 9. Some chitin synthesis inhibitors (from top): Recruit HD tube and Advance bait containers.

Manufacturer photos



Figure 10. Some chitin synthesis inhibitor baits.

CSI baits are considered to provide dose-independent mortality. Most insecticides kill faster when a larger amount of insecticide is consumed, compared with a smaller amount that kills slower. Because CSIs kill insects at the time of molt, a large quantity that is ingested will kill at the same time as a smaller quantity of toxicant.

Termite baits containing CSIs are usually part of a baiting system. For instance, Recruit IV and Recruit AG contain noviflumuron and are part of the Sentricon Termite Colony Elimination System. Recruit HD is a durable bait and is part of the Sentricon Always Active system. The three Recruit bait products are intended for use by pest management professionals. The over-the-counter version, Shatter, contains hexaflumuron and is part of the HexPro termite baiting system. Both the Sentricon and HexPro systems provide for in-ground and above-ground baiting. Exterra and Advance Termite baits contain diflubenzuon and also have in-ground and above-ground baiting systems. Trelona has novaluron as the active ingredient in termite bait systems.

### Inhibitors of Energy Production (Metabolic Toxins) and Nonspecific Cellular Disruptors

#### **PYRROLE** — Figure 11

*The representative active ingredient of this class is chlorfenapyr.* Chlorfenapyr must be converted by enzymes within the insect to an active form by a process known as activation. Once inside the insect, chlorfenapyr is converted to a new molecule (called a metabolite) that is insecticidal. Interestingly, the metabolite is toxic to mammals as well. However, mammals lack the necessary enzymes to make the conversion from inactive to active insecticide. The mode of action of the chlorfenapyr active metabolite is to block the ability of mitochondria to supply energy to meet the insect's needs.

Chlorfenapyr is a termiticide/insecticide and is the active ingredient in Phantom. Unlike most other soil termiticides, it affects the termite's ability to produce energy for movement and other body functions. It is a nonrepellent soil treatment termiticide that is slow acting. Termites usually die in two to 14 days. However, their movement is affected in a matter of hours.



Manufacturer photos

Figure 11. Pyrrole product: Phantom.



Figure 12. An inorganic gas compound, sulfur-containing product: Vikane.

## Structural Fumigants

### INORGANIC GAS COMPOUNDS, SULFUR-CONTAINING — Figure 12

*The representative active ingredient in this class is sulfuryl fluoride.* In the structural pest control industry, sulfuryl fluoride is used to fumigate residential and commercial buildings. It is thought that sulfuryl fluoride inhibits energy production in cells but does not appear to have a specific target site, i.e., sulfuryl fluoride is considered a nonspecific metabolic inhibitor that causes a deprivation of cellular energy.

Fumigants can be hazardous to applicators and nontarget organisms if mishandled or misapplied. Most modern fumigants do not have intrinsic warning properties such as color, repellent odor, or taste. It is for these reasons that all fumigants have strict use guidelines that require substantial applicator training. In addition, a small amount of the warning agent chloropicrin (tear gas) is applied in residential and commercial buildings prior to the introduction of sulfuryl fluoride gas. Fumigation is a part of wood-destroying insect control, but certification is handled in a special fumigation category.

### BORATES — Figure 13

*The representative active ingredients in this class are disodium octaborate tetrahydrate and boric acid.* For decades, borates have been known to have insecticidal properties. Although an essential micronutrient for both plants and animals, at higher concentrations boron can be toxic. As a micronutrient, it aids metabolism and promotes enzyme function. Boron-based active ingredients have multiple modes of action. Borates can be consumed or groomed off the insect's body after having been picked up as a dust formulation.

Boron-based active ingredients may possess multiple modes of action in insects. Primarily, borates block special enzymes from metabolizing glucose for the production of energy in cell mitochondria. This causes affected insects to starve to death.

Borates may also affect the water balance in insects. As a dry dust, borates may abrade the insect cuticle like a desiccant. Boric acid is available as a dry dust product, but is often blended into paste and gel bait formulations. Boric acid exhibits excellent water solubility and is slow acting at low concentrations. Disodium octaborate tetrahydrate (DOT) is an active ingredient in preventative wood treatments targeted at both wood-destroying insects and wood-decay fungi.



Figure 13. Some borate products: Bora-Care, Niban and InTice containers, and Perma-Dust label.

A widely used borate product for termite control is disodium octaborate tetrahydrate, which is a sodium salt of boric acid. Bora-Care can be applied to wood in structures to prevent beetle or drywood termite attack, to control wood-decay fungi, and as a new construction treatment for subterranean termites. Termites consuming treated wood die from ingesting the wood. Also termites will not construct tubes very far on concrete treated with borates.

#### DEHYDRATING DUSTS — Figures 14 and 15

*The representative active ingredients in this class are silica gels and diatomaceous earth.* Silica gels and diatomaceous earth are dusts composed of silicon dioxide. They are inorganic, i.e., do not contain carbon. Silica gels are synthetically produced, while diatomaceous earth is the fossilized, skeletal remains of minute microorganisms known as diatoms (i.e., microscopic algae) whose remains are composed of silicon dioxide. Large deposits of fossilized diatoms are unearthed, mined, and used for insect control, among a myriad of other uses.

Both silica gels and diatomaceous earth absorb the thin wax layer on insect exoskeleton. The wax layer normally prevents insects from losing water through their exoskeleton and desiccating. By absorbing the wax layer, silica gels and diatomaceous earth increase the permeability of the exoskeleton, resulting in insect death by dehydration.

Silica gels and diatomaceous earth are most effective against drywood termites where free water is limited. These treatments are usually injected into galleries by drilling and treating the infested wood. Although the toxicity of inorganic dusts is low, care should be exercised in their use because of their ability to injure the human respiratory system if breathed.



Figure 14. Drione, a silicon-based dehydrating dust.



Figure 15. Some dehydrating dust insecticides: Tri-Die can and label, and Diatect V.

## Soil Treatment With Liquid Termiticides

SOIL TREATMENT has been a main method of subterranean termite control for many years. It capitalizes on termites needing water from the soil (in most cases) to stay alive, so termites move constantly from their nests and tunnels in the soil into above ground tubes which connect to their cellulose food sources in the building. As they move back and forth between the soil and the wood in the building, termites contact treated soil and die, or they are repelled by the treatment.

Soil treatments are performed with residual chemicals that are required to kill termites for at least five years after application. Initial treatment rates are relatively high so the active ingredient which slowly degrades over time will have sufficient residual left in the soil to protect the structure at the end of five years. Once applied, the formulation dries, and the active ingredient bonds to soil particles. In most cases the soil bond is so strong that it is very difficult for the active ingredient to leach out of the soil, and the only way to move it is to move/erode soil particles.

Successful treatment with soil termiticides requires uniform treatment of the ground underneath and around the perimeter of the building. However, the most important places for treatment are critical areas for termite entry (Chapter 6, Figures 21–25). These critical areas are usually around the perimeter of the building, utility penetrations through the concrete slab, piers in crawl space construction, and cold joints where two concrete slabs meet. These critical areas are usually protected with a vertical treatment so termites are either killed or repelled before they can enter the building. Other areas of lower risk for termite entry are sub-slab areas that are usually protected with a horizontal treatment. A thorough knowledge of building construction (see Chapter 6) is required to recognize critical and lower risk areas for each type of foundation and construction type.

### Application Volume

To provide maximum protection against termite infestation, the volumes of termiticide should be applied at the finished dilution percentage specified on the termiticide label.

The vertical treatment rate is applied to critical areas at a rate of 4 gallons of finished dilution per 10 linear feet per foot of depth for foundation treatments or 1–4 gallons finished dilution per square foot around anything penetrating the slab (e.g. utility services, plumbing lines).

Foundation treatments should be applied to soil down to the footer. However, if the footing is more than 4 feet below grade, application should be made to a depth of 4 feet. Some soils will not accept those volumes of termiticide, so many labels allow twice the concentration of termiticide to be applied in half the volume of finished dilution. For example, if a 1× rate of termiticide cannot be applied to achieve 4 gallons finished dilution per 10 linear feet per foot of depth, then a 2× rate of termiticide applied in 2 gallons finished dilution per 10 linear feet per foot of depth may be substituted.

Large reductions of application volume may reduce the ability to obtain a continuous treated zone. Variance is allowed when volume and concentration are consistent with label rates and a continuous treated zone is still achieved. At reduced application volume, it may be necessary for the applicator to drill holes and rod the soil at more closely spaced intervals than normal to create a continuous treated zone.

The vertical treatment rate for utility penetrations is usually 1 gallon of finished dilution per square foot around the plumbing, electrical, and other slab penetrations to cover at least 1 square foot around each penetration.

The concrete block void treatment rate is usually 2 gallons of finished dilution per 10 linear feet. This is applied to masonry voids resting on the footing. The termiticide usually leaks out of the voids and treats the soil next to the foundation to assure a continuous zone of treatment next to the building.

The horizontal treatment rate for preconstruction treatment, or “pretreats,” is usually 1 gallon of finished dilution per 10 square feet. However, if the soil will not accept this labeled volume of termiticide, the label may allow twice the concentration of termiticide to be applied in half the volume of finished dilution.

Note: Soil that is saturated with water from recent rain storms must not be treated with liquid termiticides because the soil-binding process will not occur and treatment will leach into nontarget areas, resulting in contamination of ground water and nearby bodies of water. Under such conditions, treatment must be rescheduled until the soil will accept and hold termiticides in place.

## Trenching and Rodding

### Trenching

Trenches should be a minimum of 6 inches deep or to the bottom of the footing, whichever is less, and need not be wider than 6 inches (Figure 16). When trenching in sloping (tiered) soil, the trench should be stepped to ensure adequate distribution and to prevent termiticide from running off. The finished dilution should be mixed with soil as it is replaced in the trench. Low-pressure spray (less than 25 psi at the nozzle) should be used to treat soil as it is replaced in the trench.

### Rodding

When rodding from grade or from the bottom of a shallow trench, rod holes in the soil should be spaced to apply a continuous treated zone (not more than 12 inches apart). Rod holes should not extend below the top of the footing.

**Vertical short-rodding** practices can be used in order to apply termiticide under a slab (Figures 17, 25d and 25e). The slab needs to be drilled, and all drill holes through the slab should be spaced so as to achieve a continuous treated zone (no more than 12 inches apart). Inject termiticide dilution into the drilled holes. For best results, application should be made with a lateral dispersal nozzle. All holes in commonly occupied areas into which material has been applied should be plugged with a noncellulose material or covered by an impervious, noncellulose material.

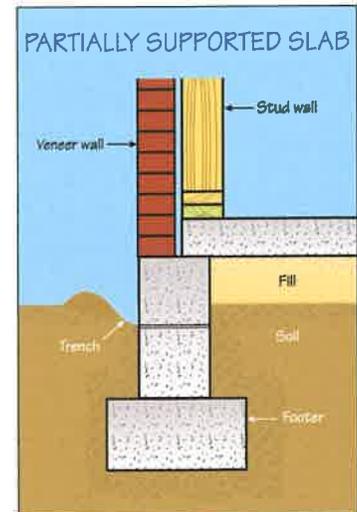


Figure 16. Trench prepared 6 inches deep by 6 inches wide along exterior foundation.



Figure 17. Apply termiticide into drilled holes when performing vertical short-rodding.

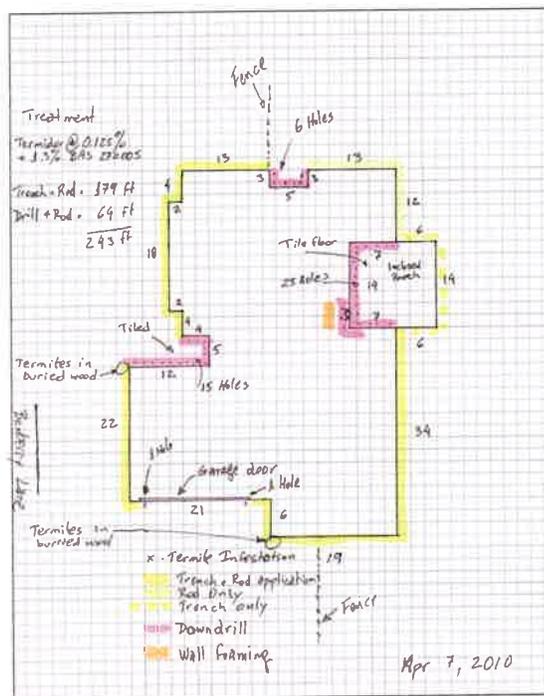


Figure 18. Diagram indicating treatment situations for both horizontal short-rodding and long-rodding beneath concrete slab structural elements.

**Horizontal short-rodding** practices can be used to establish a continuous treated zone in the soil next to the inside of a foundation wall (Figure 18). Holes should be drilled from outside the foundation at an angle which allows a finished dilution of termiticide to be deposited below any heating ducts, water/sewer lines, and electrical conduits.

**Horizontal long rodding** practices may only be employed to treat areas underneath the slab that are not accessible by vertical rodding or horizontal short rodding (Figure 18). Long rods exceeding 20 feet should not be used because the rod can bend, making an imprecise deposition of termiticide, or break at rod section connection points, resulting in treatment delays and failures.

For all horizontal rodding applications, all drill holes through the foundation should be spaced so as to achieve a continuous treated zone (no more than 12 inches apart). A dilution of termiticide is injected into the drilled holes at the vertical treatment rate. For best results, make applications with a lateral dispersal nozzle. All holes in concrete should be plugged with a noncellulose material and covered by an impervious, non-cellulose material such as mortar patch or acrylic-latex / silicone concrete sealant.

## Preconstruction Treatment

Preconstruction treatments, or “pretreats,” are defined as treatments made during all phases of construction up to and including installation of the final grade. Effective preconstruction termite control is achieved by establishing a thorough and complete horizontal and vertical treated zone.

The most effective and uniform treatment for soil termiticides occurs before the building is in place and affecting the delivery of product to the correct locations. Prior to each application, applicators should notify the general contractor, construction superintendent, or similar responsible party, of the intended termiticide application and the intended sites of application. The responsible person should be instructed to notify construction workers and other onsite individuals to leave the treatment area and not return until the termiticide has been absorbed into the soil.

When treating foundations deeper than 4 feet, apply the termiticide as the backfill is being replaced, or, if the construction contractor fails to notify the applicator to allow this, treat the foundation to a minimum depth of 4 feet after the backfill has been installed. The applicator should trench and rod into the trench or trench along the foundation walls and around pillars and other foundation elements, at the rate prescribed from grade to a depth of 4 feet. When the top of the footing is exposed, the applicator should treat the soil adjacent to the footing to a depth not to exceed the bottom of the footing. A structure should not be treated below the footing.

### Concrete Slab on Ground and Basements with Horizontal Treated Zones

An overall treatment of termiticide should be applied to the entire surface to be covered beneath the concrete slab (Figure 19). This includes the slab under the actual living area, plus carports, porches, basement floors, and any extended entrances. This treatment should be applied at the horizontal treatment rate using a coarse spray nozzle and low-pressure spray (less than 25 psi), spraying the dilution evenly and uniformly over the entire area treated.

### Vertical Treatment Zones

Termiticide should be applied at a vertical treatment rate for utility penetrations around anything penetrating the slab (e.g. utility services, plumbing lines) and at the vertical treatment rate for critical areas along the inside and outside perimeter of foundation walls (Figure 20). The applicator should trench and rod into the trench or trench along



Figure 19. Pre-construction treatment of graded soil to be covered by concrete slab.



Figure 20. Pre-construction vertical treatment zones along exterior and interior foundation perimeters.



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the foundation walls and around pillars, columns (Figure 21) and other foundation elements. The treatment along the inside of foundation walls should be applied at the vertical treatment rate per foot of depth to a depth of 4 feet below grade. When rodding from grade or from the bottom of a shallow trench, rod holes should be spaced to apply a continuous treated zone (not more than 12 inches apart). Rod holes should not extend below the top of the footing.

These two applications, horizontal treated zone (overall treatment 1 gallon/10 square feet) and vertical treated zone (the additional treatment of 4 gallons/10 linear feet) should be made prior to covering area with the concrete slab. If slab is poured prior to horizontal treatment, termiticide can be used to treat areas such as penetrations, joints, bath traps, and shower pan accesses. However, it is recommended that a complete horizontal treated zone be created prior to slab pour. If the slab is not to be poured the same day as treatment, cover the treated soil with a waterproof barrier such as polyethylene sheeting.

After completion of the grading, apply termiticide by trenching and rodding into the trench or trenching alone along the slab or foundation perimeter at the vertical treatment rate per foot of depth, or if the footing is more than 4 feet below grade, to a minimum depth of 4 feet. Trenches should be a minimum of 6 inches deep or to the bottom of the footing and need not be wider than 6 inches. When trenching in sloping (tiered) soil, the trench should be stepped to ensure adequate distribution and to prevent termiticide from running out of the trench. The finished dilution of termiticide should be mixed with the soil as it is replaced in the trench. Rod holes should be spaced to achieve a continuous treated zone (no more than 12 inches apart).

### Crawl Spaces

For crawl spaces, the vertical termiticide treatment rate should be applied to the top of the footing by trenching and rodding into the trench, or by treating the trench directly (Figure 22). The finished dilution should be mixed with soil as it is replaced in the trench. Both sides of foundation and all piers and pipes should receive treatment. When the top of the footing is exposed, the applicator should treat the soil adjacent to the footing to a depth not to exceed the bottom of the footing. Rod holes should be spaced so as to achieve a continuous treated zone (no more than 12 inches apart).

Figure 21. Once the soil has been graded around the bases of these roof support columns, the applicator can perform the vertical treatments at the column footings, as well as the horizontal treatment of the area to be covered by concrete slab.

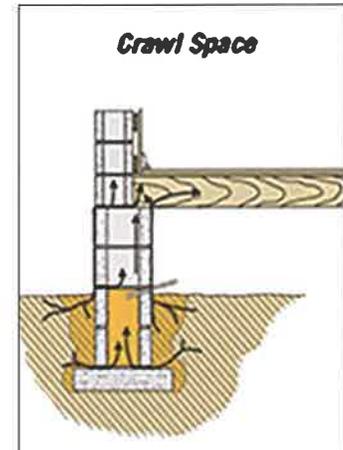


Figure 22. Crawl space foundation. Termiticide (shown in yellow) needs to be applied where termites enter and contact foundation elements.

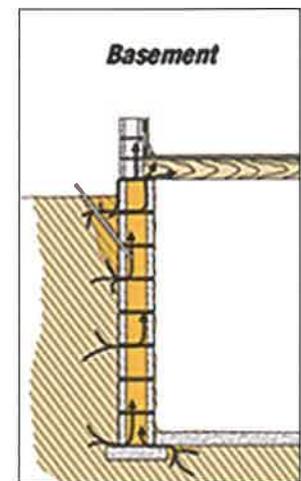


Figure 23. Basement foundation. Termiticide (shown in yellow) applied where termites enter and contact foundation elements.

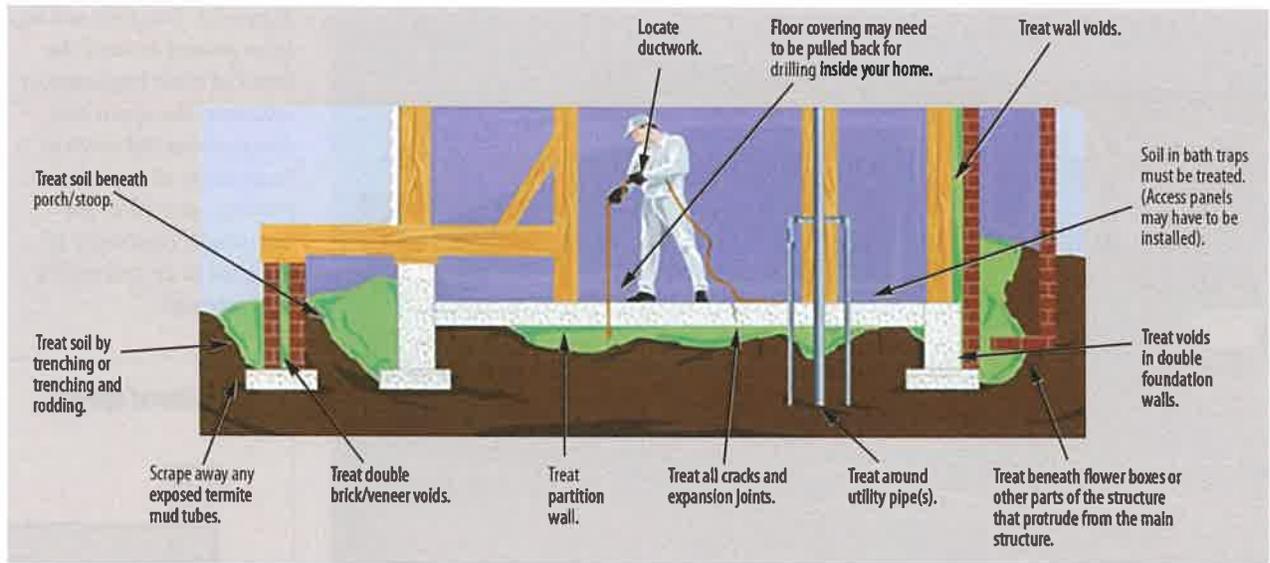


Figure 24. General application procedures. Post-construction treatment of a floating slab foundation residence showing all termiticide treatment areas (shown in green) required to correct and prevent subterranean termite invasion from surrounding soil.

### Hollow Block Foundations and Voids

Hollow block foundations or voids in masonry resting on top of the footing should be treated in order to create a continuous treatment zone next to foundations or piers (Figures 22 and 23). Applicators should drill and treat into voids of masonry elements if they are not openly accessible. The void treatment rate should be applied using a nozzle pressure of 25 psi or less. This treatment could be applied using access holes drilled below the sill plate and as close as possible to the footing.

Treatment of voids in block or rubble foundation walls should be closely examined for runoff as a precaution against application leakage from the treated areas. Some areas may not be treatable or may require alteration prior to treatment. All leaks resulting in the deposition of termiticide in locations other than the intended treatment zones should be cleaned up prior to leaving the application site.

Do not allow people or pets to contact contaminated areas or to reoccupy the contaminated areas of the structure until the cleanup is completed. Voids with insulated with rigid foam should not receive a void treatment.

### Post-Construction Treatment

Post-construction treatment is made after the final grade is installed for the purpose of protecting the structure from termite infestation and/or for controlling existing termite populations (Figures 16, 24 and 25). The usual application would be to treat vertical zones for termite protection. The applicator should trench and rod into the trench or trench along the foundation walls and around pillars and other foundation elements from grade to the top of the footing.

When the footing is more than 4 feet below grade, the applicator should trench and rod into the trench or trench along the foundation walls to a minimum depth of four feet. The actual depth of treatment will vary depending on soil type, degree of compaction, and location of termite activity. When the top of the footing is exposed, the applicator should treat the soil adjacent to the footing to a depth not to exceed the bottom of the footing.

Exterior concrete structures adjoining the foundation, such as patios, porches and sidewalks, should be drilled followed by treatment using sub-slab injection of the termiticide in order to complete the exterior vertical treatment zone along the foundation wall.

Do not apply the finished dilution of termiticide until the location and type of the following utilities are known and identified: (1) construction of heat or air-conditioning ducts and vents, (2) water, sewer or plumbing lines, and (3) electrical lines/conduits. Caution should be taken to avoid contamination of and damage to these structural elements and airways. *Note: During the initial inspection of a structure having sub-slab ductwork, a mechanic's mirror should be used in conjunction with a bright flashlight and angled in the floor vents to determine the direction in which the ducts run beneath the slab.*

**Exterior Perimeter and Concrete Slab on Ground Construction**

Soil adjacent to the foundation can be treated by trenching and rodding into the trench or trenching along the foundation at the vertical treatment rate. Trenches should be a minimum of 6 inches deep or to the bottom of the footing and need not be wider than 6 inches (Figures 25a, 25c and 26).

The finished dilution of termiticide should be mixed with the soil as it is replaced in the trench. Rod holes should be spaced so as to achieve a continuous treated zone but in no case more than 12 inches apart. However, in no case should the structure be treated below the footing.

**Sub-Slab Injection**

Sub-slab injection treatments can be made from inside the structure (Figures 24, 25d, 25e, and 27–29) or in cases when this is not possible, by drilling through the foundation from the outside. Prior to making any treatments, locate all heating/air conditioning ducts, vents, water/sewer lines, and electrical lines/conduits.

To treat under the slab, drill vertically through the slab along the interior perimeter of the foundation including the garage. Drill holes along all concrete expansion joints, cracks, plumbing, and utility services penetrating the slab. It may be necessary to drill holes along one side of the slab adjacent to an interior partition wall (Figure 25) if there is clear evidence of termite activity or damage in the wall. All drill holes through the slab should be spaced so as to achieve a continuous treated zone (no more than 12 inches apart). Inject termiticide dilution into the drilled holes at the vertical treatment rate.

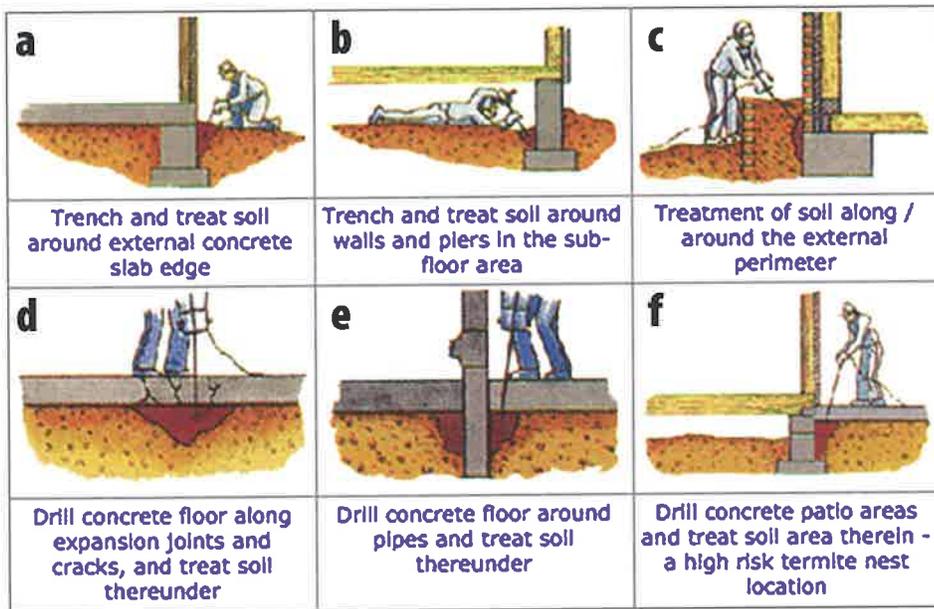


Figure 25. Termiticide application methods requiring trenching soil or drilling concrete slab followed by and vertical rodding: (a) exterior foundation; (b) crawl space interior foundation; (c) soil-filled planter at exterior foundation; (d) sub-slab injection at stress cracks; (e) pipes, drains and interior load-bearing walls penetrating slab floor; (f) slab (porch, driveway, sidewalk) abutting exterior foundation.

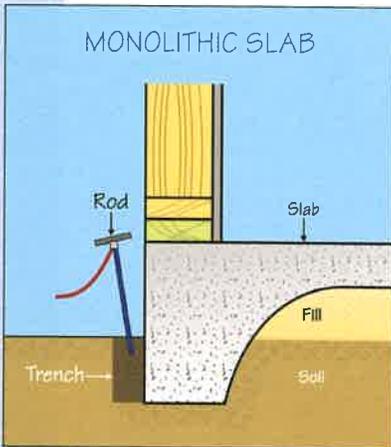


Figure 26. Typical placement of termite treatment (shaded) in a monolithic slab.

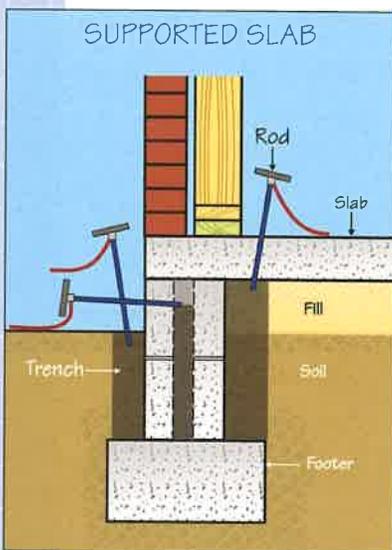


Figure 27. Typical placement of termite treatments (shaded) in a supported slab.

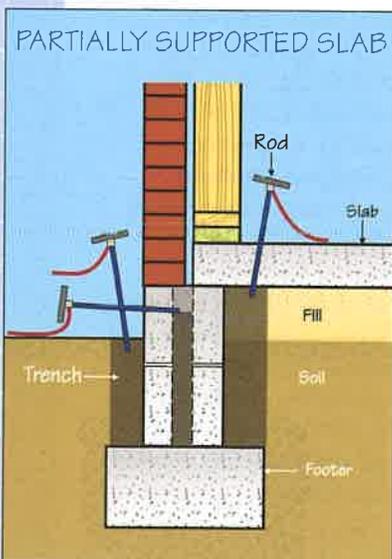


Figure 28. Typical placement of termite treatments (shaded) in a partially supported slab.

For best results, application should be made with a lateral dispersal nozzle. All holes in commonly occupied areas into which material has been applied should be plugged with a non-cellulose material and covered by an impervious, non-cellulose material such as mortar patch or acrylic-latex / silicone concrete sealant.

### Horizontal Drilling / Rodding / Sub-Slab Injection From the Exterior of the Foundation

This technique should be used to treat underneath the slab only when floors or interior design do not allow for vertical drilling. Care should be exercised not to rod into heating ducts, water/sewer lines, and electrical lines/conduits. Horizontal short-rodding practices can be used to establish a continuous treated zone in the soil proximal to the inside of the foundation wall.

Holes should be drilled from outside the foundation at an angle which allows a finished dilution of termiticide to be deposited below any heating ducts, water/sewer lines, and electrical conduits. Horizontal long rodding practices may only be employed to treat areas underneath the slab that are not accessible by vertical rodding or horizontal short rodding. Long rods exceeding 20 feet should not be used.

For all horizontal rodding applications, all drill holes through the foundation should be spaced so as to achieve a continuous treated zone (no more than 12 inches apart). Inject a dilution of termiticide into the drilled holes at the vertical treatment rate. For best results, applications should be made with a lateral dispersal nozzle. All holes should be plugged with a non-cellulose material or covered by an impervious, non-cellulose material.

**Bath Traps:** Exposed soil or soil covered with tar or similar sealant beneath or around plumbing and/or drain pipe entry areas should be treated with a minimum of 1 gallon to a maximum of 4 gallons of finished dilution per square foot. Tar or sealant may have to be removed to allow for adequate soil treatment. An access door or inspection portal should be installed if not already present. After inspection and removal of all wood/cellulose debris, the soil can be treated by rodding or drenching the soil with a label rate dilution of termiticide.

**Shower Drains:** Soil beneath and adjacent to shower pan drains should be treated. The slab adjacent to shower pan should be drilled and finished spray dilution of termiticide should be applied by sub-slab injection to the soil below. Termiticide foam can be used to maximize dispersion under the shower pan. Multiple access points can be drilled adjacent to the drain. A directional dispersal tip may be used to enhance treatment of the soil below the drain. Treat soil with a minimum of 1 gallon but no more than 4 gallons finished spray dilution per shower drain. In some cases, horizontal rodding can be used to access and treat the soil associated with the shower drain.

### Basement Structures

**Exterior Perimeter:** The exterior perimeter of basements can be treated by trenching and rodding into the trench or trenching along the foundation at the vertical treatment rate. Trenches should be a minimum of 6 inches deep or to the bottom of the footing and need not be wider than 6 inches. When trenching in sloping (tiered) soil, the trench should be stepped to ensure adequate distribution and to prevent the termiticide from running out of the trench.

The finished dilution of termiticide should be mixed with the soil as it is replaced in the trench. Rod holes should be spaced so as to achieve a continuous treated zone but in no case more than 12 inches apart. However, in no case should the structure be treated below the footing.

**Interior Perimeter:** Often basements may have sumps, wells or cisterns, and it is important not to contaminate these water sources. Drilling and short rodding through the slab can be done to treat along the interior perimeter of the foundation under the

basement floor slab. Holes should be drilled along all concrete expansion joints, cracks, plumbing, and utility services penetrating the slab. Also holes should be drilled along both sides of partition foundation walls, and around piers. It may be necessary to drill holes along one side of the slab adjacent to a non-foundation interior partition wall if there is clear evidence of termite activity in the wall.

All drill holes through the slab should be spaced to achieve a continuous treated zone (no more than 12 inches apart). A dilution of termiticide can be injected into the drilled holes at the vertical treatment rate. For best results, application should be made with a lateral dispersal nozzle. All holes in commonly occupied areas into which material has been applied should be plugged.

**French Drains and Sump Pumps:** French drains (Figure 30) eliminate water at the footer along a foundation perimeter. They are common in hollow block foundation structures to drain water seeping from the exterior perimeter or underneath the foundation. Soil should be dry before application to sites with French drains. Soil that is saturated should not be treated and treatments should not be applied while precipitation is occurring.

Do not apply treatments under any area of a slab closer than 24 inches to the French drain to prevent finished dilution from seeping into water in the drain and/or damage to the drain or the tiles. Termiticide should not be applied within 5 feet of a sump pit and pump. Do not drill through hollow block foundations that border the French drain in order to prevent drainage/seepage from the block into the drain.

Once a sump (Figure 30) has been identified, check to see if a French drain is located nearby. Otherwise, apply one or a combination of the following two methods, if the label allows. Termiticide can be applied as follows:

- 1) Unplug the sump pump. Inspect sump pit for water. If no water is present, the treatment can be made provided the sump pump remains unplugged; or
- 2) If water is in the sump pit, unplug the sump pump and remove four cups of water from the pit. Mark the water level. Wait 10 minutes and check the water level in the pit again. If the water level has risen, there is too much seepage to perform the treatment at this time. If the water level does not rise, make the treatment provided the sump pump

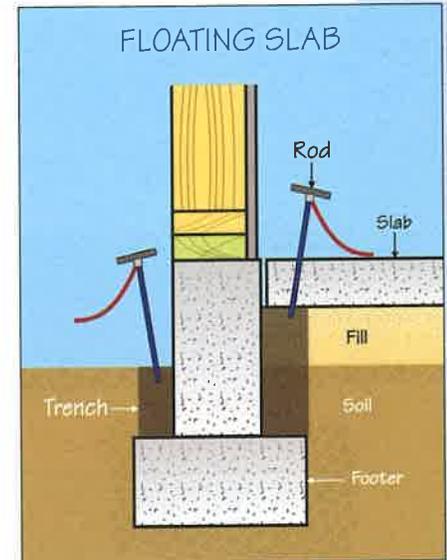


Figure 29. Typical placement of termite treatments (shaded) in a floating slab.

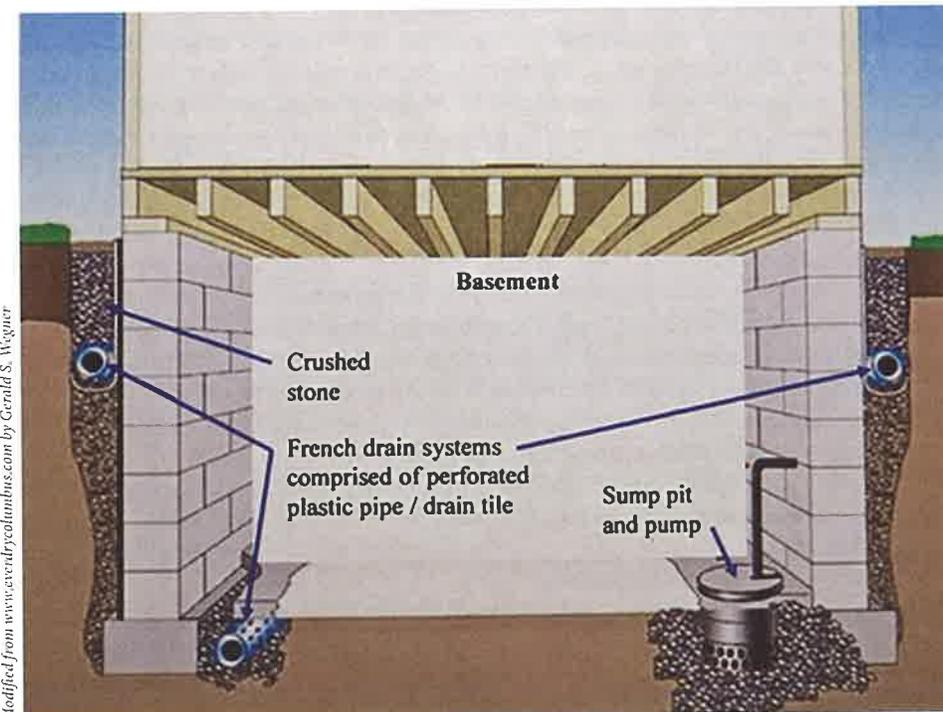


Figure 30. French drain systems conduct water away from the foundations they abut.

remains unplugged. During application, check the sump pump pit every few minutes for the presence of termiticide. If termiticide is detected (as a result of discoloration, odor or sudden rise in level), stop treatment immediately and remove the termiticide from the pump pit. All termiticide should be removed from the sump pump pit before plugging in the sump pump again. Use termiticide removed from the sump pump by applying it to sites of application listed on the label.

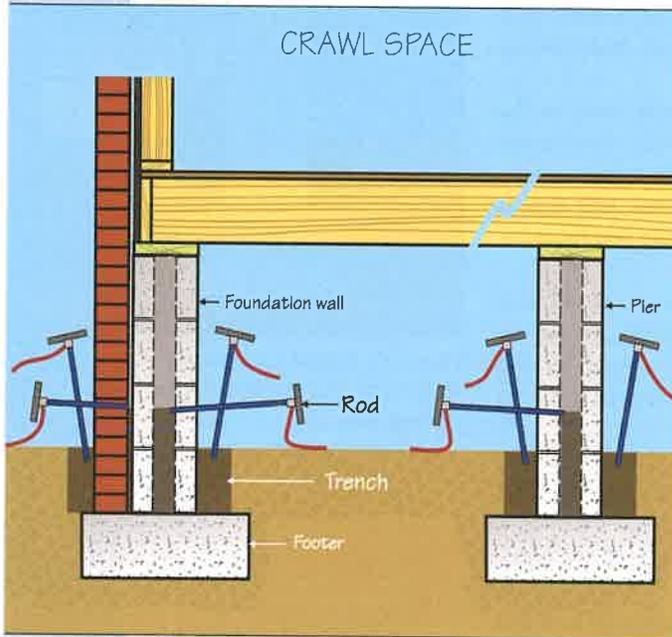


Figure 31. Typical placement of termite treatment, shown as shaded areas, in a crawl space foundation.

### Crawl Space Treatment

**Accessible Crawl Space:** Air circulation systems that move air from the area to be treated to an untreated interior space of the structure should be turned off until application has been completed and all termiticide has been absorbed by the soil. For crawl spaces, a vertical termiticide treatment should be applied at the vertical treatment rate by trenching and rodding into the trench (Figures 25b and 31). The hollow-block voids should be drilled and termiticide injected into the voids to ensure thorough treatment (Figure 31).

Both sides of the foundation and also the perimeter of all piers and pipes should be treated. Where physical obstructions, such as concrete walkways adjacent to foundation elements, prevent trenching, treatment may be made by rodding alone. When soil type and/or conditions make trenching prohibitive, rodding may be used. When the top of the footing is exposed, the applicator should treat the soil adjacent to the footing to a depth not to exceed the bottom of the footing.

**Inaccessible Crawl Space:** As with accessible crawl spaces, air circulation systems that move air from the area to be treated to an untreated interior space of the structure should be turned off until

application has been completed and all termiticide has been absorbed by the soil. For inaccessible interior areas, such as areas where there is insufficient clearance between floor joists and ground surfaces to allow operator access, excavate, if possible, and treat according to the instructions for accessible crawl spaces. Otherwise, apply one or a combination of the following two methods if the label allows:

1. The soil surface in the inaccessible crawl space can be treated by applying termiticide to the soil surface to apply a horizontal treatment, using a nozzle pressure of less than 25 psi and a coarse application nozzle. For an area that cannot be reached with the application wand, one or more extension rods can be used to make the application to the soil. Termiticide should not be broadcast or power sprayed with high pressures.

2. A horizontal treated zone can be established by drilling through the foundation wall or through the floor above and treating the soil adjacent to the foundation wall at the horizontal treatment rate. Drill spacing should be at intervals to allow a uniform horizontal treatment. Soil adjacent to foundation elements may be treated with short or long rod techniques without drilling, if access for the treatment tool is available.

**Hollow Block Foundations and Voids:** Hollow block foundations or voids in masonry resting atop the footing should be treated. Voids in multiple masonry elements can be drilled and treated of the structure extending from the structure to the soil in order to create a continuous treatment zone in the area to be treated.

Applicators may drill and treat into voids of masonry elements if not openly accessible. Apply at the void treatment rate using a nozzle pressure of 25 psi or less. When using this treatment, access holes may be drilled below the sill plate and should be as close as possible to the footing as is practical.

Treatment of voids in block or rubble foundation walls should be closely examined: Applicators should inspect areas of possible runoff as a precaution against application leakage from the treated areas. Some areas may not be treatable or may require mechanical alteration prior to treatment.

All leaks resulting in the deposition of termiticide in locations other than those prescribed on this label should be cleaned up prior to leaving the application site. Do not allow people or pets to contact contaminated areas or to reoccupy the contaminated areas of the structure until the cleanup is completed. Do not apply termiticide to voids insulated with rigid foam sheeting.

### Post-Construction Exterior / Localized Interior Treatment

For post-construction applications after the final grade is installed for the purpose of protecting the structure from termite infestation and/or for controlling existing termite populations, termiticide can be used to protect structures by using either the conventional structural treatment or the exterior perimeter/localized interior structural treatment. Structural termite protection is achieved by first establishing a continuous treated zone along the exterior foundation of the structure. Localized interior treatments are then made to areas where known termite activity is observed.

If no termite activity is observed inside the structure at treatment time, then interior local treatments are not required. This treatment method is designed to be non-invasive to the interior of the structure by applying a continuous treatment along the exterior foundation and only treating the interior areas that show termite activity. It may not be a conventional complete treatment. If you have questions regarding this treatment consult your lead state agency.

Termite activity is defined as one or more of the following infestation conditions: either (1) alates (winged termites) have swarmed inside the structure or (2) live termites are found to be active within the structure; or (3) there is clear evidence of termite activity on or in the structure (mud tubes, galleries in wood) and live termites. Do not apply termiticide as an Exterior Perimeter/Localized Interior Treatment at a finished dilution concentration lower than label rate or an application volume less than that specified in the application use directions section of the label.

### Exterior Perimeter Treatment

When conducting an exterior perimeter application, the termiticide should be applied in a manner to provide a continuous treatment zone to prevent termites from infesting the structure. Read and follow application use directions on the label if situations are encountered where the soil will not accept the full application volume recommended in the following use directions.

### Concrete Slab on Ground

Apply along the exterior foundation perimeter by trenching and rodding into the trench or trenching at the vertical treatment rate (Figures 16, 24, 25a, 25c, and 27–29). Trenches should be a minimum of 6 inches deep, or to the bottom of the footing, and need not be wider than 6 inches. The finished dilution should be mixed with the soil as it is replaced in the trench.

Rod holes should be spaced so as to achieve a continuous treatment zone but in no case more than 12 inches apart. However, in no case should the structure be treated below the footing. Where physical obstructions, such as concrete walkways adjacent to foundation elements, prevent trenching, treatment may be made by rodding alone. When soil type and/or conditions make trenching prohibitive, rodding may be used with rod holes no more than 12 inches apart.

Drilling and sub-slab treatment of sub-soil (Figure 25f) is necessary for exterior concrete structures adjoining the foundation such as patios, porches and sidewalks, to complete the exterior perimeter treatment zone. For driveways, exterior drilling is necessary only around building supports or wall elements that are permanently and physically located at driveway joints. In no case should the structure be treated below the footing.

### Basement and Inaccessible Crawl Space

Apply along the exterior foundation perimeter by trenching and rodding into the trench or trenching at the vertical treatment rate. Trenches should be a minimum of 6 inches deep or to the bottom of the footing and need not be wider than 6 inches. When trenching in sloping or tiered soil, the trench should be stepped to ensure adequate distribution and to prevent termiticide from running out of the trench. The finished dilution should be mixed with the soil as it is replaced in the trench.

Rod holes should be spaced so as to achieve a continuous treatment zone but in no case more than 12 inches apart. However, in no case should the structure be treated below the footing. Where physical obstructions, such as concrete walkways adjacent to foundation elements, prevent trenching, treatment may be made by rodding alone. When soil type and/or conditions make trenching prohibitive, rodding may be used with rod holes no more than 12 inches apart.

Drilling and sub-slab injection treatment of sub-soil is necessary for exterior concrete structures adjoining the foundation such as patios, porches and sidewalks, to complete the exterior perimeter treatment zone. For driveways, exterior drilling is necessary only around building supports or wall elements that are permanently and physically located at driveway joints. In no case should the structure be treated below the footing. If termite activity is found inside an inaccessible crawl space, the area with termite activity should be treated. A localized interior treatment should be made at the site of the termite activity and at least 2 feet in both directions from the termite activity.

**Accessible Crawl Space Treatment:** Turn off any air circulation system that moves air from area to be treated to an untreated interior space of the structure until application has been completed and all termiticide has been absorbed by the soil. For crawl spaces, apply vertical termiticide treatment at the vertical treatment rate. Apply by trenching and rodding into the trench (Figures 25b and 31).

Treat outside the foundation and around all piers and pipes. Where physical obstructions, such as concrete walkways adjacent to foundation elements, prevent trenching, treatment may be made by rodding alone. When soil type and/or conditions make trenching prohibitive, rodding may be used.

When the top of the footing is exposed, the applicator should treat the soil adjacent to the footing to a depth not to exceed the bottom of the footing. Drilling and sub-slab injection treatment of subsoil is necessary for exterior concrete structures adjoining the foundation such as patios, porches and sidewalks, to complete the exterior perimeter treatment zone.

Rod holes should be spaced so as to achieve a continuous treated zone but in no case more than 12 inches apart. Trenches should be a minimum of 6 inches deep or to the bottom of the footing, whichever is less, and need not be wider than 6 inches. When trenching in sloping (tiered) soil, the trench should be stepped to ensure adequate distribution and to prevent termiticide from running off. The termiticide dilution should be mixed with the soil as it is replaced in the trench.

### Garages

Attached garage floors should be treated in structures.

**Sub-slab injection:** Sub-slab injection treatments can be made from inside the garage or in cases where this not possible, by drilling through the foundation from the outside as directed below. Prior to making any treatments, locate all heating/air conditioning ducts, vents, water/sewer lines, and electrical lines/conduits and document their location on a site assessment diagram (Chapter 6, Figures 30–34) for reference.

**Vertical Drilling/Injection:** To treat under the slab, drill vertically through the slab along the interior perimeter of the garage foundation. Drill holes along all concrete expansion joints, cracks, plumbing, and utility services penetrating the slab. It may be necessary to drill holes along one side of the slab adjacent to an interior partition wall if there is clear evidence of termite activity or damage in the wall.

All drill holes through the slab should be spaced so as to achieve a continuous treatment zone but in no case be more than 12 inches apart. Inject a dilution of termiticide into the drilled holes at the vertical treatment rate. For best results, application should be made with a lateral dispersal nozzle. All holes in commonly occupied areas into which material has been applied should be plugged. Plugs should be of a noncellulose material or covered by an impervious, non-cellulose material such as Portland cement.

**Horizontal Drilling/Rodding/Sub-slab Injection from the Exterior of the Garage Foundation:** This technique should be used to treat underneath the slab only when interior design does not allow for vertical drilling. Care should be exercised not to rod into heating ducts, water/sewer lines, and electrical lines/conduits.

Horizontal short-rodding practices (Figure 18) can be used to establish a continuous treatment zone along the inside perimeter of the foundation. Holes should be drilled from outside the foundation at an angle which allows a finished dilution of termiticide to be deposited below/next to heating ducts, water/sewer/gas lines, and electrical conduits if present. Horizontal long rodding practices (Figure 18) may only be employed to treat areas underneath the slab that are not accessible by vertical rodding or horizontal short rodding. Long rods exceeding 20 feet should not be used.

For all horizontal rodding applications, all drill holes through the foundation should be spaced so as to achieve a continuous treatment zone but in no case be more than 12 inches apart. Inject a dilution of termiticide into the drilled holes at the vertical treatment rate. For best results, make applications with a lateral dispersal nozzle. All holes should be plugged. Plugs should be of a noncellulose material or covered by an impervious, non-cellulose material such as Portland cement.

### Localized Interior Treatment

Targeted interior applications may be made to vulnerable areas such as around plumbing/utility lines penetrating floors, bath and/or shower traps, or along expansion joints or settlement cracks as part of a complete treatment. However, if termite activity exists in the structure either in occupied areas or nonliving spaces such as crawl spaces and plenums, a localized interior treatment should be made at least 2 feet in two or more directions radiating from the site of the termite activity.

**Interior Concrete Floor:** If termite activity occurs in an interior wall or structural member, the area under the floor and behind the wall adjacent to the evidence should be treated with termiticide at finished dilution at the vertical treatment rate. This localized interior treatment should be made at the site of the termite activity and at least 2 feet in two or more directions radiating from the site. Foam can be used to maximize dispersion. Drill holes in commonly occupied areas should be plugged with a noncellulose material or covered by an impervious, noncellulose material such as Portland cement.

**Hollow Block Foundations and Voids:** If termite activity occurs in or within 2 feet of hollow block foundations or voids in masonry resting on the footing, the wall adjacent to the evidence should be drilled if not openly accessible, and termiticide at finished dilution should be injected into the void at the void treatment rate using a nozzle pressure of 25 psi or less. This localized interior treatment to hollow block should be made at the site of the termite activity and to areas above the termite activity.

Treatment should be made at least 2 feet in two or more directions radiating from the site of termite activity or along the wall pier or support post. Foam can be used to maximize dispersion. When using this treatment, access holes should be drilled below the sill plate and should be as close to the footing as is practical.

Treatment of voids in block or rubble foundation walls should be closely examined: Applicators should inspect areas of possible runoff as a precaution against application leakage in the treated areas. Some areas may not be treatable or may require mechanical alteration prior to treatment. All leaks resulting in the deposition of termiticide in locations other than those prescribed on this label should be cleaned up prior to leaving the application site.

Do not allow people or pets to contact contaminated areas or to reoccupy the contaminated areas of the structure until the cleanup is completed. The drilled holes in commonly occupied areas should be plugged with a noncellulose material and covered by an impervious, noncellulose material such as mortar patch or acrylic-latex / silicone concrete sealant.

**Bath Traps:** If termite activity is observed within 2 feet of the bath trap, then exposed soil or soil covered with tar or similar sealant around plumbing and/or drain-pipe entry areas should be treated. Tar or sealant may have to be removed to allow for adequate soil treatment. An access door or inspection portal should be installed if one is not already present. After inspection and removal of all wood/cellulose debris, the soil can be treated by rodding or drenching the soil with a dilution of termiticide. Treat with a minimum of 1 gallon to a maximum of 4 gallons of finished dilution per square foot.

**Shower Drains:** If termite activity is observed within two feet of the shower drains, then soil beneath and adjacent to shower drains should be treated. Drill through slab adjacent to shower drain (Figure 25) and apply finished dilution of termiticide by sub-slab injection to the soil below. Foam can be used to maximize dispersion. Multiple access points may be drilled adjacent to the drain. A directional dispersion tip may be used to enhance treatment of the soil below the drain. Be careful not to puncture the shower drain.

Treat soil with a minimum of 1 gallon but no more than 4 gallons finished spray dilution per shower drain. Horizontal rodding can be used to access and treat the soil associated with the shower drain.

### Retreatment of Structures

Retreatment for subterranean termites can be performed if there is clear evidence of reinfestation or disruption of the treated zone due to construction, excavation, or landscaping and/or evidence of the breakdown of the termiticide treated zone in the soil. These vulnerable or reinfested areas may be retreated using a spot, partial or complete treatment(s) in accordance with application techniques described on the label.

The timing and type of these retreatments will vary depending on factors such as termite pressure, soil types, soil conditions and other factors which may reduce the effectiveness of the treated zone. Annual retreatment of the structure is not recommended unless there is clear evidence that reinfestation, treatment zone disruption and/or evidence of breakdown has occurred.

### Combined Use of Termiticides

When a direct wood treatment termite control product is used as the primary pre-construction treatment for subterranean termites and is applied in accordance with the directions-for-use, the termiticide may be applied as an exterior perimeter pre-construction treatment using recommended dilution. If the exterior perimeter pre-construction treatment option is selected, termiticide should be applied to provide a continuous treated zone along the exterior foundation of the structure.

A complete and thorough horizontal preconstruction treatment with termiticide under the concrete slab is optional. Termiticide may also be applied to critical areas of the interior of the structure. These areas include plumbing and utility entry sites,

Gallons of Water	Foam Expansion Ratio	Gallons of Finished Foam	Consistency
1	25:1	25:1	"Dry" Foam
2.5	10:1	10:1	
5	5:1	5:1	

Table 2. Mixing rates for termiticide foams.

bath traps, shower drain penetrations, expansion joints, foundation cracks, and areas of known or suspected termite activity.

### Foam Applications

Foam applications are useful for treating areas where liquids tend to fail, such as behind veneers, piers and chimney bases, into rubble foundations, into block voids or structural voids, in wall voids, under slabs, stoops and porches, or in soil in crawl spaces and other similar voids.

Foams are made by mixing the termiticide concentrate with a volume of water and recommended amount of foaming agent. The amount of termiticide concentrate to measure is determined by the final foam volume. As shown in Table 2, concentrate quantity per gallon of water varies depending on the foam-expansion ratio: 1, 2.5, and 5 gallons of water each make 25 gallons of the final diluted foam, ranging from a "dry" to wet foam consistency. Drier foams tend to fill voids quicker and persist longer. Ready-to-use pressurized aerosol termiticide foam-generating products are available as well, which may be suitable for smaller jobs.

Apply a sufficient volume of termiticide foam to provide a continuous treated zone at the treatment rate for specific horizontal or vertical treatment zones. Use appropriate dispersion tips and application method for the specific site. Depending on the circumstances, foam applications may be used alone or in combination with liquid solution applications.

## Termite Bait Treatment

SOME TERMITE BAITS contain insect growth regulators, or IGRs, which are chitin synthesis inhibitors that prevent successful molting and development of subterranean termites. When termites are ready to molt from one stage to the next, they cannot form a new cuticle and die as they molt. This mortality is considered dose independent, meaning that termites that eat a lot of bait do not die any faster than termites that eat just a little. This is important because this delay in molting allows the bait to be passed by trophallaxis, or mutual feeding of other members of the colony, to termites that did not eat the bait, e.g., other workers, soldiers, and reproductives.

Over time, the termite colony declines to the point where the colony can no longer sustain itself and is eliminated. Termite bait is used in stations for prevention and elimination of subterranean termite colonies, and is intended to form the basis of an ongoing program providing structural protection against subterranean termites.

Other termite baits use slow-acting toxicants, i.e., metabolic toxins, that interfere with the termite's ability to utilize energy from food. Ingested bait kills termites either days or weeks later, depending on the amount of bait that is consumed. This delayed toxicity allows termites to pass food among other members of the colony.

Use of a termite baiting system involves the installation of stations in the ground or above ground to monitor for termite activity and for delivery of bait. When the bait is inspected and replenished, it provides ongoing prevention and elimination of termite colonies. Target sites for this termite baiting can include buildings, fences, utility poles, decking, landscape plantings, and trees, or other features that could be damaged by termite feeding and foraging activity.

Termite bait can be used on the inside or outside of foundation walls of crawl space areas, or through access holes made through concrete and asphalt, if adequate soil is not accessible and such action is warranted. Termite baiting programs can be used as a treatment of newly constructed buildings and a means of preventing termite infestation of new structures in Florida, but may not be acceptable in some other states.

Termite baiting can be categorized as treatment with nondurable baits, treatment with durable baits, and above-ground baiting.

## Termite Bait Treatment with Nondurable Baits

Nondurable baits degrade over time when placed in stations in the soil. Therefore, these baits are usually placed only when termite activity is detected. Typically there is a label-prescribed stepwise process for using a nondurable bait system that involves 1) monitoring, 2) self-recruitment and nondurable bait placement, 3) placement of auxiliary bait stations, 4) inspection of termite bait, and 5) reversion to monitoring when termites are controlled. Some manufacturers of nondurable termiticide baits have revised their products to skip the monitoring step and proceed with bait placement in stations, e.g., Sentricon Always Active. *Note: the Sentricon Colony Elimination System was replaced by Sentricon Always Active, so the monitoring phase of baiting may apply only to certain competitor products.*

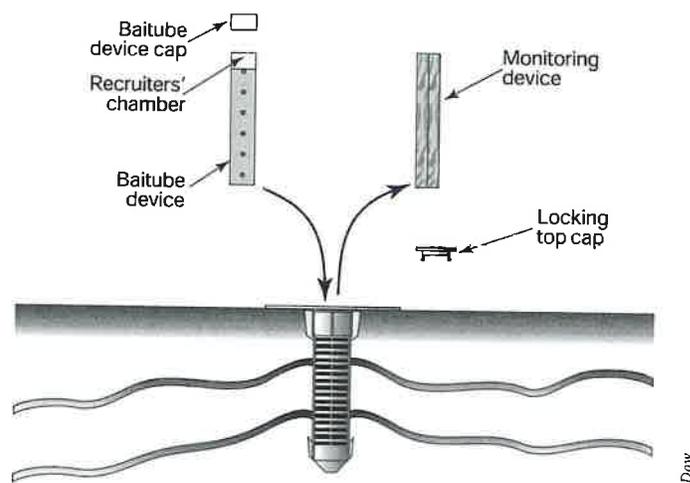


Figure 32. Installation of an in-ground termite bait station intended for non-durable termiticide bait, beginning with monitoring.

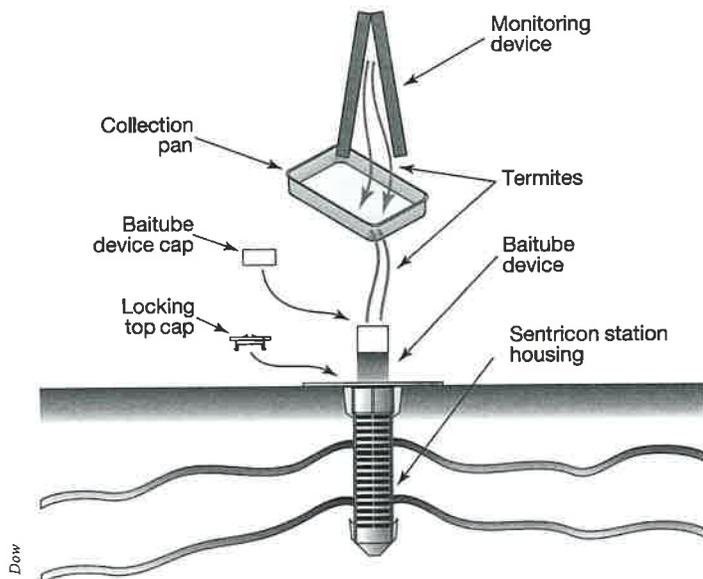


Figure 33. The monitoring station transitions to active baiting via self-recruitment.

## Monitoring

Traditionally, the first step in treating a structure with nondurable termite bait is to monitor for termites (Figure 32). Because nondurable termite bait degrades over time, bait is usually put in bait stations when termites are active inside the station. Monitoring stations contain untreated wood or some other cellulose material to detect termites foraging in the area.

Monitoring stations can be placed in the ground around the structure at intervals not to exceed 20 feet. If the structure foundation is known to have been previously treated with a soil-applied termiticide, the applicator is advised to not install monitoring stations in the soil closer than 18 inches from the foundation. Based upon the evaluation of the installer, additional monitoring stations can be installed in areas conducive to termite activity. Examples of areas for additional monitoring include:

- locations near visible termite activity such as foraging tubes, termite infested plants, wood, and other materials
- bath traps
- moist soil in shaded areas
- irrigation sprinkler heads
- roof downspouts and other moist areas
- planting beds or other areas with plant root systems

Monitoring devices should be inspected at least every three months when environmental conditions are favorable for termite feeding.

## Self-Recruitment and Nondurable Bait Placement

When live termites are observed in a monitoring station or when there is evidence of termite consumption of the monitoring device, nondurable bait should be placed in the station, converting the monitoring station into a bait station (Figure 33).

Self-recruitment can be utilized to recruit other termites to the bait station. Some systems require the removal of the termites from the monitoring station and subsequent transfer to the termite bait. Other systems allow bait placement without disturbing the termites in the monitor.

If self-recruitment by removal of termites is utilized, remove termites present in the monitoring device, and introduce them into the termite bait as follows:

1. Prepare the termite bait for introduction of termites. Wet the bait with potable water or sugar-containing solution. This moisture helps termites to survive the self-recruitment procedure. Allow the water or sugar-containing solution to be absorbed by the bait before transferring termites to the bait station.

2. Transfer termites from the infested monitoring device to the termite bait:

- (a) Remove monitoring device from the monitoring station and place it in a container suitable for collecting termites and associated debris that will be introduced into the termite bait. A shallow pan works well for this purpose, or, with experience, users may fashion other devices more suitable for this purpose.

- (b) Carefully remove termites, debris, soil and mud tube material (via gentle tapping) from the surface of the monitoring device. Save this material to add to the termite bait along with termites. The termites will then recruit other members of the colony to feed on the bait.

### Installation of Auxiliary Stations

A bait or monitoring station is considered to be free-standing if it is more than 12 inches from another station. Installation of auxiliary stations creates a cluster of two or more stations in which each station is located 12 inches or less from an adjacent active station. When a free-standing bait station has one or more auxiliary stations nearby there is usually faster and increased bait consumption, provided there is minimal disturbance of the surrounding soil during installation.

Auxiliary stations may be baited immediately or they may contain a monitoring device, in which case bait would only be placed in stations that are active. The self-recruitment process may also be utilized in baited auxiliary stations if adequate numbers of termites are available.

Also, bait could be installed in auxiliary stations without the termites first having been found in monitoring stations. Auxiliary stations containing termite bait may be installed, provided the auxiliary stations are located within 12 inches of the original station that contained active monitoring devices or termite bait. Termite feeding on bait can be enhanced by wetting the bait with potable water or a sugar-containing solution, such as a sports performance drink.

**Inspection of the Termite Bait.** Termite bait should be inspected by visually examining it for termites. If termites are active in the termite bait and the material is nearly or totally consumed (or if the material appears to be degraded or moldy), the old bait should be replaced with new bait.

If possible, termites should be transferred by gently tapping the termites from the old bait into the new bait using the self-recruitment procedure. It is not desirable to have all termite bait consumed before replacing it with new bait, because termites may abandon empty stations and forage elsewhere in search of food. Adjacent monitoring device locations should be inspected and termite bait should be placed in stations when termites are found in monitors.

**Reversion to Monitoring.** If upon inspecting a bait station no active termites or evidence of new termite feeding are observed, the termite bait should be replaced with a monitoring device. Monitoring should be resumed and performed on at least a three-month schedule. If auxiliary stations have been installed and there are no termites in them they should be removed, leaving the original monitoring station in place.

## Termite Bait Treatment with Durable Baits

### Installation of Durable Termite Bait

Install termite bait stations (Figure 34) around the building at intervals not to exceed 20 feet where soil access is not restricted. If the structural foundation is known to have been previously treated with a soil-applied termiticide, do not install stations in the soil closer than 18 inches from the foundation. Remove the bait from its packing material and place the termite bait in each bait station when the station is installed.

Based upon the professional evaluation of the installer, additional bait stations can be installed in areas conducive to termite activity near the structure. Termite bait may also be placed in previously installed bait stations upon removal of an existing monitoring device or bait.

### Service of Stations Containing Durable Termite Bait

The purpose of the service phase is to:

- detect the presence of subterranean termites or signs of termite activity in bait stations,
- monitor for termites,
- aid in termite bait replacement, and
- confirm termite control.

Baiting does not attract termites from other locations. Termite bait is inspected manually for detection of termites, termite activity, or to identify the need to replace bait. If termite bait is more than one-third depleted, replace it with new termite bait. If possible, gently tap the termites from the used bait into the bait station containing the new termite bait, being careful to not injure the termites. Introduce these termites after the new termite bait has been installed into the station.

Bait stations containing durable termite bait can be inspected and serviced on at least an annual basis. When annual service is being provided, an annual inspection date should be assigned for each structure. Stations should be inspected and serviced at intervals not exceeding 30 days beyond the annual inspection date unless unfavorable conditions exist. Unfavorable conditions include water-saturated soil or normal seasonal decline in subterranean termite foraging activity that may temporarily disrupt feeding on termite bait. Inspections should not be spaced any more than fifteen months apart.

Seasonal effects on termite activity vary geographically, but feeding activity typically declines during periods of prolonged cold weather (<50F). Inspection and servicing may be suspended during these periods. However, do not allow more than 15 months to elapse between inspections.

## Above-Ground Termite Baiting

Above-ground baiting may be used to eliminate subterranean termites from buildings. The process starts with a thorough inspection of the site to be protected. The inspection is required to determine if subterranean termites are present and accessible.

Above-ground baits are placed in bait stations inside termite-infested structures. Target sites for use of this product include interior and exterior surfaces of buildings and crawl spaces, fences, utility poles, decking, landscape decorations, trees, or other features that could be damaged by termite foraging and feeding activity. Above-ground baiting is effective only when applied to areas where termites are active and direct access to the station is possible. Installation of above-ground bait stations does not attract termites.

Areas suitable for placement of bait include interior and exterior surfaces where (1) live termites are observed in foraging tubes or subsurface galleries; (2) feeding activity



Figure 34. Sentricon Always Active, utilizing Recruit HD, is an example of a durable termite bait product.

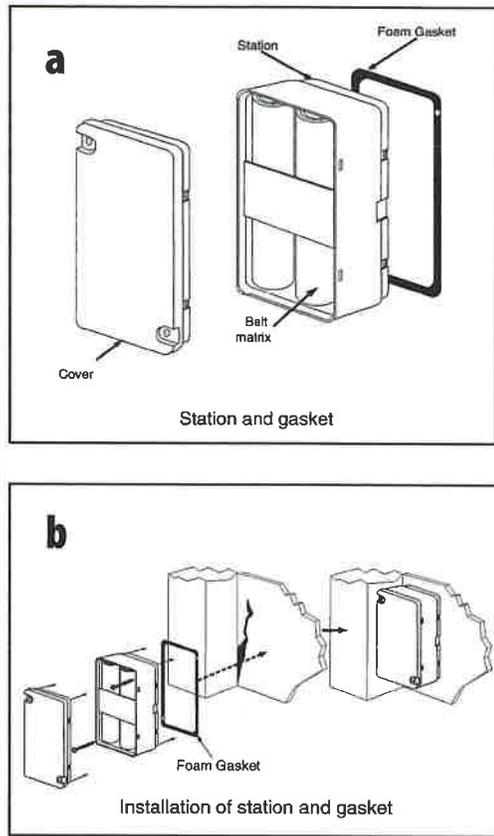


Figure 35. Above-ground termite bait station showing components (a) and installation (b).

is detected using an acoustic emission detector; or (3) termite foraging tubes, feeding damage, or emergence holes have recently appeared.

The surface area for installation of the bait station should be large enough to allow the station to be firmly attached to the structure. Once suitable areas for placement are identified, some surface preparation may be necessary before installation. In areas where there are no obvious subsurface galleries, feeding damage, or emergence holes, but termite feeding activity is detected, holes approximately  $\frac{3}{8}$  inch in diameter may be drilled to intercept feeding galleries within the area to be covered by the bait station. Be careful to not scrape off or disturb surface foraging tubes during the drilling process.

Above-ground baits may be installed in both food and nonfood areas of all types of food-handling establishments, i.e., food service, food processing and food manufacturing establishments. This includes but is not limited to restaurants, grocery stores, bakeries, bottling plants, canneries, meat and poultry processing plants, and grain mills. However, station placement should be planned to avoid disturbance or contamination by the activities of building occupants.

The bait station usually consists of a rigid plastic housing containing the bait matrix (Figure 35a). A cover allows for internal inspection of the bait station after installation. When attached to the mounting surface, the access window (open side) of the bait station allows termites to have direct access to the bait.

Installation (Figure 35b):

(1) Make sure the surface to which the station will be attached is clean and dry.

(2) You should moisten the bait matrix before securing the station in place since it is more difficult to moisten the bait matrix once it is attached. Carefully add 1–2 fluid ounces (30–60 ml) of potable water or a sugar-containing solution such as a sports performance drink to the matrix slowly enough that it is absorbed completely with no spillage or runoff.

(3) Align the opening of the station housing with the termite gallery openings, exit holes, drilled holes, or mud foraging tubes and secure the station to the surface. Avoid crushing surface foraging mud tubes when installing the bait station. Crushing these tubes will deny termite access to the bait. Appropriate use of breakout points where surface foraging mud tubes intersect the edges of the station housing will allow secure attachment without crushing the tubes.

(4) Firm and secure attachment of the station housing to the structure is necessary for it to remain in place under adverse weather conditions and to prevent tampering. Suitable attachment materials include screws, tape, non-volatile adhesives, latex-based caulk, or other appropriate materials. Avoid use of adhesives or caulking materials with volatile solvents that can temporarily repel termites.

(5) Apply adhesive caulking material to the surfaces of the station housing which contact the mounting surface, but do so only after the final mounting position has been determined. Termites may abandon a station that allows light, air movement, drying of the matrix, disturbance by human activities, pets, nuisance wildlife, or invasion by ants or other predators. Proper attachment and sealing of the station housing to the structure is critical.

Once installed, bait stations should remain in place as long as termites are actively feeding on the bait material. These stations and bait should be inspected a minimum of two- to four-week intervals depending upon feeding activity, to ensure that termites do not entirely consume the bait matrix.

If one-third to one-half of the bait matrix has been consumed and active feeding continues, auxiliary stations should be added. Auxiliary stations allow for addition of bait stations. When feeding has not been observed for two consecutive monitoring periods, the bait station can be removed followed by periodic inspection of the structure for renewed termite activity.

Above-ground bait can be applied in conjunction with other termite-control methods, including soil treatments and in-ground baits. However, application of pesticides to baits or to the immediate area to which it is attached may repel termites and should be delayed until after the entire baiting process is complete.

## Wood Treatment With Termiticides

WOOD TREATMENTS can be applied as a remedial treatment to infested wood or as a preventive treatment (before signs of infestations are observed) of wood in existing or new construction. Also, wood treatment for subterranean termites can be either as a primary structural protectant or a supplemental treatment to a residual soil or bait treatment. Wood treatment can be used for protection of all interior and exterior wood (including wood-foam composite structural components).

Wood treatment solutions can be applied selectively to galleries of termites and other wood destroying organisms or to bare wood, plywood, particleboard and other cellulosic materials where an intact water-repellent barrier, such as paint, stain or sealer, is not present. Wood treatment can be long lasting, provided the treated material is not exposed to rain, continuous contact with water, or in direct contact with the ground.

Wood treatments may be used on nonfood-contact surfaces of cellulosic materials including wood, plywood, particleboard, paper, oriented strand board (OSB), cardboard (nonfood packaging material), and wood composite structural components. They may also be applied to noncellulosic structural elements such as concrete, block, brick, metals, PVC plumbing pipes and other noncellulosic materials found in structures.

Wood treatment termiticides contain either a residual organic insecticide, e.g. pyrethroid, or an inorganic borate salt that is soluble in water. Borate wood treatments are a common form of wood treatment for structural protection from wood-destroying organisms. However, pyrethroids are also being developed for that use as well. The active ingredient in the borate treatment is an inorganic salt and, once in place, will not decompose or volatilize out of the wood.

## Treatment Rates

Application rates are for product application to nonsealed wood to the point of wetness (runoff), which is considered to be 1 gallon of dilution per 400 square feet of surface area. When two coats are required, that would increase the quantity applied to two applications of 1 gallon (for a total of 2 gallons) per 400 square feet.

For new slab on ground pretreatments, applications are made to all wall studs, bath traps, exterior (e.g., OSB) siding walls, exterior concrete block walls, plumbing and utility penetrations, expansion joints, and cracks in slabs. The rates of application for slab-on-ground construction are to the point of wetness.

Volumes needed for thorough treatment can be calculated by adding up all the volumes required for all the structural elements and features to be targeted, as seen in the treatment rate worksheet on the following page. This worksheet lists the step calculations for determining the total amount of insecticide formulation needed to treat a wood building in the framing stage of construction.

## Treatment Rate Worksheet

**Step 1**

Number of all interior and exterior wall studs  
 × 2 feet up  
 + linear footage of all interior and exterior sills  
 × 2 coats (extending 8 to 12 inches outward on slab on both sides)  
 ÷ 400 gallons  
 = gallons of dilution

**Step 2**

Linear footage of all exterior wall siding/sheathing  
 × 2 feet up  
 × 2 (both) sides  
 ÷ 400 gallons  
 = gallons of dilution

**Step 3**

Linear footage of all exterior concrete block walls and foundation blocks (indoor surface)  
 × 2 ft. up  
 ÷ 400 gallons  
 = gallons of dilution

**Step 4**

Linear footage of all foundation slab cold joints and/or expansion joints  
 ÷ 400 gal.  
 = gallons of dilution

**Step 5**

Linear footage of all foundation slab cracks  
 × 2 sides (for application 1 foot out on both sides)  
 ÷ 400 gallons  
 = gallons of dilution

**Step 6**

Number of pipe/utility penetrations of slab  
 × 0.03 gallon (for application 2 feet up and 2 to 8 inches out)  
 = gallons of dilution

**Step 7**

Number of bath traps  
 × 0.125 gallons  
 = gallons of dilution

**Step 8**

Total volume of wood protectant insecticide dilution needed to treat the wood frame building  
 = Total gallons from sum of steps 1 through 7

## Supplemental Wood Treatment

Most termiticides registered for soil treatment can also be applied to wood as a supplement/complement to other types of products approved for structural protection. Many general-use insecticides are labeled for direct treatment of termites in galleries, as well. Typically, these formulations are sprayed onto infested wood or injected into galleries. These treatments can provide a rapid mortality of wood-destroying insects in the structure. However, they are not intended to replace soil or bait treatments that protect the structure from subterranean termite attack. The primary purpose of these supplemental wood treatments is to control wood-destroying insects in above ground areas.

For subterranean termites, wood treatments can be applied directly to their galleries. These areas are moist and can keep termites alive for weeks or months. These wood treatments are usually used to reduce callbacks and lessen the risk of swarms in the structure after a residual soil or bait treatment. Wood treatment alone may not be a complete structural protectant, but it can be a complement to products that provide complete structural protection. Even in new construction, wood treatments for the prevention of subterranean termites can be applied as a supplement to residual soil or bait treatments.

## Primary Wood Treatment

**New Construction Treatments for Subterranean Termites:** Wood treatments can be used to prevent termite attack to new construction. Treatments should be applied when access to wooden structural components is likely and when no further framing modifications will be made, such as after final framing inspection. If treatment is carried out prior to the framing inspection, a second visit would be needed to ensure the full treatment has not been altered by additional construction.

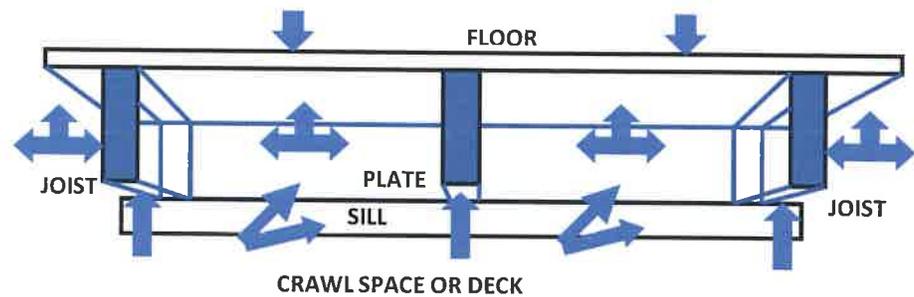
In areas where access is limited to one or two sides of a wood member, including exterior wall base plates and any stud and corner posts, two coats of solution should be applied to the exposed surfaces. The first application should be allowed to dry by waiting at least 20 minutes between applications.

**Buildings on Concrete Slabs:** Apply solution to all sill and base plates and the bottom two feet of all interior and exterior wall studs. All wood in plumbing walls, bath traps and any wood adjacent to plumbing, electrical conduit and duct penetrations should be treated to provide a minimum 2-foot-wide treatment around the slab penetration site. When spraying base plates, an overspray of the concrete slab should be applied outward a minimum of 2 inches to a maximum of 8 inches from plates. The concrete slab should be treated where any visible cracks may be occurring, extending treatment 8 to 12 inches out on each side of the concrete slab crack.

All penetrations such as plumbing, expansion joints and abutting concrete slabs should be treated by spraying solution two feet high and extending application to cover at least 6 inches of concrete slab out from penetration site. All bath trap penetrations should be treated at least 1 foot out with solution. The interior side of wall surface (concrete, cinder block or noncellulosic surfaces) of exterior walls should be treated 2 feet up from the concrete slab. The treatment should be applied as a continuous 2-foot barrier to interior-facing (indoor) surfaces of all exterior walls.

The total linear footage of the cellulosic base plates needs to be at least 60% of the total linear footage of all base plates in the structure including exterior and interior walls. In new construction with 60% or more linear footage of base plates, but without continuous wood on every exterior wall, the treatment should be installed to all other exterior structural construction materials, including brick or block, to a height of 2 feet and extended out onto the slab a minimum of 2 inches to a maximum of 8 inches.

Figure 36. Treatment (arrows) of wooden floor or deck structural members from beneath and above. All surfaces of the wood should be treated.



Gerald S. Neffner

**Buildings on Crawl Spaces and Basements:** Apply one coat of a solution in a 2-foot-wide uninterrupted band to the point of surface saturation to all structural wood surfaces in crawl spaces and basements (Figure 36), to include all sills, plates, floor joists, piers, girders and subfloors as well as structural wood exposed to direct vertical access from the soil.

To prevent termite shelter tubes on crawl space walls, solution should be applied to crawl space concrete or block walls in a 2-foot band up from the ground on interior wall surfaces. A 2-foot band around construction materials and structural wood adjacent to plumbing, electrical conduit and ducts should be treated where they penetrate subfloors, if they provide a direct vertical access from the soil. All structural wood, including wall studs and sills, should be treated in finished-out basements where structural wood framing is immediately adjacent to the exterior foundation walls with the concrete slab being sprayed from 2 inches to a maximum of 8 inches from the wall.

To prevent termite shelter tubes on basement walls, all interior concrete or block foundation walls should be treated with a 2-foot band up from the concrete slab area. If accessible, the exterior of structural wood sill areas around the entire perimeter of the structure should be treated with a 2-foot-wide band of solution beginning with the sill area and extending upwards onto the sheathing material.

On multiple-story structures, treat only the first story above the masonry foundation level. Coated or painted structural wood may be treated by pressure injecting solution into holes drilled into the wood at 8- to 10-inch intervals.

**Foamboard Insulation:** Foamboard insulation should be treated with a low-pressure surface spray or injection of solution into or on the infested area. Some types of foam insulation, such as polyisocyanurate and extruded polystyrene, have closed cell consistency that do not allow significant penetration from surface application. Inject and spray the surface of these types of insulation.

## Preventive Treatment for Drywood Termites and Powderpost Beetles

Solution should be applied to the point of surface wetness to all structural wood surfaces using a brush, spray or mist. Two coats of solution should be applied to those surfaces where access is limited to one or two sides of structural wood members. Allow first application to dry by waiting at least 20 minutes between applications.

## Preventive Treatment of Wooden Structures

Wood treatment provides only limited and temporary protection of wood in contact with the ground and is not a substitute for products registered for protection of wood in contact with the ground. Wood treatment may be applied as a treatment to protect wood from Formosan, drywood and dampwood termites, carpenter ants, old house borers, powderpost and listed wood boring beetles and wood decay fungi.

Wood treatment should be applied when access to wooden structural components is optimized such as at the “dried-in” stage when sheathing and roofing are in place, yet before installation of insulation, wiring, plumbing and other mechanical components. For framed wood surfaces above ground, treatment should be applied to the point of surface wetness. Application should be concentrated in areas susceptible to attack, to include all sills, plates, floor joists, piers, girders and subfloors.

Structural wood in all plumbing, electrical and ductwork areas should be treated where these utilities penetrate walls and/or floors. All structural wood base plates and studs on interior and exterior walls should be treated, especially those surrounding any high moisture areas such as bathrooms, kitchens and laundry rooms.

For buildings built on concrete slabs, all structural wood in contact with the concrete slab and all interior and exterior wall studs and wall sheathing material should be treated. In attics, all structural wood, including ceiling joists, trusses, top plates, rafters and roof decking should be treated. All structural wood sill plates and structural wood contacting garages and porches should be treated.

In areas where access is limited to one or two sides of a wood member, including exterior wall base plates and any married studs, two coats of solution should be applied to the exposed surfaces. The first application should be allowed to dry by waiting at least 20 minutes between applications. All exterior wood including siding, fascia, soffits, eaves, roofing, porches, decks and railings should be treated.

## Remedial Wood Treatment

As a remedial treatment, wood treatment can be used to both eliminate infestations of subterranean termites, wood boring beetles, and in some cases wood decay fungi. It may also be used as a supplement or alternative to fumigation to provide long-term residual control.

**Insect Gallery Treatment:** Wood treatments can be sprayed or injected into beetle holes, termite galleries and decay pockets. In cases where the infestation is not accessible from the surface, small holes can be drilled into the wood to gain access to the infested area. Solution can be injected to completely flood galleries or voids. Adjacent wood may be treated by pressure injecting solution into holes drilled into the wood at 8- to 10-inch intervals.

**Wood Surface Treatment:** The surface of wood that is not sealed with paint, varnish, or stain can be treated. One coat of solution should be sprayed or painted to the point of surface saturation to all infested and susceptible wood if all sides of the wood are accessible. If the wood has only one or two exposed sides, two coats of solution should be applied to those wood members. Additional coats can be applied to heavily infested areas after allowing the first application to dry by waiting at least 20 minutes between applications.

When spraying overhead interior areas of homes, apartment buildings, etc., all surfaces below the areas being sprayed should be covered with plastic sheeting or other material that can be discarded if contamination from dripping occurs. Applications should not be made in food serving areas while food is exposed. All food contact and preparation surfaces should be covered prior to treatment. After treat-

ment, these surfaces should be cleaned with a soapy water solution followed with a water rinse. All pets should be removed from the treatment area; and fish aquarium pumps should be turned off and the aquarium should be covered.

**Basements and Crawl Spaces:** One coat of formulation can be applied to the point of surface saturation to all accessible surfaces (Figure 31) including sill plates, piers, girders, subfloors, floor joists and any floor surfaces exposed from above. Where wood access is limited to one or two sides of wood members, such as sills and plates on foundation walls, two coats of solution should be applied by waiting at least 20 minutes between applications to allow the treatment to absorb into the wood and dry.

**Buildings on Concrete Slabs:** Solution can be applied into wall voids by foaming or misting. Each stud should be located and a small hole should be drilled through the wall covering to gain access to the infested area. Holes can be drilled every 18–24 inches adjacent to the side of each stud and solution can be injected into each hole. At least one hole should be drilled per stud void near the floor in order to treat the base plate in each void. The entire wall area should be treated as opposed to treating a single void between studs. At least 6 inches of concrete slab should have an overspray area out from wall.

**Wood Flooring:** Treat by spray, brush or roller application. Prior to application, remove any existing finish by complete coarse sanding or stripping. Apply solution to the floor surface. For treating infestations of subterranean or Formosan termites, two coats may be required, waiting at least one hour between applications. Allow floor to completely dry, typically 48 to 72 hours. Moisture content must be 16% or less before applying final finish.

Water solution applications may raise the grain of the wood and an additional light sanding may be necessary before applying a new finish. The solution is compatible with most floor coatings; always test a small section of treated floor with the new finish and check for appropriate adhesion prior to coating the entire floor. Note: If surface is tacky or residue is evident after 72 hours of drying time, wash affected area with clean water and a mop, cloth or sponge, rinsing frequently. Allow surface to dry prior to final light sanding and application of finish coat.

**Inaccessible Wall Voids, Wall Studs and Wood Members:** Apply by foaming or misting into voids and channels of damaged or suspected infested wood and/or through small holes drilled into walls and baseboard areas. Space holes no more than 24" part along each member to be treated and at least 1 hole must be drilled between each wall stud when treating base plates. Use sufficient amount of solution to cover all areas to the point of surface saturation. Note: Existing insulation may interfere with distribution of the solution. If necessary, move or displace insulation during or prior to treatment.

**Foam Application:** Foam should be applied to bare wood surfaces and void areas by mixing concentrate with water and adding foaming agent. Foam takes approximately 1 hour to return to liquid state and soak into bare wood. Foam should be applied to void spaces with enough foam to fill the void and contact all wood surfaces in the void space.

**Foamboard Insulation:** Apply by injecting a solution into the infested area and/or by low pressure surface spraying. To protect insulation from infestation, borate solutions can be applied to insulation materials during or prior to installation at 0.5–1.5% by weight. Note: Some types of foamboard insulation, such as polyisocyanurate and extruded polystyrene, have closed cell consistency that does not allow significant penetration from surface application. These types of insulation should be treated by both injection and surface spray.

**For Remedial Treatments:** A supplemental treatment can be applied to concrete, block or brick on the interior of crawl space and basement foundations to prevent shelter tubing by subterranean termites. A solution can be applied at the rate of 1

gallon to 400 square feet of surface area. In crawl spaces, solution can be applied to cover the wall 2 feet up from the ground on interior wall surfaces.

In unfinished basements with bare concrete slabs, solution can be applied 2 feet up from the concrete slab on interior foundation walls. In addition to the wall treatment, application can be extended out 6 inches away from foundation walls onto the horizontal surface of the bare concrete slab. Bath trap areas in concrete slab construction can be treated, after obtaining access to the area, by evenly applying solution into the traps and out at least 1 foot in all directions from the edge of the trap area.

Other termite access areas such as plumbing penetrations, expansion joints, and abutting slabs can be treated by applying formulation into the penetration and out at least 1 foot in all directions from the edge of the penetration area. Also, protruding utilities and adjacent wood should be treated to a height of 2 feet.



# 9 Termiticides and the Environment

**T**ERMITICIDES can damage the environment when they are not properly applied. In most cases, termiticides are intended for application underneath and around structures. These areas are usually dry, not susceptible to leaching, soil does not usually move from the treatment zone, and children, pets, and wildlife would normally not contact the treatment. However, there are some particular situations that could result in environmental damage from improper termiticide application. This damage could be by contamination of water, food plants and animals, water, exposure of people, pets and wildlife (bees, birds, fish, and vertebrate animals), and structural surface contamination. There is also concern about the mobility of termiticides in the soil and their ability to contaminate areas away from the treatment site.

## Preventing Water Contamination with Termiticides

In most cases, buildings needing termite control are built well above the water table, but in some of Florida's soils and the water table or tidal zone may be very close below the foundation of structure. Most structures have some proximity to water or method of removing water from the structure. Care needs to be taken with termiticide applications so water is not contaminated. All plumbing pipes, sewer lines, and floor drains need to be located and identified before any treatments are applied. None of these elements should be punctured or contaminated as a result of drilling or treating.

Termiticides should not be applied to intertidal areas below the mean high water mark. In some locations in Florida, buildings are barely above the mean high water mark. The foundations of these buildings are sometimes below the tidal level. Residual soil treatments should not be made to any intertidal areas regardless of the need to treat the building. Other forms of treatment (i.e., mechanical barrier systems, above-ground structural element treatment/protection, termiticide baiting systems and structure fumigation) should be considered.

Water movement and runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Care must be taken to avoid runoff. Cleaning equipment or disposal of wastes is a common way to contaminate water. Make sure all equipment rinsate and wash water is collected and saved for later use. DO NOT contaminate water when disposing of equipment wash waters or rinsate.

Anti-backflow or air gap equipment (Figures 1 and 2) should be installed and used on power sprayers. During tank filling, termiticide from the tank could flow back into water sources if this protective equipment is not used or installed.

Rainfall can be difficult to predict. Residual soil applications should be timed so treatments are not made during or immediately following periods of significant rainfall or flooding. In fact, the ground to be treated should be dry so the termiticide binds to the soil particles and does not run off from the treatment site during a rain event.

Treatment of structures with wells or cisterns: Some structures have wells or cisterns near the building where termite treatments need to be applied. It is important that the



Structure Tech Home Inspections

Figure 1. Backflow preventer attached to outdoor spigot used to fill termiticide mixture tank.

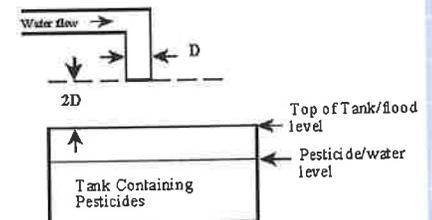


Figure 2. Diagram showing air gap distance between the water source and tank containing pesticides.

Figure 3. Foundation (French) drain being installed on new home.



NC State University

water in the well that is part of the aquifer not be contaminated with termiticide. Also, cisterns are used to collect potable water for drinking and washing in the building. It is important that this potable water not be contaminated with insecticide.

Therefore, there are specific directions for doing termiticide treatments near wells and cisterns. No termiticide should be applied within 5 feet of any well or cistern. Soil between 5 and 10 feet from a well or cistern must only be treated by the backfill method. Prior to treatment, expose water pipes coming from the well to the structure if the pipes enter the structure within 3 feet of soil surface. Treatment of soil adjacent to the water pipe(s) should be done according to the backfill method described below.

The following is the treated backfill method of termiticide application:

1. Trench and remove soil to be treated onto heavy plastic sheeting or similar material or into a wheelbarrow. Spread the soil, breaking up large clumps, so it is evenly distributed for treatment.
2. Treat soil at the vertical treatment rate of 4 gallons of termiticide per 10 linear feet per foot of depth of the trench, or 1 gallon of termiticide per 1.0 cubic foot of soil. Mix thoroughly into the soil taking care to contain the liquid and prevent runoff or spillage.
3. After the treated soil has absorbed the termiticide finished dilution, return the soil into the trench.

## Treatment of Structures with Subsurface Foundation or French Drains

Subsurface or foundation drains, sometimes called French drains, (Figure 3) are used to prevent or correct moisture problems under and around homes. They are common in hollow block foundation structures to drain water seeping from the exterior perimeter or underneath the foundation.

Some homes have foundation drains installed during construction, while others have them installed as a corrective measure, due to water drainage issues. When present, the soil above and beneath the foundation drain must be treated in a way that avoids contaminating the drainage system.

Foundation drains may go unnoticed during a termite inspection. If a pest control company is planning to treat a structure for termites, The property owner should be interviewed and questioned regarding the presence of hidden obstacles to a conventional soil treatment. All drainage systems should be located. This will help prevent accidental runoff

of the termiticide into the yard, storm sewer, pond or roadside ditch, wherever the drain line empties.

Problems can arise when drains are installed on an existing home or when a remedial termite treatment needs to be applied. The soil next to a foundation can be treated with termiticide, but the soil must be dry. Soil should not be treated if it is saturated. It is especially important to not make treatments to French drains while precipitation is occurring.

The following are some tips on treating structures with subsurface drains:

- Prior to treatment, the applicator must take precautions to limit the risk of applying the termiticide into subsurface drains that could empty into any bodies of water. This includes an evaluation of whether an application to the top of the foundation footer might contaminate the subsurface drain.
- When appropriate (e.g., on the side of the structure near a body of water), the treated backfill method described previously can be used to minimize off-site movement of termiticide.
- Treatments by drilling and rodding through the slab should not be any closer than 24 inches to a French drain. This prevents finished dilution seepage and/or damage to the drain or the tiles.

**Treatment of Areas with Sump Pumps:** Termiticide/insecticide should not be applied within 5 feet of a sump pit and pump (Figure 4). Hollow block foundations that border the French drain should not be drilled and injected with termiticide in order to prevent drainage/seepage from the concrete block foundation into the drain.

Once French drains have been identified and located, termiticide should be applied as follows:

1. Unplug the sump pump. Inspect sump pit for water. If no water is present, the treatment can be made provided the sump pump remains unplugged.
2. If water is in the sump pit, unplug the sump pump and remove four cups of water from the pit. The water level should be marked. After 10 minutes the water level should be checked again. If the water level has risen in the pit, there is too much seepage to perform the treatment at this time. If the water level does not rise, the treatment can be made provided the sump pump remains unplugged.

During application, the sump pump pit should be checked every few minutes for the presence of termiticide dilution. If dilution is detected (i.e., due to the presence of chemical odor or discoloration), the treatment should be stopped immediately. Any pesticide in the pit should be removed from the pump pit. This can be accomplished with the use of a portable electric pump or hand pump and a section of hose emptying into a pail or other suitable container. All dilution must be removed from the sump pit before plugging in the sump pump again. Dispose of dilution from the sump pump as directed by the label or use the product to treat an approved area of the structure.

## Preventing Contamination of Food, Plants, and Animals

Soil termiticide treatments should not be applied to areas where edible plants are grown or where livestock graze. Unfortunately, some homeowners place their garden next to the foundation. The general rule is that soil termiticides should not be applied within one foot from the drip line of edible plants. However, treatments can be made to lawns and ornamental plants in the landscape.

Some termites (Formosan and Asian termites) often are found in trees. As long as these trees are not producing edible fruits or nuts, these plants can be treated for termites. Termites usually attack the dead heartwood of the tree with limited exposure of their galleries on the surface. Therefore, termite carton nests in trees may be injected with termiticide dilution using a pointed injection tool. Multiple injection points to varying depths may be necessary.



Manufacturer photo

Figure 4. Sump pump.

Figure 5. Plenum configuration shown at left, compared to dirt floor crawl space at the right.



Robert Smith

## Preventing Contamination of Air in Structures

For certain types of construction it is common to drill the slab and inject termiticide under the slab. These holes later could allow volatiles from the treatment to contaminate occupied spaces in the structure. For that reason, all holes should be plugged (with noncellulose material and concrete sealant or mortar patch mix) when they occur in commonly occupied portions of the treated structure.

Soil treatment termiticides are not very volatile and do not evaporate from the soil in most situations. However, in the past, termiticides were found to contaminate the air inside certain kinds of buildings when they are improperly applied. Some structures have heating and air conditioning ducts embedded in the concrete slabs and floors of buildings. When the slab is vertically drilled to treat the soil underneath, termiticides can be accidentally injected into the air-handling system.

Termiticides should never be applied until all heating/air conditioning ducts and air vents are known and identified using construction plans, insertion of mechanic's mirror into floor vents and inspection with flashlight, or scanning with a metal detector or thermal-imaging camera. Care should be taken to not puncture or contaminate any of these air-handling systems.

**Plenum construction:** Plenum construction is a particular problem for air contamination with soil treatment termiticides. In this construction (Figure 5), the crawl space or basement is a part of the living space air that is circulated under the structure for energy conservation. With this system there is a moisture sealing fabric that is laid on the soil surface in the crawl space.

Treatment of plenum construction begins by turning off any air circulation system that moves air from the space to be treated to an untreated interior space of the structure. The water sealing fabric can be pulled back and termiticide can be applied to the soil as an interior perimeter band no more than 18 inches wide, adjacent to the foundation and as suggested for accessible crawl spaces. Once the termiticide has been absorbed by the soil the sealant fabric can be replaced.

Interior treatment of plenum structures that use a sealed underfloor space to circulate heat and/or cooled air throughout the structure need to be treated as directed below:

## Structural Surface Contamination

When treating with residual soil termiticides adjacent to an existing structure, areas to be treated should be checked for visible cracks and holes to prevent any leaks or significant exposures to persons occupying the structure. After application, the building should be checked thoroughly for leaks. All leaks resulting in the deposition of termiticide in loca-

tions other than those prescribed on the product label must be cleaned up using label-prescribed methods prior to leaving the application site.

People or pets should not be allowed to contact contaminated areas or to reoccupy contaminated areas of the structure until the cleanup is completed. Prior to drilling and treating through concrete structures such as patios, porches, sidewalks and foundation slabs, applicators should first determine that there are no habitable areas below that could be unintentionally contaminated by the treatment.

## People, Pets, and Wildlife

People present or residing in a structure during application should be advised to leave the building during treatment. For safety, only applicators wearing personal protective equipment as required by the product label should be in the area during application. Unfortunately, some residents will refuse to leave their building during treatment. If that is the case, they should be told to take their children and pets and leave the building immediately if they see any signs of leakage.

Most termiticides are toxic to fish, aquatic, and marine invertebrates. Termiticides should never be applied directly to water. They should also not be applied during rain or to areas where surface water will be present before the treatment dries. Care should be taken anytime termiticides are applied in areas adjacent to any body of water (Figure 6). They should never be applied directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark.

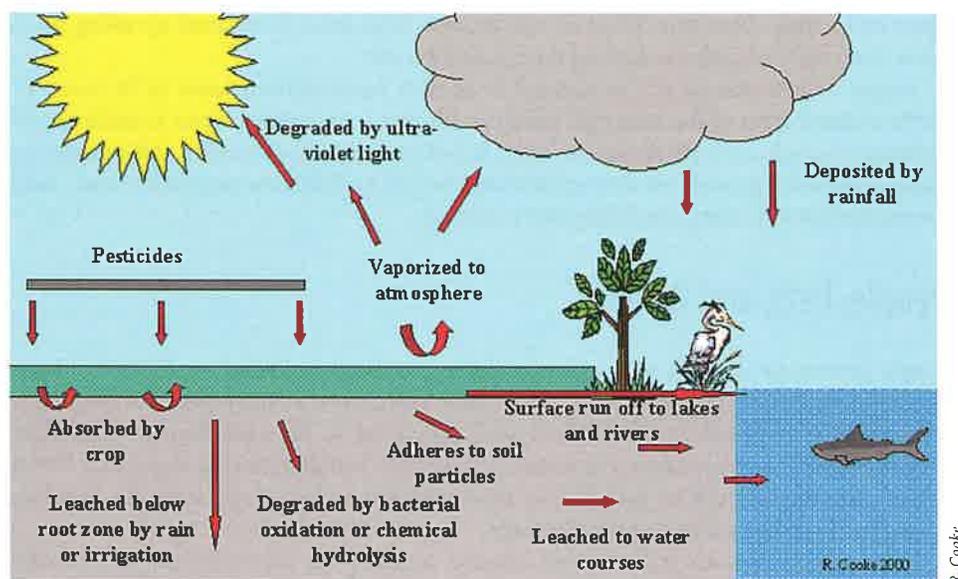
Termiticides should not be applied when weather conditions favor drift from treated areas. Most termiticides are highly toxic to bees exposed to direct treatment or residues on crops or weeds. Termiticides should not be allowed to drift to crops or weeds on which bees are actively foraging. Of course, termiticide applications are not applied in a way that results in much drift.



Tom Lane

*Figure 6. Use extreme care when a termite treatment is near a body of water or other environmentally sensitive area.*

Figure 7. The pesticide cycle.



## Termiticide Mobility in Soil

The type of soil to which a termiticide is applied may affect the mobility of the active ingredient as it moves downward in the soil profile during treatment. Generally, termiticides are applied in unsaturated soils near the soil surface, where organic carbon levels are the highest. However, the amount of organic matter typically is very low at soil depths greater than 3 feet below the surface.

Organic matter is only a small fraction of soil that essentially coats soil particles. Most termiticide active ingredients bind to the organic matter in the soil, and this decreases their downward movement in the soil profile. The higher the amount of organic matter in the soil, the more likely the termiticide will be adsorbed and bound to the soil particle so it cannot be leached by water movement.

Soil properties can also affect water flow through a soil and thus may alter the potential mobility of termiticide in soil. For example, a coarse, sandy soil has larger pores that are less able to hold water tightly, thereby increasing the speed of downward water flow. In addition, the larger particle size of sand decreases the amount of available surface area, and thus, less binding sites for the termiticide are available. Alternatively, the smaller particle size of silt and clay in soils results in smaller pores that hold water more tightly and can retard water movement. Finer textured soils generally have more surface area available for sorption.

The amount of moisture that reaches a treated termiticide zone can be extremely variable from structure to structure. Some factors that may contribute to these variations can include geographic yearly rainfall trends, prevalent directional weather exposure to particular aspects of the home exterior and foundation, soil grade, presence or absence of rain gutters, lawn and landscape irrigation, leaky exterior faucets, missing or improperly maintained downspouts, or downspouts not extending far enough from the foundation. These factors may increase or decrease the amount of moisture entering the soil and potentially moving termiticide from its point of application. Termiticide movement could potentially threaten groundwater supplies or result in lower residual levels of chemical, providing less protection from termite attack.

Termiticide movement in soil is greatest immediately during and after application. After the termiticide dries, the formulation breaks, and the active ingredient binds to soil particles and organic matter. At that point, the binding to the soil and organic matter is greater than the active ingredient's solubility in water. Therefore, after the termiticide dries on the treated soil, there is extremely low movement of termiticide in the soil.

# 10 Termite Application Equipment

**M**ANY DIFFERENT TYPES of application equipment are available to the pest management professional this equipment and their selection are the choice of the individual applicator or company. New technologies are entering the market, and as they do companies must decide which pieces of equipment work best for their business model.

Application equipment can be divided into two categories: above ground and below ground/sub-slab applications. Below ground/sub-slab applications can be subdivided into liquid, foam and baiting systems. Below ground applications of liquid termiticide are made during two phases of construction: preconstruction or postconstruction. All termiticide applications are based on the termiticide labels used.

## Liquid Application Equipment

Liquid termiticide applications made to soil require specialized equipment including but not limited to spray tank, pump and motor sprayers, volumetric injection systems (BASF), and volumetric injection systems (without tanks) utilizing the water supply from the structure being treated. These systems utilize application equipment including hoses, pressure gauges, flow meters, injectors for through-the-slab or block construction (sub-slab injectors, VersaTool), and various application tips including 360-degree and 180-degree. Straight tips are used depending on the location of the treatment of the soil under the structure.

## Foam Application Equipment

There are many types of foam application equipment available (Figures 1 and 2). Some are equipped with electric compressors, and some have hand pumps. Some foamers have stainless steel tanks, and some have polyethylene tanks.

The basic operation is the addition of air into a stream of liquid termiticide, which contains a small amount of a foaming agent. The ratio of foam is based on the amount of foaming agent and air added to the liquid termiticide, which is referred to as the expansion rate. Dry foam would have an expansion ratio of 25 to 1, where wet foam may have an expansion ratio of 10 to 1.

One way to determine the expansion ratio is to fill a 5-gallon bucket with the desired foam solution with the tip that will be used. Wait for the foam to break down into liquid (this can be sped up by using a 50/50 mix of rubbing alcohol and water and spraying it on the foam), then measure the liquid in the bucket. The ratio between foam and liquid is the expansion ratio of the foam. If you time the filling of the 5-gallon bucket you can determine the flow rate of this expansion ratio using that tip.

Applications of foam to sub-slab voids can be an effective way to treat voids due to the way foam spreads out from the application point to cover the soil and flows around pipes and other debris or obstacles in the voids. The foam then breaks down into liquid termiticide and attaches to the soil particles beneath the slab.



Figure 1. Foam application equipment.



Figure 2. Foam application equipment.



Figures 3, 4 and 5. Spray tanks.



Figure 6. Roller pump.



Figure 7. Piston pump.



Figure 8. Diaphragm pump.

## Spray Tanks

Spray tanks come in different sizes (Figures 3, 4 and 5). Commonly they are 50–400 gallons made from either fiberglass or polyethylene, which resist the corrosive properties of some pesticides. Some spray tanks are equipped with sight tubes to indicate the level of the pesticide in the tank. Spray tanks in which pesticides are mixed to which water is added shall not be filled through direct fill-pipe or hose connections protruding into the spray tank. Fill-pipes or hoses must terminate at least 2 inches above the spray tank intake fill opening or be equipped with an anti-siphoning device to prevent back siphoning into the water supply.

## Pumps

Pumps are used to generate pressure to the pesticide directly in the line rather than pressurizing the spray tank. There are many types of pumps, varying in size and capacities. Some types of pumps include roller (Figure 6), piston (Figure 7), and diaphragm (Figure 8).

Roller pumps are among the least expensive, they pump moderate volumes of liquid, 8–30 gallons per minute (gpm), at low to moderate pressures (10–300 psi). However, they do not hold up well with use of wettable powders, but are easy to repair.

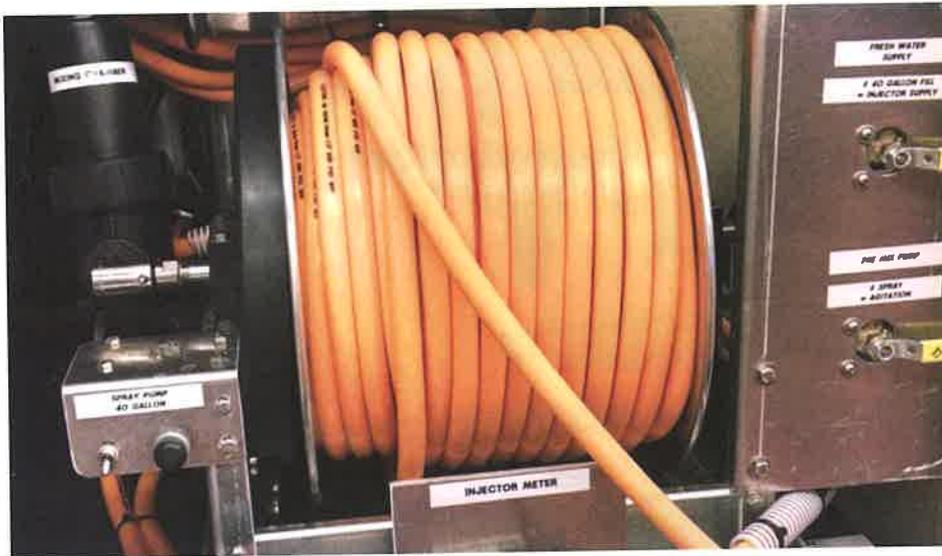
Piston pumps are the most durable of the types of pumps. They can withstand the abrasion of wettable powders. Piston pumps also create a pulsating action that can damage other pump components such as gauges, valves, and hose fittings. Therefore, a surge tank is necessary to reduce the force of the pulsation. They deliver low to medium volumes (2–25 gpm) at low to high pressures (20–600 psi).

Diaphragm pumps are used for low-volume (1.5–10 gpm) and low-pressure (10–100 psi) applications. They withstand the abrasion from wettable powders, but some solvents may damage the rubber or neoprene diaphragm.

Motors to run these pumps also come in different sizes and types — electric or gasoline — depending on a company's needs.

BASF has an injector system that injects metered termiticide (Termidor HP) through the surface of the soil without the need for trenching, as is required for other liquid termiticide labels. It has its own pump, motor and application device.

Volume injecting system: This system utilizes an injector pump to add termiticide to the flow of water, which is drawn from the water line of the structure being treated. The termiticide is mixed in-line through the pump, then out through a flow meter, then to the application device. These systems must be calibrated for the termiticide used.



Figures 9, 10 and 11. Hoses and reels.

## Hoses

Hoses are another important component of a termite treating system (Figures 9, 10 and 11). It is important to use quality hoses in good condition. Quality hoses are usually made of polyvinyl chloride (PVC) and are capable of withstanding working pressures of up to 600 psi or more. It is important to match the inside diameter of the hose with the size of the fittings used to deliver the desired volume of spray. Hose length is important as well. Most PMPs use between 150–300 feet of hose. Hose reels help protect and store the long lengths of hose. They can be operated by hand crank or by an electric motor to rewind the hose.

## Above-Ground Application Equipment

Above-ground application equipment come in a variety of configurations (Figure 12). Hand-operated pressurized equipment includes backpack sprayers, small sprayers, foam applicators, and pressurized, premixed (ready-to-use) aerosol cans.

Dry termiticide hand applicators, power sprayers, and misting equipment are used for void and wood surface applications (Figure 13). This equipment includes Mini Mister, Portable Aerosol System (PAS), Actisol units, and other power sprayers.



Manufacturer photos

Figure 12. Above-ground application equipment (above).



Figure 13. Power sprayers and misting equipment (left).

Figure 14. A variety of termiticide application components, including directional tips for rods.

### Additional termite control equipment and accessories recommended for soil and sub-slab applications:

Treating tools, including wands, rods, sub-slab injectors, VersaTool

Flow meter for application equipment

Heavy duty electric rotary hammer drill with masonry bits (for slabs)

Light duty electric hammer drill with masonry bits (for block walls and brick veneer)

Ground fault interrupter(s)

Plastic plugs, sized for masonry drill holes

Mortar patch mix or silicone concrete sealant

Shovel

Trenching tool

Hammer

Work gloves

Extension cords

Eye protection

Personal protective equipment (PPE — as required by the termiticide label used)

Manufacturer photo



## Application Tools and Components

Application tools and components are designed to apply termiticide in a variety of ways (Figure 14). Typical application tools and components include wands, rods, sub-slab injectors, spray guns, and VersaTools.

## Bait Application Stations

There are a few baiting station systems in the marketplace (Figure 15). They consist of a plastic bait stations and bait tube(s). The bait stations are inserted into holes in the soil around the perimeter of a structure, and the bait tube is placed in the station. An auger is used to make the holes.



Manufacturer photos

Figure 15. A variety of termiticide bait stations.

# 11

## Calibration and Calculation of Treatment Amounts

### Calibration

**C**ALIBRATION is the process of measuring and adjusting the amount of termiticide your equipment will apply to a specific area in, under, or around a structure. The pest management professional must know that the proper concentration of termiticide is being applied in, under or around the structure.

Without proper calibration of sprayers and applicators, the amount of termiticide delivered to the structure will be incorrect and could be a violation of the termiticide labels, which would be a violation of state and federal laws. Concentrations exceeding label directions could cause contamination of the environment via runoff, and will cost more money. Concentrations of less than the recommended labeled amount might result in a failure to control the wood-destroying organism targeted.

Technicians need to check the output of their application equipment regularly. Flow meters are very helpful for determining the output of the application equipment. Application rates can be determined with the use of a flow meter and a timer, which may be a wrist watch, stop watch, or smart phone app. The application rate or delivery rate is generally determined as the amount of time it takes to deliver 1 gallon of liquid per unit area. Application rates will vary considerably in termite control operations depending on several factors such as the soil type that the termiticides are being applied to (i.e., its compaction and composition), the method used to apply the termiticide, and the type of construction being treated.



*Figure 1. Termiticide rodding tool being calibrated for rate of flow. Note the attached flow meter.*

*The Florida Department of Agriculture and Consumer Services calibrates pre-construction spray rigs during routine pre-construction site inspections.*

Figure 2. Custom-built application rod being calibrated for rate of flow.



Application equipment may need to be calibrated for each specialized application. Flow meters are preferred because they provide the operator with a constant and accurate reading of the application rate. In the event you do not have a flow meter, you can calibrate your application equipment by using the bucket and stopwatch method. Insert the treating tool into a bucket and start the flow at the same time you start the watch. At one minute, stop the flow and measure the amount of liquid applied. This would be your flow rate.

To calibrate a termite spray rig, begin by inserting the treatment tool/wand into a bucket or similar container (with content measurements). Start the pump, then open the valve to start the flow. At the same time, start a stopwatch/timing device, and stop the flow by shutting off the valve at the 1 minute mark. Measure the amount of liquid in the container. This is the flow rate of this spray rig. (Example: If it measures 3 gallons, then your flow rate is 3 gallons per minute).

With this information and the fact that termiticide labels require trenches to be treated at the rate of 4 gallons per 10 linear feet, to treat 210 linear feet of trench at 4 gallons per 10 linear feet (per label requirements) it would take 28 minutes with the treatment tool/wand valve open, for this spray rig.

How to figure this: 210 linear feet divided by 10 (labels require you to treat trenches at 4 gallons per 10 linear feet) equal 21. Twenty-one multiplied by 4 (4 gallons per 10 linear feet) equals 84 gallons. Eighty-four gallons divided by 3 (3 gallons per minute flow rate) equals 28 minutes.

## Basic Liquid Termiticide Applications

Applications around the perimeter of the outside foundation walls are in most cases applied at the rate of 4 gallons per 10 linear feet per foot of depth to the footer or 4 feet maximum, with one exception: Termidor HE, which is applied at the rate of 2 gallons per 10 linear feet. Applications to masonry voids are applied at the rate of 2 gallons per 10 linear feet. Applications made to interior perimeter walls are applied at the rate of 4 gallons per 10 linear feet per foot of depth to the footer, or 4 feet maximum.

## Basic Termiticide Treatment Calculations

The importance of determining all essential termite/WDO treatment zones and the correct volume of insecticide dilution for treatment cannot be overstated. To begin with, the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) states that “the label is the law.” Therefore, the termiticide label-specified volume must be applied to the structure and surrounding soil being treated in order to comply with the US EPA. Additionally, the treatment target areas and rates of application must be correct to comply with Florida Department of Agriculture and Consumer Services (FDACS) and Florida Department of Environmental Protection regulations. Next, for the sake of the applicator’s reputation, the preliminary site inspection notes must include all information necessary to prepare both materially and contractually for each unique situation. Finally, the subsequent treatment must be thorough in order to be effective and have enduring results. Therefore, it is essential that all who aspire to perform site evaluations for termite/WDO treatment, or the termiticide-insecticide applications themselves, be familiar with the following methods for calculating product volumes and placement.

### Pre-treatments

**Horizontal treatments:**

1 gallon per 10 square feet

**Interior foundation walls, vertical treatments:**

4 gallons per 10 linear feet, per foot of depth to the footer

**Masonry (hollow block) voids:**

2 gallons per 10 linear feet

**Exterior foundation walls, vertical treatments (final grade treatment):**

4 gallons per 10 linear feet, per foot of depth to the footer

**Critical areas treatments (plumbing penetrations):**

1–4 gallons per square feet

### Post-treatments

**Interior foundation walls, vertical treatment:**

4 gallons per 10 linear feet, per foot of depth to the footer

**Masonry (hollow block and brick) voids:**

2 gallons per 10 linear feet

**Exterior foundation walls, vertical treatment:**

4 gallons per 10 linear feet, per foot of depth to the footer

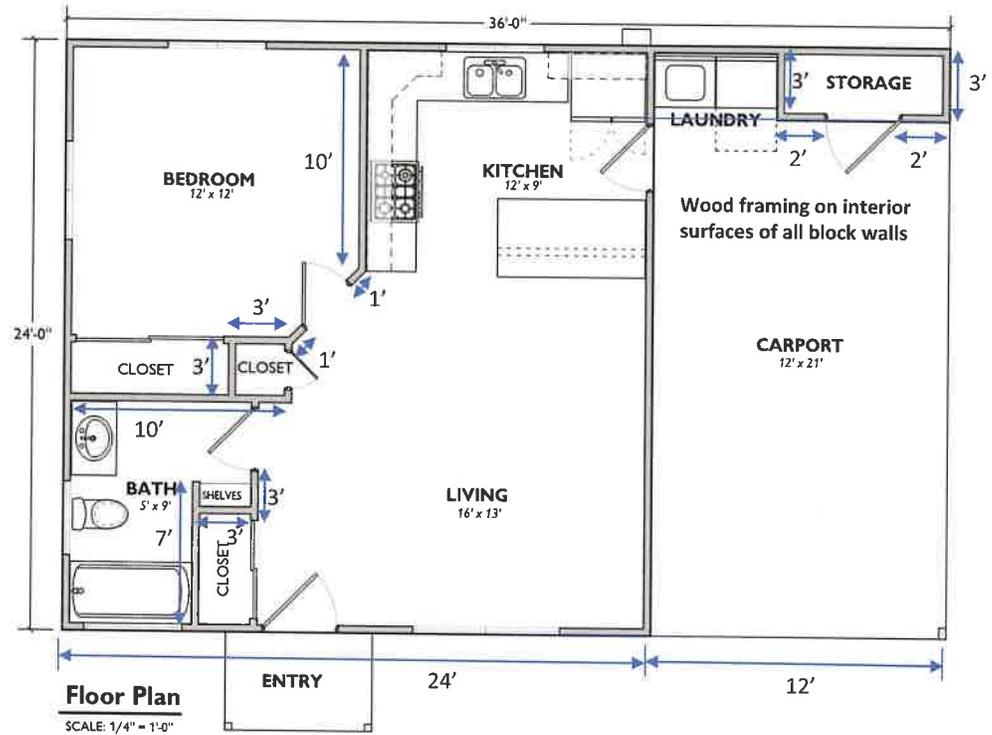
**Attached slabs:**

4 gallons per 10 linear feet, per foot of depth of the footer

**Critical areas (plumbing penetrations):**

1–4 gallons per square feet

Figure 3. Floor plan.



## Calculations

1. Calculate the amount of termiticide dilution needed in order to apply a corrective soil termiticide treatment to the house in Figure 3 (monolithic slab foundation with footing at 3 feet below grade and concrete block stemwall. Carport was poured separately with a cold joint adjacent to the main living space).
  - a. Vertical treatment
    - i. Exterior perimeter – foundation with footing  
 $[(24 \text{ ft} \times 4) + 12 \text{ ft} + (2 \times 3 \text{ ft}) + (2 \times 2 \text{ ft})] \times 4 \text{ gal}/10 \text{ ft} = 118 \text{ ft} \times 0.4 = 47.2 \text{ gal}$   
 $47.2 \text{ gal}/\text{ft of depth} \times 3 \text{ ft} = 141.6 \text{ gal} \cong 142 \text{ gal, rounded up}$
    - ii. Exterior perimeter – carport without footing  
 $(21 \text{ ft} + 12 \text{ ft}) \times 4 \text{ gal}/10 \text{ ft} \times 1 \text{ foot of depth} = 33 \text{ ft} \times 0.4 \times 1 = 13.2 \text{ gal}$   
 $\cong 14 \text{ gal, rounded up}$
    - iii. Interior perimeter  
 $[(24 \text{ ft} \times 4) + 12 \text{ ft} + (2 \times 3 \text{ ft}) + (2 \times 2 \text{ ft})] \times 4 \text{ gal}/10 \text{ ft} = 118 \text{ ft} \times 0.4 = 47.2 \text{ gal}$   
 $47.2 \text{ gal}/\text{ft of depth} \times 3 \text{ ft} = 141.6 \text{ gal} \cong 142 \text{ gal, rounded up}$
  - b. Horizontal treatment (low rate)
  - c. Plumbing penetrations, including bath trap (high rate)  
 $5 \text{ penetrations} \times 4 \text{ sq ft} \times 4 \text{ gal}/\text{sq ft} = 20 \text{ sq ft} \times 4 = 80 \text{ gal}$
  - d. Total treatment (vertical + penetrations), using rounded-up gallonage calculations  
 $142 \text{ gal} + 14 \text{ gal} + 142 \text{ gal} + 80 \text{ gal} = 378 \text{ gal, rounded}$

2. Calculate the amount of termiticide dilution needed in order to apply a pre-construction soil termiticide treatment to this house (floating slab with footing at 3 ft below grade and concrete block stemwall; carport was poured separately with a cold joint adjacent to the main living space)
- Vertical treatment
    - Exterior perimeter  
 $[(24 \text{ ft} \times 4) + 12 \text{ ft} + (2 \times 3 \text{ ft}) + (2 \times 2 \text{ ft})] \times 4 \text{ gal}/10 \text{ ft} = 118 \text{ ft} \times 0.4 = 47.2 \text{ gal}$   
 $47.2 \text{ gal}/\text{ft of depth} \times 3 \text{ ft} = 141.6 \text{ gal} \cong 142 \text{ gal, rounded up}$
    - Interior perimeter  
 $[(24 \text{ ft} \times 4) + 12 \text{ ft} + (2 \times 3 \text{ ft}) + (2 \times 2 \text{ ft})] \times 4 \text{ gal}/10 \text{ ft} = 118 \text{ ft} \times 0.4 = 47.2 \text{ gal}$   
 $47.2 \text{ gal}/\text{ft of depth} \times 3 \text{ ft} = 141.6 \text{ gal} \cong 142 \text{ gal, rounded up}$
    - Carport cold joint:  
 $24 \text{ ft} \times 4 \text{ gal}/10 \text{ ft} = 24 \text{ ft} \times 0.4 = 9.6 \text{ gal}/\text{ft of depth}$   
 $9.6 \text{ gal} \times 3 \text{ ft of depth} = 28.8 \text{ gal} \cong 29 \text{ gal, rounded up}$
  - Concrete block void treatment  
 $[(24 \text{ ft} \times 4) + 12 \text{ ft} + (2 \times 3 \text{ ft}) + (2 \times 2 \text{ ft})] \times 2 \text{ gal}/10 \text{ ft} = 118 \text{ ft} \times 0.2 = 23.6 \text{ gal}$   
 $\cong 24 \text{ gal, rounded up}$
  - Horizontal treatment (low rate)  
 $(24 \text{ ft} \times 36 \text{ ft}) \times 1 \text{ gal}/10 \text{ sq ft} = 864 \text{ sq ft} \times 0.1 = 86.4 \text{ gal} \cong 87 \text{ gal, rounded up}$
  - Plumbing penetrations, including bath trap (high rate)  
 $(5 \text{ penetrations} \times 4 \text{ sq ft}) \times 4 \text{ gal}/\text{sq ft} = 20 \text{ sq ft} \times 0.4 = 80 \text{ gal}$
  - Total Treatment, using rounded-up gallonage calculations  
 $142 \text{ gal} + 142 \text{ gal} + 29 \text{ gal} + 24 \text{ gal} + 87 \text{ gal} + 80 \text{ gal} = 504 \text{ gal}$
3. Calculate the minimum number of durable bait stations needed to treat the exterior perimeter of this structure  
 $(24 \text{ ft} + 36 \text{ ft}) \times 2] \times 1 \text{ station}/20 \text{ ft} = 120 \text{ ft} \times 0.05 = 6 \text{ bait stations}$
4. Calculate the amount of wood treatment product needed for this house. Assume all wood frame around living space (no carport treatment) (2 ft between studs)
- Linear footage of all interior and exterior wall studs (sills, slab and 2 ft up) =  
 $\text{number of wall studs} \times 2 \text{ ft up} / 200 = \text{gal of dilution}$   
 $\{[(24 \text{ ft} \times 4) + (36 \text{ ft} - 24 \text{ ft}) + (2 \times 10 \text{ ft}) + 7 \text{ ft} + (6 \times 3 \text{ ft}) + (3 \times 2 \text{ ft}) + (2 \times 1 \text{ ft})]$   
 $/ 2 \text{ ft spacing}\} \times 2 \text{ ft up} / 200 \text{ gal}$   
 $= (161 \text{ ft} / 2 \text{ ft spacing}) \times 2 \text{ ft up} / 200 \text{ gal}$   
 $\text{Treatment needed for wood framing} = 161 \text{ sq ft}/200 \text{ gal} = 0.805 \text{ gal} \cong 0.8 \text{ gal}$   
 $[\text{In ounces: } 0.805 \text{ gal} \times 128 \text{ oz}/\text{gal} \cong 103 \text{ oz.}]$
  - Linear feet of all exterior siding walls (2 ft up from slab and on both sides) =  
 $\text{linear feet} \times 2 \text{ ft up} / 400 = \text{gal of dilution}$   
 $[(24 \text{ ft} \times 4) + (36 \text{ ft} - 24 \text{ ft}) + \text{approx. } 3 \text{ ft}] \times 2 \text{ ft up} \times 2 \text{ sides} = 444 \text{ sq ft of siding}$   
 $\text{Treatment needed for siding} = 444 \text{ sq ft}/400 \text{ gal} = 1.11 \text{ gal}$   
 $[\text{In ounces: } 1.11 \text{ gal} \times 128 \text{ oz}/\text{gal} \cong 142 \text{ oz} \cong 1. \text{ gal } 14 \text{ oz}]$

- c. Linear feet of all exterior concrete block walls and foundation blocks =  
 linear feet  $\times$  2 ft up / 400 = gal of dilution  
 $[(24 \text{ ft} \times 4) + (36 \text{ ft} - 24 \text{ ft}) + 3 \text{ ft}] \times 2 \text{ ft up} \times 2 \text{ sides} = 444 \text{ sq ft of block}$   
 Treatment needed for concrete block walls =  $444 \text{ sq ft} / 400 \text{ gal} = 1.11 \text{ gal}$   
 [In ounces & combined gal + oz:  $1.11 \text{ gal} \times 128 \text{ oz/gal} \cong 142 \text{ oz} \cong 1. \text{ gal } 14 \text{ oz}$  ]
- d. Linear feet of cold joints, expansion joints =  
 Linear feet / 400 = gal of dilution  
 Treatment needed for cold (expansion) joints =  $24 \text{ ft} / 400 \text{ gal} = 0.06 \text{ gal}$   
 [In ounces:  $0.06 \text{ gal} \times 128 \text{ oz/gal} \cong 8 \text{ oz}$  ]
- e. Linear feet of cracks (apply 1 ft out on both sides) =
- i. Linear feet / 200 = gal of dilution
  - ii.  $(8 \text{ ft} \times 2 \text{ sides}) / 200 \text{ gal} = 0.08 \text{ gal}$   
 [In ounces:  $0.08 \text{ gal} \times 128 \text{ oz/gal} \cong 11 \text{ oz}$  ]
- f. Number of pipe penetrations of slab (apply 2 ft up and 2-8 inches out) =  
 Number  $\times$  0.03 gal = gal of dilution  
 Treatment needed for pipe penetrations of slab =  
 $[(1 \text{ sq ft} \times 2 \text{ ft. up}) \times 4] \times 0.03 \text{ gal} = 8 \text{ sq ft} \times 0.03 \cong 0.24 \text{ gal}$   
 [In ounces:  $0.24 \text{ gal} \times 128 \text{ oz/gal} \cong 31 \text{ oz}$  ]
- g. Number of bath traps  $\times$  0.125 gal = gal of dilution  
 Treatment needed for bath trap =  
 $1 \text{ bath trap} \times 0.125 \text{ gal} = 0.125 \text{ gal}$   
 [In ounces:  $0.125 \text{ gal} \times 128 \text{ oz/gal} = 16 \text{ oz}$  ]

# 12 Reading and Interpreting WDO Labels

**W**HAT IS the label? The label is the document that is attached to a termiticide container. What is the labeling? The documents that include the termiticide label, all related documents issued by the manufacturer, and all legal documents issued by the US Environmental Protection Agency to help ensure the termiticide's directions for use are clear and the information facilitates maximum benefit and minimum risk to humans and the environment.

Most termiticides are required to be registered by the USEPA and the state of Florida. "Use" of a termiticide is generally defined as all aspects of a termiticide's handling, including its transportation, storage, mixing, loading, application and disposal. All termiticide labels under the section "Directions for Use" have this statement: "It is a violation of Federal Law to use this product in a manner inconsistent with its labeling."

The information on termiticide labels is grouped by content. This varies, of course, even for the same active ingredient. A termiticide may have different labels in use, because labels change over time. For example, older containers of "Termiticide A" may have one label, while newly manufactured Termiticide A containers bear a newly approved label with content somewhat different from the older label.

Even though there are different versions of the same termiticide, the applicator is required to follow the directions listed on the label that is attached to or came with the product container he or she is using. For this reason, do not rely on your memory. Before each use, review the label that is attached to the product or came with the product container. Also, supplemental labels can be issued by the manufacturer when changes for uses are approved by USEPA.



Manufacturer photos

*Figure 1. All termiticides have a different label for each formulation.*

On the following two pages are portions of a generalized pesticide label. You should become familiar with the various parts of the labels and know what information each part offers. Take a look at this label.

The parts of the pesticide label attached are explained in the order in which they appear on the label.

**Use classification**

- Tells if the product is a restricted-use termiticide.

**Content information**

- Shows the termiticide's brand name, weight or volume, ingredients and formulation.

**Registration information**

- Lists USEPA registration and establishment numbers, and manufacturer name and address.

**Signal word (CAUTION, WARNING or DANGER)**

- Tells if the termiticide is of low, moderate or high toxicity.

**Statement of practical treatment (FIRST AID)**

- Tells what to do if you are exposed to the termiticide.

**Hazards to humans and domestic animals**

- Tells how the termiticide can be harmful, and how to avoid being harmed.

**Personal protective equipment (PPE) instructions**

- Tells what PPE should be worn and when.

**Hazards to the environment**

- Tells if possible harm to bees, fish, aquatic invertebrates and ground water, and how to avoid it.

**Misuse statement**

- Warns that not following label directions is a violation of federal law.

**Use directions and restrictions**

- Tells how to mix and apply, and where and when the termiticide can be applied.

**Storage and disposal instructions**

- Tells how to properly store and dispose of the termiticide and its container.

**Mixing instructions**

- Gives dilution rates and tells how to prepare the termiticide for use.

**Re-entry statement**

- Gives conditions under which it is permitted to re-enter the treated area.

The organization of information on termiticide labels is consistent from one product to the next, so if you know where to find what you're looking for on one label, you will know where to look for it on the next label you read. The more labels you read, the more knowledgeable you will be, and the more capable you will be as a pest management professional to protect the health of people, property and the environment.

Additional information about a termiticide can be found on its Safety Data Sheet (SDS). An SDS contains information on a termiticide's properties, the hazards it poses, how to avoid those hazards, and what to do if hazards are not avoided.

**RESTRICTED USE PESTICIDE**  
**FOR RETAIL SALE TO AND USE ONLY BY CERTIFIED APPLICATORS OR**  
**PERSONS UNDER THEIR DIRECT SUPERVISION, AND ONLY FOR THOSE USES**  
**COVERED BY THE CERTIFIED APPLICATOR'S CERTIFICATION.**

# PERMATRIP<sup>EC</sup>

## TERMITICIDE CONCENTRATE

**ACTIVE INGREDIENTS:**

Permethrin\* ..... 10%  
 Inert Ingredients ..... 90%

\*3-Phenoxybenzyl (1RS)-cis,trans-3-(2,2-dichlorovinyl)-  
 2,2 dimethylcyclopropanecarboxylate

EPA Reg. No. 0000-111  
 EPA Est. No. 0000-MO-1  
 Lefehlo, Incorporated  
 DeSoto, MO, USA

**KEEP OUT OF REACH OF CHILDREN**

## WARNING

### FIRST AID

<b>IF SWALLOWED</b>	Call a Poison Control Center or physician immediately for advice.
<b>ON SKIN OR CLOTHES</b>	Remove contaminated clothes, rinse skin with water for 20 minutes.
<b>IF INHALED</b>	If person is not breathing, call 911 and give artificial respiration.
<b>IF IN EYES</b>	Flush eyes with water for 20 minutes.

NOTE: Have the product label with you when contacting a Poison Control Center or physician.

**PRECAUTIONARY STATEMENTS**

**HAZARDS TO HUMANS AND DOMESTIC ANIMALS**

WARNING: Harmful if swallowed, absorbed or inhaled. Causes eye irritation.

**PERSONAL PROTECTIVE EQUIPMENT (PPE)**

All pesticide handlers (mixers, loaders and applicators) must wear a long-sleeved shirt and long pants, socks, shoes and chemical-resistant gloves. In addition: all pesticide handlers must wear a respiratory protection device when working in a non-ventilated space; all pesticide handlers must wear protective eyewear when working in a non-ventilated space or when applying termiticide by rodding or sub-slab injection.

**USER SAFETY RECOMMENDATIONS**

After using termiticide, wash hands thoroughly before eating, drinking, chewing, smoking or using the toilet. Wash clothing with detergent and hot water before reusing. Remove PPE after handling, and wash before reusing.

**ENVIRONMENTAL HAZARDS**

This pesticide is toxic to birds, fish and aquatic invertebrates. Do not apply to water. Avoid runoff. Do not contaminate water with cleaning rinsate. Do not use PERMATRIP around edible plants, including fruit or nut trees.

**MISUSE STATEMENT**

*It is a violation of federal law to use this product in a manner inconsistent with its labeling. Read the entire label before using this product.*

**DIRECTIONS FOR USE****STORAGE AND DISPOSAL**

Do not contaminate water, food or feed when storing or disposing of this pesticide. Store in original container only, and out of reach of children and animals.

Improper disposal of pesticide is a violation of federal law. In case of leaks or minor spills, soak up termiticide with sand, soil or other absorbent material and dispose of contaminated material below grade in soil that is to be treated, or in a landfill. Triple-rinse containers for disposal, and offer for recycling or puncture containers and dispose of in a landfill or by burning (check state and local regulations).

**MIXING INSTRUCTIONS**

Mix the termiticide use dilution in the following manner:

1. Fill tank one-fourth to one-third full with water.
2. Start pump to begin bypass agitation and place end of treating tool in tank to allow circulation through hose.
3. Add appropriate amount of PERMATRIP.
4. Add remaining amount of water.
5. Let pump run and allow recirculation through the hose for two to three minutes.

To prepare a 0.6% water emulsion, ready for use, dilute 1 gallon of PERMATRIP with 99 gallons of water. To prepare a 1.2% water emulsion, ready for use, dilute 1 gallon of PERMATRIP with 49.5 gallons of water. For termite control operations requiring smaller volumes use 1.3 fluid ounces of PERMATRIP per gallon of water to achieve a 0.6% concentration.

**RE-ENTRY**

Keep people and pets out of treated interior parts of structures for two hours after treatment.

## Permatrip EC Label Section Information

Review the Permatrip label on the previous two pages. Identify the following label parts found on the Permatrip label.

- 1. USE CLASSIFICATION.** Tells if the product is a restricted-use termiticide

Permatrip EC is a *RESTRICTED USE PESTICIDE*
- 2. CONTENT INFORMATION.** Shows the termiticide's brand name, weight or volume, ingredients and formulation.

Brand name: *PERMATRIP*  
 Ingredients: *permethrin 10%*  
 Formulation: *EC — emulsifiable concentrate*

Weight: Not supplied on this unofficial sample label for the Permatrip product.
- 3. REGISTRATION INFORMATION.** Lists US EPA registration and establishment numbers, and manufacturer name and address.

US EPA Number: *0000-111*  
 US EPA Establishment Number: *0000-MO-1*  
 Manufacturer name and address: *Lefehlo, Incorporated, Desoto, MO USA*
- 4. SIGNAL WORD (CAUTION, WARNING, or DANGER).** Tells if the termiticide is of low, moderate or high toxicity.

Signal word: *WARNING — moderate toxicity*
- 5. STATEMENT OF PRACTICAL TREATMENT (FIRST AID).** Tells what to do if you are exposed to the termiticide.

<i>IF SWALLOWED</i>	<i>Call a Poison Control Center or physician immediately for advice</i>
<i>ON SKIN OR CLOTHES</i>	<i>Remove contaminated clothes, rinse skin with water for 20 minutes.</i>
<i>IF INHALED</i>	<i>If person is not breathing, call 911 and give artificial respiration.</i>
<i>IF IN EYES</i>	<i>Flush eyes with water for 20 minutes.</i>

*NOTE: Have the product label with you when contacting a Poison Control Center or physician*
- 6. HAZARDS TO HUMANS AND DOMESTIC ANIMALS.** Tells how the termiticide can be harmful, and how to avoid being harmed.

*Harmful if swallowed, absorbed or inhaled. Causes eye irritation.*
- 7. PERSONAL PROTECTIVE EQUIPMENT (PPE) INSTRUCTIONS.** Tells what PPE should be worn and when.

*All pesticide handlers (mixers, loaders and applicators) must wear a long-sleeved shirt and long pants, socks, shoes and chemical-resistant gloves. In addition: all pesticide handlers must wear a respiratory protection device when working in a non-ventilated space; all pesticide handlers must wear protective eyewear when working in a non-ventilated space or when applying termiticide by rodding or sub-slab injection.*
- 8. HAZARDS TO THE ENVIRONMENT.** Tells if possible harm to bees, fish, aquatic invertebrates and ground water, and how to avoid it.

*This pesticide is toxic to birds, fish and aquatic invertebrates. Do not apply to water. Avoid runoff. Do not contaminate water with cleaning rinsate. Do not use PERMATRIP around edible plants, including fruit or nut trees.*
- 9. MISUSE STATEMENT.** Warns that not following label directions is a violation of federal law.

*It is a violation of federal law to use this product in a manner inconsistent with its labeling. Read the entire label before using this product.*

- 10. USE DIRECTIONS AND RESTRICTIONS.** Tells how to mix and apply, and where and when the termiticide can be applied.

*MIXING INSTRUCTIONS*

*Mix the termiticide use in the following manner:*

- 1. Fill tank one-fourth to one-third full with water.*
- 2. Start pump to begin bypass agitation and place end of treating tool in tank to allow circulation through hose.*
- 3. Add appropriate amount of PERMATRIP.*
- 4. Add remaining amount of water.*
- 5. Let pump run and allow recirculation through the hose for two to three minutes.*

*To prepare a 0.6% water emulsion, ready for use, dilute 1 gallon of PERMATRIP with 99 gallons of water. To prepare a 1.2% water emulsion, ready for use, dilute 1 gallon of PERMATRIP with 49.5 gallons of water. For termite control operations requiring smaller volumes use 1.3 fluid ounces of PERMATRIP per gallon of water to achieve a 0.6% concentration.*

Application directions were not supplied on this unofficial sample label for the Permatrip product.

- 11. STORAGE AND DISPOSAL INSTRUCTIONS.** Tells how to properly store and dispose of the termiticide and its container.

*Do not contaminate water, food or feed when storing or disposing of this pesticide. Store in original container only, and out of reach of children and animals.*

*Improper disposal of pesticide is a violation of federal law. In case of leaks or minor spills, soak up termiticide with sand, soil or other absorbent material and dispose of contaminated material below grade in soil that is to be treated, or in a landfill. Triple-rinse containers for disposal, and offer for recycling or puncture containers and dispose of in a landfill or by burning (check state and local regulations).*

# 13 Reading and Interpreting the WDO Sections

## WDO Sections of Statute 482 and Rule 5E-14

After completely studying this chapter, you should be able to:

- Understand the various state and federal laws that govern pesticide use, handling, and storage.
- Know the regulatory agencies that are responsible for pesticide applications
- Understand why protecting the public and the environment from exposure to pesticides is the certified operator in charge and applicator's responsibility.
- Know the responsibilities of the certified operator in charge.
- Know the types of certifications under Florida Statute, Chapter 482.

Pesticide applicators licensed in Florida who are licensed in the category of Termites and Other Wood Destroying Organisms must understand their requirements in Federal Laws, Florida Statute Chapter 482, and Florida Administrative Code 5E-14.

### Federal Law

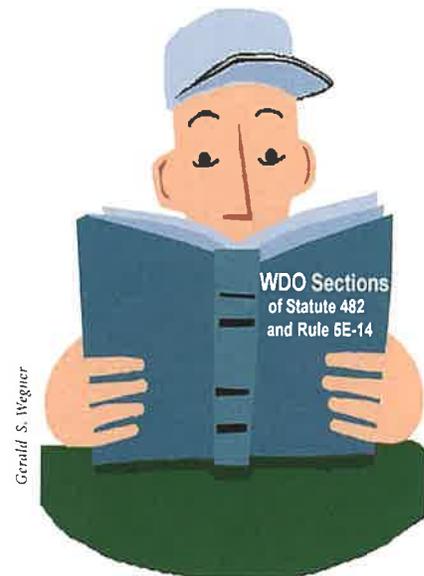
**Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).** The US Congress enacted legislation that regulates the production, transportation, sale, use, and disposal of all pesticides. FIFRA was enacted in 1947 and amended several times since then. It is administered by the US Environmental Protection Agency (EPA).

All pesticides that are used in the United States must be registered or authorized for use by the EPA. The EPA also regulates the pesticide labels, hence "the label is the law."

All pesticides are classified according to their potential hazards when being used according to the label directions. There are two main classifications of pesticides: Restricted Use and Unclassified, commonly referred to as General Use. Restricted Use pesticides are classified as such because of their potential to cause harm to humans or the environment. Therefore, they can only be bought and used under the direct supervision of a certified operator/certified applicator.

### Florida Pesticide Laws

Pesticide applicators in Florida must know their responsibilities under federal and Florida state law.



*Figure 1. Florida pesticide applicators must know their responsibilities under federal and Florida state laws.*

State Law	Topics Covered	State Agency
Chapter 252 FS	Storage facility and pesticide spill reporting	Florida Department of Community Affairs (FDCA)
Chapter 388 FS	Public Health pest control and applicator licensing	Florida Department of Agriculture and Consumer Services (FDACS)
Chapter 403	Waste management and container burning	Florida Department of Environmental Protection (FDEP)
Chapter 482	Pest control businesses and applicator licensing	FDACS
Chapter 487	Pesticide registration and applicator licensing	FDACS

**Florida Department of Agriculture and Consumer Services (FDACS):** The state agency that enforces the provisions of FIFRA and Florida pesticide laws.

**The Bureau of Inspections and Incident Response** is the bureau that regulates the pesticide applicators in Florida, under Florida Statutes chapters 388, 482 and 487.

- **Chapter 482**, known as the “Structural Pest Control Act.” Administered by the Bureau of Inspections and Incident Response, which regulates the application of both restricted use and unclassified (general use) pesticides for commercial pest control purposes. The types of pest control regulated under this law include structural fumigation, general household pest control, termite and other wood destroying organisms control, lawn and ornamental pest control, and perimeter mosquito control treatments.
- **Chapter 5E-14** is the Florida Administrative Code, which is referred to as the “Rules” by which Chapter 482 is enforced.

Other related chapters pertaining to pesticide application, storage and disposal:

- **Chapter 252** is the chapter that regulates pesticide storage facilities and pesticide spill reporting (FDCA).
- **Chapter 388** is the chapter that regulates the public health pest control (FDACS).
- **Chapter 403** is the chapter that regulates waste management and pesticide container burning (FDEP).
- **Chapter 487** is the chapter that regulates agricultural and related pest control (FDACS).

## Chapter 482 Florida Statute and 5E-14 Florida Administrative Code Sections

### DEFINITIONS

**Pest control** includes:

The use of any method or device or the application of any substance to prevent, destroy, repel, mitigate, curb, control, or eradicate any pest in, on, or under a structure, lawn, or ornamental; the identification of or inspection for infestations or infections in, on, or under a structure, lawn, or ornamental the use of any pesticide, economic poison, or mechanical device for preventing, controlling, eradicating, identifying, inspecting for, mitigating, diminishing, or curtailing insects, vermin, rodents, pest birds, bats, or other pests in, on, or under a structure, lawn, or ornamental.

**All phases of fumigation:**

The advertisement of, solicitation of, or acceptance of remuneration for any work described in this subsection, but does not include the solicitation of a bid from a licensee to be incorporated in an overall bid by an unlicensed primary contractor to supply services to another.

**“Structure”** means:

Any type of edifice or building, together with the land there under, the contents thereof, and any patio or terrace thereof; that portion of land upon which work has commenced for the erection of an edifice or building; or a railway car, motor vehicle, trailer, barge, boat, ship, aircraft, wharf, dock, warehouse, or common carrier.

**“Termites and other wood-destroying organisms pest control”** means:

Pest control with respect to any termite or other wood-destroying organisms, including fungi, by the use of any chemical or mechanical methods, including moisture control for the prevention or control of fungus in existing structures, but not including fumigation or general household pest control.

**License** (a license is not the same as a certificate):

A license may be issued to qualified businesses to engage in the business of pest control in this state. The business must meet certain requirements as follows; must pay the licensing fee, must employ a Certified Operator in the category in which it intends to operate, must carry the required insurance (bodily injury: \$250,000 per person and \$500,000 per occurrence; and property damage: \$250,000 per occurrence and \$500,000 in the aggregate, or a combined single-limit coverage: \$500,000 in the aggregate. It is unlawful for any person to operate a pest control business that is not licensed by the Department.

**Licensee** means:

A person, partnership, firm, corporation, or other business entity having a license issued by the Department for engaging in the business of pest control at a particular location.

**Certified Operator:**

An individual holding a current pest control operator’s certificate issued by the Department. To obtain it you must qualify to take the state exam by a combination of either education and/or completing the required time of field experience, completing the required number of “jobs,” and by passing the state certification exam.

There are four categories of certification:

- General Household Pest Control,
- Lawn and Ornamental Pest Control,
- Structural Fumigation Pest Control, and
- Termite and Other Wood Destroying Organisms Pest Control.

There are four limited certifications:

- Commercial Landscape Maintenance Applicator Certification,
- Limited Governmental or Private Applicator Certification,
- Limited Urban Commercial Fertilizer Applicator Certification, and
- Limited Commercial Wildlife Management Certification.

**Certified Operator in charge** means a certified operator:

Whose primary occupation is the pest control business, is employed full time by the licensee, and whose principal duty is the personal supervision of the licensee’s operation in a category or categories of pest control in which the operator is certified.

**“Identification Cardholder”:**

An owner or employee to whom a current card has been issued by the Department identifying the holder to the public or to any law enforcement officer or any agent of the department charged with, or entitled to exercise any function in connection with, the enforcement of Chapter 482 and 5E-14.

**“Wood-destroying organism”** means:

An arthropod or plant life which damages and can reinfest seasoned wood in a structure, namely termites, powderpost beetles, old house borers, and wood-decay fungi.

**Duties of the Certified Operator in charge of pest control activities of a licensee:**

Shall have her or his primary occupation with the licensee and shall be a full time employee of the licensee, and her or his principal duty shall include the responsibility for the personal supervision of and participation in the pest control activities at the business location of the licensee as the same related to: the selection of proper and correct chemicals for

the particular pest control work performed. The safe and proper use of the pesticides used. The correct concentration and formulation of pesticides used in all pest control work performed and the training of personal in the proper and acceptable methods of pest control. The control measures and procedures used. The notification of the Department of any accidental human poisoning or death connected with pest control work performed on a job she or he is supervising, within 24 hours after she or he has knowledge of the poisoning or death. The certified operator in charge must display his/her certificate and renewal receipt at the business location where he/she is in charge.

**Employee identification cards:**

Each employee who performs pest control for a licensee must have an identification card. Either the licensee or the licensee's certified operator in charge must apply to the Department for an identification card for each employee who will perform pest control therefore within 30 days after employment of that employee. An identification cardholder must be an employee of the licensee and work under the direction and supervision of the licensee's certified operator in charge and shall not be an independent contractor. An identification cardholder shall operate only out of, and for customers assigned from the licensee's licensed business location. An identification cardholder shall not perform any pest control independently of and without the knowledge of the licensee and the licensee's certified operator in charge and shall perform pest control only for the licensee's customers. The identification card shall be carried on the employee's person while performing or soliciting pest control and shall be presented upon demand to the person for whom pest control is being performed or solicited, to any inspector of the Department, or to any of such other persons as are designated by the rules of the Department. An employee may not perform pest control without carrying on her or his person a current identification card affixed with the employee's signature and current photograph. An identification cardholder may use only the licensee's pesticides, equipment, and other materials when performing pest control. An identification cardholder shall consult regularly with the licensee's certified operator in charge concerning; the selection of proper and correct chemicals for the particular pest control work to be performed; the safe and proper use of the particular pesticides used; and the correct concentrations and formulations of pesticides used for the various types of pest control work performed.

For every employee who performs inspections for wood-destroying organisms pursuant to 482.226, the licensee or certified operator in charge must apply for an identification card that identifies that employee as having received the special training specified in this subsection in order to perform inspections pursuant to 482.226. The application for such identification card must be accomplished by an affidavit, signed by the prospective identification cardholder and by the licensee or certified operator in charge, which states that the prospective identification cardholder has received training in the detection, and control of wood-destroying organisms, including but not limited to training in: The biology, behavior, and identification of wood-destroying organisms with particular emphasis on ones common in this state and damage caused by such organisms; the inspection forms to be used to report the findings; and the applicable federal, state, and local laws or ordinances.

**Permit to perform preventive termite treatment services for new construction only:**

A licensee must have a permit to perform preventive termite treatments for new construction, except for preventive termite treatments on additions to existing structures for which the licensee has a current termite treatment contract. There is no fee for this permit. It renews at the renewal of the pest control license. The permit must be conspicuously displayed at the licensed location. One of the provisions of the permit is that the licensee must maintain accurate records of all pesticides purchased, obtained, or available for its use; the total amount of the area treated using soil applied termiticides; and the total number of sites treated using this and any other method of treatment. These records must be made available to the Department upon request.

# 14

## Contracts Statute 482 and Rule 5E-14.105

**E**ACH LICENSEE must enter into a written contract with the property owner or his/her authorized agent for control or prevention of wood-destroying organisms. The contract must be provided to the property owner or his/her authorized agent for acceptance or rejection prior to any portion of the work is done and before payment, in part or full, is received by the licensee.

The contract shall clearly set forth the following information:

- the complete name and address of the property owner or authorized agent,
- the complete address of the property to be treated,
- the buildings or structures on the property to be included for treatment,
- the complete name and business address of the licensee,
- the date upon which the written contract is entered into,
- the period of time covered by the contract and renewal option, if any,
- the complete common name(s) of the wood destroying organism(s) to be controlled or for which preventative treatment is intended under the contract, and
- the location of the treatment notice/sticker within the structure per 482.226(5).

*(Note: The treatment notice must be at least 3 inches by 5 inches and consist of a material that will last at least three years.)*

The contract must clearly set forth on the front page:

- if the contract covers subterranean termites, drywood termites, or both,
- if Formosan termites (*Coptotermes formosansus*) are to be excluded from the coverage, this species must be named as excluded,
- whether the treatment is offered for control of existing infestation or prevention of infestation,
- whether or not reinspections are to be made under the contract and the approximate time intervals between inspections,
- the conditions under which retreatments for reinfestation will be made,
- the conditions under which repairs will be made, if any,
- the total maximum price to be charged for treatment service,
- the exact annual renewal fees to be charged under the contract, if any,
- fees other than the renewal fee if any, and
- the total maximum price to be charged for structural repairs, if any, shown separately.

The signatures of the licensee or his/her authorized representative, the property owner or authorized agent must appear on the contract.

Contracts covering preconstruction treatments for subterranean termites shall clearly set forth that additional treatment(s) shall be performed to control an infestation should one occur to the structure during the warranty period.



*Figure 1. A written WDO service contract must be provided to the property owner or his/her authorized agent before treatment and receipt of payment.*

The warranty shall:

- show the date of the initial or final treatment, shall
- be issued to the property owner or agent within 30 days of the date specified on the contract, and be valid for a period of not less than one year from that date,
- have an optional extension for an additional four (4) years,
- conform with Section 482.227, and
- contain information required by 5E-14.105.

For multiple properties of a single owner, if individual contracts are not issued prior to treatments, a licensee shall either:

- enter into a master agreement with the owner or authorized agent prior to treatment that provides for the fulfillment of the requirements of 5E-14.105 (1)(a)(b), or
- issue an assignable contract on the property on completion of the treatment. This applies only to treatment for the control of subterranean termites for new construction which does not physically attach to or adjoin existing structures.

## Permit 482.0815

Prior to a licensee performing preventative treatments for new construction they must obtain a Permit 482.0815 to perform them; the permit is not required for additions to existing structures for which the licensee has a current termite treatment contract. This permit may be suspended for violations, it can be reinstated, and it must be displayed in the business location of the licensee.

Pesticides used as the primary treatment for the prevention of subterranean termites for new construction shall be applied in the specific amounts, concentrations, and treatment areas designated by the label. Each pesticide used for the primary preventative treatment of new construction for the prevention of subterranean termites, in its original formulation, shall be mixed at the treatment site immediately prior to application. A copy of the label of each registered pesticide being used shall be carried in the vehicle from which the application is performed.

When a pesticide registered for new construction has been applied as a primary preventive treatment for a structure or will be applied prior to completion of construction, a secondary treatment using a second pesticide registered for preventative treatment for new construction may be applied in accordance with label directions.

Treatment records for the prevention of subterranean termites for new construction shall be maintained by the licensee and shall contain:

- the date of application,
- address of the property,
- total square footage of the structure,
- pesticide used,
- percent concentration of mixture applied,
- total volume applied,
- the total amount of area treated, and
- the total number of sites treated using this and any other method of treatment for the prevention of subterranean termites.

The licensee shall also maintain records of all termiticides purchased, obtained, or available for use.

*Note:* Structure foundation graphs/diagrams prepared during WDO inspections of properties and in preparation for treatment, showing details of termite and other WDO activity and damage sites as well as treatment methodology, should be retained as documentation.

Contracts covering spot treatments for wood destroying organisms: shall meet the requirements of 5E-14(1) and (2). Also, any specified areas in, on or under the structure to be treated shall be listed in the written contract, and a statement that a spot treatment only was performed shall be made on the treatment notice posted as required by 482.226(5). If no responsibility is to be assumed by the licensee for retreatment of the specified area(s) of a structure where the spot treatment is to be made, the licensee shall furnish the property holder or authorized agent with a signed statement to this effect, prior to treatment.

When periodic reinspections are specified in wood-destroying organism preventative or corrective control contracts, the licensee shall furnish the property owner or authorized agent a signed report of the condition of the property with respect to the presence or absence of wood-destroying organisms covered by the contract and whether retreatment was made. A copy of the inspection report shall be retained by the licensee for not less than three (3) years.

A structure shall not knowingly be placed under a second contract for the same wood-destroying organism in disregard of the first contract, without first obtaining specific written consent signed by the property owner or authorized agent using FDACS form 13671 *Consumer Consent Form*.

**Each licensee shall comply with the terms of each pest control contract it issues:**

All wood-destroying organism protection contracts must comply with the following: A licensee must inspect for an infestation that is included under a retreatment provision of a contract within 30 days of written notification by the property owner or agent, and must perform a retreatment within ninety days of discovery of an infestation subject to the retreatment provision of a contract unless:

- access to the property is prevented by the property owner, or
- the treatment is waived or postponed in writing by the owner or agent, or
- the subject property is a commercial or multiunit structure, in which case, the treatment must be performed within 180 days.

In the event that the contract expires before a retreatment can be accomplished, the licensee shall make a written offer to perform the retreatment within 90 days at no additional charge.

## Redress of Service Issues

A licensee may not use a limitation, exclusion, or condition clause to deny treatment of a termite infestation or repair of termite damage to the holder of a contract, unless:

- the infestation or damage was primarily caused by the subject of the limitation, exclusion, or condition clause in the contract,
- the licensee was aware of the condition and provided written notice to the property owner or agent of that condition within sixty (60) days of discovery,
- the licensee provided the property owner the opportunity to correct the condition, and
- the property owner did not correct the condition within the sixty (60) days of the written notice.

Under such circumstances of property owner or agent noncompliance, the licensee may use the limitation, exclusion, or condition clause in the contract to deny repair or retreatment.

## 482.227 Guarantees and Warranties

Contracts for wood-destroying organisms must state on the front page in **BOLD** print that the contract is offered:

- for repair and retreatment, or
- for retreatment only, or
- that no warranty or guarantee is offered, or
- whether the contract contains any disclaimers, limitations, conditions, or exclusions.

Contract sections describing disclaimers, limitations, conditions or exclusions must contain headings in **BOLD** print. Contracts that contain disclaimers, limitations, conditions or exclusions may not use the term “full” or “unlimited” together with the term “guarantee” or “warranty.”

**Consumer Notice document:**

No such contract shall be entered into after six (6) months following the effective date of this rule without first obtaining specific written consent signed by the property owner or authorized agent using the *Consumer Notice Form*, (FDACS-13692, Rev 10/15), which is hereby adopted and incorporated by reference and available online at **<http://www.flrules.org/Gateway/reference.asp?No=Ref-XXXXX>** or at 3125 Conner Boulevard, Bldg. 8, Tallahassee, FL 32399. After the rule is published, visit **<https://www.flrules.org/Gateway/reference.asp?No=Ref-07325>** online.

# WOOD-DESTROYING ORGANISMS

## ➔ Termites. Borers. Fungi.

What do they have in common? They all can wreak havoc in the wood we use to build. This WDO Manual is full of comprehensive information about insects and other organisms that damage and destroy wood in homes. It is an ideal study guide to prepare pest control operators for their certification exams.

Inside the WDO Manual you will learn about:

- ✓ Insect biology and life cycles
- ✓ Integrated Pest Management
- ✓ Pesticide laws
- ✓ Pesticide safety
- ✓ Pesticide handling
- ✓ Pesticide disposal

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