

Performance standards and acceptable test conditions for preventive termiticide and insecticide treatments, termite baiting systems, and physical barriers for new structures or buildings under construction (pre-construction; during construction; post-construction)

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Abstract

Florida Administrative Code (FAC) 5E-2.0311, "Performance Standards and Acceptable Test Conditions for Preventive Termite Treatments for New Construction," approved in 2003, currently remains without change as originally written. This Code requires broad revision to include updating existing and new termite management methods and technologies, describing acceptable testing protocols that objectively evaluate termite management product efficacy, and clearly and accurately define product performance standards required for approval and use in Florida, USA. This manuscript provides modification and expansion of the existing Code, first in outline form, then followed by a proposed complete revision including detailed explanations for each outline heading and sub-heading. Efficacy requirements, acceptable test conditions, and performance standards requirements are described for termite management products, materials, and non-chemical physical exclusion barriers. We also include testing protocols for field plot and structure efficacy tests. Minimum performance standards also are described for field plots and structure tests to include: (1) termiticide applications to soil, (2) termite baiting systems, (3) pesticides applied directly to wood and building components, (4) pesticide combination mixtures, and (5) new application technologies, products, and methodologies. Although this manuscript addresses revision of a specific Florida Administrative Code, it also is appropriate for consideration by the United States Environmental Protection Agency (USEPA) as well as regulatory entities in other states responsible for pesticide regulation and consumer protection services when writing or revising their code requirements for termite management.

Key Words: structural pest control; product testing standards; wood-destroying insects

Resumen

El Código Administrativo de Florida 5E-2.0311, "Estándares de Desempeño y Condiciones de Prueba Aceptables para Tratamientos Preventivos contra Termitas para Construcciones Nuevas" aprobado en el 2003, actualmente permanece sin cambios como se escribió originalmente. Este Código requiere una revisión amplia para incluir la actualización de los métodos y tecnologías de manejo de termitas existentes y nuevos, describiendo protocolos de prueba aceptables que evalúan objetivamente la eficacia del producto de manejo de termitas y definen de manera clara y precisa los estándares de desempeño del producto requeridos para su aprobación y uso en Florida, EE. UU. Este manuscrito proporciona la modificación y expansión del Código existente, primero en forma de esquema, luego seguido de una revisión completa propuesta que incluye explicaciones detalladas para cada encabezado y subtítulo del esquema. Los requisitos de eficacia, las condiciones de prueba aceptables y los requisitos de los estándares de rendimiento se describen para los productos, materiales y barreras de exclusión física no químicas para el manejo de termitas. También incluimos protocolos de prueba para pruebas de eficacia de estructuras y parcelas de campo. También se describen estándares mínimos de desempeño para parcelas de campo y pruebas de estructura para incluir: (1) aplicaciones de termiticidas al suelo, (2) sistemas de cebo de termitas, (3) pesticidas aplicados directamente a la madera y componentes de construcción, (4) mezclas de combinación de pesticidas, y (5) nuevas tecnologías, productos y metodologías de aplicación. Aunque este manuscrito aborda la revisión de un Código Administrativo específico para la Florida, también es apropiado para que sea considerado por la USEPA, así como las entidades reguladoras en otros estados responsables de la regulación de pesticidas y los servicios de protección al consumidor al redactar o revisar los requisitos de su código para el manejo de termitas.

Palabras Clave: control estructural de plagas; estándares de prueba de productos; insectos destructores de la madera

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NOTE: Normal FLAENT guidelines not strictly adhered to because this document will be an official government guideline, and wording will be lifted directly for official termite document Rule.

Florida Administrative Code FAC 5E-2.0311⁶ (FAC 2003), widely known as the “Florida Rule” (Rule), was approved in 2003. The inception of this Rule was one result that came from the Association of Structural Pest Control Regulatory Officials (ASPCRO)/National Pest Management Association (NPMA)/Responsible Industry for a Sound Environment (RISE) Termite Control Workgroup that met first in August 2001. Before formation of this Workgroup, the United States Environmental Protection Agency (USEPA) policy revision on termiticide efficacy was Pesticide Registration Notice (PRN) 96-7 – Termiticide Labeling, which set the USEPA’s “policy with respect to certain labeling statements and minimum product performance (5 years) for soil treatment termiticide products”, meaning ≥ 5.0 years of 100% efficacy (PRN 1996).

Need for Code Revision

The Florida pest control industry as well as structural and urban entomologists recognized the need to revise, update, and develop objective, science-based testing and efficacy requirements for termite management products, methods, and techniques, with participation from a team of national termite experts (authors) who actively participated in the project and compiled this proposed comprehensive revision of the Rule. The pace of innovation and product evolution has outstripped the original Rule and motivated the authors to evaluate efficacy requirements for new and existing technologies. Herein, our revision encompasses termiticides; termite baiting systems; pesticides applied to wood; pesticide combination mixtures; physical barriers and exclusion devices; termite resistant building construction; and new application technologies, products, and methodologies for termite management in new structures, and during all stages of building construction (pre-construction, during construction, and post-construction).

Arrivals of invasive exotic termites and the emergence of new termite management treatments provide further justification for Rule revision. Florida has more invasive termite species than any other US state (Scheffrahn et al. 2003; Scheffrahn 2013), yet FAC 5E-2.0311 currently does not account for either recent or potential new termite arrivals. Recent records identify 6 invasive termites of which the 5 species on the following list are established.

Coptotermes formosanus Shiraki (Blattodea: Isoptera: Rhinotermitidae), Formosan subterranean termite

Coptotermes gestroi (Wasmann) (Blattodea: Isoptera: Rhinotermitidae), Asian subterranean termite

Cryptotermes brevis (Walker) (Blattodea: Isoptera: Kalotermitidae), West Indian drywood termite

Incisitermes minor (Hagen) (Blattodea: Isoptera: Kalotermitidae), western drywood termite

Nasutitermes corniger (Motschulsky) (Blattodea: Isoptera: Termitidae Termitidae), conehead termite

Efforts to eradicate the conehead termite are ongoing (FDACS 2020). One additional species, *Heterotermes cardini* (Snyder) (Blattodea: Isoptera: Rhinotermitidae), occasionally is reported on boats in Florida waters but is not established (Scheffrahn & Crowe 2011). It was identified genetically by Eaton et al. (2016) and confirmed by Carrijo et al. (2020).

Florida Pest Management Industry

The compelling issue impacting the Rule is that termite management products, technology, and equipment have evolved since 2003. Improvements include reformulated termiticides and baits, new application equipment and methods, multi-use physical barriers, new and improved termite detection devices, and revised product testing protocols, outdated market and consumer needs addressed by the current Rule. Waiting for notable increases in formal consumer complaints to compel revising and updating FAC 5E-2.0311 is imprudent and reactive, and not an efficient or timely approach. A proactive up-to-date revision benefits the pest management industry as well as Florida consumers.

Pest management companies incur significant liability for pre-construction termite management treatments. Florida Statute FS 482.051(5) requires “that the licensee maintain for 3 years the record of each pre-construction treatment” (FS 482 2020). In addition, FAC 5E-14.105 requires that for pre-construction treatment contracts, the pest management company must provide a warranty for at least 1 year, with a homeowner option to renew for up to 4 years (FAC 5E-14 2017). Therefore, the pest management industry in Florida potentially is liable for new construction treatments for up to 5 years. However, FAC 5E-2.0311 currently requires that termite management products only show efficacy for 1 to 3 years, depending on the product and type of inspection.

Another reason to update termite management product and use efficacy requirements is that Florida ranks third ($n = 284$ [2020]) in a search of US legal cases that include the search term “termite*,” just behind California ($n = 552$) and Louisiana ($n = 344$). There are limitations in how this abbreviated search should be interpreted. Despite the following limitations, it is the only publicly accessible dataset of which we are aware that can provide an indication of the seriousness of termite damage in Florida relative to other states (Nexis Uni 2020). First, this dataset cannot be directly correlated with failed ‘new construction’ treatments. Second, the number of settled cases is not known and cannot be publicly searched. Finally, using logical connectors in Nexis Uni such as “damage” (that can also refer to damages awarded to plaintiffs), “negligenc*,” and “fraud*,” cases that did not directly pertain to our intended use were returned in the search results, or cases that we knew to exist were excluded. Thus, we used the broadest search terms that we believed to yield the most accurate results. To derive the number of cases directly related to termite damage, fraud, or negligence and the pest control industry, we excluded citations that were used in opinions as “examples of precedent” or as “bright line” cases that define a legal rule or standard. For example, when arguing against excessive punitive awards, tobacco and other industries in Florida repeatedly cited *Arab Termite and Pest Control v. Jenkins* (case 409 So. 2d 1039).

As a result of manually reviewing 284 references, there were 76 references to “termite*” with published opinions related to accusations of negligence, fraud, and termite damage involving the pest control industry. More than 60 citations were published without opinion, so these allegations were not readily discernable. Other citations not included in our count were related to employee non-compete agreements, construction defects where termites were referenced as a potential liability, or responsible entities failing to maintain structures resulting in termite infestation. There were 3 cases involving Florida Department of Agriculture and Consumer Services (FDACS): *Baker v. FDACS* (case 937 So. 2d 1161 [2006]), *Gardner v. FDACS* (case 673 So. 2d 35 [1996]), and *Atlas Termite and Pest Control of Cantonment v. FDACS* (case 924 So. 2d 812 [2006]).

⁶FAC 5E-2.0311: Performance Standards and Acceptable Test Conditions for Preventive Termite Treatments for New Construction (2003).

Revised Florida Code

We provide herein our proposed and recommended revised Florida Administrative Code 5E-2.0311 (with additional slight revision since fall 2020 submission to FDACS) that was submitted to FDACS with the modified title "Performance Standards and Acceptable Test Conditions for Preventive Termiticide and Insecticide Treatments, Termite Baiting Systems, and Physical Barriers for New Structures or Buildings Under Construction [Pre-Construction; During Construction; Post-Construction]." This proposed revision follows next and defines science-based, practical, objective acceptable minimum efficacy requirements and recommendations that must be achieved for approval and use of existing and emerging termite management products and technologies, and termite management methodologies in Florida.

Florida Administrative Code 5E-2.0311 (Proposed Revision 2021): Performance Standards and Acceptable Test Conditions for Preventive Termiticide and Insecticide Treatments, Termite Baiting Systems, and Physical Barriers for New Structures or Buildings Under Construction [Pre-Construction; During Construction; Post-Construction]

I. PERFORMANCE STANDARDS

I.a. Termiticide Applications to Soil

- I.a.1. Field plot tests
- I.a.2. Partial treatments
- I.a.3. Field plot building tests

I.b. Termite Baiting Systems

- I.b.1. Products formulated for use in stand-alone baiting systems
- I.b.2. Field plot baiting system tests
- I.b.3. Tests with termite baiting systems using buildings with an existing subterranean termite infestation(s)
 - I.b.3.(a). Buildings or structures where termites are eliminated
 - I.b.3.(b). Building tests conducted before the effective date of this revised Rule
- I.b.4. Tests with termite baiting systems using buildings with no existing subterranean termite infestation(s)
 - I.b.4.(a). Evaluating termite monitors and termite-free test buildings and structures
- I.b.5. USEPA updates and revised requirements

I.c. Pesticides Applied Directly to Wood or Other Building Components

- I.c.1. Pesticides applied directly to wood and other building or structural components
- I.c.2. Field plot tests
- I.c.3. Building tests
- I.c.4. Pre-construction wood preservative treatments

I.d. Pesticide Combinations or Unique Application Technologies and Methodologies Not Addressed Previously in This Revised Rule

- I.d.1. Systems or products that use combinations of pesticides, or unique application technologies and methodologies
- I.d.2. Building tests

II. ACCEPTABLE TEST CONDITIONS AND REQUIREMENTS

II.a. Preventive Termiticide and Pesticide Treatments

- II.a.1. Termiticides applied to soil under field conditions
- II.a.2. Termiticide field tests

II.a.3. Field plot test data

- II.a.3.(a). USDA FS field tests
- II.a.4. USDA FS termiticide field tests
- II.a.5. Alternative field tests

II.b. Test Conditions Required for Stand-Alone Bait Systems

- II.b.1. Field plot tests and building tests geographic locations
- II.b.2. Field plot tests and building tests
- II.b.3. Bait system tests
- II.b.4. Original Rule requirements
- II.b.5. Data collection
- II.b.6. Good Laboratory Practices

II.c. Pesticides Applied to Wood

- II.c.1. Test plot replication
- II.c.2. Acceptable wood species
- II.c.3. Test unit configuration and evaluation
- II.c.4. Alternative field test protocol
- II.c.5. Data collection

II.d. Pesticide Combinations or Unique Application Technologies and Methodologies

- II.d.1. Test conditions
- II.d.2. Pre-revised-Rule tests
- II.d.3. Post-revised-Rule tests

III. PHYSICAL EXCLUSION DEVICES AND BARRIERS, CHEMICALLY ENHANCED OR NOT CHEMICALLY ENHANCED

III.a. Field Plot Tests and Structure Tests

- III.a.1. Test results
- III.a.2. Required effectiveness
- III.a.3. Devices and barriers

IV. DATA REVIEW AND PUBLICATION OF RESULTS

IV.a. Results

- IV.a.1. Performance evaluation and standards
- IV.a.2. Data review
- IV.a.3. Review process

IV.b. Granting Registration

I. PERFORMANCE STANDARDS

Performance standards required for products claiming prevention or control for termite management effectiveness to include termiticides (insecticides applied to soil or wood), termite baiting systems, physical exclusion devices and barriers, and new and emerging technologies intended for use with new construction at any time during the pre-construction and new construction process including any treatments after all construction and final grade are completed are described herein. The registrant of any termiticide product or termite management device containing a label statement that includes directions for use as a preventive, management, or control treatment for subterranean termites for new construction or post construction must provide test data to the Florida Department of Agriculture and Consumer Services (FDACS) demonstrating that the product meets the performance standards specified for the type of termiticide product(s), baiting system, physical exclusion device(s) and barriers, or new technologies listed herein.

For products registered before the effective date of this revised Rule, the registrant shall have 1.0 year from the effective date of this

revised Rule to provide data required to meet this revised Rule performance standards, or a period specified by FDACS to meet the test conditions herein, whichever is greater. When generation of data requires more than 1.0 year, the registrant must provide annual update reports to FDACS. However, within 3.0- to 6.0-years maximum from the effective date of this revised Rule, all termite preventive, management, or control products and devices currently registered in Florida, as well as new registrations proposed for use in Florida must meet this revised Rule performance requirements and standards. This will require existing test data and may require additional test results validating that this revised Rule requirements and standards are met. If a performance standard(s) is not met during the 3.0- to 6.0-year additional test period, the provisions of sub-section 487.041(3)(e)¹, Registration (2020), Florida Statutes, and all other Section 041 sub-sections shall apply (FS 487 2020).

All tests must be installed and conducted in geographic locations with proven indigenous subterranean termite activity and also exotic termite activity. Test materials must be exposed to both *Reticulitermes* and *Coptotermes* genera. At least 30.0% of test replicates must be conducted for *Coptotermes formosanus*, the Formosan subterranean termite, or *C. gestroi*, the Asian subterranean termite, or a combination of at least 30.0% or greater of these 2 species. If an exotic termite such as *Nasutitermes* sp. occurs within a test site, its inclusion in tests would be beneficial and enhance the value of the tests. However, its inclusion in tests is not required unless the tests are intended to evaluate product(s) effectiveness and make control claims for this specific termite genus.

The goal of the performance standards in this revised Rule is to ensure that any building or structure that receives any type of termite management or control treatment or application described in this revised Rule is protected from damage by subterranean termites for at least the minimum number of years or more as specified in this revised Rule. Termite management products and devices such as termiticides and insecticides, termite baiting systems, physical exclusion devices and barriers, and new and emerging technologies must demonstrate a minimum cumulative effectiveness of 90% to 100% success for their entire testing duration as stated in this revised Rule. Appropriate non-treated 'control' plots or replicates must be installed for any and all tests, and demonstrate current termite activity throughout the test plots and test location. For a test site or location to be acceptable, any and all types of non-treated 'control' and monitoring plots or structures (replicates or plots) must demonstrate 60% or greater aggregate termite activity across all control replicates or plots by the end of the test.

Test(s) and data collection start on the date of the first applications or installation of field or structure tests or other types of FDACS-accepted and approved tests and protocols. Validation of continuing active subterranean termite populations within all test locations is required.

I.a. Termiticide Applications to Soil

I.a.1. Field plot tests. Termiticide or insecticide products intended for application to soil (or building surfaces, wood or other materials [see sub-section I.c.]) during or immediately after construction must provide field test results showing an average cumulative American Society for Testing and Materials International (ASTM) damage scale rating for subterranean termite damage to the wooden test samples used in-field tests of at least 9.0 to 10.0 (9 = light attack, surface etching or nibbles only; 10 = sound, surface nibbles permitted) under the "Standard Test Method of Evaluating Wood Preservatives by Field Tests with Stakes," 1996, ASTM

D 1758-96 scale (ASTM International, 100 Barr Harbor Drive, P. O. Box C700, West Conshohocken, Pennsylvania 19428-2959, USA) in at least 90% to 100% of all wooden test samples for a minimum duration of at least 5.0 years. To evaluate progressive damage over time, wooden blocks and board test samples or other wood test units or structures that are placed on top of termiticide treated soil and that are subsequently damaged by termites during the test period must remain on their plot(s) until they sustain at least the minimum damage rating(s) described in the next sentence. Each wooden block or board test sample, wooden test unit, or wooden test structure will be replaced with a fresh new sapwood block or board, or sapwood test unit or test structure, only when its ASTM damage rating reaches or exceeds 4.0 or more severe (4 to 0; 4 = heavy damage, wood easily broken apart by hand; 0 = failure, completely destroyed). This damage rating standard applies to all products applied to soil or wood, whether marketed as 'repellent' or 'non-repellent' termiticides or insecticides that are registered by the USEPA.

Products registered before the effective date of this revised Rule must show a cumulative average United States Department of Agriculture Forest Service (USDA FS) test damage scale rating to wood equal to 0.0 to 1.0 (0 = no damage; 1 = surface etching or nibbles only) for a minimum duration of 5.0 years using the USDA FS wood damage rating scale (modified from Verrall [1959], "Preservative, moisture-repellent treatments for wooden packing boxes." Forest Products Journal 9: 1–22. Available from the Forest Products Laboratory, Durability and Wood Protection, 201 Lincoln Green, Starkville, Mississippi 39759, USA), or an average cumulative ASTM damage rating of 9 to 10 (9 = light attack, surface etching or nibbles only; 10 = sound, surface nibbles permitted) for at least 90% to 100% of all test samples for a minimum duration of 5.0 years. If test results meet the damage rating requirements of this sub-section (I.a.1.), then the product(s) tested meets the requirement, and is considered able to protect the structure that received the treatment from subterranean termite damage for a minimum duration of 5.0 years.

I.a.2. Partial treatments. Products with label directions that allow partial preventive treatments for new construction, defined as any treatment other than complete termiticide coverage under and around a foundation, must meet the performance standards specified in sub-sections I.d.1 and I.d.2. Test results data must be provided in accordance with sub-section I.d.2. (Building Tests) and results must demonstrate that the required performance standard(s) was met.

I.a.3. Field plot building tests. Termiticide applications to soil for tests installed on field plots using wooden test buildings or wooden test structures as the test units to be protected, must show no termite infestation or damage in 90% to 100% of test units for a minimum duration of 5.0 years after termiticide applications to soil and installation of the test units. These field tests must meet conditions under sub-sections II.a.1., II.a.2., II.a.3, and II.a.5.

I.b. Subterranean Termite Baiting Systems

I.b.1. Products formulated for use in stand-alone baiting systems. Formulated bait products submitted for registration after the effective date of this revised Rule must be tested in both field plot tests and building tests that meet the acceptable test condition requirements of sub-section II.b. (Test Conditions Required for Stand-Alone Bait Systems), and must meet the performance standards for field plot tests specified in sub-section I.b.2. Building tests must meet performance standards specified in either sub-section I.b.3.

or I.b.4. Active ingredient (a.i.) bait stations and termite monitors containing non-a.i. matrix must all remain in place for the entire test duration. Active ingredient bait matrix will be replaced with new bait a.i. matrix according to label directions. When label directions describe conditions requiring bait matrix replacement, old a.i. matrix will be replaced with new a.i. matrix if mold and fungal decay or other factors deteriorate the a.i. matrix to a label-specified amount of matrix volume or mass, thereby rendering the bait not palatable. All tests must be conducted in geographic locations with soil classifications similar to Florida soils, and with proven termite infestations in the soil.

All records of termite activity shall include collecting a clean, debris-free sample of termites from each active monitoring field plot, monitoring bait station, termite-active field plot, active a.i. bait station, and active building or structure. These termite samples must be labelled and stored under normal refrigeration in 90% ethyl alcohol (EtOH), or preserved using proven specimen storage methods appropriate to scientific methods used for subsequent colony determination. These termite specimens shall be analyzed by an appropriate proven scientific method to identify and associate the collected termites with a specific termite colony.

Wood or non-a.i. matrix in termite monitors will be replaced only when 75% or greater of the wood or non-a.i. matrix has been eaten by termites, or is 75% or greater moldy or decayed. For products registered before the effective date of this revised Rule, bait products must undergo building tests that meet the requirements of sub-section II.b., and also must meet the performance standards in either sub-section I.b.3. or I.b.4. to be re-registered in Florida. Products registered or re-registered after the effective date of this revised Rule shall not be granted FDACS approval for a building test in Florida until required results in sub-section I.b.2. of this revised Rule are met. All baits must first be registered by the USEPA to be considered for use in Florida.

I.b.2. Field plot baiting system tests. Field plot tests (in-ground; not structures) must show cumulative cessation of termite activity for the installed number of a.i. bait matrix plots by at least 90% to 100% of a.i. bait stations within 12.0 months after first feeding occurs on at least 1 bait matrix containing a.i. Wood in field termite activity monitoring plots (non-a.i. wooden boards, blocks, or stakes), as well as termite activity monitoring bait stations (containing non-a.i. bait matrix), that are 'mixed in' and incorporated within the field plot layout along with the a.i. bait stations in field plot tests must demonstrate cumulative cessation of subterranean termite feeding in these monitoring plots and monitoring bait stations by at least 90% to 100% within 12.0 months of first feeding on nearby active bait matrix. In addition, this minimum required 90% to 100% cessation of termite activity in monitoring plots and stations must be maintained for at least 4.0 years after the first 12.0 months of testing. If subterranean termite activity continues in the same field plot(s) past the first 12.0 months, or ceases (90 to 100% cessation) and then returns within the first 12.0 months or up to 5.0 years after initial feeding, meaning 90% to 100% cessation of subterranean termite activity has not been achieved and maintained, then additional termite specimens shall be collected. These additional specimens shall be identified genetically and compared with the subterranean termites collected from the same bait station or field plot at the start of the study. If the resurgent termites are from the same original colony then test requirements for success have not been met at that point in time. If they are from a different colony then the 5.0-year test period re-starts for the new colony(ies) on their specific test site(s).

For comparison and complete scientific testing, a separate group of field 'monitoring' plots (non-a.i. wooden controls) or monitoring stations (non-a.i. bait matrix controls) in separate nearby field installations in the same general location(s) as the baiting system tests must demonstrate continuous feeding by an identified termite colony (or a series of colonies) during the same first 12.0 months, and throughout the entire test period thereafter.

I.b.3. Tests with termite baiting systems using buildings with an existing subterranean termite infestation(s). Tests using a.i. bait stations placed around a building(s) or structure(s) must be installed and maintained according to label directions. Results data must show 100% cessation of subterranean termite activity in the building(s) of the termite colony that was identified initially as infesting the structure, and also for possible subsequent infestation by other colonies, for at least 90% to 100% of the test buildings within the first 12.0 months of testing. For a different subsequently infesting colony, the 12.0 months re-starts upon determination that a new colony has replaced the eliminated colony. In addition, independent non-a.i. termite monitors (in-ground or above-ground monitors) must be placed around and within test buildings with an existing infestation(s) of subterranean termites and must show at least a cumulative 100% cessation of termite activity in at least 90% to 100% of all test buildings and in at least 90% to 100% of independent monitors within 12.0 months after initial feeding occurs on a.i. bait matrix. Cessation of termite activity must be attributed to a specific colony identified from an active a.i.-bait building location. During the entire test duration, a.i. bait stations must be evaluated regularly for termite feeding (at least every 3.0 months) to evaluate and record the presence or absence of active termites or signs of termite activity, and to evaluate colony affiliation for termites found in any station and estimate the amount of termite feeding in each station. Continued feeding or cessation of termite feeding in stations will be evaluated, with the estimated percentage volume and mass of a.i. bait matrix eaten recorded. When 75% or more of an individual a.i. bait station matrix is eaten, that matrix will be replaced with fresh a.i. bait matrix, unless different a.i. bait matrix replacement directions are included on the label, to which those directions will then be adhered.

I.b.3.(a). In buildings or structures where subterranean termites are eliminated, no re-infestation by subterranean termites can occur within 5.0 years following elimination as verified by visual and instrument or other detection device(s) inspections. Inspection devices may include but are not limited to bath trap inspection ports, moisture meters, acoustic detection, metabolic gas detection (CO_2 ; CH_3), microwave technology, canine detection, fiber optics, infrared technology, laser thermometers, Walabot® *rf* technology, and X-ray scanning to determine if any reinfestation has occurred, or validate that subterranean termites remain absent. Additional new and emerging pest detection devices also may be used to evaluate buildings and structures for pest infestations if use of such devices is accepted and approved by FDACS.

I.b.3.(b). For building tests conducted before the effective date of this revised Rule, verification of no re-infestation within a minimum of 12.0 months using a combination of the techniques as set forth sub-section I.b.3.(a). is acceptable.

I.b.4. Tests with termite baiting systems using buildings with no existing subterranean termite infestation(s). Tests using a.i. bait stations placed around a building(s) or structure(s) must be installed and maintained according to label directions. If termites

begin to infest any of the test buildings or structures, results data must show 100% cessation of termite activity in the building(s) of the termite colony initially identified as infesting the structure, and also 100% cessation for possible simultaneous or subsequent infestation by other colonies, for at least 90% to 100% of the test buildings within 12.0 months of the first infestation discovered.

Tests must install a.i.-bait stations around a building(s) or structure(s) plus independent non-a.i. termite monitors (in-ground or above-ground monitors) placed around and within test buildings with no existing infestation(s) of subterranean termites. All test buildings and structures must have proven subterranean termite activity in the soil within 3.1 meters (10.0 feet) or closer to the test structure(s) before starting the test. Test results must show 90% to 100% cumulative cessation of subterranean termite activity in at least 90% to 100% of all the termite-active independent non-a.i. termite monitors within 12.0 months after initial termite feeding on a.i. bait matrices that were placed outside of the structure(s) in addition to the non-a.i. termite monitors. During the entire test duration, bait stations (a.i.) and termite monitors (non-a.i.) must be evaluated regularly (at least every 3.0 months) for termite feeding using the requirements delineated in sub-section I.b.3.

I.b.4.(a). When evaluating termite monitors and termite-free test buildings and structures where termites have not been detected or where termites have been eliminated in the soil immediately adjacent to the buildings or structures, no new infestation(s) can occur in any of the test buildings or structures for at least 5.0 years after cessation of termite activity following initial termite feeding on exterior-installed formulated a.i. bait stations as verified by visual and instrument or other detection device(s) inspections. Absence or presence of termite activity will be verified using a combination of visual and instrument or other detection device and inspection techniques to delineate locations of new active termite infestation(s) as described in sub-section I.b.3 (a).

I.b.5. USEPA updates and revised requirements. For all termite baiting systems, if the USEPA updates and revises bait system test evaluation and duration requirements, subsequent following tests must meet the new requirements. If USEPA newly approved revised labels or re-registered labels are in force, future tests must meet the new label directions and requirements.

I.c. Pesticides Applied Directly to Wood or Other Building Components

I.c.1. Pesticides applied directly to wood or other building or structural components. When pesticides are applied directly to non-preserved-treated, pesticide-free raw wood or other cellulose or non-cellulose building components that are free of surface-applied coatings such as paint, stain, or varnish, field plot tests and building tests must be conducted to evaluate the effectiveness of these applications in preventing damage to wood by subterranean termites.

I.c.2. Field plot tests. Subterranean termite cumulative average ASTM damage scale ratings for both treated and non-treated wood must equal at least 9.0 to 10.0 (9 = light attack, surface etching or nibbles only; 10 = sound, surface nibbles permitted) under the Standard Test Method of Evaluating Wood Preservatives by Field Tests with Stakes, 1996, ASTM D1758-96 scale in at least of 90% to 100% of treated test wood samples for a minimum duration of at least 5.0 years (ASTM 1996). For products registered before the effective date of this revised Rule, test results must equal a damage rating of 0.0 to 1.0 (0 = no damage; 1 = surface etching or nibbles

only) using the USDA FS wood damage rating scale (modified from Verrall 1959), or the ASTM scale damage rating of at least 9 to 10 (ASTM D 1758-96) in at least of 90% to 100% of the test specimens for a minimum duration of at least 5.0 years.

I.c.3. Building tests. Tests with buildings or structures must show no termite infestation in 90% to 100% of test buildings for a minimum duration of at least 5.0 years after the treatments to the wood or wooden building components.

I.c.4. Pre-construction wood preservative treatments. For wooden building components that are preservative-treated through a variety of methods such as dip-diffusion, vacuum-pressure applications, hot or cold baths, or other AWPA-accepted wood preservative treatment before construction begins, results of field plot and building tests must meet the same test criteria and result requirements as stated in sub-sections I.c.1, I.c.2, and I.c.3.

I.d. Pesticide Combinations or Unique Application Technologies and Methodologies Not Addressed Previously in this Revised Rule

I.d.1. Systems or products that use combinations of pesticides, or unique application technologies and methodologies. Systems and products registered after the effective date of this revised Rule that claim to protect structures by detrimentally affecting or eliminating termite populations must conduct both field plot tests and building tests in accordance with Section II. These tests must meet performance standards for field plot tests (sub-section I.a.), and building tests (sub-section I.b).

Systems and products registered before the effective date of this revised Rule that claim to protect structures by detrimentally affecting or eliminating termite populations must have conducted and completed field plot tests and building tests as specified in sub-sections (1)(a), (1)(b), and (1)(c) of the original Rule.

I.d.2. Building tests must be conducted for all other products in addition to those in sub-section I.d.1., and must show no termite infestation in at least 90% to 100% of test buildings or structures for a minimum duration of 5.0 years after treatment.

II. ACCEPTABLE TEST CONDITIONS AND REQUIREMENTS

II.a. Preventive Termiticide and Pesticide Treatments

New construction tests must allow for development of scientific data showing that the product(s) meet(s) the performance standards as specified for the type of pesticide, termiticide, device, or barrier listed below. All field plot tests, building tests, or other termite management or control tests started before the effective date of this revised Rule must comply with original Rule requirements.

II.a.1. Termiticides applied to soil under field conditions. Field tests must be conducted in geographic locations that approximate Florida climate conditions with respect to rainfall, temperature, and soil types, and that have similar termite species. All field tests initiated after the effective date of this revised Rule must be conducted on soil plots that have not previously been treated with any termiticide(s), insecticide(s), or pesticide(s) applied to soil, and have not been treated with any baiting system installed in soil or in or around any nearby structures at any time in the past.

II.a.2. Termiticide field tests. Field tests must be installed and conducted using at least 10 replicates of each different treatment tested, and in 3 different field locations. If more than 10 replicates of a treatment(s) are used, the results of all additional replications

must be reported. Wood used in tests must not be preservative-treated or chemically treated previously to resist termite or other wood-destroying arthropod or microbial attack, and must not be a wood species naturally resistant to termites or other arthropods as defined in Section 2304.12² of the Florida Building Code, Seventh Edition, 2020. Department of Community Affairs, 2555 Shumard Oak Boulevard, Tallahassee, Florida 32339, USA. <https://codes.iccsafe.org/content/FLBC2020/1/chapter-23-wood> (Building Code 2020).

II.a.3. Field plot test data. All data must be collected in a manner acceptable to the United States Environmental Protection Agency and must be in compliance with USEPA's Product Performance Testing Guidelines for Structural Treatments (OPPTS 810.3600, EPA 712-C-98-424, March 1998. USEPA Office of Prevention, Pesticides, and Toxic Substances, 1200 Pennsylvania Avenue NW, Washington, DC 20460, USA) (OPPTS 1998).

II.a.3.(a). In addition to sub-section II.a.3., field tests conducted by the USDA FS described in sub-section II.a.4. are acceptable to FDACS.

II.a.4. USDA FS termiticide field tests. Minimum 5.0-year duration field tests conducted by the USDA FS using the concrete-slab method and ground-board method described in their 'termiticide-applied-to-soil field-plot residual treatment testing protocol' (February 11, 1994, RWU-4502-2-1994; Forest Products Laboratory, Durability and Wood Protection, 201 Lincoln Green, Starkville, Mississippi 39759, USA) are acceptable to FDACS (USDA FS 1994).

II.a.5. Alternative field tests. In lieu of testing described in sub-sections II.a.3 and II.a.4., field tests can be conducted under alternative protocols submitted to FDACS that receive official acceptance and approval by FDACS before field tests are initiated.

II.b. Test Conditions Required for Stand-Alone Bait Systems

II.b.1. Field plot tests and building tests geographic locations. Tests must be conducted in geographic locations that approximate Florida climate conditions as described in sub-section II.a.1. Field plot tests that evaluate the effect of bait system a.i. on termite populations must demonstrate existence of an active foraging and feeding termite population(s) before installation of the bait a.i. system into the test plots or test buildings or structures. Field plot bait system tests must evaluate at least 3 separate (different) baited termite colonies, and at least 1 additional non-baited termite colony (control replicate, no a.i.). Effects of baiting on foraging activity can be quantified by measuring consumption of bait matrix, estimating changes of foraging population sizes using triple-mark-release-recapture techniques, or genetic analyses or other FDACS-approved molecular technique(s), or changes in number of attacks and bait matrix consumption in a.i. baiting systems and non-a.i. monitoring stations, or other FDACS-accepted and officially approved testing protocols.

II.b.2. Field plot tests and building tests. Tests started before the effective date of this revised Rule must comply with the original Rule requirements. Both independent non-a.i. termite monitors and a.i. baiting systems must have been used in these original Rule tests.

II.b.3. Bait system tests. For all bait system tests initiated after the effective date of this revised Rule, tests must be conducted on buildings that have not been treated with any termiticide(s), insecticide(s), or pesticide(s) applied to soil or building components within 5.0 years or longer before test(s) initiation, and not

treated with any bait or baiting system within the immediate 5.0 years before initiation of tests. No exterior wood or interior wood except wall base 'sill plates' can have received any previous insecticide or preservative treatment applied at any time previous to or after test initiation.

II.b.4. Original Rule requirements. All field plot tests, building and structure tests, or other termite control tests started before the effective date of this revised Rule must comply with original Rule requirements.

II.b.5. Data collection. Accurate and complete data must be collected on each independent non-a.i. termite monitor and a.i. bait station for all plots and structures for the entire test duration. After test initiation, any plots, buildings, or structures removed from the test can be removed only through approval by FDACS. Results data on all plots, all structures, all independent non-a.i. termite monitors, and all a.i. bait systems must be evaluated and recorded for a minimum duration of 5.0 years. All data must be provided to FDACS on an annual basis through a minimum duration of 5.0 years after test initiation. When termites are encountered in any test, specimens must be collected into 90% ethyl alcohol (EtOH) in glass or plastic containers, labelled, and provided to FDACS. Specimens must include worker and soldier castes (and winged termites or termite wings when possible). Alternatively, upon agreement with FDACS, termite specimens may be stored and maintained by the entity(ies) or registrant conducting test(s), and provided to FDACS upon request.

II.b.6. Good Laboratory Practices. Results data collected from field plot and building tests should be developed under Good Laboratory Practices Standards (GLP. 40 CFR Part 160, revised 2001), or under a USEPA quality assurance agreement, or using a FDACS accepted and officially approved protocol. All tests must use the a.i. bait as it is formulated for registration, and must exactly follow directions for use on the registered label or the label proposed for registration.

II.c. Pesticides Applied to Wood

II.c.1. Test plot replication. Field plot tests and building or structure tests must be conducted with at least 10 replicates of each different treatment tested. If more replications are installed, results of all replications must be reported to FDACS. Non-treated 'control' field plots or 'control' buildings or structures must be incorporated into these tests. Field plot and building or structure tests must include at least 1 non-treated 'control' plot or non-treated building or structure for each 10 different treatment replicates.

II.c.2. Acceptable wood species. Wood used in field plot tests and building tests must be a species commonly used in wood frame construction in Florida, for example, aspen, fir, pine, or spruce. The wood species used in all tests should be identified to genus and common name when possible. Heartwood of any species must not be used in any tests. Only sapwood can be used in tests.

II.c.3. Test unit configuration and evaluation. Field plot test units must be configured with each treated wood block or board 'sandwiched' between two same-size non-treated raw wood blocks or boards placed on the top and bottom of the treated test wood. These wood 'sandwich' test units are then placed in field plots in an acceptable statistical design such as "Completely Random" or "Randomized-Complete-Block" on a 'checkerboard' configured

grid layout. Test units may be placed directly on bare mineral soil or elevated up to a maximum height of 21 cm (8.3 inches) above the soil surface on similar size concrete pads with openings in their center to allow foraging termites to move upward to locate the wooden test unit. Non-treated palatable raw wood must be placed into the concrete pad or block centralized holes to provide a connecting forging wooden pathway from the soil for termites to reach the test unit bottom block or board.

The objective is to demonstrate and evaluate whether or not the treatment will protect the insecticide-treated wood or preservative-treated wood or building component(s) from attack and damage by soil-dwelling subterranean termites that are actively feeding in the contiguous non-treated top or bottom wooden blocks or boards of the test unit.

Field tests must be installed and conducted using at least 10 replicates of each different treatment tested, and in three different field locations. Results from all replicates must be reported. Wood used in the bottom and top boards or blocks of test units must not be chemically treated previously or naturally arthropod-resistant as defined in sub-section II.a.2.

Once installed in the field, each test unit must be enclosed completely within a secured-in-place large bucket or other protective enclosure device to exclude sunlight, precipitation, weather events, and animals from affecting or damaging any test unit(s). The covering material or device must be rigid and contain ventilation holes to allow air exchange and reduce wood decay occurrence on test unit components.

Termite-damaged or decay-deteriorating test unit raw wood top and bottom non-treated wood blocks or non-treated boards must be replaced with a fresh new raw sapwood block or board, but not until their ASTM damage rating reaches or exceeds 4.0 or more severe (4 to 0) as defined in sub-section I.a.1. The center treated test block or test board must remain in place for the entire test duration or until it is completely destroyed by termites (ASTM damage rating = 0; failure, completely destroyed). If the treated test block or treated test board is destroyed, then that individual test unit is removed from the test and evaluated as a failure.

For a treatment to wood to be evaluated as successful, the subterranean termite damage ratings for the treated wood must equal at least an average cumulative ASTM damage rating of 9.0 to 10.0 (9 = light attack, surface etching or nibbles only; 10 = sound, surface nibbles permitted) in at least 90% to 100% of all treated wood test samples for a minimum duration of at least 5.0 years as described in sub-section I.a.1. No test replicates can be removed or eliminated from any tests without official approval from FDACS.

II.c.4. Alternative field test protocol. Instead of conducting field tests as described in sub-section II.c.3., field tests may be conducted in accordance with American Wood Protection Association Standard E26-15, *STANDARD FIELD TEST FOR EVALUATION OF WOOD PRESERVATIVES INTENDED FOR INTERIOR APPLICATIONS (UC1 AND UC2)*; *GROUND PROXIMITY TERMITE TEST* (Adopted 2010; Revised 2013, 2015) (AWPA 2015). Success will be evaluated as described in sub-section II.c.3.

II.c.5. Data collection. Field plot tests and building tests must be conducted and data must be collected in a manner acceptable to the USEPA as described in sub-section II.a.3. Alternatively, field plot tests and building tests may be conducted in accordance with other protocols officially accepted and approved by FDACS before initiation of field tests.

II.d. Pesticide Combinations or Unique Application Technologies and Methodologies not Addressed Previously under Sub-sections II.a., II.b., and II.c. of this Revised Rule

II.d.1. Test conditions. Termiticides, pesticides, bait systems, and devices registered after the effective date of this revised Rule that claim to protect structures by detrimentally affecting or eliminating termite populations must conduct field plot tests and building tests that meet the acceptable test conditions specified in Section II.

II.d.2. Pre-revised-Rule tests. Field plot tests and building tests started before the effective date of this revised Rule must comply with original Rule requirements.

II.d.3. Post-revised-Rule tests. After the effective date of this revised Rule, all pesticides, termiticides, bait systems, pesticide treatments to wood, or other termite management devices, chemistries, or technologies not addressed earlier in this revised Rule must meet all testing conditions and requirements appropriate for the specific technology as stated in this revised Rule.

III. PHYSICAL EXCLUSION DEVICES AND BARRIERS, CHEMICALLY ENHANCED OR NOT CHEMICALLY ENHANCED

III.a. Field Plot Tests and Structure Tests Must be Conducted to Evaluate Efficacy of All Exclusion Devices and Barriers for at Least 5.0 Years.

At least three separate groups of test plots or test structures must be used, with a minimum of 10 replicates of each different treatment in each group. At least one non-treated 'control' plot or 'control' structure must be included for every 10 replicates of each different treatment.

III.a.1. Test results. Results data must be collected on all field plot or building and structure replicates. No replicate may be removed from any test(s) without official approval from FDACS. The registrant or testing agency must provide annual update reports to FDACS.

III.a.2. Required effectiveness. Devices and barriers tested must show cumulative effective termite exclusion and lack of breaching of any device or barrier in at least of 90% to 100% of all test replicates for a minimum duration of 5.0 years after installation.

III.a.3. Devices and barriers. Physical exclusion devices and barriers can be any of the following materials, or future technologies and materials accepted by the building code and FDACS for use in Florida.

III.a.3.(a). Sheetmetal or termite-impenetrable-material shields and barriers.

III.a.3.(b). Stainless steel mesh screening termite shields or barriers.

III.a.3.(c). Polyguard® Geotextile Barrier System or other flexible natural or synthetic sheeting barrier.

III.a.3.(d). Polyguard® TERM Sized Sand Particle Barrier, stone particles, or other sized-rock or sized-sand particle barrier materials.

III.a.3.(e). All tapes, glues, adhesives, and parging cements, or supplementary materials that claim to be resistant to termite or other arthropod damage.

III.a.3.(f). Any physical exclusion device(s) or barrier(s) seeking approval or registration for use in Florida that claim(s) pest management or control, or exclusion characteristics.

IV. DATA REVIEW AND PUBLICATION OF RESULTS

IV.a. Results. Test results data acquired before the effective date of this revised Rule must be published under requirements of the original Rule. Data and results generated from tests initiated after the effective date of this revised Rule must comply with this revised Rule. To comply with this revised Rule, FDACS must publish the results of its review(s) of submitted test results and data within 90 to 120 working days after receipt of a complete set of data and a completed test report for tests conducted under the acceptable test conditions and standards established in this revised Rule.

IV.a.1. Performance evaluation and standards. If FDACS determines that the product(s) tested does not meet the performance standards set forth in this revised Rule, the data submitter will be allowed a maximum of 120 days from notification of non-acceptable test results by FDACS to provide additional supplemental data and data interpretation(s) for consideration by FDACS. FDACS must review its earlier determination that the product(s) tested did not meet performance standards with consideration of any additional supplemental data provided, but only if the additional supplemental data meets the performance standards and test conditions delineated in this revised Rule.

IV.a.2. Data review. Data from field plot tests or building tests conducted before the effective date of this revised Rule must be

reviewed for acceptance by FDACS, and a determination made of whether or not the test conditions and conduct of the test(s) meet acceptable test standards of the original Rule. Under this revised Rule, all field plot tests, and building and structure tests, must be conducted using a viable statistical design accepted and officially approved by FDACS, and must include non-treated control replicates.

IV.a.3. Review process. The termiticide efficacy protocol review process for field plot tests and building tests must be reviewed by FDACS using the "Protocol Review Process for Efficacy Tests of Termiticides for Preventive Treatment for New Construction" (November 13, 2002), which is adopted into this revised Rule.

IV.b. Granting Registration. Upon granting a registration, FDACS will publish a report with a description of the testing design and protocol(s) used to evaluate product(s) efficacy, including test locations, field plot test or building test statistical design, and also clearly identify who and what company or organization conducted the testing. This report must provide results of testing stating whether or not the tests met required applicable performance standards. The report also will provide information about the test standards and methods that were used to evaluate registration, and any potential limitations to evaluating product efficacy associated with using the test method(s) and data. Any additional information and results that would assist the general public and other interested parties in accurately evaluating any product or device effectiveness may be included in the report.

¹By statute, products claiming termite protection must have at least 5.0 years of field testing data under Florida conditions (FS Section 041, sub-section 487.041(3) (e) 2020), and "Require data demonstrating the efficacy of pesticide products containing label statements that include directions for use as preventive treatments for termites for new construction. The department shall review the data and determine if the data "supports [sic]" label claims of termite prevention or protection from termite damage. Label claims for protection from damage must be supported by data that "shows [sic]" the product will prevent damage to a structure and its contents for a minimum of 5 years under Florida conditions. If the data does not support such label claims, then the product cannot be registered or re-registered. The department shall adopt rules specifying performance standards and acceptable test conditions for data submitted in support of an efficacy claim, or may reference such performance standards and test conditions established by the United States Environmental Protection Agency."

²The 2020 Florida Building Code defines naturally durable wood resistant to termites as "The heartwood of the following species except for the occasional piece with corner sapwood, provided 90% or more of the width of each side on which it occurs is heartwood. Decay resistant is described as redwood, cedar, black locust and black walnut. Termite resistant is described as redwood, Alaska yellow cedar, Eastern red cedar and Western red cedar."

No Additional Proposed Code Revision Follows

Discussion

We anticipate that FDACS and similar agency personnel in other states will use this publication when initially writing or revising laws and regulations for required minimum performance standards and required acceptable test conditions for products intended for approval and use in termite management in their jurisdictions. Recommendations and standards provided in this revised Code were developed with the goals of scientific rigor of test protocol design and clearly defined results requirements, while being practical and realistic to implement in field trials. This Code will better protect consumers (property owners receiving termite management treatments) as well as pest management professionals because it better ensures that the testing protocols used and products tested will meet solid, objective standards and efficacy requirements. This revised and updated Rule (Code) also details field trial requirements for termite management treatments for product manufacturers and registrants, thereby efficiently and effectively providing guiding protocols and data expectations. This revision will benefit structural protection for consumers, reduce liability for applicators, steer registrants to proper experimental design and results standards and strengthen criteria for treatment approval decisions for regulators. This proposed revision is the result of a grant from FDACS with the primary goal of updating and modernizing the existing 2003

Rule. Therefore, as expected, this proposed revision has some of the same areas of emphasis, wording, and sections as the original Rule plus additional new sub-sections. The authors give credit to FDACS for all similarities between the 2003 Rule and this proposed revised Rule.

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References Cited

- ASTM. 1996. ASTM Designation: D 1758-96. Standard Method of Evaluating Wood Preservatives by Field Tests with Stakes. American Society for Testing and Materials International, West Conshohocken, Pennsylvania, USA.
- AWPA. 2015. American Wood Protection Association Standard E26-15: *STANDARD FIELD TEST FOR EVALUATION OF WOOD PRESERVATIVES INTENDED FOR INTERIOR APPLICATIONS (UC1 AND UC2); GROUND PROXIMITY TERMITE TEST* (adopted 2010; revised 2013, 2015). American Wood Protection Association, Birmingham, Alabama, USA.

- Building Code. 2020. Section 2304.12, Protection Against Decay and Termites. Florida Building Code (Seventh edition). Department of Community Affairs, Tallahassee, Florida, USA. <https://codes.iccsafe.org/content/FLBC20201/chapter-23-wood>
- Carrizo TF, Pontes-Nogueira M, Santos RG, Morales AC, Cancellato EM, Scheffrahn RH. 2020. New World *Heterotermes* (Isoptera, Rhinotermitidae): molecular phylogeny, biogeography and description of a new species. *Systematic Entomology* 45: 527–539.
- Eaton TD, Jones SC, Jenkins TM. 2016. Species diversity of Puerto Rican *Heterotermes* (Dictyoptera: Rhinotermitidae) revealed by phylogenetic analyses of two mitochondrial genes. *Journal of Insect Science* 16: 111. doi: 10.1093/jisesa/iw099
- FAC – Florida Administrative Code. 2003. FAC 5E-2.0311: Performance Standards and Acceptable Test Conditions for Preventive Termite Treatments for New Construction. Florida Rulemaking Authority 487.041(4)(e) FS. Law Implemented 487.041(4)(e) FS. History–New 3-23-03, Amended 12-16-03. Florida Department of Agriculture and Consumer Services, 3125 Conner Boulevard, Tallahassee, Florida 32399, USA.
- FAC 5E-14. 2017. FDACS, DAES, Chapter: Entomology–Pest Control Regulations. FAC Rule 5E-14.105. Contractual Agreements in Public's Interest–Control and Preventive Treatment for Wood-Destroying Organisms. Rulemaking Authority 482.051, 570.07(22), 570.07(23) FS. Law Implemented 482.051(3) FS. History–New 1-1-77, Joint Administrative Procedures Committee Objection Withdrawn–See FAW Vol. 3, No. 30, 29 Jul 1977, Amended 27 Jun 1979, 25 Oct 1990. Formerly 10D-55.105, Amended 11 Aug 1993, 17 Apr 2003, 1 Jun 2006, 17 Sep 2008, 16 Nov 2008, 9 Jan 2017.
- FDACS – Florida Department of Agriculture and Consumer Services. 2020. <https://www.freshfromflorida.com/Consumer-Resources/Health-and-Safety/Protect-Your-Home-from-Pests/Termites/Conehead-Termite-Program>
- FS 482. 2020. 2020 Florida Statutes Title XXXII: Regulation of Professions and Occupations. Chapter 482: Pest Control. Section 051: Rules. <https://www.flsenate.gov/laws/statutes/2020/482.051> (last accessed 12 Jun 2021).
- FS 487. 2020. Florida Statutes Title XXXII: Regulation of Professions and Occupations. Chapter 487: Pesticide Regulation and Safety. Section 041: Registration. <https://www.flsenate.gov/laws/statutes/2020/487.041> (last accessed 12 Jun 2021).
- Nexis Uni. 2020. Nexis Uni Academic Homepage. <http://www.lexisnexis.com/hottopics/Inacademic> (last accessed 12 Jun 2021).
- OPPTS. 1998. Product Performance Test Guidelines. OPPTS 810.3600, Structural Treatments. United States Environmental Protection Agency. Prevention, Pesticides and Toxic Substances (7101). EPA 712-C-98-424, Mar 1998. US Environmental Protection Agency, Washington, DC, USA.
- PRN. 1996. Pesticide Registration Notice PRN 96-7: Termiticide Labeling. EPA 730-N-96-006. 1 Oct 1996. <https://www.epa.gov/pesticide-registration/prn-96-7-termiticide-labeling#background> (last accessed 12 Jun 2021).
- Scheffrahn RH. 2013. Overview and current status of non-native termites (Isoptera) in Florida. *Florida Entomologist* 96: 781–788.
- Scheffrahn RH, Crowe W. 2011. Ship-borne termite (Isoptera) border interceptions in Australia and onboard infestations in Florida, 1986–2009. *Florida Entomologist* 94: 57–63.
- Scheffrahn RH, Jones SC, Krecke J, Chase JA, Mangold JR, Su N-Y. 2003. Taxonomy, distribution, and notes on the termites (Isoptera: Kalotermitidae, Rhinotermitidae, Termitidae) of Puerto Rico and the U.S. Virgin Islands. *Annals of the Entomological Society of America* 96: 181–201.
- USDA FS. 1994. Termiticide-Applied-to-Soil Field-Plot Residual Treatment Testing Protocol. RWU-4502-2-1994. USDA Forest Service, Forest Products Laboratory, Durability and Wood Protection, Starkville, Mississippi, USA.
- Verrall AF. 1959. Preservative moisture-repellent treatments for wooden packing boxes. *Forest Products Journal* 9: 1–24.