UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460

OFFICE OF CHEMICAL SAFETY AND
POLLUTION PREVENTION

MEMORANDUM September 19, 2019

SUBJECT: Science Review of the AEATF II Airless Paint Sprayer Human Exposure Monitoring Study (AEATF II Project ID AEA10; MRID 50879401).

PC Code(s): Not Applicable (NA)	DP Barcode(s)/No(s): NA
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This memorandum presents the EPA/OPP Antimicrobials Division (AD) science review of the human exposure airless paint sprayer study submitted by the Antimicrobial Exposure Assessment Task Force II (AEATF II). The dermal and inhalation exposure data as represented in this review are acceptable and, subject to the considerations described below, are recommended for use for pesticide handler exposure assessments.

EXECUTIVE SUMMARY

This document represents the USEPA, Office of Pesticides Program, Antimicrobials Division (AD) review of the Antimicrobial Exposure Assessment Task Force II (AEATF II) airless paint sprayer study. The AEATF II designed the study to develop unit exposures for painting using an airless sprayer. The results of the study are reported herein. The protocol for this completed study was previously reviewed by the EPA and the Human Studies Review Board (HSRB) for ethical and scientific design. Both EPA and HSRB approved the protocol and provided recommendations for some minor modifications (discussed within this memo). This memo contains the scientific review, recommended unit exposures, and study limitations to be considered by users. The ethics review is contained in a separate memo. Both reviews are to be presented to the HSRB at the planned October 22-24, 2019 meeting.

The study investigators monitored inhalation and dermal exposures to 18 different test subjects. Propiconazole was the active ingredient in the paint used as the surrogate test compound by all test subjects. All test subjects were recruited from the commercial painter population. All painting activities were performed indoors. Each subject was randomly assigned to paint 10, 15, or 30 gallons of paint treated with either 1,200 or 12,000 ppm of propiconazole. Painting duration ranged from 58 to 192 minutes (average 127 minutes). Subjects opened the 5-gallon buckets of paint, strained/poured the paint (previously treated with propiconazole), and used an electric powered airless sprayer to paint the walls, ceilings, closets/shelving in rooms that were purposely constructed in a warehouse for this study. Subjects were instructed to paint as they normally would do. EPA confirms that the data are considered the most reliable data for assessing handler exposures from antimicrobial-treated paints when using an airless sprayer. The reader is referred to Section 3.0 for a discussion on the data limitations and use of the data as surrogate.

EPA intends to use this AEATF II airless sprayer dataset instead of the Pesticide Handlers Exposure Database (PHED) datasets to assess exposure for persons painting with an antimicrobial treated paint product. The exposure data in the AEATF II airless sprayer scenario represent the painting with an airless sprayer, it does not cover the pouring of an antimicrobial product into the paint nor painting with a brush/roller. Those scenarios are monitored in separate AEATF II studies.

Select summary statistics for the "unit exposures" (*i.e.,* exposures normalized to pounds active ingredient handled) are presented in Table 1 for the dermal and inhalation routes of exposure. Each test subject wore both inner and outer whole-body dosimeters (WBD) that were sectioned and analyzed separately for each body part (*e.g.,* lower leg, upper leg, lower arm, upper arm, etc). This WBD sectioning allows for estimating unit exposures for various clothing combinations of long/short pants and/or long/short sleeved shirts.

For comparison, results from the PHED airless sprayer study used in prior risk assessments is also presented in Table 1. The summary statistics from the new AEATF II study reported in Table 1 are estimated using the lognormal simple random sampling model while the PHED results are empirical estimates.

Table 1. Unit Exposures (UE) for the AEATF II Airless Sprayer Scenario.				
Exposure Route	**Clothing**	**PHED ("best fit")[a]**	**AEATF II[b, c] (n= 18)**	
			Arithmetic Mean[d]	**95th Percentile[e]**
Dermal (mg/lb ai)	Long pants/long-sleeves, no gloves	42.6	43.6	81.6
	Long pants/short-sleeves, no gloves	NA	63.7	126
	Short pants/short-sleeves, no gloves	160	105	212
Inhalation	Breathing Zone (mg/lb ai)[f]	0.56 (OVS)	0.993 (OVS)	1.56 (OVS)
		NA (Respirable)	0.123 (PPI)	0.237 (PPI)
	Breathing Zone (8-hr TWA mg/m^3/lb ai)[g]	0.070 (OVS)	0.124 (OVS)	0.195 (OVS)
		NA (Respirable)	0.0154 (PPI)	0.0296 (PPI)

[a] Historically PHED data along with data from MRID 43600102 have been used to assess the painter airless sprayer exposures to antimicrobial products added to paint. PHED/MRID 43600102 inhalation dose estimates were calculated assuming a breathing rate of 1.0 m^3/hour and they represent inhalable (total) particulates. The unit exposures in the "PHED" column are based on the arithmetic mean. PHED dermal unit exposures are as reported in the USEPA/OPP/HED Occupational Pesticide Handler Unit Exposure Surrogate Reference Table for the commercial painters (*i.e.,* long pants/long-sleeved shirts) and HED SOPs for residential pesticide exposure assessment (*i.e.,* short pants/short-sleeves). Note: For the dermal route's short pants/short-sleeves, data are from PHED study #467 only; for the inhalation route and for the dermal route's long pants/long-sleeves, data are from both PHED study #467 combined with MRID 43600102 as noted in HED SOPs for residential pesticide exposure assessment.

[b]Dermal and inhalation UEs are corrected for field recoveries.

[c] Statistics are estimated using a lognormal simple random sampling model. For AEATF data, all dermal and PPI inhalation are greater than LOQ; OVS NDs are estimated using substitution by ½ the midpoint value. Details are described in Appendix A.

[d] Arithmetic Mean (AM) = GM * exp{0.5*(lnGSD)^2}

[e] 95th percentile = GM * GSD$^{1.645}$

[f] Inhalation (mg/lb ai) = air conc ((mg/m^3) / lb ai) * breathing rate (1 m^3/hour) * painting duration (hours/day)

[g] 8-Hour Time Weighted Average (TWA) ((mg/m^3)/lb ai) = air conc ((mg/m^3) / lb ai) * painting duration (hours/day) / 8 (hours)

The following important points with respect to these data are noted:

- The AEATF II airless sprayer data and associated unit exposures are considered superior to the existing airless sprayer dataset for antimicrobial uses (*i.e.,* PHED and/or PHED combined with MRID 43600102). AEATF II efforts represented a well-designed, concerted process to collect reliable exposure data in a way that takes advantage of and incorporates a more robust statistical design, better analytical methods, and improved data handling techniques.
- The dermal unit exposures recommended in Table 1 are based on either the long-sleeved shirt, long pants, no gloves or the short pants, short-sleeved shirt, no gloves. Note: head exposure is also included in these estimates and represents workers wearing "no hat" (unprotected head). Antimicrobials are typically used in paints as material preservatives and are considered treated articles and are sold with no pesticide labels, and therefore, it is not possible to provide for personal protective equipment, such as chemical resistant gloves (or painter's hats). Typically, EPA/OPP assesses commercial painters using the long pants, long-sleeved shirts, no gloves scenario and residential painters using the short pants, short-sleeved shirt, no gloves scenario. The long pants, short-sleeved shirt, no gloves scenario is provided as an option for risk managers.
- Estimates of the geometric mean (GM), arithmetic mean (AM), and 95th percentile (P95) were shown to be accurate within 3-fold with 95% confidence for all scenarios. At this time, no additional monitoring for the airless sprayer scenario is required. Furthermore, as discussed in the protocol review (USEPA 2017), the existing airless paint sprayer data were not going to be combined with these newer data if the accuracy goals were met because of the data quality of the older studies discussed in the protocol review.
- The statistical analysis (Section 2.4) provides evidence consistent with log-log-linearity with a slope of 1[1] between dermal exposure and pounds of active ingredient (ai) handled. An ideal result of the log-log-linearity test is an estimated slope between 0 and 1 with a confidence interval that includes 1 but not zero indicating that independence between exposure and pounds of active ingredient (a slope of zero) is rejected and that log-log-linearity with a slope of 1 is not rejected. The results of this analysis indicate the following:
    - The analyses of log-log-linearity in Section 2.4, Table 9, show that independence between exposure and pounds of active ingredient is rejected for every exposure route.
    - The analyses of log-log-linearity in Section 2.4, Table 9, show that log-linearity with a slope of 1 between exposure and pounds of active ingredient is not rejected for about half of the exposure routes.

[1] The statistical analysis of log-log-linearity tests whether the slope of log exposure against log ai is 1, which supports the use of the data in the "unit exposure" formats. We now refer to these analyses as the log-log-linearity analyses. In the Governing Documents and in previous reviews of the AEATF II studies we have referred to these analyses as a "proportionality" analysis, but this has caused some confusion because the statistical models do not assume that the exposure is directly proportional to the AI but instead assume that the logarithm of the exposure is linear in the logarithm of AI with a slope of 1, which is a related finding but a very different model, as explained in more detail in Appendix A. We have therefore changed the terminology from "proportionality" to "log-log-linearity with a slope of 1."

- Even for the cases where the slope is significantly different from 1, the estimated slope is at least 0.7 and the upper bound is at least 0.9, so the "unit exposure" assumption is a reasonable approximation.

To assess the risks resulting from painting with an airless sprayer, EPA will combine appropriate unit exposure (UE) values with chemical-specific inputs (*e.g.*, maximum labeled application rates, dermal absorption, toxicological endpoints of concern) and default inputs (high end applied) in the standard pesticide handler exposure algorithm: Potential exposure = UE (mg/lb ai or mg/m^3/lb ai) x absorption (%) if applicable x maximum label rate (% ai by weight) x Weight of treated product/article (pounds).

1.0 Background

The AEATF II is developing a database representing inhalation and dermal exposure during many antimicrobial handler scenarios. A scenario is defined as a pesticide handling task based on activity (*e.g.*, application or mixing/loading) and equipment type (*e.g.*, paint brush/roller, airless paint sprayer, ready-to-use wipes, trigger pump sprayer, mop & bucket, pressure treatment of wood facilities, etc). The AEATF II is monitoring residues on both inner and outer dosimeters, which will allow the EPA to estimate exposures to various clothing configurations (*e.g.,* long pants, long-sleeved shirt or long pants, short-sleeved shirt or short pants, short-sleeved shirt). Hand exposure as well as inhalation exposures are also being monitored. Prior to conducting intentional exposure studies in humans, the protocols are reviewed by the Human Studies Review Board (HSRB). The HSRB reviewed this airless sprayer exposure study protocol on October 25, 2017.

1.1 Airless Sprayer Scenario Defined

The airless sprayer scenario in this study is defined as commercial painters/subjects painting as they normally would do by opening the 5-gallon buckets of paint, straining the paint to remove lumps, submerging sprayer pump into buckets, selecting spray nozzle tips (from those provided by researcher), adjusting sprayer pressure to subject's desired level, spraying the paint while using a ladder, rags, and wand extensions if desired. Paint was poured by the subjects from one bucket to another to re-fill the one with the sprayer pump. At the end of the painting event, the subjects reeled in the hose and closed the lids on the buckets. As indicated in the AEATF's airless sprayer protocol, *"The primary purpose of the paint application with airless sprayer monitoring study is to develop more accurate information on potential worker exposures to antimicrobials in paints and coatings. These data will consist of dermal and inhalation exposure estimates derived from monitoring human test subjects under conditions constructed to broadly represent those expected under actual use conditions."* Subjects wore whole body dosimeters (WBD) underneath long-sleeved shirts, and long pants, and a hat with a patch underneath (plus two personal air samplers). The test subjects wore no gloves. The conditions under which the study participants handle the pesticide as they are monitored are referred to as the scenario. Both inner and outer dosimeters were worn by the monitored study participants, and both inner and outer dosimeters were analyzed for residues.

1.2 Study Objective

The AEATF II's study objective is to monitor inhalation and dermal exposures to be used as inputs in exposure algorithms to predict future exposures to persons painting with an airless sprayer when using a paint treated with an antimicrobial product (*e.g.,* material preservative). Dermal and inhalation exposure monitoring was conducted while study participants painted using various equipment (nozzle tips, wand extension, spray pressures, rags, ladder, fan, etc). These exposures will be used in pesticide exposure assessments as "unit exposures".

"Unit exposure" (UE) is defined as the expected external chemical exposure an individual may receive (*i.e.,* "to-the-skin" or "in the breathing zone") per weight-unit of chemical handled and is the default data format used in pesticide handler exposure assessments. Mathematically, unit exposures are expressed as "handler" exposure normalized by the amount of active ingredient

(ai) handled by participants in scenario-specific exposure studies (*e.g.*, mg ai exposure/lb ai handled). EPA uses these UEs generically to estimate exposure for other chemicals having the same or different application rates.

Criteria for determining when a scenario is considered complete and operative have been developed (SAP 2007). Outlined in the AEATF II Governing Document, the criteria can be briefly summarized as follows:

- The AEATF II's objective for this study design is to be 95% confident that key statistics of normalized exposure are accurate within 3-fold. Specifically, the upper and lower 95% confidence limits should be no more than 3-fold (K=3) higher or lower than the estimates for each of the geometric mean, arithmetic mean, and 95th percentile unit exposures. To meet this objective, AEATF II proposed an experimental design with 18 monitoring events (MEs) for professional subjects painting surfaces with an airless sprayer.

A secondary objective for EPA is for meeting 80% power for detecting log-log-linearity with a slope of 1. This objective is approximately met if the widths of the confidence intervals for the slope based on the lognormal model are at most 1.4.

1.3 Protocol Modifications, Amendments, and Deviations

1.3.1 Protocol Modifications Based on EPA and HSRB Reviews

EPA and the HSRB provided science-based changes to the airless sprayer protocol during the review (EPA 2017 and HSRB 2017). The review comments and AEATF II responses are summarized in Table 2a for the EPA comments and Table 2b for the HSRB comments.

Table 2a. EPA Review and AEATF II Responses.

EPA Issue Raised	AEATF Response	EPA Comments
1. Need to randomly assign MEs to the differently sized rooms within the 3 groups of paint volumes	AEATF agreed.	The AEATF indicated that "*...if a balanced design is not feasible, then we suggest that after the monitoring schedule is known and an initial assignment of ME's to volumes of paint and rooms is made, check to make sure that each Group has at least one ME in Module 1, at least one ME in Module 2, and at least one ME in Module 3; if that is not the case, reassign the MEs "randomly" until the condition is met."* The description above has been met as reported in the Study Report's Table 11 (page 84-85), which indicates that each of the 3 Paint Volume Groups included MEs in each of the 3 Modules.

EPA Issue Raised	AEATF Response	EPA Comments
2. Add additional "logistics" to the "stowing" of the airless sprayer at the completion of the ME	AEATF clarified how the subject would complete the task (*i.e.,* reel up the hose) and the steps taken by the researcher to clean the equipment with water between MEs.	The study report (p. 28-29) discusses the roles of the Study Director, Study Monitor, and Principal Field Investigator which included completing painting of the room after the ME was finished (if need be to ensure a consistent color) and cleaning the sprayer and nozzles.
3. The EPA noted that the study captures a range of exposure conditions, but it is not likely to cover the full range of variation that is expected to exist.	AEATF acknowledges that the study does not cover all the range in variation that exists when using an airless sprayer, but by using latex paint this study does cover the vast majority of types of materials that will be used in an airless sprayer. Latex paints account for more than 80% of all architectural paints. According to Sherwin-Williams it would be very unusual to paint interior walls and ceilings with oil-based paints. If oil is used indoors, it is applied by brush and generally only for trim of window and doors and baseboards. If oil-based paint is used, it is generally used outdoors, more in the northern region of the US, and most often applied with a brush to siding, wood trim, railings, and other high traffic areas. Because of its viscosity, it is not typically applied by airless sprayer.	Although the study was designed to purposively capture what is believed to be a reasonable representative to high-end painting scenario to predict future exposures to material preservatives, EPA agrees that it does not likely capture the full range of variation of painting with airless sprayers that may occur throughout the population of both consumer and commercial applicators. For example, the rooms painted did not include open windows nor working HVAC systems, instead, fans were provided to the subjects to be used by their choosing (only 2 subjects chose to use a fan). It is conceivable that many, but not all sites, would use ventilation during painting. The maximum amount of paint handled was 30 gallons and only one subject painted at a time. There will be instances where painters will use more than this amount and it is unknown if multiple painters are in close enough proximity to substantially affect exposures. Additionally, subjects were recruited from professional painters with at least 3 months experience, not capturing the variation of exposure conditions from consumers. Painting was restricted to indoors, excluding outdoor conditions/variations.
4. Although not discussed in the protocol, if a subject decides to thin the paint with water in order to spray, the researcher needs to document this activity/amount.	The AEATF II determined that professional painters do not use water to thin the paint like some consumers do (rationale was that consumers try to save money but end up applying two coats of paint)	The results of the study indicated that none of the subjects used water to thin the paint. The only water used was by the researchers at the end of the ME to clean the equipment; residual water in the hose at the beginning of the next ME was sprayed out to prime the pump.

EPA Issue Raised	AEATF Response	EPA Comments
5. Multiple wording change suggestions and typo corrections.	Protocol will be updated with corrections as appropriate.	Completed.

Table 2b. HSRB Review and AEATF II Responses.

HSRB Recommendation	AEATF Responses	EPA Comments
1. In order to identify whether respirator use should be mandatory and if so, the appropriate respirator type, the study sponsor should clearly identify the potential hazards (contaminants) based on the type of paint and sprayers used, and determine the level/concentration of the contaminant(s) in the air.	The Sponsor, as a user of this product, is relying on the paint manufacturer's label and SDS to identify hazards and contaminants in the paint. The Sponsor will rely on the US EPA's hazard characterization of the paint. The EPA hazard characterization will be added as an appendix to the Study Design Document to justify the need for respirators to be worn by test subjects in the study. AEATF is requesting that EPA reformat the memo to include a cover page that states the agency, author(s), and date of preparation.	In brief, EPA provided a memo to the AEATF (USEPA 2018a) which discussed the various chemicals in the paint, the VOCs, propiconazole and the need for respiratory protection for the subjects in this study. EPA concluded that a 2.5x protection factor (PF) would be needed and thus the 10x PF afforded by a filtering facepiece respirator would be needed as well as proper fit testing (29CFR1910.134)
2. The study sponsor should provide an updated Safety Data Sheet (SDS) for the Sherman Williams Superpaint. The SDS provided includes discrepancies, indicating a respirable dust/total dust hazard, yet suggesting the use of a combination organic vapor/particulate respirator	AEATF will contact the paint manufacturer to confirm which one is the most recent SDS. The SDS states that sanding or abrading dried film may release nuisance particles/dust and these may be at hazardous levels; when sanding/abrading dried paint, use a NIOSH approved dust/mist respirator. The SDS also states (under circumstances not associated with sanding/abrading) that if levels of materials listed in Section 2 cannot be controlled by ventilation, a properly fitted NIOSH/OSHA approved organic vapor/particulate respirator should be worn.	See response above (USEPA 2018a). The paint contains low VOCs and the respirator needed is protection from particulates, not vapors.
3. If the only hazard is dust/total dust, then a particulate respirator is adequate.	No sanding will take place during this study, so there will be no release of nuisance dust.	Exposure is to particulates. Filtering facepiece respirator was worn by subjects.

HSRB Recommendation	AEATF Responses	EPA Comments
4. Should a volatile organic compound (VOC) be present and an organic vapor respirator be required, details on the VOC should be listed within the Composition/Information on the Ingredients Section of the SDS.	According to the Environmental Data Sheet (Aug 16, 2017) for this paint, this is a low VOC product and therefore exposure to volatile organic compounds is expected to be low. This is also stated in the EPA hazard characterization memo.	Paint contained low VOCs.
5. In addition, the study sponsor should provide data on the concentration of the hazard during the task, either by performing sampling or by providing an industry accepted concentration. Once the concentration is determined, the study sponsor can use the United States Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) for each of the identified hazards to guide respirator selection.	Potential airborne concentrations of hazards from the paint will not be discussed in the protocol; instead the AEATF will refer to the EPA's memo in the Scenario Design Document appendix to substantiate the need for subjects to wear a respirator while participating in the study. Adding this type of information to the protocol will detract from the objective of the study which is to measure potential exposure to antimicrobials in paint when using airless sprayers.	See response above (2018a) for respiratory selection.
6. Once the concentration is determined, the study sponsor can use the United States Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) for each of the identified hazards to guide respirator selection. Respirators should be required if concentration of the contaminant is above OSHA PEL and can be voluntary if the concentration during activity is below OSHA PEL. Based on the protection factor and hazard characteristics (particle versus VOC) the correct type of respirator should be chosen.	Based on EPA's calculation of potential exposure to total inhalable nuisance dust (Particles Not Otherwise Regulated) from airless spraying with 30 gallons of SuperPaint indoors, a filtering facepiece respirator is required when using the more conservative input assumptions. It is EPA's recommendation that a particulate filtering facepiece respirator be worn by all test subjects in the study.	See response above (2018a) for respiratory selection.

HSRB Recommendation	AEATF Responses	EPA Comments
7. To ensure that all subjects are adequately protected, EPA is requesting that AEATF apply the requirement to use respirators to all study participants. Because the respirator use would be mandatory based on the OSHA PEL, EPA also recommends ensuring that all subjects have been fit tested, whether by their employer or as part of their participation in the study. [Note: The fit testing issue was initially raised during the HSRB protocol review meeting by the Board and followed-up by EPA]	AEATF will follow EPA's recommendation and cite the EPA's memo as the justification. Test subjects who have respirators but cannot provide evidence of being fit tested within the last year will be fit tested using their own respirators. Those subjects who do not have their own respirators will be fit tested with a NIOSH-approved particulate filtering respirator provided by AEATF. Fit testing of subjects will be done by a respirator fit testing company hired by AEATF.	Only one subject (ME11) had been fit-tested prior to the study; the rest of the subjects were fit-tested specifically for this study (see Study Report page 13).
8. Remove the upper age limit of 65 or justify why there is an age limit	The upper age limit was removed.	Addressed in EPA's ethics review.
9. Revise recruitment ads to indicate that a government issued ID is needed	This was updated.	
10. At least two types of hearing protection devices should be provided	Two types of ear plugs will be available for test subjects to use. Over the head hearing protection or ear muffs will not be provided as these would interfere with the hat dosimeter.	
11. Add the risk of climbing a small ladder to the protocol and ICF	The risks of using a ladder will be added.	
12. More detail about videotaping is needed in the ICF and give subjects the option of indicating if they do not wish to be videotaped.	More detail about the videotaping will be added including the statement that subjects who do not wish to be videotaped cannot participate.	
13. Revise the study screening material to ask whether subjects have ever had an allergic response to paint instead of asking whether they are allergic to propiconazole.	This will be revised.	

HSRB Recommendation	AEATF Responses	EPA Comments
14. Revise the justification for using only 30 gallons of paint in the study; the Board recommends acknowledging in the protocol that the study may not be capturing the very highest exposed population and that the survey is based on a small sample size.	These comments will be incorporated in the Study Design Document which contains the rationale for selecting the amount of paint to be used in the study and a copy of the survey.	These comments were incorporated into the revised Study Design Document; highlighting seven commercial painting companies of which one indicated 100 to 200 gallons could be painted, but unclear if it was by one or more than one person, and that *"…this study may not capture exposure from the highest risk individuals who paint very high volumes of paint or who paint alongside multiple painters."*
15. The Board had questions about the Margin of Exposure calculations referenced in the protocol.	EPA will address these questions.	See USEPA 2018a.
16. Include that this paint was used in the previous AEATF painter study and is a commonly used paint	This is stated in the Study Design Document; it will be added to the study protocol.	--
17. The Board recommends generating custom field data collection forms for environmental conditions and worker activities that indicate what parameters are to be collected and the frequency of collection	Custom data collection forms will be generated and used by the field researchers. Field researchers will receive training on the data collection and the forms in order to ensure consistency in the data being collected.	--

HSRB Recommendation	AEATF Responses	EPA Comments
18. The Board recommended adding more detail regarding the risk assumptions when extrapolating from professionals to consumers, specifically that the study could underestimate exposure to consumers.	This will be stated in the Scenario Design Document.	The Scenario Design Document states *"…the antimicrobial regulatory approval process is based on the highest exposure scenario, which is commercial painters because of the higher amount of paint they handle in a day in comparison to consumers. As such, the subjects in this study will paint for a longer period of time and use higher volume spray equipment than what is typical for consumers which may tend to bias exposure to the higher end. The AEATF II does not foresee any other significant sources of underestimation bias for exposure estimates derived from data resulting from the proposed scripted study."* EPA provides additional discussion in Section 3.0 below.
19. Add information from EPA's slide showing the overview of the use patterns and "formulation types" that are being addressed by AEATF.	This will be added to the Scenario Design Document.	EPA's slide was added to the Scenario Design Document as that document's Appendix A.
20. The protocol does not mention how personnel will be trained with respect to data collection.	That personnel will be trained will be added to the protocol	--
21. It was recommended that there be a drying time before dosimeters are cut and packaged and that there should be methods to limit contact with and transfer of paint from dosimeters. Additionally the Board requested an explanation of why the researcher's latex gloves are not included in the sample	A 25 minute drying period for the dosimeters will be added to the protocol and handling procedures will be clarified. The researcher's latex gloves are not included in the sample as unlike with painting with a brush or roller it is very unlikely that there will be large areas of wet paint on the clothing. The small amount of residue that might be removed by the researcher's gloves touching the edges of the clothing would be minimal compared to the high levels expected on the clothing.	--
22. To make the protocol consistent with the ICF, add that the subjects will wash their hands before the study.	This is already in the protocol; it will be moved to a more visible location.	--

HSRB Recommendation	AEATF Responses	EPA Comments
23. Clarify what size ladder will be used, whether it requires fall protection, and add falling and/or slipping risks when using ladders and tarps to the protocol.	6 foot portable ladders will be available; these do not require fall protection. Tarps will not be used in the study and will be removed from the protocol. The risk of falling while using a ladder will be added to the protocol as well as the maximum weight for the ladder.	Addressed in EPA's ethics review.
24. Clarify the handling of alternate subjects – will they go to the site every day and how/when are they contacted to come in	This will be clarified.	
25. Clarify whether food will be available for the subjects or if they should bring their own.	The protocol and ICF will be revised to indicate that food will be available for the test subjects at the test site.	

1.3.2 Protocol Amendments

The study report (page 66) lists 5 protocol amendments. The amendments included (1) changes to the subject recruiting advertisement (*i.e.,* the use of Craigslist, billboards, and social media); (2) changes to sample collection (*i.e.,* reduce the pre-exposure sampling time from 60 to 30 minutes for the ambient air samples and the use of foil/bags for storage of hat samples instead of glass jars); (3 & 4) correct typos for heat index cutoff and experimental start date; and (5) *"changed the reporting procedures for protocol deviations to harmonized them with the overseeing IRB's requirements for when a deviation requires IRB review (p. 66)".*

1.3.3 Protocol, Method, and SOP Deviations

Seven protocol and four SOP deviations were noted in the study (study report pages 66 and 67). Examples of the reported deviations include one ME not wearing eye protection during the straining of paint, not analyzing one of the field fortification solutions, not measuring one of the ME's pre-wetting of hand solution for the hand wash, having the subjects rather than the researchers use the gauze pads to scrub their hands for the hand wash (page study report p. 262), and extra spray tip nozzle was available for selection by the subject as well as a longer extension wand. For a detailed description of each of the protocol and SOP deviations the reader is referred to the study report. EPA accepts the study author's conclusion that these deviations did not adversely affect the outcome of the study.

1.4 Material & Methods

The following is a summary of the key field aspects of the study.

- ***Study Location:*** The airless paint sprayer study was conducted indoors in a warehouse with purposely built rooms specifically for this study. The warehouse was located in Orlando, Florida. Test site schematics and photos of the site/rooms are in Appendix C & D starting on page 283 of the study report.

- ***Substance Tested:*** The test substance monitored was propiconazole as the active ingredient; CAS number 60207-90-1. Propiconazole (50% ai) was formulated as a liquid in the product named Preventol A 12 TK-50 (EPA Reg. No. 39967-121).
- ***Paint Used:*** The study used Sherwin-Williams Superpaint Interior Flat Latex Paint (Product Code A86W00151). This paint has a density of 11.37 pounds per gallons.
- ***Test System:*** The study was designed to monitor exposures to subjects painting with an airless sprayer while varying amounts of paint and two concentrations of propiconazole in paint and thus various total amounts of active ingredient handled (AaiH). Three building modules were constructed within the warehouse for the subject's to paint: Module 1 = 3,080 ft^2, Module 2 = 3,045 ft^2, and Module 3 = 2,592 ft^2. *"Two of the modules were constructed to simulate houses with bedrooms, bathrooms, kitchen, hallways, and closets with shelving, etc. The third module simulated an office building with small and large offices, conference rooms, and hallways. Doors and windows were not installed since flat wall and ceilings were the desired targets for the sprayed paint. However, unhung doors placed in the middle of larger rooms were painted as is typical for interior spraying. Each subject was required to paint several unhinged doors (without hardware) which were placed upright at angles, secured to each other accordion style, in the center of one or more of the rooms they had to paint. MEs assigned to 10, 15, or 30 gallons of paint were required to paint 2, 3, or 6 doors, respectively. (p.25)"* "*Rooms were allocated such that different rooms in different modules were utilized for different MEs within each spray group. This ensured that no subject painted the exact same combination of rooms. (p. 26)"* Painting equipment available to each subject included strainer, multiple nozzle tips, ladder, extension wands (10, 15, 20, and 30 inches), spray shields (not used by any of the subjects), 5-gallon buckets of paint, and painter's rag; the use of such equipment was left up to the discretion of the subjects as they were allowed to paint as they normally would do. Figures 1 - 4 below illustrate the opening, pouring and straining of paint, and spray-painting doors and shelves in the test rooms.

Figure 1. Opening 5-gallon Paint Buckets and Airless Sprayer Hose.

Figure 2. Pouring Paint Through Strainer (Intake Hose on Outside of Strainer Bag).

Figure 3. Spraying Doors in Test Room Built for Airless Sprayer Study.

Figure 4. Spraying Above Shelving in Test Room Using a Ladder.

- ***Sample Size:*** The study consisted of 18 monitoring events (ME). Each ME is a different subject (*i.e.,* different person/individual). The 18 MEs in this study generated a total of ~1,300 samples of individual dosimeters and QA/QC samples.

- ***Duration:*** The sampling times ranged from 58 to 192 minutes (average 127 minutes). A Summary of the monitoring durations for each ME is reported on page 73 of the study report and individual ME air sampling pump flow rates and start/stop sampling times are reported on page 114 of the study report.

- ***AaiH:*** The AaiH ranged from 0.122 to 4.08 lb propiconazole. The specific AaiH for each individual ME is reported on page 74 of the study report.

- ***Surface Area Painted & Paint Handled:*** The target amount of paint sprayed was grouped as 10, 15, or 30 gallons per ME and this amount was roughly achieved (the 10-gallon group ranged from 46.08 to 48.67 kg paint (8.9 to 9.4 gallons); 15-gallon group ranged from 71.73 to 72.18 kg paint (13.9 to 14.0 gallons); and 30-gallon group ranged from 151.69 to 154.31 kg (29.4 to 29.9 gallons) paint sprayed). Surface area painted by each ME was estimated and provided to EPA by the AEATF II; an average of 4,944 ± 3,574 ft^2 (mean ± standard deviation) was painted ranging from 1,040 ft^2 (ME05) to 13,673 ft^2 (ME 13).

- ***Painting Procedures***: The subjects were provided closed 5-gallon buckets of pre-treated propiconazole paint. Subjects opened the paint buckets and poured the paint through strainers that were placed into empty 5-gallon buckets to remove lumps of paint. The sprayer pumps were submerged in the strained paint (some subjects put the hose on the outside of the strainer bag within the bucket, see picture in Figure 2). Subjects then

selected nozzle tips from a selection and unreeled the spray hose, switched on the sprayers and primed the pump using any remaining residual water from the previous night's cleaning and paint from a bucket and adjusted the spray pressure as they normally would choose/do (between 1,500 to 3,000 psi). Subjects started their spraying, typically from the back-end of the module, 8 of the subjects used the ladder, 7 subjects used a wand extension, 2 used fans, and most used the painter's rags (some just wiped their hands on their clothing). Paint was poured from one bucket into the one with the pump as needed. At the end of the painting, the subjects reeled up the hoses, covered the paint buckets with their lids and stacked the buckets. Study investigator's observational notes are on pages 80-83 of the study report. Appendix B shows the observer's map of each module and room setup they used to record the systematic progression of the subject's painting. The study report's pages 84-85 (Table 11) reports the number of rooms within each module that each subject painted; for example, ME 04 painted the lowest number of rooms (4 rooms within module 2) and ME 13 painted the most rooms (18 rooms in module 1 and 8 rooms in module 2).

- ***Environmental Conditions*:** Environmental conditions (humidity and indoor temperatures) are reported for each individual ME on page 78 of the study report. Indoor temperatures ranged from 61.0 to 87.3 ° F. The humidity indoors ranged from 35.1 to 94.1% (next two highest measurements 88.2 and 80.9%). "*There was no HVAC system, and warehouse and module doorways were left open to simulate real world airless spraying conditions. Fans and blowers were available for the subjects to use as needed. (p. 13)"* The study reported that only 2 subjects used the available fans.

2.0 Results

2.1 QA/QC

Controls. The results of the non-fortified field and laboratory control samples (blanks) were as follows: All the field control matrix samples were less than the limit of quantification (LOQ) (study report page 335); the laboratory control matrix samples were also all less than the LOQ (study report pages 354-361).

The LOQs for the various matrices were: air sampling OVS tubes 2 µg/sample, PPI filters 0.1 µg/sample, neck/face wipe 1 µg/sample, WBD sections 3 µg/section, painter's hat 100 µg/sample, and hand wash 0.04 µg/mL (hand wash samples were 550 mL per sample).

Method Validation. The pre-study method validation was conducted for each of the sampling matrices. "*Validation consisted of fortifying seven replicate samples at each of three fortification levels for each matrix. The ten matrices (PVC air filters, OVS tubes (front and back as separate samples), hand wipe/wash solutions, face/neck wipes, outer dosimeters, inner dosimeter, painter's hats, hat inner dosimeters…) were used in the validation."* (page 58 of the study report). The results of the method validation ranged from 87±4% (mean ± standard deviation) for the low-level fortification of the OVS tubes to 116±2% for the mid-level fortification of the PVC filters (page 87 of the study report).

Laboratory Recoveries. The concurrent laboratory recovery values for the hand wash solution was 97.8±6.47% (n=5), face/neck wipes 103±6.11% (n=6), OVS tubes 109±11.6% (n=8), PPI filters 104±11.1% (n=6), painter's hat 104±12.1% (n=8), hat inner dosimeter 111±15.2% (n=6), inner dosimeters 109±8.22% (n=24), and outer dosimeters 105±10.5% (n=14). Actual field samples (*i.e.,* subject's dosimeters) were not corrected for concurrent laboratory results (results of the laboratory recoveries are provided on pages 337 and 364 to 381 of the study report).

Field Recoveries. The field recovery values for the matrices are as follows:

Sampling Matrix	Fortification Levels	% recovery
Air sampling OVS tubes	20 and 200 µg/sample	99.2±8.67 (n=24)
Air sampling PPI filters	1 and 30 µg/sample	106±5.56 (n=24)
Hand wash	0.4, 4.0, and 12 µg/mL	107±5.51 (n=36)
Face/neck wipes	10, 100, and 1000 µg/sample	106±10.7 (n=36)
Inner dosimeters	10, 1,000, and 10,000 µg/sample	109±6.81 (n=36)
Painters hat	500, 1,000, and 10,000 µg/sample	111±11.4 (n=36)

With the exception of the OVS tubes, the average field recoveries were above 100 percent. The field recoveries for each fortification level were also above 100 percent, with the exception of the face/neck wipes which had a field recovery of 97.2 percent at the lowest fortification level of 10 ug/sample. The results for dermal field samples (*i.e.,* subject's dosimeter samples) and the PPI filter air samples were not adjusted for the field recovery because the recoveries at the relevant fortification levels were above 100 percent. The face neck results were not adjusted because the residues ranged from 99.7 to 3842 ug, which were in the range of the mid to high fortification levels which had recoveries of above 100 percent. The results for the OVS tubes were adjusted for an average field recovery of 99.2%. The field recovery samples were transported, stored, and analyzed with the corresponding field (dosimeter) samples. Results of the recoveries are provided on pages 338 and 382 to 397 of the study report.

2.2 Calculating Unit Exposures

Dermal Unit Exposure. Dermal exposure was measured using 100% cotton inner and outer whole-body dosimeters (WBD). The inner WBDs were worn underneath normal work clothing (*i.e.,* long-sleeved shirt and long pants). The normal work clothing worn over the inner WBDs were also analyzed and reported as outer dosimeters. In addition, dermal exposures also included hand washes, face/neck wipes, a painter's hat, and a patch worn underneath the painter's hat. The inner and outer WBDs were sectioned and analyzed by body part (*i.e.,* upper and lower arms, front and rear torso, and upper and lower legs). Samples were adjusted, as appropriate, according to recovery results from field fortification samples (*i.e.,* field recovery results were used to correct field samples where field recoveries were <100%; only the OVS tubes had field recoveries <100%).

A hand wash removal efficiency study was previously conducted by the AEATF II and reviewed by EPA and presented and reviewed by the HSRB (April 25, 2018) with human subjects for BIT in paint. Hand washes were collected in the BIT hand wash removal efficiency study as follows: *"Dermal hand exposure was assessed by washing and scrubbing the subjects' hands with 500*

mL of water/IPA (50:50, v/v) solution and one package of gauze wipes (two per package). Over a sample collection bowl, a small amount (~50 mL) of the premeasured 500 mL of isopropyl alcohol/water (50:50, v/v) sample was poured over one of the gauze wipes (BAND-AID® Johnson & Johnson Large Mirasorb® Gauze Sponges, 4 in. x 4 in.) and the subject's hands to moisten the paint. With the wet gauze wipe, study personnel scrubbed one hand, loosening and removing the paint. The second gauze wipe was wet with some fresh isopropyl alcohol/water (50:50, v/v) and used to scrub the second hand, loosening and removing the paint. The two gauze wipes were added to the collection bowl. Study personnel then poured more of the isopropyl alcohol/water (50:50, v/v) over the subject's hands while they rubbed and washed their hands together like one would when washing under a faucet. Subjects were instructed to rub and scrub their hands together. The remainder of the premeasured 500 mL of isopropyl alcohol/water (50:50, v/v) was slowly poured over the subject's hands while they were directed to rub and rinse their hands for a final clean rinse. The solution and wipes were collected as a sample." (V1:37)

As planned for in the airless sprayer protocol, the BIT hand wash removal efficiency study was to be used as a surrogate for propiconazole in the airless sprayer exposure study (USEPA 2017). USEPA (2017) specifically stated:

> *The final determination in the use of the BIT study results as a surrogate to correct the hand sampling for loss of propiconazole during this study will be made after the study's final report is submitted and subsequently reviewed by the EPA and the Human Studies Review Board (HSRB). The AEATF II has provided a rationale to bridge the BIT hand wash study to propiconazole (V1:36). The rationale includes several skin wash removal results from various dermal absorption studies and the water solubility of the two chemicals; BIT is slightly soluble in water at 1100 mg/L and propiconazole is less soluble in water at 100 mg/L (V1:41). Table 2 summarizes the average skin wash removal percentages. Although none of the existing data are an exact match to a hand wash sampling method, the overall data indicate that propiconazole will wash off of skin at least as well as BIT and that use of the skin wash removal data for BIT as a surrogate will not underestimate exposure to propiconazole. Therefore, EPA does not believe exposing human test subjects in a new study is warranted.*

Based on the review and acceptance of the BIT hand wash removal efficiency study, the hand wash samples in the airless sprayer study were corrected using the results from the hand wash removal efficiency study which indicated a removal efficiency of 73.3% for low level fortification of 154 ppm of BIT in paint and 60.3% removal efficiency for the high level fortification of 547 ppm of BIT in paint (USEPA 2018). The propiconazole concentrations in paint in this airless sprayer study were above the high-level fortification, and therefore, the 60% removal efficiency was used to correct hand residues. Although not part of the protocol's objective for the hand wash removal efficiency study, the face/neck wipe samples were also corrected using these same correction factors (Appendix A, Section 13 compares the results of the dermal exposures using the 60% vs 73% correction factors). Figures 5 and 6 illustrate the subject's hands after spray painting prior to the hand wash procedure and after the hand wash procedure. Note: Protocol Deviation No. 4 had the subjects rather than the researchers scrub their own hands for the handwash procedure to improve efficiency of removing paint from hands.

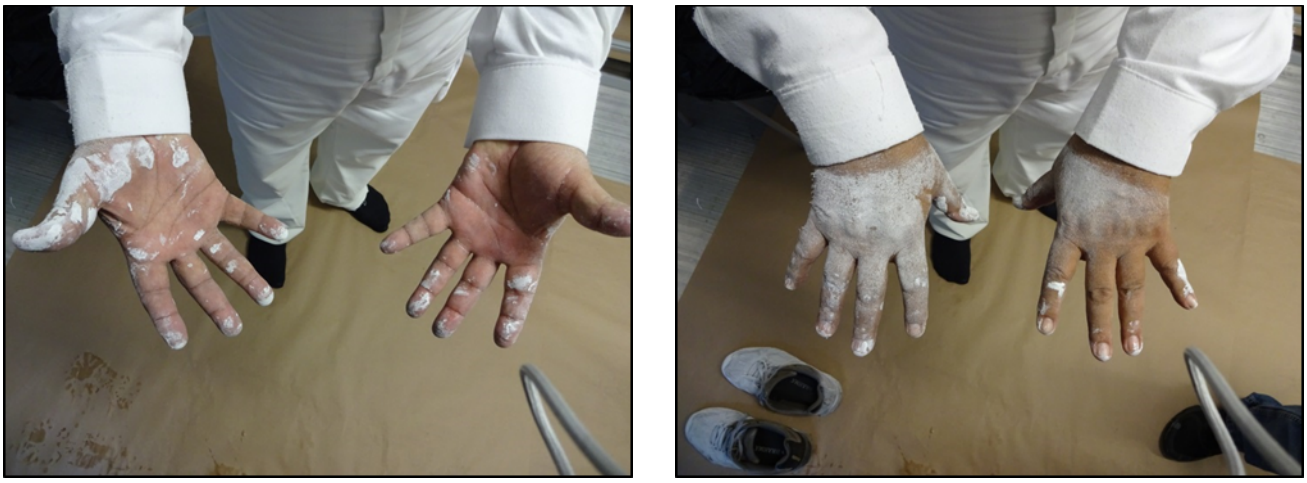


Figure 5. Subject's Hands Before Hand Wash Procedure.

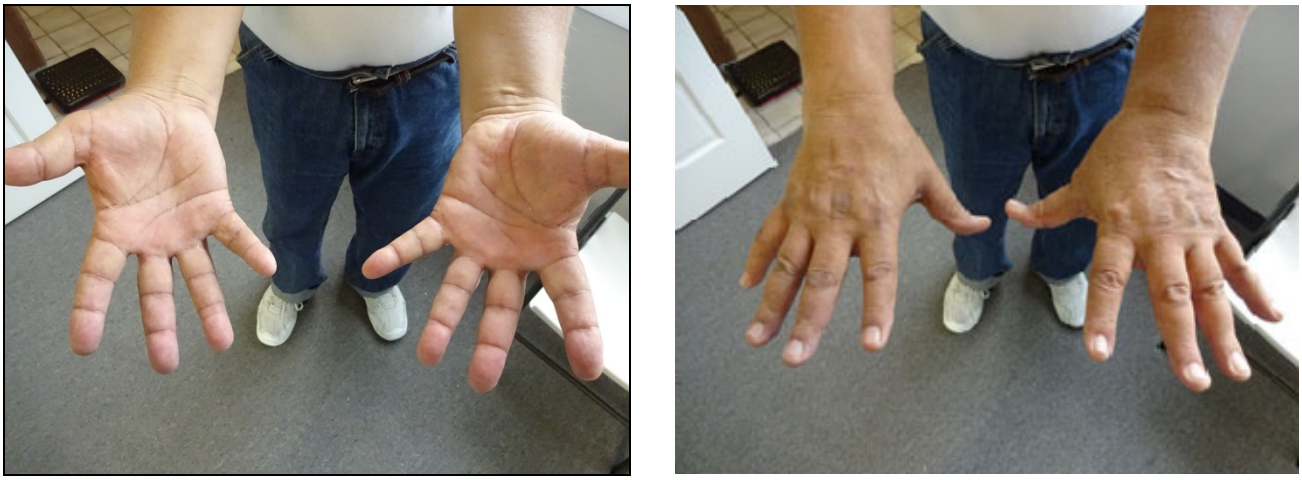


Figure 6. Subject's Hands After Hand Wash Procedure.

One final adjustment factor was used for the face/neck samples to correct for the area of the face covered by the half-face respirator and safety glasses. A correction factor of 1.43 (as per AEATF SOP 9K.0, which assumes that 30% of the total surface area of the face and neck are covered by safety glasses and respiratory protection) was used to correct the face/neck residue values (page 59 of the study report).

The various analyses of residues on the dosimeters worn by each individual subject allow for the estimation of exposure for the following 3 clothing configurations:

(1) "Long-Long" or "Long Long Dermal" or "Long Dermal" = long pants, long-sleeved shirt, and no gloves for commercial painters;
(2) "Long-Short" or "Long Short Dermal" = long pants, short-sleeved shirt, and no gloves for commercial and/or residential/consumer painters; and

(3) “Short-Short” or “Short Dermal” = short pants, short-sleeved shirt, no gloves for residential/consumer painters.

Total dermal exposure is calculated by summing exposure across all body parts for each individual monitored. The following WBD sections are summed to calculate the clothing configuration of long pants, long-sleeved shirts (Long-Long) plus face/neck wash, painter’s hat, inner dosimeter painter’s hat (note: the head exposure in all scenarios represents total exposure to the head with no protection afforded by a “hat”), and hand wash:

- inner lower and inner upper arms,
- inner front and inner rear torso, and
- inner lower and inner upper legs.

The following WBD sections are summed to calculate the clothing configuration of long pants, short-sleeved shirts (Long-Short) plus face/neck wash, painter’s hat, inner dosimeter painter’s hat, and hand wash:

- outer and inner lower arms,
- inner upper arms,
- inner front and inner rear torso, and
- inner lower and inner upper legs.

The following WBD sections are summed to calculate the clothing configuration of short pants, short-sleeved shirts (Short-Short) plus face/neck wash, painter’s hat, inner dosimeter painter’s hat, and hand wash:

- outer and inner lower arms,
- inner upper arms,
- inner front and inner rear torso,
- inner upper legs, and
- inner and outer lower legs.

Dermal unit exposures (*i.e.,* mg/lb ai handled) are calculated by dividing the summed total exposure by the amount of active ingredient handled.

Inhalation Exposure. Inhalation exposure was measured using two personal air sampling pumps. The inhalation sampling consisted of “*…two low-volume, SKC personal air-sampling pumps were attached to the subject’s belt, one with an OSHA Versatile Sampler (OVS) air-sampling tube containing a glass filter and XAD-2 sorbent (SKC catalog number 226-30-16), and the other with a disposable preloaded Parallel Particle Impactor (PPI) (SKC Catalog # 225-3851) containing a 37 mm PVC filter and 37 mm support pad. The OVS tube is designed to capture total inhalable residue while the PPI is designed to trap respirable particles. Samplers were attached to the subject’s collar, one on each side, in the subjects’ breathing zone to determine subject’s potential inhalation exposure to propiconazole. The sampler intakes were positioned downward to simulate the nasal passage of the subject. The airflow of each pump was calibrated to a target airflow of 2.0 liters per minute prior to use and documented. (page 31-32 of study report)”* All inhalation samples in both the PPI and OVS samplers were greater than the

LOQ (pages 126 and 127 of the study report). All the individual PPI filter residues were greater than the LOQ (pages 124 and 125 of the study report). Of the 77 OVS tube sections, 73 front sections and 3 back sections were greater than the LOQ (pages 120 to 123 of the study report).

Inhalation unit exposures for the PPI (measuring respirable particles with a 50% cut point of 4 µm) and OVS sampling tubes (measuring total inhaled residues) are provided using the two following methods:

(1) Air concentration expressed as an 8-hour time weighted average (TWA) and normalized by AaiH (*i.e.,* (mg/m^3)/lb ai handled) is calculated as the air concentration ((mg/m^3) / lb ai) * sampling duration (hours/day) / 8 (hours / day).
(2) Inhalation exposure (mg/lb ai) or dose is calculated as the air concentration ((mg/m^3) / lb ai) * breathing rate (1 m^3/hour) * sampling duration (hours/day).

2.3 Dermal and Inhalation Exposure Results

Results. A summary of the individual and mean dermal and inhalation results of the airless sprayer study is presented in Table 4. Both empirical means and the results of the lognormal simple random sample means are provided for comparison; the latter being the recommended values summarized in Table 1. The clothing configuration of long pants, long sleeved shirts (Long-Long) as well as short pants, short-sleeved shirts (Short-Short), and no gloves are provided. The clothing configurations of long pants, short sleeved-shirts (Long-Short), and no gloves are also provided. Also shown for comparison to the total dermal exposure are the dermal results for the hand exposures only and for the head exposures only (painter's hat plus painter's hat inner dosimeter). These tables report the results for each individual subject along with empirical and lognormal simple random sampling method statistical summaries.

Appendix A to this memo provides statistical models to estimate the unit exposure summary statistics, including:

- Empirical simple random sampling model (see Appendix A, Tables 1 through 10 for detailed summaries);
- Lognormal simple random sampling model (see Appendix A, Tables 12 and 18).

The results of the lognormal simple random sampling model have been selected to best represent the summary statistics for the unit exposures (for summary results of recommended unit exposures see Table 1 above). The estimates using substitution of half the LOD for non-detected values below the LOD, or of the average of the LOD and LOQ for non-detected values between the LOD and the LOQ (this only applies for the OVS tubes, all other sample results are greater than the LOQ), are recommended. For a detailed discussion of the lognormal simple random sampling model calculations and results the reader is referred to Appendix A, which includes quantile plots to compare normal and log-normal distributions for the unit exposures.

Appendix A also provides various alternative statistical models for estimating the exposure from the ai instead of simply using the unit exposures. The main model is a linear regression model for log exposure against the log of the ai. Also included is the HSRB-recommended quadratic

regression model regressing log exposure against log ai and log ai squared. Quantile and regression plots are used to evaluate the linear regression model. Additional models considered in Appendix A are linear regression models with adjustments for the propiconazole concentration or paint volume, and log-log-logistic, three-parameter logistic, and gamma regression models recommended by the HSRB. Of these alternative regression models, the best-fitting models for most exposure routes are the linear and quadratic models, based on the AIC statistical criterion.

In Appendix A the impacts of monitored minutes, amount (pounds) of paint used, temperature, relative humidity, the use of a fan, ladder, or wrench, and the spray tip or tips used were also considered. To evaluate whether these factors could improve the exposure estimates, the residuals of the linear regression model were plotted against each of these factors. In most cases the plots suggested that accounting for these factors would not tend to improve the model. As an exception, for Inhalation (OVS Total) Concentration and Inhalation (PPI Total) Concentration, the residuals tend to be lower for the high numbers of minutes monitored or amount of paint used, which may suggest the need for alternative models to also take into account the minutes of monitoring and the amount of paint used. The best alternative approach is complicated by the fact that the experimental design and regression model accounts for the amount of active ingredient used, which increases with the amount of paint used and with the pesticide concentration. To account for the amount of paint used, the study controlled for paint volumes by assigning three groups. Appendix A includes separate statistical analyses by volume group, although those results are limited due to the fact that each group only had 6 subjects. The minutes of monitoring also tended to increase with the paint volume, but some subjects painted more quickly than others.

Study Observations. The airless sprayer study includes the recorded individual participant activities by observers. Detailed observations recorded during each ME capturing the events that occurred during the painting activities can be viewed in the study report pages 80 to 83. Although a review of these observations indicates some instances where the subjects came in contact with the treated paint (*e.g.,* ME 17 "*used bare hands to force paint through strainer bags…"*), these types of exposures are expected based on the task and are not considered outliers in the data. There was one instance (in ME 6) where the observer noted "*problem with sprayer – addressed and fixed by researcher…*"; which was the only outside interference (other than collecting samples) by the study investigators noted by the observers.

It is also noted that…"*Subjects who used their hands to squeeze the paint out of the bags told researchers that they normally would wash their hands with water from a faucet following this procedure before they started spraying. Since allowing the subjects to rinse their own hands would remove residues from their hands, subjects were offered the choice of doing a hand wash or using the provided painter's rags to wipe their hands (painter's rags were not analyzed). One subject (ME 17) requested a hand wash following the paint straining process while the others used rags to wipe the wet paint off their hands*." (study report p. 33-34) "*Three subjects (MEs 4, 6, and 17) manually squeezed the strainer bags to help force the paint through the bags while most of the other workers held the strainer bags allowing gravity to move the paint through the bags; and a few placed the strainer bags in buckets.*" (study report p. 57) The choices by the researchers at this point would have been to allow the subjects to wash their hands without collecting the paint/residues, conduct a hand wash collecting the paint/residues, or providing the

subjects with the paint rag. Observational notes indicated that MEs 04 and 06 used rags to wipe hands. ME 17 had the highest overall hand exposure (mg ai) but not the highest normalized hand exposure (mg/lb ai). As can be seen in Table 4, ME 04 has the lowest hand exposure on a normalized basis (mg/lb ai), but not the lowest overall hand exposure (mg ai). "Cleaning" one's hands after manually straining the paint is what the subjects indicated that they would "normally do". Although, the paint residues on the hands of ME 17 would only be available for dermal absorption for a short time prior to being washed off, they are not viewed as an outlier and have been included as part of the data set. As for the "lost" residues from the hands of MEs 04 and 06 due to the subject's wipe their hands on the rags, this is viewed as part of their normal painting procedure/habits.

The following observations are highlighted:

- **ME17:** Subject had the highest overall hand and inhalation exposure (hand = 97.6 mg ai and OVS = 1.68 mg ai/m^3) and overall dermal exposure 167 (mg ai) but only the 9th highest dermal unit exposure (41.8 mg/lb ai) and 5th highest inhalation exposure (1.14 mg ai/m^3). This subject using "…*bare hands to force paint through strainer bags, hand wash performed following this procedure*"; and was in Group 3, handled the 12,000 ppm concentration of paint, and the second highest AaiH at 4.01 lb ai.
- **ME03:** Subject had the highest dermal unit exposure (93.5 mg/lb ai) but the 7th lowest overall exposure (11.7 mg ai). This subject used their hands to adjust spray tip, wiped inside of respirator with rag, but no out of the ordinary contacts with paint. Subject was in Group 1, handled the 1200 ppm concentration of paint, and one of the lowest AaiH at 0.125 lb ai.
- "**Wore hat backwards"**: MEs 7, 8, 9, 11, 18 chose to wear their hats backwards and their face/neck exposures were 0.262, 0.557, 0.718, 9.18, and 5.98 mg ai, respectively. The 9.18 mg ai was the highest measured face/neck of all subjects. The empirical average of the 18 face/neck exposures was 2.78 mg ai.
- **MEs 08, 10, 11, 14** changed nozzles during their painting events. None of these subjects had the highest hand exposures (mg ai).
- **General Observation:** Observer notes included incidental contact with paint by subjects as one might expect and captured general practices by subjects during MEs.

Impact of Non-detects. Almost all the samples (face/neck, hand, PPI, OVS tube front section, hat, hat patch, and individual WBD for both inner and outer sectioned body parts) were above the limit of quantification (LOQ). Most of the OVS tube back sections were either below the LOD or LOQ. For the OVS inhalation results, alternative estimates are provided in Appendix A (Table 18), including the substituting of the non-detects with the midpoint of lowest and highest value, maximum value, minimum value, and the maximum likelihood method for censored data. Because the front sections of the OVS tubes contained sufficiently high enough detectable residues, the handling of the non-detects in the back of the OVS tube sections had only a small effect on the inhalation results.

Table 4. Summary of Dermal and Inhalation Unit Exposure Estimates.

Monitoring Event (ME)	AaiH (lb)	Dermal Unit exposure (mg/lb AaiH)					Inhalation 8 Hour TWA Unit Exposure ((mg/m^3)/lb AaiH)	
		Short-Short	Long-Short	Long-Long	Hands	Hat	OVS	PPI
1	0.122	73.39	54.34	46.61	34.19	7.60	0.106	0.015
2	0.122	105.14	85.58	76.42	62.14	6.34	0.195	0.033
3	0.125	228.46	142.04	93.46	52.21	29.00	0.195	0.023
4	1.270	51.42	29.03	18.94	9.44	5.69	0.086	0.009
5	1.250	57.63	40.56	27.26	12.40	10.52	0.092	0.009
6	1.290	86.48	44.70	30.53	15.02	12.09	0.108	0.006
7	0.190	61.69	49.17	31.24	24.68	3.28	0.122	0.019
8	0.184	206.95	103.12	59.43	38.00	16.06	0.165	0.023
9	0.191	146.38	82.84	50.27	29.18	12.24	0.095	0.015
10	1.760	117.07	72.15	43.72	17.11	18.99	0.201	0.028
11	1.890	130.20	90.53	58.32	34.13	14.25	0.120	0.013
12	1.910	74.80	33.64	27.50	17.38	6.28	0.099	0.013
13	0.401	179.90	111.61	64.00	26.92	30.89	0.117	0.013
14	0.393	118.79	45.31	33.14	23.00	6.76	0.084	0.014
15	0.391	48.44	29.75	23.85	14.71	6.21	0.113	0.011
16	3.940	42.01	36.48	27.59	17.35	7.60	0.072	0.006
17	4.010	81.00	53.94	41.76	24.35	9.69	0.143	0.014
18	4.080	69.80	38.20	27.71	16.78	6.76	0.120	0.011
Empirical Mean	1.307	104.42	63.50	43.43	26.06	11.68	0.124	0.015
Empirical SD	1.400	55.39	32.45	20.25	13.96	7.78	0.040	0.007
Lognormal Simple Random Sample Mean	1.525	104.89	63.70	43.55	26.15	11.68	0.124	0.015
Lognormal Simple Random Sample SD	3.148	56.60	32.72	20.15	13.87	7.53	0.039	0.008

Let X_i be the i^{th} AaiH or unit exposure value and let $Y_i = \ln(X_i)$.

Empirical Mean = $\overline{X} = \sum_{i=1}^{18} X_i / 18$

Empirical SD = $S_X = \sqrt{\sum_{i=1}^{18} \left(X_i - \overline{X}\right)^2 / 17}$. Suppose X is lognormally distributed, so that Y = ln(X) is normally distributed with a population mean μ and a population variance σ^2.

Lognormal Simple Random Sample Mean = Estimated population mean of X = Estimate of $\exp(\mu + \frac{1}{2} \sigma^2) = \exp(\overline{Y} + \frac{1}{2} S_Y^2)$ where $\overline{Y} = \sum_{i=1}^{18} Y_i / 18$ and $S_Y = \sqrt{\sum_{i=1}^{18} \left(Y_i - \overline{Y}\right)^2 / 17}$.

Lognormal Simple Random Sample SD = Estimated population standard deviation of X = Estimate of $\exp(\mu + \frac{1}{2} \sigma^2) \sqrt{\exp(\sigma^2) - 1} = \exp(\overline{Y} + \frac{1}{2} S_Y^2) \sqrt{\exp(S_Y^2) - 1}$.

2.4 Evaluation of Scenario Benchmark Objective

Benchmark Objective. The data from the study has been analyzed to see if the airless sprayer scenario meets the AEATF II objective of a relative 3-fold accuracy (*i.e.,* K = 3). These analyses used the SAS code originally developed by the Agricultural Handler Exposure Task Force (AHETF) and independently confirmed by the Health Effects Division (HED) (and now modified by the Antimicrobial Division (AD)). Appendix A (starting page 22) provides the detailed benchmark analysis which is summarized as follows:

Benchmark Objective: fold Relative Accuracy (fRA)

The benchmark objective for AEATF II scenarios is for select statistics – the geometric mean (GM), the arithmetic mean (AM), and the 95th percentile (P95) – to be accurate within 3-fold with 95% confidence (*i.e.,* "fold relative accuracy" also expressed as "K-factor"). EPA has analyzed the data using various statistical techniques to evaluate this benchmark. First, to characterize the unit exposures (also referred to as "normalized exposure"), normal and lognormal probability plots of dermal and inhalation UEs are provided in Appendix A (pages 28 to 37, Figures 2 to 21) to illustrate that the lognormal distribution is a better fit than the normal distribution for the normalized exposure (albeit in some cases the difference between the normal and log-normal fit is small). Overall, these plots support the assumed lognormal distributions for the normalized exposure. Note: all logarithms defined in this review are natural logarithms.

Next, EPA calculated estimates of the GM, AM and P95 based on two different calculation methods:

- Empirical estimates; and
- Assuming a lognormal distribution and a simple random sample (SRS).

The 95% confidence limits for each of these estimates were obtained by generating 10,000 parametric bootstrap samples from the fitted lognormal distribution. Then, the fRA for each was determined as the maximum of the two ratios of the statistical point estimates with their respective upper and lower 95% confidence limits. EPA has determined that the airless sprayer study results meet the 3-fold relative accuracy objective (see Tables 5 and 6). Appendix A also presents fRA values calculated using a non-parametric bootstrap approach, with generally similar results.

The results of the long pants, long sleeved shirts, no gloves (Long-Long), short pants, short sleeved shirts, no gloves (Short-Short), as well as the inhalation exposures for the OVS and PPI for the 8-hr TWA are presented below. To review the results for the other iterations (*e.g.,* long pants, short sleeved shirts, no gloves, OVS and PPI for the dose (mg/lb ai)) the reader is referred to Appendix A).

Table 5: Results of Primary Benchmark Analysis for Dermal Exposure						
	Long Dermal Exposure			Short Dermal Exposure		
Statistic	**Unit Exposure Estimate (mg/lb ai)**	**95% CL**	**fRA**	**Unit Exposure Estimate (mg/lb ai)**	**95% CL**	**fRA**
GM_S	39.5	48.4	1.2	92.3	116	1.3
GSD_S	1.55	1.80	1.2	1.66	1.97	1.2
GM_S = geometric mean assuming SRS = "exp(average of 18 ln(UE)) values" GSD_S = geometric standard deviation assuming SRS = "exp(standard deviation of 18 ln(UE)) values"						
AM_S	43.4	53.5	1.2	104	133	1.3
AM_U	43.6	53.9	1.2	105	134	1.3
AM_S = average of 18 unit exposures AM_U = arithmetic mean based on $GM_S = GM_S * \exp\{0.5*(\ln(GSD_S)^2\}$						
$P95_S$	93.5	147	1.6	229	416	1.8
$P95_U$	81.6	111	1.4	212	303	1.4
$P95_S$ = 95th percentile (*i.e.,* estimated as the maximum unit exposure from the 18 unit exposures) $P95_U$ = 95th percentile based on $GM_S = GM_S * GSD_S^{1.645}$						

Table 6: Results of Primary Benchmark Analysis for Inhalation (Inhalable and Respirable TWA)).						
	OVS Total			PPI < 4 µm		
Statistic	**Unit Exposure Estimate (8-hr TWA mg/m³/lb ai)**	**95% CL**	**fRA**	**Unit Exposure Estimate (8-hr TWA mg/m³/lb ai)**	**95% CL**	**fRA**
GM_S	0.119	0.136	1.1	0.0138	0.0171	1.2
GSD_S	1.35	1.50	1.1	1.59	1.86	1.2
GM_S = geometric mean assuming SRS = "exp(average of 18 ln(UE)) values" GSD_S = geometric standard deviation assuming SRS = "exp(standard deviation of 18 ln(UE)) values"						
AM_S	0.124	0.143	1.2	0.0153	0.0191	1.3
AM_U	0.124	0.143	1.2	0.0154	0.0193	1.3
AM_S = average of 18 unit exposures AM_U = arithmetic mean based on $GM_S = GM_S * \exp\{0.5*(\ln(GSD_S)^2\}$						
$P95_S$	0.201	0.292	1.5	0.0327	0.0548	1.7
$P95_U$	0.195	0.242	1.2	0.0296	0.0410	1.4
$P95_S$ = 95th percentile (*i.e.,* estimated as the maximum unit exposure from the 18 unit exposures) $P95_U$ = 95th percentile based on $GM_S = GM_S * GSD_S^{1.645}$						

Presumption of Log-log-linearity With Slope 1. EPA evaluated the presumption that the mean exposure is a multiple of the amount of active ingredient handled (AaiH or ai). In the Governing Document and in statistical reviews of some previous AEATF II studies, this presumption has been referred to as "proportionality" but we are now referring to this analysis as a "log-log-linearity" analysis to clarify that the statistical models do not assume that the exposure is directly proportional to the amount of active ingredient handled. If the log-log-linear model has a slope of 1, then the arithmetic mean exposure will be a multiple of the amount of active ingredient handled. The statistical test compares the slope of 1 with a slope of 0, where 0 corresponds to complete independence between exposure and amount of active ingredient handled.

To evaluate the relationship for this scenario EPA performed **regression analysis of log(exposure) against log(AaiH)** to determine if the slope of this log-log-linear model is not significantly different than 1 – providing support for a "proportional" (an abbreviation for " log-log-linear with slope 1") relationship – or if the slope is not significantly different than 0 – providing support for an independent relationship. If the slope is positive, not zero and not 1, then the arithmetic mean exposure tends to increase with the AaiH but not proportionally, so that, for example, doubling the AaiH will not tend to double the exposure. If the slope confidence interval excludes both 1 and 0 but the slope is positive, then the statistical evidence rejects both proportionality and independence and shows that the exposure tends to increase with the AaiH but not proportionally. **Note: the slope for the dermal (or inhalation) exposure measures the change in log mg dermal (or inhalation) exposure for each unit change in log lb ai. A slope of 1 implies that the log of the unit exposure (mg/lb ai) is equal to a constant plus a random error, so that the unit exposure has the same mean for any amount of ai, and thus the mg dermal (or inhalation) exposure is proportional to the lb ai.**

The resulting regression slopes and confidence intervals are summarized in Table 7. A more detailed discussion and table of the slopes is presented in Appendix A (starting on page 38 and Table 29).

For the Long-Long and Short-Short dermal exposures, the slopes are both 0.82 and the confidence intervals for the slope did not include zero, included one for Short Dermal (upper bound 1.01) but did not include 1 for Long Dermal (upper bound 0.97). Thus, for Short Dermal the analyses rejected independence (a slope of zero) and supported (more precisely, did not reject) proportionality (a slope of one). For Long Dermal, the analyses rejected independence (a slope of zero) and rejected proportionality (a slope of one), although the statistical significance for rejecting proportionality was marginal. For the OVS and PPI inhalation exposures, the slopes are 0.93 and 0.80, respectively, and the confidence intervals for the slope included one for the OVS but not for PPI (upper bound 0.952) but did not include zero. Thus, for the OVS tubes, the analyses rejected independence (a slope of zero) and supported (more precisely, did not reject) proportionality (a slope of one). For the PPI inhalation exposures, the analyses rejected independence (a slope of zero) and rejected proportionality (a slope of one), although the statistical significance for rejecting proportionality was again marginal. Even for the Long Dermal and PPI Inhalation cases where the slope is significantly different from 1, the estimated slope is about 0.8 and the upper bound is at least 0.9, so the "unit exposure" assumption is a reasonable approximation.

A secondary objective for EPA is for meeting 80% power for detecting log-log-linearity with a slope of 1. This objective is met if the widths of the confidence intervals for the slopes are at most 1.4. This secondary objective was met for all scenarios and so the statistical (post-hoc) power is greater than 80%.

Figures 7 to 10 show the data and corresponding fitted regression models for the dermal exposure routes. The data points marked with the symbols "l" and "L", "m" and "M" and "h" and "H" are the measured values in the three volume groups for l = low = 10 gals, m = mid = 15 gals, and h = high = 30 gals; lower case letters show the low concentration MEs (1200 ppm) and upper case letters show the high concentration MEs (12000 ppm). Appendix A (pages 42 to 49, Figures 22 to 29) also presents probability plots of the residuals from these fitted regression models; these probability plots show that this simple log-log-linear regression model fits reasonably well.

Table 7. 95 Percent Confidence Intervals for the Slope of Log Exposure (mg) versus Log Pounds of Active Ingredient for Dermal and Inhalation Exposures.

Clothing	Slope	Confidence Interval	Confidence Interval Width
Long pants, long sleeved-shirt (Long-Long)	0.816	0.663 – 0.969	0.305
Short pants, short sleeved-shirt (Short-Short)	0.820	0.635 – 1.005	0.370
Inhalation – OVS (8-hr TWA mg/m^3)	0.927	0.808 – 1.045	0.237
Inhalation – PPI (8-hr TWA mg/m^3)	0.795	0.639 – 0.952	0.312

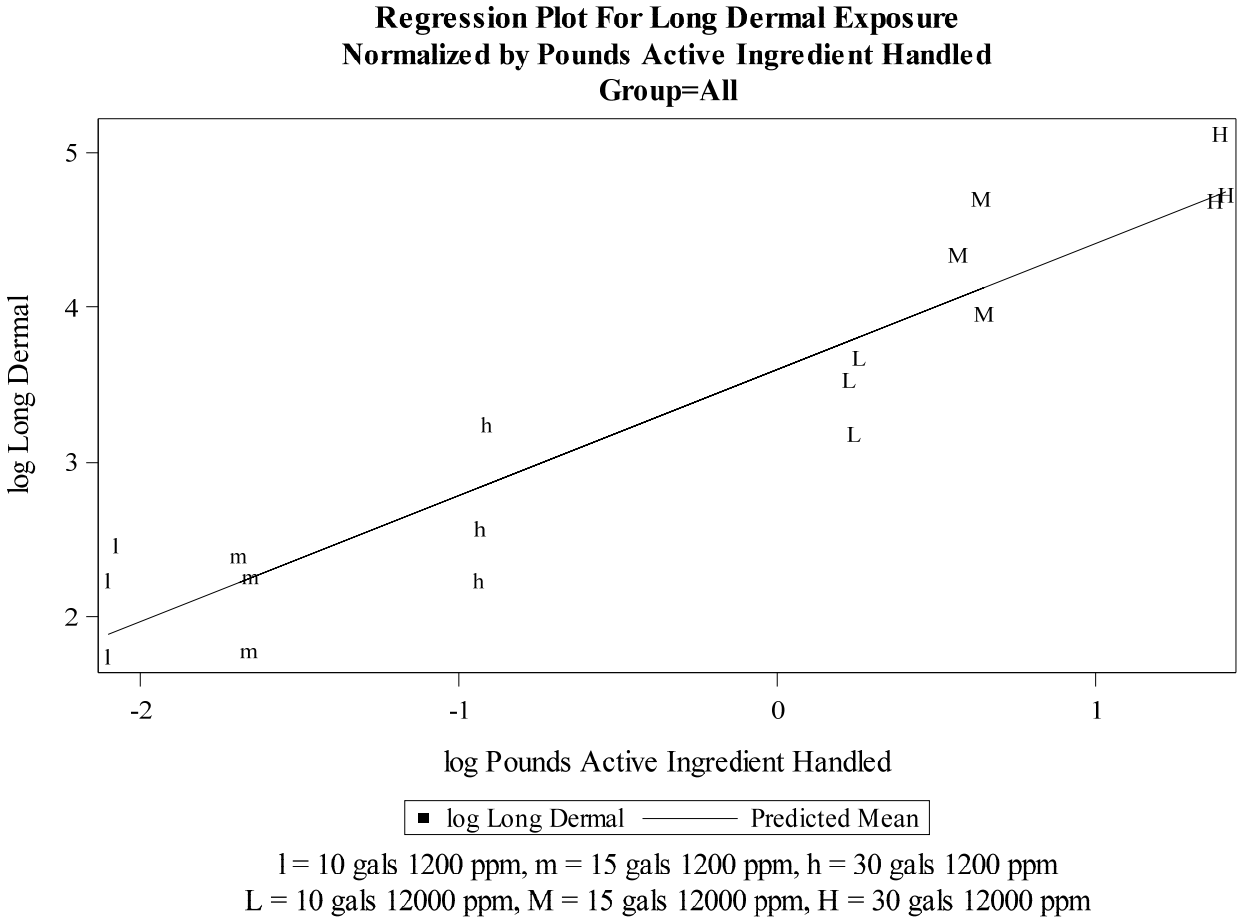
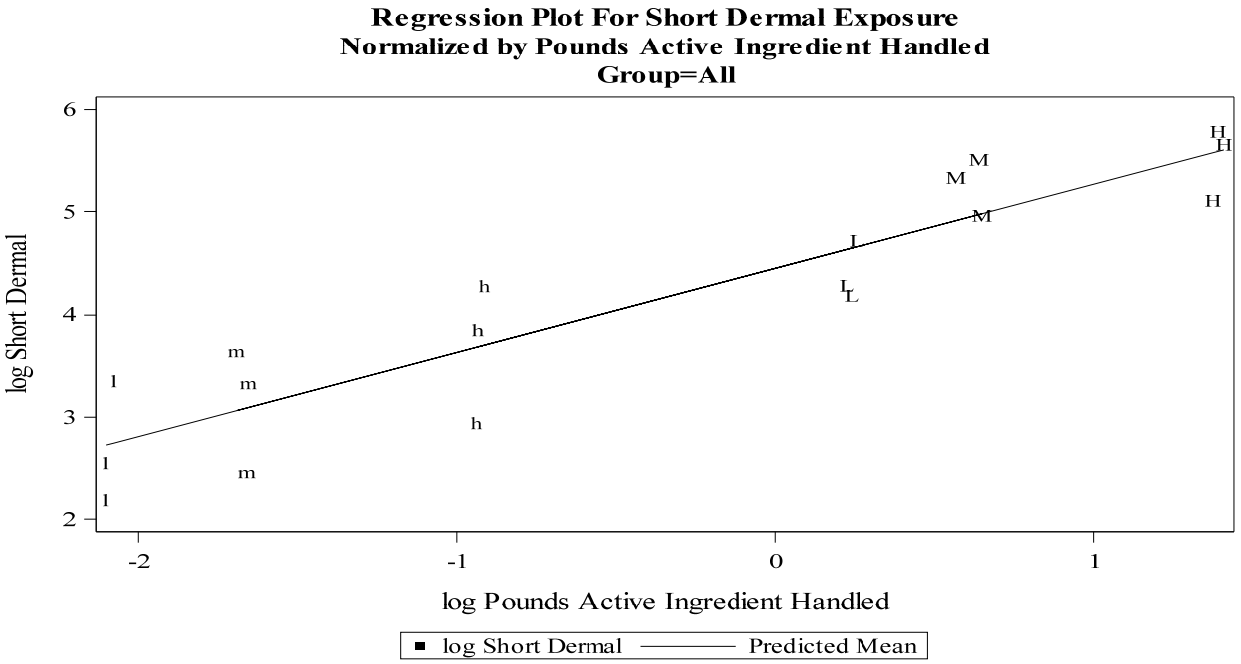
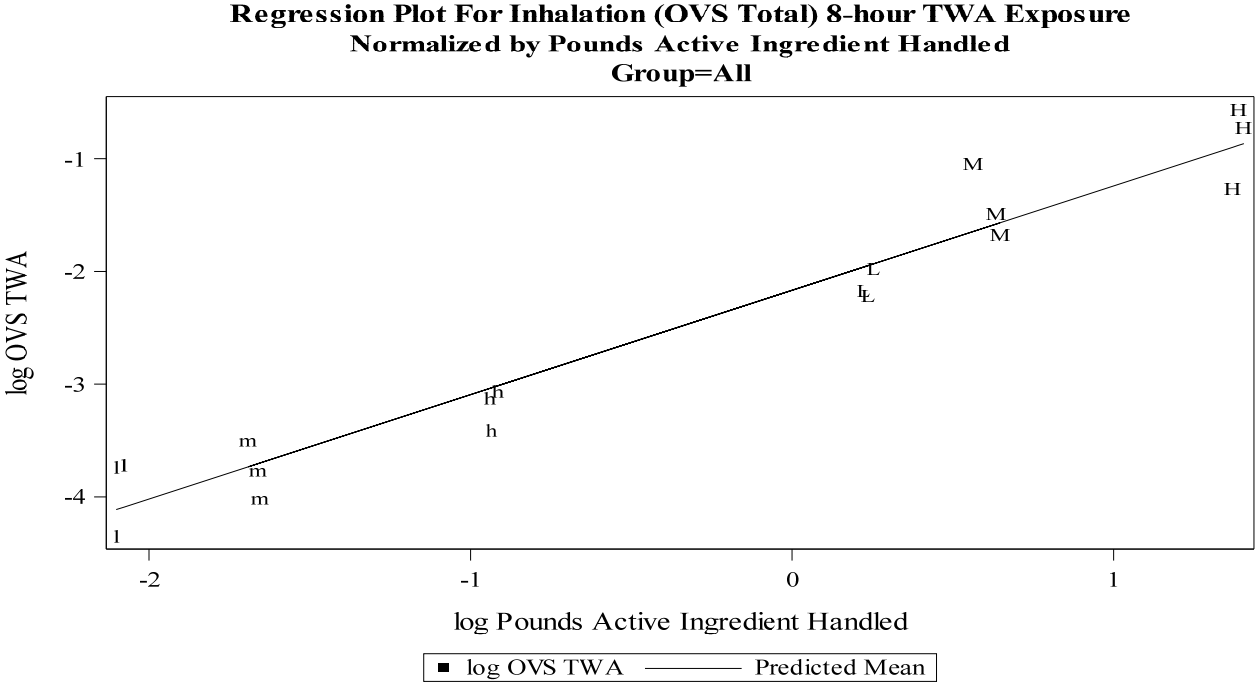


Figure 7. Regression plot for Long Dermal (mg)



l = 10 gals 1200 ppm, m = 15 gals 1200 ppm, h = 30 gals 1200 ppm
L = 10 gals 12000 ppm, M = 15 gals 12000 ppm, H = 30 gals 12000 ppm

Figure 8. Regression plot for Short Dermal (mg)



l = 10 gals 1200 ppm, m = 15 gals 1200 ppm, h = 30 gals 1200 ppm
L = 10 gals 12000 ppm, M = 15 gals 12000 ppm, H = 30 gals 12000 ppm

Figure 9. Regression plot for Inhalation (OVS Total) TWA Exposure (mg/m^3)

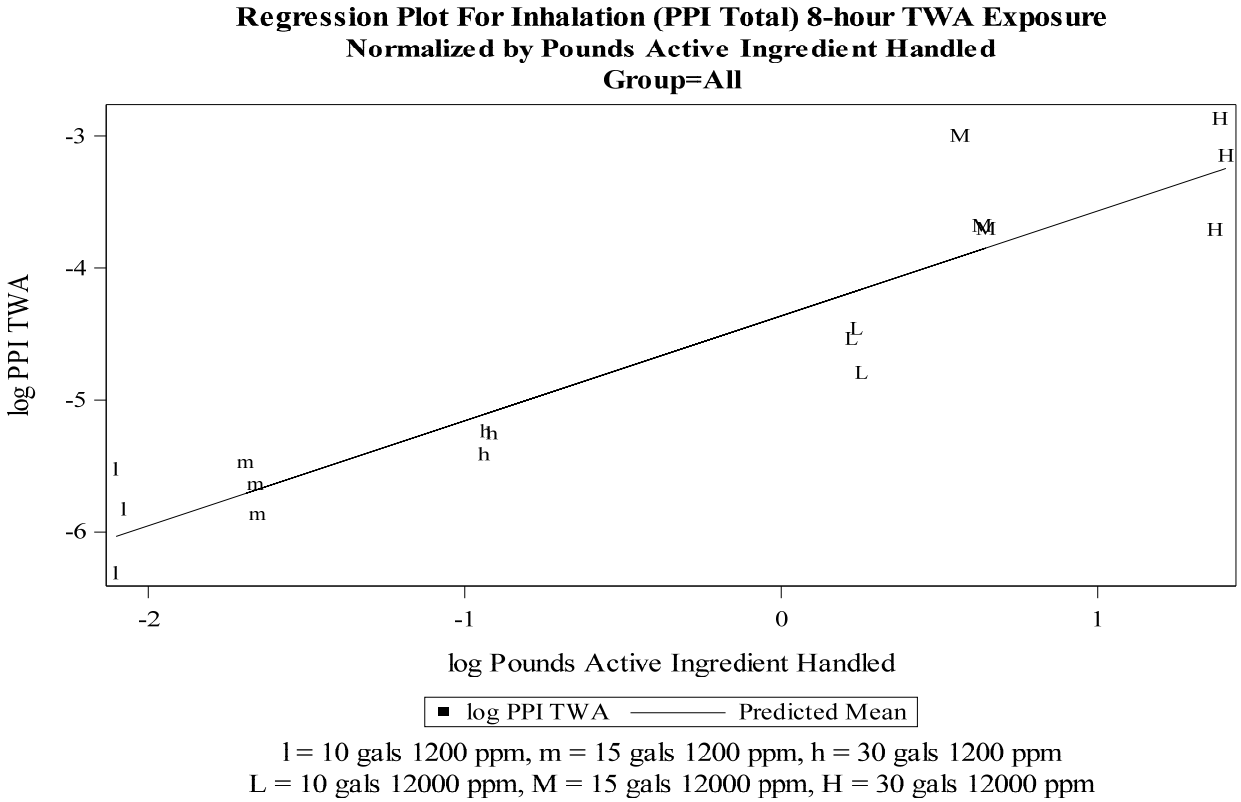


Figure 10. Regression plot for Inhalation (PPI Respirable) TWA Exposure (mg/m^3)

Threshold of AaiH for Over- or Under-Predicting Exposure – The log-log-linear regression model regresses the log exposure against the log lb ai. The normalized (unit) exposure model is the log-log-linear regression model where the slope of log exposure against log lb ai is assumed to be equal to 1. The analysis is based on comparing the two model predictions of the conditional means, *i.e.,* the estimated arithmetic means for a given amount of active ingredient. It is shown in Appendix A (starting on page 85) that if the regression formulation is correct and the estimated regression slope is less than one, then the conditional arithmetic mean exposure for a given amount of ai will be over-predicted if the normalized exposure model is extrapolated to high levels of the amount of active ingredient and the conditional arithmetic mean exposure will be under-predicted at low levels of the amount of active ingredient. This applies to all the dermal and inhalation exposure cases.

For the dermal exposure cases, Table 8 gives the threshold amounts of active ingredient handled which are the minimum amounts of active ingredient handled for which the normalized exposure mixed model will over-estimate the expected exposure (under-estimate if the slope is greater than 1). Also tabulated are the corresponding exposure values at the threshold levels of active ingredient.

Table 8. Threshold values for the minimum AaiH for which the normalized exposure model will over- or under-estimate dermal and inhalation exposure.

Clothing	Slope (log mg / log lb ai)	Threshold (lb ai)	Exposure at threshold (Dermal mg and Air mg/m^3)
Long pants, long-sleeved shirt (Long-Long)	0.816	0.584	25.4
Short pants, short-sleeved shirt (Short-Short)	0.820	0.593	62.2
Inhalation – OVS (8-hr TWA mg/m^3)	0.927	0.648	0.080
Inhalation – PPI (8-hr TWA mg/m^3)	0.795	0.573	0.0088

Figures 11 through 14 show the statistical models and thresholds for the dermal and inhalation exposure routes. These figures display the measured values together with the predicted conditional arithmetic mean exposure calculated using the normalized exposure model (where the slope of log exposure against log ai is assumed to be one) and using the more general regression model (where the slope of log exposure against log ai is estimated). The threshold is the amount of ai for which the two predicted conditional means are the same. The data points marked with the symbols “l” and “L”, “m” and “M” and “h” and “H” are the measured values in the three volume groups for l = low = 10 gals, m = mid = 15 gals, and h = high = 30 gals; lower case letters show the low concentration MEs (1200 ppm) and upper case letters show the high concentration MEs (12000 ppm). The normalized exposure model calculation is plotted as a green line; this calculation uses unit exposures to estimate the conditional mean exposure for a given amount of active ingredient. The log-log-linear regression model calculation is plotted as a brown curve, since both axes are linear; this calculation uses the log-log-linear regression model to estimate the conditional mean exposure for a given amount of active ingredient.

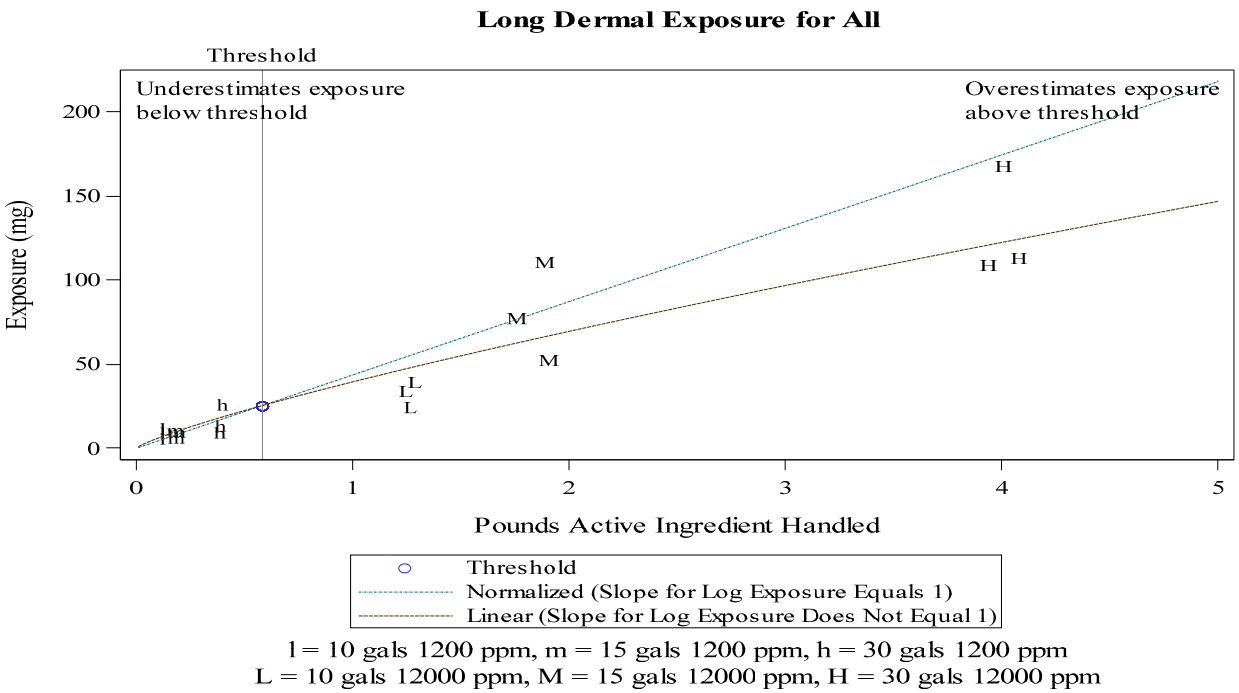


Figure 11. Threshold plot for Long-Long Dermal Exposure (mg).

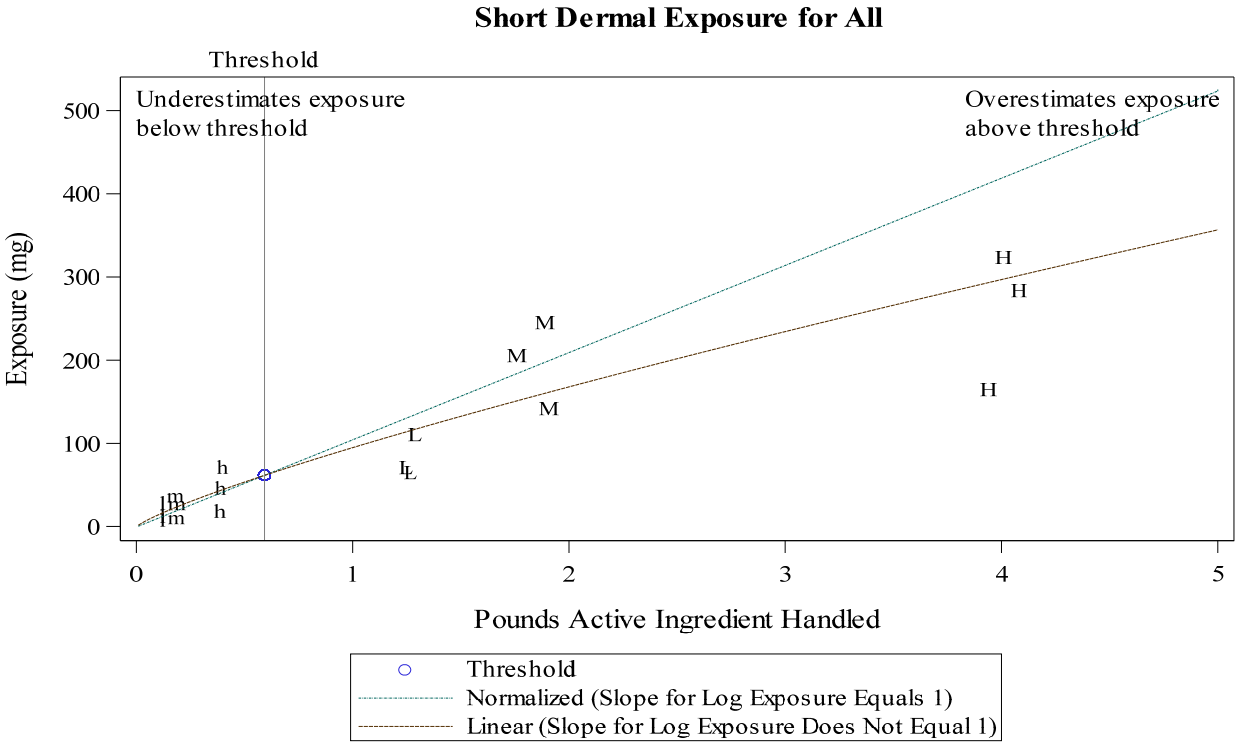


Figure 12. Threshold plot for Short-Short Dermal Exposure (mg).

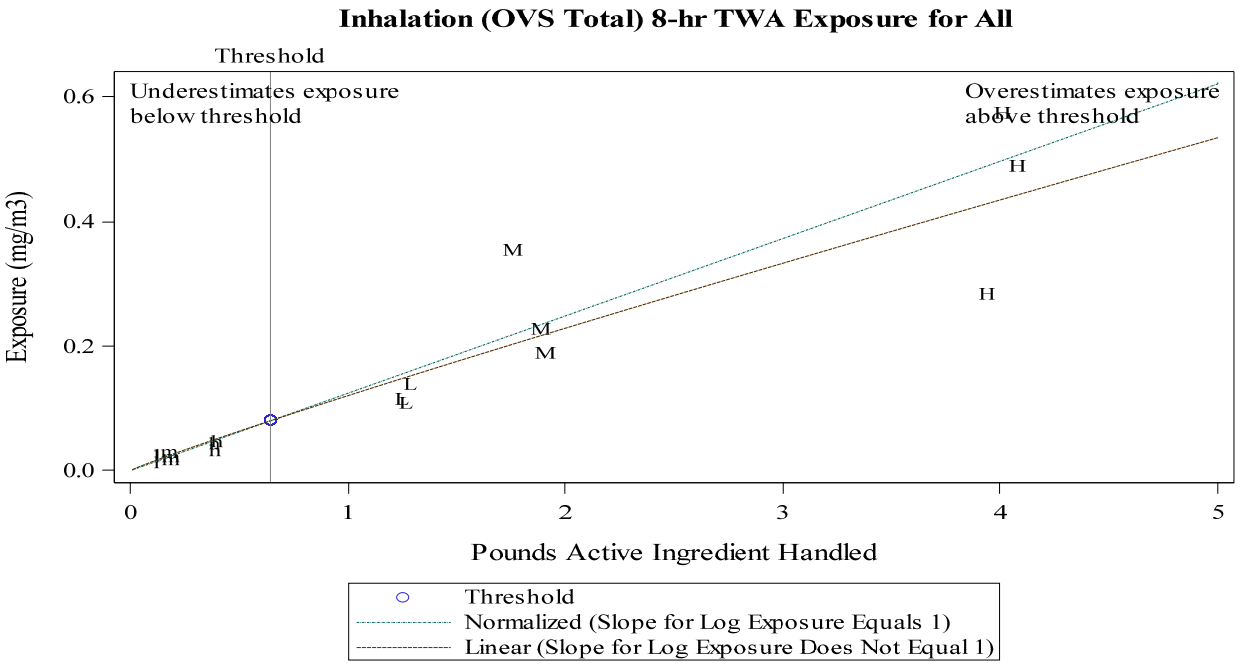


Figure 13. Threshold plot for inhalation (OVS Total) 8-hr TWA (mg/m^3).

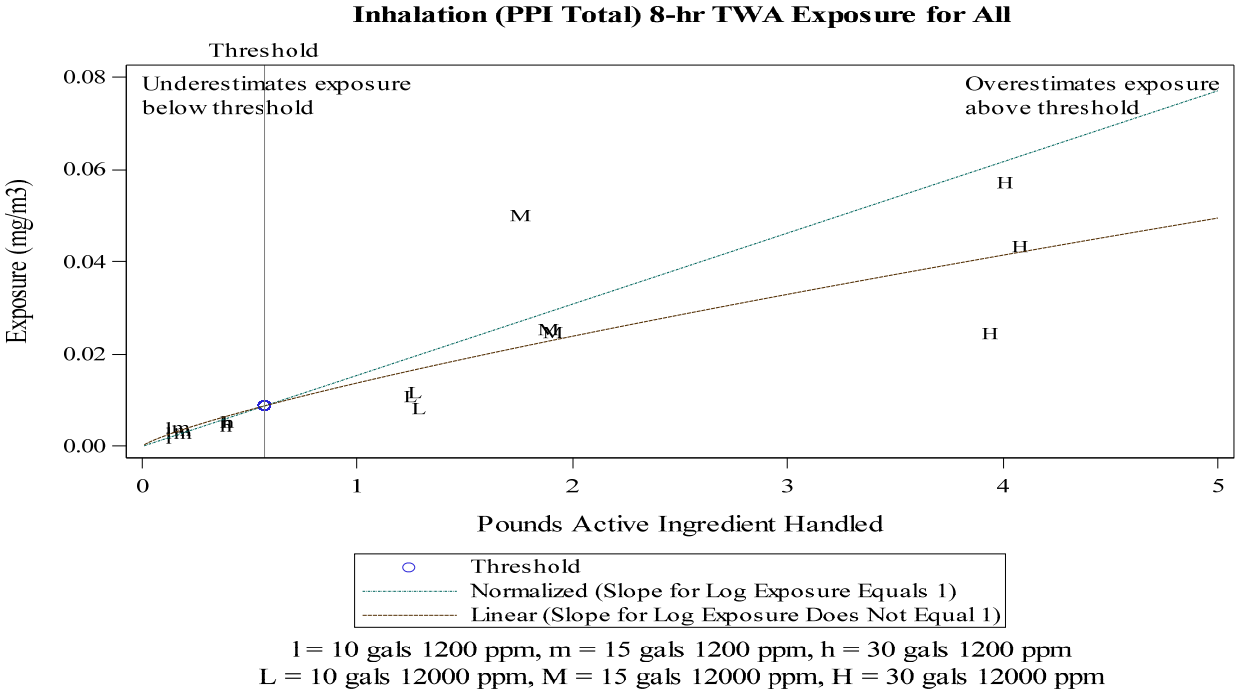


Figure 14. Threshold plot for inhalation (PPI Respirable) 8-hr TWA (mg/m^3).

3.0 Discussion of Data Generalizations and Limitations

The regulatory need for a generic data base of pesticide handlers for antimicrobial pesticide products has been discussed previously (SAP 2007). The study design for this airless sprayer painting study incorporated random diversity selection where feasible. Such a study design requires a discussion of how the data can be generalized and the limitations of the results. The following items are provided to potential users of these data to characterize the results of this sampling effort:

(1) The study purposively selected Orlando, FL, as the study location. This selection criterion, rather than a random selection of sites across the country, limits to some degree the statistical generalizations of the data. Thus, we cannot determine whether these results provide unbiased estimates of exposure distributions from applying antimicrobial treated paints in locations other than Orlando, FL, and it is not possible to use these data to estimate the potential bias or the geographic variability. To generalize these results to the whole country requires an assumption that the exposure distribution for these scenarios is independent of the geographic location. The statistical limitations of the purposive site selection are deemed acceptable by the Joint Regulatory Committee (JRC). It is reasonable to assume that the mechanics of using an airless sprayer to apply paint to walls/ceilings indoors in Orlando are not substantially different than painting with an airless sprayer inside other buildings throughout the country. The indoor site is also deemed a worse-case scenario compared to outdoors. Given a limited set of resources for the overall AEATF II monitoring program, the assumption that painting does not vary geographically was sufficiently reasonable to forgo the random site selection (of all buildings throughout the country) in favor of spending the limited resources to monitor additional distinctly different scenarios (*e.g.*, trigger pump spray, aerosol spray cans, hand held spray wands, etc).

(2) The data generated in this study are acceptable to use as surrogate for assessing other chemicals considered to have low volatility (*i.e.,* vapor pressures less than ~1E-4 mmHg @ 20ºC). This "rule-of–thumb" for the vapor pressure threshold is reviewed by EPA on a case-by-case basis, particularly for those antimicrobial pesticides with vapor pressures that are near to this threshold. For example, for those chemicals with vapor pressures of ~1E-4 mmHg, EPA reviews the available inhalation toxicity data to see if the toxicity studies were performed as a gas or with an aerosol.

(3) The small sample size by itself does not create statistical limitations since the confidence intervals for the summary statistics based on the primary statistical model were reasonably narrow (meeting better than the 3-fold relative accuracy goal).

More important is the fact that the original sets of subject participants, locations, and dates from which the subjects, and sampling dates were chosen were limited and hence might not be representative of all professional painters living in Florida (*e.g.*, those that paint but did not volunteer), buildings (*e.g.*, a warehouse with purposely built rooms was selected for this study), and time periods (*e.g.*, summer versus winter, day versus night, etc.). In other words, the most significant limitation is that these data were not derived from a fully stratified random sample of MEs even though the statistical analyses made that assumption. At a minimum this increases the uncertainty of the estimates (so the calculated confidence intervals are too narrow) and there may also be some bias (*e.g.*, study participants not in the volunteer pool might be more or less prone to exposure than the selected group).

(4) EPA will continue using exposures normalized by AaiH as a default condition. In this review we evaluated the presumption of "proportionality" that the mean exposure is a positive multiple of the AaiH (*i.e.,* the mean exposure is proportional to the AaiH and the exposure tends to increase with increasing AaiH). Proportionality is evaluated by testing if the log-log-linear model has a slope of 1. The analyses of log-log-linearity show that dermal and inhalation exposure tends to increase with pounds of active ingredient handled (AaiH). Data will continue to be collected by the AEATF II to add to the knowledge base of normalized exposures.

(5) The correction factors developed from hand wash removal efficiency study were used to correct both the hands and the face/neck wipe residues. Although the hand wash procedure is different than the face/neck wipe procedure because there is no rinse step in the face/neck procedure, it is more conservative (protective of worker exposure) than making no correction for potential losses during sampling. However, the lack of a rinse step might mean that the corrected face/neck wipe residues were underestimated. Additionally, Protocol Deviation No. 4 (study report p. 262) changed the handwash procedure by having the subjects scrub the paint off their own hands using the gauze pads rather than the researchers do this procedure (while the researchers watched). This change in procedure modifies the hand wash removal efficiency study method that was developed to adjust the hand wash results. It was noted in the protocol deviation that this modification was done to increase the efficiency of the method to remove the dried paint from the hands, fingers, and finger nails. The photographic evidence indicates both methods removed the paint from the hands, but if the subject's self-scrubbing increased the removal efficiency, there is the potential that the residues on the hands have been over-corrected resulting in dermal exposures being overestimated.

(6) The number of gallons of paint sprayed in this study included three groups of six MEs per group spraying 10, 15, and 30 gallons. To determine the volume of paint sprayed, the AEATF conducted a small survey of seven commercial painting companies. *"One company surveyed indicated that the maximum amount of paint that can be sprayed in a day is 50 gallons while the other six companies indicated less than 50 gallons is sprayed per day. Factors such as the type of job (commercial or residential), the size of the job, and whether the job is interior or exterior, will determine whether someone will use an airless sprayer for the entire day can spray 50 gallons of paint in a day. Two companies indicated that higher amounts (100 and 200 gallons) could be sprayed in a day, but it was not clear whether this is based on just one person spraying or multiple painters. As such, this study may not capture exposure from the highest risk individuals who paint very high volumes of paint or who paint alongside multiple painters."* (AEATF 2018). EPA uses 50 gallons of paint sprayed per day for commercial painters in assessing material preservatives in paint and plans to extrapolate the unit exposures by the amount of active ingredient handled (AaiH). An example of the extrapolation is illustrated in Figure 7 above on the regression plot where dermal exposure increases as AaiH increases. Figure 11 above also illustrates for the same dermal scenario that the unit exposure approach is a conservative approach (*i.e.,* overestimates exposure at the high end of AaiH) compared to the linear model extrapolation when the slope is less than 1 (the slope of the log exposure (mg) versus log pounds AaiH is 0.816 for this scenario (Table 7)).

(7) The subjects monitored in this study were professional painters employed as painters ranging from 2 years (ME 14) to 28 years (ME 01) and experienced in using an airless sprayer from once per month (but not currently employed using an airless sprayer) up to 20x/month. The rationales for selecting professionals instead of consumers as test subjects

were discussed in the protocol review (*e.g.,* airless sprayers are less common for consumers; consumers would spray less paint/less surface area; consumers would need to be trained on how to use the equipment for safety reasons). Nonetheless, because antimicrobials are used as material preservatives in paints (i.e., paint is a treated article with no pesticide label) and there are no restrictions on their use, consumers also apply paints via airless sprayers, albeit at less volumes. Therefore, EPA will use the exposure monitoring data from this study to assess exposure/risk to consumers. While the effect of familiarization with the equipment and experience painting with an airless sprayer on exposure (under- or over-estimating exposure) is unknown, one could assume, to be health-protective, that the consumer's unit exposure will be under-estimated by this study. However, in EPA's assessments, the professional painters are assessed at a higher volume of paint (50 gallons) (and thus higher AaiH) than the consumers (15 gallons).

4.0 Conclusions

EPA has reviewed the AEATF II airless sprayer study and concludes that the AEATF II made the appropriate changes to the protocol proposed by the EPA and HSRB and has properly executed the study. The protocol deviations that occurred and were properly reported have not adversely impacted the reliability of these data. The EPA recommends that the inhalation and dermal UEs generated in this airless sprayer study be used provided the data are used within the boundaries set forth in this review. The following is a summary of our conclusions:

- The AEATF II data for inhalation and dermal exposures represent reliable data for assessing paint treated with antimicrobial products with an airless sprayer. The AEATF II unit exposures summarized in Table 1 are recommended to be used for regulatory purposes.

- Estimates of the GM, AM, and P95 were shown to be accurate within 3-fold with 95% confidence. At this time, no additional monitoring for the airless sprayer scenarios is required.

5.0 References

AEATF 2018. Airless Sprayer Scenario: Rationale for Study Design; Study Title: A study for Measurement of Potential Dermal and Inhalation Exposure During the Application of Paint Containing an Antimicrobial using an Airless Sprayer. Sponsor Study Identification: AEA10. January 15, 2018.

ACC. 2011. American Chemistry Council, Antimicrobial Exposure Assessment Task Force II (AEATF II) Governing Document for a Multi-year Antimicrobial Chemical Exposure Monitoring Program. Interim Draft Document. Version 3. July 8, 2011.

HSRB Report. 2018. EPA-HSRB-18-01, Subject: October 25, 2017, EPA Human Studies Review Board Meeting Report, from Liza Dawson, PhD, Chair EPA Human Studies Review Board to Jennifer Orme-Zavaleta, Ph.D., EPA Science Advisor, Office of the Science Advisor, 1200 Pennsylvania Avenue, NW, Washington, DC 20460, dated January 3, 2018.

MRID 43600102. Formella, T. (1995) Potential Exposure of Workers to Chlorothalonil when Handling and Applying Paint Containing Chlorothalonil: Lab Project Number: 94-0204: ISKB-1894-002-02: 5227-94-0204-CR-001. Unpublished study prepared by Ricerca, Inc. 272 p.

MRID 50879401. Final Report. A Study for Measurement of Potential Dermal and Inhalation Exposure During the Application of Paint Containing an Antimicrobial using an Airless Sprayer. AEATF II Project ID: AEA10. June 10, 2019.

SAP. 2007. Memorandum: Transmittal of Meeting Minutes of the FIFRA Scientific Advisory Panel Meeting Held January 9 – 12, 2007 on the Review of Worker Exposure Assessment Methods. U.S. Environmental Protection Agency.

USEPA. 2017. Science and Ethics Review of AEATF II Airless Sprayer Painting Scenario Design and Protocol for Exposure Monitoring. Memorandum from Timothy Leighton (USEPA) to Laura Parsons (USEPA), dated September 29, 2017.

USEPA. 2018. Science and Ethics Review of AEATF II Determination of Removal Efficiency of 1,2-Benzisothiazol-3(2H)-one (BIT) from Hand Surfaces Using an Isopropyl Alcohol/Water Wipe and Wash Procedure (AEATF II Study Number: AEA08; MRID 50521601). Memorandum from Timothy Leighton (USEPA) and Jonathan Cohen, Ph.D. (ICF) to Laura Parsons (USEPA), dated March 23, 2018.

USEPA. 2018a. Respirator Requirements for the AEATF Airless Sprayer Exposure Study. Memorandum from Timothy Dole, CIH (USEPA) to Michelle Arling (USEPA), dated January 2, 2018.

Appendix A

Statistical Review of the AEATF II Airless Sprayer Study

(To be included as a separate electronic file)

Appendix B

Module Maps for Observer Notes

AEATF Study Number: AEA10 LRCI Study Number: LR15135

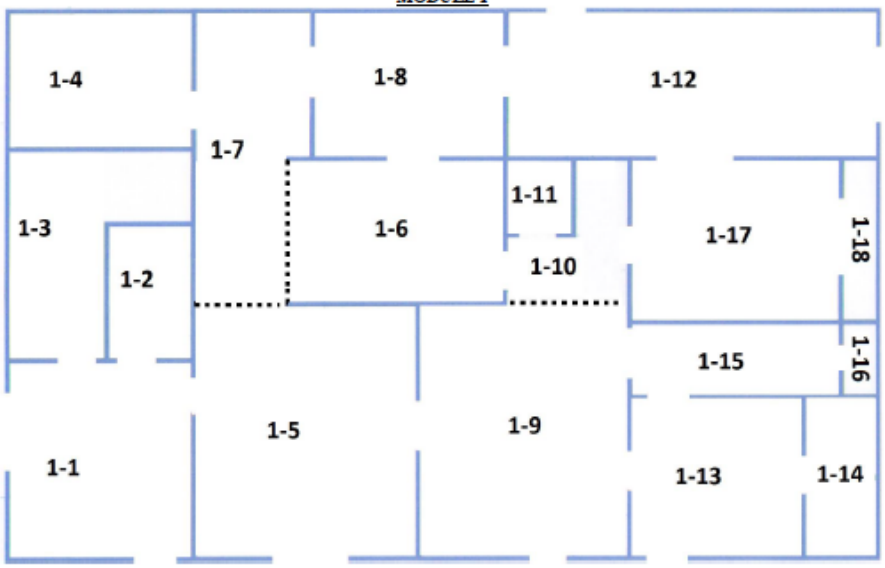
A Study for Measurement of Potential Dermal and Inhalation Exposure
During the Application of Paint Containing an Antimicrobial using an Airless Sprayer

WORKER OBSERVATION MAP

Date of Monitoring:_____ **ME ID:**_____

Draw arrows as the ME paints rooms. Mark an "X" next to walls that the ME completely finishes. Mark a "X" in the middle of the room if the ME completely paints the ceiling. Mark a "P" next to walls that are partially painted then estimate the % of the wall or ceiling that is painted.

MODULE 1



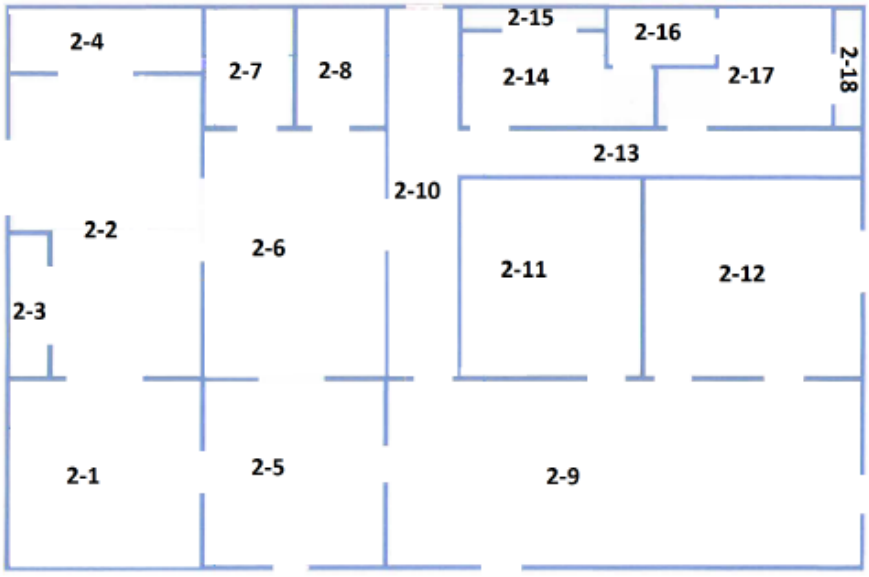
_____ _____
Signature Date

WORKER OBSERVATION MAP

Date of Monitoring:_____ **ME ID:**_____

Draw arrows as the ME paints rooms. Mark an "X" next to walls that the ME completely finishes. Mark a "X" in the middle of the room if the ME completely paints the ceiling. Mark a "P" next to walls that are partially painted then estimate the % of the wall or ceiling that is painted.

MODULE 2



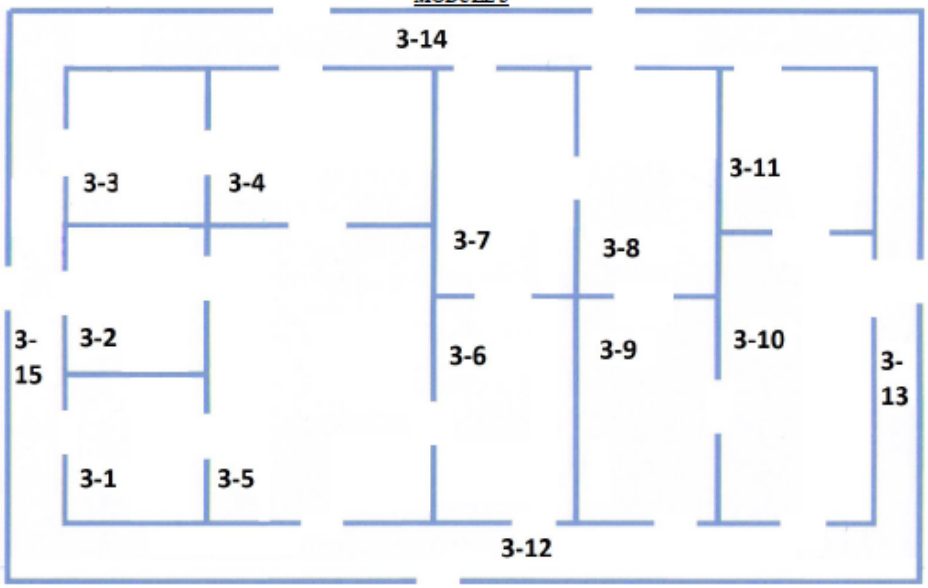
_____ _____
Signature Date

WORKER OBSERVATION MAP

Date of Monitoring:_____ **ME ID:**_____

Draw arrows as the ME paints rooms. Mark an "X" next to walls that the ME completely finishes. Mark a "X" in the middle of the room if the ME completely paints the ceiling. Mark a "P" next to walls that are partially painted then estimate the % of the wall or ceiling that is painted.

MODULE 3



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Signature Date