UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY AND
POLLUTION PREVENTION

MEMORANDUM

DATE: DATE

SUBJECT: **Tetrachlorvinphos:** Revised Final Occupational and Residential Exposure Assessment for Registration Review

PC Code: 083701, 083702
Decision No.: 559447
Risk Assessment Type: Occupational/Residential Exposure Assessment
TXR No.: NA
MRID No.: NA

DP Barcode: D457031
Registration Nos.: NA
Regulatory Action: Registration Review

Case No.: 1321
CAS No.: 22248-79-9

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THROUGH: Michael Metzger, Chief
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Exposure Science Advisory Committee (ExpoSAC) / HED

TO: Patricia Biggio, Chemical Review Manager
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Risk Management and Implementation Branch I (RMIBI)
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Office of Pesticide Programs

Introduction

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As part of Registration Review, the Pesticide-Re-evaluation Division (PRD) of OPP has requested that the Health Effects Division (HED) conduct a final occupational and residential exposure assessment to estimate the risk to human health that will result from the currently registered uses of tetrachlorvinphos (TCVP). This document only presents HED's assessment of potential non-dietary exposures from the use of TCVP products (not dietary exposure).

In 2016, a final occupational and residential exposure (ORE) assessment of TCVP exposures[1] was conducted. Since then, additional data addressing the registered pet collar uses of TCVP have been submitted to the Agency and reviewed. The following updates have been included in this current assessment:

- The residential post-application exposure assessment for pet collars has been updated to reflect updated application rates for certain pet collars, incorporation of additional pet collar specific TCVP transferable residue and formulation type (i.e., liquid/solid) data that were submitted since the last ORE, and inclusion of an adjustment factor for trimming of pet collars when applied to animals (i.e., 20% removal after application).
- The amount of cattle that can be treated by a pitcher, shaker can, or spoon has been updated based on information provided by the Biological and Economic Analysis Division (BEAD) for DDVP.

It is HED policy to use the best available data to assess exposure. Several sources of generic data were used in this assessment as surrogate data in the absence of chemical-specific data, including the Pesticide Handlers Exposure Database Version 1.1 (PHED 1.1); the Agricultural Handler Exposure Task Force (AHETF) database, the Residential SOPs (Treated Pets); as well as a TCVP dust/powder applicator exposure study (MRID 45519601), a mixer/loader/applicator wettable powder study (MRID 42622301), and a TCVP dust and pump spray study (MRID 45485501). Some of these data are proprietary, and subject to the data protection provisions of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

Data were also used from a literature study using TCVP pet collars, *Davis, M. et. al., Assessing Intermittent Pesticide Exposure from Flea Control Collars Containing the Organophosphorus Insecticide Tetrachlorvinphos. Journal of Exposure Science and Environmental Epidemiology. (2008) 18, 564-57).* This study, herein referred to as the "Davis study," underwent review by the Human Studies Review Board (HSRB) on January 12 -13, 2016.

Note: This memorandum was originally reviewed by the Exposure Science Advisory Committee (ExpoSAC) on December 1, 2016.

[1] W. Britton et al. Tetrachlorvinphos: Final Occupational and Residential Exposure Assessment for Registration Review. 12/21/2016. D436833.

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Table of Contents

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ED_005822_00001553-00003

1.0 Executive Summary

TCVP [(Z)-2-chloro-1-(2,4,5-trichlorophenyl) vinyl dimethyl phosphate] is a member of the organophosphate (OP) class of pesticides. TCVP is used as a direct animal treatment to livestock (i.e., cattle, horses, poultry and swine) and their premises, in kennels, outdoors as a perimeter treatment, and as a flea treatment on cats and dogs.

In 2016, a final occupational and residential (ORE) assessment of TCVP exposures was conducted[2]. Since then, additional data addressing the registered pet collar uses of TCVP have been submitted to the Agency and reviewed. The following updates have been included in this current assessment:

- The residential post-application exposure assessment for pet collars has been updated to reflect updated application rates for certain pet collars, incorporation of additional pet collar specific TCVP transferable residue (MRID 50881801[3]) and formulation type data (i.e., dust torsion study, MRID 50931601[4]) that were submitted since the last ORE, and inclusion of an adjustment factor for trimming of pet collars when applied to animals (i.e., 20% removal after application).
- The amount of cattle that can be treated by a plunger, shaker can, or spoon has been updated based on information provided in HAD for DDVP.

Commented [RK1]: Maybe we could just say here that we are assuming 20% of the collar is removed when trimming; therefore, 20% of the ai is also removed? (if I'm reading the use profile table correctly)?

Commented [kml2R1]: Added something in parenthesis to clarify

Exposure and Use Profile

Occupational handler exposures are anticipated from the use of TCVP in/on livestock, as an outdoor perimeter treatment, and on pets. The TCVP livestock and perimeter treatment uses are formulated as follows: dusts (D), emulsifiable concentrates (EC), feed through (solid and liquid food additives), feed blocks, and wettable powders (WP). The personal protective equipment (PPE) required for occupational use of TCVP varies by formulation and application/equipment type. For feed through (solid and liquid food additives) and feed blocks, occupational handlers are required to wear baseline clothing (i.e., long sleeved shirt, long pants, shoes and socks) and gloves. For all other end-use labels with livestock and outdoor perimeter uses, required PPE can vary dependent on the application/equipment type and range from baseline clothing and gloves, to the addition of coveralls, or respiratory protection. Occupational handler exposures are also expected from use of TCVP on pets by veterinarians, veterinary assistants, and groomers. The pet use formulations include collars, dusts/powders, and pump and trigger sprays. All but one of the TCVP pet product labels do not require PPE (i.e., EPA Reg No. 47000-123 which requires double layer clothing, gloves and dust mist respirator) as these are intended for residential sale as well as for occupational use. A summary of all TCVP occupational use sites and application rates is presented in Appendix A.

Occupational post-application exposures are not anticipated for TCVP based on the manner in which it is applied. Further, restricted entry intervals (REIs) are not included on TCVP product labeling as the registered uses (i.e., livestock or other animals, or in or around animal premises) are not covered by the Worker Protection Standard (WPS).

[2] W. Britton et al. Tetrachlorvinphos: Final Occupational and Residential Exposure Assessment for Registration Review. 12/21/2016. D436833.
[3] MRID 50881801. D453149. TCVP: Review and Summary of Residue Transfer Studies Submitted.
[4] MRID 50931601. D454190. Submitted in response to GDCI-083702-1791.

ED_005822_00001553-00004

Residential handler and post-application exposures are anticipated from the use of TCVP pet products.

Hazard

For TCVP, like other OPs, the initiating event in the adverse outcome pathway/mode of action (AOP/MOA) involves inhibition of the enzyme acetylcholinesterase (AChE) *via* phosphorylation of the serine residue at the active site of the enzyme. This inhibition leads to accumulation of acetylcholine and ultimately to neurotoxicity in the central and/or peripheral nervous system. TCVP does not require metabolic activation to an oxon to inhibit AChE; i.e., the parent compound is the active form inhibiting AChE. OPs generally exhibit a phenomenon known as steady state AChE inhibition. After repeated dosing at the same dose, the degree of inhibition comes into equilibrium with the production of new, uninhibited enzyme. At this point, the amount of AChE inhibition at a given dose remains consistent across duration. In general, OPs reach steady state within 2-3 weeks; a pattern that is observed for most OPs, but not every OP, like TCVP, which shows no difference in response across duration. For TCVP the steady state is reached after a single day of exposure. As such, the endpoint selection for TCVP considers data available for all durations of dosing when choosing the most protective point of departure.

No quantification of dermal non-cancer risk is required for TCVP since there were: (1) no treatment related effects (no clinical signs) at doses up to and including the limit dose of 1000 mg/kg/day in the dermal toxicity study; (2) both red blood cell (RBC) and brain cholinesterase activity were assessed in the dermal study and neither compartment was affected at the limit dose; (3) no quantitative susceptibility was observed for juvenile or gestational lifestages in the developmental, reproductive, or comparative cholinesterase study (CCA) toxicity studies. High quality AChE data for the other routes are available and allow for route specific evaluation. RBC AChE inhibition was observed in both sexes in the inhalation study (brain AChE was not assessed).

TCVP is classified as a Group C possible human carcinogen (based on statistically significant increases in combined hepatocellular adenoma/carcinoma in female mice) with a linear low-dose approach for quantification of risk using the oral slope factor (Q1*) of 1.83 x 10^{-3} $(mg/kg/day)^{-1}$. Whereas parent compound TCVP is the residue of concern for AChE inhibition, TCVP plus metabolites containing the 2,4,5 trichlorobenzene moiety are the residues of concern for cancer assessment. For purposes of calculating dermal doses for cancer assessment, a dermal absorption factor of 9.6% was used based on a dermal penetration study in rats.

Uncertainty Factors

For TCVP, as for other OPs, the Food Quality Protection Act (FQPA) safety factor (SF) of 10X has been retained for infants, children, youths, and women of childbearing age for all residential exposure scenarios and a 10X Database Uncertainty Factor (UF_{DB}) has been applied for occupational scenarios since the science addressing neurodevelopmental effects related to the OPs remains unresolved due to uncertainty in the human dose-response relationship for neurodevelopmental effects.

A total uncertainty factor of 1000X is appropriate for residential incidental oral exposures (10X for interspecies extrapolation, 10X for intraspecies variation, and a 10X FQPA SF). A total

Commented [RK3]: Not sure if we want to keep this language consistent with chlorpyrifos throughout? Its basically the same but slightly different?

Despite several years of study, the science addressing neurodevelopmental effects remains unresolved. Therefore, the dietary, residential, aggregate, and non-occupational exposure assessments have been conducted with retention of the 10X FQPA safety factor and the occupational exposure assessments have been conducted with retention of a 10X Database Uncertainty Factor (UF_{DB}).

Commented [MM4R3]: We could keep something similar, but we couldn't mention dietary or aggregate since we're only considering residential here.

Commented [kml5R3]: Edited to be more similar

Commented [RK6]: Not sure if we want to keep this language consistent with chlorpyrifos throughout? Its basically the same but slightly different?

Despite several years of study, the science addressing neurodevelopmental effects remains unresolved. Therefore, the dietary, residential, aggregate, and non-occupational exposure assessments have been conducted with retention of the 10X FQPA safety factor and the occupational exposure assessments have been conducted with retention of a 10X Database Uncertainty Factor (UF_{DB}).

Commented [MM7R6]: We could keep something similar, but we couldn't mention dietary or aggregate since we're only considering residential here.

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uncertainty factor of 300X is appropriate for all inhalation exposures (3X for interspecies extrapolation, 10X for intraspecies variation, and a 10X FQPA SF for residential assessments or a 10X database uncertainty factor for occupational assessments to protect potentially pregnant female workers due to uncertainty in the human dose-response relationship for neurodevelopmental effects). The interspecies extrapolation factor for the inhalation route has been reduced from 10X to 3X because the reference concentration (RfC) methodology for inhalation has been used to determine a human equivalent concentration (HEC) and takes into consideration the pharmacokinetic differences between animals and humans.

Residential Exposure and Risk

Residential exposures (handler and post-application) are anticipated from the use of TCVP pet products. Residential TCVP handler exposures are anticipated to be short-term (1 to 30 days) and post-application exposures are anticipated to be short- (1 to 30 days), intermediate-term (1 to 6 months), and long-term (>6 months – *for pet collar scenarios only*) in duration. Residential handler and post-application non-cancer dermal risks for all TCVP pet products have not been quantitatively assessed due to the finding of no dermal hazard for TCVP. Dermal doses have been calculated for estimation of cancer risks for adults only.

Residential Handler

Pet Collars: The residential handler assessment for the TCVP pet collars was performed assuming pet collars are a combination of liquid and dust formulations, assuming a 99.62% liquid/0.38% dust ratio based on a TCVP chemical-specific torsion study[5]. No non-cancer steady-state inhalation risk estimates of concern were identified for residential handlers for pet collars. Inhalation MOEs range from 370,000 to 2,400,000 (LOC = 300). Residential handler estimated cancer risks (combined dermal and inhalation) for TCVP pet collars assuming a 99.62% liquid/0.38% dust formulation ratio range from 10^{-9} to 10^{-8}.

Dust/Powder and Pump/Trigger Spray: No non-cancer inhalation risk estimates of concern were identified for residential handlers for the TCVP pet dust/powder and pump/trigger spray formulations. Inhalation MOEs range from 5,600 to 160,000 (LOC = 300). Residential handler estimated cancer risks (combined dermal and inhalation) for TCVP dusts/powders range from 10^{-9} to 10^{-7}, and for pump/trigger sprays range from 10^{-9} to 10^{-8}.

Residential Post-application

Since there is no non-cancer dermal hazard for TCVP and post-application inhalation exposures to treated pets are negligible, a quantitative non-cancer post-application exposure assessment was not performed for adults; there are no residential non-cancer risk estimates of concern for adults contacting pets treated with TCVP products.

Pet Collars: The post-application assessment for the TCVP pet collars was performed assuming pet collars are a combination of liquid and dust formulations, assuming a 99.62% liquid/0.38% dust ratio based on the available TCVP chemical-specific torsion study mentioned above. The application rate for pet collars has been adjusted to account for trimming of the pet collar when applied to an animal. The adjustment factor is based on information provided in a TCVP

[5] MRID 50931601. D454190. Submitted in response to GDCI-083702-1791.

ED_005822_00001553-00006

efficacy study submitted for dog collars[6]. In addition, HED has presented post-application risks using two available transferable residue studies: a literature study (i.e., the Davis study[7]) and a TCVP pet collar residue transfer study (MRID 50881801[8]). Both studies have been deemed acceptable for risk assessment and indicate similar fraction transfer values. The Davis study was used in previous risk assessments, represents a sample size of 23 dogs, and resulted in a percent transferable residue of about 0.4%. MRID 50881801 was recently submitted and results in a slightly lower percent transferable residue of about 0.2% but only represents a sample size of 3 dogs. Therefore, both studies have been included in the non-cancer assessment and residential post-application risks have been presented using both sets of data. For the calculation of potential cancer risk estimates, a fraction transferred value from the Davis study (which allowed for calculation of potential transfer over a longer duration – 114 days) was used.

Commented [BW8]: Are we going to explain anywhere why we're departing from the Davis transfer we used for the last assessment? Or, should we not?

Assuming a 99.62% liquid/0.38% dust formulation ratio and using the fraction transferred value derived from the Davis study, the residential steady-state non-cancer incidental oral MOEs for children (1 to <2 years old) exposed to pets treated with TCVP pet collars ranged from 570 to 4,500 (LOC = 1000). Assuming a 99.62% liquid/0.38% dust formulation ratio, residential post-application cancer (adult only) risk estimates for TCVP pet collars range from 10^{-7} to 10^{-6}.

Dust/Powder and Pump/Trigger Spray: Residential non-cancer incidental oral MOEs for children (1 to < 2 years old) exposed to pets treated with TCVP dust/powders range from 98 to 640 (LOC = 1000). Residential non-cancer incidental oral MOEs for children (1 to < 2 years old) exposed to pets treated with TCVP pump/trigger spray products range from 1,600 to 15,000 (LOC = 1000). Residential post-application cancer (adult only) risks estimated for TCVP dust/powder products range from 10^{-7} to 10^{-6}, and for TCVP pump/trigger sprays are all 10^{-7}.

A quantitative residential post-application inhalation exposure assessment was not performed as inhalation exposure is expected to be negligible from applications to pets.

Spray Drift

A quantitative spray drift assessment was not conducted because the use of TCVP for direct animal treatment to livestock and their premises, in kennels, outdoors as a perimeter treatment, and as a flea treatment on cats and dogs are either 1) not applied via aircraft, groundboom, or airblast equipment or 2) for applications to poultry buildings with groundboom equipment, the use is indoors and not anticipated to be a significant source of spray drift.

Occupational Exposure and Risk

Non-cancer and cancer exposures and risks were calculated for occupational handlers of TCVP. In order to determine what level of personal protection is required to alleviate risk concerns and to ascertain if label modifications are needed, exposure and risk estimates were calculated for

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[6] MRID 51079501. *Efficacy and Repellence of Ectoparasiticidal Treatments Against Ticks (Dermacentor Variabilis, Ixodes Scapularis, Rhipicephalus Sanguineus), Fleas (Ctenocephalides Felis) and Mosquitos (Aedes Aegypti) on Dogs*. May 7, 2019. Table 4 (p. 37 – 39).

[7] D430707. Davis, M. et. al., *Assessing Intermittent Pesticide Exposure from Flea Control Collars Containing the Organophosphorus Insecticide Tetrachlorvinphos*. Journal of Exposure Science and Environmental Epidemiology. (2008) 18, 564-57).

[8] MRID 50881801. D453149. TCVP: Review and Summary of Residue Transfer Studies Submitted.

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occupational handlers of TCVP for a variety of exposure scenarios at differing levels of personal protection including engineering controls.

There is a total of 172 occupational handler exposure scenarios assessed. The majority (143) are not of concern (i.e., inhalation MOEs are ≥ the LOC of 300) with currently required personal protective equipment (PPE) (i.e., respiratory protection). Of the remaining 29 handler exposure scenarios, 20 are not of concern with consideration of increasing levels of respiratory protection. However, 9 occupational handler exposure scenarios result in estimated risks of concern despite the addition of respiratory protection or engineering controls.

Occupational cancer risks (combined dermal and inhalation) were estimated for both private/farmer and contract/commercial handlers. Cancer risks, with currently required PPE, range from 10^{-10} to 10^{-5} for private/farmer handlers and from 10^{-10} to 10^{-4} for contract/commercial handlers with currently required PPE.

Occupational post-application exposures are not anticipated for TCVP as the majority of use sites are not to foliar surfaces (e.g., poultry house, livestock or pet treatments are not considered foliar applications). The use of TCVP outdoors as a perimeter treatment is not expected to result in occupational post-application exposure as reentry activities related to crop production (e.g., scouting, harvesting) are not anticipated for this use pattern.

Human Studies Review

This risk assessment relies in part on data from studies in which human subjects were intentionally exposed to a pesticide or other chemical. These data, which include studies from PHED 1.1; the AHETF database; the Residential SOPs (Treated Pets); as well as a TCVP dust/powder applicator exposure study (MRID 45519601), a mixer/loader/applicator wettable powder study (MRID 42622301) and TCVP dust and pump spray study (MRID 45485501) are (1) subject to ethics review pursuant to 40 CFR 26, (2) have received the review necessary for consideration in this assessment, and (3) are compliant with applicable ethics requirements. For certain studies, the ethics review may have included review by the Human Studies Review Board (HSRB). Descriptions of data sources, as well as guidance on their use, can be found at the agency website[9].

Data were also used from a literature study using TCVP pet collars, *Davis, M. et. al., Assessing Intermittent Pesticide Exposure from Flea Control Collars Containing the Organophosphorus Insecticide Tetrachlorvinphos. Journal of Exposure Science and Environmental Epidemiology. (2008) 18, 564-57).* On January 12-13 the EPA HSRB met to address the scientific and ethical charge questions related to Davis study. The HSRB concluded that, "the research is scientifically sound and, if used appropriately, the pet fur transferable residue data from the rubbing protocol used in the study can provide useful information for evaluating potential exposures of adults and children from contact with dogs treated with tetrachlorvinphos containing pet collars."[10]

[9] https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-handler-exposure-data and https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-post-application-exposure

[10] Letter from Liza Dawson, PhD, Chair of the EPA HSRB to Thomas Burke, PhD, MPH, EPA Science Advisor. Subject: January 12-13, 2016 EPA Human Studies Review Board Meeting Report. March 30, 2016.

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2.0 Risk Assessment Conclusions and Recommendations

2.1 Summary of Risk Estimates

Residential Handler

Pet Collars: No non-cancer steady-state inhalation risk estimates of concern were identified for residential handlers for pet collars assuming a 99.62% liquid/0.38% dust formulation ratio. Inhalation MOEs range from ~~470370~~,000 to ~~32,000400~~,000 (LOC = 300). Residential handler cancer risks estimated for TCVP pet collars assuming a 99.62% liquid/0.38% dust formulation ratio range from 10^{-9} to 10^{-8}.

Dust/Powder and Pump/Trigger Spray: No non-cancer inhalation risk estimates of concern were identified for residential handlers for the TCVP pet dust/powder pump/trigger spray formulations. Inhalation MOEs range from 5,600 to 160,000. (LOC = 300). Residential handler estimated cancer risks (combined dermal and inhalation) for TCVP dusts/powders range from 10^{-9} to 10^{-7}, and for pump/trigger sprays range from 10^{-9} to 10^{-8}.

Residential Post-application

Since there is no non-cancer dermal hazard for TCVP and post-application inhalation exposures to treated pets are negligible, a quantitative non-cancer post-application exposure assessment was not performed for adults; there are no residential non-cancer risk estimates of concern for adults contacting pets treated with TCVP products.

Pet Collars: Assuming a 99.62% liquid/0.38% dust formulation ratio ~~and using the Incion transferred value derived from the Davis study~~, the residential steady-state non-cancer incidental oral MOEs for children (1 to <2 years old) exposed to pets treated with TCVP pet collars ranged from 570 to 4,500 (LOC = 1000). Assuming a 99.62% liquid/0.38% dust formulation ratio, residential post-application cancer (adult only) risk estimates for TCVP pet collars range from 10^{-7} to 10^{-6}.

Dust/Powder and Pump/Trigger Spray: Residential non-cancer incidental oral MOEs for children (1 to < 2 years old) exposed to pets treated with TCVP dust/powders are of concern and range from 98 to 640 (LOC = 1000). Residential non-cancer incidental oral MOEs for children (1 to < 2 years old) exposed to pets treated with TCVP pump/trigger spray products are not of concern and range from 1,600 to 15,000 (LOC = 1000). Residential post-application cancer (adult only) risks estimated for TCVP dust/powder products range from 10^{-7} to 10^{-6}, and for TCVP pump/trigger sprays are all 10^{-7}.

Occupational

There is a total of 172 occupational handler exposure scenarios assessed. The majority (143) are not of concern (i.e., inhalation MOEs are ≥ 300) with currently required personal protective equipment (PPE) (i.e., respiratory protection). Of the remaining 29 handler exposure scenarios, 20 are not of concern with consideration of increasing levels of respiratory protection. However, 9 occupational handler exposure scenarios result in estimated risks of concern despite the addition of respiratory protection or engineering controls.

Commented [RK9]: I guess its hard to give PRD more information since we can't even cut the risk estimates by application rate since lower rate doesn't necessarily mean lower risks because of the way the collars are also parsed by size?

Commented [RK10R9]: For cats, at 584 mg/ai rate there are no post-app risks for children

For dogs, all rates are of concern when assuming a small dog. It looks like a rate of slightly less than 2,219 would be ok for all dogs. Not sure if that would be useful to PRD? Or worth your time to calculate ☺

Commented [kml11R9]: Since Hartz is already proposing mitigation, not sure this is necessary to provide at this point.

Commented [MM12R9]: Agree.

Commented [RK13]: I wonder if we should be more clear here and say all dusts/powders were of concern?

Commented [kml14R13]: added

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Occupational cancer risks were estimated for both private/farmer and contract/commercial handlers. Cancer risks, with currently require PPE, range from 10^{-10} to 10^{-5} for private/farmer handlers and from 10^{-10} to 10^{-4} for contract/commercial handlers.

3.0 Hazard Characterization and Dose-Response Assessment

TCVP is a member of the OP class of pesticides. For TCVP, like other OPs, the initiating event in the adverse outcome pathway/mode of action (AOP/MOA) involves inhibition of the enzyme acetylcholinesterase (AChE) *via* phosphorylation of the serine residue at the active site of the enzyme. This inhibition leads to accumulation of acetylcholine and ultimately to neurotoxicity in the central and/or peripheral nervous system. TCVP does not require metabolic activation to an oxon to inhibit AChE; i.e., the parent compound is the active form inhibiting AChE. OPs generally exhibit a phenomenon known as steady state AChE inhibition. After repeated dosing at the same dose, the degree of inhibition comes into equilibrium with the production of new, uninhibited enzyme. At this point, the amount of AChE inhibition at a given dose remains consistent across duration. In general, OPs reach steady state within 2-3 weeks; a pattern that is observed for most OPs, but not every OP, like TCVP, which shows no difference in response across duration. For TCVP the steady state is reached after a single day of exposure. As such, the endpoint selection for TCVP considers data available for all durations of dosing when choosing the most protective point of departure.

Acute Toxicity

In acute lethality studies, TCVP has low acute toxicity by the oral, dermal, and inhalation routes of exposure. It is a slight dermal irritant, a moderate eye irritant, and a dermal sensitizer.

Table 3.1. Acute Toxicity of Tetrachlorvinphos Technical

Guideline No.	Study Type	MRID No.	Results	Toxicity Category
870.1100	Acute Oral – Rat	41222504	LD_{50} = 1480 mg/kg (M); 465-965 mg/kg (F)	III
870.1200	Acute Dermal – Rabbit	41222505	LD_{50} > 2000 mg/kg	III
870.1300	Acute Inhalation - Rat	00138933	LC50 > 3.61mg/L	IV
870.2400	Acute Eye Irritation - Rabbit	41222506	Moderate	III
870.2500	Acute Dermal Irritation - Rabbit	41222507	Slight	IV
870.2600	Skin Sensitization - Guinea Pig	41377902, 42981001	Sensitizer	N/A
870.6100	Acute Delayed Neurotoxicity	41905901	No clinical signs of neurotoxicity observed (NTE not measured)	N/A

Toxicological Points of Departure (PODs) Used for Risk Assessment

Incidental Oral, Steady State: The steady state incidental oral POD (2.8 mg/kg/day) was selected from an acute dose CCA study (MRID 448773401a) in juvenile rats. A $BMDL_{10}$ (or the lower confidence bound on the BMD_{10} which is the estimated dose where ChE is inhibited by 10% compared to background) of 2.8 mg/kg/day associated with RBC cholinesterase inhibition

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in male and female post-natal day (PND) 11 and 21 rats was selected as a suitable POD for the steady state incidental oral exposure scenario. The duration of this study is considered appropriate for this exposure scenario since AChE data across the TCVP database demonstrate that there is no progression of AChE inhibition over exposure duration, and steady state inhibition occurs essentially after a single dose.

Inhalation, Steady State: The steady state inhalation POD was selected from a 4-week inhalation toxicity study (MRID 48803501) in rats, based on an increase in RBC cholinesterase inhibition in both sexes. Males had slightly lower modeled values ($BMDL_{10}$ of 0.022 mg/L: BMD_{10} of 0.12 mg/L). The duration of this study is considered appropriate for the steady state exposure scenario since steady state occurs within 1 day and a longer-term exposure would not be expected to result in a lower POD. The methods and dosimetry equations described in the agency's reference concentration (RfC) guidance are suited for calculating human equivalent concentrations (HECs) based on the inhalation toxicity POD obtained in rats exposed for 6 hr/day for an average of 5.5 days/week. The regional deposited dose ratio (RDDR), which accounts for the particulate diameter (mass median aerodynamic diameter [MMAD] and geometric standard deviation [GSD] of aerosols) can be used to estimate the different dose fractions deposited along the respiratory tract surface areas. Thus, the RDDR can be used to adjust an observed inhalation particulate exposure of an animal to the predicted inhalation exposure for a human. For the subchronic inhalation toxicity study with TCVP, an RDDR of 2.525 was estimated based on extrarespiratory effects (RBC cholinesterase inhibition) in Sprague Dawley rats (bodyweight = 267g). The MMAD and GSD of 2.57 and 3.785 µm, respectively, at 0.05 mg/L were used to derive the RDDR.

The HECs are summarized in Table 3.2, as well as human equivalent doses (HEDs) calculated for residential and occupational handler scenarios. The standard interspecies extrapolation uncertainty factor can be reduced from 10X to 3X due to the HEC calculation accounting for pharmacokinetic (not pharmacodynamic) interspecies differences. The intraspecies uncertainty factor remains at 10X.

Table 3.2. Summary of HEC/HED Values for TCVP.

Population	Scenario	Tox Duration Adjustment		HEC[a]		HED[b]
		Hours/Day	Days/Week	mg/L	mg/m³	mg/kg/day
Occupational	Handler	0.75	1	0.042	41.663	3.94
Residential	Handler	N/A	N/A	0.056	55.550	1.31
	Bystander	0.25	0.714	0.010	9.920	N/A

a. HEC = human-equivalent concentration; HED = human-equivalent dose.
Occupational Handler HEC = rat POD (0.022 mg/L) × daily duration adjustment (6/8 or 0.75) × weekly daily duration adjustment (5/5 or 1) × RDDR (2.525).
Residential Handler HEC = rat POD (0.022 mg/L) × RDDR (2.525).
Residential Bystander HEC = rat POD (0.022 mg/L) × daily duration adjustment (6/24 or 0.25) × weekly daily duration adjustment (5/7 or 0.714) × RDDR (2.525).

b. HED = HEC × human-specific conversion factor (11.8 L/hr-kg BW) × daily duration (8 hr for occupational and 2 hr for residential).

Dermal, Steady State: No quantification of dermal non-cancer risk is required for TCVP since there were: (1) no treatment related effects (no clinical signs) at doses up to and including the limit dose of 1000 mg/kg/day in the dermal toxicity study; (2) both RBC and brain cholinesterase

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activity were assessed in the dermal study and neither compartment was affected at the limit dose; and (3) no quantitative susceptibility was observed for juvenile or gestational lifestages in the developmental, reproductive, or CCA toxicity studies.

Commented [RK15]: But we are retaining the 10X for the potential for neurodevelopmental effects so does this need revision? I feel like we can't have it both ways – we are using 69kg for body weight and retaining the 10X but also saying here we aren't concerned?

Commented [MM16R15]: I think we need to keep this, but I agree that it sounds inconsistent. Part of the problem we're dealing with here in that we have no quantitative information clearly indicating increased susceptibility, and the statement here is correct, as written. It's just the epi data.

Cancer Classification: TCVP is classified as a Group C, possible human carcinogen, based on statistically significant increases in combined hepatocellular adenoma/carcinoma (primarily carcinomas) in the female B6C3F1 mouse, suggestive evidence of thyroid c-cell adenomas, and adrenal pheochromocytomas in the rat, as well as mutagenicity concerns. Following a reassessment of the mutagenicity data available on TCVP, it was determined that the relevance of the mutagenic findings to the tumorigenic response seen in female mice cannot be established. Therefore, a follow-up mouse micronucleus assay (OPPTS Harmonized Guideline 870.5395) is required for TCVP. Additionally, a study that investigates possible genotoxic activity in the target organ (liver) is required. This study should examine DNA damage potential (Comet assay, DNA adduct formation, or any other DNA target)[11]. A cancer potency factor (Q1 *) of 1.83 x 10^{-3} $(mg/kg/day)^{-1}$ was estimated using the Weibull 83 time-to-tumor model. A 3/4 body weight scaling factor was used to convert from mouse to human equivalents. Following the submission and review of the required assays, the need for an updated cancer assessment will be determined.

Uncertainty Factors

A total uncertainty factor of 1000X is appropriate for the assessment of the oral route of exposures [10X for interspecies extrapolation, 10X for intraspecies variation and a 10X Food Quality Protection Act (FQPA) Safety Factor (SF)]. The FQPA SF, which is specific to residential exposure scenarios, has been retained for infants, children, youths, and women of childbearing age for all exposure scenarios due to uncertainty in the human dose-response relationship for neurodevelopmental effects[12]. For the inhalation route of exposure, a total SF of 300X is appropriate [3X for interspecies extrapolation, 10X for intraspecies variation, and 10X FQPA SF/database uncertainty factor (UF_{DB})]. The interspecies extrapolation is reduced from 10X to 3X because the reference concentration (RfC) methodology for inhalation is used to determine an HEC and takes into consideration the pharmacokinetic differences between animals and humans. The database uncertainty factor was also retained for the protection of occupational workers (dermal and inhalation exposures) who may be pregnant due to uncertainty in the human dose-response relationship for neurodevelopmental effects.

Absorption

Despite the determination of the lack of dermal hazard for TCVP, dermal exposures from TCVP must be quantified for the purpose of cancer risk assessment. Because the cancer assessment is based on an oral study, a dermal absorption factor (DAF) of 9.6% was used in the route-to-route extrapolation. The DAF is based on the results of a dermal penetration study in rats. Since the inhalation POD was based on a route-specific toxicity study, no absorption factor was necessary to estimate exposure.

Body Weight

[11] N. McCarroll, 12/21/2016, Tetrachlorovinphos (TCVP): Revisit of Mutagenicity Studies, TXR#0057553, D437226.

[12] For more information, please reference Sections 4.4 and 4.5 of the Tetrachlorvinphos (TCVP) Revised Human Health Risk Assessment for Registration Review. D. Drew *et al.* D436834. 12-DEC-2016.

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For adults, when an endpoint is not sex-specific (i.e., the endpoints are not based on developmental or fetal effects), a body weight of 80 kg is typically used in risk assessment; however, in this case, a female-specific body weight of 69 kg was used. While the endpoint of concern, RBC AChE inhibition, is not sex-specific, the female body weight was used for pregnant women due to uncertainty in the human dose-response relationship for potential neurodevelopmental effects. A body weight of 11 kg was assumed for children 1 to < 2 years old.

Table 3.3. Summary of Toxicological Doses and Endpoints for TCVP for Use in Dietary and Non-Occupational Human Health Risk Assessments.

Exposure/ Scenario	Point of Departure	Uncertainty Factors*	Level of Concern	Study and Toxicological Effects
Incidental Oral (steady state)	$BMDL_{10}$ = 2.8 mg/kg/day	UF_A= 10X UF_H=10X FQPA SF = 10X	Residential LOC for MOE = 1000	Repeat dose CCA study (MRID 48773401a) - Rat BMD_{10} = 3.2 mg/kg/day, based on PND 21 male RBC ChE inhibition
Dermal (steady state)	No potential hazard *via* the dermal route, based on the lack of treatment-related effects, including the lack of RBC and brain cholinesterase inhibition following repeat dermal exposure of rats at dose levels up to 1000 mg/kg/day and quantitative susceptibility was not observed.			
Inhalation (steady state)	$BMDL_{10}$=0.022 mg/L (males)	UF_A= 3X UF_H=10X FQPA SF = 10X	Residential LOC for MOE = 300	Subchronic Inhalation Toxicity Study (MRID 48803501) – Rat BMD_{10} = 0.12 mg/L, based on RBC ChE inhibition in both sexes
Cancer (oral, dermal, inhalation)	Classification: A possible human (Group C) carcinogen. Q_1* = 1.83 x 10^{-3} $(mg/kg/day)^{-1}$			

Point of Departure (POD) = A data point or an estimated point that is derived from observed dose-response data and used to mark the beginning of extrapolation to determine risk associated with lower environmentally relevant human exposures. NOAEL = no observed adverse effect level. LOAEL = lowest observed adverse effect level. UF = uncertainty factor. UF_A = extrapolation from animal to human (interspecies). UF_H = potential variation in sensitivity among members of the human population (intraspecies). MOE = margin of exposure. LOC = level of concern. RBC = red blood cell. $BMDL_{10}$= benchmark dose lower limit for 10% response.

*The 10X FQPA SF is retained for infants, children, youths, and women of childbearing age for all exposure scenarios due to uncertainty in the human dose-response relationship for neurodevelopmental effects.

Table 3.4. Summary of Toxicological Doses and Endpoints for TCVP for Use in Occupational Human Health Risk Assessments.

Exposure/ Scenario	Point of Departure	Uncertainty Factors*	Level of Concern	Study and Toxicological Effects
Dermal (steady state)	No potential hazard *via* the dermal route, based on the lack of treatment-related effects, including the lack of RBC and brain cholinesterase inhibition following repeat dermal exposure of rats at dose levels up to 1000 mg/kg/day and quantitative susceptibility was not observed.			
Inhalation (steady state)	$BMDL_{10}$=0.022 mg/L (males)	UF_A= 3X UF_H=10X UF_{DB}= 10X	Occupational LOC for MOE = 300	Subchronic Inhalation Toxicity Study (MRID 48803501) - Rat BMD_{10} = 0.12 mg/L, based on RBC ChE inhibition in both sexes

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Table 3.4. Summary of Toxicological Doses and Endpoints for TCVP for Use in Occupational Human Health Risk Assessments.				
Exposure/ Scenario	Point of Departure	Uncertainty Factors*	Level of Concern	Study and Toxicological Effects
Cancer (oral, dermal, inhalation)	Classification: A possible human (Group C) carcinogen. $Q_1^* = 1.83 \times 10^{-3}$ $(mg/kg/day)^{-1}$			

Point of Departure (POD) = A data point or an estimated point that is derived from observed dose-response data and used to mark the beginning of extrapolation to determine risk associated with lower environmentally relevant human exposures. NOAEL = no observed adverse effect level. LOAEL = lowest observed adverse effect level. UF = uncertainty factor. UF_A = extrapolation from animal to human (interspecies). UF_H = potential variation in sensitivity among members of the human population (intraspecies); UF_{DB} = database uncertainty factor; MOE = margin of exposure. LOC = level of concern. RBC = red blood cell. $BMDL_{10}$= benchmark dose lower limit for 10% response.
*The 10X FQPA SF is retained for infants, children, youths, and women of childbearing age for all exposure scenarios due to uncertainty in the human dose-response relationship for neurodevelopmental effects.

4.0 Use Profile

TCVP is used as a direct animal treatment to livestock (i.e., cattle, horses, poultry and swine) and their premises, in kennels, outdoors as a perimeter treatment, and as a flea treatment on cats and dogs. There are 42 registered TCVP end-use products. The TCVP livestock and perimeter treatment uses are formulated as follows: dusts (D), emulsifiable concentrates (EC), feed through (solid (granular and pelleted/tableted) and liquid food additives), feed blocks, and wettable powders (WP). TCVP can be applied by a variety of equipment types including: backrubber/facerubber; backpack; cup; groundboom, handheld fogger; manually-pressurized handwand; mechanically-pressurized handwand; open pour (dust and liquid formulations); paint (airless sprayer or brush/roller); pet collar; plunger; rotary duster; shaker can; spoon; stationary fogger; and trigger spray.

The PPE required for occupational use of TCVP varies by formulation type. For feed through (solid and liquid food additives) and feed blocks, occupational handlers are required to wear baseline clothing (i.e., long sleeved shirt, long pants, shoes and socks) and gloves. For all other end-use labels with livestock and outdoor perimeter uses, required PPE can vary dependent on the application type or equipment and can range from baseline clothing and gloves, to the addition of coveralls, or respiratory protection.

A summary of all registered TCVP labels and use directions are presented in Appendix A of this document. Table A.1 presents the livestock uses and Table A.2 presents pet uses.

5.0 Residential Exposure and Risk Estimates

Residential exposures (handler and post-application) are anticipated from the use of TCVP pet products for dogs and cats including collars, dusts/powders, and pump/trigger sprays. Exposures are expected for adults who apply TCVP products to their pets and from post-application exposures for adults and children who may contact previously treated pets.

Residential TCVP handler exposures are anticipated to be short-term (1 to 30 days) and post-application exposures are anticipated to be short- (1 to 30 days), intermediate- (1 to 6 months), and long-term (>6 months – *for pet collar scenarios only*). However, because of the steady

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state AChE inhibition exhibited by the OPs, steady state exposures (typically 21 days and longer for OPs, but 1 day for tetrachlorvinphos) were assessed and presented for residential exposures to TCVP pet products.

A risk assessment of all currently registered TCVP pet products was first completed in 2014 (D420283[13]). In 2015, these risk outcomes were updated during Registration Review (D426984[14]) to reflect the following changes: (1) the incidental oral and inhalation LOCs increased 10 fold due to uncertainty in the human dose-response relationship for potential neurodevelopmental effects, (2) the determination of no dermal hazard from TCVP, and (3) the use of a female-specific body weight, 69 kg, for assessment of adult exposures instead of the average adult body weight of 80 kg due to uncertainty for potential neurodevelopmental effects. In 2016, a revised ORE assessment[15] was conducted for Registration Review to incorporate additional changes including: (1) the reduction of the incidental oral POD from a $BMDL_{10}$ of 8.0 mg/kg/day to 2.8 mg/kg/day, (2) the use of the literature study, Davis, M. *et. al*, *Assessing Intermittent Pesticide Exposure from Flea Control Collars Containing the Organophosphorus Insecticide Tetrachlorvinphos. Journal of Exposure Science and Environmental Epidemiology.* ((2008) 18, 564-57), for assessment of residential post-application risks from exposures to TCVP pet collars, and (3) an updated pet collar assessment assuming that the TCVP pet collar product exists as a liquid and solid form concurrently (with varying ratios of liquid to dust[16]).

Since the 2016 assessment, additional residue transfer data, as well as formulation data, have been submitted for TCVP pet collars. These data have been incorporated into this revised ORE assessment.

5.1 Residential Handler Exposures

HED uses the term "handlers" to describe those individuals who are involved in the pesticide application process. HED believes that there are distinct tasks related to applications and that exposures can vary depending on the specifics of each task. Residential handlers are assumed to complete all elements of an application without use of any protective equipment.

Residential handler exposures to TCVP pet products may occur via the dermal or inhalation routes while the product is placed on a cat or dog. Both steady state non-cancer and cancer residential handler exposure assessments were performed for adult homeowners applying TCVP pet collars, dusts/powders, and pump/trigger sprays products to cats and dogs. Since there is no non-cancer dermal hazard for TCVP, the steady state (non-cancer) handler assessment includes only inhalation exposures. For the cancer assessment, both dermal and inhalation exposures are assessed.

Residential Non-Cancer Handler Exposure Data and Assumptions

[13] W. Britton. Residential Exposure Assessment in Response to the Natural Resources Defense Council Petition to Cancel All Pet Uses for Tetrachlorvinphos. 11/05/2014. D420283

[14] W. Britton. Tetrachlorvinphos: Occupational and Residential Exposure Assessment for Registration Review. 12/21/2015. D426984.

[15] W. Britton et al. Tetrachlorvinphos: Final Occupational and Residential Exposure Assessment for Registration Review. 12/21/2016. D436833.

[16] See Appendix I for a detailed explanation of the pet collar formulation issue.

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Application Rate: The application rates used in the assessment of pet products typically represent the maximum amount of active ingredient (ai) that could be applied by weight of the treated animal (small, medium, and large). However, this is only possible when the product is manufactured for use, or is labeled specifically, for different animal weight ranges. If this information is not provided, a number~~number~~ of assumptions are used which are described in HED's 2012 Residential SOPs (Treated Pets SOP).

The majority of pet collar formulations are registered as a single collar for use on all animal weight ranges. These have been assumed for use on different weight ranges as specified in the Residential SOPs which include:

- Cats – Small (up to 5 lbs), Medium (6 to 12 lbs), Large (13 lbs and up).
- Dogs - Small (up to 20 pounds), Medium (21 to 50 lbs) and Large (51 lbs and up).

While the pet collar product labels recommend trimming of the pet collar after it is applied to the animal, since the handler would be exposed to the full length of the collar during application, trimming of the collar was not accounted for in the residential handler exposure calculations.

For TCVP dusts/powders, all products identify a specific amount to use per animal weight that allows for determination of the maximum application rate. For TCVP pump sprays, all registered products direct the user to apply a specific number of "strokes" per animal size. In order to determine the amount of ai applied per treatment as specified by number of strokes, HED requested additional information from the product registrant. Hartz Mountain Corporation provided information regarding the volume of product released per stroke for pump and trigger spray products; 0.19 and 0.93 grams, respectively. Only trigger spray products are registered for dogs; however, both pump and trigger spray products are registered for cats. Additionally, per request of HED, in March 2014 Hartz Mountain Corporation amended the master label of EPA Reg. No. 2596-140 to recommend a number of strokes per animal size. Previously, a number of strokes per cat/dog were not recommended.

Pet Collar Formulation Issue: For pet collars, HED has been conducting assessments assuming the active ingredient is present as both liquid and solid forms concurrently (more detailed explanation provided in Appendix I). Due to the uncertainty associated with pet collar formulation type, and without chemical-specific data, HED ~~has~~ typically assume~~d~~s a range of ratios to cover the range of potential exposures (e.g., 1/99, 50/50, and 99/1 liquid/dust). This approach was taken for TCVP in the 2016 ORE assessment. However, since that assessment, a TCVP-specific dust torsion study was submitted and reviewed (MRID 50931601[17]). This study was submitted to address the uncertainty surrounding the ratio of liquid/dust in the TCVP pet collars. In the study, the weight difference of collar pieces before and after the torsion tests (which involved mechanical torsion and stress by twisting and pulling the collar three times) was measured. This weight difference was assumed to represent the amount of TCVP lost from the collar in the form of dust. Based on the results of this study, it was determined that 0.38% mass (assumed to be dust) is lost from the collar due to torsional stress. Therefore, in the current

[17] MRID 50931601. D454190. Submitted in response to GDCI-083702-1791.

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exposure and risk calculations for TCVP pet collars, HED assumed a liquid/dust ratio of 99.62/0.38.

Unit Exposures: Chemical-specific unit exposure data were provided in support of residential handler risk assessment for the dust/powder formulations only (MRID 45519601). The study, "Determination of Dermal and Inhalation Exposures to Tetrachlorovinphos (TCVP) During the Application of an Insecticide Powder to a Dog," was previously reviewed by the Agency[18] and determined to be acceptable. This exposure data was used as a surrogate to estimate handler exposures from the TCVP dust/powder products. The study resulted in average unit exposures for the dermal and inhalation routes of exposure of 1,700 mg/lb ai and 3.1 mg/lb ai, respectively.

In the absence of exposure data for residential handling of pet collars and pump/trigger sprays, HED used exposure values from the 2012 Residential SOPs: Treated Pets as a surrogate to estimate handler exposures. Surrogate exposure data for a groomer trigger pump spray application to dogs was used to estimate handler exposures from TCVP pump spray products.

For assessment of residential handler exposure to TCVP pet collars, the liquid-specific unit exposure (UE) values (i.e., surrogate data from a spot-on applicator study) from the 2012 Residential SOPs were used when assuming the TCVP pet collars are a liquid formulation. When assuming the pet collars are a solid formulation, HED used the best available data, a TCVP dust/powder applicator exposure study (MRID 45519601). The liquid formulation spot-on surrogate UE data assumes negligible inhalation exposure; therefore, only the dust-specific UE data (i.e., a TCVP dust/powder applicator exposure study) is expected to result in the potential for inhalation exposures.

Area Treated or Amount Handled: Per the 2012 Treated Pet SOP, it is assumed that residential handlers of pet treatment products will treat 2 animals per application.

Residential Non-Cancer Handler Exposure and Risk Equations

The algorithms used to estimate non-cancer exposure and dose for residential handlers can be found in Appendix B and/or the 2012 Residential SOPs.[19]

Summary of Residential Handler Non-Cancer Exposure and Risk Estimates

Pet Collars: No non-cancer steady-state inhalation risk estimates of concern were identified for residential handlers for pet collars assuming a 99.62% liquid/0.38% dust formulation ratio. Inhalation MOEs range from 370,000 to 2,400,000 (LOC = 300). Residential handler non-cancer risk estimates for pet collars are presented in Appendix Table C.2.

Dust/Powder and Pump/Trigger Spray: No non-cancer inhalation risk estimates of concern were identified for residential handlers for the TCVP pet dust/powder pump/trigger spray formulations. Inhalation MOEs range from 5,600 to 160,000 (LOC = 300). Residential handler

[18] S. Hanley. HED's Review of *Determination of Dermal and Inhalation Exposures to Tetrachlorvinphos (TCVP) During the Application of an Insecticide Powder to a Dog.* 1/9/02. D278626.

[19] [HYPERLINK "http://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide"]

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non-cancer risk estimates for dust/powder and pump/trigger spray products are presented in Appendix Table C.3.

Residential Cancer Handler Exposure Data and Assumptions

A series of assumptions and exposure factors served as the basis for completing the residential cancer handler risk assessment. All exposure data and assumptions that underlie the residential handler cancer risk estimates can be referenced in the 2014 residential assessment. Some of these are highlighted below:

Days per Year of Exposure: For the purpose of assessing residential handler cancer exposure/risk from TCVP product application, HED has assumed 4 days per year for collars, and 6 days per year for dusts/powders and pump sprays. The collar is based on a worst-case assumption of a single application every 3 months. Collar re-treatment intervals range from 3 to 7 months. HED assumed a bi-monthly retreatment interval for dusts/powders and pump sprays.

Years per Lifetime of Exposure: It is assumed that residential handlers would be exposed for 50 years out of a 78 year lifespan. This factor is routinely used as a conservative estimate of the number of years an individual could continually use a single pesticide product.

Lifetime Expectancy: Life expectancy values are from the Exposure Factors Handbook 2011 Edition Table 18-1 (U.S. EPA, 2011). The table shows that the overall life expectancy is 78 years based on life expectancy data from 2007. In 2007, the average life expectancy for males was 75 years and 80 years for females. Based on the available data, the recommended value for use in cancer risk assessments is 78 years.

Residential Handler Cancer Exposure and Risk Estimate Equations

Cancer risk estimates were calculated using a linear low-dose extrapolation approach in which a Lifetime Average Daily Dose (LADD) is first calculated and then compared with a Q_1* that has been calculated for TCVP based on dose response data in the appropriate toxicology study (Q_1* = 1.83×10^{-3} $(mg/kg/day)^{-1}$). Absorbed average daily dose (ADD) levels were used as the basis for calculating the LADD values. Dermal and inhalation ADD values were first added together to obtain combined ADD values. LADD values were then calculated and compared to the Q_1* to obtain cancer risk estimates.

The algorithms used to estimate the LADD and cancer risk for residential handlers can be found in Appendix B.

Summary of Residential Handler Cancer Exposure and Risk Estimates

Pet Collars: Residential handler cancer risks estimated for TCVP pet collars assuming a 99.62% liquid/0.38% dust formulation ratio range from 10^{-9} to 10^{-8}. Residential handler cancer risk estimates for pet collars are presented in Appendix Table D.1.

Dust/Powder and Pump/Trigger Spray: Residential handler cancer risks for TCVP dusts/powders range from 10^{-9} to 10^{-7}, and for pump/trigger sprays range from 10^{-9} to 10^{-8}.

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Residential handler cancer risk estimates for dust/powder and pump/trigger spray products are presented in Appendix Table D.2.

5.2 Residential Post-application Exposure/Risk Estimates

There is the potential for post-application exposure for individuals exposed as a result of contacting a cat/dog previously treated with TCVP pet products (dusts/powders, pump/trigger sprays, pet collars). The quantitative exposure/risk assessment for residential post-application exposures is based on the following scenario: Post-application incidental oral (hand-to-mouth) exposure (children 1 to < 2 years old only) from contacting cats and dogs treated with TCVP.

Since there is no non-cancer dermal hazard for TCVP, a quantitative non-cancer post-application dermal exposure assessment was not performed for adults or children. A quantitative residential post-application inhalation exposure assessment was not performed as inhalation exposure is expected to be negligible from applications to pets.

The lifestages selected for each post-application scenario (i.e., children 1 to < 2 years old) are based on an analysis provided as an Appendix in the 2012 Residential SOPs[20]. While not the only lifestage potentially exposed for these post-application scenarios, the lifestage that is included in the quantitative assessment is health protective for the exposures and risk estimates for any other potentially exposed lifestage.

Residential Non-Cancer Post-Application Exposure Data and Assumptions

A series of assumptions and exposure factors served as the basis for completing the residential non-cancer post-application risk assessment. The exposure data and assumptions that underlie the residential non-cancer post-application risk estimates can be found in the 2016 residential assessment and the 2012 Residential SOPs. These assumptions are highlighted below.

Application Rate: The application rates used in the assessment of pet products typically represent the maximum amount of active ingredient (ai) that could be applied by weight of the treated animal (small, medium, and large). However, this is only possible when the product is manufactured for use, or is labeled specifically, for different animal weight ranges. If this information is not provided, a number of assumptions are used which are described in HED's 2012 Residential SOPs (Treated Pets SOP).

For pet collars, the label typically directs users to cut off and dispose of any excess length once the product is fit and buckled into place. Per the Treated Pet SOP, the full length of the collar is assumed in pet collar assessments, ~~since, As described in the Treated Pet SOP,~~ since the exact length that is cut off cannot be determined~~.~~; therefore, the corresponding ai loss cannot be quantified ~~and, therefore, exposure is assessed assuming the full collar length.~~ In the previous assessment, HED assessed the TCVP pet collars assuming the full collar length. Since that time, the Registrant has submitted pet collar efficacy data to ~~try to~~ address this uncertainty. The

Commented [RK17]: Maybe "is uncertain" to match the next sentence?

Commented [kml18R17]: I'm thinking of leaving this the same to try and keep the original language the same as much as possible

Commented [MM19]: Is this sentence still applicable?

Commented [kml20R19]: I might edit it a little, but I think it's good to have in here to explain why we don't typically (and didn't in previous assessments for TCVP) adjust for trimming

[20] Available: http://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide

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data provided (from MRID 51079501[21]) is from a 7-month efficacy study in dogs. A total of 63 dogs (range in weights of 11 to 22 kg) were included in the data summary, and the weights of the collars were provided, including the pre-cut weight, the weight of the cut-off piece, and the weight of the fitted collar. The percent of collar removed was calculated by taking the weight of the cut-off piece and dividing by the weight of the pre-cut collar. The percent of the collar removed ranged from 20% to 43%, with an average of 30% being removed. In order to provide a conservative assumption of how much collar might be removed during use, HED has chosen to use a value of 20% to adjust the application rate for pet collars. Accounting for fractionthe percentage of the pet collar removed is believed to better represent typical usage of the product as it is fit to the treated animal.

Pet Collar Formulation Type Approach: As was mentioned in Section 5.1, in the current exposure and risk calculations for TCVP pet collars, HED assumed a liquid/dust ratio of 99.62/0.38. For the residential post-application exposure assessment, the agency used transfer coefficients (dermal exposures) and the fraction of active ingredient on hands from the transfer coefficent studies (hand-to-mouth exposures) specific to both liquid and solid formulation types when assessing pet collar exposures.

Transfer Data: Surrogate and chemical-specific residue transfer studies were used for assessment of post-application exposures from registered TCVP pet products. For dust/powder products and pump sprays, HED relied on a TCVP powder and pump spray study (MRID 45485501). In 2014, in support of the Agency's response to the NRDC petition, the study was reevaluated based on current standards of conduct for pet residue transfer studies.[22] For the purposes of the non-cancer assessment, the transferable residue from the day of application (Day 0) was used as follows: 0.048% (maximum observed) for dusts/powders and 0.81% for pump sprays (maximum observed).

For pet collars, HED has used two TCVP-specific residue transfer studies available for pet collars. The first is a literature study[23] (the Davis study), which was used previously, and the second is a newly submitted TCVP pet collar residue transfer study (MRID 50881801[24]).

Davis Study Residue Transfer Factor: For the purpose of non-cancer and cancer post-application risk assessment, only the results of the pet fur transferable residue collection (petting/rubbing with a gloved cotton hand) were used. This collection method is the agency standard for determining the residues that can transfer from a treated animal to an exposed individual, referred to as the fraction of application rate (F_{AR}) transferred. In the previous risk assessment for TCVP, it was noted that the petting/rubbing method used in this study was not conducted based entirely upon the current agency guidance for studies of this type; however, the method is

[21] MRID 51079501. *Efficacy and Repellence of Ectoparasiticidal Treatments Against Ticks (Dermacentor Variabilis, Ixodes Scapularis, Rhipicephalus Sanguineus), Fleas (Ctenocephalides Felis) and Mosquitos (Aedes Aegypti) on Dogs*. May 7, 2019. Table 4 (p. 37 – 39).

[22] W. Britton. Tetrachlorvinphos: Reevaluation of "HED's Review of *Determination of the Dislodgeability of Tetrachlorvinphos (TCVP) from the Fur of Dogs Following the Application of an Insecticide Powder, Pump Spray or Aerosol*; MRID 45485501. 5/16/14. D420285.

[23] Davis, M. et. al., *Assessing Intermittent Pesticide Exposure from Flea Control Collars Containing the Organophosphorus Insecticide Tetrachlorvinphos*. Journal of Exposure Science and Environmental Epidemiology. (2008) 18, 564-57). D430707

[24] D453149. TCVP: Review and Summary of Residue Transfer Studies Submitted. MRID 50881801.

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was relevant for the time at which it was conducted, and ~~has been~~it was deemed adequate for risk quantitation. ~~Based on~~Upon comparison of the Davis study data and the recently submitted TCVP transfer study, HED reevaluated the methodology used in the Davis study~~, HED re-reviewed~~; specifically, the information provided in the literature study regarding how the petting simulations were conducted. The study authors describe that dogs were petted by volunteers *continuously for a five-minute period* with cotton gloves. Transferable residue petting/rubbing samples were collected 1) from the fur of the neck (after application and rubbing over the collar), 2) from the fur of the neck (after application and then removal of ~~with~~ the collar ~~removed~~), and 3) along the back in the tail region after application of the collar, during two studies; the first study was conducted for 112 days and the second study was conducted for 12 days. In the previous risk assessment, HED had relied on residues collected in the Davis study from the fur of the neck (rubbing over the collar) and from the tail region. The rationale had been ~~The F_{AR} value was determined by dividing the sum of the residues measured from the fur over the collar and from the back in the tail region by the amount of active ingredient in the pet collar (as reported in the Davis study), 4,800 mg. The~~that collection of the transferable residue ~~measures~~ from the fur of the neck with the collar removed was not ~~summed with the other measures since the collection of residues under the collar is in~~consistent with the current guidance for pet fur transfer residue studies which requires petting to occur over the pet collar assuming that the pet collar is secured in place as directed by product labeling. While it is true that HED guidance indicates that petting "*should be performed without regard for the location of collar or spot-on product applications; that is, the treatment spot will not be avoided during the petting simulation process*", the guidance also indicates that the petting stroke should begin "*from the head/neck*" and end "*at the tail base*." Therefore, it has been determined that the continuous rubbing over the neck and collar for five minutes that was conducted in the Davis study likely overestimated the potential transferable residue from typical contact with a pet or what would be expected to be measured following the current HED petting guidance. While the residues collected from the fur of the neck after application and then removal of the collar may not have been conducted according to current guidance, HED has determined that the residues likely do not underestimate exposure considering the continuous rubbing methodology that was followed. Therefore, for the current exposure assessment for pet collars, HED has updated the calculation of the F_{AR} value by dividing the sum of the residues measured from the fur of the neck (without the collar present) and from the back in the tail region by the amount of active ingredient in the pet collar (as reported in the Davis study), 4,800 mg. The F_{AR} proposed for non-cancer post-application risk assessment, therefore, is 0.0017 (0.17%), and is based on the mean residues (12 days) reported from study 2 [where (8 mg + 0.08 mg)/ 4,800 mg = 0.0017]. ~~Further~~Upon reevaluation, HED has determined that the Davis study F_{AR} and the F_{AR} determined from ~~the Hartz Mountain~~MRID 50881801 transfer study (described below) are similar.

MRID 50881801 Residue Transfer Factor: Hartz Mountain Corporation submitted a TCVP-specific residue transfer study for pet collars in 2019 (MRID 50881801). The purpose of the study was to measure the transferability of the test substance, TCVP, from the hair of a dog wearing a TCVP-impregnated collar. Each collar contained 14.55% TCVP (wt/wt). A total of 9 dogs were used in the study, randomly assigned to 3 groups. Dogs in Group 1 were petted for 5 simulations, dogs in Group 2 received 10 petting simulations, and dogs in Group 3 received 25 petting simulations. Each simulation consisted of three strokes conducted using a mannequin hand fitted with three cotton gloves. The first stroke was on the right side, the second on the left

Commented [RK21]: Can we describe a little bit here about the number of days? Since in the non-cancer you used a 12 day estimate and in the cancer its 112 day estimate. It seems like the study measured out to at least 112 days so maybe mention that here?

Commented [kml22R21]: Added something about the duration of the studies conducted by Davis

Commented [RK23]: So the collar was there, and then taken off for these estimates? Maybe we can make that more clear above?

Commented [kml24R23]: Tried to reword above so that it's clearer

side, and the third was along the back line. Percent transferable residues of TCVP were calculated by taking the ratio of the residues of TCVP observed on the glove to the total amount of TCVP in the collar at application (calculated as the percent TCVP * initial weight of collar). This results in percent transfer values ranging from 0.049% to 0.228%. The average percent transferable residues of TCVP were 0.098% for Group 1 (5 petting simulations), 0.086% for Group 2 (10 petting simulations), and 0.167% for Group 3 (25 petting simulations). For the purpose of non-cancer post-application risk assessment, only the results from group 3 were used since that group used 25 petting simulations which most closely compares with the current methodology recommendation, which is 20 petting simulations.

Since both studies are representative of potential exposure to currently registered TCVP pet collars and provide similar estimates of transferable residue, ~~HED has presented the~~ risk estimates ~~presented are representative of utilizing~~ both data sets.

A summary of the residue transfer data that has been considered for assessing exposure to TCVP pet collars is provided in Appendix J, including considerations related to the use of the Davis study and summaries of both the Davis study and MRID 50881801.

Residential Non-Cancer Post-application Exposure and Risk Equations

The algorithms used to estimate non-cancer exposure and dose for residential post-application can be found in Appendix B and the 2012 Residential SOPs.

Summary of Residential Post-Application Non-Cancer Exposure and Risk Estimates

Pet Collars: Assuming a 99.62% liquid/0.38% dust formulation ratio ~~and using a fraction transferred value of 0.[illegible]7~~, the residential steady-state non-cancer incidental oral MOEs for children (1 to <2 years old) exposed to pets treated with TCVP pet collars ranged from 570 to 4,500 (LOC = 1000). Residential post-application non-cancer risk estimates for pet collars are presented in Appendix Table E.2.

Dust/Powder and Pump/Trigger Spray: Residential non-cancer incidental oral MOEs for children (1 to < 2 years old) exposed to pets treated with TCVP dust/powders range from 98 to 640 (LOC = 1000). Residential non-cancer incidental oral MOEs for children (1 to < 2 years old) exposed to pets treated with TCVP pump/trigger spray products range from 1,600 to 15,000 (LOC = 1000). Residential post-application non-cancer risk estimates for dust/powders and pump/trigger sprays are presented in Appendix Table E.3.

Residential Cancer Post-Application Exposure Data and Assumptions

A series of assumptions and exposure factors served as the basis for completing the residential cancer post-application risk assessment. All exposure data and assumptions that underlie the residential post-application cancer risk estimates can be referenced in the 2014 residential assessment. Some of these are highlighted below:

Dust/Powder and Trigger Pump Sprays Transfer Data: For purpose of quantification of estimated TCVP post-application cancer exposures/risks, HED recommends use the average percent residue transfer from the TCVP dust/powder and pump spray studies. Due to the reasons

Commented [RK25]: Ok so I think I'm following this. We are saying that the Davis study Far estimates WITH the collar could be too conservative because of the way the petting was done (rubbing continuously over the collar) and that the estimates from Davis without the collar matched the MRID Far described below so probably a more accurate representation of exposure. Right? ☺

Commented [kml26R25]: Exactly.

DRAFT

described above with use of the TCVP dust/powder and pump spray exposure data, HED used an average of the maximum observed percent residue transfer for each day tested for calculation of cancer exposures/risks resulting in an F_{AR} of 0.022% and 0.18% for dusts/powders and pump sprays, respectively.

Pet Collar Transfer Data: For the assessment of cancer post-application risks, longer-term residue transfer values from study 1 of the Davis study (which was conducted for 112 days) were used to best represent the assumption of 180 days/year exposure for cancer assessment. As noted above for the non-cancer estimate, HED had previously included the residues from the fur of the neck with the collar present in the calculation of the F_{AR}. Updated calculations of the F_{AR} used for cancer post-application risk assessment was also conducted, resulting in a revised fraction transfer of 0.00092 (0.09%), which is based on the mean residue (0.13 days) reported from study 2 in the Davis study [where (4.3 mg = 0.13)/ 4,800 mg = 0.09% [2].

Days per Year of Exposure:
For purpose of estimating adult dermal cancer risks, exposure was assumed for 180 of 365 total days per year. This factor is used as a health protective estimate of the number of days that an individual could be exposed to a treated animal per year of product use. The recommendation of 6 months exposure is conservative, particularly when paired with the assumption that this exposure duration is repeated for 50 years during an adult's lifetime.

Years per Lifetime of Exposure:
It is assumed that adults would be exposed for 50 years out of a 78 year lifespan. This factor is routinely used as a conservative estimate of the number of years an individual could continually use a single pesticide product.

Lifetime Expectancy: Life expectancy values are from the Exposure Factors Handbook 2011 Edition Table 18-1 (U.S. EPA, 2011). The table shows that the overall life expectancy is 78 years based on life expectancy data from 2007. In 2007, the average life expectancy for males was 75 years and 80 years for females. Based on the available data, the recommended value for use in cancer risk assessments is 78 years.

Residential Cancer Post-application Exposure and Risk Estimate Equations

As was done for residential handlers, cancer post-application risk estimates for adults were calculated using a linear low-dose extrapolation approach in which a LADD is first calculated and then compared with a Q_1* that has been calculated for TCVP based on dose response data in the appropriate toxicology study (Q_1* = 1.83 x 10^{-3} $(mg/kg/day)^{-1}$). The algorithms used to estimate the LADD and cancer risk for residential post-application exposure can be found in Appendix B.

Summary of Residential Post-application Cancer Exposure and Risk Estimates

Pet Collars: Assuming a 99.62% liquid/0.38% dust formulation ratio, residential post-application cancer (adult only) risk estimates for TCVP pet collars range from 10^{-7} to 10^{-6}.

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Residential post-application cancer risk estimates for pet collars are presented in Appendix Table F.1.

Dust/Powder and Pump/Trigger Spray: Residential post-application cancer (adult only) risks estimated for TCVP dust/powder products range from 10^{-7} to 10^{-6}, and for TCVP pump/trigger sprays are all 10^{-7}. Residential post-application cancer risk estimates for dust/powders and pump/trigger sprays are presented in Appendix Table F.2.

6.0 Non-Occupational Spray Drift Exposure and Risk Estimates

A quantitative spray drift assessment was not conducted because the use of TCVP for direct animal treatment to livestock and their premises, in kennels, outdoors as a perimeter treatment, and as a flea treatment on cats and dogs are either 1) not applied via aircraft, groundboom, or airblast equipment or 2) for applications to poultry buildings with groundboom equipment, the use is indoors and not anticipated to be a significant source of spray drift.

7.0 Non-Occupational Bystander Post-Application Inhalation Exposure and Risk Estimates

A quantitative residential post-application inhalation exposure assessment was not performed as inhalation exposure is expected to be negligible from applications to pets.

8.0 Occupational Exposure and Risk Estimates

Occupational handler risks have been updated herein to reflect the updated ratio of liquid/dust for the pet collar formulations and to reflect an updated assumption for the number of animals treated using a plunger, shaker can, or spoon. All other occupational handler data, assumptions, and algorithms used for the 2016 ORE assessment remain the same.

8.1 Occupational Handler Exposure/Risk Estimates

HED uses the term handlers to describe those individuals who are involved in the pesticide application process. HED believes that there are distinct job functions or tasks related to applications and exposures can vary depending on the specifics of each task. Job requirements (amount of chemical used in each application), the kinds of equipment used, the target being treated, and the level of protection used by a handler can cause exposure levels to differ in a manner specific to each application event.

Based on the anticipated use patterns and current labeling, types of equipment and techniques that can potentially be used, occupational handler exposure is expected from the proposed uses. The quantitative exposure/risk assessment developed for occupational handlers is based on the following scenarios:

Mixer/Loaders:

(1a) Liquid: Groundboom Applications

DRAFT

(1b) Liquid: Paint Applications
(2a) Wettable Powder: Groundboom Applications
(2b) Wettable Powder: Paint Applications
(3a) Dust: Paint Applications

Applicators:

(4) Groundboom Applications
(5) Open Pour Liquid Additive for Feed Through
(6) Ready-to-Use (RTU) Pet Collar – 99.6% Liquid/0.38% Dust Ratio Formulation
(7) RTU Dust/Powder – Pets
(8) RTU Pump/Trigger Sprays - Pets

Mixer/Loader/Applicators:

(9a) Liquid: Backpack Sprayer
(9b) Liquid: Manually-Pressurized Handwand
(9c) Liquid: Mechanically-Pressurized Handgun
(9d) Liquid: Backrubber or Facerubber
(10a) Wettable Powder: Backpack Sprayer
(10b) Wettable Powder: Manually-Pressurized Handwand
(10c) Wettable Powder: Mechanically-Pressurized Handgun
(10d) Wettable Powder: Fogging Equipment (handheld, portable, and stationary)
(10e) Wettable Powder: Rotary Duster
(10f) Wettable Powder: Plunger Duster
(11a) Dust: Self-Treating Dust Bag
(11b) Dust: Shaker Can
(11c) Dust: Rotary Duster
(11d) Dust: Plunger Duster
(12a) Paint: Brush or Roller
(12b) Paint: Airless Sprayer
(13) Solid Feed Additive for Feed Through: Cup

Occupational Handler Exposure Data and Assumptions
A series of assumptions and exposure factors served as the basis for completing the occupational handler risk assessments. Each assumption and factor is detailed below on an individual basis.

Application rate: A summary of all TCVP occupational use sites and application rates is presented in Appendix A.

Pet Collar Formulation Assumptions: As was mentioned in the residential sections, in the 2016 ORE assessment for TCVP, the specific ratio liquid:dust in the TCVP pet collars was unknown; therefore, HED had assumed a range of ratios to cover the range of potential exposures (e.g., 1/99, 50/50, and 99/1 liquid/dust). However, as noted in Section 5.1, since the 2016 assessment, a torsion study was submitted measuring the amount of solids (dust/powder) released from a flea and tick collar and the active ingredient content of the released solids when the collar is exposed

DRAFT

to mechanical torsion and stress[25]. Based on the results of this study, it was determined that 0.38% mass (assumed to be dust) is lost from the collar due to torsional stress. Therefore, in the current exposure and risk calculations for pet collars, HED assumed a liquid/dust ratio of 99.62/0.38.

Unit Exposures: It is the policy of HED to use the best available data to assess handler exposure. Sources of generic handler data, used as surrogate data in the absence of chemical-specific data, include PHED 1.1, the AHETF database, the Outdoor Residential Exposure Task Force (ORETF) database, or other registrant-submitted occupational exposure studies. Some of these data are proprietary (e.g., AHETF data), and subject to the data protection provisions of FIFRA. The standard values recommended for use in predicting handler exposure that are used in this assessment, known as "unit exposures", are outlined in the "Occupational Pesticide Handler Unit Exposure Surrogate Reference Table[26]", which, along with additional information on HED policy on use of surrogate data, including descriptions of the various sources, can be found at the agency website[27].

A single chemical-specific exposure study, Monitoring Exposure of Mixer/Loaders and Applicators Treating Agricultural Premises with Tetrachlorvinphos (Rabon® 50 WP Insecticide) in Handheld Wand-Type Sprayers (MRID 42622301), was used as appropriate (i.e., exposure scenario 10c, mix/load and apply WP with mechanically-pressurized handgun) in the most recent occupational risk assessment for TCVP.[28] Per the prior risk assessment, risks for the exposure scenario were estimated with use of the chemical-specific exposure data as well as surrogate PHED data. This exposure study was summarized in the 2015 draft ORE assessment for Registration Review[29].

The PHED data recommended for the exposure scenario reflects unit exposure values (dermal and inhalation) that represent an individual conducting all activities, mixing/loading/applying, for use of the WP product by mechanically pressurized handgun. In contrast, the chemical-specific exposure study was conducted in a manner which separated out the mixing/loading and application components of the exposure scenario. Exposure scenario 10c has been assessed, and estimated risks presented separately, (i.e., mixer/loader and applicator) with use of the chemical-specific data, and for all activities with use of PHED. When applied, the dermal and inhalation unit exposures resulting for product application result in risk estimates that are very similar to risk estimates using the PHED data. Non-cancer and cancer private/farmer and contract/commercial occupational handler risk estimates for exposure scenario 10c are presented separately from the risk summaries for all other occupational handler exposure scenarios in Appendix G: Table G.2 and Appendix H: Tables H.2 and H.4, respectively.

In some cases, due to the lack of data for an exposure scenario or the unique nature of the scenario, surrogate exposure data were used as follows:

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[25] MRID 50931601. D454190. Submitted in response to GDCI-083702-1791.
[26] Available: [HYPERLINK "http://www.epa.gov/opp00001/science/handler-exposure-table.pdf"]
[27] Available: [HYPERLINK "http://www.epa.gov/pesticides/science/handler-exposure-data.html"]
[28] J. Dawson. Tetrachlorvinphos: Further Revisions to Occupational Risk Assessment for Uses in the Poultry and Cattle Production Industries. 3/28/2002. D281972.
[29] W. Britton. Tetrachlorvinphos: Occupational and Residential Exposure Assessment for Registration Review. 12/21/2015. D426984.

DRAFT

- Exposure data for the loading/application of dust formulations were used as a surrogate for the loading/application of wettable powders for rotary and plunger duster applications (10e, 10f). For exposure scenario 10e, exposure data for plunger dusters were used due to the lack of data for the rotary duster application method.
- For the assessment of pet collars as a dust formulation, data for applying dusts using a shaker can were used as a surrogate.
- Unlike more typical exposure scenarios where a RTU paint is only loaded or applied, for TCVP the paint must be mixed/loaded for the liquid (1b), wettable powder (2b), and dust (3a) formulations. These exposure scenarios were assessed using the exposure data appropriate for mixing/loading for each formulation with the exception of dust where WP formulation was used as a surrogate for dust.
- For TCVP applications to livestock with a dust formulation via shaker can, a RTU product is not available; therefore, exposures from the mixing/loading of the dust formulation must be assessed in addition to potential exposure resulting from application via shaker can. As a result, the exposure data for the loading/application via a RTU shaker can was used for the assessment of all scenarios relating to the use. The use of these data results in a more protective assessment than would be if the mixing/loading of the dust were assessed separately.
- Exposures from the application of feed (salt or mineral) blocks in livestock – typically, 5 – 15 per head of cattle or horses – is assumed to be negligible if gloves are worn when placing the blocks. Furthermore, for these products the greater majority of the active ingredient is contained within the block, thus further reducing the exposure potential.

Area Treated or Amount Handled: The following inputs are consistent with those used in the most recently conducted occupational risk assessment for TCVP and, for those inputs relating to the poultry industry, are reflective of research conducted by BEAD at that time.

- Groundboom: 100,000 square feet for applications to poultry buildings
- Backpack and manually pressurized handwand: 20,000 square feet for applications to poultry buildings
- Mechanically pressurized handwand: 100,000 square feet for applications to poultry buildings
- Backpack, handheld/stationary fogger, manually pressurized handwand, mechanically pressurized handwand, rotary spreader: 20,000 birds for direct application to poultry (i.e., approximately 1 square foot/bird)
- Backrubber/facerubber: 50 gallons
- Paint applications: 2 gallons

Most of the inputs below are based on either the most recently conducted permethrin occupational and residential exposure and risk assessment for similar use patterns[30] or best professional judgment of product usage, unless otherwise noted.

[30] C. Smith. Permethrin: Third Revision of the Occupational and Residential Exposure Assessment for the Reregistration Eligibility Decision Document. 4/4/2006. D325428.

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- All handheld equipment (backpack sprayers, manually pressurized handwands, and mechanically-pressurized handguns): 400 animals treated daily
- Handheld/stationary fogger: 100,000 square feet to poultry buildings
- Plunger, shaker can, spoon: 30 animals for cattle/swine[31], 1,000 birds or 1,000 square feet
- Pet collar, pump/trigger spray, and shaker can applications: 8 animals treated daily
- Self-treating dust bags: 10 filled daily (assuming a 12.5 lb dust bag)

The following inputs are consistent with EPA regulatory definitions for large concentrated animal feeding operations (CAFOs)[32]. The inputs assume that a single individual is responsible for the food preparation for the entire CAFO and applies the TCVP feed-through products to the animal feed.

- Cup, pour on: 1,000 cows, 500 horses, and 6,250 pigs for liquid and solid feed-through applications. The number of cows and horses represents the maximum identified for large CAFO operations. The number of pigs was estimated by averaging the maximum number weighing over 55 lbs (2,500) and less than 55 lbs (10,000) in large CAFO operations.

Exposure Duration: Occupational handler exposure is expected to be short- and intermediate-term in duration. Because of the steady state AChE inhibition exhibited by the OPs, steady state exposures (typically 21 days and longer for OPs, but 1 day to reach steady state for tetrachlorvinphos) were assessed and presented for occupational exposures to TCVP products.

Mitigation/Personal Protective Equipment: Estimates of non-cancer inhalation exposure were calculated for various levels of PPE (i.e., respiratory protection). Results are presented for no respirator, PF10 respirator, or engineering controls (EC).

The PPE required for occupational use of TCVP varies by formulation type. The respiratory protection required for the occupational handling of TCVP can, at times, differ from label to label with consideration of the same formulation and exposure scenario. Occupational handler exposures are expected from use of TCVP on livestock and pets by livestock handlers, veterinarians, veterinary assistants, and groomers. The pet use formulations include collars, dusts/powders, and pump and trigger sprays. All but one of the TCVP pet product labels do not require PPE, as these are intended for residential sale as well as for occupational use. A summary of PPE required for all TCVP products is presented in Appendix A.

Days per Year of Exposure: To assess cancer risk, it is assumed that private applicators/farmers would be exposed 10 days per year and commercial applicators would be exposed 30 days per year. The term "private applicators/farmer" means that the applicators or one of the workers would apply the pesticides to land owned or operated by the farmer. Commercial applicators mean the applicators are completing multiple applications for multiple clients.

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[31] Based on BEAD memo on DDVP (Dichlorvos (DDVP) Usage on Dairy Cattle, Beef Cattle, Swine, and Poultry (Animals and Facilities); D340495; D. Atwood; 8/16/2007) which states "The best estimate for the maximum herd size which would be sprayed by hand is 30 head (from a 1994 memo to Mike Bringer)."

[32] [HYPERLINK "http://www.epa.gov/npdes/pubs/sector_table.pdf"]

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Years per Lifetime of Exposure: It is assumed that handlers would be exposed for 35 years out of a 78-year lifespan.

Lifetime Expectancy: Life expectancy values are from the Exposure Factors Handbook 2011 Edition Table 18-1 (U.S. EPA, 2011). The table shows that the overall life expectancy is 78 years based on life expectancy data from 2007. In 2007, the average life expectancy for males was 75 years and 80 years for females. Based on the available data, the recommended value for use in cancer risk assessments is 78 years.

Occupational Handler Non-Cancer Exposure and Risk Estimate Equations
The algorithms used to estimate non-cancer exposure and dose for occupational handlers can be found in Appendix B.

Combining Exposures/Risk Estimates
Although occupational dermal and inhalation exposures are anticipated for TCVP, risks have been estimated for inhalation exposures only due to the lack of dermal hazard. Therefore, no combined occupational exposures/risk estimates have been quantified.

Summary of Occupational Handler Non-Cancer Exposure and Risk Estimates
A summary of all non-cancer occupational handler exposure scenarios is presented in Appendix G. For risk management purposes, the currently labeled level of respiratory protection and EC has been identified (shaded) for each individual exposure scenario.

There is a total of 172 occupational handler exposure scenarios assessed. The majority (143) are not of concern (i.e., inhalation MOEs are ≥ the LOC of 300) with currently required personal protective equipment (PPE) (i.e., respiratory protection). Of the remaining 29 handler exposure scenarios, 20 are not of concern with consideration of increasing levels of respiratory protection. However, 9 occupational handler exposure scenarios result in estimated risks of concern despite the addition of respiratory protection or engineering controls.

Occupational Handler Cancer Exposure and Risk Equations

Cancer risk estimates were calculated using a linear low-dose extrapolation approach in which an LADD is first calculated and then compared with a Q1* that has been calculated for TCVP based on dose response data in the appropriate toxicology study (Q1* = 1.83×10^{-3} (mg/kg/day)-1). ADD levels were used as the basis for calculating the LADD values. Dermal and inhalation ADD values were first added together to obtain combined ADD values. LADD values were then calculated and compared to the Q1* to obtain cancer risk estimates. The algorithms used to estimate the LADD and cancer risk for occupational handlers can be found in Appendix B.

Summary of Occupational Handler Cancer Exposure and Risk Estimates
Occupational cancer risks were estimated for both private/farmer and contract/commercial handlers. A summary of occupational cancer risks as estimated at all levels of personal protection and with use of engineering controls is presented in Appendix H. Tables H.1 and H.2 present cancer risks for private/farmer handlers and Tables H.3 and H.4 risks for

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contract/commercial handlers. For risk management purposes, the currently labeled level of respiratory protection and EC has been identified (shaded) for each individual exposure scenario.

Cancer risks, with currently required PPE, range from 10^{-10} to 10^{-5} for private/farmer handlers and from 10^{-10} to 10^{-4} for contract/commercial handlers with currently required PPE.

Unlike the occupational handler non-cancer risk estimates which were based only on inhalation exposures, the occupational handler cancer risk estimates are quantified based on both dermal and inhalation exposures. This is because, despite the determination of the lack of dermal hazard for TCVP, dermal exposures from TCVP must be quantified for the purpose of cancer risk assessment. As previously described, the PPE required for the occupational use of TCVP varies by formulation type. For example, for feed through (solid and liquid food additives) and feed blocks, occupational handlers are required to wear baseline clothing (i.e., long sleeved shirt, long pants, shoes and socks) and gloves. For all other end-use labels with livestock and outdoor perimeter uses, required PPE can vary dependent on the application type or equipment and can range from baseline clothing and gloves, to the addition of coveralls, or respiratory protection.

8.2 Occupational Post-application Exposure/Risk Estimates

HED uses the term post-application to describe exposures that occur when individuals are present in an environment that has been previously treated with a pesticide (also referred to as re-entry exposure). Such exposures may occur when workers enter previously treated areas to perform job functions, including activities related to crop production, such as scouting for pests or harvesting. Post-application exposure levels vary over time and depend on such things as the type of activity, the nature of the crop or target that was treated, the type of pesticide application, and the chemical's degradation properties.

Occupational post-application exposures are not anticipated for TCVP as the majority of application scenarios are not to foliar surfaces. The use of TCVP outdoors as a perimeter treatment is not expected to result in occupational post-application exposure as reentry activities related to crop production (e.g., scouting, harvesting) are not anticipated for this use pattern.

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Appendix A – Summary of TCVP Labels and Use Directions

Table A.1. Summary of TCVP Occupational Livestock Use
Table A.2. Summary of TCVP Occupational/Residential Pet Products

Table A.1. Summary of TCVP Occupational Livestock Use

EPA Reg. No.	Use Site	Applic. Type/ Equipment	Applic. Rate (lb ai/A)	PPE	Use Directions and Limitations
Feed Through (Solid Additive)					
270-164	Horse Oral Larvicide	Cup	1,100 lb horse: 0.0015 lb ai/animal/day (2.468% ai)	Baseline clothing and gloves	Feed to horses through top dress on grain or mixed with the horse's total ration. 300-500 lb horse: Feed 2/5 oz. per horse per day 500-700 lb horse: Feed 2/5 oz. per horse per day 700-900 lb horse: Feed 2/5 oz. per horse per day 900-1,100 lb horse: Feed 2/5 oz. per horse per day For larger horses over 1,00 lbs. of body weight feed ¼ oz. for each 250 lbs.
270-165			1,100 lb horse: 0.00077 lb ai/animal/day (1.234% ai)		Feed the recommended dosage to each horse separately to make certain he receives the full portion. Feed to horses through top dress on grain or mixed with the horse's total ration. 300-500 lb horse: Feed 2/5 oz. per horse per day 500-700 lb horse: Feed 2/5 oz. per horse per day 700-900 lb horse: Feed 2/5 oz. per horse per day 900-1,100 lb horse: Feed 2/5 oz. per horse per day For larger horses over 1,100 lbs. of body weight feed ¼ oz. for each 250 lbs.
7698-7	Beef Cattle Oral Larvicide		1,400 lb beef cow (estimated max): 0.0022 lb ai/animal/day		Mix uniformly with cattle feeds following standard mixing procedures. Common feed mixing equipment (i.e., vertical mixers, horizontal blenders, mixer/feeder truck) may be used to prepare formulated feeds. Can be offered by force-feeding or free-choice feeding, but not both. Feed 1/3 lb per 100 lbs. per month, or an average daily intake of 70 mg daily.
73600-4	Cattle and Horse Oral Larvicide		0.0017 lb ai/animal/day		To prepare a larvicidal ration, mix 1.5 lbs. of product per ton of complete mixed ration. Full feed this larvicidal ration to feeder cattle weighing from 400 – 1,400 lbs or to dairy cattle at a rate sustaining milk production, but not less than 2.6 lbs of the ration per 100 lbs of body weight daily. Product can also be mixed with concentrate feeds that will provide 792 mg per animal per day.
Feed Through (Liquid Additive)					
6552-17	Cattle (concentrate feed)	Cup/Pour	1,700 lb cow (labeled max): 0.0039 lb ai/animal/day	Baseline clothing and gloves	This product can be used to prepare concentrate feeds that will provide 70 mgs. of ai/ 100 lbs. body weight daily. Feed the appropriate concentrate indicated to cattle weighing between 400 and 1,200 lbs. For large cattle weighing between 1,200 and 1,700 lbs, increase the amount of premix per ton of concentrate to 1.5 times that indicated.
	Cattle (complete ration)		1,400 lb cow (labeled max feeder cow): 0.0022 lb ai/animal/day		This product can be used to prepare rations containing 26.4 mg of ai/ pound of complete ration. Full feed the ration to feeder cattle weight from 400 to 1,400 lbs, but not less than 2.6 pounds of the ration per 100 lbs of body weight daily.
	Swine		0.00060 lb ai/animal/day		Mix 2.6 lbs of this product per ton of meal type feed and offer 4-6 lbs of feed per animal per day.

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Table A.1. Summary of TCVP Occupational Livestock Use					
EPA Reg. No.	Use Site	Applic. Type/ Equipment	Applic. Rate (lb ai/A)	PPE	Use Directions and Limitations
					This is equivalent to 45.4 mg of product per lb of feed.
	Horse		1,100 lb horse (estimated max): 0.0017 lb ai/animal/day		Use this product to prepare concentrate feeds/topdressings that will provide 70 mgs of ai per 100 lbs of weight daily.
11556-160	Cattle		1,700 lb cow (labeled max): 0.0039 lb ai/animal/day	Baseline clothing and gloves	Roughage fed separately: This product is used to prepare concentrate feeds that will provide 70 mg ai per 100 lbs body weight. Feed the appropriate larvicidal concentrate to cattle weighing between 400 and 1,200 lbs. For large cattle weighting between 1,200 and 1,700 lbs, increase the amount of premix per ton of concentrate to 1.5 times that indicated.
			1,400 lb cow (labeled max): 0.0022 lb ai/animal/day		No other roughage fed: Mix 1.5 lbs of product per ton of complete mixed ration containing both grain and roughage. Full feed this complete ration to feeder cattle weighing from 400 to 1,400 lbs or to dairy cattle at a rate to sustain milk production, but not less than 2.6 lbs of the ration per 100 lbs of body weight daily.
	Swine		0.00060 lb ai/animal/day		Mix 2.6 lbs of this product per ton of meal type feed and offer 4 to 6 lbs of feed per animal per day. This is equivalent to 45.5 mg ai per pound of feed.
	Horse		1,100 lb horse (estimated max): 0.0017 lb ai/animal/day		Use this product to prepare concentrate feeds that will provide 70 mg ai per 100 lbs body weight daily.
Feed Block					
6552-17	Cattle and Horse Oral Larvicide	Hand Dispersal	1,100 lb horse (estimated max): 0.0017 lb ai/animal/day 1,400 lb cow (estimated max): 0.0022 lb ai/animal/day (0.473% ai)	Baseline clothing and gloves	Provide 1 block per 5 head of cattle or horses. Feed at a daily rate of 0.07 grams of Larvicide in 0.5 ounces of block per 100 pounds of body weight.
7698-17			1,100 lb horse (estimated max): 0.0017 lb ai/animal/day 1,400 lb cow (estimated max): 0.0022 lb ai/animal/day		Place in dry spots near loafing and watering areas. Cattles (or horses) should consume 1.05 lbs of the product per 100 lbs of body weight per month. This will supply the recommended average daily intake of 70 mg per 100 lbs of body weight.
7698-18			1,100 lb horse (estimated max): 0.0017 lb ai/animal/day 1,400 lb cow (estimated max):		Cattles (or horses) should consume 0.68 lbs of the product per 100 lbs of body weight per month. This will supply the recommended average daily intake of 70 mg per 100 lbs of body weight.

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Table A.1. Summary of TCVP Occupational Livestock Use					
EPA Reg. No.	Use Site	Applic. Type/ Equipment	Applic. Rate (lb ai/A)	PPE	Use Directions and Limitations
			0.0022 lb ai/animal/day		
9078-12			1,100 lb horse (estimated max): 0.0017 lb ai/animal/day 1,400 lb cow (estimated max): 0.0022 lb ai/animal/day (0.31% ai)		Feed approximately ½ lb block per 1,000 lb animal daily
9374-8			1,100 lb horse (estimated max): 0.0017 lb ai/animal/day 1,400 lb cow (estimated max): 0.0022 lb ai/animal/day (0.30% ai)		Allow free choice for cattle and horses. Cattle and horses should consume an average of 0.8 oz of the product per 100 lbs of body weight per day. This will supply the recommended average daily intake of 70 mg.
55392-3			1,100 lb horse (estimated max): 0.0017 lb ai/animal/day 1,400 lb cow (estimated max): 0.0022 lb ai/animal/day (0.30% ai)		Provide one block per 15-20 head of cattle or horses. Consumption should average 0.83 oz of the block per 100 lbs. This will supply the recommended average daily intake of 70 kg.
73600-1			1,100 lb horse (estimated max): 0.0017 lb ai/animal/day 1,400 lb cow (estimated max): 0.0022 lb ai/animal/day (0.49% ai)		Feed 1 block per 5 head of cattle or horses. Feed blocks at the rate of 0.5 oz per 100 lb of bodyweight per day. This intake will supply 0.07 g of larvicide per 100 lb. of bodyweight per day.
73600-3			1,100 lb horse (estimated max): 0.0017 lb ai/animal/day 1,400 lb cow (estimated max): 0.0022 lb ai/animal/day (0.49% ai)		Feed only as a free choice source of salt, other minerals or vitamins. The product should be fed at a level to provide 70 mg per 100 lb of bodyweight per day.

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Table A.1. Summary of TCVP Occupational Livestock Use					
EPA Reg. No.	Use Site	Applic. Type/ Equipment	Applic. Rate (lb ai/A)	PPE	Use Directions and Limitations
73600-5			1,100 lb horse (estimated max): 0.0017 lb ai/animal/day 1,400 lb cow (estimated max): 0.0022 lb ai/animal/day (0.30% ai)		Feed one block per 10-15 head of cattle or horses. Feed blocks at the rate of 0.88 oz. per 100 lb. of body weight per day. This intake will supply 0.07 g of Larvicide per 100 lb. of bodyweight per day.
73600-6					Feed 1 block per 5 head of cattle or horses. Feed blocks at the rate of 0.88 oz. per 100 lb. of bod weight per day. This intake will supply 0.7 g of Larvicide per 100 lb. of bodyweight per day.
Dust					
11556-158	Beef Cattle and Dairy Cattle	Shaker Can, Rotary Duster, Spoon	2 oz. dust: 0.0038 lb ai 4 oz dust: 0.0075 lb ai (3% ai)	M/L/A: Baseline clothing, gloves, and respirator	Hand dusting: apply 2 oz. of dust by shaker can, rotary duster or by spoon to the upper portions of the back, neck and poll, and to the face. Also can be used after grubs have encysted by applying 3-4 oz. of dust down the backline and rubbing in.
		Hand Pour	12.5 lbs (estimated max dust bag): 0.38 lb ai per dust bag	Loaders and others handling dust bags: Baseline clothing, gloves	Self-treating dust bag: put dust in a cotton cloth or double burlap bag or use prepacked weather proof cattle dust bags and hang in door exits or alleyways leading from animal buildings, salt or mineral blocks or watering holes. The dust bag can also be placed in a loafing shed, holding pens, feedlots, near watering holes or other areas where cattle gather.
	Swine	Hand, Power Duster, Shaker Can	4 oz dust/animal: 0.0075 lb ai/animal 1 lb. per 150 sq. ft: 0.00020 lb/ sq ft.	M/L/A: Baseline clothing, gloves, and respirator	Hand dusting: apply 3-4 oz of dust by hand or power duster to each animal. In severe infestations, both animals and bedding may be treated. One lb. of 3% dust should be applied per 150 sq. ft.
	Poultry	Plunger, Rotary Type Duster, Shaker can Duster	0.00010 lb ai/ bird		Wire cage housing: Apply 1 lb dust/300 birds with plunger or rotary type duster or shaker can duster.
		Plunger, Rotary Type Duster	0.00030 lb ai/ sq ft		Floor management litter: Apply 1 lb/100 sq ft with plunger or rotary type duster. Or, apply 3 to 8 oz/ 100 sq ft with plunger or rotary type duster for treatment of darkling beetles.
		Plunger, Rotary Type Duster, Shaker can Duster	0.00060 lb ai/bird		Dust box: Apply 2 lbs/100 birds
		Paint	0.030 lb ai/ gallon (1 gallon treats 800 sq ft)		Roost paint: Make a thick slurry by mixing 1 lb of dust with 1 pint of water. Apply 1 lb/100 sq ft.
11556-182	Beef Cattle and Dairy Cattle	Shaker can, Rotary Duster, Spoon	1 oz. dust: 0.0038 lb ai	M/L/A: Baseline clothing,	Hand dusting: apply 1 oz. of dust by shaker can, rotary duster or by spoon to the upper portions of the back, neck and poll, and to the face.

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Table A.1. Summary of TCVP Occupational Livestock Use					
EPA Reg. No.	Use Site	Applic. Type/ Equipment	Applic. Rate (lb ai/A)	PPE	Use Directions and Limitations
			2 oz dust: 0.0075 lb ai (6% ai)	gloves, and respirator	Also can be used after grubs have encysted by applying 1.5-2 oz. of dust down the backline and rubbing in.
		Hand Pour	12.5 lbs (estimated max dust bag): 0.75 lb ai per dust bag	Loaders and others handling dust bags: Baseline clothing, gloves	Self-treating dust bag: put dust in a cotton cloth or double burlap bag or use prepacked weather proof cattle dust bags and hang in door exits or alleyways leading from animal buildings, salt or mineral blocks or watering holes. The dust bag can also be placed in a loafing shed, holding pens, feedlots, near watering holes or other areas where cattle gather.
	Swine	Hand, Power Duster, Shaker Can	2 oz dust/animal: 0.0075 lb ai/animal 0.5 lb. per 150 sq. ft: 0.00020 lb/ sq ft.	M/L/A: Baseline clothing, gloves, and respirator	Hand dusting: apply 1.5-2 oz of dust by hand or power duster to each animal. In severe infestations, both animals and bedding may be treated. One half lb. of 6% dust should be applied per 150 sq. ft.
	Poultry	Plunger, Rotary Type Duster, Shaker Can Duster	0.00010 lb ai/ bird		Wire cage housing: Apply 1 lb dust/600 birds with plunger or rotary type duster or shaker can duster.
		Plunger, Rotary Type Duster	0.00030 lb ai/ sq ft		Floor management litter: Apply 0.5 lb/100 sq ft with plunger or rotary type duster. Or, apply 1.5 to 4 oz/ 100 sq ft with plunger or rotary type duster for treatment of darkling beetles.
		Plunger, Rotary Type Duster, Shaker Can Duster	0.00060 lb ai/bird		Dust box: Apply 1 lbs/100 birds
		Paint	0.030 lb ai/ gallon (1 gallon treats 800 sq ft)		Roost paint: Make a thick slurry by mixing 1 lb of dust with 1 pint of water. Apply 0.5 lb/100 sq ft.
19713-340	Beef Cattle and Dairy Cattle	Shaker can, Rotary Duster, Spoon	2 oz. dust: 0.0038 lb ai 4 oz dust: 0.0075 lb ai (3% ai)	Baseline clothing and gloves	Hand dusting: apply approximately 2 oz. of dust by shaker can, rotary duster or by spoon to the upper portions of the back, neck and poll, and to the face.
		Hand Pour	12.5 lbs (estimated max dust bag): 0.38 lb ai per dust bag		Self-treating dust bag: put dust in a cotton cloth or durable bag or use pre-packed weather proof cattle dust bags and hang in barn door exits or alleyways leading from animal buildings, salt or mineral blocks or watering holes.
	Swine	Hand, Power Duster, Shaker Can	2 oz dust/animal: 0.0038 lb ai/animal 1 lb. per 150 sq. ft: 0.00020 lb/ sq ft		Hand dusting: apply 1.5-2 oz of dust by conventional hand or power duster to each animal with special attention given to the neck and around the ears. One lb of 3% dust should be applied per 150 sq ft of bedding.

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Table A.1. Summary of TCVP Occupational Livestock Use					
EPA Reg. No.	Use Site	Applic. Type/ Equipment	Applic. Rate (lb ai/A)	PPE	Use Directions and Limitations
47000-113	Beef Cattle and Dairy Cattle	Shaker can, Rotary Duster, Spoon	2 oz. dust: 0.0038 lb ai 4 oz dust: 0.0075 lb ai (3% ai)	Baseline clothing and gloves	Hand dusting: apply 2 oz. of dust by shaker can, rotary duster or by spoon to the upper portions of the back, neck and poll, and to the face. Also can be used after grubs have encysted by applying 3-4 oz. of dust down the backline and rubbing in.
		Hand Pour	12.5 lbs (estimated max dust bag): 0.38 lb ai per dust bag		Self-treating dust bag: put dust in a cotton cloth or double burlap bag or use prepacked weather proof cattle dust bags and hang in door exits or alleyways leading from animal buildings, salt or mineral blocks or watering holes. The dust bag can also be placed in a loafing shed, holding pens, feedlots, near watering holes or other areas where cattle gather.
	Swine	Hand, Power Duster, Shaker Can	4 oz dust/animal: 0.0075 lb ai/animal 1 lb. per 150 sq. ft: 0.00020 lb/ sq ft.		Hand dusting: apply 3-4 oz of dust by hand or power duster to each animal. In severe infestations, both animals and bedding may be treated. One lb. of 3% dust should be applied per 150 sq. ft.
	Poultry	Plunger, Rotary Type Duster, Shaker Can	0.00010 lb ai/ bird		Wire cage housing: Apply 1 lb dust/300 birds with plunger or rotary type duster or shaker can duster.
		Plunger, Rotary Type Duster	0.00030 lb ai/ sq ft		Floor management litter: Apply 1 lb/100 sq ft with plunger or rotary type duster. Or, apply 3 to 8 oz/ 100 sq ft with plunger or rotary type duster for treatment of darkling beetles.
		Plunger, Rotary Type Duster, Shaker Can Duster	0.00060 lb ai/bird		Dust box: Apply 2 lbs/100 birds
		Paint	0.030 lb ai/ gallon (1 gallon treats 800 sq ft)		Roost paint: Make a thick slurry by mixing 1 lb of dust with 1 pint of water. Apply 1 lb/100 sq ft.
47000-122	Beef Cattle and Dairy Cattle	Shaker Can, Rotary Duster, Spoon	2 oz. dust: 0.0038 lb ai (3% ai)	Baseline clothing and gloves	Hand dusting: apply 2 oz. of dust by shaker can, rotary duster or by spoon to the upper portions of the back, neck and poll, and to the face.
		Hand Pour	12.5 lbs (estimated max dust bag): 0.38 lb ai per dust bag		Self-treating dust bag: put dust in a cotton cloth or double burlap bag or use prepacked weather proof cattle dust bags and hang in door exits or alleyways leading from animal buildings, salt or mineral blocks or watering holes. The dust bag can also be placed in a loafing shed, holding pens, feedlots, near watering holes or other areas where cattle gather.
	Swine	Hand, Power Duster, Shaker Can	4 oz dust/animal: 0.0075 lb ai/animal 1 lb. per 150 sq. ft: 0.00020 lb/ sq ft.		Hand dusting: apply 3-4 oz of dust by hand or power duster to each animal. In severe infestations, both animals and bedding may be treated. One lb. of 3% dust should be applied per 150 sq. ft.

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Table A.1. Summary of TCVP Occupational Livestock Use					
EPA Reg. No.	Use Site	Applic. Type/ Equipment	Applic. Rate (lb ai/A)	PPE	Use Directions and Limitations
47000-123	Beef Cattle and Dairy Cattle	Shaker Can, Rotary Duster, Spoon	2 oz. dust: 0.0013 lb ai (1% ai)	Baseline clothing, coveralls, gloves and dust mist respriator	Hand dusting: apply 2 oz. of dust by shaker can, rotary duster or by spoon to the upper portions of the back, neck and poll, and to the face.
		Hand Pour	12.5 lbs (estimated max dust bag): 0.13 lb ai per dust bag		Self-treating dust bag: put dust in a cotton cloth or double burlap bag or use prepacked weather proof cattle dust bags. Suspend bags in gateways or lanes through which the animals pass daily for water, feed or minerals. The dust bag can also be placed in a loafing shed, holding pens, feedlots, near watering holes or other areas where cattle gather.
		Hand, Power Duster	12 oz dust/animal: 0.0075 lb ai/animal 3 lb. per 150 sq. ft: 0.00020 lb/ sq ft.		Hand dusting: apply 9-12 oz of dust by hand or power duster to each animal. In severe infestations, both animals and bedding may be treated. Three lbs of 1% dust should be applied per 150 sq. ft.
	Horse	Hand, Shaker Can	6 oz. dust/animal: 0.0038 lb ai/animal No application rate defined for premise dusting.*		Apply 6 oz by shaker can, hand duster, grooming brush or dust mitt. Cover upper portions of the back, neck and to the face, mane and tail for added control of face flies. For premise dusting, apply to barn or stall area floors where manure accumulates.*
	Dogs (Kennels)	Plunger Duster, Shaker Can	No application rate defined.*		Occasional dusting in and around sleeping quarters and other areas will help free area of ticks and fleas. Dust bedding as well.*
47000-125	Beef Cattle and Dairy Cattle	Shaker Can, Rotary Duster, Spoon	2 oz. dust: 0.0038 lb ai (3% ai)	Baseline clothing and gloves	Hand dusting: apply 2 oz. of dust by shaker can, rotary duster or by spoon to the upper portions of the back, neck and poll, and to the face.
		Hand, Pour	12.5 lbs (estimated max dust bag): 0.38 lb ai per dust bag		Self-treating dust bag: put dust in a cotton cloth or double burlap bag or use prepacked weather proof cattle dust bags and hang in door exits or alleyways leading from animal buildings, salt or mineral blocks or watering holes. The dust bag can also be placed in a loafing shed, holding pens, feedlots, near watering holes or other areas where cattle gather.
	Swine	Hand, Power Duster, Shaker Can	4 oz dust/animal: 0.0075 lb ai/animal 1 lb. per 150 sq. ft: 0.00020 lb/ sq ft.		Hand dusting: apply 3-4 oz of dust by hand or power duster to each animal. In severe infestations, both animals and bedding may be treated. One lb. of 3% dust should be applied per 150 sq. ft.
	Poultry	Plunger, Rotary Type Duster, Shaker can Duster	0.00010 lb ai/ bird		Wire cage housing: Apply 1 lb dust/300 birds with plunger or rotary type duster or shaker can duster.
		Plunger, Rotary Type Duster	0.00030 lb ai/ sq ft		Floor management litter: Apply 1 lb/100 sq ft with plunger or rotary type duster. Or, apply 3 to 8 oz/ 100 sq ft with plunger or rotary type duster for treatment of darkling beetles.
		Hand	0.00060 lb ai/bird		Dust box: Apply 2 lbs/100 birds

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Table A.1. Summary of TCVP Occupational Livestock Use					
EPA Reg. No.	Use Site	Applic. Type/ Equipment	Applic. Rate (lb ai/A)	PPE	Use Directions and Limitations
		Paint	0.030 lb ai/ gallon (1 gallon treats 800 sq ft)		Roost paint: Make a thick slurry by mixing 1 lb of dust with 1 pint of water. Apply 1 lb/100 sq ft.
Emulsifiable Concentrate Spray					
11556-162	Beef Cattle	Spray	0.026 lb ai/animal (23% ai)	Baseline clothing, coveralls, and gloves	Dilute 1 gallon of product in 75 gallons of water. Use between 0.5 and 1 gallon of diluted spray solution per animal.
			0.039 lb ai/animal		For severe tick infestations, dilution may be increased to 1 gallon in 50 gallons water.
	Lactating Dairy Cattle		0.0049 lb ai/animal		Dilute 1 gallon of product in 200 gallons of water. Direct spray to cover thoroughly with up to 0.5 gallon of the dilution per animal.
	Beef and Dairy Cattle	Backrubber or Facerubber	0.077 lb/gallon		Dilute 1 gallon of product in 25 gallons water. Pour diluted solution into oil reservoir of mechanical rubbing devices or pour 1 gallon per 20 feet on burlap or rope backrubbers.
	Poultry (Caged)	Spray	0.039 lb ai/100 birds 0.00031 lb ai/bird		Dilute 1 gallon product in 50 gallons of water. Apply 1 gallon of dilution/100 birds under high pressure. For individual bird treatment, apply 1 oz/ bird.
	Poultry (Chickens on Litter)		0.000078 lb ai/ sq ft		Dilute 1 gallon product in 50 gallons of water. Apply 1-2 gallons of dilution/1,000 square feet evenly with penetration of litter surface.
	Poultry	Roost Paint or Spray	0.077 lb ai/ gallon		Dilute 1 gallon of product in 25 gallons of water. Apply 1 pint of dilution/100 ft of roost area with brush or spray.
		Buildings	0.00077 lb ai/ sq ft		Dilute 1 gallon of product in 25 gallons of water. Apply 1 gallon of dilution/100-150 sq ft to thoroughly cover walls, ceilings, floors, cracks and crevices using high pressure spray.
	Poultry and Livestock Facilities	Spray	0.00015 lb ai/ sq ft		Residual surface spray: Dilute 1 gallon of product in 25 gallons of water. Apply 1 gallon of dilution/500-1,000 sq ft. Extreme infestations may necessitate increasing the diluted spray to 1 gallon product per 12.5 gallon water.
			0.00077 lb ai/ sq ft		Larvicide: Dilute 1 gallon of product in 25 gallons of water. Apply 1 gallon of dilution/100 sq ft.
	Kennels		0.000078 lb ai/ sq ft		Dilute 1 gallon of product in 50 gallons of water. Apply 1 gallon of dilution/500-1,000 sq ft as a spot treatment only once per year.
67517-33	Beef Cattle	Spray	0.032 lb ai/animal (24% ai)	Baseline, gloves, and organic vapor respirator	Dilute to a 0.30% - 0.50% solution. Use between 0.5 to 1 gallon of spray per animal.
	Lactating Dairy Cattle		0.0013 lb ai/ animal		Dilute to a 0.040% solution. Use 0.50 gallon of spray per animal.
	Beef and Lactating Dairy Cattle	Backrubber	0.064 lb ai/gallon	Baseline, gloves, coveralls, and organic vapor respirator	Dilute to a 1.0% solution. Mix with #2 diesel oil or any approved backrubber base oil.
	Swine	Spray, High Pressure Sprayer	0.016 lb ai/animal	Baseline, gloves, and	Dilute to a 0.5% solution. Apply a coarse spray using 0.25 to 0.5 gallon per head to thoroughly wet the animal.

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Table A.1. Summary of TCVP Occupational Livestock Use					
EPA Reg. No.	Use Site	Applic. Type/ Equipment	Applic. Rate (lb ai/A)	PPE	Use Directions and Limitations
	Poultry (Wire Cage)		0.032 lb ai/100 birds (gallon) 0.00025 lb ai/bird	organic vapor respirator	Dilute to a 0.5% solution. Apply 1 gallon/100 birds directly to birds, spray vent and fluff areas from below. For individual bird treatment, apply 1 oz of mixture per bird.
	Poultry (Floor Management)		0.000064 lb ai/ sq ft (2 gallons)		Dilute to 0.5% solution. Apply 1-2 gallons/1,000 sq ft evenly for penetration to litter surface.
	Poultry (Roost Paint)	Paint	0.064 lb ai/ gallon		Dilute to 1.0% solution. Apply 1 pint solution/100 sq ft. Treat with a brush or spray thoroughly.
	Poultry (Fowl Tick)	Power Sprayer	0.00064 lb ai/ sq ft		Dilute to 1.0% solution. Apply 1 gallon solution/100-150 sq ft to walls, ceiling, floors, cracks and crevices with a power sprayer.
	Poultry (Flies Residual)	Spray	0.00013 lb ai/ sq ft		Dilute to 1.0% solution. Apply 1 gallon/500-1,000 sq ft thoroughly to point of runoff to walls, ceilings, and where flies congregate and feed.
	Poultry (Larvicide)		0.00064 lb ai/ sq ft		Dilute to 1.0% solution. Apply 1 gallon solution/100 sq ft of droppings.
	Woody Borders of Kennels, Yards, Campgrounds, Recreational Parks, Footpaths and Roadways		0.032 lb ai/ sq ft		Dilute to 0.5% solution. Apply as a spot spray.
Wettable Powder					
11556-156	Beef Cattle	Spray	0.040 lb ai/animal (1 gallon)	MLA for dusting, low pressure handwand and paint applications: Baseline clothing, gloves, coveralls, dust mist respirator All other MLA and other handlers: Baseline clothing and gloves	Dilute to a 0.35-0.50% solution. Use a low pressure coarse spray and apply to point before runoff. Use between 0.5 to 1 gallon of spray solution per animal.
	Swine		0.020 lb ai/animal (0.5 gallon)		Dilute to a 0.50% solution. Apply as a low pressure coarse spray and apply only to point before runoff. Use 0.25 to 0.50 gallon maximum solution per head to treat.
	Poultry (Wire Cages)		0.00040 lb ai/ bird (gallon) 0.00031 lb ai/bird (1 oz)		Dilute to a 0.50% solution. Apply directly to birds (1 gallon solution/100 birds). For individual bird treatment apply 1 oz of the mixture per bird. Use power sprayer.
	Poultry (Floor Management Dusting)	Handheld Fogger, Plunger Duster, Stationary Fogger	0.0016 lb ai/ bird		Apply 2.5 oz wettable powder/50 birds.
	Poultry (Floor Management Roost Paint)	Paint	0.080 lb ai/ gallon (1 gallon treats 800 sq ft)		Dilute to a 1.0% solution. Treat with brush or spray thoroughly using 1 pint/100 ft.
	Poultry (Floor Management Litter)	Spray	0.00080 lb ai/ sq ft (2 gallons)		Dilute to a 0.50% solution. Apply 1-2 gallons solution/100 sq ft for penetration of litter surface.
		Handheld Fogger, Rotary Duster, Stationary Fogger	0.00023 lb ai/ sq ft (0.75 oz)		Treat evenly using 0.75 oz wettable powder/100 sq ft. Use rotary, mechanical or electrostatic duster.

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Table A.1. Summary of TCVP Occupational Livestock Use					
EPA Reg. No.	Use Site	Applic. Type/ Equipment	Applic. Rate (lb ai/A)	PPE	Use Directions and Limitations
	Poultry (Fowl Tick)	Spray	0.00080 lb ai/ sq ft (1 gallon)		Dilute to a 1.0% solution. Apply 1 gallon solution/100-150 sq ft to walls, ceiling, floor cracks, and crevices with power sprayer.
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings		0.00032 lb ai/ sq ft (1 gallon)		Dilute to a 2.0% solution. For dry whitewashed wood or concrete block surfaces use 1 gallon of solution/500 sq ft.
			0.00016 lb ai/ sq ft (1 gallon)		Dilute to a 1.0% solution. For unpainted wood or painted concrete block surfaces, use 1 gallon of solution/500 sq ft.
			0.000080 lb ai/ sq ft (0.5 gallon)		Dilute to a 1.0% solution. For Masonite or galvanized sheet metal surfaces, use 0.5 gallon of solution/ 500 sq ft.
	Poultry Droppings, Manure Piles, Garbage Piles, Under Feed Troughs		0.0008 lb ai/ sq ft (1 gallon)		Dilute to a 1.0% solution. Apply 1 gallon of solution/100 sq ft.
	Kennels, Yards, Campgrounds, Picnic Areas, and Recreational Parks		0.000040 lb ai/ sq ft (spot)		Dilute to a 0.5% solution. Apply as a spot treatment using a low pressure handwand sprayer only. Apply woody borders.
47000-126	Beef Cattle	Spray	0.040 lb ai/gallon	MLA for dusting and paint applications: Baseline clothing, gloves, coveralls, dust mist respirator All other MLA: Baseline clothing, gloves	Dilute to a 0.35-0.50% solution. Use a low pressure coarse spray and apply to point before runoff. Use between 0.5 to 1 gallon of spray solution per animal.
	Swine		0.020 lb ai/animal (0.5 gallon)		Dilute to a 0.50% solution. Apply as a coarse spray. Use 0.25 to 0.50 gallon maximum solution per head to treat.
	Poultry (Wire Cages)		0.00040 lb ai/ bird (gallon) 0.00031 lb ai/bird (1 oz)		Dilute to a 0.50% solution. Apply directly to birds (1 gallon solution/100 birds). For individual bird treatment apply 1 oz of the mixture per bird. Use power sprayer.
	Poultry (Floor Management – Litter)	Handheld Fogger, Plunger Duster, Stationary Fogger	0.00078 lb ai/ sq ft		Treat evenly and thoroughly using 2.5 oz/100 sq ft.
	Poultry (Floor Management - Dusting)		0.0016 lb ai/ bird		Apply 2.5 oz wettable powder/50 birds.
	Poultry (Floor Management Roost Paint)	Paint	0.080 lb ai/ gallon (1 gallon treats 800 sq ft)		Dilute to a 1.0% solution. Treat with brush or spray thoroughly using 1 pint/100 ft.
	Poultry (Fowl Tick)	Spray**	0.00080 lb ai/ sq ft (1 gallon)		Dilute to a 1.0% solution. Apply 1 gallon solution/100-150 sq ft to walls, ceiling, floor cracks, and crevices with power sprayer.
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings		0.00032 lb ai/ sq ft (1 gallon)		Dilute to a 2.0% solution. For dry whitewashed wood or concrete block surfaces use 1 gallon of solution/500 sq ft.
			0.00016 lb ai/ sq ft (1 gallon)		Dilute to a 1.0% solution. For unpainted wood or painted concrete block surfaces, use 1 gallon of solution/500 sq ft.
			0.000080 lb ai/ sq ft (0.5 gallon)		Dilute to a 1.0% solution. For Masonite or galvanized sheet metal surfaces, use 0.5 gallon of solution/ 500 sq ft.

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Table A.1. Summary of TCVP Occupational Livestock Use					
EPA Reg. No.	Use Site	Applic. Type/ Equipment	Applic. Rate (lb ai/A)	PPE	Use Directions and Limitations
	Poultry Droppings, Manure Piles, Garbage Piles, Under Feed Troughs		0.000080 lb ai/ sq ft (1 gallon)		Dilute to a 1.0% solution. Apply 1 gallon of solution/100 sq ft.

Table A.2. Summary of TCVP Occupational/Residential Pet Products			
EPA Reg. No.	Use Site	Application Rate	Use Restrictions
Collars			
2596-49 (collar weight: 11.3 g)	Cats	11.3 gram collar (14.6 % ai) Total ai: 0.0036 lb ai or 1,650 mg ai 20% removed: 1,320 mg ai	Do not use in kittens under 12 weeks of age. Place the collar around the cat's neck, adjust for proper fit, and buckle in place. Leave 2 or 3 inches on the collar for extra adjustment and cut off and dispose of the extra length. Replace the collar every 3 months, every 2 months for severe infestation.
2596-50 (collar weight: 19 g)	Dogs	19 gram collar (14.6 % ai) Total ai: 0.0061 lb ai or 2,774 mg ai 20% removed: 2,219 mg ai	Do not use on puppies less than 6 weeks of age. Place the collar around the dog's neck, adjust for proper fit, and buckle in place. Leave 2 or 3 inches on the collar for extra adjustment and cut off and dispose of the extra length. Replace the collar every 3 months, every 2 months for severe infestation.
2596-62 (collar weight: 19 – 32 g)		32 gram collar (14.6 % ai) Total ai: 0.0103 lb ai or 4,672 mg ai 20% removed: 3,738 mg ai	
2596-63 (collar weight: 15 – 17 g)	Cats	15 gram collar (14.6% ai) Total ai: 0.0048 lb ai or 2,190 mg ai 20% removed: 1,752 mg ai 17 gram collar (14.6% ai) Total ai: 0.0055 lb ai or 2,482 mg ai 20% removed: 1,986 mg ai	Do not use on kittens less than 12 weeks of age. Place the collar around the cat's neck, adjust for proper fit, and buckle in place. Leave 2 or 3 inches on the collar for extra adjustment and cut off and dispose of the extra length. Replace the collar every 5 months, every 4 months for severe infestation.
2596-83 (collar weight: 12 – 25 g)	Cats	12 gram collar (14.6% ai) Total ai: 0.0039 lb ai or 1,752 mg ai 20% removed: 1,402 25 gram collar (14.6% ai) Total ai: 0.0080 lb ai or 3,650 mg ai 20% removed: 2,920 mg ai	Do not use on kittens less than 12 weeks of age. Place the collar around the cat's neck, adjust for proper fit, and buckle in place. Leave 2 or 3 inches on the collar for extra adjustment and cut off and dispose of the extra length. Replace the collar every 7 months, every 5 months for severe infestation.
2596-139 (collar weight: 5 – 25 g[1]; assumed lower end of range for cats)	Cats	5 gram collar (14.6% ai) Total ai: 0.0016 lb ai or 730 mg ai 20% removed: 584 mg ai	Do not use on puppies under 6 weeks old/ kittens under 12 weeks old. Place the collar around the cat's/dog's neck, adjust for proper fit, and buckle in place. Leave 2 or 3 inches on the collar for extra adjustment and cut off and dispose of the extra length. Replace the collar every 7 months, or more frequently for severe infestation.
2596-84 (collar weight: 19 – 32 g)	Dogs	19 gram collar (14.6% ai) Total ai: 0.0061 lb ai or 2,774 mg ai	Do not use on puppies under 6 weeks of age. Place the collar around the dog's neck, adjust for proper fit, and buckle in place.

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Table A.2. Summary of TCVP Occupational/Residential Pet Products			
EPA Reg. No.	Use Site	Application Rate	Use Restrictions
		20% removed: 2,219 mg ai 32 gram collar (14.6% ai) Total ai: 0.0103 lb ai or 4,672 mg ai 20% removed: 3,738 mg ai	Leave 2 or 3 inches on the collar for extra adjustment and cut off and dispose of the extra length. Replace the collar every 7 months, every 5 months for severe infestation.
2596-139 (collar weight: 5 – 25 g[1]; assumed lower end of range for cats)	Dogs	25 gram collar (14.6% ai) Total ai: 0.0080 lb ai or 3,650 mg ai 20% removed: 2,920 mg ai	Do not use on puppies under 6 weeks old/ kittens under 12 weeks old. Place the collar around the cat's/dog's neck, adjust for proper fit, and buckle in place. Leave 2 or 3 inches on the collar for extra adjustment and cut off and dispose of the extra length. Replace the collar every 7 months, or more frequently for severe infestation.
Dusts/Powders			
2596-78	Cats	0.3 ounce of powder for a small cat or 0.5 ounce for a large cat (3.3% ai) Small cat: 8.5 grams product = 0.00062 lb ai or 280.5 mg ai Large cat: 14.2 grams product = 0.00103 lb ai or 468.6 mg ai	Not for use on kittens less than 12 weeks of age. Dust entire cat beginning at head and working back. Use approximately 1/3 ounce of powder for a small cat or ½ ounce for a large cat. Repeat at weekly intervals if necessary.
2596-79	Dogs	0.5 ounce of powder for a small dog; 1 oz for a medium dog; and 1.25 oz for large dogs (3.3% ai) Small: 14.2 grams product = 0.00103 lb ai or 468.6 mg ai Medium: 28.4 grams product = 0.00206 lb ai or 937.2 mg ai Large: 35.5 grams product = 0.00258 lb ai or 1171.5 mg ai	Not for use on puppies less than 12 weeks of age. Dust entire dog beginning at the head and working back. Make sure powder gets down to the skin. Lightly dust the dog's bedding with approximately the same amount of powder. Repeat treatment of dog and bedding at weekly intervals if necessary. Use ½ ounce of powder for a small dog; 1 oz for a medium dog; and 1 ¼ oz for large dogs.
47000-123	Cats	0.3 oz (8.5 grams) of powder per every 10 pounds of body weight (1.0% ai) Estimated Range: Small (5 lbs): 4.25 grams product = 0.00009 lb ai or 42.5 mg ai Medium (12 lbs): 10.2 grams product = 0.00022 lb ai or 102 mg ai Large (18 lbs): 15.3 grams product = 0.00034 lb ai or 153 mg ai, large	Do not apply to kittens or puppies under 12 weeks old. Dust powder evenly over the animal and rub thoroughly through the hair coat to skin. Use 1/3 oz (8.5 grams) of powder per every 10 pounds of body weight of your cat or dog. Do not reapply product for 30 days. *PPE: Baseline clothing, coveralls, gloves and dust mist respirator.
	Dogs	1/3 oz (8.5 grams) of powder per every 10 pounds of body weight (1.0% ai) Estimated Range: Small (20 lbs): 17 grams product = 0.00037 lb ai or 170 mg ai Medium (50 lbs): 42.5 grams product = 0.00094 lb ai or 425 mg ai Large (80 lbs): 68 grams product = 0.0015 lb ai or 680 mg ai	
Pump/Trigger Sprays[2]			
2596-125	Dogs (Trigger)	1.1% ai	Do not apply to pets (puppies) less than 6 weeks old.

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Table A.2. Summary of TCVP Occupational/Residential Pet Products			
EPA Reg. No.	Use Site	Application Rate	Use Restrictions
		Small: 30 strokes = 27.78 grams product = 0.00066 lb ai or 300 mg ai Medium: 40 strokes = 37.04 grams product = 0.00088 lb ai or 400 mg ai Large: 70 strokes = 64.82 grams product = 0.0015 lb ai or 700 mg ai, large	Hold bottle upright about 6 inches from pet. Spray lightly until the tips of the pet's hair are moist. Rub spray into animal's coat. Repeat once per week. Recommended dosage: Spray 25-30 strokes for a small dog. Spray 30-40 strokes for a medium dog. Spray 40-70 strokes for a large dog. More spray may be needed for longhaired dogs.[3]
2596-126	Cats (Trigger)	1.1% ai Small: 25 strokes = 23.15 grams product = 0.00055 lb ai or 250 mg ai Large: 35 strokes = 32.41 grams product = 0.00077 lb ai or 350 mg ai	Do not apply to pets (kittens) less than 6 weeks old. Hold bottle upright about 6 inches from pet. Spray lightly until the tips of the pet's hair are moist. Rub spray into animal's coat. Repeat once per week. Recommended dosage: Spray 15-25 strokes for a small cat. Spray 25-35 strokes for a large cat. More spray may be needed for longhaired cats.[3]
2596-140	Cats[5] (Pump)	1.1% ai Small: 25 strokes = 4.73 grams product = 0.00011 lb ai or 51 mg ai Large: 35 strokes = 6.62 grams product = 0.00016 lb ai or 71 mg ai	Do not use on puppies or kittens less than 12 weeks old. Hold bottle upright about 6 inches from pet. Spray lightly until the tips of the pet's hair are moist. Rub spray into animal's coat. Repeat once per week. Recommended dosage: Spray 15-25 strokes for a small cat. Spray 25-35 strokes for a large cat.[4] Recommended dosage: Spray 25-35 strokes for a small dog. Spray 30-40 strokes for a medium dog. Spray 40-70 strokes for a large dog.[4]
	Cats[5] (Trigger)	1.1% ai Small: 25 strokes = 23.15 grams product = 0.00055 lb ai or 250 mg ai Large: 35 strokes = 32.41 grams product = 0.00077 lb ai or 350 mg ai	
	Dogs (Trigger)	1.1% ai Small: 35 strokes = 32.41 grams product = 0.00077 lb ai or 350 mg ai Medium: 40 strokes = 37.04 grams product = 0.00088 lb ai or 400 mg ai Large: 70 strokes = 64.82 grams product = 0.0015 lb ai or 700 mg ai	

1. Correspondence from Registrant (5/26/2020) indicated that this product (EPA Reg. #2696-139) is approved for both cats and dogs, and is packaged/sold as a single unit and as a 2-pack so that the net weight statement on the product label reflects the weight of 2 collars. Therefore, HED has assumed that the weight of 1 collar is half of the weight range indicated on the product label (10 to 50 g).
2. Application rates for liquid spray products determined using information provided by the Registrant regarding the volume of product released per stroke: pump spray products = 0.19 g and trigger-spray products = 0.93 g.
3. Current label language (EPA Reg. No. 2596-125 and 2596-126) allows for more than a prescribed amount of strokes per cat/dog. Assessment is based on the amount labelled for each weight range. Any such label language allowing for an exceedance should be removed.
4. The recommended number of strokes as presented for EPA Reg. No. 2596-140 is based on master label amendments proposed by the registrant and granted by EPA (March 2014). Previously, a number of strokes per cat/dog was not recommended. The maximum number of strokes was considered in the risk assessment for cats and dogs based on animal size.
5. EPA Reg. No. 2596-140 registered as both a pump spray and trigger spray for cats.

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Appendix B: Summary of Occupational and Residential Non-cancer Algorithms

Residential Dermal and Inhalation Handler Exposure Algorithm

Daily dermal and inhalation exposure (mg/day) for residential pesticide handlers, for a given formulation-application method combination, is estimated by multiplying the formulation-application method-specific unit exposure by an estimate of the amount of active ingredient handled in a day, using the equation below:

$$E = UE * AR * A$$

where:

E = exposure (mg/day);
UE = unit exposure (mg/lb ai);
AR = application rate (e.g., lb ai/ft^2, lb ai/gal); and
A = number of animals treated per day.

Residential Post-application Dermal Exposure Algorithm

The following method is used to calculate dermal exposures that are attributable to an adult or child contacting a treated companion pet:

$$E = TC * TR * ET$$

where:

E = exposure (mg/day);
TC = transfer coefficient (cm^2/hr);
TR = transferable residue (mg/cm^2); and
ET = exposure time (hours/day).

$$TR = \frac{AR * F_{AR}}{SA}$$

where:

TR = transferable residue (mg/cm^2);
AR = application rate or amount applied to animal (mg);
F_{AR} = fraction of the application rate available as transferable residue; and
SA = surface area of the pet (cm^2).

Absorbed dermal dose, normalized to body weight, is calculated as:

$$D = \frac{E * AF}{BW}$$

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where:

D = dose (mg/kg-day);
E = exposure (mg/day);
AF = absorption factor (dermal); and
BW = body weight (kg).

Table B.1. Treated Pets – Inputs for Residential Post-application Dermal Exposure

Algorithm Notation	Exposure Factor Units		Point Estimates
AR	Application rate (mg)		Unique for each product
SA	Surface Area of Animal (cm^2)	Small Cat, Dog	Cat – 1,500 Dog – 3,000
		Medium Cat, Dog	Cat – 2,500 Dog – 7,000
		Large Cat, Dog	Cat – 4,000 Dog – 11,000
F_{AR}	Fraction of AR Available for Transfer (recommended point estimate)		Non-Cancer Collar (MRID 50881801): 0.0017 Collar (Davis study): 0.0017 Dust/Powder (TCVP): 0.00048 Pump Spray (TCVP): 0.0081 Cancer Collar (Davis study): 0.00092 Dust/Powder (TCVP): 0.00022 Pump Spray (TCVP): 0.0018
TC	Transfer Coefficient – Liquids (cm^2/hr)	Adult	5,200
		Children 1 < 2 years old	1,400
	Transfer Coefficient – Solids (cm^2/hr)	Adult	140,000
		Children 1 < 2 years old	38,000
ET	Exposure Time (hours per day)	Adult	0.77
		Children 1 < 2 years old	1.0
BW	Body weight (kg)	Adult	80
		Children 1 < 2 years old	11

Residential Post-application Hand-to-Mouth Exposure Algorithm

Exposure from hand-to-mouth activity is calculated as follows (based on algorithm utilized in SHEDS-Multimedia):

$$E = [HR * (F_M * SA_H) * (ET * N\_Replen) * (1- (1- SE)^{(Freq\_HtM/N\_Replen)})]$$

where:

E = exposure (mg/day);

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HR = hand residue loading (mg/cm^2);
SA_H = surface area of one child hand (cm^2);
F_M = fraction hand surface area mouthed /event (fraction/event);
ET = exposure time (hr/day);
N_Replen = number of replenishment intervals per hour (intervals/hour);
SE = saliva extraction factor (i.e., mouthing removal efficiency); and
Freq_HtM = number of hand-to-mouth contacts events per hour (events/hour).

and

$$HR = \frac{E * Fai_{hands}}{2 * SA_H}$$

where:

HR = hand residue loading (mg/cm^2);
E = dermal exposure (mg);
Fai_{hands} = fraction of a.i. on hands compared to total residue from dermal transfer coefficient study (unitless); and
SA_H = surface area of one child hand (cm^2).

Oral dose, normalized to body weight, is calculated as:

$$D = \frac{E}{BW}$$

where:

D = dose (mg/kg-day);
E = exposure (mg/day); and
BW = body weight (kg).

Table B.2. Treated Pets – Inputs for Residential Post-application Hand-to-Mouth Exposure

Algorithm Notation	Exposure Factor (units)		Point Estimate(s)
Fai_{hands}	Fraction of a.i. on hands from transfer coefficient studies (unitless)		Solid = 0.37 Liquid = 0.040
F_M	Fraction hand surface area mouthed /event (fraction/event)		0.13
N_Replen	Replenishment intervals per hour (intervals/hr)		4
ET	Exposure time (hours/day)	Children 1 < 2 years old	1.0
SE	Saliva extraction factor		0.48
Freq_HtM	Hand-to-mouth events per hour (events/hr)	Children 1 < 2 years old	20
SA_H	Typical surface area of one child hand (cm^2)	Children 1 < 2 years old	150
BW	Body Weight (kg)	Children 1 < 2 years old	11

Occupational Non-cancer Handler Algorithms

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Potential daily exposures for occupational handlers are calculated using the following formulas:

$$E = UE * AR * A * 0.001\ mg/ug$$

where:

E	=	exposure (mg ai/day),
UE	=	unit exposure (µg ai/lb ai),
AR	=	maximum application rate according to proposed label (lb ai/A or lb ai/gal), and
A	=	area treated or amount handled (e.g., A/day, gal/day).

The daily doses are calculated using the following formula:

$$ADD = \frac{E * AF}{BW}$$

where:

ADD	=	average daily dose absorbed in a given scenario (mg ai/kg/day),
E	=	exposure (mg ai/day),
AF	=	absorption factor (dermal and/or inhalation), and
BW	=	body weight (kg).

Margin of Exposure: Non-cancer risk estimates for each application handler scenario are calculated using a Margin of Exposure (MOE), which is a ratio of the toxicological endpoint to the daily dose of concern. The daily dermal and inhalation dose received by occupational handlers are compared to the appropriate POD (i.e., NOAEL) to assess the risk to occupational handlers for each exposure route. All MOE values are calculated using the following formula:

$$MOE = \frac{POD}{ADD}$$

where:

MOE	=	margin of exposure: value used by HED to represent risk estimates (unitless),
POD	=	point of departure (mg/kg/day), and
ADD	=	average daily dose absorbed in a given scenario (mg ai/kg/day).

Occupational and Residential Cancer Algorithms

After the development of the ADD values, the next step required to calculate carcinogenic risk estimates is to amortize these values over the anticipated lifetime, which results in the LADD. LADD values are calculated using the following equation:

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$$LADD = ADD * \frac{Days\ per\ Year\ of\ Exposure}{365\ Days\ per\ Year} * \frac{Years\ per\ Lifetime\ of\ Exposure}{Lifetime\ Expectancy}$$

where:

LADD	=	absorbed dose over a lifetime (mg ai/kg/day),
ADD	=	average daily dose absorbed in a given scenario (mg ai/kg/day),
Days per Year of Exposure	=	annual frequency of an application by an individual (days/year),
Years per Lifetime of Exposure	=	amount of a lifetime that an individual would be expected to use pesticides (years), and
Lifetime Expectancy	=	average life expectancy of an individual (years).

Cancer risk estimate calculations are completed by comparing the LADD values calculated above to the Q_1* for the chemical. Cancer risk estimates are calculated using the following equation:

$$Total\ Cancer\ Risk\ Estimate = (Dermal\ LADD + Inhalation\ LADD) * Q_1*$$

where:

Cancer Risk Estimate	=	probability of incidence of cancer cases over a lifetime (unitless),
Dermal LADD	=	absorbed dose from dermal exposure over a lifetime (mg ai/kg/day),
Inhalation LADD	=	absorbed dose from inhalation exposure over a lifetime (mg ai/kg/day), and
Q_1*	=	quantitative dose response factor used for linear, low-dose response cancer risk estimate calculations $(mg/kg/day)^{-1}$.

Table B.3. Treated Pets – Inputs for Cancer Exposure/Risk

Algorithm Notation	Exposure Factor (units)	Point Estimate(s)
EF	Exposure Frequency (days/year)	Occupational: Private/Farmer – 10 days/year Contract/Commercial – 30 days/year
		Residential: Handlers - Collars, 4 Dusts/Powders and Pump/Trigger Sprays, 6 Post-application (all formulations) - 180
ET	Exposure Time (years)	35: occupational 50: residential
AT	Averaging Time (years)	78
CF	Conversion Factor (days/year)	365

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Appendix C – Summary of Residential Handler Non-Cancer Exposures and Risks

Table C.1. Residential Handler Non-Cancer Dermal and Inhalation Doses Assuming a Liquid or Dust Formulation for Pet Collars.
Table C.2. Residential Handler Non-Cancer Risk Estimates from Use of TCVP Pet Collars Assuming 99.62% Liquid/0.38% Dust Ratio Formulation.
Table C.3. Residential Handler Non-Cancer Risk Estimates from Use of TCVP Dust/Powder and Pump/Trigger Spray Products.

Table C.1. Residential Handler Non-Cancer Dermal and Inhalation Doses Assuming a Liquid or Dust Formulation for Pet Collars.

Exposure Scenario	Reg. No. (Target Animal)	Dermal Unit Exposure (mg/lb ai)	Inhalation Unit Exposure (mg/lb ai)	Maximum Application Rate[1] (lb ai/pet)	Amount Handled Daily (animals treated per day)[2]	Dermal Dose (mg/kg/day)[3]	Inhalation Dose (mg/kg/day)[4]
Assume Liquid Formulation -- Use of Spot-On Exposure Data (based on 2012 Residential SOPs)							
Application of TCVP Collars	2596-49 (Cat)	120	Negligible	0.0036	2	0.0012	Negligible
	2596-50, 62 (Dog)			0.0061 (small collar)		0.0020	
				0.0103 (large collar)		0.0034	
	2596-63 (Cat)			0.0048 (small collar)		0.0016	
				0.0055 (large collar)		0.0018	
	2596-83 (Cat)			0.0039 (small collar)		0.0013	
				0.0080 (large collar)		0.0027	
	2596-84 (Dog)			0.0061 (small collar)		0.0014	
				0.0103 (large collar)		0.0023	
	2596-139 (Cat)			0.0016		0.0005	
	2596-139 (Dog)			0.0080		0.0027	
Assume Dust Formulation -- Use of TCVP Dust Applicator Exposure Data (MRID 45519601)							
Application of TCVP Collars	2596-49 (Cat)	1,700	3.1	0.0036	2	0.017	0.00033
	2596-50, 62 (Dog)			0.0061 (small collar)		0.029	0.00055
				0.0103 (large collar)		0.049	0.00092
	2596-63 (Cat)			0.0048 (small collar)		0.023	0.00043
				0.0055 (large collar)		0.026	0.00049
	2596-83 (Cat)			0.0039 (small collar)		0.018	0.00035
				0.0080 (large collar)		0.038	0.00072
	2596-84 (Dog)			0.0061 (small collar)		0.019	0.00037
				0.0103 (large collar)		0.032	0.00062
	2596-139 (Cat)			0.0016		0.008	0.00014
	2596-139 (Dog)			0.0080		0.038	0.00072

1 Based on registered TCVP pet product labels ~~and an adjustment for 20% of the collar being removed due to trimming~~ (see Table A2). Application rate (lb ai/pet) = (collar weight in grams ~~adjusted for 20% trimming~~ × 454 lb/g conversion factor) * percent ai in collar.
2 Based on HED's 2012 Residential SOPs (http://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide).
3 Dermal Dose = Dermal Unit Exposure (mg/lb ai) × Application Rate (lb ai/pet) × Area Treated or Amount Handled (pets/day) × Dermal Absorption Factor (9.6 %) ÷ Body Weight (69 kg).
4 Inhalation Dose = Inhalation Unit Exposure (mg/lb ai) × Application Rate (lb ai/pet) × Area Treated or Amount Handled (pets/day) ÷ Body Weight (69 kg).

Commented [RK27]: Not sure what I'm doing wrong but I get 0.0029 lb ai/pet using the footnote equation. ((11.3g*0.8)/454)*14.6%

Commented [kml28R27]: Thanks for catching that. Initially I had included the 20% trimming for handlers but then after thinking about it some more, realized that probably did not make any sense since the handler is exposed to the full collar length as they put it on the dog and then trim off the excess. So I backtracked and kept these values the same. I missed that I had adjusted the footnote though. I'll take out the 20% from the footnote.

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Table C.2. Residential Handler Non-Cancer Risk Estimates from Use of TCVP Pet Collars Assuming 99.62% Liquid/0.38% Dust Ratio Formulation. LOC = 300

Exposure Scenario	Reg. No. (Target Animal)	Maximum Application Rate[1] (lb ai/pet)	Amount Handled Daily (animals treated per day)[2]	Combined 99.62%/0.38% Liquid/Dust Dermal Dose (mg/kg/day)[3]	Combined 99.62%/0.38% Liquid/Dust Inhalation Dose (mg/kg/day)[4]	Combined 99.62%/0.38% Liquid/Dust Ratio Inhalation MOE **(LOC = 300)**[5]
Application of TCVP Collars	2596-49 (Cat)	0.0036	2	0.0013	0.0000012	1,100,000
	2596-50, 62 (Dog)	0.0061 (small collar)		0.0021	0.0000021	630,000
		0.0103 (large collar)		0.0036	0.0000035	370,000
	2596-63 (Cat)	0.0048 (small collar)		0.0017	0.0000016	800,000
		0.0055 (large collar)		0.0019	0.0000019	700,000
	2596-83 (Cat)	0.0039 (small collar)		0.0013	0.0000013	990,000
		0.0080 (large collar)		0.0028	0.0000027	480,000
	2596-84 (Dog)	0.0061 (small collar)		0.0014	0.0000014	940,000
		0.0103 (large collar)		0.0024	0.0000023	560,000
	2596-139 (Cat)	0.0016		0.0006	0.0000005	2,400,000
	2596-139 (Dog)	0.0080		0.0028	0.0000027	480,000

1 Based on registered TCVP pet product labels ~~and an adjustment for 20% of the collar being [illegible] to trimming~~ (see Table A2). Application rate (lb ai/pet) = (collar weight in grams ~~adjusted for 20% trimming~~ ÷ 454 lb/g conversion factor) * percent ai in collar.
2 Based on HED's 2012 Residential SOPs (http://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide).
3 Combined 99.62%/0.38% Liquid/Dust Dermal Dose = (Liquid dermal dose * 0.9962) + (Dust dermal dose * 0.0038).
4 Combined 99.62%/0.38% Liquid/Dust Inhalation Dose = (Liquid inhalation dose * 0.9962) + (Dust inhalation dose * 0.0038).
5. No dermal MOE estimated due to lack of dermal hazard. Inhalation MOE = Inhalation HED (1.31 mg/kg/day) ÷ Combined 99.62%/0.38% Liquid/Dust Inhalation Dose (mg/kg/day).

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Table C.3. Residential Handler Non-Cancer Risk Estimates from Use of TCVP Dust/Powder and Pump/Trigger Spray Products.

Exposure Scenario	Reg. No. (Target Animal)	Dermal Unit Exposure (mg/lb ai)	Inhalation Unit Exposure (mg/lb ai)	Maximum Application Rate[1] (lb ai/pet)	Amount Handled Daily (animals treated per day)[2]	Dermal		Inhalation	
						Dose (mg/kg/day)[3]	MOE[4]	Dose (mg/kg/day)[5]	MOE **(LOC = 300)**[6]
Application of TCVP Dusts/Powders	47000-123 (Dog)	1,700	3.1	0.00037 (small animal)	2	0.0018	N/A, No Dermal Hazard	0.000034	39,000
				0.00094 (medium animal)		0.0044		0.000084	16,000
				0.0015 (large animal)		0.0071		0.00013	9,700
	47000-123 (Cat)			0.000094 (small animal)		0.00044		0.0000084	160,000
				0.00023 (medium animal)		0.0011		0.000020	65,000
				0.00034 (large animal)		0.0016		0.000030	43,000
	2596-78 (Cat)			0.00062 (small animal)		0.0029		0.000056	24,000
				0.0010 (large animal)		0.0049		0.000093	14,000
	2596-79 (Dog)			0.0010 (small animal)		0.0049		0.000093	14,000
				0.0021 (medium animal)		0.0097		0.00019	7,100
				0.0026 (large animal)		0.0122		0.00023	5,600
Application of TCVP Pump/Trigger Sprays	2596-126, -140 (Cat) (Trigger)	820	3.3	0.00055 (small animal)		0.0013	N/A, No Dermal Hazard	0.000053	25,000
				0.00077 (medium animal)		0.0018		0.000074	18,000
	2596-140 (Cat) (Pump)			0.00011 (small animal)		0.00026		0.000011	120,000
				0.00016 (large animal)		0.00036		0.000015	87,000
	2596-125, -140 (Dog) (Trigger)			0.00077 (small animal)		0.0018		0.000074	18,000
				0.00088 (medium animal)		0.0020		0.000084	16,000
				0.0015 (large animal)		0.0035		0.00015	8,900

1 Based on registered TCVP pet product labels.
2 Based on HED's 2012 Residential SOPs (http://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide)
3 Dermal Dose = Dermal Unit Exposure (mg/lb ai) × Application Rate (lb ai/pet) × Area Treated or Amount Handled (pets/day) × Dermal Absorption Factor (9.6%) ÷ Body Weight (69 kg). Dermal dose presented only for purpose of calculation of cancer risks for residential handlers.
4 No dermal MOE estimated due to lack of dermal hazard.

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5 Inhalation Dose = Inhalation Unit Exposure (mg/lb ai) × Application Rate (lb ai/pet) × Area Treated or Amount Handled (pets/day) ÷ Body Weight (69 kg).
6 Inhalation MOE = Inhalation HED (1.31 mg/kg/day) ÷ Inhalation Dose (mg/kg/day).

Appendix D – Summary of Residential Handler Cancer Exposure and Risk Estimates

Table D.1. Residential Handler Cancer Risk Estimates from Use of TCVP Pet Collars Assuming 99.62% Liquid/0.38% Dust Ratio Formulation.
Table D.2. Residential Handler Cancer Risk Estimates from Use of TCVP Dust/Powder and Pump/Trigger Spray Products.

Table D.1. Residential Handler Cancer Risk Estimates from Use of TCVP Pet Collars Assuming 99.62% Liquid/0.38% Dust Ratio Formulation.

Reg No./ Animal Type	Animal Size	Lifestage	Liquid LADD[1]	Dust LADD[2]	99.62% Liquid / 0.38% Dust Cancer Risk Estimate[3]
2596-49 (Cat)	Any	Adult	8.5E-06	1.2E-04	1.6E-08
2596-50, 62 (Dog)	Small		1.4E-05	2.1E-04	2.7E-08
	Medium, Large		2.4E-05	3.5E-04	4.6E-08
2596-63 (Cat)	Small		1.1E-05	1.6E-04	2.2E-08
	Medium, Large		1.3E-05	1.8E-04	2.5E-08
2596-83 (Cat)	Small		9.0E-06	1.3E-04	1.7E-08
	Medium, Large		1.9E-05	2.7E-04	3.6E-08
2596-84 (Dog)	Small		9.6E-06	1.4E-04	1.8E-08
	Medium, Large		1.6E-05	2.3E-04	3.1E-08
2596-139 (Cat)	Any		3.8E-06	5.4E-05	7.2E-09
2596-139 (Dog)	Any		1.9E-05	2.7E-04	3.6E-08

1 Liquid LADD = [Inhalation + Dermal Dose (mg/kg/day)] × [Days per year of exposure (4 days/yr) ÷ 365 days/year] × [Years per lifetime of exposure (50 yrs) ÷ Lifetime expectancy (78 yrs)]. Inhalation exposures considered negligible based on use of spot-on data for liquid pet collar formulation.
2 Dust LADD = [Inhalation + Dermal Dose (mg/kg/day)] × [Days per year of exposure (4 days/yr) ÷ 365 days/year] × [Years per lifetime of exposure (50 yrs) ÷ Lifetime expectancy 78 (yrs)].
3 Cancer risk estimates = [(Liquid LADD * 0.9962) + (Dust LADD * 0.0038)] × Q_1^*, where $Q_1^* = 1.83 \times 10^{-3}$ $(mg/kg/day)^{-1}$

Table D.2. Residential Handler Cancer Risk Estimates from Use of TCVP Dust/Powder and Pump/Trigger Spray Products.

Reg No./ Animal Type	Animal Size	Lifestage	Total LADD[1,2]	Cancer Risk Estimate[3]
Dust/Powder				
47000-123 (Dog)	Small	Adult	1.9E-05	3.5E-08
	Medium		4.7E-05	8.7E-08
	Large		7.6E-05	1.4E-07
47000-123 (Cat)	Small		4.7E-06	8.7E-09
	Medium		1.1E-05	2.1E-08
	Large		1.7E-05	3.1E-08
2596-78 (Cat)	Small		3.1E-05	5.7E-08
	Medium		5.2E-05	9.6E-08
2596-79 (Dog)	Small		5.2E-05	9.6E-08
	Medium		1.0E-04	1.9E-07
	Large		1.3E-04	2.4E-07
Pump/Trigger Sprays				
2596-126, -140 (Cat) (Trigger)	Small	Adult	1.4E-05	2.5E-08
	Large		1.9E-05	3.5E-08
2596-140 (Cat) (Pump)	Small		2.8E-06	5.1E-09
	Large		3.9E-06	7.2E-09
2596-125, -140 (Dog) (Trigger)	Small		1.9E-05	3.5E-08
	Medium		2.2E-05	4.0E-08
	Large		3.9E-05	7.0E-08

1 Total Lifetime Average Daily Dose (LADD, mg/kg/day) = Dermal LADD (mg/kg/day) + Inhalation LADD (mg/kg/day).
2 Dermal and Inhalation LADD equations provided in Appendix B.
3 Cancer risk estimates = Total LADD × Q_1^*, where $Q_1^* = 1.83 \times 10^{-3}$ $(mg/kg/day)^{-1}$

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Appendix E – Summary of Residential Post-Application Non-Cancer Exposure and Risk Estimates

Table E.1. Residential Post-application Non-cancer Incidental Oral Dose Assuming a Liquid or Dust Formulation for Pet Collars.
Table E.2. Residential Post-Application Non-Cancer Risk Estimates from Use of TCVP Pet Collars Assuming 99.62% Liquid/0.38% Dust Ratio Formulation.
Table E.3. Residential Post-Application Non-Cancer Risk Estimates from Use of TCVP Dust/Powder and Pump/Trigger Spray Formulations.

Table E.1. Residential Post-application Non-cancer Incidental Oral Dose Assuming a Liquid or Dust Formulation for Pet Collars.

Animal Type	Animal Size	Application Rate (mg ai)	F_{ai_hands}	DE Dermal Exposure (mg)	SA_H Surface area of 1 hand (cm^2)	HR Hand residue loading (mg/cm^2)	F_{ft} Fraction of hand mouthed	ET Exposure Time (hours/day)	Replenish-ment interval (min)	N_Replen # replenish-ment intervals per hour (intervals/hr)	SE Fraction Saliva Extraction	Freq_HtM Number of hand-to-mouth contacts events per hour (events/hr)	Incidental oral Absorbed Dose ($mg/kg/day^1$)
Assume Liquid Formulation													
Cat (2596-49)	small	1,320	0.04	2.1	150	0.0003	0.13	1	15	4	0.48	20	0.0019
	medium	1,320	0.04	1.3	150	0.0002	0.13	1	15	4	0.48	20	0.0011
	large	1,320	0.04	0.8	150	0.0001	0.13	1	15	4	0.48	20	0.0007
Dog (2596-50,62)	small	2,219	0.04	1.8	150	0.0002	0.13	1	15	4	0.48	20	0.0016
	large	3,738	0.04	0.8	150	0.0001	0.13	1	15	4	0.48	20	0.0007
Cat (2596-83)	small	1,402	0.04	2.2	150	0.0003	0.13	1	15	4	0.48	20	0.0020
	large	2,920	0.04	1.7	150	0.0002	0.13	1	15	4	0.48	20	0.0016
Cat (2596-139)	small	584	0.04	0.9	150	0.0001	0.13	1	15	4	0.48	20	0.0008
	medium	584	0.04	0.6	150	0.0001	0.13	1	15	4	0.48	20	0.0005
	large	584	0.04	0.3	150	0.00005	0.13	1	15	4	0.48	20	0.0003
Dog (2596-84)	small	2,219	0.04	1.8	150	0.0002	0.13	1	15	4	0.48	20	0.0016
	large	3,738	0.04	0.8	150	0.0001	0.13	1	15	4	0.48	20	0.0007
Dog (2596-139)	small	2,920	0.04	2.3	150	0.0003	0.13	1	15	4	0.48	20	0.0021
	medium	2,920	0.04	1.0	150	0.0001	0.13	1	15	4	0.48	20	0.0009
	large	2,920	0.04	0.6	150	0.0001	0.13	1	15	4	0.48	20	0.0006
Cat (2596-63)	small	1,752	0.04	2.8	150	0.0004	0.13	1	15	4	0.48	20	0.0025
	large	1,986	0.04	1.2	150	0.0002	0.13	1	15	4	0.48	20	0.0011
Assume Dust Formulation													
Cat (2596-49)	small	1,320	0.37	37	150	0.0701	0.13	1	15	4	0.48	20	0.48
	medium	1,320	0.37	34	150	0.0421	0.13	1	15	4	0.48	20	0.29
	large	1,320	0.37	21	150	0.0263	0.13	1	15	4	0.48	20	0.18
Dog (2596-50,62)	small	2,219	0.37	48	150	0.0589	0.13	1	15	4	0.48	20	0.40
	large	3,738	0.37	22	150	0.0271	0.13	1	15	4	0.48	20	0.18
Cat (2596-83)	small	1,402	0.37	60	150	0.0744	0.13	1	15	4	0.48	20	0.51
	large	2,920	0.37	47	150	0.0582	0.13	1	15	4	0.48	20	0.40
Cat (2596-139)	small	584	0.37	25	150	0.0310	0.13	1	15	4	0.48	20	0.21
	medium	584	0.37	15	150	0.0186	0.13	1	15	4	0.48	20	0.13
	large	584	0.37	9	150	0.0116	0.13	1	15	4	0.48	20	0.08
Dog (2596-84)	small	2,219	0.37	48	150	0.0589	0.13	1	15	4	0.48	20	0.40

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Table E.1. Residential Post-application Non-cancer Incidental Oral Dose Assuming a Liquid or Dust Formulation for Pet Collars.

Animal Type	Animal Size	Application Rate (mg ai)	$F_{ai_{hands}}$	DE: Dermal Exposure (mg)	SA_H: Surface area of 1 hand (cm^2)	HR: Hand residue loading (mg/cm^2)	F_m: Fraction of hand mouthed	ET: Exposure Time (hours/day)	Replenish-ment interval (min)	N_Replen: # replenish-ment intervals per hour (intervals/hr)	SE: Fraction Saliva Extraction	Freq_HtM: Number of hand-to-mouth contacts events per hour (events/hr)	Incidental oral Absorbed Dose (mg/kg/day)
	large	3,738	0.37	22	150	0.0271	0.13	1	15	4	0.48	20	0.18
Dog (2596-139)	small	2,920	0.37	63	150	0.0775	0.13	1	15	4	0.48	20	0.53
	medium	2,920	0.37	27	150	0.0332	0.13	1	15	4	0.48	20	0.23
	large	2,920	0.37	17	150	0.0211	0.13	1	15	4	0.48	20	0.14
Cat (2596-63)	small	1,752	0.37	75	150	0.0931	0.13	1	15	4	0.48	20	0.63
	large	1,986	0.37	32	150	0.0395	0.13	1	15	4	0.48	20	0.27

1. Application rates are label defined and adjusted for 20% removal of the pet collar. Refer to Table A.2.
2. Dermal Exposure (mg/day) = [Transfer Coefficient (cm^2/hr)] * [Application Rate (label defined) * Fraction Application Rate (0.0017; Davis, M. et. al and MRID 50881801) ÷ Surface Area of Cat/Dog (Cat: Small, 1,500; Medium, 2,500; Large, 4,000 cm^2; Dog: Small, 3,000; Medium, 7,000; Large, 11,000 cm^2)] x [Exposure Time (Adults, 0.77 hours/day; Children, 1.0 hours/day))
3. Incidental Oral Dose (mg/kg/day) = [Hand Residue Loading (mg/cm^2)] × [Fraction of Hand Mouthed (0.13) × Surface Area of 1 Child Hand (150 cm^2)] x [Exposure Time (1.0 hrs/day) × # of Replenishment Intervals/hr (4 int/hr)) × (1-((1-Saliva Extraction Factor (0.5)) (Number of Hand-to-Mouth Events per Hour (20 events/hr)) ÷ (# of Replenishment Intervals/hr))] / [Body Weight (11 kg child 1 to < 2 years old years old)]
   Where the Hand Residue Loading (mg/cm^2) = [Fai_{hands} (Solid, 0.37; Liquids, 0.040) x Dermal Exposure (mg/day)] ÷ [Surface Area of 1 Child Hand (150 cm^2) x 2]

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Table E.2. Residential Post-Application Non-Cancer Risk Estimates from Use of TCVP Pet Collars Assuming 99.62% Liquid/0.38% Dust Ratio Formulation.

EPA Reg. No./ Animal	Lifestage	Application Rate (mg ai)[1]	Animal Size	Liquid Incidental Oral Dose (mg/kg/day)[2]	Dust Incidental Oral Dose (mg/kg/day)[3]	Combined Dose[4] (99.62%/0.38% Liquid/Dust) ~~(mg/kg/day)~~	99.62% Liquid/0.38% Dust Combined Incidental Oral MOE **(LOC = 1000)**[5]
2596-49: Cat	Children 1 < 2	1,320	Small	0.0019	0.48	0.0037	**750**
			Medium	0.0011	0.29	0.0022	1300
			Large	0.0007	0.18	0.0014	2000
2596-50, 62: Dog	Children 1 < 2	2,219	Small	0.0016	0.40	0.0031	**900**
		3,738	Large	0.0007	0.18	0.0014	2000
2596-83: Cat	Children 1 < 2	1,402	Small	0.0020	0.51	0.0039	**710**
		2,920	Large	0.0016	0.40	0.0031	**910**
2596-139: Cat	Children 1 < 2	584	Small	0.0008	0.21	0.0016	1700
			Medium	0.0005	0.13	0.0010	2800
			Large	0.0003	0.08	0.0006	4500
2596-84: Dog	Children 1 < 2	2,219	Small	0.0016	0.40	0.0031	**900**
		3,738	Large	0.0007	0.18	0.0014	2000
2596-139: Dog	Children 1 < 2	2,920	Small	0.0021	0.53	0.0041	**680**
			Medium	0.0009	0.23	0.0018	1600
			Large	0.0006	0.14	0.0011	2500
2596-63: Cat	Children 1 < 2	1,752	Small	0.0025	0.63	0.0049	**570**
		1,986	Large	0.0011	0.27	0.0021	1300

1. Application rates are label defined. Refer to Table A.2.
2. Liquid ~~and Dust~~ HTM Doses from Table E.1.
3. Dust HTM Doses from Table E.1.
~~2-4. 99.62% Liquid/0.38% Dust Combined Dose (mg/kg/day) = (Liquid HTM Dose * 0.9962) + (Dust HTM Dose * 0.0038).~~
~~3-~~5. 99.62% Liquid/0.38% Dust Combined MOE = Incidental Oral NOAEL (2.8 mg/kg/day) ÷ ~~[(Liquid HTM Dose * 0.9962) + (Dust HTM Dose * 0.0038~~Combined Dose~~)] (mg/kg/day)~~

Commented [RK29]: These are the same as 2596-50 right? Is there supposed to be a difference?

Commented [kml30R29]: I'll double check the labels, but the spreadsheets have always had them as having the same g ai to start with.

Commented [kml31R29]: Confirmed – same range of collar weights

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Table E.3. Residential Post-Application Non-Cancer Risk Estimates from Use of TCVP Dust/Powder and Pump/Trigger Spray Formulations.

EPA Reg. No./ Animal	Lifestage	Application Rate (mg ai)[1]	Animal Size	Dermal Exposure (mg/day)[2]	Incidental Oral Dose (mg/kg/day)[3]	Incidental Oral MOE **(LOC = 1000)**[4]
Dusts/Powders						
47000-123: Dog	Children 1 < 2	170	Small	1.0	0.0087	**320**
		430	Medium	1.1	0.0093	**300**
		680	Large	1.1	0.0095	**300**
47000-123: Cat	Children 1 < 2	43	Small	0.52	0.0043	**640**
		100	Medium	0.74	0.0063	**450**
		150	Large	0.70	0.0059	**480**
2596-78: Cat	Children 1 < 2	280	Small	3.4	0.0287	**98**
		470	Large	2.1	0.0180	**160**
2596-79: Dog	Children 1 < 2	470	Small	2.9	0.0240	**120**
		940	Medium	2.4	0.0205	**140**
		1,200	Large	1.9	0.0163	**170**
Pump/Trigger Sprays						
2596-126, 140: Cat (Trigger)	Children 1 < 2	250	Small	1.9	0.00172	1,600
		350	Large	0.99	0.00090	3,100
2596-140: Cat	Children	51	Small	0.39	0.00035	8,000

Table E.3. Residential Post-Application Non-Cancer Risk Estimates from Use of TCVP Dust/Powder and Pump/Trigger Spray Formulations.

EPA Reg. No./ Animal	Lifestage	Application Rate (mg ai)[1]	Animal Size	Dermal Exposure (mg/day)[2]	Incidental Oral Dose (mg/kg/day)[3]	Incidental Oral MOE **(LOC = 1000)**[4]
(Pump)	1 < 2	71	Large	0.20	0.00018	15,000
2596-125, -140: Dog (Trigger)	Children 1 < 2	350	Small	1.3	0.00120	2,300
		400	Medium	0.65	0.00059	4,800
		700	Large	0.72	0.00066	4,300

1. Application rates are label defined. Refer to Table A.2.
2. Dermal Exposure (mg/day) = [Transfer Coefficient (cm^2/hr)] * [Application Rate (label defined) * Fraction Application Rate (Dust, 0.00048; Spray, 0.0081) ÷ Surface Area of Cat/Dog (Cat: Small, 1,500; Medium, 2,500; Large, 4,000 cm^2 - Dog: Small, 3,000; Medium, 7,000; Large, 11,000 cm^2)] x [Exposure Time (Adults, 0.77 hours/day; Children, 1.0 hours/day))]
3. Incidental Oral Dose (mg/kg/day) = [Hand Residue Loading (mg/cm^2)] × [Fraction of Hand Mouthed (0.13) × Surface Area of 1 Child Hand (150 cm^2)] x [Exposure Time (1.0 hrs/day) × # of Replenishment Intervals/hr (4 int/hr)) × (1-((1-Saliva Extraction Factor (0.5))^(Number of Hand-to-Mouth Events per Hour (20 events/hr)) × (# of Replenishment Intervals/hr))] / [Body Weight (11 kg child 1 to < 2 years old years old)]
   Where the Hand Residue Loading (mg/cm^2) = [Fai_{hands} (Dusts, 0.37; Liquids, 0.040) x Dermal Exposure (mg/day)] ÷ [Surface Area of 1 Child Hand (150 cm^2) x 2]
4. MOE = Incidental Oral NOAEL (2.8 mg/kg/day) ÷ Incidental Oral Dose (mg/kg/day).

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Appendix F – Summary of Residential Post-Application Cancer Exposure and Risks

Table F.1. Residential Post-Application Cancer Risk Estimates from Use of TCVP Pet Collars Assuming 99.62% Liquid/0.38% Dust Ratio Formulation.

Table F.2. Residential Post-Application Cancer Estimates from Use of TCVP Dust/Powder and Pump/Trigger Spray Formulations.

Table F.1. Residential Post-Application Cancer Risk Estimates from Use of TCVP Pet Collars Assuming 99.62% Liquid/0.38% Dust Ratio Formulation.

Animal Type	Animal Size	Lifestage	Liquid LADD[1]	Dust LADD[2]	Combined 99.62% Liquid/0.38% Dust LADD[3]	Cancer Risk Estimate[4]
2596-49: Cat	Small	Adult	1.4E-03	3.8E-02	1.6E-03	2.9E-06
	Medium		8.5E-04	2.3E-02	9.4E-04	1.7E-06
	Large		5.3E-04	1.4E-02	5.9E-04	1.1E-06
2596-50,62: Dog	Small		1.2E-03	3.2E-02	1.3E-03	2.4E-06
	Large		5.5E-04	1.5E-02	6.0E-04	1.1E-06
2596-83: Cat	Small		1.5E-03	4.1E-02	1.7E-03	3.0E-06
	Large		1.2E-03	3.2E-02	1.3E-03	2.4E-06
2596-139: Cat	Small		6.3E-04	1.7E-02	6.9E-04	1.3E-06
	Medium		3.8E-04	1.0E-02	4.1E-04	7.6E-07
	Large		2.4E-04	6.3E-03	2.6E-04	4.7E-07
2596-84: Dog	Small		1.2E-03	3.2E-02	1.3E-03	2.4E-06
	Large		5.5E-04	1.5E-02	6.0E-04	1.1E-06
2596-139: Dog	Small		1.6E-03	4.2E-02	1.7E-03	3.2E-06
	Medium		6.7E-04	1.8E-02	7.4E-04	1.4E-06
	Large		4.3E-04	1.2E-02	4.7E-04	8.6E-07
2596-63: Cat	Small		1.9E-03	5.1E-02	2.1E-03	3.8E-06
	Large		8.0E-04	2.2E-02	8.8E-04	1.6E-06

1 Liquid LADD = [Dermal Dose (mg/kg/day)] × [Days per year of exposure (180 days/yr) ÷ 365 days/year] × [Years per lifetime of exposure (50 yrs) ÷ Lifetime expectancy (78 yrs)]. Dermal dose calculated using fraction transferred value from Davis study of 0.00092.

2 Dust LADD = [Dermal Dose (mg/kg/day)] × [Days per year of exposure (180 days/yr) ÷ 365 days/year] × [Years per lifetime of exposure (50 yrs) ÷ Lifetime expectancy (78 yrs)]

3 Combined 99.62% Liquid/0.38% Dust LADD = (Liquid LADD * 0.9962) + (Dust LADD * 0.0038).

4 Cancer risk estimates = Combined 99.62% Liquid/0.38% Dust LADD × Q_1^*, where $Q_1^* = 1.83 \times 10^{-3}$ $(mg/kg/day)^{-1}$

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Table F.2. Residential Post-Application Cancer Estimates from Use of TCVP Dust/Powder and Pump/Trigger Spray Formulations.

Animal Type	Animal Size	Lifestage	Total LADD[1,2]	Cancer Risk Estimate[3]
Dust/Powder				
47000-123: Dog	Small	Adult	5.9E-04	1.1E-06
	Medium		6.3E-04	1.2E-06
	Large		6.4E-04	1.2E-06
47000-123: Cat	Small		2.9E-04	5.4E-07
	Medium		4.2E-04	7.8E-07
	Large		4.0E-04	7.3E-07
2596-78: Cat	Small		1.9E-03	3.6E-06
	Large		1.2E-03	2.2E-06
2596-79: Dog	Small		1.6E-03	3.0E-06
	Medium		1.4E-03	2.5E-06
	Large		1.1E-03	2.0E-06
Pump/Trigger Spray				
2596-126, 140: Cat (Trigger)	Small	Adult	5.3E-04	9.6E-07
	Large		2.8E-04	5.1E-07
2596-140: Cat (Pump)	Small		1.1E-04	2.0E-07
	Large		5.6E-05	1.0E-07
2596-125, -140: Dog (Trigger)	Small		3.7E-04	6.7E-07
	Medium		1.8E-04	3.3E-07
	Large		2.0E-04	3.7E-07

1 Total Lifetime Average Daily Dose (mg/kg/day) = Dermal LADD (mg/kg/day) + Inhalation LADD (mg/kg/day).
2 Dermal and Inhalation LADD equations provided in Appendix B.
3 Cancer risk estimates = Total LADD × Q1*, where Q1* = 1.83×10^{-3} $(mg/kg/day)^{-1}$

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Appendix G – Summary of Occupational Handler Non-Cancer Exposures and Risks

Table G.1. TCVP Occupational Handler Non-Cancer Risk Estimates.

Table G.2. TCVP Occupational Handler Non-Cancer Risk Estimates – Scenario 10c (mixing/loading and applying wettable powders using mechanically-pressurized handgun) with Use of Chemical-Specific Data and PHED.

Table G.1. TCVP Occupational Handler Non-Cancer Risk Estimates.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/ unit)	Area Treated or Amount Handled[2] (units/day)	Inhalation Dose (mg/kg/day)[3]			Inhalation MOEs (LOC = 300)[4] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario.		
				No R	PF10 R	EC	No R	PF10 R	EC
Mixer/Loaders									
(1a) Mixing/Loading Liquids for Groundboom Applications	Poultry Buildings (Floors)	0.00077 lb ai/sq ft	100,000 sq ft	2.5E-04	2.5E-05	9.3E-05	16,000	160,000	43,000
	Poultry Buildings (Floor Management, Fowl Tick)	0.00064 lb ai/sq ft		2.0E-04	2.0E-05	7.7E-05	19,000	190,000	51,000
	Poultry Buildings (Flies Residual)	0.00013 lb ai/sq ft		4.1E-05	4.1E-06	1.6E-05	95,000	950,000	250,000
	Poultry Floor Management	0.000064 lb ai/sq ft		2.0E-05	2.0E-06	7.7E-06	190,000	1,900,000	510,000
(1b) Mixing/Loading Liquids for Paint Applications	Poultry Buildings (Roost)	0.077 lb ai/gallon	2 gallons	4.9E-07	4.9E-08	1.9E-07	8.1E+06	8.1E+07	2.1E+07
		0.064 lb ai/gallon		4.1E-07	4.1E-08	1.5E-07	9.7E+06	9.7E+07	2.6E+07
(2a) Mixing/Loading Wettable Powders for Groundboom Applications	Poultry Buildings (Including: Droppings, Floor Management Litter, Fowl Tick)	0.00080 lb ai/sq ft	100,000 sq ft	0.050	0.0050	0.00028	**79**	790	14,000
	Dairy Barns, Poultry Houses, Swine Barns, or Other Animal Buildings	0.00032 lb ai/sq ft		0.020	0.0020	0.00011	**200**	2,000	35,000
(2b) Mixing/Loading Wettable Powders for Paint Applications	Poultry (Floor Management – Roost)	0.080 lb ai/gallon	2 gallons	1.0E-04	1.0E-05	5.6E-07	40,000	400,000	7,100,000
(3a) Mixing/Loading Dusts for Paint Applications (WP Data as Surrogate)		0.030 lb ai/gallon		3.7E-05	3.7E-06	2.1E-07	110,000	1,100,000	1.9E+07
Applicators									
(4) Groundboom Applications	Poultry Buildings (Including: Droppings, Floor Management Litter, Fowl Tick,	0.00080 lb ai/sq ft	100,000 sq ft	3.9E-04	3.9E-05	5.0E-05	10,000	100,000	79,000

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Table G.1. TCVP Occupational Handler Non-Cancer Risk Estimates.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/ unit)	Area Treated or Amount Handled[2] (units/day)	Inhalation Dose (mg/kg/day)[3]			Inhalation MOEs (LOC = 300)[4] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario.		
				No R	PF10 R	EC	No R	PF10 R	EC
	Garbage Piles, Manure Piles, Under Feed Troughs)								
	Poultry Buildings (Including: Ceilings, Floors, Larvicide, Walls)	0.00077 lb ai/sq ft		3.8E-04	3.8E-05	4.8E-05	10,000	100,000	82,000
	Poultry Buildings (Including: Floor Management, Fowl Tick, Larvicide)	0.00064 lb ai/sq ft		3.2E-04	3.2E-05	4.0E-05	12,000	120,000	99,000
	Dairy Barns, Poultry Houses, Swine Barns, or Other Animal Buildings	0.00032 lb ai/sq ft		1.6E-04	1.6E-05	2.0E-05	25,000	250,000	200,000
	Poultry Buildings (Flies Residual)	0.00013 lb ai/sq ft		6.4E-05	6.4E-06	8.1E-06	61,000	610,000	490,000
	Poultry (Floor Management)	0.000064 lb ai/sq ft		3.2E-05	3.2E-06	4.0E-06	120,000	1,200,000	990,000
(5) Open Pour Liquid Additive for Feed Through Applications	Cattle Feed (Concentrate)	0.0039 lb ai/animal	1,000 cows	1.2E-05	1.2E-06	No Data	320,000	3,200,000	No Data
	Cattle Feed (Concentrate)	0.0022 lb ai/animal		7.0E-06	7.0E-07	No Data	560,000	5,600,000	No Data
	Horse Feed	0.0017 lb ai/animal	500 horses	2.7E-06	2.7E-07	No Data	1,500,000	15,000,000	No Data
	Swine Feed	0.00060 lb ai/animal	6,250 pigs	1.2E-05	1.2E-06	No Data	330,000	3,300,000	No Data
(6) RTU Pet Collars – 99.62% liquid/0.38%dust ratio	Cat (2596-49)	0.0036 lb ai/animal	8 animals	2.80E-05	2.80E-06	No Data	140,000	1,400,000	No Data
	Dog (2596-50,62) - Small	0.0061 lb ai/animal		4.71E-05	4.71E-06	No Data	84,000	840,000	No Data
	Dog (2596-50,62) - Large	0.0103 lb ai/animal		7.94E-05	7.94E-06	No Data	50,000	500,000	No Data
	Cat (2596-63) - Small	0.0048 lb ai/animal		3.72E-05	3.72E-06	No Data	110,000	1,100,000	No Data
	Cat (2596-63) - Large	0.0055 lb ai/animal		4.22E-05	4.22E-06	No Data	93,000	930,000	No Data
	Cat (2596-83) - Small	0.0039 lb ai/animal		2.98E-05	2.98E-06	No Data	130,000	1,300,000	No Data
	Cat (2596-83) - Large	0.0080 lb ai/animal		6.23E-05	6.23E-06	No Data	63,000	630,000	No Data

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Table G.1. TCVP Occupational Handler Non-Cancer Risk Estimates.									
Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/ unit)	Area Treated or Amount Handled[2] (units/day)	Inhalation Dose (mg/kg/day)[3]			Inhalation MOEs (LOC = 300)[4] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario.		
				No R	PF10 R	EC	No R	PF10 R	EC
	Dog (2596-84) – Small	0.0041 lb ai/animal		3.14E-05	3.14E-06	No Data	130,000	1,300,000	No Data
	Dog (2596-84) – Large	0.0069 lb ai/animal		5.28E-05	5.28E-06	No Data	75,000	750,000	No Data
	Cat (2596-139) - All	0.0016 lb ai/animal		1.24E-05	1.24E-06	No Data	320,000	3,200,000	No Data
	Dog (2596-139) - All	0.0080 lb ai/animal		6.23E-05	6.23E-06	No Data	63,000	630,000	No Data
(7) RTU Dust/Powder Applications	Dog (47000-123) - Small	0.00037 lb ai/animal		0.00075	0.000075	No Data	5,200	52,000	5,200
	Dog (47000-123) - Medium	0.00094 lb ai/animal		0.0019	0.00019	No Data	2,100	21,000	2,100
	Dog (47000-123) - Large	0.0015 lb ai/animal		0.0030	0.00030	No Data	1,300	13,000	1,300
	Cat (47000-123) - Small	0.000090 lb ai/animal		0.00018	0.000018	No Data	22,000	220,000	22,000
	Cat (47000-123) - Medium	0.00022 lb ai/animal		0.00045	0.000045	No Data	8,800	88,000	8,800
	Cat (47000-123) - Large	0.00034 lb ai/animal		0.00069	0.000069	No Data	5,700	57,000	5,700
	Cat (2596-78) - Small	0.00062 lb ai/animal		0.0013	0.00013	No Data	3,100	31,000	3,100
	Cat (2596-78) - Large	0.0010 lb ai/animal		0.0020	0.00020	No Data	1,900	19,000	1,900
	Dog (2596-79) - Small	0.0010 lb ai/animal		0.0020	0.00020	No Data	1,900	19,000	No Data
	Dog (2596-79) - Medium	0.0021 lb ai/animal		0.0043	0.00043	No Data	920	9,200	No Data
	Dog (2596-79) - Large	0.0026 lb ai/animal		0.0053	0.00053	No Data	750	7,500	No Data
	Dog (67517-82) - Small	0.0011 lb ai/animal		0.0022	0.00022	No Data	1,800	18,000	No Data
	Dog (67517-82) - Medium	0.0028 lb ai/animal		0.0057	0.00057	No Data	690	6,900	No Data
	Dog (67517-82) - Large	0.0045		0.0091	0.00091	No Data	430	4,300	No Data

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Table G.1. TCVP Occupational Handler Non-Cancer Risk Estimates.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/ unit)	Area Treated or Amount Handled[2] (units/day)	Inhalation Dose (mg/kg/day)[3]			Inhalation MOEs (LOC = 300)[4] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario.		
				No R	PF10 R	EC	No R	PF10 R	EC
		lb ai/animal							
	Cat (67517-82) - Small	0.00028 lb ai/animal		0.00057	0.000057	No Data	6,900	69,000	No Data
	Cat (67517-82) - Medium	0.00067 lb ai/animal		0.0014	0.00014	No Data	2,900	29,000	No Data
	Cat (67517-82) - Large	0.0010 lb ai/animal		0.0020	0.00020	No Data	1,900	19,000	No Data
(8) RTU Pump/Trigger Spray Applications	Cat (2596-126,140) - Trigger -Small	0.00055 lb ai/animal		0.00021	0.000021	No Data	19,000	190,000	No Data
	Cat (2596-126,140) - Trigger - Large	0.00077 lb ai/animal		0.00029	0.000029	No Data	13,000	130,000	No Data
	Cat (2596-140) - Pump - Small	0.00011 lb ai/animal		0.000042	0.0000042	No Data	94,000	940,000	No Data
	Cat (2596-140) - Pump - Large	0.00016 lb ai/animal		0.000061	0.0000061	No Data	64,000	640,000	No Data
	Dog (2596-125,-140) - Small	0.00077 lb ai/animal		0.00029	0.000029	No Data	13,000	130,000	No Data
	Dog (2596-125,-140) - Medium	0.00088 lb ai/animal		0.00034	0.000034	No Data	12,000	120,000	No Data
	Dog (2596-125,-140) - Large	0.0015 lb ai/animal		0.00057	0.000057	No Data	6,900	69,000	No Data
Mixers/Loaders/Applicators									
(9a) Liquid: Backpack Sprayer	Beef Cattle - Direct Applied	0.039 lb ai/animal	400 animals	0.0068	0.00068	No Data	580	5,800	No Data
		0.032 lb ai/animal		0.0056	0.00056	No Data	710	7,100	No Data
	Woody Borders of Kennels, Yards, Campgrounds, Recreational Parks, Footpaths and Roadways	0.032 lb ai/sq ft	1,000 sq ft (spot)	0.014	0.0014	No Data	**280**	2,800	No Data
	Beef Cattle - Direct Applied	0.026 lb ai/animal	400 animals	0.0045	0.00045	No Data	870	8,700	No Data
	Swine - Direct Applied	0.049 lb ai/animal		0.0085	0.00085	No Data	460	4,600	No Data
	Lactating Dairy Cattle - Direct Applied	0.0049 lb ai/animal		0.00085	0.000085	No Data	4,600	46,000	No Data

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Table G.1. TCVP Occupational Handler Non-Cancer Risk Estimates.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/ unit)	Area Treated or Amount Handled[2] (units/day)	Inhalation Dose (mg/kg/day)[3]			Inhalation MOEs (LOC = 300)[4] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario.		
				No R	PF10 R	EC	No R	PF10 R	EC
		0.0013 lb ai/animal		0.00023	0.000023	No Data	17,000	170,000	No Data
	Poultry Buildings (Walls, Ceilings, Floors, Larvicide)	0.00077 lb ai/sq ft	20,000 sq ft	0.0067	0.00067	No Data	590	5,900	No Data
	Poultry Buildings (Floor Management, Fowl Tick, Larvicide)	0.00064 lb ai/sq ft		0.0056	0.00056	No Data	710	7,100	No Data
	Poultry (Caged) - Direct Applied	0.00032 lb ai/bird	20,000 birds	0.0028	0.00028	No Data	1,400	14,000	No Data
	Poultry Buildings (Flies Residual) -	0.00013 lb ai/sq ft	20,000 sq ft	0.0011	0.00011	No Data	3,500	35,000	No Data
	Poultry (Chicken on Litter) - Direct Applied	0.000078 lb ai/bird	20,000 birds	0.00068	0.000068	No Data	5,800	58,000	No Data
	Poultry Floor Management	0.000064 lb ai/sq ft	20,000 sq ft	0.00056	0.000056	No Data	7,100	71,000	No Data
(9b) Liquid: Manually-Pressurized Handwand	Beef Cattle - Direct Applied	0.039 lb ai/animal	400 animals	0.0068	0.00068	No Data	580	5,800	No Data
		0.032 lb ai/animal		0.0056	0.00056	No Data	710	7,100	No Data
	Woody Borders of Kennels, Yards, Campgrounds, Recreational Parks, Footpaths and Roadways	0.032 lb ai/sq ft	1,000 sq ft (spot)	0.0139	0.0014	No Data	**280**	2,800	No Data
	Beef Cattle - Direct Applied	0.026 lb ai/animal	400 animals	0.0045	0.00045	No Data	870	8,700	No Data
	Swine - Direct Applied	0.049 lb ai/animal		0.0085	0.00085	No Data	460	4,600	No Data
	Lactating Dairy Cattle - Direct Applied	0.0049 lb ai/animal		0.00085	0.000085	No Data	4,600	46,000	No Data
		0.0013 lb ai/animal		0.00023	0.000023	No Data	17,000	170,000	No Data
	Poultry Buildings (Walls, Ceilings, Floors, Larvicide) -	0.00077 lb ai/sq ft	20,000 sq ft	0.0067	0.00067	No Data	590	5,900	No Data
	Poultry Buildings (Floor Management, Fowl Tick, Larvicide)	0.00064 lb ai/sq ft		0.0056	0.00056	No Data	710	7,100	No Data
	Poultry (Caged) - Direct Applied	0.00032 lb ai/bird	20,000 birds	0.0028	0.00027	No Data	1,400	14,000	No Data

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Table G.1. TCVP Occupational Handler Non-Cancer Risk Estimates.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/ unit)	Area Treated or Amount Handled[2] (units/day)	Inhalation Dose (mg/kg/day)[3]			Inhalation MOEs (LOC = 300)[4] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario.		
				No R	PF10 R	EC	No R	PF10 R	EC
	Poultry Buildings (Flies Residual) -	0.00013 lb ai/sq ft	20,000 sq ft	0.0011	0.00011	No Data	3,500	35,000	No Data
	Poultry (Chicken on Litter) - Direct Applied	0.000078 lb ai/bird	20,000 birds	0.00068	0.000068	No Data	5,800	58,000	No Data
	Poultry Floor Management	0.000064 lb ai/sq ft	20,000 sq ft	0.00056	0.000056	No Data	7,100	71,000	No Data
(9c) Liquid: Mechanically-Pressurized Handgun	Beef Cattle - Direct Applied	0.039 lb ai/animal	400 animals	0.018	0.0018	No Data	**220**	2,200	No Data
		0.032 lb ai/animal		0.015	0.0015	No Data	**270**	2,700	No Data
	Woody Borders of Kennels, Yards, Campgrounds, Recreational Parks, Footpaths and Roadways	0.026 lb ai/animal		0.012	0.0012	No Data	330	3,300	No Data
	Beef Cattle - Direct Applied	0.049 lb ai/animal		0.023	0.0023	No Data	**180**	1,800	No Data
	Swine - Direct Applied	0.0049 lb ai/animal		0.0023	0.00023	No Data	1,800	18,000	No Data
	Lactating Dairy Cattle - Direct Applied	0.0013 lb ai/animal		0.00060	0.000060	No Data	6,600	66,000	No Data
	Poultry Buildings (Walls, Ceilings, Floors, Larvicide) -	0.00077 lb ai/sq ft	20,000 sq ft	0.018	0.0018	No Data	**220**	2,200	No Data
	Poultry Buildings (Floor Management, Fowl Tick, Larvicide)	0.00064 lb ai/sq ft		0.015	0.0015	No Data	**270**	2,700	No Data
	Poultry (Caged) - Direct Applied	0.00032 lb ai/bird	20,000 birds	0.0073	0.00073	No Data	540	5,400	No Data
	Poultry Buildings (Flies Residual)	0.00013 lb ai/sq ft	20,000 sq ft	0.0030	0.00023	No Data	1,300	13,000	No Data
	Poultry (Chicken on Litter) - Direct Applied	0.000078 lb ai/bird	20,000 birds	0.0018	0.00018	No Data	2,200	22,000	No Data
	Poultry Floor Management	0.000064 lb ai/sq ft	20,000 sq ft	0.0015	0.00015	No Data	2,700	27,000	No Data
(9d) Liquid: Backrubber or Facerubber	Cattle - Direct Applied	0.077 lb ai/gallon	50 gallons	1.2E-05	1.2E-06	No Data	320,000	3,200,000	No Data
		0.064		1.0E-05	1.0E-06	No Data	390,000	3,900,000	No Data

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Table G.1. TCVP Occupational Handler Non-Cancer Risk Estimates.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/ unit)	Area Treated or Amount Handled[2] (units/day)	Inhalation Dose (mg/kg/day)[3]			Inhalation MOEs (LOC = 300)[4] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario.		
				No R	PF10 R	EC	No R	PF10 R	EC
		lb ai/gallon							
(10a) Wettable Powder: Backpack Sprayer	Beef Cattle - Direct Spray	0.040 lb ai/animal	400 animals	0.0070	0.00070	No Data	570	5,700	No Data
	Swine - Direct Spray	0.020 lb ai/animal		0.0035	0.00035	No Data	1,100	11,000	No Data
	Poultry (Floor Management Litter, Fowl Tick), Poultry Droppings, Manure Piles, Garbage Piles, Under Feed Troughs	0.00080 lb ai/sq ft	20,000 sq ft	0.0070	0.00070	No Data	570	5,700	No Data
	Poultry (Wire Cages) - Direct Spray	0.00040 lb ai/bird	20,000 birds	0.0035	0.00035	No Data	1,100	11,000	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.00032 lb ai/sq ft	20,000 sq ft	0.0028	0.00028	No Data	1,400	14,000	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.00016 lb ai/sq ft		0.0014	0.00014	No Data	2,800	28,000	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.000080 lb ai/sq ft		0.00070	0.000070	No Data	5,700	57,000	No Data
	Kennels, Yards, Campgrounds, Picnic Areas, and Recreational Parks	0.000040 lb ai/sq ft	1,000 sq ft (spot)	0.000017	0.0000017	No Data	230,000	2,300,000	No Data
(10b) Wettable Powder: Manually-Pressurized Handwand	Beef Cattle - Direct Spray	0.040 lb ai/animal	400 animals	0.0070	0.00070	No Data	570	5,700	No Data
	Swine - Direct Spray	0.020 lb ai/animal		0.0035	0.00035	No Data	1,100	11,000	No Data
	Poultry (Floor Management Litter, Fowl Tick), Poultry Droppings, Manure Piles, Garbage Piles, Under Feed Troughs	0.00080 lb ai/sq ft	20,000 sq ft	0.0070	0.00070	No Data	570	5,700	No Data
	Poultry (Wire Cages) - Direct Spray	0.00040 lb ai/bird	20,000 birds	0.0035	0.00035	No Data	1,100	11,000	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.00032 lb ai/sq ft	20,000 sq ft	0.0028	0.00028	No Data	1,400	14,000	No Data
		0.00016 lb ai/sq ft		0.0014	0.00014	No Data	2,800	28,000	No Data
		0.000080		0.00070	0.000070	No Data	5,700	57,000	No Data

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Table G.1. TCVP Occupational Handler Non-Cancer Risk Estimates.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/ unit)	Area Treated or Amount Handled[2] (units/day)	Inhalation Dose (mg/kg/day)[3]			Inhalation MOEs (LOC = 300)[4] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario.		
				No R	PF10 R	EC	No R	PF10 R	EC
		lb ai/sq ft							
	Kennels, Yards, Campgrounds, Picnic Areas, and Recreational Parks	0.000040 lb ai/sq ft	1,000 sq ft (spot)	0.000017	0.0000017	No Data	230,000	2,300,000	No Data
(10c) Wettable Powder: Mechanically-Pressurized Handgun	See Table G.2.								
(10d) Wettable Powder: Fogging Equipment (handheld, portable, and stationary)	Poultry (Floor Management)	0.0016 lb ai/bird	20,000 birds	4.13	0.413	No Data	**1.0**	**10**	No Data
		0.00078 lb ai/sq ft	100,000 sq ft	10.10	1.010	No Data	**0.39**	**3.9**	No Data
	Poultry (Floor Management Litter)	0.00023 lb ai/sq ft		2.97	0.297	No Data	**1.3**	**13**	No Data
(10e) Wettable Powder: Rotary Duster (Dust - Plunger Data as Surrogate)	Poultry (Floor Management Litter)	0.00023 lb ai/sq ft	20,000 sq ft	0.11	0.011	No Data	**35**	350	No Data
(10f) Wettable Powder: Plunger Duster (Dust Data as Surrogate)	Poultry (Floor Management)	0.0016 lb ai/bird	1,000 birds	0.039	0.0039	No Data	**100**	1,000	No Data
		0.00078 lb ai/sq ft	1,000 sq ft	0.019	0.0019	No Data	**210**	2,100	No Data
	Poultry (Floor Management Litter)	0.00023 lb ai/sq ft		0.0056	0.00056	No Data	700	7,000	No Data
(11a) Dust: Self-Treating Dust Bag	Cattle	0.75 lb ai/dust bag	10 dust bags	0.18	0.018	No Data	**21**	**210**	No Data
		0.38 lb ai/dust bag		0.093	0.0093	No Data	**42**	420	No Data
		0.13 lb ai/dust bag		0.032	0.0032	No Data	**120**	1,200	No Data
(11b) Dust: Shaker Can	Cattle, Swine – Direct Applied	0.0075 lb ai/animal	30 animals	0.057	0.0057	No Data	**69**	690	No Data
		0.0038 lb ai/animal		0.029	0.0029	No Data	**140**	1,400	No Data
	Cattle – Direct Applied	0.0013		0.0099	0.00099	No Data	400	4,000	No Data

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Table G.1. TCVP Occupational Handler Non-Cancer Risk Estimates.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/ unit)	Area Treated or Amount Handled[2] (units/day)	Inhalation Dose (mg/kg/day)[3]			Inhalation MOEs (LOC = 300)[4] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario.		
				No R	PF10 R	EC	No R	PF10 R	EC
		lb ai/animal							
	Poultry (Dust Box) – Direct Applied	0.00060 lb ai/ bird	1,000 birds	0.15	0.015	No Data	**26**	**260**	No Data
	Poultry (Floor Management)	0.00030 lb ai/sq ft	1,000 sq ft	0.076	0.0076	No Data	**52**	520	No Data
	Swine - Bedding	0.00020 lb ai/sq ft		0.051	0.0051	No Data	**78**	780	No Data
	Poultry (Wire Cage) – Direct Applied	0.00010 lb ai/ bird	1,000 birds	0.025	0.0025	No Data	**160**	1,600	No Data
(11c) Dust: Rotary Duster (Plunger Data as Surrogate)	Cattle, Swine – Direct Applied	0.0075 lb ai/animal	30 animals	0.074	0.0074	No Data	**54**	540	No Data
		0.0038 lb ai/animal		0.037	0.0037	No Data	**110**	1,100	No Data
	Cattle – Direct Applied	0.0013 lb ai/animal		0.013	0.0013	No Data	310	3,100	No Data
	Poultry (Dust Box) – Direct Applied	0.00060 lb ai/bird	20,000 birds	0.29	0.029	No Data	**13**	**130**	No Data
	Poultry (Floor Management)	0.00030 lb ai/sq ft	20,000 sq ft	0.15	0.015	No Data	**27**	**270**	No Data
	Poultry (Wire Cage) – Direct Applied	0.00010 lb ai/bird	20,000 birds	0.049	0.0049	No Data	**80**	800	No Data
(11d) Dust: Plunger Duster	Poultry (Dust Box) – Direct Applied	0.00060 lb ai/bird	1,000 birds	0.015	0.0015	No Data	**270**	2,700	No Data
	Poultry (Floor Management)	0.00030 lb ai/ sq ft	1,000 sq ft	0.0074	0.00074	No Data	540	5,400	No Data
	Poultry (Wire Cage) – Direct Applied	0.00010 lb ai/bird	1,000 birds	0.0025	0.00025	No Data	1,600	16,000	No Data
(12a) Paint: Brush or Roller	Poultry (Roost Paint)	0.08 lb ai/gallon	2 gallons	0.00065	0.000065	No Data	6,100	61,000	No Data
		0.077 lb ai/gallon		0.00063	0.000063	No Data	6,300	63,000	No Data
		0.064 lb ai/gallon		0.00052	0.000052	No Data	7,600	76,000	No Data
		0.03 lb ai/gallon		0.00024	0.000024	No Data	16,000	160,000	No Data

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Table G.1. TCVP Occupational Handler Non-Cancer Risk Estimates.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/ unit)	Area Treated or Amount Handled[2] (units/day)	Inhalation Dose (mg/kg/day)[3]			Inhalation MOEs (LOC = 300)[4] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario.		
				No R	PF10 R	EC	No R	PF10 R	EC
(12b) Paint: Airless	Poultry (Roost Paint)	0.08 lb ai/gallon	2 gallons	0.0013	0.00013	No Data	3,000	30,000	No Data
		0.077 lb ai/gallon		0.0013	0.00013	No Data	3,200	32,000	No Data
		0.064 lb ai/gallon		0.0010	0.00010	No Data	3,800	38,000	No Data
		0.03 lb ai/gallon		0.00049	0.000049	No Data	8,100	81,000	No Data
(13) Solid Feed Additive for Feed Through Applications via Cup (Granular Data as Surrogate)	Horse Feed	0.0015 lb ai/animal	500 horses	0.00014	0.000014	No Data	29,000	290,000	No Data
		0.00077 lb ai/animal		0.000070	0.0000070	No Data	57,000	570,000	No Data
	Cattle Feed	0.0022 lb ai/animal	1,000 cows	0.00040	0.000040	No Data	9,900	99,000	No Data
		0.0017 lb ai/animal		0.00031	0.000031	No Data	13,000	130,000	No Data

1 Based on registered labels. See Appendix A.
2 Area Treated or Amount Handled based on Exposure Science Advisory Council Policy #9.1 or assumptions as outlined in Section 6.1.
3 Inhalation Dose = Inhalation Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × Application Rate (lb ai/unit) × Area Treated or Amount Handled Daily (unit/day) ÷ BW (69 kg). The inhalation unit exposure is based on the "Occupational Pesticide Handler Unit Exposure Surrogate Reference Table" (https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-handler-exposure-data); Level of PPE: No-R = no respirator (baseline), PF10 = respirator assumed to reduce inhalation exposure by 90%, and EC = engineering controls (closed systems or enclosed cabs).
4 Inhalation MOE = Inhalation POD (3.94 mg/kg/day) ÷ Inhalation Dose (mg/kg/day).

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Table G.2. TCVP Occupational Handler Non-Cancer Risk Estimates – Scenario 10c (mixing/loading and applying wettable powders using mechanically-pressurized handgun) with Use of Chemical-Specific Data and PHED.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Inhalation Dose (mg/kg/day)[3]			Inhalation MOEs (LOC = 300)[4] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario.		
				No R	PF10 R	EC	No R	PF10 R	EC
Mixer/Loaders									
(10c) Wettable Powder: Mechanically-Pressurized Handgun MRID 42622301	Beef Cattle - Direct Spray	0.040 lb ai/animal	400 animals	0.0070	No Data	No Data	570	No Data	No Data
	Swine - Direct Spray	0.020 lb ai/animal		0.0035	No Data	No Data	1,100	No Data	No Data
	Poultry (Floor Management Litter, Fowl Tick), Poultry Droppings, Manure Piles, Garbage Piles, Under Feed Troughs	0.00080 lb ai/ sq ft	100,000 sq ft	0.035	No Data	No Data	**110**	No Data	No Data
	Poultry (Wire Cages) - Direct Spray	0.00040 lb ai/birds	20,000 birds	0.0035	No Data	No Data	1,100	No Data	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.00032 lb ai/sq ft	100,000 sq ft	0.014	No Data	No Data	**280**	No Data	No Data
		0.00016 lb ai/sq ft		0.0070	No Data	No Data	570	No Data	No Data
		0.000080 lb ai/sq ft		0.0035	No Data	No Data	1,100	No Data	No Data
Applicators									
(10c) Wettable Powder: Mechanically-Pressurized Handgun MRID 42622301	Beef Cattle - Direct Spray	0.040 lb ai/animal	400 animals	0.0016	No Data	No Data	2,400	No Data	No Data
	Swine - Direct Spray	0.020 lb ai/animal		0.00081	No Data	No Data	4,900	No Data	No Data
	Poultry (Floor Management Litter, Fowl Tick), Poultry Droppings, Manure Piles, Garbage Piles, Under Feed Troughs	0.00080 lb ai/sq ft	100,000 sq ft	0.0081	No Data	No Data	490	No Data	No Data
	Poultry (Wire Cages) - Direct Spray	0.00040 lb ai/birds	20,000 birds	0.00081	No Data	No Data	4,900	No Data	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.00032 lb ai/sq ft	100,000 sq ft	0.0033	No Data	No Data	1,200	No Data	No Data
		0.00016 lb ai/sq ft		0.0016	No Data	No Data	2,400	No Data	No Data
		0.000080 lb ai/sq ft		0.000812	No Data	No Data	4,900	No Data	No Data

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Table G.2. TCVP Occupational Handler Non-Cancer Risk Estimates – Scenario 10c (mixing/loading and applying wettable powders using mechanically-pressurized handgun) with Use of Chemical-Specific Data and PHED.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Inhalation Dose (mg/kg/day)[3]			Inhalation MOEs (LOC = 300)[4] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario.		
				No R	PF10 R	EC	No R	PF10 R	EC
Mixer/Loader/Applicators									
(10c) Wettable Powder: Mechanically-Pressurized Handgun PHED	Beef Cattle - Direct Spray	0.040 lb ai/animal	400 animals	0.018	0.0018	No Data	**220**	2,200	No Data
	Swine - Direct Spray	0.020 lb ai/animal		0.0092	0.00092	No Data	430	4,300	No Data
	Poultry (Floor Management Litter, Fowl Tick), Poultry Droppings, Manure Piles, Garbage Piles, Under Feed Troughs	0.00080 lb ai/sq ft	100,000 sq ft	0.092	0.0092	No Data	**43**	430	No Data
	Poultry (Wire Cages) - Direct Spray	0.00040 lb ai/birds	20,000 birds	0.0092	0.00092	No Data	430	4,300	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.00032 lb ai/sq ft	100,000 sq ft	0.037	0.0037	No Data	**110**	1,100	No Data
		0.00016 lb ai/sq ft		0.018	0.0018	No Data	**220**	2,200	No Data
		0.000080 lb ai/sq ft		0.0092	0.00092	No Data	430	4,300	No Data

1 Based on registered labels. See Appendix A.
2 Area Treated or Amount Handled based on Exposure Science Advisory Council Policy #9.1 or assumptions as outlined in Section 6.1.
3 Inhalation Dose = Inhalation Unit Exposure (µg/lb ai) × Conversion Factor (0.001 mg/µg) × Application Rate (lb ai/unit) × Area Treated or Amount Handled Daily (unit/day) ÷ BW (69 kg). The inhalation unit exposure is based on the "Occupational Pesticide Handler Unit Exposure Surrogate Reference Table" ([HYPERLINK "https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-handler-exposure-data"]) or MRID 42622301; Level of PPE: No-R = no respirator (baseline), PF10 = respirator assumed to reduce inhalation exposure by 90%, and EC = engineering controls (closed systems or enclosed cabs).
4 Inhalation MOE = Inhalation POD (3.94 mg/kg/day) ÷ Inhalation Dose (mg/kg/day).

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Appendix H – Summary of Occupational Handler Cancer Risk Estimates

Table H.1. TCVP Occupational Handler Cancer Risk Estimates – Private/ Farmer.
Table H.2. TCVP Occupational Handler Cancer Risk Estimates - Scenario 10c (mixing/loading and applying wettable powders using mechanically-pressurized handgun) with Use of Chemical-Specific Data and PHED – Private/Farmer.
Table H.3. TCVP Occupational Handler Cancer Risk Estimates – Contract/ Commercial
Table H.4. TCVP Occupational Handler Cancer Risk Estimates - Scenario 10c (mixing/loading and applying wettable powders using mechanically-pressurized handgun) with Use of Chemical-Specific Data and PHED – Contract/Commercial.

Table H.1. TCVP Occupational Handler Cancer Risk Estimates – Private/ Farmer.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Private/Farmer Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL/G PF10 R	DL/G PF10 R	EC
Mixer/Loaders										
(1a) Mixing/Loading Liquids for Groundboom Applications	Poultry Buildings (Including: Ceilings, Floors, Larvicide, Walls)	0.00077 lb ai/sq ft	100,000 sq ft	5E-07	9E-08	7E-08	5E-07	9E-08	7E-08	2E-08
	Poultry Buildings (Including: Floor Management, Fowl Tick, Larvicide)	0.00064 lb ai/sq ft		4E-07	8E-08	6E-08	4E-07	7E-08	6E-08	2E-08
	Poultry Buildings (Flies Residual)	0.00013 lb ai/sq ft		9E-08	2E-08	1E-08	9E-08	2E-08	1E-08	4E-09
	Poultry Floor Management	0.000064 lb ai/sq ft		4E-08	8E-09	6E-09	4E-08	7E-09	6E-09	2E-09
(1b) Mixing/Loading Liquids for Paint Applications	Poultry Buildings (Roost)	0.077 lb ai/gallon	2 gallons	1E-09	2E-10	1E-10	1E-09	2E-10	1E-10	5E-11
		0.064 lb ai/gallon		9E-10	2E-10	1E-10	9E-10	1E-10	1E-10	4E-11
(2a) Mixing/Loading Wettable Powders for Groundboom Applications	Poultry Buildings (Including: Droppings, Floor Management Litter, Fowl Tick, Garbage Piles, Manure Piles, Under Feed Troughs)	0.00080 lb ai/sq ft	100,000 sq ft	1E-05	2E-06	1E-06	9E-06	5E-07	4E-07	3E-08
	Dairy Barns, Poultry Houses, Swine Barns, or Other Animal Buildings	0.00032 lb ai/ sq ft		4E-06	6E-07	6E-07	4E-06	2E-07	2E-07	1E-08
(2b) Mixing/Loading Wettable Powders for Paint Applications	Poultry (Floor Management – Roost)	0.080 lb ai/gallon	2 gallons	8E-09	1E-09	1E-09	7E-09	4E-10	3E-10	2E-11

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Table II.1. TCVP Occupational Handler Cancer Risk Estimates – Private/ Farmer.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Private/Farmer Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL.G PF10 R	DL/G PF10 R	EC
(3a) Mixing/Loading Dusts for Paint Applications (WP Data as Surrogate)		0.030 lb ai/gallon		8E-09	1E-09	1E-09	7E-09	4E-10	3E-10	2E-11
Applicators										
(4) Groundboom Applications	Poultry Buildings (Including: Droppings, Floor Management Litter, Fowl Tick, Garbage Piles, Manure Piles, Under Feed Troughs)	0.00080 lb ai/sq ft	100,000 sq ft	2E-07	5E-08	4E-08	2E-07	4E-08	3E-08	1E-08
	Poultry Buildings (Including: Ceilings, Floors, Larvicide, Walls)	0.00077 lb ai/sq ft		2E-07	5E-08	4E-08	2E-07	4E-08	3E-08	1E-08
	Poultry Buildings (Including: Floor Management, Fowl Tick, Larvicide)	0.00064 lb ai/sq ft		2E-07	4E-08	3E-08	2E-07	3E-08	3E-08	1E-08
	Dairy Barns, Poultry Houses, Swine Barns, or Other Animal Buildings	0.00032 lb ai/sq ft		8E-08	2E-08	2E-08	8E-08	2E-08	1E-08	5E-09
	Poultry Buildings (Flies Residual)	0.00013 lb ai/sq ft		3E-08	8E-09	6E-09	3E-08	7E-09	5E-09	2E-09
	Poultry (Floor Management)	0.000064 lb ai/sq ft		2E-08	4E-09	3E-09	2E-08	3E-09	3E-09	1E-09
(5) Open Pour Liquid Additive for Feed Through Applications	Cattle Feed (Concentrate)	0.0039 lb ai/animal	1,000 cows	3E-08	5E-09	4E-09	3E-08	5E-09	3E-09	No Data
	Cattle Feed (Concentrate)	0.0022 lb ai/animal		2E-08	3E-09	2E-09	1E-08	3E-09	2E-09	No Data
	Horse Feed	0.0017 lb ai/animal	500 horses	6E-09	1E-09	8E-10	6E-09	1E-09	8E-10	No Data
	Swine Feed	0.00060 lb ai/animal	6,250 pigs	3E-08	5E-09	4E-09	3E-08	4E-09	3E-09	No Data
(6) RTU Pet Collar Applications – 99.62% Liquid/ 0.38% Dust Ratio	Cat (2596-49)	0.0036 lb ai/animal	8 animals	1E-07	6E-08	4E-08	1E-07	6E-08	4E-08	No Data
	Dog (2596-50,62) - Small	0.0061 lb ai/animal		2E-07	1E-07	6E-08	2E-07	1E-07	6E-08	No Data
	Dog (2596-50,62) - Large	0.0103 lb ai/animal		3E-07	2E-07	1E-07	3E-07	2E-07	1E-07	No Data
	Cat (2596-63) - Small	0.0048 lb ai/animal		2E-07	8E-08	5E-08	2E-07	8E-08	5E-08	No Data
	Cat (2596-63) - Large	0.0055 lb ai/animal		2E-07	9E-08	6E-08	2E-07	9E-08	6E-08	No Data

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Table H.1. TCVP Occupational Handler Cancer Risk Estimates – Private/ Farmer.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Private/Farmer Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL.G PF10 R	DL/G PF10 R	EC
	Cat (2596-83) - Small	0.0039 lb ai/animal		1E-07	7E-08	4E-08	1E-07	6E-08	4E-08	No Data
	Cat (2596-83) - Large	0.0080 lb ai/animal		3E-07	1E-07	8E-08	3E-07	1E-07	8E-08	No Data
	Dog (2596-84) – Small	0.0041 lb ai/animal		1E-07	7E-08	4E-08	1E-07	7E-08	4E-08	No Data
	Dog (2596-84) – Large	0.0069 lb ai/animal		2E-07	1E-07	7E-08	2E-07	1E-07	7E-08	No Data
	Cat (2596-139) - All	0.0016 lb ai/animal		5E-08	3E-08	2E-08	5E-08	3E-08	2E-08	No Data
	Dog (2596-139) - All	0.0080 lb ai/animal		3E-07	1E-07	8E-08	3E-07	1E-07	8E-08	No Data
(7) RTU Dust/Powder Applications	Dog (47000-123) - Small	0.00037 lb ai/animal		4E-07	3E-08	2E-08	4E-07	1E-08	8E-09	No Data
	Dog (47000-123) - Medium	0.00094 lb ai/animal		1E-06	7E-08	6E-08	9E-07	3E-08	2E-08	No Data
	Dog (47000-123) - Large	0.0015 lb ai/animal		2E-06	1E-07	9E-08	2E-06	5E-08	3E-08	No Data
	Cat (47000-123) - Small	0.000090 lb ai/animal		9E-08	6E-09	6E-09	9E-08	3E-09	2E-09	No Data
	Cat (47000-123) - Medium	0.00022 lb ai/animal		2E-07	2E-08	1E-08	2E-07	7E-09	5E-09	No Data
	Cat (47000-123) - Large	0.00034 lb ai/animal		4E-07	2E-08	2E-08	3E-07	1E-08	8E-09	No Data
	Cat (2596-78) - Small	0.00062 lb ai/animal		6E-07	4E-08	4E-08	6E-07	2E-08	1E-08	No Data
	Cat (2596-78) - Large	0.0010 lb ai/animal		1E-06	7E-08	6E-08	1E-06	3E-08	2E-08	No Data
	Dog (2596-79) - Small	0.0010 lb ai/animal		1E-06	7E-08	6E-08	1E-06	3E-08	2E-08	No Data
	Dog (2596-79) - Medium	0.0021 lb ai/animal		2E-06	2E-07	1E-07	2E-06	7E-08	5E-08	No Data
	Dog (2596-79) - Large	0.0026 lb ai/animal		3E-06	2E-07	2E-07	3E-06	8E-08	6E-08	No Data
	Dog (67517-82) - Small	0.0011 lb ai/animal		1E-06	8E-08	7E-08	1E-06	3E-08	2E-08	No Data
	Dog (67517-82) - Medium	0.0028 lb ai/animal		3E-06	2E-07	2E-07	3E-06	9E-08	6E-08	No Data
	Dog (67517-82) - Large	0.0045 lb ai/animal		5E-06	3E-07	3E-07	5E-06	1E-07	1E-07	No Data
	Cat (67517-82) - Small	0.00028 lb ai/animal		3E-07	2E-08	2E-08	3E-07	9E-09	6E-09	No Data

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Table II.1. TCVP Occupational Handler Cancer Risk Estimates – Private/ Farmer.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Private/Farmer Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL.G PF10 R	DL/G PF10 R	EC
	Cat (67517-82) - Medium	0.00067 lb ai/animal		7E-07	5E-08	4E-08	7E-07	2E-08	2E-08	No Data
	Cat (67517-82) - Large	0.0010 lb ai/animal		1E-06	7E-08	6E-08	1E-06	3E-08	2E-08	No Data
(8) RTU Pump/ Trigger Spray Applications	Cat (2596-126,140) - Trigger - Small	0.00055 lb ai/animal		8E-08	7E-08	4E-08	7E-08	7E-08	4E-08	No Data
	Cat (2596-126,140) - Trigger - Large	0.00077 lb ai/animal		1E-07	1E-07	6E-08	1E-07	1E-07	5E-08	No Data
	Cat (2596-140) - Pump - Small	0.00011 lb ai/animal		2E-08	1E-08	8E-09	1E-08	1E-08	7E-09	No Data
	Cat (2596-140) - Pump - Large	0.00016 lb ai/animal		2E-08	2E-08	1E-08	2E-08	2E-08	1E-08	No Data
	Dog (2596-125,-140) - Small	0.00077 lb ai/animal		1E-07	1E-07	6E-08	1E-07	1E-07	5E-08	No Data
	Dog (2596-125,-140) - Medium	0.00088 lb ai/animal		1E-07	1E-07	7E-08	1E-07	1E-07	6E-08	No Data
	Dog (2596-125,-140) - Large	0.0015 lb ai/animal		2E-07	2E-07	1E-07	2E-07	2E-07	1E-07	No Data
Mixers/Loaders/Applicators										
(9a) Liquid: Backpack Sprayer	Beef Cattle - Direct Applied	0.039 lb ai/animal	400 animals	4E-06	4E-06	2E-06	4E-06	4E-06	2E-06	No Data
		0.032 lb ai/animal		1E-06	1E-06	8E-07	1E-06	1E-06	6E-07	No Data
	Woody Borders of Kennels, Yards, Campgrounds, Recreational Parks, Footpaths and Roadways	0.032 lb ai/sq ft	1,000 sq ft (spot)	3E-06	3E-06	2E-06	3E-06	2E-06	2E-06	No Data
	Beef Cattle - Direct Applied	0.026 lb ai/animal	400 animals	9E-07	9E-07	6E-07	8E-07	8E-07	5E-07	No Data
	Swine - Direct Applied	0.049 lb ai/animal		2E-06	2E-06	1E-06	2E-06	2E-06	1E-06	No Data
	Lactating Dairy Cattle - Direct Applied	0.0049 lb ai/animal		2E-07	2E-07	1E-07	2E-07	2E-07	1E-07	No Data
		0.0013 lb ai/animal		5E-08	5E-08	3E-08	4E-08	4E-08	3E-08	No Data

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Table H.1. TCVP Occupational Handler Cancer Risk Estimates – Private/ Farmer.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Private/Farmer Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL.G PF10 R	DL/G PF10 R	EC
	Poultry Buildings (Walls, Ceilings, Floors, Larvicide)	0.00077 lb ai/sq ft	20,000 sq ft	1E-06	1E-06	9E-07	1E-06	1E-06	8E-07	No Data
	Poultry Buildings (Floor Management, Fowl Tick, Larvicide)	0.00064 lb ai/sq ft		1E-06	1E-06	8E-07	1E-06	1E-06	6E-07	No Data
	Poultry (Caged) - Direct Applied	0.00032 lb ai/bird	20,000 birds	6E-07	6E-07	4E-07	5E-07	5E-07	3E-07	No Data
	Poultry Buildings (Flies Residual) -	0.00013 lb ai/sq ft	20,000 sq ft	2E-07	2E-07	2E-07	2E-07	2E-07	1E-07	No Data
	Poultry (Chicken on Litter) - Direct Applied	0.000078 lb ai/bird	20,000 birds	1E-07	1E-07	9E-08	1E-07	1E-07	8E-08	No Data
	Poultry Floor Management	0.000064 lb ai/sq ft	20,000 sq ft	1E-07	1E-07	8E-08	1E-07	1E-07	6E-08	No Data
	Beef Cattle - Direct Applied	0.039 lb ai/animal	400 animals	5E-05	4E-07	3E-07	5E-05	2E-07	2E-07	No Data
		0.032 lb ai/animal		4E-05	3E-07	3E-07	4E-05	2E-07	2E-07	No Data
	Woody Borders of Kennels, Yards, Campgrounds, Recreational Parks, Footpaths and Roadways	0.032 lb ai/sq ft	1,000 sq ft (spot)	1E-04	7E-07	7E-07	1E-04	5E-07	4E-07	No Data
(9b) Liquid: Manually-Pressurized Handwand	Beef Cattle - Direct Applied	0.026 lb ai/animal	400 animals	3E-05	2E-07	2E-07	3E-05	1E-07	1E-07	No Data
	Swine - Direct Applied	0.049 lb ai/animal		6E-05	4E-07	4E-07	6E-05	3E-07	2E-07	No Data
	Lactating Dairy Cattle - Direct Applied	0.0049 lb ai/animal		6E-06	4E-08	4E-08	6E-06	3E-08	2E-08	No Data
		0.0013 lb ai/animal		2E-06	1E-08	1E-08	2E-06	7E-09	6E-09	No Data
	Poultry Buildings (Walls, Ceilings, Floors, Larvicide) -	0.00077 lb ai/sq ft	20,000 sq ft	5E-05	4E-07	3E-07	5E-05	2E-07	2E-07	No Data
	Poultry Buildings (Floor Management, Fowl Tick, Larvicide)	0.00064 lb ai/sq ft		4E-05	3E-07	3E-07	4E-05	2E-07	2E-07	No Data
	Poultry (Caged) - Direct Applied	0.00032 lb ai/bird	20,000 birds	2E-05	1E-07	1E-07	2E-05	9E-08	8E-08	No Data

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Table II.1. TCVP Occupational Handler Cancer Risk Estimates – Private/ Farmer.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Private/Farmer Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL.G PF10 R	DL/G PF10 R	EC
	Poultry Buildings (Flies Residual) -	0.00013 lb ai/sq ft	20,000 sq ft	8E-06	6E-08	5E-08	8E-06	4E-08	3E-08	No Data
	Poultry (Chicken on Litter) - Direct Applied	0.000078 lb ai/bird	20,000 birds	5E-06	4E-08	3E-08	5E-06	2E-08	2E-08	No Data
	Poultry Floor Management	0.000064 lb ai/sq ft	20,000 sq ft	4E-06	3E-08	3E-08	4E-06	2E-08	2E-08	No Data
(9c) Liquid: Mechanically-Pressurized Handgun	Beef Cattle - Direct Applied	0.039 lb ai/animal	400 animals	1E-06	7E-07	6E-07	9E-07	3E-07	2E-07	No Data
		0.032 lb ai/animal		1E-06	6E-07	5E-07	7E-07	3E-07	2E-07	No Data
	Woody Borders of Kennels, Yards, Campgrounds, Recreational Parks, Footpaths and Roadways	0.026 lb ai/animal		8E-07	5E-07	4E-07	6E-07	2E-07	1E-07	No Data
	Beef Cattle - Direct Applied	0.049 lb ai/animal		2E-06	9E-07	7E-07	1E-06	4E-07	3E-07	No Data
	Swine - Direct Applied	0.0049 lb ai/animal		2E-07	9E-08	7E-08	1E-07	4E-08	3E-08	No Data
	Lactating Dairy Cattle - Direct Applied	0.0013 lb ai/animal		4E-08	2E-08	2E-08	3E-08	1E-08	7E-09	No Data
	Poultry Buildings (Walls, Ceilings, Floors, Larvicide) -	0.00077 lb ai/sq ft	20,000 sq ft	1E-06	7E-07	6E-07	9E-07	3E-07	2E-07	No Data
	Poultry Buildings (Floor Management, Fowl Tick, Larvicide)	0.00064 lb ai/sq ft		1E-06	6E-07	5E-07	7E-07	3E-07	2E-07	No Data
	Poultry (Caged) - Direct Applied	0.00032 lb ai/bird	20,000 birds	5E-07	3E-07	2E-07	4E-07	1E-07	9E-08	No Data
	Poultry Buildings (Flies Residual)	0.00013 lb ai/sq ft	20,000 sq ft	2E-07	1E-07	9E-08	2E-07	6E-08	4E-08	No Data
	Poultry (Chicken on Litter) - Direct Applied	0.000078 lb ai/bird	20,000 birds	1E-07	7E-08	6E-08	9E-08	3E-08	2E-08	No Data
	Poultry Floor Management	0.000064 lb ai/sq ft	20,000 sq ft	1E-07	6E-08	5E-08	7E-08	3E-08	2E-08	No Data
(9d) Liquid: Backrubber or Facerubber	Cattle - Direct Applied	0.077 lb ai/gallon	50 (gallons/ day)	3E-08	5E-09	4E-09	3E-08	5E-09	3E-09	No Data
		0.064		2E-08	4E-09	3E-09	2E-08	4E-09	3E-09	No Data

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Table H.1. TCVP Occupational Handler Cancer Risk Estimates – Private/ Farmer.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Private/Farmer Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL.G PF10 R	DL/G PF10 R	EC
		lb ai/gallon								
(10a) Wettable Powder: Backpack Sprayer	Beef Cattle - Direct Spray	0.040 lb ai/animal	400 animals	1E-06	1E-06	9E-07	1E-06	1E-06	8E-07	No Data
	Swine - Direct Spray	0.020 lb ai/animal		7E-07	7E-07	5E-07	6E-07	6E-07	4E-07	No Data
	Poultry (Floor Management Litter, Fowl Tick), Poultry Droppings, Manure Piles, Garbage Piles, Under Feed Troughs	0.00080 lb ai/sq ft	20,000 sq ft	1E-06	1E-06	9E-07	1E-06	1E-06	8E-07	No Data
	Poultry (Wire Cages) - Direct Spray	0.00040 lb ai/bird	20,000 birds	7E-07	7E-07	5E-07	6E-07	6E-07	4E-07	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.00032 lb ai/ sq ft	20,000 sq ft	6E-07	6E-07	4E-07	5E-07	5E-07	3E-07	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.00016 lb ai/sq ft		3E-07	3E-07	2E-07	3E-07	2E-07	2E-07	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.000080 lb ai/sq ft		1E-07	1E-07	9E-08	1E-07	1E-07	8E-08	No Data
	Kennels, Yards, Campgrounds, Picnic Areas, and Recreational Parks	0.000040 lb ai/sq ft	1,000 sq ft (spot)	3E-09	3E-09	2E-09	3E-09	3E-09	2E-09	No Data
(10b) Wettable Powder: Manually-Pressurized Handwand	Beef Cattle - Direct Spray	0.040 lb ai/animal	400 animals	5E-05	4E-07	3E-07	5E-05	2E-07	2E-07	No Data
	Swine - Direct Spray	0.020 lb ai/animal		2E-05	2E-07	2E-07	2E-05	1E-07	1E-07	No Data
	Poultry (Floor Management Litter, Fowl Tick), Poultry Droppings, Manure Piles, Garbage Piles, Under Feed Troughs	0.00080 lb ai/sq ft	20,000 sq ft	5E-05	4E-07	3E-07	5E-05	2E-07	2E-07	No Data
	Poultry (Wire Cages) - Direct Spray	0.00040 lb ai/bird	20,000 birds	2E-05	2E-07	2E-07	2E-05	1E-07	1E-07	No Data
		0.00032	20,000	2E-05	1E-07	1E-07	2E-05	9E-08	8E-08	No Data

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Table H.1. TCVP Occupational Handler Cancer Risk Estimates – Private/ Farmer.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Private/Farmer Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL.G PF10 R	DL/G PF10 R	EC
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	lb ai/sq ft	sq ft							
		0.00016 lb ai/sq ft		1E-05	7E-08	7E-08	1E-05	5E-08	4E-08	No Data
		0.000080 lb ai/sq ft		5E-06	4E-08	3E-08	5E-06	2E-08	2E-08	No Data
	Kennels, Yards, Campgrounds, Picnic Areas, and Recreational Parks	0.000040 lb ai/sq ft	1,000 sq ft (spot)	1E-07	9E-10	8E-10	1E-07	6E-10	5E-10	No Data
Wettable Powder: Mechanically-Pressurized Handgun	See Table H.2.									
(10d) Wettable Powder: Fogging Equipment (handheld, portable, and stationary)	Poultry (Floor Management)	0.0016 lb ai/bird	20,000 birds	9E-05	9E-05	9E-05	9E-06	9E-06	9E-06	No Data
		0.00078 lb ai/sq ft	100,000 sq ft	2E-04	2E-04	2E-04	2E-05	2E-05	2E-05	No Data
	Poultry (Floor Management Litter)	0.00023 lb ai/sq ft		7E-05	7E-05	7E-05	7E-06	7E-06	7E-06	No Data
(10e) Wettable Powder: Rotary Duster (Dust - Plunger Data as Surrogate)	Poultry (Floor Management Litter)	0.00023 lb ai/sq ft	20,000 sq ft	6E-04	9E-05	7E-05	6E-04	8E-05	7E-05	No Data
(10f) Wettable Powder: Plunger Duster (Dust Data as Surrogate)	Poultry (Floor Management)	0.0016 lb ai/bird	1,000 birds	9E-06	2E-06	2E-06	8E-06	1E-06	1E-06	No Data
		0.00078 lb ai/sq ft	1,000 sq ft	4E-06	1E-06	9E-07	4E-06	6E-07	5E-07	No Data
	Poultry (Floor Management Litter)	0.00023 lb ai/sq ft		1E-06	3E-07	3E-07	1E-06	2E-07	2E-07	No Data
(11a) Dust: Self-Treating Dust Bag	Cattle	0.75 lb ai/dust bag	10 dust bags	4E-05	1E-05	9E-06	4E-05	6E-06	5E-06	No Data
		0.38 lb ai/dust bag		2E-05	5E-06	4E-06	2E-05	3E-06	3E-06	No Data
		0.13 lb ai/dust bag		7E-06	2E-06	2E-06	7E-06	1E-06	9E-07	No Data

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Table H.1. TCVP Occupational Handler Cancer Risk Estimates – Private/ Farmer.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Private/Farmer Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL.G PF10 R	DL/G PF10 R	EC
(11b) Dust: Shaker Can	Cattle, Swine – Direct Applied	0.0075 lb ai/animal	30 animals	3E-05	2E-06	2E-06	3E-05	9E-07	6E-07	No Data
		0.0038 lb ai/animal		1E-05	1E-06	9E-07	1E-05	5E-07	3E-07	No Data
	Cattle – Direct Applied	0.0013 lb ai/animal		5E-06	4E-07	3E-07	5E-06	2E-07	1E-07	No Data
	Poultry (Dust Box) – Direct Applied	0.00060 lb ai/bird	1,000 birds	8E-05	5E-06	5E-06	8E-05	2E-06	2E-06	No Data
	Poultry (Floor Management)	0.00030 lb ai/sq ft	1,000 sq ft	4E-05	3E-06	2E-06	4E-05	1E-06	8E-07	No Data
	Swine - Bedding	0.00020 lb ai/sq ft		3E-05	2E-06	2E-06	3E-05	8E-07	6E-07	No Data
	Poultry (Wire Cage) – Direct Applied	0.00010 lb ai/bird	1,000 birds	1E-05	9E-07	8E-07	1E-05	4E-07	3E-07	No Data
(11c) Dust: Rotary Duster (Plunger Data as Surrogate)	Cattle, Swine – Direct Applied	0.0075 lb ai/animal	30 animals	1E-06	3E-07	3E-07	1E-06	2E-07	2E-07	No Data
		0.0038 lb ai/animal		6E-07	1E-07	1E-07	6E-07	9E-08	8E-08	No Data
	Cattle – Direct Applied	0.0013 lb ai/animal		2E-07	5E-08	5E-08	2E-07	3E-08	3E-08	No Data
	Poultry (Dust Box) – Direct Applied	0.00060 lb ai/bird	20,000 birds	7E-05	2E-05	1E-05	6E-05	1E-05	8E-06	No Data
	Poultry (Floor Management)	0.00030 lb ai/sq ft	20,000 sq ft	3E-05	8E-06	7E-06	3E-05	5E-06	4E-06	No Data
	Poultry (Wire Cage) – Direct Applied	0.00010 lb ai/bird	20,000 birds	1E-05	3E-06	2E-06	1E-05	2E-06	1E-06	No Data
(11d) Dust: Plunger Duster	Poultry (Dust Box) – Direct Applied	0.00060 lb ai/bird	1,000 birds	3E-06	8E-07	7E-07	3E-06	5E-07	4E-07	No Data
	Poultry (Floor Management)	0.00030 lb ai/sq ft	1,000 sq ft	2E-06	4E-07	4E-07	2E-06	2E-07	2E-07	No Data
	Poultry (Wire Cage) – Direct Applied	0.00010 lb ai/bird	1,000 birds	6E-07	1E-07	1E-07	5E-07	8E-08	7E-08	No Data
(12a) Paint: Brush or Roller	Poultry (Roost Paint)	0.08 lb ai/gallon	2 gallons	9E-07	1E-07	1E-07	9E-07	1E-07	1E-07	No Data
		0.077 lb ai/gallon		9E-07	1E-07	1E-07	9E-07	1E-07	1E-07	No Data

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Table H.1. TCVP Occupational Handler Cancer Risk Estimates – Private/ Farmer.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Private/Farmer Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL.G PF10 R	DL/G PF10 R	EC
		0.064 lb ai/gallon		7E-08	1E-08	1E-08	7E-08	1E-08	9E-09	No Data
		0.03 lb ai/gallon		3E-07	5E-08	5E-08	3E-07	4E-08	4E-08	No Data
(12b) Paint: Airless	Poultry (Roost Paint)	0.08 lb ai/gallon	2 gallons	2E-07	9E-08	8E-08	2E-07	6E-08	6E-08	No Data
		0.077 lb ai/gallon		2E-07	8E-08	8E-08	2E-07	6E-08	5E-08	No Data
		0.064 lb ai/gallon		2E-08	7E-09	6E-09	2E-08	5E-09	4E-09	No Data
		0.03 lb ai/gallon		9E-08	3E-08	3E-08	8E-08	2E-08	2E-08	No Data
(13) Solid Feed Additive for Feed Through Applications via Cup (Granular Data as Surrogate)	Horse Feed	0.0015 lb ai/animal	500 horses	1E-09	7E-10	7E-10	6E-10	1E-10	1E-10	No Data
		0.00077 lb ai/animal		6E-10	3E-10	3E-10	3E-10	6E-11	6E-11	No Data
	Cattle Feed	0.0022 lb ai/animal	1,000 cows	2E-08	1E-08	1E-08	8E-09	2E-09	2E-09	No Data
		0.0017 lb ai/animal		1E-08	7E-09	7E-09	7E-09	1E-09	1E-09	No Data

1 Based on registered labels. See Appendix A.
2 Area Treated or Amount Handled based on Exposure Science Advisory Council Policy #9.1 or assumptions as outlined in Section 6.1.
3 Cancer risk estimates = LADD × Q_1^* where $Q_1^* = 1.83 \times 10^{-3}$ $(mg/kg/day)^{-1}$

Table H.2. TCVP Occupational Handler Cancer Risk Estimates - Scenario 10c (mixing/loading and applying wettable powders using mechanically-pressurized handgun) with Use of Chemical-Specific Data and PHED – Private/Farmer.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Private/Farmer Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL.G PF10 R	DL/G PF10 R	EC
Mixer/Loaders										

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Table H.2. TCVP Occupational Handler Cancer Risk Estimates - Scenario 10c (mixing/loading and applying wettable powders using mechanically-pressurized handgun) with Use of Chemical-Specific Data and PHED – Private/Farmer.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Private/Farmer Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL/G PF10 R	DL/G PF10 R	EC
(10c) Wettable Powder: Mechanically-Pressurized Handgun MRID 42622301	Beef Cattle - Direct Spray	0.040 lb ai/animal	400 animals	No Data	3E-07	No Data	No Data	No Data	No Data	No Data
	Swine - Direct Spray	0.020 lb ai/animal		No Data	2E-07	No Data	No Data	No Data	No Data	No Data
	Poultry (Floor Management Litter, Fowl Tick), Poultry Droppings, Manure Piles, Garbage Piles, Under Feed Troughs	0.00080 lb ai/sq ft	20,000 sq ft	No Data	2E-06	No Data	No Data	No Data	No Data	No Data
	Poultry (Wire Cages) - Direct Spray	0.00040 lb ai/bird	20,000 birds	No Data	2E-07	No Data	No Data	No Data	No Data	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.00032 lb ai/sq ft	20,000 sq ft	No Data	7E-07	No Data	No Data	No Data	No Data	No Data
		0.00016 lb ai/sq ft		No Data	3E-07	No Data	No Data	No Data	No Data	No Data
		0.000080 lb ai/sq ft		No Data	2E-07	No Data	No Data	No Data	No Data	No Data
Applicators										
(10c) Wettable Powder: Mechanically-Pressurized Handgun MRID 42622301	Beef Cattle - Direct Spray	0.040 lb ai/animal	400 animals	No Data	5E-07	No Data	No Data	No Data	No Data	No Data
	Swine - Direct Spray	0.020 lb ai/animal		No Data	2E-07	No Data	No Data	No Data	No Data	No Data
	Poultry (Floor Management Litter, Fowl Tick), Poultry Droppings, Manure Piles, Garbage Piles, Under Feed Troughs	0.00080 lb ai/sq ft	20,000 sq ft	No Data	2E-06	No Data	No Data	No Data	No Data	No Data
	Poultry (Wire Cages) - Direct Spray	0.00040	20,000 birds	No Data	2E-07	No Data	No Data	No Data	No Data	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.00032 lb ai/sq ft	20,000 sq ft	No Data	1E-06	No Data	No Data	No Data	No Data	No Data
		0.00016 lb ai/sq ft		No Data	5E-07	No Data	No Data	No Data	No Data	No Data
		0.000080 lb ai/sq ft		No Data	2E-07	No Data	No Data	No Data	No Data	No Data
Mixer/Loader/Applicators										
(10c) Wettable Powder:	Beef Cattle - Direct Spray	0.040 lb ai/animal	400 animals	1E-06	7E-07	6E-07	9E-07	4E-07	2E-07	No Data
	Swine - Direct Spray	0.020		6E-07	4E-07	3E-07	5E-07	2E-07	1E-07	No Data

Table H.2. TCVP Occupational Handler Cancer Risk Estimates - Scenario 10c (mixing/loading and applying wettable powders using mechanically-pressurized handgun) with Use of Chemical-Specific Data and PHED – Private/Farmer.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Private/Farmer Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL G PF10 R	DL/G PF10 R	EC
Mechanically-Pressurized Handgun PHED		lb ai/animal								
	Poultry (Floor Management Litter, Fowl Tick), Poultry Droppings, Manure Piles, Garbage Piles, Under Feed Troughs	0.00080 lb ai/sq ft	20,000 sq ft	6E-06	4E-06	3E-06	5E-06	2E-06	1E-06	No Data
	Poultry (Wire Cages) - Direct Spray	0.00040	20,000 birds	6E-07	4E-07	3E-07	5E-07	2E-07	1E-07	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.00032 lb ai/sq ft	20,000 sq ft	3E-06	1E-06	1E-06	2E-06	7E-07	4E-07	No Data
		0.00016 lb ai/sq ft		1E-06	7E-07	6E-07	9E-07	4E-07	2E-07	No Data
		0.000080 lb ai/sq ft		6E-07	4E-07	3E-07	5E-07	2E-07	1E-07	No Data

1 Based on registered labels. See Appendix A.
2 Area Treated or Amount Handled based on Exposure Science Advisory Council Policy #9.1 or assumptions as outlined in Section 6.1.
3 Cancer risk estimates = LADD × Q_1^*, where $Q_1^* = 1.83 \times 10^{-3}$ $(mg/kg/day)^{-1}$

Table H.3. TCVP Occupational Handler Cancer Risk Estimates – Contract/ Commercial

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated[2] (units/day)	Contract/ Commercial Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL G PF10 R	DL/G PF10 R	EC
Mixer/Loaders										
(1a) Mixing/ Loading Liquids for Groundboom Applications	Poultry Buildings (Including: Ceilings, Floors, Larvicide, Walls)	0.00077 lb ai/sq ft	100,000 sq ft	2E-06	3E-07	2E-07	2E-06	3E-07	2E-07	7E-08
	Poultry Buildings (Including: Floor Management, Fowl Tick, Larvicide)	0.00064 lb ai/sq ft		1E-06	2E-07	2E-07	1E-06	2E-07	2E-07	6E-08
	Poultry Buildings (Flies Residual)	0.00013 lb ai/sq ft		3E-07	5E-08	4E-08	3E-07	5E-08	4E-08	1E-08
	Poultry Floor Management	0.000064 lb ai/sq ft		1E-07	2E-08	2E-08	1E-07	2E-08	2E-08	6E-09
(1b) Mixing/	Poultry Buildings (Roost)	0.077 lb ai/gallon	2 gallons	3E-09	6E-10	4E-10	3E-09	5E-10	4E-10	1E-10

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Table II.3. TCVP Occupational Handler Cancer Risk Estimates – Contract/ Commercial

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated[2] (units/day)	Contract/ Commercial Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL/G PF10 R	DL/G PF10 R	EC
Loading Liquids for Paint Applications		0.064 lb ai/gallon		3E-09	5E-10	4E-10	3E-09	4E-10	3E-10	1E-10
(2a) Mixing/ Loading Wettable Powders for Groundboom Applications	Poultry Buildings (Including: Droppings, Floor Management Litter, Fowl Tick, Garbage Piles, Manure Piles, Under Feed Troughs)	0.00080 lb ai/sq ft	100,000 sq ft	3E-05	5E-06	4E-06	3E-05	2E-06	1E-06	9E-08
	Dairy Barns, Poultry Houses, Swine Barns, or Other Animal Buildings	0.00032 lb ai/sq ft		1E-05	2E-06	2E-06	1E-05	6E-07	5E-07	4E-08
(2b) Mixing/ Loading Wettable Powders for Paint Applications	Poultry (Floor Management – Roost)	0.080 lb ai/gallon	2 gallons	2E-08	3E-09	3E-09	2E-08	1E-09	1E-09	7E-11
(3a) Mixing/ Loading Dusts for Paint Applications (WP Data as Surrogate)		0.030 lb ai/gallon		2E-08	3E-09	3E-09	2E-08	1E-09	1E-09	7E-11
Applicators										
(4) Groundboom Applications	Poultry Buildings (Including: Droppings, Floor Management Litter, Fowl Tick, Garbage Piles, Manure Piles, Under Feed Troughs)	0.00080 lb ai/sq ft	100,000 sq ft	6E-07	1E-07	1E-07	6E-07	1E-07	1E-07	4E-08
	Poultry Buildings (Including: Ceilings, Floors, Larvicide, Walls)	0.00077 lb ai/sq ft		6E-07	1E-07	1E-07	6E-07	1E-07	9E-08	4E-08
	Poultry Buildings (Including: Floor Management, Fowl Tick, Larvicide)	0.00064 lb ai/sq ft		5E-07	1E-07	1E-07	5E-07	1E-07	8E-08	3E-08
	Dairy Barns, Poultry Houses, Swine Barns, or Other Animal Buildings	0.00032 lb ai/sq ft		2E-07	6E-08	5E-08	2E-07	5E-08	4E-08	2E-08
	Poultry Buildings (Flies Residual)	0.00013 lb ai/sq ft		1E-07	2E-08	2E-08	9E-08	2E-08	2E-08	7E-09
	Poultry (Floor Management)	0.000064 lb ai/sq ft		5E-08	1E-08	1E-08	5E-08	1E-08	8E-09	3E-09
(5) Open Pour Liquid Additive	Cattle Feed (Concentrate)	0.0039 lb ai/animal	1,000 cows	8E-08	1E-08	1E-08	8E-08	1E-08	1E-08	No Data

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Table II.3. TCVP Occupational Handler Cancer Risk Estimates – Contract/ Commercial

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated[2] (units/day)	Contract/ Commercial Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL.G PF10 R	DL/G PF10 R	EC
for Feed Through Applications	Cattle Feed (Concentrate)	0.0022 lb ai/animal		5E-08	8E-09	6E-09	4E-08	8E-09	6E-09	No Data
	Horse Feed	0.0017 lb ai/animal	500 horses	2E-08	3E-09	2E-09	2E-08	3E-09	2E-09	No Data
	Swine Feed	0.00060 lb ai/animal	6,250 pigs	8E-08	1E-08	1E-08	8E-08	1E-08	1E-08	No Data
(6) RTU Pet Collar Applications – 99.62% Liquid/0.38% Dust Ratio	Cat (2596-49)	0.0036 lb ai/animal	8 animals	3E-07	2E-07	1E-07	3E-07	2E-07	1E-07	No Data
	Dog (2596-50,62) - Small	0.0061 lb ai/animal		6E-07	3E-07	2E-07	6E-07	3E-07	2E-07	No Data
	Dog (2596-50,62) - Large	0.010 lb ai/animal		9E-07	5E-07	3E-07	9E-07	5E-07	3E-07	No Data
	Cat (2596-63) - Small	0.0048 lb ai/animal		5E-07	2E-07	2E-07	5E-07	2E-07	1E-07	No Data
	Cat (2596-63) - Large	0.0055 lb ai/animal		5E-07	3E-07	2E-07	5E-07	3E-07	2E-07	No Data
	Cat (2596-83) - Small	0.0039 lb ai/animal		4E-07	2E-07	1E-07	4E-07	2E-07	1E-07	No Data
	Cat (2596-83) - Large	0.0080 lb ai/animal		8E-07	4E-07	3E-07	8E-07	4E-07	2E-07	No Data
	Dog (2596-84) – Small	0.0061 lb ai/animal		6E-07	3E-07	2E-07	6E-07	3E-07	2E-07	No Data
	Dog (2596-84) – Large	0.010 lb ai/animal		9E-07	5E-07	3E-07	9E-07	5E-07	3E-07	No Data
	Cat (2596-139) - All	0.0032 lb ai/animal		3E-07	2E-07	1E-07	3E-07	2E-07	1E-07	No Data
	Dog (2596-139) - All	0.016 lb ai/animal		2E-06	8E-07	5E-07	2E-06	8E-07	5E-07	No Data
	Dog (11556-164) - All	0.0072 lb ai/animal		7E-07	4E-07	2E-07	7E-07	4E-07	2E-07	No Data
	Cat (11556-165) - All	0.0045 lb ai/animal		4E-07	2E-07	1E-07	4E-07	2E-07	1E-07	No Data
(7) RTU Dust/Powder Applications	Dog (47000-123) - Small	0.00037 lb ai/animal		1E-07	1E-07	9E-08	1E-07	1E-07	8E-08	No Data
	Dog (47000-123) - Medium	0.00094 lb ai/animal		4E-06	4E-06	3E-06	4E-06	4E-06	2E-06	No Data

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Table II.3. TCVP Occupational Handler Cancer Risk Estimates – Contract/ Commercial

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated[2] (units/day)	Contract/ Commercial Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL/G PF10 R	DL/G PF10 R	EC
	Dog (47000-123) - Large	0.0015 lb ai/animal		3E-06	3E-06	2E-06	3E-06	3E-06	2E-06	No Data
	Cat (47000-123) - Small	0.000090 lb ai/animal		2E-06	2E-06	1E-06	2E-06	2E-06	1E-06	No Data
	Cat (47000-123) - Medium	0.00022 lb ai/animal		1E-05	1E-05	6E-06	1E-05	1E-05	6E-06	No Data
	Cat (47000-123) - Large	0.00034 lb ai/animal		3E-06	3E-06	2E-06	3E-06	3E-06	2E-06	No Data
	Cat (2596-78) - Small	0.00062 lb ai/animal		8E-06	8E-06	6E-06	8E-06	7E-06	5E-06	No Data
	Cat (2596-78) - Large	0.0010 lb ai/animal		3E-06	3E-06	2E-06	2E-06	2E-06	2E-06	No Data
	Dog (2596-79) - Small	0.0010 lb ai/animal		5E-06	5E-06	3E-06	5E-06	5E-06	3E-06	No Data
	Dog (2596-79) - Medium	0.0021 lb ai/animal		5E-07	5E-07	3E-07	5E-07	5E-07	3E-07	No Data
	Dog (2596-79) - Large	0.0026 lb ai/animal		1E-07	1E-07	9E-08	1E-07	1E-07	8E-08	No Data
	Dog (67517-82) - Small	0.0011 lb ai/animal		4E-06	4E-06	3E-06	4E-06	4E-06	2E-06	No Data
	Dog (67517-82) - Medium	0.0028 lb ai/animal		3E-06	3E-06	2E-06	3E-06	3E-06	2E-06	No Data
	Dog (67517-82) - Large	0.0045 lb ai/animal		2E-06	2E-06	1E-06	2E-06	2E-06	1E-06	No Data
	Cat (67517-82) - Small	0.00028 lb ai/animal		1E-05	1E-05	6E-06	1E-05	1E-05	6E-06	No Data
	Cat (67517-82) - Medium	0.00067 lb ai/animal		3E-06	3E-06	2E-06	3E-06	3E-06	2E-06	No Data
	Cat (67517-82) - Large	0.0010 lb ai/animal		8E-06	8E-06	6E-06	8E-06	7E-06	5E-06	No Data
(8) RTU Pump/Trigger Spray Applications	Cat (2596-126,140) - Trigger -Small	0.00055 lb ai/animal		3E-06	3E-06	2E-06	2E-06	2E-06	2E-06	No Data
	Cat (2596-126,140) - Trigger - Large	0.00077 lb ai/animal		5E-06	5E-06	3E-06	5E-06	5E-06	3E-06	No Data
	Cat (2596-140) - Pump - Small	0.00011 lb ai/animal		5E-07	5E-07	3E-07	5E-07	5E-07	3E-07	No Data

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Table II.3. TCVP Occupational Handler Cancer Risk Estimates – Contract/ Commercial										
Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated[2] (units/day)	Contract/ Commercial Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL/G PF10 R	DL/G PF10 R	EC
	Cat (2596-140) - Pump - Large	0.00016 lb ai/animal		1E-07	1E-07	9E-08	1E-07	1E-07	8E-08	No Data
	Dog (2596-125,-140) - Small	0.00077 lb ai/animal		4E-06	4E-06	3E-06	4E-06	4E-06	2E-06	No Data
	Dog (2596-125,-140) - Medium	0.00088 lb ai/animal		3E-06	3E-06	2E-06	3E-06	3E-06	2E-06	No Data
	Dog (2596-125,-140) - Large	0.0015 lb ai/animal		2E-06	2E-06	1E-06	2E-06	2E-06	1E-06	No Data
Mixers/Loaders/Applicators										
(9a) Liquid: Backpack Sprayer	Beef Cattle - Direct Applied	0.039 lb ai/animal	400 animals	1E-05	1E-05	6E-06	1E-05	1E-05	6E-06	No Data
		0.032 lb ai/animal		3E-06	3E-06	2E-06	3E-06	3E-06	2E-06	No Data
	Woody Borders of Kennels, Yards, Campgrounds, Recreational Parks, Footpaths and Roadways	0.032 lb ai/sq ft	1,000 sq ft (spot)	8E-06	8E-06	6E-06	8E-06	7E-06	5E-06	No Data
	Beef Cattle - Direct Applied	0.026 lb ai/animal	400 animals	3E-06	3E-06	2E-06	2E-06	2E-06	2E-06	No Data
	Swine - Direct Applied	0.049 lb ai/animal		5E-06	5E-06	3E-06	5E-06	5E-06	3E-06	No Data
	Lactating Dairy Cattle - Direct Applied	0.0049 lb ai/animal		5E-07	5E-07	3E-07	5E-07	5E-07	3E-07	No Data
		0.0013 lb ai/animal		1E-07	1E-07	9E-08	1E-07	1E-07	8E-08	No Data
	Poultry Buildings (Walls, Ceilings, Floors, Larvicide)	0.00077 lb ai/sq ft	20,000 sq ft	4E-06	4E-06	3E-06	4E-06	4E-06	2E-06	No Data
	Poultry Buildings (Floor Management, Fowl Tick, Larvicide)	0.00064 lb ai/sq ft		3E-06	3E-06	2E-06	3E-06	3E-06	2E-06	No Data
	Poultry (Caged) - Direct Applied	0.00032 lb ai/bird	20,000 birds	2E-06	2E-06	1E-06	2E-06	2E-06	1E-06	No Data
	Poultry Buildings (Flies Residual) -	0.00013 lb ai/sq ft	20,000 sq ft	7E-07	7E-07	5E-07	6E-07	6E-07	4E-07	No Data
	Poultry (Chicken on Litter) - Direct Applied	0.000078 lb ai/bird	20,000 birds	4E-07	4E-07	3E-07	4E-07	4E-07	2E-07	No Data
	Poultry Floor Management	0.000064 lb ai/sq ft	20,000 sq ft	3E-07	3E-07	2E-07	3E-07	3E-07	2E-07	No Data

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Table II.3. TCVP Occupational Handler Cancer Risk Estimates – Contract/ Commercial

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated[2] (units/day)	Contract/ Commercial Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL/G PF10 R	DL/G PF10 R	EC
(9b) Liquid: Manually-Pressurized Handwand	Beef Cattle - Direct Applied	0.039 lb ai/animal	400 animals	1E-04	1E-06	1E-06	1E-04	7E-07	6E-07	No Data
		0.032 lb ai/animal		1E-04	9E-07	8E-07	1E-04	5E-07	5E-07	No Data
	Woody Borders of Kennels, Yards, Campgrounds, Recreational Parks, Footpaths and Roadways	0.032 lb ai/sq ft	1,000 sq ft (spot)	3E-04	2E-06	2E-06	3E-04	1E-06	1E-06	No Data
	Beef Cattle - Direct Applied	0.026 lb ai/animal	400 animals	1E-04	7E-07	7E-07	1E-04	4E-07	4E-07	No Data
	Swine - Direct Applied	0.049 lb ai/animal		2E-04	1E-06	1E-06	2E-04	8E-07	7E-07	No Data
	Lactating Dairy Cattle - Direct Applied	0.0049 lb ai/animal		2E-05	1E-07	1E-07	2E-05	8E-08	7E-08	No Data
		0.0013 lb ai/animal		5E-06	4E-08	3E-08	5E-06	2E-08	2E-08	No Data
	Poultry Buildings (Walls, Ceilings, Floors, Larvicide) -	0.00077 lb ai/sq ft	20,000 sq ft	1E-04	1E-06	1E-06	1E-04	7E-07	6E-07	No Data
	Poultry Buildings (Floor Management, Fowl Tick, Larvicide)	0.00064 lb ai/sq ft		1E-04	9E-07	8E-07	1E-04	5E-07	5E-07	No Data
	Poultry (Caged) - Direct Applied	0.00032 lb ai/bird	20,000 birds	6E-05	4E-07	4E-07	6E-05	3E-07	2E-07	No Data
	Poultry Buildings (Flies Residual) -	0.00013 lb ai/sq ft	20,000 sq ft	2E-05	2E-07	2E-07	2E-05	1E-07	9E-08	No Data
	Poultry (Chicken on Litter) - Direct Applied	0.000078 lb ai/bird	20,000 birds	1E-05	1E-07	1E-07	1E-05	7E-08	6E-08	No Data
	Poultry Floor Management	0.000064 lb ai/sq ft	20,000 sq ft	1E-05	9E-08	8E-08	1E-05	5E-08	5E-08	No Data
(9c) Liquid: Mechanically-Pressurized Handgun	Beef Cattle - Direct Applied	0.039 lb ai/animal	400 animals	4E-06	2E-06	2E-06	3E-06	1E-06	6E-07	No Data
		0.032 lb ai/animal		3E-06	2E-06	1E-06	2E-06	9E-07	5E-07	No Data
	Woody Borders of Kennels, Yards, Campgrounds, Recreational Parks, Footpaths and Roadways	0.026 lb ai/animal		3E-06	1E-06	1E-06	2E-06	7E-07	4E-07	No Data
	Beef Cattle - Direct Applied	0.049 lb ai/animal		5E-06	3E-06	2E-06	3E-06	1E-06	8E-07	No Data

Table II.3. TCVP Occupational Handler Cancer Risk Estimates – Contract/ Commercial

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated[2] (units/day)	Contract/ Commercial Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL.G PF10 R	DL/G PF10 R	EC
	Swine - Direct Applied	0.0049 lb ai/animal		5E-07	3E-07	2E-07	3E-07	1E-07	8E-08	No Data
	Lactating Dairy Cattle - Direct Applied	0.0013 lb ai/animal		1E-07	7E-08	6E-08	9E-08	3E-08	2E-08	No Data
	Poultry Buildings (Walls, Ceilings, Floors, Larvicide) -	0.00077 lb ai/sq ft	20,000 sq ft	4E-06	2E-06	2E-06	3E-06	1E-06	6E-07	No Data
	Poultry Buildings (Floor Management, Fowl Tick, Larvicide)	0.00064 lb ai/sq ft		3E-06	2E-06	1E-06	2E-06	9E-07	5E-07	No Data
	Poultry (Caged) - Direct Applied	0.00032 lb ai/bird	20,000 birds	2E-06	9E-07	7E-07	1E-06	4E-07	3E-07	No Data
	Poultry Buildings (Flies Residual)	0.00013 lb ai/sq ft	20,000 sq ft	6E-07	4E-07	3E-07	5E-07	2E-07	1E-07	No Data
	Poultry (Chicken on Litter) - Direct Applied	0.000078 lb ai/bird	20,000 birds	4E-07	2E-07	2E-07	3E-07	1E-07	6E-08	No Data
	Poultry Floor Management	0.000064 lb ai/sq ft	20,000 sq ft	3E-07	2E-07	1E-07	2E-07	9E-08	5E-08	No Data
(9d) Liquid: Backrubber or Facerubber	Cattle - Direct Applied	0.077 lb ai/gallon	50 gallons	8E-08	1E-08	1E-08	8E-08	1E-08	1E-08	No Data
		0.064 lb ai/gallon		7E-08	1E-08	9E-09	7E-08	1E-08	9E-09	No Data
(10a) Wettable Powder: Backpack Sprayer	Beef Cattle - Direct Spray	0.040 lb ai/animal	400 animals	4E-06	4E-06	3E-06	4E-06	4E-06	2E-06	No Data
	Swine - Direct Spray	0.020 lb ai/animal		2E-06	2E-06	1E-06	2E-06	2E-06	1E-06	No Data
	Poultry (Floor Management Litter, Fowl Tick), Poultry Droppings, Manure Piles, Garbage Piles, Under Feed Troughs	0.00080 lb ai/sq ft	20,000 sq ft	4E-06	4E-06	3E-06	4E-06	4E-06	2E-06	No Data
	Poultry (Wire Cages) - Direct Spray	0.00040 lb ai/bird	20,000 birds	2E-06	2E-06	1E-06	2E-06	2E-06	1E-06	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.00032 lb ai/sq ft	20,000 sq ft	2E-06	2E-06	1E-06	2E-06	2E-06	1E-06	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.00016 lb ai/sq ft		8E-07	8E-07	6E-07	8E-07	7E-07	5E-07	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.000080 lb ai/sq ft		4E-07	4E-07	3E-07	4E-07	4E-07	2E-07	No Data

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Table H.3. TCVP Occupational Handler Cancer Risk Estimates – Contract/ Commercial

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated[2] (units/day)	Contract/ Commercial Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL.G PF10 R	DL/G PF10 R	EC
	Kennels, Yards, Campgrounds, Picnic Areas, and Recreational Parks	0.000040 lb ai/sq ft	1,000 sq ft (spot)	1E-08	1E-08	7E-09	9E-09	9E-09	6E-09	No Data
(10b) Wettable Powder: Manually-Pressurized Handwand	Beef Cattle - Direct Spray	0.040 lb ai/animal	400 animals	1E-04	1E-06	1E-06	1E-04	7E-07	6E-07	No Data
	Swine - Direct Spray	0.020 lb ai/animal		7E-05	5E-07	5E-07	7E-05	3E-07	3E-07	No Data
	Poultry (Floor Management Litter, Fowl Tick), Poultry Droppings, Manure Piles, Garbage Piles, Under Feed Troughs	0.00080 lb ai/sq ft	20,000 sq ft	1E-04	1E-06	1E-06	1E-04	7E-07	6E-07	No Data
	Poultry (Wire Cages) - Direct Spray	0.00040 lb ai/bird	20,000 birds	7E-05	5E-07	5E-07	7E-05	3E-07	3E-07	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.00032 lb ai/sq ft	20,000 sq ft	6E-05	4E-07	4E-07	6E-05	3E-07	2E-07	No Data
		0.00016 lb ai/sq ft		3E-05	2E-07	2E-07	3E-05	1E-07	1E-07	No Data
		0.000080 lb ai/sq ft		1E-05	1E-07	1E-07	1E-05	7E-08	6E-08	No Data
	Kennels, Yards, Campgrounds, Picnic Areas, and Recreational Parks	0.000040 lb ai/sq ft	1,000 sq ft (spot)	4E-07	3E-09	3E-09	4E-07	2E-09	1E-09	No Data
(10c) Wettable Powder: Mechanically-Pressurized Handgun	See Table H.4.									
(10d) Wettable Powder: Fogging Equipment (handheld, portable, and stationary)	Poultry (Floor Management)	0.0016 lb ai/bird	20,000 birds	3E-04	3E-04	3E-04	2E-03	2E-04	2E-04	No Data
		0.00078 lb ai/sq ft	100,000 sq ft	7E-04	7E-04	7E-04	2E-03	2E-04	2E-04	No Data
	Poultry (Floor Management Litter)	0.00023 lb ai/sq ft		2E-04	2E-04	2E-04	2E-03	2E-04	2E-04	No Data
(10e) Wettable Powder: Rotary Duster	Poultry (Floor Management Litter)	0.00023 lb ai/sq ft	20,000 sq ft	2E-03	3E-04	2E-04	2E-03	2E-04	2E-04	No Data

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Table II.3. TCVP Occupational Handler Cancer Risk Estimates – Contract/ Commercial

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated[2] (units/day)	Contract/ Commercial Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL.G PF10 R	DL/G PF10 R	EC
(Dust - Plunger Data as Surrogate)										
(10f) Wettable Powder: Plunger Duster (Dust Data as Surrogate)	Poultry (Floor Management)	0.0016 lb ai/bird	1,000 birds	3E-05	6E-06	6E-06	2E-05	4E-06	3E-06	No Data
		0.00078 lb ai/sq ft	1,000 sq ft	1E-05	3E-06	3E-06	1E-05	2E-06	2E-06	No Data
	Poultry (Floor Management Litter)	0.00023 lb ai/sq ft		4E-06	9E-07	8E-07	4E-06	6E-07	5E-07	No Data
(11a) Dust: Self-Treating Dust Bag	Cattle	0.75 lb ai/dust bag	10 dust bags	1E-04	3E-05	3E-05	1E-04	2E-05	2E-05	No Data
		0.38 lb ai/dust bag		6E-05	1E-05	1E-05	6E-05	9E-06	8E-06	No Data
		0.13 lb ai/dust bag		2E-05	5E-06	5E-06	2E-05	3E-06	3E-06	No Data
(11b) Dust: Shaker Can (Plunger Data Surrogate)	Cattle, Swine – Direct Applied	0.0075 lb ai/animal	30 animals	9E-05	6E-06	5E-06	8E-05	3E-06	2E-06	No Data
		0.0038 lb ai/animal		4E-05	3E-06	3E-06	4E-05	1E-06	1E-06	No Data
	Cattle – Direct Applied	0.0013 lb ai/animal		2E-05	1E-06	9E-07	1E-05	5E-07	3E-07	No Data
	Poultry (Dust Box) – Direct Applied	0.00060 lb ai/ bird	1,000 birds	2E-04	2E-05	1E-05	2E-04	7E-06	5E-06	No Data
	Poultry (Floor Management)	0.00030 lb ai/sq ft	1,000 sq ft	1E-04	8E-06	7E-06	1E-04	4E-06	3E-06	No Data
	Swine - Bedding	0.00020 lb ai/sq ft		8E-05	5E-06	5E-06	8E-05	2E-06	2E-06	No Data
	Poultry (Wire Cage) – Direct Applied	0.00010 lb ai/bird	1,000 birds	4E-05	3E-06	2E-06	4E-05	1E-06	8E-07	No Data

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Table II.3. TCVP Occupational Handler Cancer Risk Estimates – Contract/ Commercial

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated[2] (units/day)	Contract/ Commercial Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL/G PF10 R	DL/G PF10 R	EC
(11c) Dust: Rotary Duster (Plunger Data as Surrogate)	Cattle, Swine – Direct Applied	0.0075 lb ai/animal	30 animals	4E-06	9E-07	8E-07	3E-06	6E-07	5E-07	No Data
		0.0038 lb ai/animal		2E-06	4E-07	4E-07	2E-06	3E-07	2E-07	No Data
	Cattle – Direct Applied	0.0013 lb ai/animal		7E-07	2E-07	1E-07	6E-07	1E-07	8E-08	No Data
	Poultry (Dust Box) – Direct Applied	0.00060 lb ai/bird	20,000 birds	2E-04	5E-05	4E-05	2E-04	3E-05	2E-05	No Data
	Poultry (Floor Management)	0.00030 lb ai/sq ft	20,000 sq ft	1E-04	2E-05	2E-05	9E-05	1E-05	1E-05	No Data
	Poultry (Wire Cage) – Direct Applied	0.00010 lb ai/bird	20,000 birds	3E-05	8E-06	7E-06	3E-05	5E-06	4E-06	No Data
(11d) Dust: Plunger Duster	Poultry (Dust Box) – Direct Applied	0.00060 lb ai/bird	1,000 birds	1E-05	2E-06	2E-06	9E-06	1E-06	1E-06	No Data
	Poultry (Floor Management)	0.00030 lb ai/sq ft	1,000 sq ft	5E-06	1E-06	1E-06	5E-06	7E-07	6E-07	No Data
	Poultry (Wire Cage) – Direct Applied	0.00010 lb ai/bird	1,000 birds	2E-06	4E-07	4E-07	2E-06	2E-07	2E-07	No Data
(12a) Paint: Brush or Roller	Poultry (Roost Paint)	0.08 lb ai/gallon	2 gallons	3E-06	4E-07	4E-07	3E-06	4E-07	3E-07	No Data
		0.077 lb ai/gallon		3E-06	4E-07	4E-07	3E-06	3E-07	3E-07	No Data
		0.064 lb ai/gallon		2E-07	3E-08	3E-08	2E-07	3E-08	3E-08	No Data
		0.03 lb ai/gallon		1E-06	1E-07	1E-07	1E-06	1E-07	1E-07	No Data
(12b) Paint: Airless	Poultry (Roost Paint)	0.08 lb ai/gallon	2 gallons	7E-07	3E-07	2E-07	6E-07	2E-07	2E-07	No Data
		0.077 lb ai/gallon		7E-07	2E-07	2E-07	6E-07	2E-07	2E-07	No Data

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Table H.3. TCVP Occupational Handler Cancer Risk Estimates – Contract/ Commercial

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated[2] (units/day)	Contract/ Commercial Cancer Risk Estimates[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL.G PF10 R	DL/G PF10 R	EC
		0.064 lb ai/gallon		6E-08	2E-08	2E-08	5E-08	1E-08	1E-08	No Data
		0.03 lb ai/gallon		3E-07	1E-07	9E-08	2E-07	7E-08	6E-08	No Data
(13) Solid Feed Additive for Feed Through Applications via Cup (Granular Data as Surrogate)	Horse Feed	0.0015 lb ai/animal	500 horses	3E-09	2E-09	2E-09	2E-09	3E-10	3E-10	No Data
		0.00077 lb ai/animal		2E-09	1E-09	1E-09	9E-10	2E-10	2E-10	No Data
	Cattle Feed	0.0022 lb ai/animal	1,000 cows	5E-08	3E-08	3E-08	3E-08	5E-09	5E-09	No Data
		0.0017 lb ai/animal		4E-08	2E-08	2E-08	2E-08	4E-09	4E-09	No Data

1 Based on registered labels. See Appendix A.
2 Area Treated or Amount Handled based on Exposure Science Advisory Council Policy #9.1 or assumptions as outlined in Section 6.1.
3 Cancer risk estimates = LADD × Q_1^*, where $Q_1^* = 1.83 \times 10^{-3}$ $(mg/kg/day)^{-1}$

Table H.4. TCVP Occupational Handler Cancer Risk Estimates - Scenario 10c (mixing/loading and applying wettable powders using mechanically-pressurized handgun) with Use of Chemical-Specific Data and PHED – Contract/Commercial.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Contract/Commercial[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario.						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL.G PF10 R	DL/G PF10 R	EC
Mixer/Loaders										
(10c) Wettable Powder: Mechanically-Pressurized Handgun MRID 42622301	Beef Cattle - Direct Spray	0.040 lb ai/animal	400 animals	No Data	1E-06	No Data	No Data	No Data	No Data	No Data
	Swine - Direct Spray	0.020 lb ai/animal		No Data	5E-07	No Data	No Data	No Data	No Data	No Data
	Poultry (Floor Management Litter, Fowl Tick), Poultry Droppings, Manure Piles, Garbage Piles, Under Feed Troughs	0.00080 lb ai/sq ft	20,000 sq ft	No Data	5E-06	No Data	No Data	No Data	No Data	No Data

Table H.4. TCVP Occupational Handler Cancer Risk Estimates - Scenario 10c (mixing/loading and applying wettable powders using mechanically-pressurized handgun) with Use of Chemical-Specific Data and PHED – Contract/Commercial.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Contract/Commercial[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario.						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL G PF10 R	DL/G PF10 R	EC
	Poultry (Wire Cages) - Direct Spray	0.00040 lb ai/bird	20,000 birds	No Data	5E-07	No Data	No Data	No Data	No Data	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.00032 lb ai/sq ft	20,000 sq ft	No Data	2E-06	No Data	No Data	No Data	No Data	No Data
		0.00016 lb ai/sq ft		No Data	1E-06	No Data	No Data	No Data	No Data	No Data
		0.000080 lb ai/sq ft		No Data	5E-07	No Data	No Data	No Data	No Data	No Data
Applicators										
(10c) Wettable Powder: Mechanically-Pressurized Handgun MRID 42622301	Beef Cattle - Direct Spray	0.040 lb ai/animal	400 animals	No Data	1E-06	No Data	No Data	No Data	No Data	No Data
	Swine - Direct Spray	0.020 lb ai/animal		No Data	7E-07	No Data	No Data	No Data	No Data	No Data
	Poultry (Floor Management Litter, Fowl Tick), Poultry Droppings, Manure Piles, Garbage Piles, Under Feed Troughs	0.00080 lb ai/sq ft	20,000 sq ft	No Data	7E-06	No Data	No Data	No Data	No Data	No Data
	Poultry (Wire Cages) - Direct Spray	0.00040 lb ai/bird	20,000 birds	No Data	7E-07	No Data	No Data	No Data	No Data	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.00032 lb ai/sq ft	20,000 sq ft	No Data	3E-06	No Data	No Data	No Data	No Data	No Data
		0.00016 lb ai/sq ft		No Data	1E-06	No Data	No Data	No Data	No Data	No Data
		0.000080 lb ai/sq ft		No Data	7E-07	No Data	No Data	No Data	No Data	No Data
Mixer/Loader/Applicators										
(10c) Wettable Powder: Mechanically-Pressurized Handgun PHED	Beef Cattle - Direct Spray	0.040 lb ai/animal	400 animals	4E-06	2E-06	2E-06	3E-06	1E-06	7E-07	No Data
	Swine - Direct Spray	0.020 lb ai/animal		2E-06	1E-06	9E-07	1E-06	5E-07	3E-07	No Data
	Poultry (Floor Management Litter, Fowl Tick), Poultry	0.00080 lb ai/sq ft	20,000 sq ft	2E-05	1E-05	9E-06	1E-05	5E-06	3E-06	No Data

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Table H.4. TCVP Occupational Handler Cancer Risk Estimates - Scenario 10c (mixing/loading and applying wettable powders using mechanically-pressurized handgun) with Use of Chemical-Specific Data and PHED – Contract/Commercial.

Exposure Scenario	Crop or Target	App. Rate[1] (lb ai/unit)	Area Treated or Amount Handled[2] (units/day)	Contract/Commercial[3] For risk management purposes, the currently labeled level of PPE and EC has been identified (shaded) for each individual exposure scenario.						
				SL/NoG No R	SL/G NoR	DL/G No R	SL/No G PF10 R	SL G PF10 R	DL/G PF10 R	EC
	Droppings, Manure Piles, Garbage Piles, Under Feed Troughs									
	Poultry (Wire Cages) - Direct Spray	0.00040 lb ai/bird	20,000 birds	2E-06	1E-06	9E-07	1E-06	5E-07	3E-07	No Data
	Dairy Barns, Poultry Houses, Swine Barns, or other Animal Buildings	0.00032 lb ai/sq ft	20,000 sq ft	8E-06	4E-06	4E-06	6E-06	2E-06	1E-06	No Data
		0.00016 lb ai/sq ft		4E-06	2E-06	2E-06	3E-06	1E-06	7E-07	No Data
		0.000080 lb ai/sq ft		2E-06	1E-06	9E-07	1E-06	5E-07	3E-07	No Data

1 Based on registered labels. See Appendix A.
2 Area Treated or Amount Handled based on Exposure Science Advisory Council Policy #9.1 or assumptions as outlined in Section 6.1.
3 Cancer risk estimates = LADD × Q_1^*, where $Q_1^* = 1.83 \times 10^{-3}$ $(mg/kg/day)^{-1}$

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Appendix I. Summary of Pet Collar Formulation Issue

In 2009, the Natural Resources Defense Council (NRDC) petitioned the EPA to cancel all pet uses for the pesticide TCVP. In 2014, the agency responded to the 2009 petition by conducting a human health risk assessment for all currently registered TCVP products which include collars, dusts/powders, and pump and trigger spray formulations. That risk assessment was dated November 5, 2014. At that time, no human health risks of concern were identified for any TCVP pet product and the petition to cancel all pet products was denied on November 6, 2014. The NRDC subsequently responded to the agency's denial with arguments presented in the Natural Resources Defense Council, Inc.'s (NRDC) Aug. 5, 2015 Opening Brief in *NRDC v. EPA*, Case No. 15-70025 (9th Cir.) (Opening Brief). Among the arguments raised by NRDC was the assertion that the agency incorrectly considered the TCVP flea collar formulation to be a liquid formulated product:

"NRDC states that the EPA 'failed to research the TCVP flea collar label; instead it ignored the information in the label right on the box regarding the chemical formulation' [NRDC Opening Brief, p.67]. The label for the Hartz UltraGuard Flea and Tick Collar for Dogs (EPA Reg. No. 2596-84) states that 'as the collar begins to work, a fine white powder will appear on the surface.' As a result, NRDC argues that the transfer coefficient (TC) recommended for solid formulations should have been used instead of the transfer coefficent for liquid formulations as is recommended by the 2012 Residential SOPs."[33]

The agency responded to this and all other arguments raised by NRDC in a December 21, 2015 memorandum[NOTEREF _Ref468780609 \h * MERGEFORMAT] issued along with the draft risk assessment for Registration Review. The following is an excerpt of the agency's response relating to the pet collar formulation issue:

"Per EPA's 2012 Residential SOPs[34]*: Treated Pets, pet collar products are categorized as a liquid formulation. This position was based on research conducted at the time of SOP development that supported that pet collars function by means of diffusion, transferring from the collar to the surrounding area. More specifically, the active ingredient, which is embedded in the collar matrix, diffuses slowly through the matrix, thus controlling the amount of the active ingredient at the collar's surface. The active ingredient available on the surface of the pet collar then "rubs off" or transfers from the collar to the animal's hair coat via embedded lubricants which function as transfer agents at the surface of the collar. Based on the categorization of pet collars as liquid formulations, the assessment of post-application exposures for these product types would be conducted with use of the TCs, and the fraction active ingredient on the hands from TC studies (Fai_{hands}) recommended for the assessment of liquid formulated products as recommended in the 2012 Residential SOPs.*

The information provided by NRDC states that the label for the Hartz UltraGuard Flea and Tick Collar for Dogs (EPA Reg. No. 2596-84) states that "as the collar begins to work, a fine white powder will appear on the surface." HED has confirmed that this statement is present on the

[33] W. Britton. Tetrachlorvinphos (TCVP): Responses to Arguments Presented in the Natural Resources Defense Council, Inc.'s (NRDC) Aug. 5, 2015 Opening Brief in *NRDC v. EPA*, Case No. 15-70025 (9th Cir.). 12/21/15, D430589.

[34] [HYPERLINK "http://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/standard-operating-procedures-residential-pesticide"]

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current labeling for the identified product and that an identical statement is also found on the following TCVP pet collar products (5 of 9 total pet collar products): EPA Reg. Nos. 2596-62, 2596-63, 2596-83, 2596-84, and 2596-139. Taking label statements into account, and based upon further research which suggests that some pet collars may act by extrusion of the active ingredient from the collar matrix as a fine dust, HED has reconsidered the position that the TCVP pet collars are all liquid formulated products. As a result of this uncertainty, in the TCVP draft human health risk assessment in support of registration review, HED has updated the assessment of post-application risks from TCVP pet collars in consideration of both the dust- and liquid-specific TCs and Fai_{hands} *recommended SOP values."*

In response to the 2015 draft risk assessment for Registration Review, Bayer HealthCare, LLC submitted comments to address the formulation type issue. Bayer agreed with the approach employed by the agency, stating: "*Based on the NRDC assertion and the statement on the collar packaging the agency has taken the understandable approach of calculating the post-application exposure, using both liquid and solid formulation transfer coefficients, until the uncertainty is resolved.*" Bayer proceeded to address the formulation type issue by describing how the active ingredient is released from the collar and distributed on the animal. Bayer described that, "*To achieve their goal of effective pest control, the flea collars are designed to deliver the insecticide from the collar in either a liquid or solid state. The collar is made from a mixture of plastic resins and resin modifiers. The resins are formulated to have appropriate strength and flexibility so the collar can withstand the shaping operations without cracking or crumbling. The resins must also have appropriate release characteristics, such that the TCVP (or other insecticide active ingredient) can escape the collar at the proper rate, while inert components remain in the collar.*"

Per Bayer, TCVP is distributed on the animal by abrasion or movement against the animal or diffusion from the animal's body heat. "*Within a few days after manufacture, the insecticide begins to migrate from within the body of the collar and form a coating of particles, resembling a dust or powder on the surface of the collar. As the particles of the active ingredient are displaced or shaken from the surface due to the normal activity of the animal, additional particles appear by migration from the body of the composition to replace the insecticide particles displaced from the surface (i.e., the displaced particles are replenished continuously). This describes the typical release mechanism and explains the presence of the powder as raised by NRDC. The powders are in the immediate vicinity of the collar; however, this is not necessarily the form in which the insecticide is dispersed to the animal or relevant to the transfer coefficient.*" They continued to describe that the sebaceous glands within the dog's skin that lubricate the hair are the mechanism for dispersion of the insecticide. "*Insecticides that are used in flea collars are lipophilic and soluble in the animal's skin oils. So, even though the collars may release some of the insecticides as a solid they are dispersed along the animal's body as a solution or suspension in the animal's skin via the natural skin oils.*" As such, the assessment of human health risks from TCVP pet collars were conducted in a manner that accounts for the likelihood of the presence of both liquid and solid forms while considering the isolated location (i.e., the head/neck) of ai in the dust/powder form.

While informative, Bayer's comments pose a dilemma for the agency. Although they describe the mechanism of dispersion of active ingredient along the animal's body as a solution or

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suspension in the skin, they also indicate that the insecticide begins to migrate from within the collar as a "coating of particles, resembling a dust or powder form on the surface of the collar" and that "flea collars are designed to deliver the insecticide from the collar in either a liquid or solid state." The mechanism of active ingredient dispersion via the skin alone is not adequate to describe the potential for post-application exposures. If the active ingredient is present as a liquid or particulate or dust on the surface of the pet collar, it could be transferred in either form from the collar to the pet's fur immediately surrounding and result in the potential for post-application exposures from either direct contact with the pet collar, or the surrounding fur.

Subsequent to the 2016 risk assessment, Hartz Mountain Corporation provided several submissions related to its registered tetrachlorvinphos (TCVP, CAS# 22248-79-9) pet collar products to support that the physical form "dispensed from the collar" is liquid rather than solid/dust. In those submissions, Hartz stated that the physical form of TCVP and a plasticizer inert, combine in a mixture to make a liquid (whether a paste, film, viscous liquid, emulsion or suspension). Hartz asserts that TCVP, a solid at room temperature, behaves as a liquid in the presence of the inert ingredient and that the physical chemical properties of the ai and inerts alone could be used to estimate the form of residues released from the collar and predict how the collar functions. This argument was brought to HED's Chemistry Science Advisory Council (ChemSAC) on 8/21/19. ChemSAC concluded that the data and supporting information do not definitively support that TCVP will behave solely as a liquid form. ChemSAC generally agreed that once TCVP and the inert interact with the sebum, the lipophilicity of the inert and TCVP supports that TCVP is likely in a liquid, or otherwise semi-solid form. However, the committee could not rule out that dust exposure to TCVP was possible during collar activation/placement or from contact with the animal after collar placement, especially near the collar/neck area. ChemSAC was also uncertain of the composition of the white powder/dust during activation. More information is needed about the components of the visible "fine white powder." For instance, the powder could be analyzed to determine if TCVP is found in the powder and if so, whether the form of TCVP found in the powder during activation is in a polymorphic form that is not bioavailable. ChemSAC noted the uncertainty of the ratios of TCVP to the inert, since it is unknown how a much higher relative amount of TCVP to the inert impacts the physical state of the active ingredient. ChemSAC noted that additional information about the analyzed ratios of TCVP to the inert would help inform the physical state of TCVP. Ultimately, ChemSAC concluded that the data submitted to support that the physical/chemical properties of the inert and TCVP do not definitively support that TCVP residues released from the collar are/behave solely as a liquid. Therefore, HED has continued to assess exposure to TCVP pet collars assuming potential exposure to both a liquid and solid (dust) form.

Pet Collar Formulation Type Approach: A unique approach has been applied in order to account for the potential for exposures from the presence of TCVP to exist as both liquid and solid forms concurrently. The approach uses the same methodologies described in the 2012 Residential SOPs for assessment of residential handler and post-application exposure assessment for pet collar usage. However, whereas the 2012 Residential SOPs recommend that pet collars be assessed as a liquid formulation, the present approach assesses pet collar exposures as both a liquid and solid form. For residential handlers, this means use of the liquid UE data as recommended by the 2012 Residential SOPs and chemical-specific dust UE data for these formulation types. For the residential post-application exposure assessment, this means use of transfer coefficients (dermal exposures) and the fraction of active ingredient on hands from the

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transfer coefficent studies (hand-to-mouth exposures) specific to both liquid and solid formulation types.

The individual dust and liquid formulation handler and post-application doses were estimated, and then another step was included in the assessment where the liquid and dust doses were averaged assuming a ratio of liquid to dust in the collar formulation. The methodologies and inputs used for the individual formulation assessments for residential handlers and residential post-application exposures are described in Appendix B of this document.

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Appendix J. Summary of Residue Data Used in TCVP Pet Collar Assessments

For pet collars, data from two residue transfer studies have been used in previous risk assessments for estimating exposures to the TCVP collar uses: an amitraz pet collar residue transfer study (MRID 49468801) and a literature study using TCVP pet collars (Davis, M., 2008).

In the 2014 residential risk assessment for TCVP, a propoxur pet collar residue transfer study was used for assessment of post-application risks from TCVP pet collars. Subsequent to the completion of the 2014 residential risk assessment, an amitraz pet collar residue transfer study was submitted to EPA. Based on the review of the amitraz pet collar study, it was determined that the mean Day 0 residue transfer resulting from the amitraz pet collar exceeded the mean residue transfer measured on Day 0 from the propoxur pet collar. As a result, HED updated the risk estimates for exposures resulting from contact with a TCVP pet collar-treated pet using the amitraz pet collar transfer study.

The Davis study was used in addition to the amitraz study to assess non-cancer and cancer post-application risks following contact with TCVP pet collar treated pets. The study measured exposures by means of petting/rubbing TCVP pet collar treated dogs with a cotton gloved hand, t-shirts worn by children, urinary biomonitoring of adults and children exposed to the treated dogs, as well as monitoring of plasma ChE levels of the treated dogs. The Davis study publication was considered for use in the assessments due to arguments submitted by NRDC in its August 5th, 2015, Opening Brief in *NRDC v. EPA*, Case No. 15-70025 (9th Cir.) (Opening Brief). NRDC's Opening Brief was filed in litigation challenging EPA's November 6, 2014 denial of NRDC's 2009 petition to cancel all TCVP pet products[35]; the denial was based on the 2014 residential pet product assessment. The agency provided a point-by-point response to the NRDC's arguments in a December 21, 2015 memorandum,[36] issued in conjunction with the 2015 draft TCVP risk assessment for Registration Review. Among the arguments presented by the NRDC was that the agency "failed to consider the Davis study for the estimation of post-application risks for exposures to the TCVP pet collar." In its 2015 memorandum, the agency acknowledged consideration of the potential effect of using the Davis study as the basis for residential post-application assessment of exposures from TCVP pet collars, the study was reviewed,[37] an OPP ethics review was conducted[NOTEREF _Ref468700070 \h * MERGEFORMAT], and preliminary risk estimates were presented with use of these data. However, the formal use of the Davis study was put on hold pending review by EPA's HSRB in January 2016. The Davis study includes 1) glove residue data collected by adult volunteers petting TCVP treated dogs 2) plasma cholinesterase (ChE) measures from treated dogs 3) tee shirt samples collected from children exposed to TCVP treated dogs and 4) urinary biomonitoring for adults and children exposure to TCVP treated dogs. However, for purposes of the TCVP risk assessment, EPA may rely only on the transferable residue data [in light of 40 CFR Part 26, subpart Q regarding ethical standards

[35] Natural Resources Defense Council, Inc., Petitioner, v. U.S. Environmental Protection Agency, Respondent. On Petition to Review of an Order of the U.S. Environmental Protection Agency. In the United State Court of Appeals for the Ninth Circuit. 8/5/2015. No. 15-70025.

[36] W. Britton. Tetrachlorvinphos (TCVP): Responses to Arguments Presented in the Natural Resources Defense Council, Inc.'s (NRDC) Aug. 5, 2015 Opening Brief in *NRDC v. EPA*, Case No. 15-70025 (9th Cir.). 12/21/15, D430589.

[37] W. Britton. Science Review of "Davis et al., 2008. Assessing Intermittent Pesticide Exposure from Flea Control Collars Containing the Organophosphorus Insecticide Tetrachlorvinphos" for HSRB Consideration. D430707. 12/16/2015.

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for assessing whether to rely on the results in human research in EPA actions] as these are the only data from the study that result in the potential for greater risks, are applicable to human exposures (in the case of the dog plasma ChE measures), or in the case of the urinary biomonitoring data, are useful given current scientific limitations (i.e., a physiologically based pharmacokinetic (PBPK) model applicable to TCVP). While EPA proposed to rely only on the glove residue data (which did not involve children), since these data were collected as part of broader research which did involve children, HSRB review was necessary.

On January 12-13, 2016, the EPA HSRB addressed the scientific and ethical charge questions related to Davis study. Ethics and science reviews were conducted by the agency in support of the HSRB meeting. [38,39] A Federal Register (FR) notice was published on April 11, 2016, providing the following information: EPA's proposal to rely on the Davis study; the reason for review by HSRB; the background on ethical conduct of research; summary of discussion on ethics-related questions; the standards applicable to ethical conduct and reliance on data; and the availability of HSRB meeting materials.[40]

The HSRB concluded that, "The research is scientifically sound and, if used appropriately, the pet fur transferable residue data from the rubbing protocol used in the study can provide useful information for evaluating potential exposures of adults and children from contact with dogs treated with tetrachlorvinphos containing pet collars."[41] Per EPA's response to NRDC's Opening Brief arguments, "EPA would rely on these data (Davis study) for regulatory decision making if HSRB determines that the study is scientifically valid and it meets appropriate human ethics requirements," since these data result in in greater potential risks than those estimated using the amitraz pet collar residue transfer study (which had been relied upon in the previous risk assessments) and are, therefore, more protective of human health. Accordingly, post-application risks were assessed with use of the Davis study data only in the 2016 ORE assessment.

The use of the Davis study as the primary data source was consistent with, and supported by, the recommendations from the comments following the 2015 draft ORE assessment for Registration Review including those submitted by NRDC and the Hartz Mountain Corporation. Per NRDC, "the Davis Study has met the appropriate scientific and ethical criteria and should be relied upon for the evaluation of exposures from TCVP containing flea collars" and the Hartz Mountain Corporation describes that, "the glove residue data measured in the Davis et al. (2008) study are valuable because they represent actual measurements of TCVP transfer from dogs wearing commercial collars to the hands of individuals petting them." Further, the NRDC states that, "EPA's utilization of transferable residue data from the amitraz study is not supported by the evidence and should not be relied upon to evaluate risk."

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[38] M. Lydon. Ethics Review of Davis et al Research on Flea Collars with TCVP. 12/15/2015.
[39] W. Britton. Science Review of "Davis et al., 2008. Assessing Intermittent Pesticide Exposure from Flea Control Collars Containing the Organophosphorus Insecticide Tetrachlorvinphos" for HSRB Consideration. D430707. 12/16/2015.
[40] [HYPERLINK "https://www.federalregister.gov/documents/2016/04/11/2016-08281/tetrachlorvinphos-tcvp-epa-proposal-to-rely-on-data-from-human-research-on-tcvp-exposure-from-flea"]
[41] Letter from Liza Dawson, PhD, Chair of the EPA HSRB to Thomas Burke, PhD, MPH, EPA Science Advisor. Subject: January 12-13, 2016 EPA Human Studies Review Board Meeting Report. March 30, 2016.

DRAFT

In 2019, Hartz Mountain submitted a TCVP-specific residue transfer study that has also been reviewed by HED and determine to be acceptable for risk assessment (MRID 50881801[42]). Both studies are representative of potential exposure to currently registered TCVP pet collars; however, the Davis study indicates a greater fraction transfer value than MRID 50881801, but the latter study only had a limited number of samples (i.e., a total of 9 dogs with only 3 dogs per petting simulation group). Due to the fact that (1) both available studies are representative of current TCVP pet collars and have been considered acceptable for risk assessment, (2) the Davis study provides a more protective assessment of potential exposure, and (3) in consideration of the limited sample size in MRID 50881801, HED has presented risk estimates utilizing both data sets.

A summary of the Davis study and MRID 50881801 is provided below.

Davis Study - ***Davis, M., et al. Assessing Intermittent Pesticide Exposure from Flea Control Collars Containing the Organophosphorus Insecticide Tetrachlorvinphos. Journal of Exposure Science and Environmental Epidemiology. (2008) 18, 564-570).***

Commented [BW32]: Is there anything in this section which needs updating due to the Davis changes we've made?

Commented [kml33R32]: I took out the alternate approach to calculating the transfer factor that Hartz proposed since it didn't really apply anymore.

The journal article, Davis et al., 2008, was conducted with the purpose of investigating the exposures to TCVP that could occur in children and adults from the use of a TCVP-containing collar on pet dogs. A single product was tested, Hartz Mountain Ultimate Flea Collar, which is composed of 14.55% TCVP. Two separate studies were conducted with the test product as a part of the journal article. Both were conducted in Oktibbeha County, Mississippi, with volunteer households having pet dogs.

Study 1: The first study was conducted for approximately 4 months (112 days), and evaluated the time course of TCVP residue transfer (peak residue and dissipation) to white cotton gloves used to rub, or pet, the dogs' fur. Twenty-three dogs of different breeds and weights were treated with the TCVP flea collar in study 1. Dogs were petted by volunteers continuously for a 5 minute period with use of a cotton glove in following with a defined rubbing protocol. Although not described in the article, it was deduced that the rubbing protocol was repeated for each dog/volunteer to result in a measure of transferable residue 1) from the fur of the neck (rubbing over the collar), 2) from the fur of the neck (with the collar removed), and 3) along the back of the dog in the tail region. Study 1 also analyzed plasma cholinesterase (ChE) activity from blood samples taken from each dog at the same time as the rubbing samples. Pre-collar and post-collar application samples were collected for the evaluation of residue transfer to gloves and the dogs blood ChE activity.

Significant increases in transferable TCVP residues were observed on the cotton gloves used to pet dogs compared to pretreatment concentrations. In study 1, transferable residues from all three sampling locations decreased (86% decline) throughout the 112 days following a peak at day 7 post-collar application, 24,000 ± 4,000 µg/glove over the collar. Similar trends were also observed in detectable residues around the neck without the collar in place and in the tail region where there were 94% and 71% decreases, respectively. Mean glove residues for all sampling

[42] MRID 50881801. D453149.

DRAFT

times were 14,300 µg/glove over the collar, 4,300 µg/glove on the neck with the collar removed, and 130 µg/glove in the tail region. No significant changes in dog plasma ChE were measured.

Study 2: The second, subsequent study was conducted on the basis that results from study 1 indicated that TCVP residues peaked and then suddenly dropped within 3 weeks of collar placement. Therefore, the second study was conducted over a 3 week (21 day) period, and included human biomonitoring of the TCVP metabolite, 2,4,5-trichloromandelic acid (TCMA), in urine of adults and children. The second study also measured TCVP residues as transferred from treated dogs to cotton t-shirts worn by children, as well as those transferred to cotton gloves from petting the dogs' fur. Pre- and post-collar samples were collected for the residue collection by glove, t-shirt, and the biomonitoring phase of study 2.

In study 2, TCVP residues obtained over the collar and around the neck without the collar in place decreased (30% decline) from 5 to 12 days post-collar application, while residues obtained from the tail region remained fairly constant (81 µg/glove at 5 days and 82 µg/glove at 12 days). The peak transferable residues collected over the collar at 5 days post-collar application were of a similar magnitude to those observed in study 1. Mean residues (for all gloves analyzed) post-collar application were 19,000 µg/glove over the collar, 8,000 µg/glove on the neck with the collar removed, and 80 µg/glove in the tail region.

The average amount of TCVP residues detected on children's t-shirts on sampling days 7-11 post-collar application was 1.8 ± 0.8 µg/shirt, with no significant differences among the sampling days. Transferable residues were significantly greater than the mean pre-treatment residue of 0.03 ± 0.006 µg/shirt.

Urine samples collected from children generally contained more urinary TCMA than that from the adults with significant differences between the ages occurring on only 1 of the 5 sampling days (day 11). The ranges of TCMA concentrations were large across all adults and children; 1.4 - 582 ng/ml urine for adults, and 2.1 - 1,558 ng/ml urine in children. However, no significant differences in urinary TCMA concentrations were observed within each adult or child in the study. The urinary TCMA concentrations were all adjusted for creatinine content; however, there were no differences in outcomes and, as a result, reported values were unadjusted. No significant correlations were identified among t-shirt TCVP residues, the amount of time spent with treated dogs, and urinary TCMA concentrations.

~~In Hartz Mountain Corporation's comments following the 2015 ORE assessment, an alternative method of calculating the average residues from the Davis study was proposed. This method involves the use of a 90-day time-weighted average (TWA) that takes into account the exponential decay of the transferable residues with respect to time. Using the methods described by Hartz Mountain Corporation, a 90-day TWA residue transfer value equivalent to 0.26% was quantified. Hartz Mountain supports that the use of the 90-day TWA is more appropriate than the 12-day average used by EPA since it more accurately reflects the duration of the oral toxicity study used for assessment of residential post-application incidental oral exposures. ofor The resulting TWA is 1.5-fold lower than the 0.40% value used by the agency.~~

DRAFT

~~TCVP, like other OPs, exhibits a phenomenon known as steady state AChE inhibition. After repeated dosing at the same dose, the degree of inhibition comes into equilibrium with the production of new, uninhibited enzyme. TCVP shows no difference in response across duration. As a result, the steady state incidental oral endpoint was selected from an acute CCA study (MRID 44877340 1a) for assessment of a steady state exposure duration. Accordingly, the 12-day mean was used by the agency since it is the shortest exposure duration presented in Davis study summaries for use in risk assessment. EPA has identified no fault with regard to the methods used by Hartz Mountain Corporation for quantification of the 90-day TWA; however, since TCVP show no difference in response across duration, the use of the longer-term 90-day TWA, would potentially underestimate risks.~~

MRID 50931601. D454190. Submitted in response to GDCI-083702-1791.

In 2019, Hartz Mountain Corporation submitted a TCVP-specific residue transfer study for pet collars (MRID 50881801). The purpose of the study was to measure the transferability of the test substance (TCVP) and a plasticizing agent from the hair of a dog wearing a TCVP-impregnated collar. Each collar contained 14.55% TCVP (wt/wt). The collars are typically applied to dogs by securing the collar around the dog's neck and cutting off any excess collar length.

A total of 9 dogs were used in the study, randomly assigned to 3 groups. Each group had different assigned number of simulations. Dogs in Group 1 were petted for 5 simulations, dogs in Group 2 received 10 petting simulations, and dogs in Group 3 received 25 petting simulations. Each simulation consisted of three strokes conducted using a mannequin hand fitted with three cotton gloves. The first stroke was on the right side, the second on the left side, and the third was along the back line. After the simulations, all 3 gloves were removed and placed individually into labeled jars. Samples were collected from each dog 4 days prior to application of the collar (4 days prior to treatment or -4DAT) and 10 days after application of the collar (10DAT). In addition, at the end of the study, each collar used on the animals was collected, stored in separate containers, and sent to the analytical testing laboratory facility.

Fortification samples were prepared on -4DAT and 10DAT. Duplicate samples were fortified with each analyte at three levels: 120 µg/sample (LOQ), 2,000 µg/sample, and 4,400 µg/sample. Fortified samples were handled, stored and shipped in the same manner as the residue samples. Average recoveries for the low-, mid- and high-level fortified samples ranged from 87.3 – 114% for TCVP on sampling day 10 and from 82.5-105% for the inert.

Glove samples collected prior to the application (-4DAT) did not have any detectable residues and are not discussed herein. HED corrected the 10-DAT field samples using the 10-DAT field fortification recoveries. Residues ≤660 µg were corrected for the average low level field fortification recovery (87.3% for TCVP and 82.5% for the inert); residues >2,800 µg were corrected for the average high level field fortification recovery (106% for TCVP and 100% for the inert); and residues between 600 µg and 2,800 µg were corrected for the average mid-level field fortification recovery (114% for TCVP and 105% for the inert). HED calculated residues in µg/glove, µg/cm^2 of dog surface area, percent of initial TCVP in collar, and percent of applied dose transferred.

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The difference between the initial collar weight and the end weight was multiplied by the percent active ingredient in the collar (14.55%) to calculate the actual dose applied. The actual dose applied ranged from 0.052 to 0.2639 g ai (51,914 to 268,622 µg ai). In addition, HED calculated the initial TCVP in the collar by multiplying the percent active ingredient in the collar (14.55%) by the initial weight of the collar. The initial TCVP in the collar ranged from 2.52 to 3.05 g ai (2,524,192 to 3,048,429 µg ai).

The highest average residues of TCVP occurred on gloves after 20 petting simulations (Group 3) at 4,527.5 µg/gloves (5.98% of applied dose and 0.886 µg/cm^2). The lowest average residues of TCVP were observed on gloves from Group 2 (10 petting simulations) at 2,512.9 µg/gloves (1.53% of applied dose and 0.456 µg/cm^2). For the inert, average residues were highest on gloves from Group 3 (20 petting simulations) at 473.9 µg/gloves. The relative ratio of TCVP/the inert ranged from 7.0 to 14.5; the highest average ratio was observed in Group 2 at 12.9.

Percent transferable residues of TCVP based on the initial TCVP in the collar ranged from 0.049% to 0.228%; average percent transferable residues of TCVP were 0.098% for Group 1 (5 petting simulations), 0.086% for Group 2 (10 petting simulations), and 0.167% for Group 3 (25 petting simulations).

Percent transferable residues of applied TCVP dose ranged from 0.93% to 6.83%; average percent transferable residues of applied TCVP were 2.38% for Group 1 (5 petting simulations), 1.53% for Group 2 (10 petting simulations), and 5.98% for Group 3 (25 petting simulations).

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