Tetrachlorvinphos Pet Products Human Health Risk Assessment Summary

- The revised human health risk assessment for TCVP pet collars presents risk estimates with the 10X FQPA Safety Factor/Database Uncertainty Factor retained.
    - Inhalation LOC = 300
    - Incidental Oral LOC = 1000

- Residential Handler Pet Product Risk Summary:
    - No risks of concern identified (all MOEs ≥ LOC of 300)
    - Cancer Risk Estimates range from 10^{-9} to 10^{-7}

- Residential Post-application Exposure Data Issues related to Pet Collars:
    - Transferable residue:
        - Hartz submitted a residue transfer study to determine the amount of TCVP residues (solid or liquid) which transfer over time from the fur of an animal treated with the pet collar to the exposed person (MRID 50881801)
        - HED had been using a transferable residue study from the literature (i.e., the Davis study) which had been deemed acceptable for risk assessment
        - HED has presented post-application risks using both studies/sets of data for the following reasons:
            - The Davis study is acceptable and was used in previous risk assessments, represents a sample size of 23 dogs, and resulted in a percent transferable residue of about 0.4% (a more protective estimate of potential exposure).
            - The study submitted by Hartz is also acceptable, results in a slightly lower percent transferable residue of about 0.2%, which only represents a sample size of 3 dogs.

- Residential Post-application Pet Product Risk Summary:
    - Dusts/Powders:
        - Risks of concern identified for all dust/powder products
        - MOEs range from 98- 640
        - Cancer risk estimates range from 10^{-7} to 10^{-6}
    - Pump/Trigger Sprays
        - No risks of concern identified
        - MOEs range from 1,600 – 15,000
        - Cancer risk estimates are all 10^{-7}
    - Pet Collars
        - The agency conducted a refined assessment using data submitted by Hartz (August 2019) which includes:
            - Dust torsion study: Refined assumption of liquid:dust ratio for pet collars (99.62% liquid/0.38% dust)
            - Additional transferable residue study (MRID 50881801): Percent transfer = 0.2%; results based on 3 dogs
        - Risks of concern identified using:
            - Previously submitted "Davis study" residue transfer data (percent transfer for non-cancer = 0.4%; percent transfer for cancer = 0.3%; results based on 23 dogs)
                - MOEs range from 120 – 780
                - Cancer risk estimates range from 10^{-6} to 10^{-5}
            - Recently submitted Hartz study data (MRID 50881801):

    - MOEs range from 270 – 1,800

- Occupational Handler Risk Summary: No risks identified for pet products

Summary tables for the residential scenarios are provided below.

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.

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	
				0.010 (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)		0.0021	
				0.010 (large collar)		0.0034	
	2596-139 (Cat)			0.0032		0.0011	
	2596-139 (Dog)			0.016		0.0054	
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
				0.010 (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)		0.029	0.00055
				0.010 (large collar)		0.049	0.00092
	2596-139 (Cat)			0.0032		0.015	0.00029
	2596-139 (Dog)			0.016		0.076	0.00144

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).
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).

Table C.2. Residential Handler Non-cancer Risk Estimates Assuming 99.62% Liquid/0.38% Dust Ratio Formulation Pet Collars. 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
		0.010 (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)		0.0022	0.0000021	630,000
		0.010 (large collar)		0.0036	0.0000035	370,000
	2596-139 (Cat)	0.0032		0.0011	0.0000011	1,200,000
	2596-139 (Dog)	0.016		0.0056	0.0000055	240,000

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 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).

Table C.3. Residential Handler Non-cancer Exposure and 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
				0.00067 (medium animal)		0.0032		0.000061	22,000
				0.0010 (large animal)		0.0048		0.000091	14,000
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.

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).

Summary of Residential Handler Cancer Exposure and Risk Estimates

Table D.1. Residential Handler Cancer Exposure and Risk Estimates from TCVP Pet Collar Products Using 99.62% Liquid/0.38% Dust Ratio.

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		1.4E-05	2.1E-04	2.8E-08
	Medium, Large		2.4E-05	3.5E-04	4.6E-08
2596-139 (Cat)	Any		7.5E-06	1.1E-04	1.4E-08
2596-139 (Dog)	Any		3.8E-05	5.4E-04	7.2E-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 Dermal and Inhalation Cancer Exposure and Risk Estimates from 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
	Medium		3.4E-05	6.2E-08
	Large		5.1E-05	9.4E-08
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 $Q_1^* = 1.83 \times 10^{-3}$ $(mg/kg/day)^{-1}$

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 – USING DAVIS STUDY (2008).

Animal Type	Animal Size	Application Rate (mg ai)	$F_{alhands}$	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)
Assume Liquid Formulation													
Cat (2596-49)	small	1650	0.04	6.1	150	0.0008	0.13	1	15	4	0.48	20	0.0056
	medium	1650	0.04	3.7	150	0.0005	0.13	1	15	4	0.48	20	0.0033
	large	1650	0.04	2.3	150	0.0003	0.13	1	15	4	0.48	20	0.0021
Dog (2596-50,62)	small	2774	0.04	5.1	150	0.0007	0.13	1	15	4	0.48	20	0.0047
	large	4672	0.04	2.4	150	0.0003	0.13	1	15	4	0.48	20	0.0021
Cat (2596-83)	small	1752	0.04	6.5	150	0.0009	0.13	1	15	4	0.48	20	0.0059
	large	3650	0.04	5.1	150	0.0007	0.13	1	15	4	0.48	20	0.0046
Cat (2596-139)	small	1460	0.04	5.4	150	0.0007	0.13	1	15	4	0.48	20	0.0049
	medium	1460	0.04	3.2	150	0.0004	0.13	1	15	4	0.48	20	0.0030
	large	1460	0.04	2.0	150	0.0003	0.13	1	15	4	0.48	20	0.0018
Dog (2596-84)	small	2774	0.04	5.1	150	0.0007	0.13	1	15	4	0.48	20	0.0047
	large	4672	0.04	2.4	150	0.0003	0.13	1	15	4	0.48	20	0.0021
Dog (2596-139)	small	7300	0.04	13.5	150	0.0018	0.13	1	15	4	0.48	20	0.0123
	medium	7300	0.04	5.8	150	0.0008	0.13	1	15	4	0.48	20	0.0053
	large	7300	0.04	3.7	150	0.0005	0.13	1	15	4	0.48	20	0.0034
Cat (2596-63)	small	2190	0.04	8.1	150	0.0011	0.13	1	15	4	0.48	20	0.0074
	large	2482	0.04	3.5	150	0.0005	0.13	1	15	4	0.48	20	0.0031
Assume Dust Formulation													
Cat (2596-49)	small	1650	0.37	166	150	0.2049	0.13	1	15	4	0.48	20	1.40
	medium	1650	0.37	100	150	0.1229	0.13	1	15	4	0.48	20	0.84
	large	1650	0.37	62	150	0.0768	0.13	1	15	4	0.48	20	0.52
Dog (2596-50,62)	small	2774	0.37	140	150	0.1723	0.13	1	15	4	0.48	20	1.18
	large	4672	0.37	64	150	0.0791	0.13	1	15	4	0.48	20	0.54
Cat (2596-83)	small	1752	0.37	176	150	0.2176	0.13	1	15	4	0.48	20	1.48
	large	3650	0.37	138	150	0.1700	0.13	1	15	4	0.48	20	1.16
Cat (2596-139)	small	1460	0.37	147	150	0.1813	0.13	1	15	4	0.48	20	1.24
	medium	1460	0.37	88	150	0.1088	0.13	1	15	4	0.48	20	0.74
	large	1460	0.37	55	150	0.0680	0.13	1	15	4	0.48	20	0.46
Dog (2596-84)	small	2774	0.37	140	150	0.1723	0.13	1	15	4	0.48	20	1.18
	large	4672	0.37	64	150	0.0791	0.13	1	15	4	0.48	20	0.54
Dog (2596-139)	small	7300	0.37	368	150	0.4533	0.13	1	15	4	0.48	20	3.09

Table E.1. Residential Post-application Non-cancer Incidental Oral Dose Assuming a Liquid or Dust Formulation for Pet Collars – USING DAVIS STUDY (2008).													
Animal Type	Animal Size	Application Rate (mg ai)	$F_{aihands}$	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)
	medium	7300	0.37	158	150	0.1943	0.13	1	15	4	0.48	20	1.33
	large	7300	0.37	100	150	0.1236	0.13	1	15	4	0.48	20	0.84
Cat (2596-63)	small	2190	0.37	221	150	0.2720	0.13	1	15	4	0.48	20	1.86
	large	2482	0.37	94	150	0.1156	0.13	1	15	4	0.48	20	0.79

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 (0.0040; Davis, M. *et. al*) ÷ 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]

Table E.2. Residential Post-application Non-cancer Incidental Oral Dose Assuming a Liquid or Dust Formulation for Pet Collars – USING MRID 50881801 (2019).													
Animal Type	Animal Size	Application Rate (mg ai)	$F_{aihands}$	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)
Assume Liquid Formulation													
Cat (2596-49)	small	1650	0.04	2.6	150	0.0003	0.13	1	15	4	0.48	20	0.0024
	medium	1650	0.04	1.6	150	0.0002	0.13	1	15	4	0.48	20	0.0014
	large	1650	0.04	1.0	150	0.0001	0.13	1	15	4	0.48	20	0.0009
Dog (2596-50,62)	small	2774	0.04	2.2	150	0.0003	0.13	1	15	4	0.48	20	0.0020
	large	4672	0.04	1.0	150	0.0001	0.13	1	15	4	0.48	20	0.0009
Cat (2596-83)	small	1752	0.04	2.8	150	0.0004	0.13	1	15	4	0.48	20	0.0025
	large	3650	0.04	2.2	150	0.0003	0.13	1	15	4	0.48	20	0.0020
Cat (2596-139)	small	1460	0.04	2.3	150	0.0003	0.13	1	15	4	0.48	20	0.0021
	medium	1460	0.04	1.4	150	0.0002	0.13	1	15	4	0.48	20	0.0013
	large	1460	0.04	0.9	150	0.0001	0.13	1	15	4	0.48	20	0.0008
Dog (2596-84)	small	2774	0.04	2.2	150	0.0003	0.13	1	15	4	0.48	20	0.0020
	large	4672	0.04	1.0	150	0.0001	0.13	1	15	4	0.48	20	0.0009
Dog (2596-139)	small	7300	0.04	5.8	150	0.0008	0.13	1	15	4	0.48	20	0.0053
	medium	7300	0.04	2.5	150	0.0003	0.13	1	15	4	0.48	20	0.0023
	large	7300	0.04	1.6	150	0.0002	0.13	1	15	4	0.48	20	0.0014

Table E.2. Residential Post-application Non-cancer Incidental Oral Dose Assuming a Liquid or Dust Formulation for Pet Collars – USING MRID 50881801 (2019).

Animal Type	Animal Size	Application Rate (mg ai)	$F_{aihands}$	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)
Cat (2596-63)	small	2190	0.04	3.5	150	0.0005	0.13	1	15	4	0.48	20	0.0032
	large	2482	0.04	1.5	150	0.0002	0.13	1	15	4	0.48	20	0.0013
Assume Dust Formulation													
Cat (2596-49)	small	1650	0.37	71	150	0.0876	0.13	1	15	4	0.48	20	0.60
	medium	1650	0.37	43	150	0.0526	0.13	1	15	4	0.48	20	0.36
	large	1650	0.37	27	150	0.0329	0.13	1	15	4	0.48	20	0.22
Dog (2596-50,62)	small	2774	0.37	60	150	0.0737	0.13	1	15	4	0.48	20	0.50
	large	4672	0.37	27	150	0.0338	0.13	1	15	4	0.48	20	0.23
Cat (2596-83)	small	1752	0.37	75	150	0.0931	0.13	1	15	4	0.48	20	0.63
	large	3650	0.37	59	150	0.0727	0.13	1	15	4	0.48	20	0.50
Cat (2596-139)	small	1460	0.37	63	150	0.0775	0.13	1	15	4	0.48	20	0.53
	medium	1460	0.37	38	150	0.0465	0.13	1	15	4	0.48	20	0.32
	large	1460	0.37	24	150	0.0291	0.13	1	15	4	0.48	20	0.20
Dog (2596-84)	small	2774	0.37	60	150	0.0737	0.13	1	15	4	0.48	20	0.50
	large	4672	0.37	27	150	0.0338	0.13	1	15	4	0.48	20	0.23
Dog (2596-139)	small	7300	0.37	157	150	0.1939	0.13	1	15	4	0.48	20	1.32
	medium	7300	0.37	67	150	0.0831	0.13	1	15	4	0.48	20	0.57
	large	7300	0.37	43	150	0.0529	0.13	1	15	4	0.48	20	0.36
Cat (2596-63)	small	2190	0.37	94	150	0.1163	0.13	1	15	4	0.48	20	0.79
	large	2482	0.37	40	150	0.0494	0.13	1	15	4	0.48	20	0.34

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 (0.0017; MRID 50881801/D453149) ÷ 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]

Table E.3. Residential Post-Application Non-Cancer Incidental Oral Exposure Risk Estimates from TCVP Pet Collars Using 99.62% Liquid/0.38% Dust Ratio – USING DAVIS STUDY (2008).						
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]	99.62% Liquid/0.38% Dust Combined Incidental Oral MOE (**LOC = 1000**)[4]
2596-49: Cat	Children 1 < 2	1,650	Small	0.0056	1.40	**260**
			Medium	0.0033	0.84	**430**
			Large	0.0021	0.52	**690**
2596-50, 62: Dog	Children 1 < 2	2,770	Small	0.0047	1.18	**310**
		4,670	Large	0.0021	0.54	**670**
2596-83: Cat	Children 1 < 2	1,750	Small	0.0059	1.48	**240**
		3,650	Large	0.0046	1.16	**310**
2596-139: Cat	Children 1 < 2	3,650	Small	0.0049	1.24	**290**
			Medium	0.0030	0.74	**490**
			Large	0.0018	0.46	**780**
2596-84: Dog	Children 1 < 2	2,770	Small	0.0047	1.18	**310**
		4,670	Large	0.0021	0.54	**670**
2596-139: Dog	Children 1 < 2	7,300	Small	0.0123	3.09	**120**
			Medium	0.0053	1.33	**270**
			Large	0.0034	0.84	**430**
2596-63: Cat	Children 1 < 2	2,190	Small	0.0074	1.86	**190**
		2,480	Large	0.0031	0.79	**460**

1. Application rates are label defined. Refer to Table A.2.
2. Liquid and Dust HTM Doses from Table E.1 (using Davis study).
3. 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)].

Table E.4. Residential Post-Application Non-Cancer Incidental Oral Exposure Risk Estimates from TCVP Pet Collars Using 99.62% Liquid/0.38% Dust Ratio – USING MRID 50881801 (2019).						
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]	99.62% Liquid/0.38% Dust Combined Incidental Oral MOE (**LOC = 1000**)[4]
2596-49: Cat	Children 1 < 2	1,650	Small	0.0024	0.60	**600**
			Medium	0.0014	0.36	1000
			Large	0.0009	0.22	1600
2596-50, 62: Dog	Children 1 < 2	2,770	Small	0.0020	0.50	**720**
		4,670	Large	0.0009	0.23	1600
2596-83: Cat	Children 1 < 2	1,750	Small	0.0025	0.63	**570**
		3,650	Large	0.0020	0.50	**730**
2596-139: Cat	Children 1 < 2	3,650	Small	0.0021	0.53	**680**
			Medium	0.0013	0.32	1100
			Large	0.0008	0.20	1800
2596-84: Dog	Children 1 < 2	2,770	Small	0.0020	0.50	**720**
		4,670	Large	0.0009	0.23	1600
2596-139: Dog	Children 1 < 2	7,300	Small	0.0053	1.32	**270**
			Medium	0.0023	0.57	**640**
			Large	0.0014	0.36	1000
2596-63: Cat	Children 1 < 2	2,190	Small	0.0032	0.79	**450**
		2,480	Large	0.0013	0.34	1100

1. Application rates are label defined. Refer to Table A.2.
2. Liquid and Dust HTM Doses from Table E.1 (using MRID 50881801).
3. 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)].

Table E.5. Residential Post-Application Non-Cancer Exposure and Risk Estimates from 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 (Pump)	Children 1 < 2	51	Small	0.39	0.00035	8,000
		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).

Summary of Residential Post-Application Cancer Exposure and Risks

Table F.1. Residential Post-Application Cancer Exposure and Risk Estimates from TCVP Pet Collar Using 99.62% Liquid/0.38% Dust Ratio – USING DAVIS STUDY (2008).

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	5.8E-03	1.6E-01	6.4E-03	1.2E-05
	Medium		3.5E-03	9.4E-02	3.8E-03	7.0E-06
	Large		2.2E-03	5.8E-02	2.4E-03	4.4E-06
2596-50,62: Dog	Small		4.9E-03	1.3E-01	5.3E-03	9.8E-06
	Large		2.2E-03	6.0E-02	2.5E-03	4.5E-06
2596-83: Cat	Small		6.2E-03	1.7E-01	6.8E-03	1.2E-05
	Large		4.8E-03	1.3E-01	5.3E-03	9.7E-06
2596-139: Cat	Small		5.1E-03	1.4E-01	5.6E-03	1.0E-05
	Medium		3.1E-03	8.3E-02	3.4E-03	6.2E-06
	Large		1.9E-03	5.2E-02	2.1E-03	3.9E-06
2596-84: Dog	Small		4.9E-03	1.3E-01	5.3E-03	9.8E-06
	Large		2.2E-03	6.0E-02	2.5E-03	4.5E-06
2596-139: Dog	Small		1.3E-02	3.5E-01	1.4E-02	2.6E-05
	Medium		5.5E-03	1.5E-01	6.0E-03	1.1E-05
	Large		3.5E-03	9.4E-02	3.8E-03	7.0E-06
2596-63: Cat	Small		7.7E-03	2.1E-01	8.4E-03	1.5E-05
	Large		3.3E-03	8.8E-02	3.6E-03	6.6E-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)]. Dose calculated using a fraction transfer value of 0.003 from the Davis study.
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)]. Dose calculated using a fraction transfer value of 0.003 from the Davis study.
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 $Q_1^* = 1.83 \times 10^{-3}$ $(mg/kg/day)^{-1}$

Table F.2. Residential Post-Application Cancer Exposure and Risk Estimates from TCVP Pet Products.

Animal Type	Animal Size	Lifestage	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} $(mg/kg/day)^{-1}$