



**US Environmental Protection Agency
Office of Pesticide Programs**

**Occupational Pesticide Handler Unit
Exposure Surrogate Reference Table**

June 2018

**USEPA / Office of Pesticide Programs / Health Effects Division
Occupational Pesticide Handler Unit Exposure Surrogate Reference Table**

Exposure Scenario (Activity, Equipment, Formulation, Site, etc.) ¹	Exposure Route	Personal Protective Equipment (PPE) Level ²	Data Source ^{3,4,5}	Statistic	Unit Exposure (µg/lb ai)
Mixing / Loading Dry Flowable	Dermal	Single layer, no gloves (A)	AHETF (MEA)	Mean	227
		Single layer, gloves	AHETF (MEA)	Mean	51.6
		Double layer, gloves (B)	AHETF (MEA)	Mean	41.2
		Engineering control (water-soluble packaging)	AHETF (MEA)	Mean	12.5
	Inhalation	No Respirator	AHETF	Mean	8.96
		PF10 (C)	AHETF	Mean	0.896
		PF50 (D)	AHETF	Mean	0.179
Engineering control (water-soluble packaging)		AHETF	Mean	2.6	
Mixing / Loading Granules	Dermal	Single layer, no gloves (A)	AHETF (MEA)	Mean	23.6
		Single layer, gloves	AHETF (MEA)	Mean	8.12
		Double layer, gloves (B)	AHETF (MEA)	Mean	5.80
		Engineering control (closed loading system)	PHED	"Best fit"	8.6
	Inhalation	No Respirator	AHETF	Mean	0.825
		PF10 (C)	AHETF	Mean	0.083
		PF50 (D)	AHETF	Mean	0.017
Engineering control (closed loading system)		PHED	"Best fit"	0.083	
Mixing / Loading Liquids	Dermal	Single layer, no gloves (A)	AHETF (MEA)	Mean	220
		Single layer, gloves	AHETF (MEA)	Mean	37.6
		Double layer, gloves (B)	AHETF (MEA)	Mean	29.1
		Engineering control (closed loading system)	PHED	"Best fit"	8.6
	Inhalation	No Respirator	AHETF	Mean	0.219
		PF10 (C)	AHETF	Mean	0.022
		PF50 (D)	AHETF	Mean	0.0044
Engineering control (closed loading system)		PHED	"Best fit"	0.083	
Mixing / Loading Microencapsulates	Dermal	Single layer, no gloves (A)	AHETF (MEA)	Mean	220
		Single layer, gloves	AHETF (MEA)	Mean	37.6
		Double layer, gloves (B)	AHETF (MEA)	Mean	29.1
		Engineering control (closed loading system)	PHED	"Best fit"	8.6

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Exposure Scenario (Activity, Equipment, Formulation, Site, etc.) ¹	Exposure Route	Personal Protective Equipment (PPE) Level ²	Data Source ^{3,4,5}	Statistic	Unit Exposure (µg/lb ai)	
	Inhalation	No Respirator	AHETF	Mean	0.219	
		PF10 (C)	AHETF	Mean	0.022	
		PF50 (D)	AHETF	Mean	0.0044	
		Engineering control (closed loading system)	PHED	"Best fit"	0.083	
Mixing / Loading Wettable Powders	Dermal	Single layer, no gloves (A)	AHETF	Mean	77.7	
		Single layer, gloves	AHETF	Mean	57.5	
		Double layer, gloves (B)	AHETF	Mean	32.8	
		Engineering control (water-soluble packaging)	AHETF (MEA)	Mean	12.5	
	Inhalation	No Respirator	AHETF	Mean	2.75	
		PF10 (C)	AHETF	Mean	0.275	
		PF50 (D)	AHETF	Mean	0.055	
		Engineering control (water-soluble packaging)	AHETF	Mean	2.6	
Applicator, Aerial, Fixed-Wing	Liquids	Dermal	Engineering control (Enclosed cockpit)	AHETF (MEA)	Mean	2.08
		Inhalation	Engineering control (Enclosed cockpit)	AHETF (MEA)	Mean	0.0049
	Granules	Dermal	Engineering control (Enclosed cockpit)	PHED	"Best fit"	1.7
		Inhalation	Engineering control (Enclosed cockpit)	PHED	"Best fit"	1.3
Applicator, Aerosol Can	All sites (except animal treatments)	Dermal	Single layer, no gloves	PHED	"Best fit"	190000
			Single layer, gloves	PHED	"Best fit"	81000
			Double layer, gloves (B)	PHED	"Best fit"	64000
		Inhalation	No Respirator	PHED	"Best fit"	1300
			PF10 (C)	PHED	"Best fit"	130
			PF50 (D)	PHED	"Best fit"	26
	Animal (pet and livestock) treatments	Dermal	Single layer, no gloves	MRID 44433302	Mean	544000
			Single layer, gloves (E)	MRID 44433302	Mean	503000
			Double layer, gloves (B, E)	MRID 44433302	Mean	273000
		Inhalation	No Respirator	MRID 44433302	Mean	3270
PF10 (C)	MRID 44433302		Mean	327		
		PF50 (D)	MRID 44433302	Mean	66	
Applicator, Open Cab Airblast		Dermal	Single layer, no gloves (A)	AHETF	Mean	1770

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		Single layer, gloves	AHETF	Mean	1590
		Single layer, gloves, chemical-resistant hat	AHETF (MEA)	Mean	215
		Double layer, gloves (B)	AHETF	Mean	1480
		Double layer, gloves, chemical-resistant hat (B)	AHETF (MEA)	Mean	141
		Engineering control (Enclosed Cab)	AHETF (MEA)	Mean	14.6
	Inhalation	No Respirator	AHETF	Mean	4.71
		PF10 (C)	AHETF	Mean	0.471
		PF50 (D)	AHETF	Mean	0.094
		Engineering control (Enclosed Cab)	AHETF	Mean	0.068
Applicator, Open Cab Groundboom	Dermal	Single layer, no gloves (A)	AHETF (MEA)	Mean	78.6
		Single layer, gloves	AHETF (MEA)	Mean	16.1
		Double layer, gloves (B)	AHETF (MEA)	Mean	12.6
		Engineering control (Enclosed Cab)	PHED	"Best fit"	5.1
	Inhalation	No Respirator	AHETF	Mean	0.34
		PF10 (C)	AHETF	Mean	0.034
		PF50 (D)	AHETF	Mean	0.0068
		Engineering control (Enclosed Cab)	PHED	"Best fit"	0.043
Applicator, Open Cab Solid Broadcast Spreader	Dermal	Single layer, no gloves	PHED	"Best fit"	9.9
		Single layer, gloves (E)	PHED	"Best fit"	7.2
		Double layer, gloves (B, E)	PHED	"Best fit"	4.2
		Engineering control (Enclosed Cab)	PHED	"Best fit"	2.0
	Inhalation	No Respirator	PHED	"Best fit"	1.2
		PF10 (C)	PHED	"Best fit"	0.12
		PF50 (D)	PHED	"Best fit"	0.024
		Engineering control (Enclosed Cab)	PHED	"Best fit"	0.22
Applicator, Granules by Hand	Dermal	Single layer, no gloves (A)	PHED	"Best fit"	104000
		Single layer, gloves	PHED	"Best fit"	71000
		Double layer, gloves (B)	PHED	"Best fit"	40280

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		Inhalation	No Respirator	PHED	"Best fit"	470		
			PF10 (C)	PHED	"Best fit"	47		
			PF50 (D)	PHED	"Best fit"	9.4		
Applicator, Brush/roller		Dermal	Single layer, no gloves	PHED	"Best fit"	180000		
			Single layer, gloves (E)	PHED	"Best fit"	24000		
			Double layer, gloves (B, E)	PHED	"Best fit"	22000		
		Inhalation	No Respirator	PHED	"Best fit"	280		
			PF10 (C)	PHED	"Best fit"	28		
			PF50 (D)	PHED	"Best fit"	5.6		
Applicator, Airless Sprayer		Dermal	Single layer, no gloves	PHED MRID 43600102	Mean	42600		
			Single layer, gloves (E)	PHED MRID 43600102	Mean	11700		
			Double layer, gloves (B, E)	PHED MRID 43600102	Mean	10600		
		Inhalation	No Respirator	PHED MRID 43600102	Mean	560		
			PF10 (C)	PHED MRID 43600102	Mean	56		
			PF10 (C)	PHED MRID 43600102	Mean	11.2		
		Flagger		Dermal	Single layer, no gloves	PHED	"Best fit"	11
					Single layer, gloves	PHED	"Best fit"	12
					Double layer, gloves (B)	PHED	"Best fit"	10.6
Inhalation	No Respirator			PHED	"Best fit"	0.35		
	PF10 (C)			PHED	"Best fit"	0.035		
	PF50 (D)			PHED	"Best fit"	0.007		
Granules	Dermal			Single layer, no gloves (F)	PHED	"Best fit"	2.75	
				Single layer, gloves (E, F)	PHED	"Best fit"	2.73	
				Double layer, gloves (E, G)	PHED	"Best fit"	1.59	
Inhalation	No Respirator	PHED	"Best fit"	0.15				
	PF10 (C)	PHED	"Best fit"	0.015				
	PF50 (D)	PHED	"Best fit"	0.003				
Loader / Applicator, Belly Grinder		Dermal	Single layer, no gloves	PHED	"Best fit"	10000		
			Single layer, gloves	PHED	"Best fit"	9300		
			Double layer, gloves (B)	PHED	"Best fit"	5700		

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		Inhalation	No Respirator	PHED	"Best fit"	62	
			PF10 (C)	PHED	"Best fit"	6.2	
			PF50 (D)	PHED	"Best fit"	1.24	
Loader / Applicator, "Push-type" Rotary Spreader		Dermal	Single layer, no gloves	ORETF	Mean	440	
			Single layer, gloves	ORETF	Mean	240	
			Double layer, gloves (B)	ORETF	Mean	130	
		Inhalation	No Respirator	ORETF	Mean	10	
			PF10 (C)	ORETF	Mean	1.0	
			PF50 (D)	ORETF	Mean	0.2	
Mixer / Loader / Applicator, Manually-pressurized Handwand		Dermal	Single layer, no gloves	PHED	"Best fit"	100000	
			Single layer, gloves	PHED	"Best fit"	430	
			Double layer, gloves (B)	PHED	"Best fit"	365	
		Inhalation	No Respirator	PHED	"Best fit"	30	
			PF10 (C)	PHED	"Best fit"	3.0	
			PF50 (D)	PHED	"Best fit"	0.6	
		Dermal	Single layer, no gloves (A)	PHED	"Best fit"	29000	
			Single layer, gloves	PHED	"Best fit"	8600	
			Double layer, gloves (B)	PHED	"Best fit"	6200	
			Inhalation	No Respirator	PHED	"Best fit"	1100
				PF10 (C)	PHED	"Best fit"	110
				PF50 (D)	PHED	"Best fit"	22
Mixer / Loader / Applicator, Backpack Sprayer		Dermal	Single layer, no gloves (A)	PHED	"Best fit"	2510	
			Single layer, gloves	PHED	"Best fit"	2500	
			Double layer, gloves (B)	PHED	"Best fit"	1600	
		Inhalation	No Respirator	PHED	"Best fit"	30	
			PF10 (C)	PHED	"Best fit"	3.0	
			PF50 (D)	PHED	"Best fit"	0.6	
		Dermal	Single layer, no gloves (A)	AHETF	Mean	13200	
			Single layer, gloves	AHETF	Mean	11200	
			Double layer, gloves (B)	AHETF	Mean	6230	

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	Nurseries, Christmas Tree Farms, Wildlife management, Rights-of-way, Forestry, Landscaping (turf/plants/bushes/trees),	Inhalation	No Respirator	AHETF	Mean	140			
			PF10 (C)	AHETF	Mean	14			
			PF50 (D)	AHETF	Mean	2.8			
		Dermal	Single layer, no gloves (A)	AHETF (MEA, fRA)	Mean	58400			
			Single layer, gloves	AHETF (MEA, fRA)	Mean	30500			
			Double layer, gloves (B)	AHETF (MEA, fRA)	Mean	16900			
		Inhalation	No Respirator	AHETF	Mean	69.1			
			PF10 (C)	AHETF	Mean	6.91			
			PF50 (D)	AHETF	Mean	1.38			
		Foundation/perimeter treatments, Aquatic areas ⁴	Dermal	Single layer, no gloves (A)	MRID 44339801	Mean	8260		
				Single layer, gloves	MRID 44339801	Mean	8260		
				Double layer, gloves (B)	MRID 44339801	Mean	4120		
	Inhalation		No Respirator	MRID 44339801	Mean	2.58			
			PF10 (C)	MRID 44339801	Mean	0.258			
			PF50 (D)	MRID 44339801	Mean	0.052			
	Ground/Soil-directed (e.g., drench treatments, herbicides in orchards, vineyards, and tree farms) ⁵	Dermal	Single layer, no gloves (A)	MRID 44339801	Mean	8260			
			Single layer, gloves	MRID 44339801	Mean	8260			
			Double layer, gloves (B)	MRID 44339801	Mean	4120			
		Inhalation	No Respirator	MRID 44339801	Mean	2.58			
			PF10 (C)	MRID 44339801	Mean	0.258			
			PF50 (D)	MRID 44339801	Mean	0.052			
Granule formulation applications	Dermal	Single layer, no gloves (A)	MRID 45167201	Mean	155				
		Single layer, gloves	MRID 45167201	Mean	144				
		Double layer, gloves (B)	MRID 45167201	Mean	72.6				
	Inhalation	No Respirator	MRID 45250702 MRID 45167201	Mean	23.8				
		PF10 (C)	MRID 45250702 MRID 45167201	Mean	2.38				
		PF50 (D)	MRID 45250702 MRID 45167201	Mean	0.476				
		Mixer / Loader / Applicator, Mechanically-pressurized Handgun Sprayer	Orchards, Vineyards, Specialty Agricultural Crops, Rights-of-way, Nurseries,	General Broadcast/Foliar Applications	Dermal	Single layer, no gloves (A)	AHETF (MEA)	Mean	6050
						Single layer, gloves	AHETF (MEA)	Mean	2050
						Double layer, gloves (B)	AHETF (MEA)	Mean	1360
Inhalation	No Respirator	AHETF	Mean	8.68					
	PF10 (C)	AHETF	Mean	0.868					
	PF50 (D)	AHETF	Mean	0.174					

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Exposure Scenario (Activity, Equipment, Formulation, Site, etc.) ¹				Exposure Route	Personal Protective Equipment (PPE) Level ²	Data Source ^{3,4,5}	Statistic	Unit Exposure (µg/lb ai)
Landscaping (non-turf), Industrial/Commercial areas, Aquatic areas, Wildlife management, Christmas Tree farms	Drench/Soil-directed Applications	All formulations, except wettable powders	Dermal	Single layer, no gloves (A)	AHETF (MEA)	Mean	6050	
				Single layer, gloves	AHETF (MEA)	Mean	2050	
				Double layer, gloves (B)	AHETF (MEA)	Mean	1360	
			Inhalation	No Respirator	AHETF	Mean	8.68	
				PF10 (C)	AHETF	Mean	0.868	
				PF50 (D)	AHETF	Mean	0.174	
		Wettable Powders	Dermal	Single layer, no gloves (A)	MRID 45773201	Mean	4310	
				Single layer, gloves	MRID 45773201	Mean	4310	
				Double layer, gloves (B)	MRID 45773201	Mean	2160	
	Inhalation		No Respirator	MRID 45773201	Mean	3931		
			PF10 (C)	MRID 45773201	Mean	393		
			PF50 (D)	MRID 45773201	Mean	78.6		
	Structural treatments, Warehouses, Poultry/livestock houses, Livestock treatments		Dermal	Single layer, no gloves	PHED	"Best fit"	1800	
				Single layer, gloves	PHED	"Best fit"	640	
				Double layer, gloves (B)	PHED	"Best fit"	365	
			Inhalation	No Respirator	PHED	"Best fit"	79	
				PF10 (C)	PHED	"Best fit"	7.9	
				PF50 (D)	PHED	"Best fit"	1.58	
	Greenhouses, Mushroom houses	General Broadcast/Foliar Applications	Dermal	Single layer, no gloves (A)	PHED	"Best fit"	3500	
				Single layer, gloves	PHED	"Best fit"	2500	
				Double layer, gloves (B)	PHED	"Best fit"	1600	
Inhalation			No Respirator	PHED	"Best fit"	120		
			PF10 (C)	PHED	"Best fit"	12		
			PF50 (D)	PHED	"Best fit"	2.4		
Drench/Soil-directed Applications		All formulations, except wettable powders	Dermal	Single layer, no gloves (A)	PHED	"Best fit"	3500	
				Single layer, gloves	PHED	"Best fit"	2500	
				Double layer, gloves (B)	PHED	"Best fit"	1600	
			Inhalation	No Respirator	PHED	"Best fit"	120	
				PF10 (C)	PHED	"Best fit"	12	
				PF50 (D)	PHED	"Best fit"	2.4	
		Wettable Powders	Dermal	Single layer, no gloves (A)	MRID 45773201	Mean	4310	
				Single layer, gloves	MRID 45773201	Mean	4310	
				Double layer, gloves (B)	MRID 45773201	Mean	2160	
Inhalation	No Respirator	MRID 45773201	Mean	3931				
	PF10 (C)	MRID 45773201	Mean	393				
	PF50 (D)	MRID 45773201	Mean	78.6				

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Exposure Scenario (Activity, Equipment, Formulation, Site, etc.) ¹		Exposure Route	Personal Protective Equipment (PPE) Level ²	Data Source ^{3,4,5}	Statistic	Unit Exposure (µg/lb ai)
Turf (lawns, fields, golf courses)	Liquids	Dermal	Single layer, no gloves (A)	ORETF	Mean	1140
			Single layer, gloves	ORETF	Mean	880
			Double layer, gloves (B)	ORETF	Mean	450
		Inhalation	No Respirator	ORETF	Mean	1.9
			PF10 (C)	ORETF	Mean	0.19
			PF50 (D)	ORETF	Mean	0.038
	Water-dispersible Granules	Dermal	Single layer, no gloves (A)	ORETF	Mean	1960
			Single layer, gloves	ORETF	Mean	1400
			Double layer, gloves (B)	ORETF	Mean	740
		Inhalation	No Respirator	ORETF	Mean	42
			PF10 (C)	ORETF	Mean	4.2
			PF50 (D)	ORETF	Mean	0.84
	Wettable Powders	Dermal	Single layer, no gloves (A)	ORETF	Mean	1650
			Single layer, gloves	ORETF	Mean	1210
			Double layer, gloves (B)	ORETF	Mean	630
		Inhalation	No Respirator	ORETF	Mean	250
			PF10 (C)	ORETF	Mean	25
			PF50 (D)	ORETF	Mean	5
	Water-soluble Packets	Dermal	Single layer, no gloves (A)	ORETF	Mean	1350
			Single layer, gloves	ORETF	Mean	855
			Double layer, gloves (B)	ORETF	Mean	458
		Inhalation	No Respirator	ORETF	Mean	18
			PF10 (C)	ORETF	Mean	1.8
			PF50 (D)	ORETF	Mean	0.36
Mixer / Loader / Applicator, Handheld/Portable Fogger/Mister		Dermal	No data available			
		Inhalation	No Respirator	MRID 49602401	Mean	8916
			PF10 (C)	MRID 49602401	Mean	892
			PF50 (D)	MRID 49602401	Mean	178
Mixer / Loader / Applicator, Stationary/Automatic Fogger/Mister (without re-entry restriction)		Dermal	No data available			
		Inhalation	No Respirator	MRID 49602401	Mean	8916
			PF10 (C)	MRID 49602401	Mean	892
			PF50 (D)	MRID 49602401	Mean	178
Applicator, Stationary/Automatic Fogger/Mister (with re-entry restriction)		Applicator not present, exposure assumed negligible.				
Applicator, Truck-mounted Fogger/Mister		Dermal	Single layer, no gloves (A)	AHETF	Mean	1770
			Single layer, gloves	AHETF	Mean	1590

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		Single layer, gloves, chemical-resistant hat	AHETF (MEA)	Mean	215	
		Double layer, gloves (B)	AHETF	Mean	1480	
		Double layer, gloves, chemical-resistant hat (B)	AHETF (MEA)	Mean	141	
		Engineering control (Enclosed Cab)	AHETF (MEA)	Mean	14.6	
	Inhalation	No Respirator	AHETF	Mean	4.71	
		PF10 (C)	AHETF	Mean	0.471	
		PF50 (D)	AHETF	Mean	0.094	
		Engineering control (Enclosed Cab)	AHETF	Mean	0.068	
Applicator, Termiticide Injection	Dermal	Single layer, no gloves (A)	PHED	"Best fit"	1300	
		Single layer, gloves	PHED	"Best fit"	360	
		Double layer, gloves (B)	PHED	"Best fit"	250	
	Inhalation	No Respirator	PHED	"Best fit"	2.2	
		PF10 (C)	PHED	"Best fit"	0.22	
		PF50 (D)	PHED	"Best fit"	0.044	
Pour in/on	Liquids	Dermal	Single layer, no gloves (A)	AHETF (MEA)	Mean	220
			Single layer, gloves	AHETF (MEA)	Mean	37.6
			Double layer, gloves (B)	AHETF (MEA)	Mean	29.1
		Inhalation	No Respirator	AHETF	Mean	0.219
			PF10 (C)	AHETF	Mean	0.022
			PF50 (D)	AHETF	Mean	0.0044
	Granules	Dermal	Single layer, no gloves (A)	AHETF (MEA)	Mean	23.6
			Single layer, gloves	AHETF (MEA)	Mean	8.12
			Double layer, gloves (B)	AHETF (MEA)	Mean	5.80
		Inhalation	No Respirator	AHETF	Mean	0.825
			PF10 (C)	AHETF	Mean	0.083
			PF50 (D)	AHETF	Mean	0.017
	Dusts	Dermal	Single layer, no gloves (A)	AHETF (MEA)	Mean	227
			Single layer, gloves	AHETF (MEA)	Mean	51.6
			Double layer, gloves (B)	AHETF (MEA)	Mean	41.2
Engineering control (water-soluble packaging)			AHETF (MEA)	Mean	12.5	
Inhalation		No Respirator	AHETF	Mean	8.96	

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Animal (pet and livestock) Treatments			PF10 (C)	AHETF	Mean	0.896	
			PF50 (D)	AHETF	Mean	0.179	
			Engineering control (water-soluble packaging)	AHETF	Mean	2.6	
	Back rubber	Dermal	Single layer, no gloves (A)	AHETF (MEA)	Mean	220	
			Single layer, gloves	AHETF (MEA)	Mean	37.6	
			Double layer, gloves (B)	AHETF (MEA)	Mean	29.1	
		Inhalation	No Respirator	AHETF	Mean	0.219	
			PF10 (C)	AHETF	Mean	0.022	
			PF50 (D)	AHETF	Mean	0.0044	
	Collar	Dermal	Single layer, no gloves (A)	MRID 44433303	Mean	112000	
			Single layer, gloves	MRID 44433303	Mean	67800	
			Double layer, gloves (B)	MRID 44433303	Mean	42000	
		Inhalation	No Respirator	Applicator inhalation exposure expected to be negligible.			
			PF10 (C)				
	PF50 (D)						
	Dip	Dermal	Single layer, no gloves (F)	MRID 45528801	Mean	54300	
			Single layer, gloves (F, E)	MRID 45528801	Mean	53400	
			Double layer, gloves (G, E)	MRID 45528801	Mean	25600	
		Inhalation	No Respirator	MRID 45528801	Mean	26.6	
			PF10 (C)	MRID 45528801	Mean	2.66	
			PF50 (D)	MRID 45528801	Mean	0.532	
	Dust bag	Dermal	Single layer, no gloves (A)	AHETF (MEA)	Mean	227	
			Single layer, gloves	AHETF (MEA)	Mean	51.6	
			Double layer, gloves (B)	AHETF (MEA)	Mean	41.2	
		Inhalation	No Respirator	AHETF	Mean	8.96	
			PF10 (C)	AHETF	Mean	0.896	
			PF50 (D)	AHETF	Mean	0.179	
Ear tag		Applicator exposure expected to be negligible; chemical-resistant gloves recommended.					
Feed-through	Liquids	Dermal	Single layer, no gloves (A)	AHETF (MEA)	Mean	220	
			Single layer, gloves	AHETF (MEA)	Mean	37.6	
			Double layer, gloves (B)	AHETF (MEA)	Mean	29.1	
		Inhalation	No Respirator	AHETF	Mean	0.219	
			PF10 (C)	AHETF	Mean	0.022	
			PF50 (D)	AHETF	Mean	0.0044	
	Dust	Dermal	Single layer, no gloves (A)	AHETF (MEA)	Mean	227	

**USEPA / Office of Pesticide Programs / Health Effects Division
Occupational Pesticide Handler Unit Exposure Surrogate Reference Table**

Exposure Scenario (Activity, Equipment, Formulation, Site, etc.) ¹		Exposure Route	Personal Protective Equipment (PPE) Level ²	Data Source ^{3,4,5}	Statistic	Unit Exposure (µg/lb ai)
	Granules		Single layer, gloves	AHETF (MEA)	Mean	51.6
			Double layer, gloves (B)	AHETF (MEA)	Mean	41.2
		Inhalation	No Respirator	AHETF	Mean	8.96
			PF10 (C)	AHETF	Mean	0.896
			PF50 (D)	AHETF	Mean	0.179
		Dermal	Single layer, no gloves (A)	AHETF (MEA)	Mean	23.6
			Single layer, gloves	AHETF (MEA)	Mean	8.12
			Double layer, gloves (B)	AHETF (MEA)	Mean	5.80
		Inhalation	No Respirator	AHETF	Mean	0.825
			PF10 (C)	AHETF	Mean	0.083
			PF50 (D)	AHETF	Mean	0.017
		Shampoo	Dermal	Single layer, no gloves (F)	MRID 44658401	Mean
	Single layer, gloves (E, F)			MRID 44658401	Mean	2052000
	Double layer, gloves (E, B)			MRID 44658401	Mean	1029000
	Inhalation		No Respirator	MRID 44658401	Mean	292
			PF10 (C)	MRID 44658401	Mean	29.2
			PF50 (D)	MRID 44658401	Mean	5.84
	Sponge	Dermal	Single layer, no gloves (F)	MRID 45528801	Mean	844000
			Single layer, gloves (F, E)	MRID 45528801	Mean	767000
			Double layer, gloves (G, E)	MRID 45528801	Mean	386000
		Inhalation	No Respirator	MRID 45528801	Mean	208
			PF10 (C)	MRID 45528801	Mean	20.8
			PF50 (D)	MRID 45528801	Mean	4.16
	Spot-on	Dermal	Single layer, no gloves (A)	MRID 44433303	Mean	112000
Single layer, gloves			MRID 44433303	Mean	67800	
Double layer, gloves (B)			MRID 44433303	Mean	42000	
Inhalation		No Respirator	Applicator inhalation exposure expected to be negligible.			
		PF10 (C)				
		PF50 (D)				
Loader / applicator, Bulb duster	Dermal	Single layer, no gloves	ORETF	Mean	166000	
		Single layer, gloves (E)	ORETF	Mean	24700	
		Double layer, gloves (E, B)	ORETF	Mean	20600	
	Inhalation	No Respirator	ORETF	Mean	1690	
		PF10 (C)	ORETF	Mean	169	
		PF50 (D)	ORETF	Mean	33.8	
Applicator, Wipe/Towelette		Dermal	Single layer, no gloves	AEATFII	Mean	2380000

**USEPA / Office of Pesticide Programs / Health Effects Division
Occupational Pesticide Handler Unit Exposure Surrogate Reference Table**

Exposure Scenario (Activity, Equipment, Formulation, Site, etc.) ¹	Exposure Route	Personal Protective Equipment (PPE) Level ²	Data Source ^{3,4,5}	Statistic	Unit Exposure (µg/lb ai)	
		Single layer, gloves (E)	AEATFII	Mean	238000	
		Double layer, gloves (E, B)	AEATFII	Mean	238000	
	Inhalation	No Respirator	AEATFII	Mean	480	
		PF10 (C)	AEATFII	Mean	48	
		PF50 (D)	AEATFII	Mean	9.6	
Loader / applicator, Cup	Dermal	Single layer, no gloves	MRID 45333401	Mean	112	
		Single layer, gloves (E)	MRID 45333401	Mean	11.2	
		Double layer, gloves (E)	MRID 45333401	Mean	11.2	
	Inhalation	No Respirator	MRID 45333401	Mean	12.5	
		PF10 (C)	MRID 45333401	Mean	1.25	
		PF50 (D)	MRID 45333401	Mean	0.25	
Loader / applicator, Spoon	Dermal	Single layer, no gloves (A, F)	MRID 45250702	Mean	4170	
		Single layer, gloves (F)	MRID 45250702	Mean	3030	
		Double layer, gloves (A, G)	MRID 45250702	Mean	1580	
	Inhalation	No Respirator	MRID 45250702	Mean	121	
		PF10 (C)	MRID 45250702	Mean	12.1	
		PF50 (D)	MRID 45250702	Mean	2.42	
Single-use Injection (gels/pastes)		Applicator exposure expected to be negligible.				
Loader / applicator, Plunger duster	Dermal	Single layer, no gloves	ORETF	Mean	166000	
		Single layer, gloves (E)	ORETF	Mean	24700	
		Double layer, gloves (E, B)	ORETF	Mean	20600	
	Inhalation	No Respirator	ORETF	Mean	1690	
		PF10 (C)	ORETF	Mean	169	
		PF50 (D)	ORETF	Mean	33.8	
Applicator, Total-release Fogger		Applicator exposure expected to be negligible.				
Applicator, Tree Injection		Applicator exposure expected to be negligible.				
Applicator, Trigger-spray Bottle	Dermal	Single layer, no gloves (A)	ORETF	Mean	3660	
		Single layer, gloves	ORETF	Mean	1800	
		Double layer, gloves (B)	ORETF	Mean	1110	
	Inhalation	No Respirator		ORETF	Mean	61.2
				MRID 41054701		
				MRID 44739301		
		PF10 (C)		ORETF	Mean	6.12
				MRID 41054701		
				MRID 44739301		
PF50 (D)		ORETF	Mean	1.22		
All application sites, except animals						

**USEPA / Office of Pesticide Programs / Health Effects Division
Occupational Pesticide Handler Unit Exposure Surrogate Reference Table**

Exposure Scenario (Activity, Equipment, Formulation, Site, etc.) ¹	Exposure Route	Personal Protective Equipment (PPE) Level ²	Data Source ^{3,4,5}	Statistic	Unit Exposure (µg/lb ai)	
	Animal treatments	Dermal	MRID 41054701	Mean	544000	
			MRID 44739301			
			MRID 44433302			
		Inhalation	Single layer, no gloves (F)	MRID 44433302	Mean	503000
			Single layer, gloves (F, E)	MRID 44433302	Mean	273000
			Double layer, gloves (G, E)	MRID 44433302	Mean	3300
			No Respirator	MRID 44433302	Mean	330
			MRID 44433302	Mean	66	
			MRID 44433302	Mean	66	
Applicator, Shaker can	Granules	Dermal	MRID 45333401	Mean	112	
			MRID 45333401	Mean	11.2	
			MRID 45333401	Mean	11.2	
		Inhalation	No Respirator	MRID 45333401	Mean	12.5
			PF10 (C)	MRID 45333401	Mean	1.25
			PF50 (D)	MRID 45333401	Mean	0.25
	Dusts	Dermal	MRID 44439901	Mean	4042000	
			MRID 45519601			
			MRID 44439901	Mean		110000
		MRID 45519601				
		Inhalation	MRID 44439901	Mean	72600	
			MRID 45519601			
			MRID 44439901	Mean		17500
		MRID 45519601				
		Inhalation	MRID 44439901	Mean	1750	
MRID 45519601						
MRID 44439901	Mean		350			
MRID 45519601						
Trap/bait station	Re-fillable	Dermal		PHED	"Best fit"	104000
			PHED	"Best fit"	71000	
			PHED	"Best fit"	40280	
		Inhalation	PHED	"Best fit"	470	
			PHED	"Best fit"	47	
			PHED	"Best fit"	9.4	
	Single-use	Applicator exposure expected to be negligible.				

¹ If the description of the scenario is silent on specific equipment, sites, formulations, etc., the data are applicable to all potential applications for that scenario.

² Single layer = long-sleeve shirt, long pants, shoes plus socks. Double layer = "coveralls" in addition to single layer.

**USEPA / Office of Pesticide Programs / Health Effects Division
Occupational Pesticide Handler Unit Exposure Surrogate Reference Table**

Exposure Scenario (Activity, Equipment, Formulation, Site, etc.) ¹	Exposure Route	Personal Protective Equipment (PPE) Level ²	Data Source ^{3,4,5}	Statistic	Unit Exposure ($\mu\text{g}/\text{lb ai}$)
<p>Exposure monitoring data representing all levels of PPE for all scenarios are unavailable. In order to represent different PPE levels, exposure values are calculated using assumptions for the protection afforded by additional layers of clothing, chemical-resistant gloves, or respirators. Exposure assessors should be mindful of the uncertainties that this convention introduces into the overall calculations. In all cases, estimates based on direct measurements representing the PPE-level specified are the most reliable. If a scenario uses PPE calculation assumptions, they are identified in the table with one or more of the following notations:</p> <p>(A) "No glove" hand exposure back-calculated from available "gloved hand" exposure data by multiplying by 10 (i.e., chemical-resistant gloves are assumed to reduce hand exposure by 90%).</p> <p>(B) "Double layer" body exposure calculated from available "single layer" body exposure data by dividing by 2 (i.e., an additional layer of clothing is assumed to reduce body exposure by 50%).</p> <p>(C) "PF10" respirator exposure calculated from available "no respirator" exposure data by dividing by 10 (i.e., a PF10 respirator is assumed to reduce inhalation exposure by 90%).</p> <p>(D) "PF50" respirator exposure calculated from available "no respirator" exposure data by dividing by 50 (i.e., a PF50 respirator is assumed to reduce inhalation exposure by 98%).</p> <p>(E) "Gloved" hand exposure calculated from available "no glove" hand exposure data by dividing by 10 (i.e., chemical-resistant gloves are assumed to reduce hand exposure by 90%).</p> <p>(F) "Single layer" body exposure calculated from available "total deposition" body exposure data by dividing by 2 (i.e., an additional layer of clothing is assumed to reduce body exposure by 50%).</p> <p>(G) "Double layer" body exposure calculated from available "total deposition" body exposure data by dividing by 4 (i.e., two layers of clothing are assumed to reduce body exposure by 75%).</p> <p>If a scenario does not have one of these notations, the data underlying the recommended values is a direct match for the indicated level of PPE.</p> <p>³ PHED = Pesticide Handler Exposure Database; AHETF = Agricultural Handler Exposure Task Force; ORETF = Outdoor Residential Exposure Task Force; MRID = Master Record Identification (#).</p> <p>⁴ Where applicable, the notation "MEA" is added to signify that the default values reflect an (upward) adjustment by the U.S. EPA for potential inefficiency of the hand wash and face/neck wipe exposure monitoring methods. MEA = Method Efficiency Adjustment.</p> <p>⁵ Where applicable, the notation "fRA" is added to signify that the default value reflects an (upward) adjustment by the U.S. EPA to reflect that the underlying data did not meet benchmark accuracy objectives. fRA = fold Relative Accuracy.</p> <p>⁶ Due to the effect that the back-calculation from "gloved hands" to represent "non-gloved hands" has on distributional variability and parametric estimates, no adjustment was made to hand measurements to represent unit exposures for "single layer, no gloves". That is, the unit exposure for "single layer, gloves" is also assigned to "single layer, no gloves".</p>					

Attachment 1
Documentation of Revisions

Date	Documentation of Revisions
Apr2011	<ul style="list-style-type: none"> • Original version, modeled based on “PHED Surrogate Guide” • Reflects move from data from PHED to AHETF for following scenarios <ul style="list-style-type: none"> ○ Open Cab Groundboom ○ Open Mix/Load Liquids ○ Open Mix/Load Dry Flowable • Published EPA webpage on occupational pesticide handler exposure, including link to reference table
May2011	<ul style="list-style-type: none"> • Replaced PHED values for “Closed Cab Airblast” with those from AHETF
Jun2011	<ul style="list-style-type: none"> • Replaced PHED values for “Open Cab Airblast” with those from AHETF • Corrected unit exposure for “Mixer / Loader / Applicator, Low-pressure Handwand, Wettable Powder, Double layer, gloves” from 620 µg/lb ai to 6200 µg/lb ai
Sep2011	<ul style="list-style-type: none"> • Reflects overhaul of exposure scenario assignment of available surrogate data <ul style="list-style-type: none"> ○ New scenarios added (e.g., pet/animal treatments) ○ Scenario subsets added (e.g., power handgun site subsets) ○ Available individual proprietary studies assigned • Footnotes edited • Orientation changed to landscape to accommodate scenario additions
Mar2012	<ul style="list-style-type: none"> • Corrected “Dip” and “Sponge” inhalation unit exposures to reflect use of ½ LOD without correction for field fortification per standard policy • Corrected “Mixing / Loading Liquids” inhalation unit exposures to 2 significant figures • Removed PPE footnote notation “(H)” since that does not apply to any scenario • Corrected PPE notations for “Spoon” scenario to reflect exposure monitoring of “total deposition with chemical-resistant gloves” • For “Mechanically-pressurized Handgun Sprayer”, added “Specialty Agricultural Crops” to a sub-set category • Added “Documentation of Revisions” as an attachment
Mar2013	<ul style="list-style-type: none"> • Aerial Applicator scenario: PHED replaced with data from the AHETF • Re-assigned MRID45773201 to drench/soil-directed applications of wettable powders only • Footnote (G) typographical correction: “100%” corrected to “75%” (unit exposures are unchanged)
Sept2015	<ul style="list-style-type: none"> • Additional livestock treatment scenarios incorporated (backpack and mechanically-pressurized handgun) • Wildlife management incorporated into mechanically-pressurized handgun scenario • Mushroom houses incorporated into mechanically-pressurized handgun scenario and manually-pressurized handwand scenario • Granule formulations added to “animal, feed-through” scenario • Characterized Animal treatments as “Pet” or “Livestock” • Incorporated new data from AHETF for backpack applicator and mechanically-pressurized handgun applicators in rights-of-ways and other similar use patterns. • Added tree injection applicator scenario.
Nov2016	<ul style="list-style-type: none"> • Incorporated new data from AHETF for mixing/loading wettable powders and mixing/loading water-soluble packets • Added clarifying footnotes to the “Data Source” • Added scenario for “Mixer/Loader/Applicator, Fogging Equipment (handheld, portable, stationary)” • Added scenario for “Applicator, Truck-mounted Fogger” • Added scenario for “Applicator, Stationary Fogger (with re-entry restriction)” • Added scenario for “Applicator, Wipe/Towelette”

	<ul style="list-style-type: none"> Revised table formatting for “Applicator, Pour in/on” scenario
Jun2018	<ul style="list-style-type: none"> Replaced data for Open Pour Loading Granules with new AHETF data. Scenarios effected: Loading Granules as well as Feed-through and Pour in/on PF5 respirators revised to PF10, bringing EPA up to date with long-standing assumptions and practice by the Occupational Safety and Health Administration (OSHA) and the National Institutes for the Occupational Safety and Health (NIOSH). PF50 respirators added as a potential PPE option. Separated and edited the “Mixer/Loader/Applicator, Fogging Equipment (handheld, portable, stationary)” into “Mixer/Loader/Applicator, Handheld/Portable Fogger/Mister” and “Mixer/Loader/Applicator, Automatic/Stationary Fogger/Mister (without re-entry restriction)” Edited scenario for “Applicator, Truck-mounted Fogger” to “Applicator, Truck-mounted Fogger/Mister” Edited scenario for “Applicator, Stationary Fogger (with re-entry restriction)” to “Applicator, Stationary/Automatic Fogger/Mister (with re-entry restriction)” For manually pressurized handwand, clarified Structural treatments by adding a scenario for Exterior building components and moving Structural treatments to a different surrogate dataset Added scenarios for Microencapsulate formulations with liquid AHETF data as the surrogate dataset Removed inapplicable engineering control scenarios from Pour in/on scenarios Edited “Paintbrush/roller” to “Brush/roller” Corrected inhalation unit exposures for Handgun/Turf/Water-soluble Packets. Previously mistakenly showed values for liquid formulations (i.e., copy/paste error). EPA calculations, however, used correct unit exposures.