



United States
Environmental Protection Agency

Office of Chemical Safety and
Pollution Prevention

**Final Risk Evaluation for
Asbestos
Part 1: Chrysotile Asbestos**

**Systematic Review Supplemental File:
Data Extraction for Consumer Exposure**

December 2020

Monitoring Data Extracted for Asbestos for Personal Breathing Zone

Country	State/ City/ Region	Site/Vehicle Type	Year	No. of Samples (Det. Freq.)/ Sample Duration	Detection Level (Method Type)	Concentration			Reference (HERO ID)			Data Type and Data Integration
						Range	Central Tendency	Standard Deviation	HERO	Citation	Data Eval. Score	
Personal Breathing Zone (f/cc*) - Brakes												
IR	Zahedan city	<i>Occupational</i> Brake repair and replacement auto shops (n=30)/ Cars	2008	32 (1)/ 45 min	0.01 (PCM)	0.116 to 2.48	0.92 (GM)	NR	1082293	(Kakooei et al., 2011)	Medium	Monitoring
IR	Zahedan city	<i>Occupational</i> Brake repair and replacement auto shops (n=30)/ Trucks	2008	28 (1)/ 45 min	0.01 (PCM)	0.117 to 1.93	0.46 (GM)	NR	1082293	(Kakooei et al., 2011)	Medium	Monitoring
IR	Zahedan city	<i>Occupational</i> Brake repair and replacement auto shops (n=30)/ Cars and Trucks	2008	32 (1) (cars, n=22 and trucks, n=10)/ 45 min	0.01 (PCM)	0.135 to 2.48	1.27 (GM)	NR	1082293	(Kakooei et al., 2011)	Medium	Monitoring
IR	Zahedan city	<i>Occupational</i> Brake repair and replacement auto shops (n=30)/ Cars and Trucks	2008	28 (1); (cars, n=10 and trucks, n=18)/ 45 min	0.01 (PCM)	0.116 to 1.62	0.29 (GM)	NR	1082293	(Kakooei et al., 2011)	Medium	Monitoring
US	New Kensington, PA	<i>Occupational</i> Former automobile repair facility; Autos from the 1960s with 4-wheel drum brakes	2001	2 test runs for baseline (NR)/ 85 and 92 min	NR (PCM)	NR	0.0217 to 0.0672 (mean)	NR	3080338	(Blake et al., 2003)	Medium	Monitoring

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US	New Kensington, PA	<i>Occupational</i> Former automobile repair facility; Autos from the 1960s with 4-wheel drum brakes	2001	4 test runs which included filing, hand sanding, or arc grinding (NR)/ 95-103 min	NR (PCM)	NR	0.0376 to 0.4368 (mean)	NR	3080338	(Blake et al., 2003)	Medium	Monitoring
US	New Kensington, PA	<i>Occupational</i> Former automobile repair facility; Autos from the 1960s with 4-wheel drum brakes	2001	1 test run which included cleaning (NR)/ 30 min	NR (PCM)	NR	0.0146 (mean)	NR	3080338	(Blake et al., 2003)	Medium	Monitoring
AU	Sydney	<i>Occupational</i> Service garages for passenger and light commercial vehicles (n=3)	1999 (pub.. date)	3 (0)/ 77 to 135 min	0.05 (PCM)	All ND	ND	NR	3080975	(Yeung et al., 1999)	Medium	Monitoring
CO	Bogota	<i>Occupational</i> Passenger and heavy-duty vehicle brake repair shops (n=18)/ heavy-duty and passenger vehicles	2016 (pub. date)	68 (NR)/ 30 min	NR (PCME)	0 to 2.148	0.316 (mean); 0.184 (median)	0.413	3520524	(Cely-García et al., 2016)	High	Monitoring
CO	Bogota	<i>Occupational</i> Passenger and heavy-duty vehicle brake repair shops (n=18)/ heavy-duty and passenger vehicles	2016 (pub. date)	64 (NR)/ 30 min	NR (PCME)	0 to 0.515	0.069 (mean); 0.019 (median)	0.111	3520524	(Cely-García et al., 2016)	High	Monitoring
CO	Bogota	<i>Occupational</i> Passenger and heavy-duty vehicle brake repair shops	2016 (pub. date)	66 (NR)/ 30 min	NR (PCME)	0.023 to 5.313	0.853 (mean); 0.459 (median)	1.036	3520524	(Cely-García et al., 2016)	High	Monitoring

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		(n=18)/ heavy-duty and passenger vehicles										
CO	Bogota	Occupational Passenger and heavy-duty vehicle brake repair shops (n=18)/ heavy-duty and passenger vehicles	2016 (pub. date)	39 (NR)/ 30 min	NR (PCME)	0 to 1.592	0.155 (mean); 0.021 (median)	0.327	3520524	(Cely-García et al., 2016)	High	Monitoring
CO	Bogota	Occupational Passenger and heavy-duty vehicle brake repair shop/ passenger vehicles (n=9)	2016 (pub. date)	43 (NR)/ NR	NR (PCME)	0 to 0.61	0.151 (mean; 8-hr TWA); 0.048 (median)	0.191	3520524	(Cely-García et al., 2016)	High	Monitoring
CO	Bogota	Occupational Passenger and heavy-duty vehicle brake repair shop/ Heavy-duty vehicles (n=9)	2016 (pub. date)	60 (NR)/ NR	NR (PCME)	0 to 0.31	0.042 (mean; 8-hr TWA); 0.021 (median)	0.057	3520524	(Cely-García et al., 2016)	High	Monitoring
CO	Bogota	Occupational Passenger and heavy-duty vehicle brake repair shop/ Cleaning	2016 (pub. date)	40 (NR)/ 30 min	NR (PCME)	0 to 0.864	0.210 (GM)	NR	3520524	(Cely-García et al., 2016)	High	Monitoring
US	NR	Occupational Small service station; Utility vehicle (n=1)	NR	2 (0)/NR	0.008 (PCM)	ND	ND (mean)	--	3655537	(Sheehy et al., 1989)	High	Monitoring

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US	NR	<i>Brake servicing on rear brakes by a "do-it-yourself" mechanic</i> Outside in a driveway/ Full size van (n=1)	NR	2 (0.5)/NR	0.006 (PCM)	ND to 0.008	0.007 (mean)	--	365537	(Sheehy et al., 1989)	High	Monitoring
US	NR	<i>Occupational Auto/truck repair facility/ Light-duty vehicles (van, truck, station wagon from 1976-1981 (n=3)</i>	2001 (pub. date)	31 (NR)/ 15 min	NR (PCM)	0.05 to 0.9	NR	NR	3531556	(Weir et al., 2001)	Medium	Experimental
US	NR	<i>Occupational Auto/truck repair facility/ Light-duty vehicles (van, truck, station wagon from 1976-1981 (n=3)</i>	2001 (pub. date)	1 (NR)/ 40 min	NR (PCM)	0.4	NR	NR	3531556	(Weir et al., 2001)	Medium	Experimental
CO	Bogota	<i>Occupational Personal exposures to asbestos fibers during brake maintenance of passenger vehicles</i>	5/2010 to 8/2010	14 (NR)/30 min	TEM	0.015 to 8.835	2.24 (median)	NR	2560364	(Cely-García et al., 2012)	High	Monitoring
CO	Bogota	<i>Occupational Personal exposures to asbestos fibers during brake maintenance of passenger vehicles</i>	5/2010 to 8/2010	11 (NR)/126 to 499 min	TEM	0.006 to 3.493	0.189 (8-hr TWA) (median)	NR	2560364	(Cely-García et al., 2012)	High	Monitoring

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Personal Breathing Zone (f/cc*) – Gasket Repair and Replacement												
US	Detroit, MI	<i>Occupational</i> Assessment of airborne asbestos exposure during the servicing and handling of automobile asbestos- containing gaskets	NR	10 (0.7)/ 60 to 156 min	NR (PCM)	0.003 to 0.027	NR	NR	3520458	(Blake et al., 2006)	Medium	Monitoring
US	NR	<i>Occupational</i> Asbestos exposure from gaskets during disassembly of a medium duty diesel engine	2005 (pub. date)	14 (0.21)/ 11 to 63 min	NR (PCM)	0.017 to <0.12***	NR	NR	3531131	(Liukonen and Weir, 2005)	Medium	Monitoring
US	Santa Rosa, CA	<i>Occupational</i> Chrysotile asbestos exposure associated with removal of automobile exhaust systems (ca. 1945-1975) by mechanics	January and July 2004	28 (0.39)/ 9 to 65 min	0.012- 0.132 (PCM)	ND****	NR	NR	3531296	(Paustenbach et al., 2006)	High	Monitoring
Personal Breathing Zone (f/cc*) – Trucks and Buses												
CN	Hong Kong	<i>Occupational</i> Bus servicing depot. Brake pad machining	NR	3 (NR)/ 10 min	NR (PCM)	0.04 to 0.83 f/ml	0.55 f/ml (mean)	NR	3083368	(Cheng and O'Kelly, 1986)	High	Monitoring
CN	Hong Kong	<i>Occupational</i> Repair and servicing facility. Cleaning brake housing by brushing	NR	2 (NR)/ 10 min	NR (PCM)	0.01 to 0.01 f/ml	0.01 f/ml (mean)	NR	3083368	(Cheng and O'Kelly, 1986)	High	Monitoring

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CN	Hong Kong	Occupational Repair and servicing facility. Cleaning brake housing by brushing	NR	2 (NR)/ 10 min	NR (PCM)	0.08 to 0.08 f/ml	0.08 f/ml (mean)	NR	3083368	(Cheng and O'Kelly, 1986)	High	Monitoring
CN	Hong Kong	Occupational Repair and servicing facility. Cleaning brake housing by brushing	NR	2 (NR)/ 10 min	NR (PCM)	0.08 to 0.12 f/ml	0.01 f/ml (mean)	NR	3083368	(Cheng and O'Kelly, 1986)	High	Monitoring
CN	Hong Kong	Occupational Repair and servicing facility. Cleaning brake housing by high pressure air jet	NR	2 (NR)/ 10 min	NR (PCM)	0.02 to 0.24 f/ml	0.22 f/ml (mean)	NR	3083368	(Cheng and O'Kelly, 1986)	High	Monitoring
CN	Hong Kong	Occupational Repair and servicing facility. Cleaning brake housing by high pressure air jet	NR	2 (NR)/ 10 min	NR (PCM)	0.01 to 0.02 f/ml	0.015 f/ml (mean)	NR	3083368	(Cheng and O'Kelly, 1986)	High	Monitoring
CN	Hong Kong	Occupational Repair and servicing facility. Cleaning brake housing by high pressure air jet	NR	2 (NR)/ 10 min	NR (PCM)	0.05 to 0.05 f/ml	0.05 f/ml (mean)	NR	3083368	(Cheng and O'Kelly, 1986)	High	Monitoring
CN	Hong Kong	Occupational Repair and servicing facility. Cleaning brake housing by high pressure air jet	NR	2 (NR)/ 10 min	NR (PCM)	0.02 to 0.24 f/ml	0.22 f/ml (mean)	NR	3083368	(Cheng and O'Kelly, 1986)	High	Monitoring

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CN	Hong Kong	Occupational Repair and servicing facility. Cleaning brake housing by high pressure air jet	NR	2 (NR)/ 10 min	NR (PCM)	0.01 to 0.01 f/ml	0.08 f/ml (mean)	NR	3083368	(Cheng and O'Kelly, 1986)	High	Monitoring
CN	Hong Kong	Occupational Repair and servicing facility. Cleaning brake housing by high pressure air jet	NR	2 (NR)/ 10 min	NR (PCM)	0.04 to 0.12 f/ml	0.08 f/ml (mean)	NR	3083368	(Cheng and O'Kelly, 1986)	High	Monitoring
CN	Hong Kong	Occupational Repair and servicing facility. Cleaning brake housing by high pressure air jet	NR	2 (NR)/ 10 min	NR (PCM)	0.16 to 0.28 f/ml	0.22 f/ml (mean)	NR	3083368	(Cheng and O'Kelly, 1986)	High	Monitoring
CN	Hong Kong	Occupational Repair and servicing facility. Cleaning brake housing by high pressure air jet	NR	2 (NR)/ 10 min	NR (PCM)	0.08 to 0.12 f/ml	0.1 f/ml (mean)	NR	3083368	(Cheng and O'Kelly, 1986)	High	Monitoring
CN	Hong Kong	Occupational 12 Garages - one bus servicing depot and 11 repair and servicing facilities. All scenarios combined - brake pad machining and cleaning brakes (airbrush and air jet)	NR	25 (NR)/ 10 min	NR (PCM)	0.01 to 0.83 f/ml	0.13 f/ml (mean)	NR	3083368	(Cheng and O'Kelly, 1986)	High	Monitoring

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FI	NR	Occupational Brake maintenance of trucks and buses; Opening of brakes	1977- 1983	25 (NR)/ 2 to 25 min	0.1 (PCM)	ND to 1.9	0.4 (mean); 0.1 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of trucks and buses; Opening and brushing of brakes	1977- 1983	6 (NR)/ 1 to 12 min	0.1 (PCM)	ND to 1	0.3 (mean); 0.3 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of trucks and buses; Cleaning of brakes by brushing	1977- 1983	8 (NR)/ 2 to 12 min	0.1 (PCM)	0.1 to 4.5	1.3 (mean); 0.9 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of trucks and buses; Cleaning of brakes with compressed air jet, enclosure and exhaust in use	1977- 1983	9 (NR)/ 1 to 14 min	0.1 (PCM)	0.2 to 3	1.2 (mean); 0.7 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of trucks and buses; Cleaning of brakes with damp cloth	1977- 1983	3 (NR)/ 2 to 5 min	0.1 (PCM)	1.1 to 3.3	1.9 (mean); 1.3 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of trucks and buses; Opening of brakes and cleaning of brakes by washing	1977- 1983	6 (NR)/ 2 to 10 min	0.1 (PCM)	ND to 0.3	0.2 (mean); 0.2 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring

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						Range	Central Tendency	Standard Deviation	HERO	Citation	Data Eval. Score	
FI	NR	Occupational Brake maintenance of trucks and buses; Cleaning of brakes by washing with water	1977- 1983	6 (NR)/ 4 to 18 min	0.1 (PCM)	ND to 0.2	0.1 (mean); 0.2 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of trucks and buses; Loosening rivets from brake linings	1977- 1983	12 (NR)/ 5 to 29 min	0.1 (PCM)	ND to 1.6	0.3 (mean); 0.2 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of trucks and buses; Cleaning of brakes shoes	1977- 1983	2 (NR)/ 3 to 5 min	0.1 (PCM)	0.3 to 0.4	--	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of trucks and buses, Punching rivets into brake linings	1977- 1983	28 (NR)/ 3 to 60 min	0.1 (PCM)	0.1 to 3.5	0.7 (mean); 0.4 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of trucks and buses, Grinding of brake linings with machine, no exhaust	1977- 1983	5 (NR)/ 4 to 27 min	0.1 (PCM)	0.3 to 125	56 (mean); 67 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of trucks and buses; Grinding of brake linings with	1977- 1983	30 (NR)/ 4 to 33 min	0.1 (PCM)	0.1 to 5.9	1.5 (mean); 0.6 f/cc (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring

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		machine, exhaust in use										
FI	NR	<i>Occupational</i> Brake maintenance of trucks and buses, Beveling edges of brake linings with file	1977- 1983	7 (NR)/ 2 to 5 min	0.1 (PCM)	0.1 to 0.9	0.4 (mean); 0.3 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	<i>Occupational</i> Brake maintenance of trucks and buses, Cleaning of brake drums by brushing	1977- 1983	2 (NR)/ 5 to 6 min	0.1 (PCM)	0.5 to 0.7	--	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	<i>Occupational</i> Brake maintenance of trucks and buses, Grinding of brake drums	1977- 1983	6 (NR)/ 3 to 26 min	0.1 (PCM)	0.1 to 0.3	0.2 (mean); 0.2 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	<i>Occupational</i> Brake maintenance of trucks and buses, Assembling of brakes	1977- 1983	9 (NR)/ 6 to 41 min	0.1 (PCM)	ND to 0.4	0.2 (mean); 0.1 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	<i>Occupational</i> Brake maintenance of trucks and buses, Sweeping floor of garage	1977- 1983	4 (NR)/ 2 to 4 min	0.1 (PCM)	ND to 1.7	0.6 (mean); 0.3 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	<i>Occupational</i> Brake maintenance of trucks and	1977- 1983	5 (NR)/ 2 to 30 min	0.1 (PCM)	ND to 0.2	0.2 (mean); ND (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring

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		buses; Other, rare operations										
FI	NR	Occupational Brake maintenance of trucks and buses, Background to brake maintenance	1977- 1983	3 (NR)/ 3 to 68 min	0.1 (PCM)	ND to 0.1	ND (mean); 0.1 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of passenger cars, Opening and brushing of brake drums	1977- 1983	4 (NR)/ 2 to 13 min	0.1 (PCM)	0.3 to 0.6	0.4 (mean); 0.4 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of passenger cars; Cleaning of drum brakes with compressed air jet, no exhaust	1977- 1983	9 (NR)/ 1 to 10 min	0.1 (PCM)	ND to 8.2	1.5 (mean); 0.4 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of passenger cars; Cleaning of drum brakes with compressed air jet, exhaust in use	1977- 1983	5 (NR)/ 2 to 15 min	0.1 (PCM)	ND to 0.2	0.1 (mean); 0.1 (median)	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of passenger cars; Cleaning of brake drum by brushing	1977- 1983	1 (NR)/ 1 min	0.1 (PCM)	0.1 to 0.1	--	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring

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FI	NR	Occupational Brake maintenance of passenger cars; Grinding of brake drums	1977- 1983	1 (NR)/ 3 min	0.1 (PCM)	0.5 to 0.5	--	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of passenger cars; Cleaning of disc brakes and changing brake pads	1977- 1983	8 (NR)/ 7 to 38 min	0.1 (PCM)	ND to 0.2	ND	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of passenger cars; Changing of brake discs	1977- 1983	2 (NR)/ 23 to 23 min	0.1 (PCM)	ND	--	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of passenger cars; Grinding of brake discs	1977- 1983	2 (NR)/ 10 to 10 min	0.1 (PCM)	ND to 0.2	--	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of passenger cars; Changing of clutch linings	1977- 1983	3 (NR)/ 8 to 12 min	0.1 (PCM)	ND to 0.1	ND	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
FI	NR	Occupational Brake maintenance of passenger cars; Background to brake maintenance	1977- 1983	1 (NR)/ 44 min	0.1 (PCM)	ND	--	NR	3100008	(Kauppinen and Korhonen, 1987)	Medium	Monitoring
US	Stockton, CA	Occupational Heavy-duty equipment service centers; no active heating, air	2005- 2006	42 (1)/ 30 min	NR (PCM)	0.007 to 0.22	0.053 (mean); 0.045 (GM)	0.029	2591959	(Madl et al., 2009)	High	Monitoring

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		conditioning, or ventilation systems/ Heavy-duty agricultural and construction equipment.										
US	Rock, IL	<i>Occupational</i> Heavy-duty equipment service centers; no active heating, air conditioning, or ventilation systems/ Heavy-duty agricultural and construction equipment.	2005-2006	8 (1)/ 30 min	NR (PCM)	0.11 to 0.622	0.338 (mean); 0.292 (GM)	0.183	2591959	(Madl et al., 2009)	High	Monitoring
CO	Bogota	<i>Occupational</i> 2 heavy vehicle brake repair shops; one with local ventilation and one with no ventilation/ Buses and trucks	2012	20 (NR)/ ~30 min	NR (PCME)	0.019 to 0.645	0.324 (mean); 0.339 (median)	NR	3078032	(Cely-García et al., 2015)	High	Monitoring
CO	Bogota	<i>Occupational</i> 2 heavy vehicle brake repair shops; one with local ventilation and one with no ventilation/ Buses and trucks	2012	2 (NR)/ ~30 min	NR (PCME)	0.086 to 0.096	0.091 (mean); 0.091 (median)	NR	3078032	(Cely-García et al., 2015)	High	Monitoring

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CO	Bogota	<i>Occupational</i> 2 heavy vehicle brake repair shops; one with local ventilation and one with no ventilation/ Buses and trucks	2012	6 (NR)/ ~30 min	NR (PCME)	0.054 to 0.255	0.147 (mean); 0.154 (median)	NR	3078032	(Cely-García et al., 2015)	High	Monitoring
CO	Bogota	<i>Occupational</i> 2 heavy vehicle brake repair shops; one with local ventilation and one with no ventilation/ Buses and trucks	2012	13 (NR)/ ~30 min	NR (PCME)	0 to 0.459	0.194 (mean); 0.201 (median)		3078032	(Cely-García et al., 2015)	High	Monitoring
Personal Breathing Zone (f/cc*) –NIOSH studies with occupational engineering controls												
US	NR	<i>Occupational</i> Garages for Cincinnati Gas and Electric/ A sedan, two vans, two pickups trucks, and a larger truck (model years not specified)	NR	8 (NR)/ Duration of brake job or 2 hours, whichever was longer	0.003 (PCM)	ND to 0.016	0.007	NR	3099264	(Cooper et al., 1988)	Not scored* *	Monitoring
US	Louisville, KY	<i>Occupational</i> U.S. Postal Service, Vehicle Maintenance Facility, brake system examination/ Postal vehicles including jeeps,	1987	22 (0.41)/ Duration of brake job or 2 hours, whichever was longer	0.004 (PCM)	ND to 0.006	ND	NR	3099353	(Cooper et al., 1987)	High	Monitoring

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		Pinto, and van (n=10)										
US	Nashville, TN	<i>Occupational</i> U.S. Postal Service, Vehicle Maintenance Facility, brake system examination/ Jeep postal delivery vehicles (n=10)	1986	20 (0.95)/ Duration of brake job or 2 hours, whichever was longer	0.004 (PCM)	ND to 0.006	ND	NR	3099476	(Godbey et al., 1987)	High	Monitoring
US	Fairfax, OH	<i>Occupational</i> Cincinnati Bell, Vehicle Maintenance Garage, evaluation of brake drum service controls/ Vehicles (n=7) including 2 autos and 5 utility vans.	1986- 1987	13 (0.62)/ Duration of a single brake job or 2 hours, whichever was longer	0.004 (PCM)	ND to 0.016	0.007	NR	3099480	(Sheehy et al., 1987b)	High	Monitoring
US	Lebanon, OH	<i>Occupational</i> Ohio Department of Transportation, Maintenance Facility, evaluation of brake drum service controls/ Vehicles	1986	18 (0)/ Duration of a single brake job or 2 hours, whichever was longer	0.004 (PCM)	All ND	ND	--	3648228	(Sheehy et al., 1987a)	High	Monitoring
Personal Breathing Zone (f/cc*) – Brakes and Clutches (Pre-1980)												
US	New York City, NY	<i>Occupational</i> New York City Department of Sanitation where	1977 (pub. date)	4 (NR)/ 2-10 min	NR (PCM)	23.7 to 72.0	37.3 (mean)	NR	3615571	(Rohl et al., 1977)	Low	Monitoring

Country	State/ City/ Region	Site/Vehicle Type	Year	No. of Samples (Det. Freq.)/ Sample Duration	Detection Level (Method Type)	Concentration			Reference (HERO ID)			Data Type and Data Integration
						Range	Central Tendency	Standard Deviation	HERO	Citation	Data Eval. Score	
		truck brakes are repaired/ Sanitation trucks										
US	Queens, NY	Occupational Sanitation Department Central Repair station/ NR	1979	2 (NR)/ 136-190 min	NR (PCM)	0.12 to 0.33	raw data available to calculate	NR	4152152	(Roberts, 1980b)	Medium	Monitoring
US	Queens, NY	Occupational Sanitation Department Central Repair station/ NR	1979	12 (NR)/ 47-196 min	NR (PCM)	0.03 to 0.44	raw data available to calculate	NR	4152152	(Roberts, 1980b)	Medium	Monitoring
US	New York City, NY	Occupational Truck Brake Service/ Truck	1976 (pub. date)	NR (NR)/ 2-10 min	NR (PCM)	1.7 to 7.0	NR	NR	3646036	(Lorimer et al., 1976)	Low	Monitoring
US	New York City, NY	Occupational Truck Brake Service/ Truck	1976 (pub. date)	NR (NR)/ 2-10 min	NR (PCM)	23.7 to 72.0	NR	NR	3646036	(Lorimer et al., 1976)	Low	Monitoring
NR	NR	NR	1976 (pub. date) Older study and is "prelimin ary"	NR	NR	NR	NR	NR	3645882	(NIOSH, 1976)	Low	Monitoring
US	New York City, NY	Occupational Automotive Brake Repair Shop/NR	1976 (pub. date)	4 (NR)/ 3-8 min	NR (PCM)	6.6 to 29.8	16 (mean)	NR	176	(Rohl et al., 1976)	Medium	Monitoring

Country	State/ City/ Region	Site/Vehicle Type	Year	No. of Samples (Det. Freq.)/ Sample Duration	Detection Level (Method Type)	Concentration			Reference (HERO ID)			Data Type and Data Integration
						Range	Central Tendency	Standard Deviation	HERO	Citation	Data Eval. Score	
US	New York City, NY	Occupational Automotive Brake Repair Shop/NR	1976 (pub. date)	3 (NR)/ 3-8 min	NR (PCM)	2 to 4.2	3.3 (mean)	NR	176	(Rohl et al., 1976)	Medium	Monitoring
US	New York City, NY	Occupational Automotive Brake Repair Shop/NR	1976 (pub. date)	2 (NR)/ 3-8 min	NR (PCM)	0.4 to 4.8	2.6 (mean)	NR	176	(Rohl et al., 1976)	Medium	Monitoring
US	New York City, NY	Occupational Automotive Brake Repair Shop/NR	1976 (pub. date)	2 (NR)/ 3-8 min	NR (PCM)	1.3 to 3.6	2.5 (mean)	NR	176	(Rohl et al., 1976)	Medium	Monitoring
US	New York City, NY	Occupational Municipal Truck Repair Shop/NR	1976 (pub. date)	10 (NR)/ 3-8 min	NR (PCM)	1.7 to 7	3.8 (mean)	NR	176	(Rohl et al., 1976)	Medium	Monitoring
US	New York City, NY	Occupational Municipal Truck Repair Shop/NR	1976 (pub. date)	5 (NR)/ 3-8 min	NR (PCM)	23.7 to 72	37.3 (mean)	NR	176	(Rohl et al., 1976)	Medium	Monitoring
US	New York City, NY	Occupational Municipal Truck Repair Shop/NR	1976 (pub. date)	2 (NR)/ 3-8 min	NR (PCM)	1.9 to 2	1.5 (mean)	NR	176	(Rohl et al., 1976)	Medium	Monitoring
US	Queens, NY	Occupational Sanitation Department Central Repair station/NR	1979	2 (NR)/ 136 and 190 min	NR (PCM)	0.12 and 0.33	--	--	4152150	(Roberts, 1980a)	Medium	Monitoring
US	NR	Occupational NR/NR	1979	1 (NR)/ 393 min	NR (PCM)	0.13	--	--	4152150	(Roberts, 1980a)	Medium	Monitoring
US	NR	Occupational Department of Transportation/NR	1979	5 (NR)/ 135-196 min	NR (PCM)	0.15 to 0.31	NR	NR	4152150	(Roberts, 1980a)	Medium	Monitoring
US	Queens, NY	Occupational Police Department/NR	1979	7 (NR)/ 47-184 min	NR (PCM)	0.03 to 0.44	NR	NR	4152150	(Roberts, 1980a)	Medium	Monitoring

Country	State/ City/ Region	Site/Vehicle Type	Year	No. of Samples (Det. Freq.)/ Sample Duration	Detection Level (Method Type)	Concentration			Reference (HERO ID)			Data Type and Data Integration
						Range	Central Tendency	Standard Deviation	HERO	Citation	Data Eval. Score	
GB	London	Occupational Service bay of a car dealership/ Cars (Brake cleaning)	1970 (pub. date)	6 (NR)/ NR; the article says that sampling covered an entire work shift	NR (NR)	0.21 to 1.12	0.68 (mean)	NR	3610801	(Hickish and Knight, 1970)	Low	Monitoring
GB	London	Occupational Service bay of a car dealership/ Trucks (Brake cleaning)	1970 (pub. date)	1 (NR)/ 1.5 - 2 hour	NR (NR)	7.09	--	--	3610801	(Hickish and Knight, 1970)	Low	Monitoring
GB	London	Occupational Service bay of a car dealership/ Trucks (After Brake cleaning)	1970 (pub. date)	1 (NR)/ 5 hours	NR (NR)	0.08	--	--	3610801	(Hickish and Knight, 1970)	Low	Monitoring
GB	London	Occupational Service bay of a car dealership/ Trucks (Brake cleaning; entire shift)	1970 (pub. date)	2 (NR)/ 6.5 - 7 hours	NR (NR)	NR	1.75 (mean; TWA)	--	3610801	(Hickish and Knight, 1970)	Low	Monitoring
GB	London	Occupational Service bay of a car dealership/ Trucks (Clutch repair during cleaning)	1970 (pub. date)	1 (NR)/ 1.5 - 2 hour	NR (NR)	2.25	--	--	3610801	(Hickish and Knight, 1970)	Low	Monitoring
GB	London	Occupational Service bay of a car dealership/ Trucks (Clutch repair after cleaning)	1970 (pub. date)	1 (NR)/ 5 hours	NR (NR)	0.11	--	--	3610801	(Hickish and Knight, 1970)	Low	Monitoring

Country	State/ City/ Region	Site/Vehicle Type	Year	No. of Samples (Det. Freq.)/ Sample Duration	Detection Level (Method Type)	Concentration			Reference (HERO ID)			Data Type and Data Integration
						Range	Central Tendency	Standard Deviation	HERO	Citation	Data Eval. Score	
GB	London	Occupational Service bay of a car dealership/ Trucks (Clutch repair; entire shift)	1970 (pub. date)	2 (NR)/ 6.5 – 7 hours	NR (NR)	NR	0.79 (mean; TWA)	--	3610801	(Hickish and Knight, 1970)	Low	Monitoring

*Units are expressed as f/cc unless otherwise specified.

**HERO 3099264 has not been evaluated in DistillerSR.

*** Blake et al. reported variable detection limits for PCM where the maximum detection limit is greater than the maximum detected value and the minimum detected value was less than the reported minimum detection limit.

****Paustenbach et al. reported variable detection limits for PCM where the maximum detection limit is greater than the maximum detected value and the minimum detected value was less than the reported minimum detection limit. Detectable concentrations are embedded in the range of nondetectable concentrations.

Study Info: The information provided includes the HERO ID and citation; country and year samples collected; number of samples and detection frequency.

Abbreviations: If a value was not applicable, it is shown in this table as "--"; ND = not detected at the reported detection limit; GM = geometric mean; NR = not reported; f/cc = fibers per cubic centimeter; f/ml = fibers per milliliter; TWA = time weighted average; PCM = Phase Contrast Microscopy; PCME = Phase Contrast Microscopy Equivalent; TEM = Transmission Electron Microscopy.

The following abbreviations are for countries/continents: AU = Australia; CN = China. CO = Colombia; FI = Finland; GB = United Kingdom; IR = Iran; US = United States.

Parameters: All statistics are shown as reported in the study. All minimum values determined to be less than the detection limit are shown in this table as "ND".

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