

TALC AND ACRYLONITRILE

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OF CARCINOGENIC HAZARDS
TO HUMANS

Table S1.13 Exposure to respirable dust in talc mines and mills (personal sampling, all values in mg/m³)

Country/location (deposit)	Period	Site	Job	Sampling strategy informati on	No. of samples	Average (range) mg/m ³	Additional information	Reference
USA/Vermont	1975–1976	Mine A ^b	NR	NR	18	0.6 ^c (2.1)	Summer	Boundy et al. (1979)
			NR	NR	16	0.5 ^c (2.1)	Winter	
		Mine B ^b	NR	NR	15	1.5 ^c (1.6)	Summer	
			NR	NR	23	0.9 ^c (1.9)	Winter	
		Mine C ^b	NR	NR	12	0.5 ^c (1.9)	Summer	
			NR	NR	19	0.7 ^c (1.8)	Winter	
		Mine C1 ^d	NR	NR	7	1.2 ^c (2.2)	Summer	
		Mine C2 ^d	NR	NR	6	1.7 ^c (3.3)	Winter	
		Mine C3 ^e	NR	NR	2	5.1 ^c (1.4)	Summer	
		Mill A	NR	NR	4	1.7 ^c (1.6)	Summer (1st shift)	
			NR	NR	13	1.7 ^c (1.9)	Winter (1st shift)	
			NR	NR	6	0.5 ^c (2.0)	Summer (2nd shift)	
			NR	NR	3	1.5 ^c (2.2)	Winter (2nd shift)	
		Mill B	NR	NR	22	1.8 ^c (1.8)	Summer (1st shift)	
			NR	NR	42	1.8 ^c (1.6)	Winter (1st shift)	
			NR	NR	12	2.9 ^c (1.7)	Summer (2nd shift)	
			NR	NR	16	1.9 ^c (1.6)	Winter (2nd shift)	
		Mill C1	NR	NR	12	0.9 ^c (2.4)	Summer (1st shift)	
			NR	NR	20	1.1 ^c (2.8)	Winter (1st shift)	

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Country/location (deposit)	Period	Site	Job	Sampling strategy informati on	No. of samples	Average (range) mg/m ³	Additional information	Reference
USA/NY (Gouverneur District)	NR	Mill C2	NR	NR	3	0.8 ^c (2.0)	Summer (3rd shift)	Dement and Zumwalde (1979)
			NR	NR	4	1.4 ^c (1.9)	Winter (3rd shift)	
			NR	NR	11	1.0 ^c (1.4)	Summer (1st shift)	
			NR	NR	8	0.5 ^c (1.7)	Winter (1st shift)	
			NR	NR	13	0.8 ^c (1.5)	Summer (2nd shift)	
			NR	NR	3	1.1 ^c (1.5)	Winter (2nd shift)	
USA/NY (Gouverneur District)	NR	Mine ^b	All	TWA _{8h}	14	0.86 (0.23–1.29)		Gamble et al. (1979)
		Mill	All	TWA _{8h}	29	0.86 (0.25–2.95)		
USA/NY (Gouverneur District)	NR	Mine ^b	All	TWA _{8h}	NR	(0.23–1.20) ^f		NIOSH (1980)
		Mill	All	TWA _{8h}	NR	(0.25–2.96) ^f		
		Mine ^b	Trammer	TWA _{8h}	3	0.64		
			Scrapper man	TWA _{8h}	3	1.29		
			Labourer	TWA _{8h}	1	0.58		
			Driller	TWA _{8h}	3	0.98		
			Cageman	TWA _{8h}	1	0.23		

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Country/location (deposit)	Period	Site	Job	Sampling strategy informati on	No. of samples	Average (range) mg/m ³	Additional information	Reference
		Mill	Repairman	TWA _{8h}	1	1.14		
			Repair helper	TWA _{8h}	1	0.86		
			Maintenance	TWA _{8h}	1	0.42		
			Foreman	TWA _{8h}	2	0.58		
			Labourer	TWA _{8h}	1	1.14		
			Crusher operator	TWA _{8h}	2	0.85		
			Hardinge operator	TWA _{8h}	2	1.09		
			Wheeler operator	TWA _{8h}	2	1.56		
			Packer	TWA _{8h}	2	0.59		
			Packer svc.	TWA _{8h}	2	0.42		
			Pack Foreman	TWA _{8h}	2	0.25		
			Fork lift operator	TWA _{8h}	3	0.35		
			Car liner	TWA _{8h}	1	0.31		
			Bulk loader	TWA _{8h}	1	0.25		
			Millwright	TWA _{8h}	2	2.37		
			Instrum. repair	TWA _{8h}	2	0.59		

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Country/location (deposit)	Period	Site	Job	Sampling strategy informati on	No. of samples	Average (range) mg/m ³	Additional information	Reference	
USA/Montana	NR	Mine ^e and mill	Millwright help	TWA _{8h}	1	2.96		Greife (1980)	
			Metal worker	TWA _{8h}	1	0.50			
			Oiler	TWA _{8h}	1	0.72			
			Welder	TWA _{8h}	1	0.75			
			All	TWA _{8h}	174	[1.21 ± 0.94]			
			All	TWA _{8h}	174	0.86 ^c			
			Mine only	All	TWA _{8h}	NR	0.66 ^c		
			Mill only	All	TWA _{8h}	NR	1.1 ^c		
			Bagger	TWA _{8h}	29	2.8 ^c			
			Labman	TWA _{8h}	4	0.3 ^c			
		Fork lift operator	TWA _{8h}	5	0.5 ^c				
		Mill operator	TWA _{8h}	7	1.0 ^c				
		Labourer	TWA _{8h}	6	1.4 ^c				
		Foreman	TWA _{8h}	14	0.6 ^c				
		Boiler operator	TWA _{8h}	2	0.1 ^c				
		Front-end operator	TWA _{8h}	14	0.8 ^c				
		Maintenance	TWA _{8h}	16	0.4 ^c				

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Table S1.13 Exposure to respirable dust in talc mines and mills (personal sampling, all values in mg/m³)

Country/location (deposit)	Period	Site	Job	Sampling strategy informati on	No. of samples	Average (range) mg/m ³	Additional information	Reference
USA/Texas	NR	Mine ^e and mill	Welder	TWA _{8h}	1	6.3 ^c		
			Wash plant operator	TWA _{8h}	2	1.4 ^c		
			Sorter	TWA _{8h}	50	1.6 ^c		
			Driller	TWA _{8h}	1	0.1 ^c		
			Truck driver	TWA _{8h}	15	0.3 ^c		
			Miner	TWA _{8h}	2	0.4 ^c		
			Shovel operator	TWA _{8h}	5	0.2 ^c		
			Calciner operator	TWA _{8h}	1	0.6 ^c		
			All	TWA _{8h}	54	[2.64 ± 7.12]		
			All	TWA _{8h}	54	1.08 ^c		
		Mine only	All	TWA _{8h}	NR	0.45 ^c		
		Mill only	All	TWA _{8h}	NR	1.56 ^c		
			Bagger	TWA _{8h}	3	3.1 ^c		
			Stacker	TWA _{8h}	1	1.6 ^c		
			Fork lift operator	TWA _{8h}	2	2.3 ^c		
			Mill operator	TWA _{8h}	1	38.4 ^c		
			Labourer	TWA _{8h}	10	1.3 ^c		

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Table S1.13 Exposure to respirable dust in talc mines and mills (personal sampling, all values in mg/m³)

Country/location (deposit)	Period	Site	Job	Sampling strategy informati on	No. of samples	Average (range) mg/m ³	Additional information	Reference
USA/North Carolina	NR	Mine ^b and mill	Foreman	TWA _{8h}	4	1.3 ^c		
			Front-end operator	TWA _{8h}	7	1.3 ^c		
			Maintenance	TWA _{8h}	10	1.0 ^c		
			Sorter	TWA _{8h}	2	0.6 ^c		
			Driller	TWA _{8h}	2	0.7 ^c		
			Truck driver	TWA _{8h}	5	0.9 ^c		
			Miner	TWA _{8h}	2	0.1 ^c		
			Shovel operator	TWA _{8h}	2	0.3 ^c		
			Calciner operator	TWA _{8h}	1	1.1 ^c		
			Crusher operator	TWA _{8h}	1	1.7 ^c		
			Welder	TWA _{8h}	1	8.5 ^c		
			All	TWA _{8h}	44	[0.28 ± 0.33]		
			All	TWA _{8h}	44	0.21 ^c		
		Mine only	All	TWA _{8h}	NR	0.14 ^c		
		Mill only	All	TWA _{8h}	NR	0.26 ^c		
			Bagger	TWA _{8h}	1	0.9 ^c		

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Table S1.13 Exposure to respirable dust in talc mines and mills (personal sampling, all values in mg/m³)

Country/location (deposit)	Period	Site	Job	Sampling strategy informati on	No. of samples	Average (range) mg/m ³	Additional information	Reference
France/Pyrenees mountains	1988	Mill	Mill operator	TWA _{8h}	1	0.9 ^c		Leophonte and Didier (1990)
			Labourer	TWA _{8h}	9	0.2 ^c		
			Foreman	TWA _{8h}	1	0.9 ^c		
			Maintenance	TWA _{8h}	2	0.03 ^c		
			Driller	TWA _{8h}	3	0.1 ^c		
			Hoist operator	TWA _{8h}	2	0.1 ^c		
			Miner	TWA _{8h}	9	0.3 ^c		
			Grader	TWA _{8h}	7	0.4 ^c		
			Packer	TWA _{8h}	1	1.2 ^c		
			Cutter	TWA _{8h}	4	1.2 ^c		
			Rounder	TWA _{8h}	1	0.9 ^c		
France/Pyrenees mountains	1989–1990	Mill	Milling	NR	NR	1		Wild et al. (1995)
			Packaging	NR	NR	3		
			All	FS	1440	1.87 ^c (0.5–50)		
			Secretaries	FS	NR	(0–5)		
			Managers	FS	NR	(0–5)		
			Railway wagon	FS	7	0.7	1986	

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Table S1.13 Exposure to respirable dust in talc mines and mills (personal sampling, all values in mg/m³)

Country/location (deposit)	Period	Site	Job	Sampling strategy informati on	No. of samples	Average (range) mg/m ³	Additional information	Reference
USA/NY (Gouverneur District)	1991	All areas	Railway wagon	FS	3	0.4	1989	Oestenstad et al. (2002)
			Railway wagon	FS	3	0.6	1991	
			Cleaners	FS	44	14.4	1986	
			Cleaners	FS	31	13.5	1989	
			Cleaners	FS	27	1.8	1991	
			Storing bags	FS	NR	60	Jute bags	
		Mill 1	NR	TWA _{8h}	NR	0.47 ± 0.49	Summer, winter	
			NR	TWA _{8h}	NR	0.59 ^c	Summer	
			NR	TWA _{8h}	NR	0.41 ^c	Winter	
			All	TWA _{8h}	NR	0.48	Summer, winter	
			Milling	TWA _{8h}	28	0.53 ± 0.71	Summer, winter	
			Palletizing	TWA _{8h}	24	0.52 ± 0.27	Summer, winter	
			Packhouse help	TWA _{8h}	16	0.32 ± 0.21	Summer, winter	
			Maintenance	TWA _{8h}	14	0.42 ± 0.31	Summer, winter	
		Mine 1 ^b	Underground	TWA _{8h}	11	0.70 ± 0.68	Summer, winter	

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Country/location (deposit)	Period	Site	Job	Sampling strategy informati on	No. of samples	Average (range) mg/m ³	Additional information	Reference
France/Pyrenees mountains	1945–1994	Mine 2 ^e	Surface crushing	TWA _{8h}	1	0.14	Summer, winter	Wild et al. (2002)
			Equipment operator	TWA _{8h}	11	0.22 ± 0.25	Summer, winter	
			Crusher	TWA _{8h}	4	0.83 ± 0.55	Summer, winter	
		Mine A ^e	Maintenance	TWA _{8h}	3	0.06 ± 0.06	Summer, winter	
			Clerical	FS	168	0.2	No exposure group (1986)	
			Maintenance, mech., & prod.	FS	100	(0.11–17)	Low exposure group (1986)	
			NR	FS	193	(0.21–134)	Med. exposure group (1986)	
Austria/Styrian mountains	1972–1995	Mine B ^b	NR	FS	173	(0.02–4.61)	Low exposure group (1988–1992)	
		Mine C ^b	NR	FS	33	(0.02–4.1)	Low exposure group (1991–1992)	
Italy/Val Chisone	1946–1995	Mine	NR	NR	NR	1.1 (0.5–2.5)		Coggiola et al. (2003)
NR	NR	Mill	Granulating	NR	NR	(3.6–6.5)	Inhalable fraction	Teikari et al. (2003)
				NR	NR	(2.0–2.9)	Thoracic fraction	
				NR	NR	(0.4–0.6)	Respirable fraction	
France/Pyrenees mountains	1988–2003	Mine ^e	All	FS	233	0.67 ^c (4.4)	1990	Wild et al. (2008)

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Country/location (deposit)	Period	Site	Job	Sampling strategy informati on	No. of samples	Average (range) mg/m ³	Additional information	Reference
France/Pyrenees mountains	1988–2003	Mill	All	FS	162	0.37 ^c (3.1)	2003	
			Workshop	FS	NR	20	Pre-1967	
			Bag filling	FS	NR	20	Pre-1984	
			28 jobs	FS	NR	> 5	Pre-1992	
			Laboratory	FS	19	18.8	1990–1994	
			Laboratory	FS	44	5.6	2000–2004	
			Other jobs	FS	NR	Below 1	2000–2004	
			All	FS	502	1.95 ^c (3.9)	1986	
			All	FS	208	0.80 ^c (4.3)	2003	
			Mill operators	FS	83	2.2	1985–1989	
			Cleaners	FS	97	11.3	1985–1989	
			Office workers	FS	156	0.16	1985–1989	
			Electricians	FS	41	5.1	Pre-1990	
			Electricians	FS	53	3.7	2000–2004	
			Granulation	FS	26	9.7	2000–2004	
			Automation	FS	11	0.1	2000–2004	
Austria/Styrian mountains	1988–2003	Mine ^a	All	FS	NR	0.65 ^c (5.3)	1992–1994	
			All	FS	NR	0.32 ^c (3.4)	1994–2000	

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Country/location (deposit)	Period	Site	Job	Sampling strategy information	No. of samples	Average (range) mg/m ³	Additional information	Reference
Austria/Styrian mountains	1988–2003	Mill	All	FS	416	0.75 ^c (3.7)	1988–1995	Romano et al. (2011)
			All	FS	237	0.30 ^c (3.3)	1996–2004	
Italy/Val Chisone	2004–2010	Mine	Miners	FS	NR	[1.9]		
		Plant	Grinders, baggers	FS	NR	[0.8]		
Italy/Val Chisone	1946–2013	Mine	Miners	NR	NR	[0.4]	2007	Pira et al. (2017)
			Miners	NR	NR	[0.7]	2008	
			Miners	NR	NR	[0.35]	2009	
			Miners	NR	NR	[0.2]	2010	
			Miners	NR	NR	[0.4]	2011	
			Miners	NR	NR	[1.6]	2012	
			Miners	NR	NR	[0.7]	2013	
			Miners	NR	NR	[0.8]	2014	
		Mill	Millers	NR	NR	[0.6]	2007	
			Millers	NR	NR	[0.3]	2008	
			Millers	NR	NR	[0.3]	2009	
			Millers	NR	NR	[0.3]	2010	
			Millers	NR	NR	[0.6]	2011	
			Millers	NR	NR	[0.4]	2012	

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Country/location (deposit)	Period	Site	Job	Sampling strategy informati on	No. of samples	Average (range) mg/m ³	Additional information	Reference
USA/Vermont	1976–2003	All mines	Millers	NR	NR	[0.9]	2013	Rossner et al. (2020)
			Millers	NR	NR	[0.6]	2014	
			NR	FS	47	1.38 ± 1.80	Company (1976)	
			NR	FS	134	0.59 ± 1.46	Company (1978–1980)	
			NR	FS	32	0.09 ± 0.16 ⁱ	Company (1999/2003)	
		Hammondsville ^b	NR	FS	32	0.83 ± 1.22	Company (1976)	
			NR	FS	71	0.32 ± 0.42	Company (1978–1980)	
			Mucker	FS	NR	2.72	Company (no year)	
			Welder	FS	NR	1.10	Company (no year)	
		Ludlow ^e	NR	FS	15	2.57 ± 2.26	Company (1976)	
			NR	FS	63	0.91 ± 2.05	Company (1978–1980)	
			NR	FS	32	0.09 ± 0.16 ^g	Company (1999/2003)	
			Automatic operator	FS	NR	5.75	Company (no year)	
			Dosco operator	FS	NR	3.18	Company (no year)	
			Loading operator	FS	NR	2.18	Company (no year)	
		All mills	NR	FS	76	1.13 ± 0.80	Company (1976)	
			NR	FS	165	0.69 ± 1.25	Company (1978–1980)	
			NR	FS	31	0.83 ± 0.96	Company (1999/2003)	

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Country/location (deposit)	Period	Site	Job	Sampling strategy informati on	No. of samples	Average (range) mg/m ³	Additional information	Reference
		Columbia mill	NR	FS	2	0.25 ± 0.21	Company (1976)	
			NR	FS	43	0.61 ± 2.01	Company (1978–1980)	
			Floorman	FS	NR	1.04	Company (no year)	
		Columbia shipping centre	NR	FS	55	1.66 ± 3.60	Company (1978–1980)	
		Gassetts mill	NR	FS	35	0.89 ± 0.41	Company (1976)	
			NR	FS	35	0.72 ± 0.54	Company (1978–1980)	
			Crusher operator	FS	NR	1.35	Company (no year)	
			Dry mill operator	FS	NR	1.15	Company (no year)	
		W. Windsor mill	NR	FS	39	1.39 ± 0.97	Company (1976)	
			NR	FS	87	0.73 ± 0.94	Company (1978–1980)	
			NR	FS	31	0.83 ± 0.96	Company (1999/2003)	
			Bagging operator	FS	NR	2.06	Company (no year)	
			Packing operator	FS	NR	2.13	Company (no year)	
			Palletizer	FS	NR	2.4	Company (no year)	
			Crushing operator	FS	NR	1.75	Company (no year)	

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Country/location (deposit)	Period	Site	Job	Sampling strategy informati on	No. of samples	Average (range) mg/m ³	Additional information	Reference
		All mines	NR	FS	10	1.27 ± 1.68	MSHA (1978–1980)	
			NR	FS	16	0.78 ± 0.50	MSHA (1981–1989)	
			NR	FS	10	0.68 ± 0.47	MSHA (1990–1998)	
		Hammondsville ^b	NR	FS	9	1.38 ± 1.74	MSHA (1978–1980)	
			NR	FS	12	0.83 ± 0.51	MSHA (1981–1989)	
			NR	FS	6	0.87 ± 0.27	MSHA (1990–1998)	
			Bagging operator	FS	NR	3.75	MSHA (no year)	
			Kiln/dryer operator	FS	NR	3.5	MSHA (no year)	
			Continuous	FS	NR	1.06	MSHA (no year)	
		Ludlow ^e	NR	FS	1	0.30	MSHA (1978–1980)	
			NR	FS	4	0.61 ± 0.51	MSHA (1981–1989)	
			NR	FS	4	0.39 ± 0.59	MSHA (1990–1998)	
			Driller	FS	NR	1.27	MSHA (no year)	
		All mills	NR	FS	16	2.83 ± 3.95	MSHA (1978–1980)	
			NR	FS	18	3.32 ± 4.45	MSHA (1981–1989)	
			NR	FS	14	0.62 ± 0.39	MSHA (1990–1998)	
		Columbia mill	NR	FS	6	6.79 ± 4.08	MSHA (1978–1980)	
			NR	FS	7	3.07 ± 2.70	MSHA (1981–1989)	

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Country/location (deposit)	Period	Site	Job	Sampling strategy informati on	No. of samples	Average (range) mg/m ³	Additional information	Reference
			NR	FS	8	0.35 ± 0.24	MSHA (1990–1998)	
			Bagging operator	FS	NR	7.97	MSHA (no year)	
			Ball mill operator	FS	NR	3.69	MSHA (no year)	
			Mechanic	FS	NR	3.92	MSHA (no year)	
			Hammer mill	FS	NR	1.61	MSHA (no year)	
		Columbia shipping centre	NR	FS	7	3.10 ± 3.78	MSHA (1981–1989)	
			Bagging operator	FS	NR	3.24	MSHA (no year)	
			Utility man	FS	NR	2.25	MSHA (no year)	
		Gassetts mill	NR	FS	2	0.24 ± 0.02	MSHA (1978–1980)	
		W. Windsor mill	NR	FS	8	0.51 ± 0.24	MSHA (1978–1980)	
			NR	FS	11	3.47 ± 5.40	MSHA (1981–1989)	
			NR	FS	6	0.99 ± 0.20	MSHA (1990–1998)	
			Kiln/dryer operator	FS	NR	10.3	MSHA (no year)	
			Flotation operator	FS	NR	1.88	MSHA (no year)	
			Hammer mill	FS	NR	1.36	MSHA (no year)	

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Country/location (deposit)	Period	Site	Job	Sampling strategy informati on	No. of samples	Average (range) mg/m ³	Additional information	Reference
			Mill operator	FS	NR	1.04	MSHA (no year)	

[], approximately (values read from figure or calculated by the Working Group); FS, full-shift (e.g. 4–8 hours) sample; Instrum., instrument; mech.; garage mechanic; mntnc., off-site maintenance worker; MSHA, Mine Safety and Health Administration; NR, not reported; NY, state of New York; svc., serviceman; prod., production worker; TWA_{8h}, 8-hour time-weighted average; USA, United States of America; W, west.

^a Underground (pre-1989), open pit (post-1989).

^b Underground mine.

^c Geometric mean (*geometric standard deviation).

^d Walk-in mine.

^e Open pit mine.

^f Referred to as range of averages by Gamble et al. (1982) but appear to be the same data reported as range by Dement and Zumwalde (1979).

^g Approximately 50% of measurements below the limit of detection.

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