

Table 2: Irritants reported to cause occupational asthma																					
Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)															Remarks	
					WORK-RELATED SYMPTOMS				LFT		BHR		PFT		SIC						
					Asthma		RADS		n/n	%	n/n	%	n/n	%	n/n	%	Reaction				
					n/n	%	all cases: + or at least one case: (+)	i(n)									l(n)	d(n)			
Acids																					
*, not specified	Kipen, Blume et al., 1994	Case reports	4	4	4/4			nd		4/4		nd		nd						1 Fire inspector and 3 hazardous waste investigators exposed to fumes of waste acid drums	
*, "	Brooks, Weiss et al., 1985	Case report	1	1	1/1		+	1/1		1/1		nd		nd						Welder. Co-exposure to welding fumes	
, various	Tarlo and Broder, 1989	Case report	1	1	1/1		+	x		1/1		x*		nd						Profession not mentioned. *Individual data for LFT/PFT not listed	
*, " (hydrochloric, hydrofluoric, nitric, perchloric, sulphuric)	Musk, Peach et al., 1988	Survey	20	4 (20.0)	9/20			2/20		5/20		1/4		nd						20 Workers in a mineral analysis laboratory	
*, glacial acetic 64-19-7	Kern, 1991	Survey	51	4(7.8)	15/51	29.4		+	4/51	7.8	9/24	37.5		nd						Hospital employees exposed to spill. Asthmatic symptoms dose-related	
, "	Rajan and Davies, 1989	Case report	1	1	1/1			x**		nd		nd		nd						Maintenance fitter exposed to massive spill. *Development of interstitial pneumonitis (P+); **reversible FVC and FEV1 decline	
*, "	Kivity, Fireman et al., 1994	Case report	1	1	1/1			1/1		1/1		nd		1/1					1	Canning factory worker	
, hydrochloric 7647-01-0	Boulet, 1988	Case report	1	1	1/1		+	1/1		nd		nd		nd						Pool cleaner; exposure to agent for 1 hour. *Severe deterioration of pre-existing asthma	
*, "	Deschamps, Soler et al., 1994	Case report	1	1	1/1		+	1/1		1/1		nd		nd						Profession not mentioned. Co-exposure to sodium hypochlorite. Respir. symptoms after 5 min. inhalation; duration of asthma after exposure > 2 years	
*, sulphuric 7664-93-9	Boulet, 1988	Case report	1	1	1/1		+	0/1		1/1		nd		nd						Cleaner. Normal LFT and SIC- on examination 2 yrs later	
Acid fluxes																					
	Gannon and Burge, 1993	Occupational diseases statistics (SHIELD)	4	4	4/4			nd		nd		x		x						4/500 occup. asthma cases in 1989-1991	
Acrylates																					
, "	Chatkin, Tarlo et al., 1999	Occupational diseases statistics (WCB), survey	2	2	2/2		+	nd		x		nd		nd						2/469 asthma claims between mid 1984 and mid 1988, identified by retrospective Review; *2/2 BHR+ and/or BD+	
, alkyl cyanoacrylates	(Savonius, Keskinen 1993)	Case reports	11	10	10/11			nd		x		nd		10/11		1	6	3		Factory employees working with glue. *Individual data not listed	
*, "	(Lozewicz, Davison et al. 1985)	Case report	1	1	1/1			nd		0/1		1/1		1/1					1	Forker in loudspeaker production industry	
*, "	(Yacoub, Lemièrè et al. 2005)	Case report	1	1	1/1			0/1		nd		nd		1/1					1	Exposure while making miniature planes	
*, cyanoacrylate glue	(Chan, Cheong et al. 1994)	Case report	1	1	1/1			1/1		nd		1/1		1/1					1	Door factory worker	
*, " [Iocite®]	(Toren, Järholm et al. 1999)	Population based case referent study	15	15	15			nd		nd		nd		nd						15/251 occupational asthma in 1996 (physician-diagnosed). OR 1.8, sign.	
*, ethyl 2-cyanoacrylate [ethylcyanoacrylate] 7085-85-0	Lozewicz, Davison et al., 1985	Case reports	3	3	3/3			nd		0/3		nd		3/3					1	2	Solderer of electronic industry, 2 factory workers assembling lampshades
*, "	Quirce, Baeza et al., 2001	Case reports	2	2	2/2			0/2		1/2		2/2		2/2					2	2 Assembly operators in weather strips and rubber-processing factory	
*, "	Kopp, McKay et al., 1985	Case report	1	1	1/1			0/1		1/1		nd		1/1					1	Accountant and computer representative building remote control model air planes	
*, mecriclate [methylcyanoacrylate] 137-05-3	Lozewicz, Davison et al., 1985	Case reports	1	1	1/1					0/1		nd		1/1					1	Worker of instrument-manufacture	

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					WORK-RELATED SYMPTOMS				LFT		BHR		PFT		SIC					
					Asthma		RADS		n/n	%	n/n	%	n/n	%	n/n	%		Reaction		
					n/n	%	all cases: + or at least one case: (+)	i(n)										l(n)	d(n)	
" "	Savonius, Keskinen et al., 1993	Case reports	4	2	2/4			nd		x*		nd		2/4			1	1	Factory workers: 1 working with glue, 1 in manufacture of earplugs, 1 producing dental fillings, 1 working with dentin primer. *Individual data not listed	
"diacrylate	Weytjens, Cartier et al., 1999	Case report	1	1	1/1			0/1		0/1		nd		1/1			1		Auto body shop worker. Preceding rhinitis	
"methyl metacrylate 80-62-6	Lozewicz, Davison et al., 1985	Case report	1	1	1/1			nd		0/1		nd		1/1			1		Dental assistant	
"	Pickering, Bainbridge et al., 1986	Case report	1	1	1/1			0/1		nd		nd		1/1			1		Theatre sister handling bone cement.	
Acrylic acid	Savonius, Keskinen et al., 1993	Case report	1	1	1/1			x**		x**		nd		1/1*			1		Mechanic in paper mill. *SIC with ink containing acrylic acid (30%), hydroxypropanoic acid (30%), bronze powder (25%), white spirit (4%), ethanol (10%); **for LFT/BHR individual data not listed	
Airbag content	Hambrook, Masci et al., 2005	Case report	1	1	1/1		+	nd		1/1		nd		nd					Head-on motor vehicle accident	
2-Aminoethanol [2-ethanolamine]	Savonius, Keskinen, 1994	Case report	1	1	1/1			nd		0/1		1/1		1/1				1	Cleaner. Subfebrile temperature 7h after SIC	
Amino-ethyl-ethanolamine	Pepys and Pickering, 1972	Case reports	3	3	3/3			2/3		nd		nd		3/3			1	2	Cable jointers	
3-Amino-5-mercapto-1,2,4-triazole 16691-43-3	Hnizdo, Sylvain et al., 2004	Survey of Case series identified by System of Occupational Risks (SENSOR)	106	6* (5,6)	6/106	5.6			x**		6/6		3/6	nd					Chemical plant workers. co-exposure to N-(2,6-difluorophenyl)-5-methyl-1,2,4-triazolol (1,5-allylimidine-2-sulfonamide). *6/106 physician-diagnosed occup. asthma; ; **for LFT no individual data listed	
Ammonia 7664-41-7																				
"	Ali, Ahmed et al., 2001	Cross-sectional	73	33 (45.2)	33/73	45.2			x*		nd		nd	nd					Ammonia workers. *FEV1 sign. reduced in symptomatic nonsmokers and at > 50 mg/m3-yrs (28/73)	
"	Bernstein and Bernstein, 1989	Case reports	4	4	4/4		+	1/4		3/3		nd		nd					Profession not mentioned. Massive accidental exposure, 4/4 P+, respiratory symptoms persisted for 12-32 months	
"	Flury, Dines et al., 1983	Case report	1	1	1/1		+	1/1		nd		nd		nd					Profession not mentioned. Pulmonary edema with acute pulmonary distress after massive exposure	
"fumes	Leduc, Gris et al., 1992	Case report with 12 year follow-up	1	1	1/1		+	1/1		nd		nd		nd					Solderer of industrial butter plant. Massive accidental exposure; P+; persisting severe airflow obstruction over 12 years	
"	Reinisch, Harrison et al., 2001	Occupational diseases statistics (SENSOR), survey		7	7/7		(+)	x*		nd		nd		nd					7/430 new-onset asthma in 1993-1996. *Individual data not listed	
Ammonium chloride (triple salt) 12125-02-9	Weir, Robertson et al., 1989	Case report	2	2	2/2			2/2		2/2		2/2		1/1			1		1 tin maker, 1 car radiator repair man: use of soft corrosive soldering fluxes. Co-exposure to zinc chloride (see also zinc chloride). Also 2/2 SIC+ with soldering flux (2 immediate)	
Ammonium thioglycolate 5421-46-5	Gelfand, 1963	Case reports	14	10	14/14			nd		nd		nd		10/10*					14 subjects exposed in the beauty culture industry. Co-exposure to monoethanolamine and ethylene diamine. *No individual reaction type listed	
Amprolium hydrochloride 137-88-2	Greene and Freedman, 1976	Case report	1	1	1/1		+	0/1		nd		nd		1/1			1		Worker of poultry-food additive manufacturing (Pancoxin). Massive accidental exposure	

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					Asthma		RADS		n/n	%	n/n	%	n/n	%	n/n	%	Reaction			
					n/n	%	all cases: + or at least one case: (+)	i(n)									l(n)	d(n)		
Anhydrides																				
" , various	Baur, Czuppon et al., 1995	Cross-sectional with follow-up of cases	92	8* (8.7)	18/ 92			11/90		4/90		nd		nd				Chemical workers. *8/18 dyspnoeic subjects with sign. obstructive ventilation pattern; 15/92 specific IgE+		
" , "	Drexler, Weber et al., 1994	Survey	110	2 (1.8)	14/ 110			nd		nd		nd		2/8*				Employees of epoxy resin plant. *Individual reaction type of SIC not listed; 16/109 specific IgE+		
" , dioctyl phthalate 117-81-7	Cipolla, Belisario et al., 1999	Case report	1	1	1/1			1/1				1/1*						Bottle stopper production worker. *PFT+: immediate		
" , himic anhydride 2746-19-2	Rosenman, Bernstein et al., 1987	Survey	20	3* (15.0)	3/20			nd		nd		nd						Chemical plant workers. 3/20 wheezing and specific IgE+; 7/20 rhinitis		
" , maleic anhydride 108-31-6	Lee, Wang et al., 1991	Case report	1	1	1/1			0/1		1/1		nd		1/1			1	Assistant technician in chemical plant		
" , phthalic anhydride 85-44-9	Wernfors, Nielsen et al., 1986	Survey	118	21 (17.8)	21/ 118			8/ 55		7/36		nd		2/2			2	Workers of plants producing alkyde and/or unsaturated polyester resins. Average conc. 3-13 mg/m3. 3/37 skin scratch test +; 4/54 specific IgE+		
" , "	Nielsen, Welinder et al., 1988	Comparative survey	60	5* (8.3)	5/60			nd		nd		nd		nd				Workers of plants producing alkyde and unsaturated polyester resins. Average conc. 0.4 mg/m3, peaks 6.6 mg/m3* All cases in heavily exposed group; 7/60 chronic bronchitis (6 heavily exposed); 4/60 spec.IgE+ exposure-related		
" , "	Fawcett, Newman Taylor et al., 1977	Case reports	5	2	5/5			2/5		nd		nd		2/5			2	Workers of plastic and paint industry		
" , "	Frans and Pahulycz, 1993	Case report	1	1	1/1		+	0/1		1/1		nd		nd				Tanker driver exposed to massive spill. At follow-up after about 1,5 years asymptomatic and BHR-		
" , "	Maccia, Bernstein et al., 1976	Case report	1	1	1/1			nd		nd		nd		1/1		1		Chemical foreman. SPT+; spec. IgE+		
" , pyromellitic dianhydride 89-32-7	Meadway, 1980	Case report with survey (colleagues)	7	2	2/7			0/7		nd		2/4*		nd				Employees working with epoxy resins. *PFT done while exposed to a.) already mixed and b.) while mixing adhesives (a.1 immediate with FEV1 of 15% decline, b.1 late with FEV1 of 18% decline)		
" , tetrachlorophthalic anhydride 117-08-8	Howe, Venables et al. 1983	Case series	7	4	7/7			0/7		nd		nd		4/4		2	2	Factory workers with epoxy resin systems. 7/7 specific IgE+		
" , "	Venables, Topping et al., 1987	Case series with follow-up	7	7	7/7			0/7		5/5		nd		nd				Factory workers with epoxy resin systems. 4 yrs follow-up; 7/7 specific IgE+ and SPT+; persistent asthmatic symptoms over 4 years in spite of avoidance		
" , "	Venables, Topping et al., 1985	Survey with follow-up	330	9* (2.7)	9*/330	2.7		nd		nd		nd		nd				Factory workers. *9/396 work-related chest symptoms, not related to IgE+; 24/300 IgE+, related to smoking		
" , "	Schlueter, Babaszak et al., 1978	Case series	5	4	5/5			3/5		1/1		nd		3/5		1	2	5 plastic industry workers		
" , benzene-1, 2, 4- tricarboxylic acid 1,2-anhydride [trimellitic anhydride] 552-30-7	Grammer, Shaughnessy et al., 1999	Survey with follow-up	286	14* (4.9)	14*/286	4.9		x**		nd		nd		nd				Workers of TMA manufacturing industry. Average conc. < 0.00045-1.7 mg/m3. *14/286 developed TMA-related respiratory symptoms within 3 years; **for LFT individual data not listed; 18/286 specific IgE+; IgG sign. disease- and exposure-related		
" , "	Zeiss, Patterson et al. 1977	Case series	14	6*	14/14			nd		nd		nd		1/1		1		Chemical plant workers. 2/14 asthma/rhinitis (immunol.), *4/14 late-onset asthma; *2/14 both diseases; 6/14 irritant syndrome; 3/14 specific IgE+		
" , "	Fawcett, Newman Taylor, 1977	Case report	1	1	1/1			1/1		nd		nd		1/1			1	Maintenance fitter		

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					Asthma		RADS		n/n	%	n/n	%	n/n	%	n/n	%		Reaction		
					n/n	%	all cases: + or at least one case: (+)	i(n)										l(n)	d(n)	
Aziridine, polyfunctional (dust) 64265-57-2	Kanerva, Keskinen et al., 1995	Case reports	9	7	7/9			nd		2/9		nd		7/9		1	5	1	5 parquet varnishers, 1 spray painter, 2 painters, 1 sales agent. 3 subjects also dermatitis. 4/7 SIC+ also SPT+;4/7 SIC+ with rhinitis	
Azobisformamide [azodicarbonamide] 123-77-3	Slovak, 1981	Survey	151	28* (18.5)	28/ 151			0/ 28		13/ 28	46.4	0/ 11		nd					Profession not mentioned. Average conc. 2-5 mg/m3. *Asthma type at onset of symptoms: 6 immediate, 16 late, 6 dual	
"	Normand, Grange et al., 1989	Case reports	4	4	4/4			1/2*		nd		nd		2/2		1	1	Workers of plastic industry. *For 2/4 subjects individual data not listed		
"	Malo, Pineau et al., 1985	Case reports	2	2	2/2			2/2		2/2		nd		2/2		1	1	Profession not mentioned		
Benzalkonium chloride (fumes) 8001-54-5	Purohit, Kopferschmitt Kubler et al., 2000	Case report	3	3	3/3			nd		2/3		3/3		3/3			3		Medical, surgical and paediatric nurses	
"	Bernstein, Stauder et al., 1994	Case report	1	1	1/1			nd		nd		nd		1/1			1		Worker in cleaning products manufacturing	
1, 2-Benzisothiazoline-3-one (fumes) 2634-33-5	Moscato, Omodeo et al., 1997	Case report	1	1	1/1			0/1		0/1		nd		1/1		1			Worker of chemical factory	
Bisulfite, SO2 SO2: 7446-09-5	Kipen, Blume et al., 1994	Case report	1	1	1/1			1/1		nd		1/1		nd					Profession not mentioned	
Bleaching agent (fumes)	Boulet, 1988	Case report		1	1/1		+	1/1		1/1		nd		nd					Acute accidental exposure to fumes, with low density phosphate, sodium metasilicate, chloride 18%. Patient tested 6 years after accident	
Bromine, hydrobromic acid	Burns and Linden, 1997	Case reports	2	2/2	2/2		+	nd		2/2		nd		nd					Non-occupational exposure during single hot tube bathing for 5-10 min.	
Bromochlorodifluoromethane (Halon 1211) 353-59-3	Matrat, Laurence et al., 2004	Case reports	4	3	2/4		+	4/4		4/4		nd		nd					Accidental release of fire extinguisher content. 1/4 subjects with aggravated asthma	
Bromotrifluoromethane (Halon 1301) 63-8	de la Hoz, 1999	Case report	1	1	1/1		+	1/1		1/1		nd		nd					Accidental exposure to fumes, caused by leak of a tank (belonging to a fire extinguishing system). Obstructive lung patterns for > 7 years; BD+	
Cadmium (fumes)	Davison, Fayers et al., 1988	Cross-sectional	101	33* (32.7)	33/ 101	32.7		33/77	42.8	nd		nd		nd					Cadmium workers. *33/101 FEV1 or FEV1/VC sign. reduced (average 30% below predicted), cumulative dose-related; lung function and chest X-ray indicate emphysema in 14/75	
Calcium oxide 1305-78-8	Tarlo and Broder, 1989	Case reports	2	2	2/2			x*		2/2		nd		nd					Profession not mentioned. Persistent asthmatic symptoms for 1.5 to 3 years; 1/2 co-exposed to welding fumes;"individual data for LFT/PFT not listed	
Captafol (chlorinated thiocarbimide fungicide) 2425-06-1	Royce, Wald et al., 1993	Case report	1	1	1/1			0/1		1/1		nd		1/1				1	Chemical worker	
Cement dust (see also chromate)	Abrons, Petersen et al., 1988	Cross-sectional	2738	148* (5.4)	148	5.4		nd		nd		nd		nd					Cement workers. *Dyspnea sign. increased (5.4% vs. 2.7% of controls); COPD also increased (4.1% vs. 3% of controls); no sign. lung function changes	
"	Kalacic, 1973	Cross-sectional	847	95(11.2)	95	11.2		nd		nd		nd		nd					Cement workers. COPD sign. increased (11.2% vs. 4.3% of controls); wheezing sign. increased (7.4% vs. 3.7% of controls, more pronounced in smokers); *high risk of bias because study only based on questionnaire	

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					WORK-RELATED SYMPTOMS				LFT		BHR		PFT		SIC					
					Asthma		RADS		n/n	%	n/n	%	n/n	%	n/n	%		i(n)	l(n)	d(n)
					n/n	%	n/n	%												
	Yang, Huang et al., 1996	Cross-sectional	412	36 (8.7)	36/ 412	8.7			x*		nd		nd							412 portland cement workers vs. 179 controls. Dyspnea sign. increased (8.7 vs. 7.2% of controls); wheezing also sign. Increased (7.6 vs. 6.2% of controls); *LFT sign. reduced FVC, FEV1, FEF50, FEF75
	Mwaiselage, Brätveit et al., 2005	Cross-sectional study	117	22 (18.8)	22/ 117	18.8			22/ 117	18.8	nd		nd							117 cement workers vs. 105 controls. 22/117 COPD (18.9% vs. 4.8% of controls), COPD and work-related shortness of breath sign. related to cumulative dust exposure
	Mengesha and Bekele, 1998	Comparative survey*	53	17 (32.1)	17/ 53	32.1			x		nd		nd							Workers of a cement factory. Asthmatic symptoms (32.1% vs. 8.5% of controls); 14/53 chronic bronchitis; *high risk of bias, because inadequate description of controls
	AbuDhaise, Rabi et al., 1997	Cross-sectional	348	55 (15.8)	55/ 348	15.8			nd		nd		nd							Asthma sign. exposure level-related
	Al-Neaimi, Gomes et al., 2001	Cross-sectional	67	4* (6.0)	4/ 67	6.0			x		nd		nd							67 cement workers vs. 134 controls. *4/67 asthma symptoms (6% vs. 3%); 9/67 bronchitis; other chronic resp. symptoms: dyspnea 14/67 (20.9% vs. 4.5%)
	de Raeve, Vandecasteele et al., 1998	Case report	1	1	1/1				0/1		1/1		1/1*						1	Floorer. *SIC with potassium dichromate; **PFT done for 50 days (17 days at work, 33 days off work); first symptoms after 34 years of exposure
	Leroyer, Malo et al., 1998	Case report	1	1	1/1				nd		1/1		nd		1/1*				1	Roofers. *SIC with potassium dichromate
	Lockman, 2002	Case report	1	1	1/1				nd		nd		nd							Leather tanning worker. SPT+ with potassium dichromate
	Shirakawa and Morimoto, 1996	Case and control	1	1	1/1				nd		nd		1/1		1					Worker of metal plating factory. Spec. IgE+
	Chloramine T (powder dust) 7080-50-4	Case series	7	7	7/7				nd		nd		nd							Brewery workers. Recovery after removal; 7/7 SPT+ done with clortol
	Feinberg and Watrous, 1945	Case series	6	6	6/6				(+)*		nd		nd							Co-exposure to halazone; *1/6 RADS
	Dijkman, Vooren et al., 1981	Case series	5	4	4/5				1/5		nd		nd		3/3			1	2	2 cleaners, 2 technicians, 1 nurse. 4/4 SPT+
	Kujala, Reijula et al., 1995	Case report	1	1	1/1				1/1		1/1		nd		1/1				1	Cleaner
	Chlorhexidine 55-56-1	Case reports	2	2	2/2				0/2		1/2*		1/2**		1/2**			1		1 nursing auxiliary. *BHR+ and a FEV1 decline of 13% after SIC, 1 midwife with **SIC+ and **PFT+
	Chlorine 7782-50-5																			
	(Bhérier, Cushman et al. 1994)	Survey with follow-up	64	15*** (29.4)	58/ 64				(+)*	16/ 51**	31.4	29/ 51**	56.9	nd		nd				289 construction workers. After multiple exposures, *71/289 with respir. symptoms and possible RADS; at follow-up 18 to 24 months **51/58 symptomatics underwent pulmonary tests; ***15/51 with obstructive lung pattern and BHR+
	Ferris, Burgess et al., 1966	Survey	147	8*	13/67	19.4			nd		nd		nd		nd					Pulpmill workers. Co-exposure to sulphur dioxide. *7 COPD, *1 asthma (physician-diagnosed)
	Leroyer, Dewitte et al., 1998	Longitudinal follow-up of case series	13	3	13/ 13				(+)	1/ 13*		2/ 13*		nd		nd				13/278 workers of metal production plant with accidental exposure. *3/13 transient FEV1 or BHR deterioration

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					WORK-RELATED SYMPTOMS		LFT		BHR		PFT		SIC							
					Asthma	RADS	n/n	%	n/n	%	n/n	%	n/n	%	n/n	%	Reaction			
																	i(n)		l(n)	d(n)
	Glindmeyer, Lefante et al., 2003	Retrospective cohort study	19601	226	x			nd		nd		nd		nd				Workers of U.S. pulp/paper mills with chlorine/chlorine dioxide-exposure (RR 1.3, sign. to new asthma). **Annual incidence 0.16% vs. 0.13% of controls. Additionally 5/447 new asthma cases in group of gassed (highly exposed) people		
	Andersson, Olin et al., 2003	Cross-sectional	385	12	53/345	15.3		nd		nd		nd		nd				*99 workers of paper department and 210 workers of bleaching department exposed to gassing (Cl2/CIO2, also to SO2). HR 5.6, sign., for gassing as a strong risk factor of asthma		
	Gautrin, Leroyer et al., 1995	Cross-sectional	239	9* (3.8)	38/239**	15.9		x***		x***		nd		nd				***38/239 workers from the smelting area with accidental exposures (puffs) over a 3 year period. 11/239 had persistent shortness of breath, *9/239 current asthma; ***LFT/BHR sign. lower/increased in group with >10 puffs compared to other exposed groups 3/239 chronic bronchitis, sign. reduced FEV1, FVC, FEV1/FVC and/or increased BHR in symptomatic or frequently exposed workers (> 10 puffs)		
	Lemière, Malo et al., 1997	Case report	1	1	1/1*		+	1/1		1/1		nd		1/1			1	Worker of water-filtration plant.*Persistent symptoms and steroid medication until 5 months after accidental inhalation; P+		
	Tarlo and Broder, 1989	Case report	1	1	1/1			x*		1/1		x*		nd				Profession not mentioned. Persistent asthmatic symptoms for 6 months; *individual data for LFT/PFT not listed		
	Chatkin, Tarlo et al., 1999	Occupational diseases statistics (WCB), survey	5	5	5/5			(+)**		nd		x*		nd				5/469 asthma claims between mid 1984 and mid 1988 identified by retrospective Review. *All 5 cases accident-related with BD+ and/or BHR+; **1/5 RADS		
	Chester, Gillespie et al., 1969	Cross-sectional	58	2	34/ 58	58.6		2/ 58	3.4	nd		2/2		nd				139 men of a chlorine gas-production plant		
	Schönhofer, Voshaar et al. 1996	Case reports	3	3	3/3		+	nd		3/3		nd		nd				Police men exposed to chlorine gas spill. Respir. symptoms > 2.5 years		
Chlorofluorocarbons (degradation products)	Piirilä, Espo et al., 2003	Case series	7	3	5/7		+	0/7		3/7		nd		nd				6 restaurant employees and 1 refrigerator maintenance worker; refrigerator fluid spill		
Chromate (not specified) [see also cement]																				
	Park, Yu et al., 1994	Case reports	4	4	4/4			nd		3/4		2/2		4/4*		1	2	3	2 metal plating, 1 construction worker, 1 worker of cement industry. *SIC done with potassium dichromate	
	Fernández-Nieto, Quirce et al., 2006	Case reports	4	4	4/4			nd		4/4		nd		4/4*		1	2	1	2 electro-plating employees, 1 cement worker, 1 welder. co-exposure to nickel. *SIC done with potassium dichromate; 2/4 also SIC+ with nickel sulphate(1 dual, 1 late). 2/4 SPT+ with both agents; 1/4 spec.IgE+ with both agents	
	Olaguibel and Basomba, 1989	Case series	5	5	5/5			nd		3/5		nd		5/5*		1	2	2	2 workers of concrete industry, 1 tanning, 1 metal plating, 1 construction worker. *SIC with potassium dichromate	
	Nagasaka, Nakano et al., 1995	Case report	1	1	1/1		+	nd		1/1		nd		1/1			1		1 worker with accidental exposure of a chrome pellet manufacturing plant.1/1 SPT+ with potassium dichromate	

Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)												Remarks			
					WORK-RELATED SYMPTOMS		LFT		BHR		PFT		SIC							
					Asthma	RADS	n/n	%	n/n	%	n/n	%	n/n	%	n/n	%		Reaction		
																		i(n)	l(n)	d(n)
	Joules, 1932	Case report	1	1*	1/1			nd		nd		nd		nd				Chromium plating. Asthma with subsiding dermatitis; *1/1 SPT+ with potassium dichromate		
	Novoy, Habib et al. 1983	Case report	1	1	1/1			1/1		nd		nd		1/1*				Metal plating worker. SIC with chromium sulfate. 1/1 SIC+ to nickel sulfate (late)		
	Bernstein and Merget 2006	Review	20	20	20/20			nd		20/20		nd		20/20		7	4	9		
Cleaning agents	Medina-Ramón, Zock et al., 2005)	Nested case control	40	26*	24/40			nd		7/40	18.0	nd		nd					*24/40 asthma symptoms vs. 0% of controls; *6% COPD vs. 1% of controls; BHR: 18% vs. 3%; bleach-related asthmatic and bronchitic symptoms	
" not specified	(Medina-Ramón, Zock et al. 2003)	Cross-sectional	4521	12.0 vs. 5.0*, **	x*			nd		nd		nd		nd					593 women (13%) employed in domestic cleaning work. Asthma sign. more prevalent than in non-cleaning workers (OR 1.46); *prevalence of work-related respir. symptoms in cleaning workers 12% vs. 5% in non-cleaning workers; **inadequate, because cases not mentioned	
" (not specified)	Kipen, Blume et al., 1994	Case report	1	1	1/1			x*		nd		nd		nd					Profession not mentioned. Low dose irritant-induced asthma; *BD+	
	Tabar, Alvarez, 1998	Case report	1	1	1/1			0/1		1/1		nd		nd					Worker of bottle-filling process with cleaning agents. Low dose irritant-induced asthma. At follow-up 6 months after leaving the workplace cessation of symptoms and BHR	
	Rosenman, Reilly et al., 2003	Occupational diseases statistics (SENSOR)	236	236*	236/236			(+)**		236/236		nd		nd					*236/1915 occup. asthma cases 1993-2001. 189 new-onset asthma including **42 cases of RADS	
	Reinisch, Harrison et al., 2001	Occupational diseases statistics (SENSOR), survey	22	22	22/22			x*		nd		nd		nd					22/430 new-onset asthma in 1993-1996. *Individual data not listed	
Cleansing agents	Murphy, Fairman et al., 1976	Case report	1	1	1/1			1/1		nd		nd		nd					House wife. Symptoms started 6-8 weeks after mixing several cleansing agents to unstop a kitchen drain	
	Mapp, Pozzato et al., 2000	Case report	1	1*	1/1					1/1									*22 year old cleaner with preexisting asthma. Immediate-onset asthma followed by toxic lung oedema	
Cobalt 7440-48-4																				
	Bernstein and Merget, 2006	Review						nd		x		nd		x*					Largest work population in hard metal industry; *SIC+ (mostly late)	
	Kusaka, Yokoyama et al., 1986	Survey	319	18 (5.6)	18/319	5.6		x*		nd		nd		9/9**		2	5	2	Hard metal workers: powder workers (8), sintering (1), shapers (3), grinders (6). *Individual data not listed; **9/18 refused SIC	
	Pisati and Zedda, 1994	Case series with follow-up	9	9	9/9			5/9		9/9		nd		9/9			8	1	9 cobalt industry workers. 3 year follow-up: 1/9 still exposed (with obstructive ventilation pattern), 7/9 BHR+, 1/1 SIC+ (late)	
	Roto, 1980	Case referend study	21	6	21/21			x*		x**		nd		6/15**					Cobalt industry workers. *For a case definition either LFT+ and/or BHR+; **5/6 SIC with cobalt chloride, 1/6 SIC with cobalt dust, individual reaction types not listed	
	Linna, Oksa et al., 2003	Case control	110	15*	15/110			0/110		nd		nd		1/1					110 cobalt production workers. Co-exposure to nickel; *15/110 suspected asthma cases by questionnaire (sign.), results if cases confirmed not clearly indicated	

Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)													Remarks		
					WORK-RELATED SYMPTOMS				LFT		BHR		PFT		SIC					
					Asthma		RADS		n/n	%	n/n	%	n/n	%	n/n	%	Reaction			
					n/n	%	all cases: + or at least one case: (+)	i(n)									l(n)		d(n)	
"	Shirakawa, Kusaka et al., 1989	Case control	8	8	8/8			8/8		7/8		nd		8/8*	2	4	2	Workers in shaping, grinding, sintering. *SIC with cobalt chloride; 4/8 IgE+		
"	Shirakawa, Kusaka et al., 1988	Case series	12	12	12/12			12/12		nd		12/12		12/12*	5	4	3	Workers in grinding, sintering, powdering. *SIC with cobalt chloride; 6/12 spec.IgE+		
"	Shirakawa, Kusaka et al., 1990	Case series	8	8	8/8			8/8*		7/8		nd		8/8**	3	3	2	Hard metal plant workers. **SIC with cobalt chloride; *BHR before SIC with nickel; 6/8 SPT+; 5/8 spec.IgE+; co-sensitization to nickel sulfate		
"	Gheysens, Auwerx et al., 1985	Case reports	3	3	3/3			1/3		2/3		nd		3/3*		1	2	Diamond workers. *SIC done with cobalt powder		
"	Gannon and Burge, 1993	Occupational diseases statistics (SHIELD)	4	4	4/4			nd		nd		x		x				4/500 occup. asthma cases in 1989-1991		
"	Baik, Yoon et al., 1995	Case report	1	1	1/1			0/1		1/1		nd		1/1		1		Worker of glass ware factory. After SIC also systemic response		
"	Wilk-Rivard and Szeinuk, 2001	Case report	1	1	1/1			nd		nd		1/1		nd				Diamond grinder		
"	Krakowiak, Dudek et al., 2005	Case report	1	1	1/1			1/1		1/1				1/1*		1		Diamond polishing disc former. SIC with cobalt chloride; SPT+ with cobalt chloride		
Colophony: see rosin core solder																				
Cotton dust, raw CNT 750 (see also endotoxin)																				
" , "	Christiani, Wang et al., 2001	Prospective cohort	447	(25%-33%)*	*			x**		nd		nd		nd				15-yr follow-up of 447 cotton textile workers. *25-33% chest symptoms; 67/447 dyspnea; **cross-shift FEV1 decline is correlated with Longitudinal FEV1 decline, also FVC decline		
" , "	Rylander, Haglund et al., 1985	Experimental study	15	15	15/15			2/15		nd		nd		x*				Cotton mill workers. *SIC with cotton samples in experimental cardroom, sign. mean FEV1 declines in 2/3 groups (8/15); FEV1 declines and symptoms related to endotoxin concn. No sign. dose-response-relationship between cotton-dust level and individual FEV1 changes		
" , "	Oldenburg and Baur 2003; Oldenburg, Latza et al., 2005	Cross-sectional	150	12** (8.0)	12/150	8.0		x***		12/74**	13.5	x*		nd				Cotton-spinning mill workers. *74/74 subjects with sign. FEV1/FVC% decline cross-shift and current endotoxin exposure-related; **sign. BHR+ increase cross-shift; ***individual data not listed		
" , "	(Kennedy, Christiani et al. 1987)	Cross-sectional	443	*				x*		nd		x**		nd				Cotton workers. *FEV1 reduction and chronic bronchitis sign. related to endotoxin concn.; **FEV1 decline cross-shift, sign. dose response to dust exposure of chronic bronchitis.		
" , yarn	Mengesha and Bekele, 1998	Comparative survey	91	24(26.4)	24/91	26.4		x		nd		nd		nd				Workers of a cotton-yarn factory. 24/91 subjects with asthmatic symptoms (26.4% vs. 8.5% in controls); 25/91 (27.5% vs. 9.5) chronic bronchitis		
" , "	Toren, Balder et al., 1999	Case control	22	22	x*			x*		x*		nd		nd				22/294 occupational asthma cases in 1996 (textile factory workers) with OR 1.9, sign.. *Individual data not listed		
Cutting oil	Kipen, Blume et al., 1994	Case report	1	1	1/1			nd		1/1		nd		nd				Profession not mentioned		

Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)												Remarks			
					WORK-RELATED SYMPTOMS				LFT		BHR		PFT		SIC					
					Asthma		RADS		n/n	%	n/n	%	n/n	%	n/n	%		Reaction		
					n/n	%	all cases: + or at least one case: (+)	i(n)										l(n)	d(n)	
	Hendy, Beattie et al., 1985	Case report	1	1	1/1			1/1		nd		1/1*		1/1**	1			Toolsetter. *PFT over a period of 5 months;**also SIC+ with reodorant (immediate), heated colophony (immediate) and artists' turpentine (immediate)		
3-(Diamino-amino)propylamine [3-(dimethylamino)propylamine] 109-55-7	Sargent, Mitchell et al., 1976	Survey	25	5(20.0)	5/25			x		nd		x*		nd				Assemblers, pressmen and other mould room workers. use of an epoxy resin system; *sign. FEV1 and FEF50 decreases cross-shift and cross-week of slightly exposed and symptomatics		
Diamine, aliphatic + cycloaliphatic (hardener)	Aleva, Aalbers et al., 1991	Case report	1	1	1/1			0/1		1/1		nd		1/1		1		Salesman selling industrial floor-covering materials		
Diazonium tetrafluoroborate 14239-22-6	Luczynska, Hutchcroft et al., 1990	Comparative study	45	2	25/45	55.6		1/2*		nd		nd		2/2*		1	1	Workers manufacturing flourine polymer precursor. 9/43 spec.IgE+; *hospital admission 2/45 for LFT/SIC		
	Graham, Coe et al., 1981	Case report	1	1	1/1			1/1		1/1		nd		1/1*		1		Production of photocopy paper. *SIC with diazonium chloride		
Dichlorodiethyl sulfide [mustard gas] +505-60-2	Emad and Rezaian, 1997	Cross-sectional	197	15*(7.6)	197/197			15/197		nd		nd		nd				Iranian veterans. Single massive exposure 10 years ago; 116 with chronic bronchitis, *89 COPD cases		
Dichlorvos (organophosphate)	Deschamps, Questel et al., 1994	Case report	1	1	1/1		+	1/1		1/1		nd		nd				Cook. Persistent asthma		
Diesel exhaust	Wade and Newman, 1993	Case reports	3	3	3/3*		+	3/3		3/3		nd		nd				Railroad workers. RADS after a high exposure over several hours in second locomotive units 2/3 "reversible restrictive" ventilation pattern; twice hospital administration after high exposure		
	Henneberger, Derk et al., 2003	Occupational diseases statistics (SENSOR)	7	7	7/7		+	x		x		nd		nd				7/424 occup. asthma cases between 1993-1995 (7/123 RADS)		
	Hart, Laden et al., 2006		536	*75	nd**			nd**		nd**		nd**		nd**				**COPD mortality cases of railroad workers. *75/536 conductors and engineers with exposure = 16 years of operating trains had a sign. increase inCOPD mortality (OR 1.35 (1.17-2.39)); sign. dose-response relationship		
Diethanolamine 111-42-2	Piipari, Tuppurainen et al., 1998	Case report	1	1	1/1			nd		1/1		1/1*		1/1		1		Metal worker. *PFT for 12 days		
2-Diethylaminoethanol [diethyl aminoethanol] 100-37-8	Gadon, Melius et al., 1994	Case series	14	7	14/14			4/12		nd		10/11		nd				Steam leak in heating system of a State office building. 7 asthma cases and 7 suspected asthma cases		
2-Dimethylaminoethanol [dimethyl ethanolamine] 108-01-0	Vallières, Cockcroft et al., 1977	Case report	1	1	1/1			0/1		1/1		1/1		1/1			1	Spray painter		
Diinrogen tetroxide [dinitrogen tetroxide] 10544-72-6	Conrad, Lo et al., 1998	Case series	234	6	6/6		+	4/6		6/6		nd		nd				6/234 symptomatics developed RADS after massive release from a railroad tanker; 207/234 shortness of breath, 151/231 wheezing after massive exposure		
ECG ink	Keskinen, Nordman et al., 1981	Case report	1	1	1/1			nd		1/1		nd		1/1			1	Laboratory nurse. also SIC+ with methyl blue (immediate) and Patent Blau V; SPT+ to methyl blue, Patent Blau V, methylene blue		
	Rodenstein and Stanescu, 1982	Case report	1	1	1/1			nd		1/1		nd		1/1		1		Technician. SIC+ also with methyl blue (immediate)		
Endotoxin (see also cotton dust, swine confinement, poultry confinement, house dust)	Milton, Wypij et al., 1996	Cross-sectional	37	6*	14/37			x**		nd		x***		nd				Maintenance and production workers of fiberglass manufacturing.Co-exposure to phenolics and formaldehyde. *6/37 new-onset asthma; **FEV1 and FVC reduction exposure-related; ***endotoxin-related PEF decline cross-shift with PFT over 10 days		

Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)												Remarks						
					WORK-RELATED SYMPTOMS				LFT		BHR		PFT		SIC								
					Asthma		RADS		n/n	%	n/n	%	n/n	%	n/n	%		Reaction					
					n/n	%	all cases: + or at least one case: (+)	i(n)										l(n)	d(n)				
	Reinisch, Harrison et al., 2001	Occupational diseases statistics (SENSOR), survey	8	8	8/8					x*		nd		nd		nd							8/430 new-onset asthma between 1993-1996. *Individual data not listed
Environmental tobacco smoke 1-09-0																							
	IARC, 2004	Critical Review and evaluation of evidence																					Suggested evidence of a causal relation
	Jaakkola, Piipari et al., 2003	Incident case control	239		x**				x**		x**		x**,***		nd								*49,2% of asthma attributable to ETS (workplace + home) during the past year (among 239 ETS-exposed), 8% attributable fraction for the whole working-age population (n=487), resp. in asthmatics lifetime workplace ETS sign. increased, OR 2.16, > 150 cigarette-years adjusted OR 2.21, in total population for lifetime workplace ETS OR 1.84; **no individual data listed; ***PFT for 2 weeks
	Greer, Abbey et al., 1993	Epidemiological		45	x**				nd		nd		nd		nd								Cohort of n=3914 in 1977 and again in 1987. ETS in the workplace increases asthma sign., OR 1.45; *45 subjects with new onset asthma between 1977 and 1987; **individual data not listed
	Blanc, Ellbjär et al., 1999	Cross-sectional; survey (ECHRHS)	1562	61 (3.9)	61/1562	3.9			x*		x*		nd		nd								Population-based sample of ECHRHS Respiratory work disability; sign. increased asthma PR for workplace ETS OR 1.8; workplace ETS associated with BHR+ and WRS; *individual data not listed
	Janson, Chinn et al., 2001	Cross-sectional	7882		x*				x*		x*		nd		nd								Subjects of 36 centres in 16 countries. ETS in the workplace associated with respir. symptoms and current asthma OR 1.9; BHR+ dose-related trend with ETS; *individual data not listed
	Flodin, Jönsson et al., 1995	Population-based case-referent study			x				x		x		nd		nd								ETS in the workplaces increased asthma cases, OR 1.5 (sign.)
	Radon, Büsching et al., 2002	Cross-sectional	1890		x				nd		nd		nd		nd								Sample of population-based ECHRHS. Increased asthma: OR for ETS at home and in the workplace 1.5; chronic bronchitis (OR 1.9) sign. increased
	Eisner, Balmes et al., 2005	Cross-sectional	2113		x				42/47*		nd		nd		nd								Population-based sample. COPD sign. increased (OR for ≥ 23 yrs workplace ETS 1.36); population-attributable fraction of ETS exposure at work = 7%; subpopulation n=47: *42/47(89.4%) obstructive lung pattern.
EPO 60 142443-98	Lambourn, Hayes et al., 1992	Case report	1	1	1/1				0/1		0/1		nd		1/1								Mould maker and fitter
Epoxy resin system; see also 3-(dimethylamino) propylamine 109-55-7																							
Ethylenediamine [ethylene diamine] 107-15-3	Gelfand, 1963	Case series	7	7	7/7				nd		nd		nd		7/7*								6 shellac handlers and 1 rubber industry worker. *Individual reaction types not listed
	Hagmar, Bellander et al., 1982	Survey	3	3	3/3*				x**		1/3		nd		nd								Chemical workers; co-exposure to other amines. *Asthma type according to onset of symptoms: 1 late, 2 dual; **individual data not listed

Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)												Remarks			
					WORK-RELATED SYMPTOMS				LFT		BHR		PFT		SIC					
					Asthma		RADS		n/n	%	n/n	%	n/n	%	n/n	%		Reaction		
					n/n	%	all cases: + or at least one case: (+)	i(n)										l(n)	d(n)	
*	Nakazawa and Matsui, 1990	Case reports	2	2	2/2			0/2		2/2		nd		2/2			2	2 chemical workers. 2/2 i.c.+		
*	Lam and Chan-Yeung, 1980	Case report	1	1	1/1			0/1		1/1		nd		1/1			1	photography laboratory worker. SIC+ also with sulphur dioxide (immediate)		
Ethylene oxide 75-21-8	Deschamps, Rosenberg et al.,	Case report	1	1	1/1			1/1		1/1		nd		nd				worker of railway station		
*	Dugue, Faraut et al., 1991	Case report	1	1	1/1			nd		nd		nd		1/1*				factory worker. 1/3 spec.IgE+; *individual reaction type not listed		
Farming																				
, (various)	Dosman, Graham et al., 1987	Survey	1824	607(33.3)	607/1824			x		nd		nd		nd				farmers. 607 dyspnea, 500 wheezing; *sign. declines of FEV ₁ , FVC, FEV ₁ /VCV with individual data not listed		
*, *	Walusiak, Krawczyk-Adamus et al., 2004	Case control	100	38(38.0)	100/100			x*		x*		nd		38/100		23	15	Polish farmers. SIC with grain dust, animal epidermis, furs and feathers! sign. risk factors of respir. symptoms, cereal farming, animal breeding; 47/100 SPT+; *individual data not listed		
*, *	Eduard, Douwes et al., 2004	Survey	1614	*	x*			nd		nd		nd		nd				Norwegian farmers. *asthma sign. elevated in cattle and pig farmers (OR 1.8 or 1.6); exposure to endotoxines, fungal spores and ammonia pos. associated with non-allergic asthma		
*, *	Hoppin, Umbach et al., 2003; Hoppin, Umbach et al., 2004	Survey (Agricultural Health Study 1994-1997)	20468/ 20898		3838*/ 20 898			nd		nd		nd		nd				20 468, and 20 898 farmers (pesticide applicators). 3838 wheezing, OR for wheeze 1.26 (dairy), and 1.70 (eggs); wheezing sign. dose-response-related for poultry and number of livestock; OR for driving diesel tractor: 1.31 (sign.), for solvents 1.16-1.33 (sign.)		
*, animals (pig, beef/veal, dairy, poultry)	Monso, Riu et al., 2004	Cross-sectional	105	18(17.1)	58/105			11/105		nd		nd		nd				58/105 participants of sample of European never-smoking farmers' study reported wheezing. 18 COPD; COPD sign. dust-related		
*, *	Portengen, Preller et al., 2005	Cross-sectional	81	36(44.4)	81/81			x		36/78*	46.1	nd		nd				Pig farmers. *sign. increased BHR (46% vs. 17% of controls); FEV1 sign. reduced; endotoxin-associated with BHR or lower lung function		
Floor sealant (aromatic hydrocarbons) (1/D)	Brooks, Weiss et al., 1985	Case report	1	1	1/1			+		0/1		1/1		nd				Grocery clerk. RADS for 14 months		
Formaldehyde (gas, dust) 50-00-0																				
*	Nordman, Keskinen et al., 1985	Survey with case reports	230	12	230/230			2/5*		29/ 209				12/230		6	4	2	230 formaldehyde workers.*individual data only listed in case reports (5 subjects)	
*	Burge, Harries et al., 1985	Case series	15	7	5/15			nd		4/14		nd		7/ 15		4	1	2	1 plastic moulder, 1 printer, 1 formaldehyde-manufacturer, 1 medicine packer, 1 farmworker, 6 printers/laminators of flexible packaging, 1 laminated tray worker, 2 core shop workers; 9/15 subjects co-exposed to isocyanates	
*	Lemière, Desjardins et al., 1995	Case reports	3	3	3/3			0/3		3/3		3/3		3/3		1	2		1 chemist, 1 carpenter, 1 wood chips factory worker	
*	Porter, 1975	Case report	1	1	1/1			1/1		nd		nd		nd					Neurology resident. P+	
*	Hendrick and Lane, 1975	Case report	1	1	1/1			nd		nd		nd		1/1			1		Nurse	

Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)														Remarks	
					WORK-RELATED SYMPTOMS				LFT		BHR		PFT		SIC					
					Asthma		RADS		n/n	%	n/n	%	n/n	%	n/n	%	Reaction			
					n/n	%	all cases: + or at least one case: (+)	i(n)									l(n)	d(n)		
	Kim, Song et al., 2001	Case report	1	1	1/1			1/1		1/1		nd		1/1*			1	Textile factory worker. *Workplace challenge; average workplace-conc.: 6 ppm, several short-term-peaks of 0.12-0.13 ppm		
	Henneberger, Derk et al., 2003	Occupational disease statistics (SENSOR)	24	24	24/24			x		x		nd		nd				24/424 asthma cases in 1993-1995		
	Piipari and Keskinen, 2005	Case reports	4	4	4/4			nd		nd		4/4*		4/4*				4/306 occup. asthma cases in 2002. *Individual data not listed		
Freon (heated)	Malo, Gagnon et al., 1984	Case report	1	1	1/1			0/1		1/1		nd		1/1			1	Refrigerator company worker. Asthma aggravation at work since two years		
Fumigating agent	Brooks, Weiss et al., 1985	Case report	1	1	1/1			1/1		1/1		nd		nd				Housewife fumigating her kitchen. Duration of symptoms for 6 months		
Furan-based binder	Cockcroft, Cartier et al., 1980	Case report	1	1	1/1			1/1		1/1		1/1		1/1*			1	Mould maker. *3 SICs+ (late): furfuryl alcohol combined with acid catalyst, sulfuric acid, or butyl alcohol		
Glutaraldehyde [glutaral] 11-30-8																				
	Jachuck and Bound, 1989	Survey	9	1*(11.1)	1/9*			nd		nd		nd		nd				Employees of endoscopy unit. *1 subject with breathlessness		
	Curran, Burge et al., 1996	Cross-sectional	20	13*	13/20	65.0		nd		nd		nd		7/8*				Hospital employees. *5/13 SIC not done, individual data on reaction type not listed; 2/11 occupational asthma cases IgE+; 3/13 false positive IgE, results at high total IgE		
	Corrado, Osman et al., 1986	Case reports	4	1	4/4			0/4		nd		nd		1/4*			1	Nurses of endoscopy units. *SIC with alkaline glutaraldehyde		
	Gannon and Burge, 1993	Occupational diseases statistics (SHIELD)	6	6	6/6			nd		nd		x		x				6/500 asthma cases in 1989-1991		
	Gannon, Bright et al., 1995	Case series	7	7	7/7			1/7		3/7		7/7		7/8			5	2	Workers of endoscopy and X-ray departments	
	Ross, Keynes et al., 1997	Case series	74	74	x*			x*		x*		x*		x*					74/1765 physician-diagnosed asthma cases in 1996	
Grain dust																				
	Chan-Yeung, Schulzer et al., 1980	Comparative survey	610		x*			x*		nd		x*		nd					Workers of grain elevator terminals. Increased chest symptoms; cross-shift and -week decrease in FEV1 and FVC (FEV1 drop of > 10% in 4.3% of the survey)	
	Schwartz, Thorne et al., 1995	Population based cross-sectional	410	58(14.1)	58	14.1		x*		45/410	11.0	nd		nd					Grain workers. *FEV1 sign. reduced and sign. endotoxin-dose-related	
	Toren, Balder et al., 1999	Case control	7	7	x*			x*		x*		nd		nd					7/294 occup. asthma cases in 1996. OR 4.2, sign.; *individual data not listed	
	Baur, Preisser et al., 2003	Case reports	2	2	2/2			2/2		2/2		nd		2/2*			2		1 farmer, 1 manager of grain ware house (SIC with wheat dust); *SIC in workplace with rye dust	
	Chan-Yeung, Enarson et al., 1992b	Review			nd			nd		nd		nd		nd					Cross-shift and chronic decreases in lung function exposure-related	
	Williams, Skoulas et al., 1964	Survey	502	35	35/ 502			nd		nd		nd		nd					Grain elevator industry workers. 78 with work-related breathlessness; 35 (7.0%) wheezing and breathlessness without cough, 20 (4.0) with cough, breathlessness and wheezing	
	Skoulas, Williams et al., 1964	Survey	51	31	31*	61.0		x*		nd		nd		nd					51 grain elevator workers out of 175 with respir. symptoms. *Most severe (n=31) symptoms associated with sign. FEV1 decline; 31/51 SPT(settled barley dust)+ (61% vs. 32%of controls)	

Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)													Remarks		
					WORK-RELATED SYMPTOMS				LFT		BHR		PFT		SIC					
					Asthma		RADS		n/n	%	n/n	%	n/n	%	n/n	%	Reaction			
					n/n	%	all cases: + or at least one case: (+)	i(n)									l(n)		d(n)	
green coffee (dust)	(Jones, Hughes et al. 1982)	Cross-sectional	372	7 (1.8)	10/372	2.6			x*		nd		nd		nd				7/372 new onset asthma; *exposure-time-related FEV1 decline; 35/362 SPT+; 24/331 IgE+	
"	(Zuskin, Kanceljak et al. 1985)	Case series	9	4	9/9				2/9		nd		nd		4/9		4		9 coffee industry workers; SIC done with aqueous extract; 5/9 symptomatics SPT+; 4/9 BD+	
Hairdressing chemicals	Piipari and Keskinen, 2005	Occupational diseases statistics Finland	6	6	x*				nd		nd		6/6*		6/6*				6/306 occupational asthma cases in 2002. *Individual data not listed	
Hexachlorophene	Nagy and Orosz, 1984	Case report	1	1	1/1				nd		1/1		nd		1/1			1	Children's nurse	
Hexamethylene tetramine 100-97-0	Gamble, McMichael et al., 1976	Comparative survey	52	8 (15.4)	8/52	15.4			x*		nd		x		nd				Workers of tire manufacturing plant. 8/52 wheezing, 14/52 chest tightness, 10/52 dyspnea; *LFT not sign. reduced	
"	Gelfand, 1963	Case series	7	7	7/7				nd		nd		nd		7/7*				Laquer handlers with asthma. 7/7 SPT+	
Hydrazine 302-01-2	Brooks, Weiss et al., 1985	Case report	1	1	1/1				+	1/1	1/1		nd		nd				Power plant utility worker. Massive exposure to pouring of 35% solution; symptoms for 34 months	
Hydrogen chloride [hydrochloric acid] 7647-01-0	Promisloff, Phan et al., 1990	Case reports	3	3	3/3				+	0/3	3/3		nd		nd				Members of police department. Massive exposure by truck accident	
"	Tarlo and Broder, 1989	Case report	1	1	1/1				x*		1/1		x*		nd				Profession not mentioned. Asthmatic symptoms persistent for 2 years	
"	Boulet, 1988	Case report	1	1	1/1				+	0/1	1/1		nd		nd				Profession not mentioned. BD+	
Hydrogen fluoride , as F [hydrofluoric acid] 7664-39-3	Franzblau and Sahakian, 2003	Case report	1	1	1/1				+	1/1	1/1		nd		nd				Cleaning with HF containing rust stain remover once. Asthmatic symptoms persistent for > 3 years	
Iridium salt	Bergman, Svedberg et al., 1995	Case report	1	1	1/1				x*		x*		nd		nd				Worker of electrochemical factory. SPT+ (immediate); individual data not listed	
Isocyanates, Isocyanurate																				
" , various (HDI, MDI, TDI)	Piirilä, Nordman et al., 2000	Case reports with long term follow-up	244	236/244	244/244				x*		3/3**		14/14**		219/219**		101	118	Asthma cases diagnosed 1976-1992. Mainly exposed to polyurethane foams production or spray painting; *individual data not listed; **case diagnosed by BHR or PFT or SIC (mainly); 91 patients re-examined in 1995 with sign. impairment of FEV1	
" , "	Baur, Dewair et al., 1984	Case series/cross-sectional	621	179 (28.8)	247/621	39.8			179/621	28.8	nd		nd		nd				Isocyanate workers of different companies. 26/247 symptomatics exposure-related COPD; spec.IgE+ (14% symptomatic vs. 0.3% asymptomatic isocyanate workers); 26.4% (14/53) symptomatics SPT+ vs. 0% (n=150) asymptomatics	
" , "	O'Brien, Harries et al., 1979	Case series	24	16	24/24				nd		12/24		nd		16/24		5	11	Profession not mentioned. 8/16 SIC+ also SIC+ with MDI (4 immediate, 4 dual), 3/8 SIC+ with 3rd agent HDI (1 immediate, 2 late)	
" , "	Cartier, Grammer et al., 1989	Case series	62	29	62/62				14/62		46/62		nd		29/62		7	15	7	Workers of foam industry (spray painters and others. 8/29 SIC+ with spec.IgE+ and
" , "	Ross, Keynes et al., 1997	Occupational diseases statistics (SWORD)	310	310	x*				x*		x*		x*		x*					310/1765 physician-diagnosed asthma cases in 1996
" , "	Piipari and Keskinen, 2005	Occupational diseases statistics Finland	6	6	6/6*				nd		nd		6/6*		6/6*					6/306 occupational asthma cases in 2002. *Individual data not listed

Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)												Remarks			
					WORK-RELATED SYMPTOMS		LFT		BHR		PFT		SIC							
					Asthma	RADS									Reaction					
															n/n	%		all cases: + or at least one case: (+)	n/n	%
"	Latzka and Baur, 2005	Occupational diseases statistics	54	54	x*			x*		nd		nd		x*						54/835 occupational asthma cases in 2003 (54/210 irritant asthma cases). *Individual data not listed
"	Chatkin, Tarlo et al., 1999	Occupational diseases statistics (WCB), Survey	9	9	9/9		(+)**	nd		9/9*		nd		nd						9/465 asthma claims between mid 1984 and mid 1988 identified by retrospective Review. *9/9 BD+ and/or BHR+; **2/9 RADS
"	Tarlo, Liss et al., 2002	Retrospective review of new OA claims of occupational diseases statistics, (WCB) between 1980-1993	425	425	x*			x*		x*		nd		x*						Review of Ontario Workers' compensation board. Diisocyanates represented 50% of all OA claims. *Individual data not listed
"	Diphenylmethane diisocyanate [MDI] 5873-54-1	Bernstein, Korbee et al., 1993	Cross-sectional	243	3 (1.2)	43/243*			nd		nd		7/43**		nd					Workers of urethane mold plant. *Diagnosis of asthma by questionnaire: 9 OA, 26 irritant respiratory symptoms, 4 non-OA; **3/9 with OA, 2/4 with non-OA and 2/23 controls PFT+ (for 2 weeks); 3/9 OA, 2/4 non-OA, 2/23 free of symptoms. At follow-up, physician diagnosed OA 3/7(BHR 6/7, S1/7)
"	Liss, Bernstein et al., 1988	Comparative survey	26	7 (26.9)	7/26			x*		nd		x		nd						Current mould and core-room workers. *Sign. FEV1 decrease cross-shift; 1/26 IgE+; * individual data not listed
"	Zammit-Tabona, Sherkin et al., 1983	Case series	78	6	12/78			5/11		9/11*		nd		6/11			4	2		Foundry workers. 0/6 with SIC+ spec.IgE-
"	Tse, Johnson et al., 1985	Cross-sectional	78	12 (15.4)	12/78			nd		12/78		nd		nd						Foundry workers. 2/78 spec. IgE+
"	Woellner, Hall et al., 1997	Case series	18	15	18/18			x*		15/16		nd		nd						Workers of a wood products plant. *Individual data not listed
"	Mapp, Boschetto et al., 1988	Case series	162	93	162/162			15/93		93/162*		nd		93/162		27	32	34		Profession not mentioned. *BHR sign. lower in 93 SIC+ vs. 69 SIC-
"	Perfetti, Brame et al., 2003	Case report	1	1	1/1		+	1/1		1/1		nd		1/1					1	Spray painter. RADS after accidental spill
"	prepolymers	Vandenplas, Malo et al., 1993	Case series	8	2	8/8			0/8		1/8		nd		2/8*					Workers of woodchip board manufacturing; 8/8 SIC+ with sign. declines of FEV1 and FVC, only *2/8 with sign. obstructive pattern (no individual reaction type given); 7/8 spec IgE+; 4/8 BD+
"	Hexamethylene diisocyanate [HDI]; plus isodurane diisocyanate 822-06-0	Lemière, Malo et al., 1996a	Case report	1	1	1/1		+	0/1		1/1		nd		0/1					Mechanic; co-exposure to several organic solvents; P+
"	HDI biuret plus 4035-89-6	(Vandenplas, Cartier et al. 1993)	Case series	20	10	20/20			6/20		15/20		nd		10/20*		4	2	4	Profession not mentioned; *SIC with monomer and prepolymers of HDI (4 only with HDI prepolymers, 1 only with HDI monomer, 5 with both)
"	Belin, Hjortsberg et al., 1981	Case report	1	1	1/1*			1/1		1/1		nd		nd						Gasoline station manager; spec IgE+; *severe asthma symptoms after exposed to high concn of car (polyurethane) paint
"	3-Isocyanatomethyl-3,5,5-trimethylcyclohexyl isocyanate [isophorone diisocyanate, IPDI] 4098-71-9	Clarke and Aldons, 1981	Case report	1	1	1/1			1/1		nd		nd		1/1*				1	Spray painter; asthma associated with abnormal chest X-ray (interstitial infiltration); *SIC by increasing exposure on following days
"	Methyl isocyanate [MIC] 624-83-9	Kamat, Patel et al., 1992	Longitudinal study, follow-up of cases	113	97	97/97			x*		nd		nd		nd					Persistently symptomatic residents exposed to MIC at Bhopal tragedy 1984. 97/113 dyspnea; 32% with lung function fluctuations; *sign. FEV1/FVC decline after 18 months, also gradual FEF25-75 decline over 24 months; predominating restrictive ventilation patterns; 97/97 BD+;

Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)												Remarks			
					WORK-RELATED SYMPTOMS				LFT		BHR		PFT		SIC					
					Asthma		RADS		n/n	%	n/n	%	n/n	%	n/n	%		Reaction		
					n/n	%	all cases: + or at least one case: (+)	i(n)										l(n)	d(n)	
" , "	Kamat, Mahashur et al., 1985	Case series	82	24	82/82			24/82*		nd		nd		nd				Exposed residents at bhopal tragedy. Predominating restrictive ventilation patterns (64/82); 24/82 BD+;		
	Vijayan and Sankaran, 1996	case series	54	17	54/54			17/54		nd		nd		nd				Bhopal tragedy. 17 subjects investigated symptomatic and moderately or severely exposed subjects with obstructive lung pattern; FEV1/FVC sign. negatively related to exposure and to BAL neutrophils (P+)		
" , "	Mehta, Mehta et al., 1990	Review	41	(11)	nd			nd		nd		nd		nd				Bhopal tragedy; Mainly mixed respiratory ailments		
" , 1,5-Naphthylene diisocyanate [NDI] 3173-72-6	Fuortes, Kiken et al., 1995	Survey	46	13*	17/46			x*		2/3	66.6	3/8	37.5	nd				Workers of wheel factory employed in production and administrative section. Co exposure to MDI; *7 cases reported to NIOSH and 6 additional cases identified by questionnaire; "individual data not listed		
" , "	Baur, Chen et al., 2001	Case reports	6	3	5/6			nd		3/5*		nd		3/5*	1	1	1	1 elastomer-, 5 synthetic resin production workers. 1/6 rhinitis; *SIC+ workers also BHR+		
" , "	Harries, Burge et al., 1979	Case reports	3	3	3/3			2/3		1/3		nd		3/3		2	1	1 chemist, 1 foreman, 1 polyurethane caster of plastic mould factory		
" , Polymethylene polyphenyl isocyanate 9016-87-9	Séguin, Allard et al., 1987	Survey	42	6 (11.8)	14/42	33.3		4/10	40.0	nd		nd		6/10	60		2	4	Paint shop workers	
" , Toluene diisocyanate, TDI 2.4: 584-84-9; 2.6:91-08-7	Ott, Klees et al., 2000	cohort study	313	19	x*			x*		nd		nd		nd					TDI production employees between 1967-1992.*Individual data not listed	
" , "	Marabini, Brugnamini et al., 1994	Case series with follow-up	40	40	x*			x**		nd		nd		40/40	9	25	6	Profession not mentioned. *Individual data not listed; **at follow-up 4-8 years after first diagnosis sign. decline of FEV1 and FVC of workers with SIC+ late		
" , "	Paggiaro, Bacci et al., 1990	Case series with follow-up	10	10	10/10			5/10		10/10				10/10		4	6	Profession not mentioned. At follow-up 3-39 months after cessation no sign. difference in FEV1 and BHR. Biopsy of bronchial mucosa with inflammatory changes in 8/8 (P+)		
" , "	Butcher, Jones et al., 1977	prospective cohort	103	9	26/89			x**		8/11				9/13	5	*	*	103 TDI workers of Longitudinal study 1973-1975. 89/103 became continuously/intermittently exposed; *4/9 SIC reaction type late or dual; **LFT not sign.		
" , "	Luo, Nelsen et al., 1990	Case reports	2	2	2/2			1/2		2/2		nd		nd					Police officers exposed to spill. Persistent asthmatic symptoms > 7years with considerable improvement	
" , "	Karol, Tollerud et al., 1994	Case series	63	34	63/63			nd		32/34*		nd		34/63	12	13	9	63 asthmatic isocyanate workers.*BHR+ associated with SIC+		
" , "	Axford, McKerrow et al., 1976	Case series with 4 year follow-up	35	30	30/35			(+)*	x**	nd		nd		nd					35 firemen at accidental exposure. 20/35 persistent respiratory symptoms 4 years later with small **FEV1/FVC decline; *8/35 chest tightness during the fire (immediate), additionally 22 within 8 hours to 3 weeks (delayed); 7/33 asthmatic symptoms after 6 months, 2/32 after 44 months.	
" , "	Tarlo and Broder, 1989	Case report	1	1	1/1			+	x*	1/1		x*		nd					RADS lasting for 1.5 years	
" , "	Chatkin, Tarlo et al., 1999	Occupational diseases statistics (WCB)	5	5	5/5			+	nd	x*		nd		2/5**					5/469 asthma claims between mid 1984 and mid 1988 identified by retrospective Review; 5/5 BD+ and/or BHR+; for SIC individual reaction type not listed	
" , "	Vandenplas, Cartier et al., 1992	Case reports	2	2	2/2			1/2		2/2		nd		2/2*		2			Workers of wood roof industry. *SIC with TDI prepolymers, TDI monomers negative	

Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)												Remarks			
					WORK-RELATED SYMPTOMS				LFT		BHR		PFT		SIC					
					Asthma		RADS		n/n	%	n/n	%	n/n	%	n/n	%		Reaction		
					n/n	%	all cases: + or at least one case: (+)	i(n)										l(n)	d(n)	
	Wisniewski, Liu et al., 2005	Systemic review															Accelerated loss of FEV1 within 4-year-period. Dose-response-relationship remains unclear			
*, Triglycidil isocyanurate 2451-62-1	Piirilä, Estlander et al., 1997a	Case report	1	1	1/1			nd		1/1		1/1		1/1	1		Laboratory technician. Spec.IgE+			
Isothiazolinone 55965-84-9	Bourke, Convery et al., 1997	Case report	1	1	1/1			1/1		1/1		1/1*		nd			Chemical plant operator; *PFT on 3 consecutive days with I. (asthma onset late)			
Lauryl dimethyl benzyl ammonium chloride 139-07-1	Burge and Richardson, 1994	Case report	1	1	1/1			nd		1/1		1/1		1/1	1		Pharmacist			
Lubricants (not specified)	Henneberger, Derk et al., 2003	Occupational diseases statistics (SENSOR)	46	46	46/46			x		x		nd		nd			46/424 occup. asthma cases in 1993-1995			
*	Latzka and Baur, 2005	Occupational diseases statistics	8	8	x*			x*		nd		nd		x*			8/835 occupational asthma cases in 2004. 3 classified as allergic asthma, 5 as irritant asthma (total irritant asthma cases = 210); *individual data not listed			
Metal coat remover (coating removing chemical)	Brooks, Weiss et al., 1985	Case report	1	1	1/1			+		1/1		1/1		nd			Remover of coatings from metals and plastics. RADS for 39 months			
Metal oxide fume	(Dube, Puruckharr et al. 2002)	Case report	1	1	1/1			+		1/1		nd		nd			Metal industry worker. RADS associated with metal fume fever			
Metal working fluids [MWF]	Zacharisen, Kadambi et al., 1998	Survey	30	12 (40.0)	30/30	100.0			5/30	16.7	12/30	40.0		nd			30 workers of an automobile engine manufacturing plant: 12 OA, 6 industrial bronchitis, 7 hypersensitivity pneumonitis			
Metam sodium 137-42-8	Cone, Wugofski et al. 1994	Retrospective case series	197	20 (10.1)	48/197	24.3			(+)*	15/30	50.0	23/23	100.0	nd			Massive spill of pesticide, 197 out of c. 3,000 exposed subjects medically evaluated. 20 new onset asthma (*17/20 RADS) plus 10 work-aggravated asthma			
Methylmercaptan 74-93-1	Chatkin, Tarlo et al., 1999	Occupational diseases statistics (WCB)	1	1	nd			+		nd		x*		nd			1/469 asthma claims between mid 1984 and mid 1988 identified by retrospective Review exposed; *1/1 BD+ and/or BHR+			
Monoethanolamine 141-43-5	Gelfand, 1963	Case series	14	10	14/14					nd		nd		nd	10/10*		Subjects, exposed in the beauty culture industry, co-exposure to ammonium-thioglycolate and ethylene diamine; *individual data not listed			
Mustard gas (see dichlorodiethyl sulfide)																				
N-methylmorpholine 109-02-4	Belin, Audunsson et al., 1983	Comparative survey	48	13 (27.1)	13/48					nd		8/44		nd			Polyurethane foam industry workers; 13/48 wheezing and dyspnea (27 vs. 17% of controls); BHR sign. increased; co exposure to 1,4-diaza-bicyclo-(2,2,2) octane and to isocyanates			
Nickel sulphate ? anhydrous 7786-81-4 ? hexahydrate 10101-97-0	Block and Yeung, 1982	Case report	1	1	1/1					0/1		1/1		1/1	1		Metal polisher. SPT+; contact dermatitis			
*	Malo, Cartier et al., 1982	Case report	1	1	1/1					0/1		0/1		1/1	1		Metal plating factory worker. **PFT for 2 weeks; spec.IgE+			
*	Estlander, Kanerva et al., 1993	Case report	1	1	1/1					0/1		0/1		1/1	1		Manual grinding of metal casting. Co-exposure to chromium; spec. IgE+; allergic contact dermatitis			
*	Novey, Habib et al., 1983	Case report	1	1	1/1					1/1		nd		nd	1		Metal plating worker. Co-exposure to chromium; spec.IgE+			
*	McConnell, Fink et al., 1973	Case report	1	1	1/1					nd		nd		nd	1		Metal plating worker. SPT+; contact dermatitis			
Ninhydrin 485-47-2	Piirilä, Estlander et al., 1997b	Case report	1	1	1/1					1/1		1/1		1/1	1		Forensic laboratory worker; preceding rhinitis; spec.IgE+ (low); SPT+			
Nitrogen trichloride	Thickett, McCoach et al., 2002	Case reports	3	3	3/3					1/3		0/3		2/2*	3/3	2	1	2 life guards of indoor swimming pools, 1 swimming teacher. Latency periods 10-14 years; *PFT over 4 weeks		
Paint (fumes)	Tarlo and Broder, 1989	Case report	1	1	1/1					x*		1/1		x*	nd		Consecutive worker; asthmatic symptoms persistent for 3 months			

Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)												Remarks		
					WORK-RELATED SYMPTOMS		LFT		BHR		PFT		SIC						
					Asthma	RADS									Reaction				
															n/n	%		i(n)	l(n)
Palladium 7440-05-3	Daenen, Rogiers et al., 1999	Case report	1	1	1/1			1/1		1/1		nd		1/1		1			Electric industry worker. SPT+
Paper dust A111	Toren, Balder et al., 1999	Case control	32	32	x*			x*		x*		nd		nd					32/294 occup. asthma cases in 1996. OR 2.1, sign.;"individual data not listed
Paraphenyldiamine 106-50-3	Silberman and Sorrell (1959)	Case series	80	37	59/80			nd		nd		nd		*37/50					80 fur industry workers; patch test (2% PPD)+: 12/33; 18/80 contact dermatitis; individual reaction type not listed
Perfume agents (research lab)	Kipen, Blume et al., 1994	Case report	1	1	1/1			nd		nd		1/1*		nd					Profession not mentioned. "Low dose RADS"; *BD+
"	Baur, Schneider et al., 1999	Case report	1	1	1/1			1/1		nd		nd		1/1*		1			Saleswoman. "SIC with perfume "Must de Cartier". SPT- and spec. IgE-
Persulphate																			
" , not specified	Pankow, Hein et al., 1989	Case report	1	1	1/1			*		1/1		nd		1/1		1			Hairdresser. "LFT could not be finished, because of incompliance
" , "	Moscato, Pignatti et al., 2005	Case series	47	21	47/47			0/21		12/21**	57.1	nd		21/47*	57.0	4	14	3	Hairdressers. SIC with ammonium persulfate; 11/21 rhinitis; 8/21 dermatitis; 6/21 BD+; **BHR+ sign. associated with SIC+
" , Sodium persulfate 7775-27-1	Parra, Igea et al., 1992	Case report	1	1	1/1			nd		1/1		nd		1/1			1		Hairdresser; SPT+, spec.IgE-
" , Dipotassium peroxy-peroxodisulfate [potassium persulfate] 7727-21-1	Muñoz, Cruz et al., 2003	Follow-up of cases	8	7	8/8			5/6		7/8		nd		7/7		1	5	1	3 cosmetic industry workers, 5 hairdressers
" , Diammonium peroxodisulfate [ammonium persulfate] 7727-54-0	Schwaiblmair, Vogelmeier et al., 1997	Survey	55	9 (16.4)	38/55	69.1		3/55		32/53		nd		9/41	28.0	5		4	Hairdressers; 13/54 SPT+
" , "	Blainey, Ollier et al., 1986	Survey	23	4 (17.4)	7/23	30.4		0/23		6/23		1/12		4/9				4	Hairdressers. SIC with bleach, 3/4 SIC+ also challenged with potassium peroxodisulfate (3/3 late); 1/23 SPT+ Chemical factory workers
" , "	Baur, Fruhmam et al., 1979	Case reports	2	2	2/2			1/2		nd		2/2		nd					
" , "	Gamboa, de la Cuesta et al., 1989	Case report	1	1	1/1			0/1		1/1		nd		1/1			1		Hairdresser
Phenyglycine acid chloride hydrochloride 39878-87-0	Kammermeyer and Mathews, 1973	Case series with controls	24	15	15/24			x*		nd		nd		2/2		2			Plant workers; 7/24 allergic, 8/24 irritant respir. symptoms; 9/24 SPT+; individual data not listed
Phosgene	Tarlo and Broder, 1989	Case report	1	1	1/1			x*		1/1	x*	nd							Co-exposure to hydrochloric acid; duration of symptoms 2 years; "individual data not listed
Piperazine dihydrochloride 142-64-3	Hagmar, Bellander et al., 1982	Survey	130	13 (10.0)	13/130*	10.0		nd		6/15		nd		1/1			1		Factory workers; co-exposure to other amines. "According to WRS, 12 late and 1 dual asthma type; additionally 16 former employees had suspected occupational asthma, asthma exposure-related; also bronchitis increased (24/117)
"	Hagmar, Bellander et al., 1984	Cross-sectional	516	170 (32.9)	170/516	32.9		nd		nd		nd		nd					Chemical workers; 33% work-related attacks of dyspnea, 27% work-related wheezing, 12% chronic bronchitis; asthma symptoms sign. related to exposure duration
"	Pepys, Pickering et al., 1972	Case reports	2	2	2/2			0/2		nd		nd		2/2			2		Chemical industry workers
Platinum salts 7440-06-4	Merget, Kulzer et al., 2000	Prospective cohort study	227	6*(2.6)	9/227			x		11/187		nd		nd					Catalyst production employees. Exposure related respir. symptoms; lung function impairment and BHR+; 9/14 with new chest symptoms within 5 yrs, smoking-related; 14/227 SPT+; *6/227 SPT- with new chest symptoms

Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)												Remarks			
					WORK-RELATED SYMPTOMS				LFT		BHR		PFT		SIC					
					Asthma		RADS		n/n	%	n/n	%	n/n	%	n/n	%		Reaction		
					n/n	%	all cases: + or at least one case: (+)	i(n)										l(n)	d(n)	
"	O'Donnell, Welford et al., 1989	Case series	57	34	57/ 57			7/ 57		34/ 57		x**		nd				Workers of aluminium smelter ; *7/7 BD+; **individual data not listed		
"	Desjardins, Bergeron et al., 1994	Case report	1	1	1/1			0/1		1/1		1/1*		nd				Worker of aluminum plant. PFT for 3 weeks		
"	Burge, Scott et al., 2000	Case report	1	1	1/1			1/1		1/1		0/1*		1/1			1	Caster of molten aluminium. SIC with aluminum chloride; *PFT with positive occupational effect (OASYS-2 score 2.67)		
"	Merget and Bernstein, 2006	Review			x			x						x				First asthma symptoms between 1 week and 10 years after first exposure. About 40% of former workers continue to have asthma. Association to RADS possible. The causative agent(s) are unknown		
Poultry confinement	Danuser, Wyss et al., 1988	Survey	26	10 (38.0)	14/ 26	53.8		10/26	38.0	nd		nd		nd				Swiss poultry farm workers. FEV ₁ decline sign. related to duration of occupation		
"	Danuser, Weber et al., 2001	Case series (representative sample)	37	37	37/ 37			nd		nd		nd		nd				Swiss poultry farm workers. Asthma OR 2.87, not sign.		
"	Hagmar, Schütz et al., 1990	Cross-sectional	23	2 (8.6)	2/ 23	8.6		0/23		nd		x*		nd				Shacklers of poultry slaughter houses. 2/23 chest symptoms; *sign. VC and FEV1 declines cross-shift		
"	Perfetti, Cartier et al., 1997	Case reports	4	4	4/4			0/4		nd		4/4		nd				Slaughterhouse workers. 4/4 SPT+ to chicken feathers		
"	Borghetti, Magarolas et al., 2002	Cross-sectional	15	1 (7.1)	5/14	35.7		2/5	40.0	nd		nd		1/5*	20.0		1	Spanish poultry farmers who participated in the European Farmers' Project. *Subject with SIC+ also allergic to storage mite		
Powder paints	Blomqvist, Düzakin-Nystedt et al., 2005	Cross-sectional	118	23 (21.9)	23/105*	30.5		x**		nd		nd		nd				Employees of powder paint shops. *Work-related asthmatic symptoms (according to physician) sign. exposure-related; IgE-; co-exposure to various organic acid anhydrides and to triglycidyl isocyanurate; **no sign. declines in LFT. 32/119 asthmatic symptoms (according to questionnaire)		
Reactive dyes	Park, Lee et al., 1991	Survey	309	13 (4.2)	78/ 309			nd		38/ 78		nd		13/78	5	1	7	Korean workers in dye-industry. 55 SPT+(5 with SIC+ had SPT-); 53/309 spec.IgE+ (23/53 also SIC+ were asymptomatic)		
"	Nilsson, Nordlinder et al., 1993	Survey	162	4* (2.5)	6/162	3.7		2/15	13.3	3/6	50.0	0/2		nd				Workers of textile plants in dye houses. *4 workers with asthma symptoms and LFT+ or BHR+		
"	Alanko, Keskinen et al., 1978	Case reports	4	4	4/4			nd		3/4		nd		4/4*	4			Workers of dye industry. *SIC with levafix brilliant yellow E-36, drimaren brilliant yellow K-GL, cibachrome brilliant scarlet 3 R, drimaren brilliant blue K-BL; 3/4 spec.IgE+; 4/4 SPT+		
"	Romano, Sulotto et al., 1992	Case report	1	1	1/1			0/1		0/1		nd		1/1*	1			Worker of textile manufacturing; *SIC with lanasal yellow 4G and anaphylactic reaction; SPT+		
Refractory ceramic fibers [RCF]	Lemasters et al., 1998	Cross-sectional and longitudinal study	742		x			x										Refractory ceramic fibers industry workers; sign respir. symptoms: dyspnea 1* in males (15.7% vs. 2.5% of controls), dyspnea 2* in females (10.5% vs. 0.0% of controls); sign. FEV1 and FVC declines in male smokers after 10 years		
"	phosphoric acid binder mixture Forrester, 1997	Case report	1	1	1/1			+	1/1	nd		nd		nd				Millwright in steel mill exposed to spill (dust). Asthma symptoms persistent for > 4 years		
Rosin core solder, thermal decomposition [colophony] 8050-09-7																				

Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)												Remarks			
					WORK-RELATED SYMPTOMS		LFT		BHR		PFT		SIC							
					Asthma	RADS	n/n	%	n/n	%	n/n	%	n/n	%	n/n	%		Reaction		
																		i(n)	l(n)	d(n)
n/n	%	all cases: + or at least one case: (+)	n/n	%	n/n	%	n/n	%	n/n	%	i(n)	l(n)	d(n)							
*	Burge, Edge et al., 1981	Survey	45	5 (11.1)	5/45	11.1		x		nd		nd		nd				Solder manufacturers. Prevalence of asthma dose-related (4% in lowest exposure group, 21% in highest and intermediate exposure group)		
*	Burge, Harries et al., 1980	Case series	51	34	51/51*			nd		16/31		nd		34/51**		34		Electric industry workers. *34/51 with occup. asthma and 17/51 with asthmatic symptoms before survey, **only sensitized with SIC+; SIC also with abietic acid (5/6 immediate)		
*	Ross, Keynes et al., 1997	Occupational disease statistics (SWORD)	94	94	x*			x*		x*		x*						*94/1765 physician-diagnosed asthma cases in 1996; *Individual data not listed		
*	Gannon and Burge, 1993	Occupational diseases statistics (SHIELD)	41	41	41/41			nd		nd		x		x				41/500 occup. asthma cases in 1989-1991		
*	Malo, 2006	Systemic Review	237		x			x						x						
	Smoke (fires, pyrolysis products)	Moisan, 1991	Case reports	3	3	3/3		+	1/3		1/1		nd		nd			1 fire fighter, 2 accidental exposures. Persistent asthma symptoms		
*	Brooks, Weiss et al., 1985	Case reports	1	1	1/1			+	nd		1/1		nd		nd			Accidental smoke exposure in burning book store. RADS for 13 months		
*	Reinisch, Harrison et al., 2001	Occupational diseases statistics (SENSOR), Survey	34	34	34/34				x*		nd		nd		nd			23/430 new-onset asthma in 1993-1996; *individual data not listed		
	Smoke, (biomass, indoor)	Ekici, Ekici et al., 2005	Cross-sectional	397	113 (28.5)	113/397			x		nd		nd		nd			Stove smoke-exposed non-smoking women. COPD prevalence 28.5% vs. 13.6% of controls		
	Sodium azide (powder dust)	Weiss, 1996	Case reports	2	2	2/2			+	2/2		2/2		nd		nd		Material handlers exposed to massive spill; asthmatic symptoms > 2 years		
	Sodium iso-nonanoyl oxybenzene sulphate [SINOS] 123354-92-7	Stenton, Dennis et al., 1990	Case reports	3	3	3/3			0/3		2/3		nd		3/3		3	Development technicians		
*	Hendrick, Connolly et al., 1988	Case report	1	1	1/1				nd		1/1		0/1		1/1		1	Laboratory technician		
*	Ferguson, Thomas et al., 1990	Case report	1	1	1/1				nd		nd		nd		1/1		1	Research worker with high exposure over 18 months		
	Sodium metabisulfite [metabisulfite sodium] 7681-57-4	Madsen, Sherson et al., 2004	Case report	1	1	1/1			1/1		1/1		nd		1/1		1	Fisherman		
*	Malo, Cartier et al., 1995b	Case report	1	1	1/1				0/1		0/1		nd		1/1		1	Agricultural producer		
*	Mergert and Korn, 2005	Case report	1	1	1/1				0/1		1/1		1/1		1/1		1	Radiographer		
	Soldering flux (fumes)	Stevens, 1976	Case report	1	1	1/1			0/1		nd		nd		1/1		1	Electronic assembler developing respir. symptoms within days after exposure		
*	Weir, Robertson et al., 1989	Case report	2	2	2/2				2/2		2/2		2/2		2/2		1 1	1 tin maker and 1 car radiator repair man. Use of soft corrosive soldering fluxes; co-exposure to zinc chloride, see also zinc chloride; 1/1 SIC+ (ammonium chloride); immediate		
	Solvents (not specified)	Toren, Balder et al., 1999	Case control study	294	38	x*			x*		x*		nd		nd			38/294 occup. asthma cases in 1996. OR 2.1, sign.; *individual data not listed		
*, "	Henneberger, Derk et al., 2003	Case series	8	8	8/8				+	x		x		nd		nd		8/424 occup. asthma cases in 1993-1995. 8/131 RADS cases		
*, " glue	Chatkin, Tarlo et al., 1999	Occupational diseases statistics (WCB)	5	5	5/5				(+)**	nd		x*		nd		nd		5/469 asthma claims between mid 1984 and mid 1988 identified by retrospective Review: 4 cases with work-aggravated asthma; *5/5 BD+ and /or BHR+; **1/5 RADS		

Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)												Remarks			
					WORK-RELATED SYMPTOMS				LFT		BHR		PFT		SIC					
					Asthma		RADS		n/n	%	n/n	%	n/n	%	n/n	%		Reaction		
					n/n	%	all cases: + or at least one case: (+)	i(n)										l(n)	d(n)	
Spray paint	Brooks, Weiss et al., 1985	Case reports	3	3	3/3			3/3		3/3		nd		nd				Painters. 2 RADS for 4 months, 1 RADS for 56 months		
Styrene monomer 100-42-5	Moscato, Biscaldi et al., 1987	Case reports	2	2	2/2			0/2		2/2		nd		2/2		2		Plastic factory workers		
Sulfur dioxide	Andersson, Knutsson et al., 2006	Cross-sectional	674	35 (5.2)	35/ 674	5.2		nd		nd		nd		nd				Sulfit mill workers. Asthma incidence rate sign. increased ; attributable fraction of incident asthma due to SO ₂ exposure 63%, and 75% due to SO ₂ gassing		
*	Koksal, Hasanoglu et al., 2003	Survey	69	10 (14.5)	55/ 69*	79.7		nd		nd		10/ 69**		nd				Workers of apricot farms. *55/69 dyspnea; **PFT+ with sign. declines also as a group in FVC, FEV ₁ , FEV ₁ /VC		
*	Härkönen, Nordman et al. 1983; Piirilä, Nordman et al., 1996	Case series with follow-up	9	7	9/9			(+)*	6/9	4/7		nd		nd				Men accidentally exposed to SO ₂ in pyrite mine in 1977. *7/9 had RADS. 6/7 re-examined after 4 and 13 years; 1 subject died hours post exposure due to pulmonary edema; 4 subjects with persisting BHR; 2/6 with persistent obstructive lung pattern.		
*	Tarlo and Broder, 1989	Case report	1	1	1/1			x*		1/1		x*		nd				Profession not mentioned; persistent asthma symptoms; co-exposure to sulphuric acid and chlorine; *individual data for LFT/PFT not listed.		
Sulphathiazole 72-14-0	Rosberg, 1946	Case reports	2	2	2/2			nd		nd		nd		2/2*				Nurses. *Individual reaction type not listed		
Sulphuric acid, fume 8014-95-7	Boulet, 1988	Case report	1	1	1/1			0/1		1/1		nd		nd				Cleaner. 2 years after exposure: SIC-, BHR+		
Swine confinement																				
*	Vogelzang, van der Gulden, 1998	Longitudinal study with follow-up	171		82/ 171			x*		nd		nd		nd				Pig farmers. *Sign. FEV1 decline 73 mL/yr, sign. related to endotoxin exposure		
*	Schwartz, Donham et al., 1995	Population based longitudinal cohort study	168		x			x*		nd		x**		nd				Pig farmers. *Sign. Longitudinal declines in FEV1, FVC, and FEF25-75 related to cross-shift declines; *FEV1 and FEF25-75 decline also related to endotoxin exposure.		
*	Radon, Büsching et al., 2002	Cross-sectional	2278	554 (24.3)*	x			x**		nd		nd		nd				Pig farmers in the European Farmers' Project. *24.3% with work-related respir. symptoms, sign. exposure-related; **individual data not listed		
*	Dosman, Lawson et al., 2004	Case reports	4	4	4/4			0/4		3/4		nd		nd				Intensive swine facility workers. Onset of first respiratory symptoms between 4.5 and 48 months; 1/1 BD+		
*	Cormier, Coll et al., 1996	Case report	1	1	1/1			+	1/1	1/1		nd		nd				Massive exposure		
Tall oil	Tarlo, 1992	Case report	1	1	1/1			0/1		1/1		1/1**		1/1*		1		Rubber tyre industry worker. SIC with Pantac 1500 (heated); **PFT for 2 weeks		
Tear gas	Bayeux-Dunglas, Deparis et al., 1999	Case report	1	1	1/1			nd		1/1		nd		nd				Teacher with repeated exposure. *Low level RADS; duration of symptoms over 6 months		
*	Hill, Silverberg et al., 2000	Case report	1	1	1/1			+	1/1	nd		nd		nd				Prisoner. Massive exposure with generalized symptoms (spongiotic lichenoid dermatitis, fever); SPT+. General and respir. symptoms over > 6 months		
*	Hu and Christiani, 1992	Case report	1	1	1/1			+	1/1	1/1		nd		nd				Massive spill in nightclub; respir. symptoms > 2 years		
Terpene (3-carene) 13466-78-9	Seaton, Cherrie et al., 1988	Case report	1	1	1/1			nd		nd		0/1		1/1		1		Laboratory technician for about 10 years. Asthma provoked by rubber glove vapours		

Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)												Remarks			
					WORK-RELATED SYMPTOMS		LFT		BHR		PFT		SIC							
					Asthma	RADS	n/n	%	n/n	%	n/n	%	n/n	%	n/n	%		Reaction		
																		i(n)	l(n)	d(n)
Tetrachloroethylene [perchloroethylene] 110-01-0	Baur and Bittner, submitted	Case reports	2	2	2/2			2/2*		nd		nd		nd			Workers engaged in odorizing natural gas; *2/2 BD+			
Tetrachloroisophthalonitrile (fungicide)	Honda, Kohrogi et al., 1992	Case report	1	1	1/1			0/1		1/1		1/1				1	Farmer			
Tetramethrin [1-(5-tretrazoly)-4-guanyl-tetrazene hydrate] 7696-12-0	Vandenplas, Delwiche et al., 2000	Case report	1	1	1/1			0/1		1/1		nd		1/1			1	Worker of insect pest extermination firm		
"	Burge and Richardson, 1994	Case report	1	1	1/1			0/1		1/1		nd		1/1			1	Hospital pharmacist		
Tributyl tin oxide [carpet fungicide]	Shelton, Urch et al., 1992	Case report	1	1	1/1			0/1		1/1		nd		1/1			1	Venipuncture technician		
Triethanolamine 102-71-6	Savonius, Keskinen et al., 1994	Case report	2	2	2/2			0/2		1/2		2/2		2/2			1	1	Metal workers	
Tungsten carbide 7440-33-7	Bruckner, 1967	Case report	1	1	1/1			nd		nd		nd		nd					Tungsten carbide worker	
Tylosin tartrate	Lee, Wang et al. 1989a	Case report	1	1	1/1			nd		1/1		nd		1/1				1	Laboratory worker	
Uranium hexafluoride 7783-81-5	Brooks, Weiss et al., 1985	Case report	1	1	1/1		+	nd		1/1		nd		nd					Chemical worker with accidental exposure	
"	Frigas, Filley et al., 1981	Case report	1	1	1/1			0/1		nd		nd		1/1				1	UF foam exposure	
Urea (fume) 57-13-6	Cockcroft, Hoepfner et al., 1982	Case reports	2	2	2/2			0/2		2/2		nd		2/2*				1	1	Carpenters. Exposure to dust from western red cedar chips with urea formaldehyde; *SIC with cedar urea formaldehyde sawdust with 1/2 borderline immediate (FEV1 decline - 14%)
"	Lemière, Malo et al., 1996b	Case report	1	1	1/1		+	nd		1/1		nd		nd						Stewardess; duration of respir. symptoms over 6 months
Vanadium 7440-62-2 *, divanadium pentoxide 1314-62-1	Irsigler, Visser et al., 1999	Case series	375	12	40/ 375			3/ 40		12/ 40										40 open cast miners with persistent resp. symptoms
"	Pistelli, Pupp et al., 1991	Survey	11	7	x*			0/11		7/11		nd		nd						Workers exposed during removal of ashes and clinker in oil-fired power station. BHR sign. increased; *individual asthma symptoms not listed
"	Musk and Tees, 1982	Case reports	4	4	4/4			3/4		2/4										
"	Esterhuizen, Hnizdo et al., 2001	Occupational diseases statistics (SORDSA)	8	8	x			x		x		nd		x						8/324 occupational asthma cases due to vanadium in 1997-1999
"	Kielkowski and Rees, 1997	Occupational diseases statistics	333	59	59/ 333			52/ 326		nd		nd		nd						Employees of vanadium plant; work-related asthma sign. increased (17.7% vs 5.1% of controls); 22/333 chronic bronchitis
Welding fumes	El-Zein, Malo et al., 2003	Epidemiological prospective cohort study	194	5	14/ 193			22/ 194		46/ 194		nd		nd						5/194 new-onset asthma cases /incidence 3%) plus 1/6 aggravated asthma; increase in incidence of BHR (11.9%); sign. FEV1 decline (- 8.4%)
"	Toren, Balder et al., 1999	Case control	26	26	x*			x*		x*		nd		nd						26/294 occupational asthma cases in 1996. OR 2.0, sign.; *individual data not listed
"	Nakadate, Aizawa et al., 1998	Cross-sectional	143	x*	x*			x*		nd		nd		nd						Electric arc welders. Cumulative exposure sign. associated with chronic cough (11/143) and with FEV1/VC decline; individual data not listed
"	Beach, Dennis et al., 1996	Cross-sectional	682	x*	x*			x*		x*		nd		nd						Welders. BHR+ sign.exposure-related;; *individual data not listed

Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)												Remarks			
					WORK-RELATED SYMPTOMS		LFT		BHR		PFT		SIC							
					Asthma	RADS	n/n	%	n/n	%	n/n	%	n/n	%	n/n	%		Reaction		
																		i(n)	l(n)	d(n)
	Jafari 2004	Case control	63	4	4/ 63			x		nd		nd		nd				Manual steel arc welders. Sign. asthma symptoms (6.3% vs. 1.3%) and sign. spirom. declines in VC, FVC, FEV1, FEF 25-75% as a group		
	Karjalainen, Martikainen et al., 2002c	Occupational diseases statistics	14	14	14/ 14			14/ 14		nd		nd						Construction workers		
	Hannu, Piipari et al., 2006	Case series with follow-up	34	34	34/ 34			18/ 34		9/ 15		nd		34/ 34		9	16	9	Workers of metal industry	
	Hannu, Piipari et al., 2005	Case reports	2	2	2/2			0/2		0/2		1/1*		2/2**			2		Metal arc welders on stainless steel. **SIC with SMO steel or duplex steel with an nickel/molybdenum electrode; *PFT for 1 week	
	Contreras and Chan-Yeung, 1997	Case series	6	3	6/6			0/6		5/6		nd		3/6		3			Welders. SIC with mild steel, stainless steel and/or galvanised steel; conc. 3.4-150 mg/m ³	
	Keskinen, Kalliomäki et al., 1980	Case series with follow-up	7	5	5/7			0/7*		2/7		nd		2/3		1	1		Metal arc stainless steel welders. (2 years later, 3 subjects re-examined, out of them 2/3 SIC+: 1 immediate, 1 late)	
	Vandenplas, Dargent et al., 1995	Case report	1	1	1/1			1/1		1/1		nd		1/1*			1		Welder manufacturing automatic gates. *SIC with gas metal arc welding on mild steel	
	Latza and Baur, 2005	Occupational diseases statistics	28	28	x*			x*		nd		nd		x*					28/835 occupational asthma cases in 2003 (28/210 irritant asthma cases). *Individual data not listed	
	Ross, Keynes et al., 1997	Occupational diseases statistics (SWORD)	22	22	x*			x*		x*		x*		x*					22/1765 physician-diagnosed asthma cases in 1996. *Individual data not listed	
	Reinisch, Harrison et al., 2001	Occupational diseases statistics (SENSOR), Survey	9	9	9/9			x*		nd		nd		nd					9/430 new onset asthma in 1993-1996. *individual data not listed	
	Piipari and Keskinen, 2005	Occupational diseases statistics (SORDSA)	6	6	6/6*			nd		nd		6/6*		6/6*					6/324 occupational asthma cases due to welding fumes in 1997-1999. *Individual data not listed	
	Bernstein and Mergert, 2006	Review		[incidence about 3.0 - 5.0]															Stainless steel sign. stronger irritant than "mild steel"	
" , aluminium	Vandenplas, Delwiche et al., 1998	Case report	1	1	1/1			0/1		1/1		nd		1/1				1		
World Trade Center desaster	Banauch, Alleyne et al., 2003; Banauch, Dhala et al., 2005)	Prospective cohort study / review	123	20 (16.3)	20/123*			+		27/ 151		24/ 112		nd					17/83 of highly, 3/40 of moderately exposed fire-fighters developed RADS (diagnosed 6 months after disaster). BHR exposure-related (31%, 10%); after 6 mo. persistent BHR in 55%; *sign. declines of spirometric parameters post WTC	
	Banauch, Hall et al., 2006	Longitudinal study	11766	48 [incidence (0.4)]	x			x		nd		nd		nd					Exposed FDNY rescue workers; respir. symptoms sign. time of arrival-related: severity (i.e., greater number) early- > intermediate-> late-arrival; sign. loss of FEV1 after disaster in each group; FEV1 < 60% in 45 exposed before, in 93 after disaster.	
	Prezant, Weiden et al., 2002	Survey with follow-up of exposed workers	9914	332 (3.3)	332/ 9914			+		332/ 9914		332/ 9914		nd					Firefighters; 332/9914 persistent cough; sign. FEV1 and FVC declines; 315 dyspnea; dose-related cough (8% of high, 3% of moderate, 1% of low exposure), and BHR (23% of high, 8% of moderate exposure)	

Agents [synonyms] CAS No.	Reference	Study type	Occupationally exposed subjects studied, n	Irritant asthma cases, n (prevalence, %)	EVIDENCE (pathological results)												Remarks		
					WORK-RELATED SYMPTOMS			LFT		BHR		PFT		SIC					
					Asthma		RADS	n/n	%	n/n	%	n/n	%	n/n	%	Reaction			
					n	%	all cases: + or at least one case: (+)									i(n)		l(n)	d(n)
*	Salzman, Moosavy, 2004	Survey	240	55 (18.5)	55/ 240			37/ 240		nd		nd		nd				Emergency services police officers. Dyspnea and prevalence of abnormal spirometry sign. related to exposure intensity	
*	Herbstman, Frank et al., 2005	Survey	119	22 (18.5)	22/ 119			x*		nd		nd						Clean-up and recovery workers. 22/119 new-onset wheezing with *6% reduced FEV ₁ (sign.); prevalence of symptoms exposure-related	
Zinc (fume) 7440-66-6	Malo and Cartier, 1987	Case report	2	2	2/2			2/2		2/2		nd		2/2				Solderers exposed to fume of galvanized metal. 1 subject with metal fever	
*	Malo and Cartier, 1993	Case report	1	1	1/1			0/1		1/1		1/1*		1/1**		1		Metal plant worker. *PFT+ (late); **SIC with zinc sulfate; SPT+	
*	Kawane, 1988	Case report	1	1	1/1			1/1		1/1		nd		nd				Welder. Presenting additionally metal fume fever	
Zinc chloride (fume) 7646-85-7	Weir, Robertson et al., 1989	Case reports	2	2	2/2			2/2		nd		2/2		2/2		2		1 worker of tin making industry and 1 car/truck repairer. Use of soldering fluxes, co-exposure to ammonium chloride (see also ammonium chloride)	
<p>n: number of subjects; n/n: number of subjects with work-related symptoms or positive test results / all investigated subjects; LFT: lung function test showing obstructive ventilation pattern; BHR: bronchial hyperresponsiveness; BD: significant bronchodilator effect; PFT: FEV1 or PEFr showing significant change in follow-up pre-, (during) and post shift; SIC: specific inhalative challenge test; i: immediate, d: dual, l: late response type; SPT: significant positive skin prick test result; IC: significant positive intracutaneous test result; IgE: positive result of specific IgE antibody measurement; *, **, ***: for details see column "Remarks"; nd: not done; WR: work-related; WRS: work-related symptoms; OA: occupational asthma; sign.: significant; P: pathology; restr. = restrictive ventilation pattern; + : positive test result; - : negative test result; x: test done, no individual results listed; nasal Ch: nasal challenge test; conj.Ch: conjunctival challenge test; oral Ch: oral challenge test; HR: histamine release test; PK: Prausnitz-Küstner test</p>																			