OCCUPATIONAL RESPIRATORY DISEASES

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APPENDIX

The U.S. Population-At-Risk to Occupational Respiratory Diseases

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In the assessment of agents associated with occupational diseases, the *population-at-risk* indicates the enormity of the problem in the workplace that future research and health needs must address.

This table juxtaposes hazardous agents with diseases they cause or provoke; conjoins these agents with involved occupations; and estimates the number of workers in these occupations potentially at risk to exposure from the associated agents. This approach provides a quick reference to the causes of each disease; the occupations where a prevalence of disease might be expected; and a ranking based on the number of people exposed. The reader should bear in mind that the agents listed may not constitute all factors contributing to the diseases (other etiologic factors may be equally weighty), nor will all workers involved in the listed occupations be exposed to the associated agents. Additionally, only the major industries and occupations in which the agents are used are included in this table; therefore, a particular disease may be exhibited in a job not delineated.

The *population-at-risk* estimate should be taken as an approximation of the number of workers who work closely with an agent and not the number of people who should be considered probable *cases* of disease. *Agents* listed are those which have been noted to contribute to or cause particular diseases. *Industries or Occupations* associated with the agents listed are revised lists from the National Institute for Occupational Safety and Health (NIOSH) criteria documents, NIOSH publication No. 77-181, and epidemiological studies. *Estimates of population-at-risk* are from the NIOSH criteria documents, the National Occupational Hazard Survey (NOHS), and revised estimates based on census data and prevalence studies. Behind each number of estimated people exposed is a letter designation, indicating the source of that estimate:

- **C** = estimates from NIOSH criteria documents addressed to the various agents.
- **H** = estimates from the National Occupational Hazard Survey (NOHS) conducted by NIOSH in 1972-74.
- **R** = estimates from census data and disease prevalence studies.

To simply state that an estimated number of people are occupationally exposed to a particular agent does not solve the complex problem of determining the true magnitude of the hazard. For this, an in-depth look at the concentrations, modes of exposure, and trends in use (among other things) should be considered. The value of these estimates is to indicate (1) where in the work force these toxic agents appear, and (2) the numbers of workers who *may* be exposed to hazardous agents.

Disease	*Agents*	*Industry or Occupation*	*Number*
Aluminosis	Aluminum (powdered metal) [Exposure to aluminum and aluminum oxide is frequently associated with exposure to silica and dusts also]	aluminum alloy grinding aluminum smelting aluminum workers ammunition makers fireworks makers foundry workers petroleum refining plastic making rubber making	575,000 H
	Aluminum oxide	abrasive manufacturing catalyst makers metal grinders potteries refractories	500,000 H
Antimony Pneumoconiosis	Antimony Stibnite (antimony sulfide)	alloy manufacturing ceramic making drug manufacturing fireworks manufacturing leather mordanting mining and milling of antimony paint manufacturing pewter manufacturing pharmaceuticals rubber production textile manufacturing typesetting	1,350,000 H
Argyria	Silver and compounds silver cyanide silver fulminate silver nitrate	alloy manufacturing ceramics coin production chemical laboratory workers dental alloy makers drug manufacturing electrical equipment manufacturing food product equipment manufacturing glass making hair dye manufacturing hard solder makers ivory etching mirror making organic chemical manufacturing photographic workers water treatment	60,000 R
Asbestosis	Asbestos actinolite	brake and clutch lining manufacture and	1,500,000 R

Disease	*Agents*	*Industry or Occupation*	*Number*
	anthophyllite asmosite crocidolite tremolite	installation cement (asbestos) production and application demolition workers furnace and kiln lining insulation and fireproofing manufacture and installation mining and milling of asbestos paint production paper manufacturing plastic manufacturing plumbing power station workers roofing tile production and installation shipbuilding	
Asthma-like Illness "Pneumoconiosis"	Cobalt	alloy manufacturing catalyst workers ceramic manufacturing drug manufacturing electroplaters glass colorers nickel workers paint dryer manufacturing porcelain coloring rubber coloring synthetic ink manufacturing	250,000 H
Baritosis	Barium sulfate	animal oil refining baryta mining brick manufacturing ceramic manufacturing glass making ink manufacturing linoleum production lithopone making paint manufacturing plastic manufacturing soap making textile manufacturing tile manufacturing wax processors	800,000 H
Berylliosis	Beryllium and compounds ammonium beryllium fluoride beryllium carbide beryllium copper alloys beryllium fluoride	aerospace equipment manufacturing alloy manufacturing beneficiation of beryllium minerals beryllium ceramic products beryllium processing and	800,000 R

Disease	*Agents*	*Industry or Occupation*	*Number*
	beryllium hydroxide beryllium oxide beryllium oxyfluoride beryllium phosphors beryllium sulfate zinc beryllium silicate	refining cathode ray tube manufacturers chemical manufacturing electronic equipment manufacturing gas mantle makers metallurgical operations missile technicians nonferrous foundry production nuclear reactor workers phosphor manufacturing refractory material makers tool and die manufacturing welding and torch cutting beryllium alloys	
Bird Breeders' Lung	Avian droppings	bird keepers	100,000 R
Bird Fanciers' Lung	Avian proteins		
Pigeon Breeders' Lung		pigeon breeders	
Byssinosis	Cotton dust	cotton classifiers cotton processing carding drawing & roving ginning growing & harvesting opening, cleaning, picking spinning, winding, twisting spooling, beaming, slashing weaving cottonseed oil mill workers cotton waste reclaimers garnetting	800,000 C
	Flax	flax carders flax mixers flax workers yarn makers	2,000 H
	Jute	jute workers	3,000 H
	Hemp	hemp workers	1,000 H
	Sisal	carpet makers combers of sisal	2,000 H

Disease	*Agents*	*Industry or Occupation*	*Number*
		drawers of sisal rope makers sisal workers twine spinners	
Cer-pneumoconiosis	Ceria (cerium oxide)	alloy manufacturing ammonia production enamel manufacturing glass making graphic art workers ink manufacturing lighter flint makers metal refining mining and milling of cerium optical lens production phosphor production rocket fuel manufacturing textile manufacturing	7,000 H
Coal Workers' Pneumoconiosis due to Carbon	Carbon black	battery manufacturing carbon electrode makers carburization workers cement workers ceramics food processing ink manufacturing paint manufacturing paper production plastic manufacturing printing production, collection, and handling of carbon black rubber manufacturing	35,000 C
	Coal dust anthracite bituminous coal lignite seacoal	loading and transporting of coal mining and milling of coal	150,000 R
	Graphite	brake lining manufacturing cathode ray tube manufacturing commutator brush manufacturing crushing and milling of graphite crucible production electrode making explosive manufacturing foundries lubricant production	250,000 H

Disease	*Agents*	*Industry or Occupation*	*Number*
		match production nuclear reactor workers paint manufacturing pencil lead making pigment manufacturing refractory material makers steel workers stove polish manufacturing	
	Lamp black	cement workers ceramic ware manufacture lamp black production and handling liquid-air explosive manufacture lubricating composition manufacturing steel making	UK
Coffee Workers' Lung	Coffee dust	coffee bean processors	12,900 R
Enzyme Workers' Lung	Bacillus subtilis (detergent enzymes)	detergent workers housewives laundry workers	175,000+ H
Epoxy Resin Workers' Lung	Phthalic anhydride	alizarin dye manufacture alkyd resin manufacture automobile finish makers cellulose acetate plastizers dacron fiber production epoxy resin workers erythrosin manufacture insecticide manufacture mylar plastic manufacture organic chemical synthesis phthalein manufacture plastics manufacture resin making vat dye makers vinyl plasticizer manufacture	54,000 R
Furriers' Lung	Hair dust (animal proteins)	furriers	4,700 R
Hard Metal Disease Tungsten Carbide Pneumoconiosis	Tungsten Carbon plus Cobalt	arc cutting hard metal manufacturing metal cutting milling of tungsten carbide with cobalt	60,000 H

Disease	*Agents*	*Industry or Occupation*	*Number*
	Metallurgical blending of tungsten and carbon with cobalt used as a binder		
Hypersensitivity Pneumonitis			
Farmers' Lung	Micropolyspora faeni (moldy compost) or hay	farmers, especially dairy farmers	2,800,000 R
Mushroom Workers' Lung	Thermoactinomyces vulgaris Thermoactinomyces viridis	clean out crews of mushroom bed houses	<1,000
Bagassosis	Thermoactinomyces sacharii (moldy sugar cane)	sugar cane workers	5,000 R
Maple Bark Strippers' Disease	Cryptostroma Corticale (moldy maple bark)	bark strippers loggers pulp mills sawmill workers	80,000 R
Malt Workers' Lung	Aspergillus claratus (moldy malt)	malt house workers	1,800 R 1,700 R
Suberosis	Penicillium frequentans (moldy cork dust)	cork workers	7,000 H
Cheese Washers' Lung	Penicillium caseii (cheese mold)	cheese workers	25,000 R
Woodworkers' Lung	Alternaria sp. (moldy wood chips)	carpenters construction workers joiners sawmill workers wood pulp workers	10,000 R
Sequoiosis	Pullalaria (moldy redwood dust)	loggers sawmills	<1,000 R
Paprika Splitters' Lung	Mucor sp. (paprika dust)	paprika splitters	
Wheat Weevil Disease	Sitophilus grainarius (wheat weevil) (infested wheat)		
Infectious Disease			
Anthrax	Bacillus anthracis	agricultural workers goat hide handlers renderies	>10,000 R

Disease	*Agents*	*Industry or Occupation*	*Number*
		veterinarians wool handlers	
Brucellosis	Brucella sp.	agricultural workers consumers of unpasteurized milk or milk products meat packers slaughterhouse workers veterinarians	>10,000 R
Histoplasmosis	Histoplasma capsulatum	farm workers endemic in certain areas	
Tuberculosis	Mycobacterium tuberculosis	coal workers foundry workers hard rock miners medical laboratory workers nurses physicians saloon workers	UK (30,000 cases per year)
Metal Fume Fever	Antimony Cadmium Copper 1° agents Iron Magnesium Manganese Nickel Selenium Tin Zinc	brass founders copper and zinc melters welders zinc galvanizers zinc smelters	40,000 R
Neoplasms Nasopharyngeal Neoplasms	Chromium salts	alloy makers chemical laboratory workers electroplaters miners and millers pigment makers tanners	1,000,000 H
	Nickel	battery makers ceramic makers chemists dyers electroplaters enamelers ink makers magnet makers oil hydrogenators paint makers pen point makers spark plug makers stainless steel workers textile dryers	250,000 H

Disease	*Agents*	*Industry or Occupation*	*Number*
		varnish makers welders	
	Nickel salts	nickel mining, smelting, refining	250,000 H
	Wood dust	carpenters furniture makers loggers plywood & structural wood producers sawmill workers woodworkers	775,000 H
No known pneumoconiosis demonstrated to be caused by fibrous glass alone.	Fibrous glass	aircraft workers construction workers glass workers glass fiber manufacturers insulation manufacturers laundry workers refrigeration workers shipyard workers	300,000 H
	Mineral wool	mineral wool manufacturers	3,000 H
No specific respiratory disease associated with the inhalation of Zirconium or its compounds	Zirconium or zirconium compounds	abrasive makers ceramic makers ceramic manufacturing crucible manufacturing deodorant manufacturing enamel manufacturing explosive manufacturing foundry workers glass makers incandescent lamp manufacturing metallurgists pigment manufacturing rayon spinneret makers refractory material makers textile waterproofers vaccuum tube manufacturing	150,000 H
Occupational Asthma and Rhinitis		See chapter: Occupational Asthma & Rhinitis	
Polymer Fume Fever	Polytetrafluorethylene (teflon, fluon) (PTFE)	polytetrafluoroethylene producers and handlers cutters of metal welders	100,000 H

Disease	*Agents*	*Industry or Occupation*	*Number*
Porcelain Refinishers' Lung Isocyanate Disease	Hexa methylene diisocyanate	rubber workers ship burners textile processors wire coating workers	3,000 H
	Toluene diisocyanate (paint catalyst)	adhesive workers foam insulation workers isocyanate resin workers lacquer workers organic chemical synthesizers paint sprayers polyurethane manufacture	6,000 H
Pulmonary Neoplasms	Arsenic	alloy makers aniline color makers arsenic workers babbitt metal workers brass makers bronze makers ceramic enamel makers ceramic makers copper smelters drug makers dye makers enamelers fireworks makers gold refiners herbicide makers hide preservers insecticide makers lead shot makers painters paint makers petroleum refinery workers pigment makers printing ink workers rodenticide makers semiconductor compound makers silver refiners taxidermists tree sprayers type metal workers water weed controllers weed sprayers	150,000 C
	Bischloromethyl ether	ion exchange resin makers laboratory workers organic chemical synthesizers polymer makers	UK
	Coal tar & pitch volatiles	artificial stone makers asbestos goods workers	250,000 H

Disease	*Agents*	*Industry or Occupation*	*Number*
		asphalt workers battery workers boatbuilders brick workers briquette makers brush makers coal tar workers creosoters coke oven workers electrode makers electric equipment makers gas house workers glass blowers insulators linemen miners painters pavers/road workers pipeline workers railroad track workers roofers rubber workers shingle makers water proffers shipyard workers wood preservers	
	Chromium	alloymakers catalyst workers ceramic workers drug makers electroplaters glass colorers nickel workers paint dryer makers porcelain colorers rubber colorers synthetic ink makers	175,000 C
	Radon daughters	uranium miners	5,900 R
Pulmonary Reactions to Man-made Fibers and Miscellaneous Pneumoconioses, Including "Mixed Dust" Pneumoconioses			
Respiratory Effects of Inhaled Toxic Agents	Ammonia	aluminum workers amine workers ammonia workers annealing	3,100,000 H

Disease	*Agents*	*Industry or Occupation*	*Number*
		bronzers	
		chemical workers	
		coal tar workers	
		coke production	
		compressed gas workers	
		drug manufacturing	
		dye manufacturing	
		electroplating	
		electrotypers	
		explosive manufacturing	
		farming	
		fertilizer manufacturing	
		galvanizing	
		glue making	
		lacquer/latex workers	
		metal extraction	
		metal powder processing	
		mirror silvering	
		paper production	
		perfume manufacturing	
		pesticide manufacturing	
		petroleum refinery workers	
		photographic film makers	
		rayon manufacturing	
		refrigeration workers	
		resin makers	
		rubber workers	
		sewer workers	
		steel workers	
		sugar refiners	
		sulfuric acid manufacturing	
		tanneries	
		transportation workers	
		water treatment	
	Cadmium and Cadmium containing compounds	alloy manufacturing	150,000 H
		auto mechanics	
		battery manufacturing	
		braziers	
		cadmium smelting, refining, processing	
		ceramics	
		copper refining	
		dental amalgam makers	
		electroplating	
		engravers	
		glass making	
		lead refining	
		metalizers	
		paint manufacturing	
		pesticide manufacturing	
		pigment makers	
		solderers	

Disease	*Agents*	*Industry or Occupation*	*Number*
		textile printing welders zinc smelting and refining	
	Cadmium Chloride		18,000 R
	Cadmium Oxide		20,000 R
	Cadmium Sulfide		25,000 R
	Chlorine	aerosol propellant makers alkali salt manufacturing aluminum purification bleaching carpet makers chemical manufacturing chlorinated solvent manufacturing chlorine workers disinfectant manufacturing dye manufacturing flour bleachers gold extraction ink manufacturing iron workers laundry workers paper/pulp bleaching pesticide manufacturing petroleum refinery workers plastic manufacturing rayon manufacturing refrigeration workers rubber production sewage treatment silver extraction submarine workers sugar refining tin recovery transportation workers water treatment	75,000 R
	Hydrogen sulfide	barium carbonate makers brewery workers caisson workers cellophane makers citrus root fumigation coke oven workers depilatory makers dye makers farmers fat renderers felt makers fermentation process workers	25,000 H

Disease	*Agents*	*Industry or Occupation*	*Number*
		fertilizer manufacture	
		fish processing	
		lithographers	
		miners	
		natural gas makers	
		paper pulp makers	
		petroleum/gas refining & processing	
		photo engravers	
		rayon makers	
		sewage treatment plant workers	
		sewer workers	
		silk makers	
		slaughterhouse workers	
		smelting of metallic ore	
		soap makers	
		sugar beet processors	
		sulfuric acid purifiers	
		sulfur makers	
		synthetic fiber makers	
		tannery workers	
		tunnel workers	
		well diggers	
	Mercury (and its compounds)	amalgam makers	150,000 R
		bacteriocide manufacturing	
		battery makers	
		boiler makers	
		bronzers	
		cap loaders, percussion	
		caustic sode makers	
		ceramic workers	
		chlorine makers	
		dentists	
		drug makers	
		explosive manufacturing	
		fireworks manufacturing	
		fungicide manufacturing	
		fur preserving/processing	
		gold/silver extraction	
		histology technicians	
		insecticide manufacturing	
		jewelers	
		mercury workers/ mining/refining	

Disease	*Agents*	*Industry or Occupation*	*Number*
		paint making paper manufacturing pesticide workers photographers tanneries taxidermists thermometer/barometer makers	
	Osmium tetroxide	alloy manufacturing drug manufacturing histology technicians organic chemical synthetization osmium tetroxide production platinum hardening synthetic ammonia manufacturing	3,000 R
	Oxides of Nitrogen Nitric oxide--NO Nitrogen dioxide--NO_2	braziers dentists diesel engine maintenance and mechanic workers dye makers fertilizer manufacturing fire fighters food and textile bleachers explosive workers garage workers gas and electric arc welders jewelers medical technicians metal cleaners miners nurses organic chemical synthesizers physicians silo fillers sulfuric acid manufacturing welders	950,000 H
	Oxides of Sulfur Sulfur dioxide--SO_2 Sulfur trioxide--SO_3	beet sugar bleachers bleachers boiler water treatment brewery workers diesel engine operators and repair disinfectant makers firemen food bleaching foundry workers fumigant manufacturing	125,000 H

Disease	*Agents*	*Industry or Occupation*	*Number*
		furnace operators	
		gelatin bleaching	
		glass manufacturing	
		ice making	
		ore smelting	
		paper manufacturing	
		petroleum refining	
		preservative makers	
		protein processing	
		refrigeration workers	
		sodium sulfite manufacturing	
		sulfuric acid manufacturing	
		tanneries	
		thermometer manufacturing (vapor)	
		wine makers	
		wood bleaching	
	Ozone	air treaters	750,000 R
		arc welding	
		cold storage food preservers	
		industrial waste treatment	
		liquor agers	
		odor controllers	
		oil bleaching	
		organic chemical synthesis	
		sewage treatment	
		textile bleaching	
		water treatment	
		wax bleaching	
		wood aging	
	Phosgene	chlorinated compound manufacturing	6,000 H
		drug manufacturing	
		dye manufacturing	
		firemen	
		isocyanate manufacturing	
		insecticide manufacturing	
		metallurgists	
		organic chemical synthesis	
		phosgene workers	
		plastics production	
		resin manufacturing	
		welding/brazing	
	Sulfuric acid	aluminum sulfate synthesis	200,000 C
		battery manufacturing	
		cellulose workers	
		chemical manufacturing	
		copper sulfate synthesis	

Disease	*Agents*	*Industry or Occupation*	*Number*
		detergent manufacturing dye manufacturing explosive manufacturing food processing glue making jewelers leather workers metal cleaners paint makers paper production phenol manufacturing	
	Vanadium and Vanadium containing compounds		174,000 R
	Vanadium pentoxide	alloy manufacturing catalysts manufacturing ceramics cleaning of oil fired boilers dye manufacturing ferrovanadium workers glass manufacturing organic chemical synthesization petroleum refining photographic chemical makers printing textile dye workers vanadium smelting, refining, processing welding	3,000 R
	Other Vanadium oxides halides salts of vanadium sulfates vanadates		
Siderosis	Iron and iron oxides	arc welders boiler scalers friction saw operators grinders metal workers mining, milling and transporting iron ores oxyacetylene cutters polishers production and refining of metal and alloys containing iron	1,775,000 R

Disease	*Agents*	*Industry or Occupation*	*Number*
		silver finishers stainless steel makers steel foundry workers welding	
	Fibrous		
Silicate Pneumoconioses	Attapulgite clay (Fuller's earth)	mining and milling of attapulgite	120,000 H
	Fibrous talc	agricultural chemical manufacturing candy molding ceramics chalk making cosmetics crayon manufacturing dusting powder manufacturing foundries (ferrous and nonferrous) insecticide manufacturing lubricant production mining and milling of talc paint manufacturing paper production pharmaceutical manufacturing pigment production polishing peanuts and rice rubber making roofing material manufacturing salami dusting soap filler addition textile manufacturing white shoe cleaners	1,800,000 H
	Sericite	of no commercial importance; was implicated in the 1930's as a cause of silicosis. Subsequent work has not supported this hypothesis.	UK
	Sillimanite	furnace patching mining and milling of sillimanite porcelain manufacturing for electrical equipment refractories	UK

Disease	*Agents*	*Industry or Occupation*	*Number*
	Wollastonite	cements production ceramics mining and milling of wollastonite plastics manufacturing	67,000 H
	Non-fibrous		
	Bentonite	decolorizing oil production making refractory linings mining and milling of bentonite preparing fine grouting fluids thickening drilling muds water softener production and addition	250,000 H
	Kaolin	bagging and loading of kaolin cements production ceramics paint making paper manufacturing pharmaceutical manufacturing mining and milling of kaolin	1,450,000 H
	Mica	electrical industry insulation production and installation mining and milling of mica or feldspar paint production paper production wallpaper manufacturing	300,000 H
	Portland cement	brick masons bridge building building construction burial vault builders cement plant production (milling) cement workers concrete workers drain tile makers heat insulation makers oil well builders silo builders storage tank builders tunnel builders water pipe makers	500,000 H

Disease	*Agents*	*Industry or Occupation*	*Number*
Silico-antimoniosis	Antimony plus Crystalline Silica	Antimony miners	50R
Silicosiderosis	Iron ore Iron oxides plus Crystalline silica	boiler scalers foundry workers iron mining iron and steel workers ochre mining welding	UK
Silicosis	Crystalline silica diatomaceous earth flint granite quartz sand sandstone slate	cement production workers coal mining and milling foundries (ferrous and nonferrous) glass making insulation production and installation metal mining and milling nonmetallic mining and milling plastic manufacturing porcelain production pottery making refractories road working rubber manufacturing sandblasting scouring soap manufacturing stone cutting stone masons tile and clay production tunneling wood filler making	2,300,000 R
Silver Polishers' Lung	Silver plus Iron oxide	jewelers silver polishing silversmiths	13,000 R
Stannosis	Tin Tin oxide	babbitt metal manufacturing brass founding brittania metal making bronze founding dye manufacturing fungicide manufacturing	225,000 H

Disease	*Agents*	*Industry or Occupation*	*Number*
		pewter makers pigment manufacturing plastic manufacturing solder manufacturing textile manufacturing tin miners and millers tin refiners and smelters type metal making	
Trimellitic Anhydride Lung Disease TMA Disease	Trimellitic anhydride	chemical manufacturers dye and pigment manufacturing epoxy resin workers paint manufacture pharmaceutical manufacturing resin manufacturing vinyl plasticizing	11,000 H 10,000 H