Appendix B. Uses for All Chemicals

Five Chemicals Alternatives Assessment Study

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Appendix B: Explanation

Major Use Category	Uses/Applications	Product Used in MA	Used in Manufacturing in MA	Availabilaity of Alternatives	Exposure Potential	Stakeholder Input	Other	Source(s)
Describe a major use category for your chemical	Describe a use/application that falls under the major use category	Y - Yes, the product is used in MA	Yes - the chemical is manufactured or used in manufacturing in MA	CA - There are commercially available alternatives made by at least one manufacturer.	O - high likelihood of occupational exposure	To be obtained after we send this matrix to stakeholders for review and comment.	Include any other key considerations for prioritization. For example, relevant regulations or whether this use is being studied by another organization.	Key sources of information.
		N - No, the product is not used in MA	No - the chemical is not manufactured or used in manufacturing in MA	I - Alternatives have been identified, by they may be in the research & development or early adoption stage.	C - high likelihood of exposure during consumer use of the product			
		If Yes, provide any data obtained on amount used nationally or in MA	If Yes, provide TURA use data	N - No known alternatives have been identified.	E - high likelihood of environmental exposure (can be air, water, soil or some combination)			
				If CA or I, then list the alternatives.				

Appendix B.1: Lead Uses - Ammunition

Major Use Category	Uses/Applications	Used as a Product in MA	Used in Manufacturing in MA	Availability of Alternatives	Exposure Potential	Stakeholder Input	Other	Source(s)
Ammunition	Used as a core material in a projectile/bullet. Also used as a slug, primer, and shot in shotgun ammunition. 48,800 metric tons annually. (107,555,200 pounds)							
	Outdoor shooting ranges				contamination of soil and groundwater			CTI
	Indoor shooting ranges - conventional primers use a lead based material which when ignited, release lead into the air at the firing line. Also, when conventional leaded ammunition is fired, lead is vapourized from the end of the projectile releasing more lead into the air.				80% of airborne lead comes from the projectile, and 20% from combustion of the primer mixture, this airborne lead can be inhaled or deposited on the shooter's skin			CTI, National Bureau of Standards, Police and Security News
	Pistol caliber - 9 mm	Y	N	CA (projectile core is a metal filled polmer - CTI, Copper Zinc alloy - RUAG, Copper/tin Sinterfire, material ? -Accutec)	O, C, E			Accutec, CTI, RUAG, Sinterfire
	Pistol caliber - 0.40 S & W	Y	N	CA (projectile core is a metal filled polmer - CTI)	O, C, E			CTI
	Pistol caliber - .380, .38 SPL, .357 Magnum, .357 SIG, 45 Auto/ACP	Y	N	CA (Accutec, material?)	O, C, E			Accutec
	Rifle caliber - 7.62 x 39 mm, 7.62 x 51 mm, .308,	Y	N	CA (Accutec, material?)	O, C, E			Accutec
	Rifle caliber - 50 cal BMG SRTA, 50 cal BMG	Y	N	I (Accutec, material?)	O, C, E			Accutec
	Rifle caliber - 5.56 mm	Y	N	CA (projectile core is a metal filled polmer - CTI)	O, C, E		Army investigating non-lead alternatives.	Environmental Security Technology Certification Program
	22 caliber ammunition	Y (8,500 pounds per year nationally)	N		O, C, E		Army investigating non-lead alternatives.	Environmental Security Technology Certification Program
	miscellaneous bullets	Y	N	CA (zinc, nylon composite, polymer-copper, tin, tungsten alloy, steel, bismuth)	O, C, E			
	shotgun ammunition	Y	N	CA (bismuth/tin, iron (steel), iron/tungsten, tungsten/nickel/iron, tungsten matrix, tungsten polymer, tungsten/tin/bismuth)	O, C, E		Lead shot has been banned in the U.S. for waterfowl hunting since 1992	U.S. Fish and Wildlife Service
	slugs	Y	N		O, C, E			
	primer - typically uses lead styphnate	Y	N	CA (DiazodiNitroPhenol DDNP - Federal Cartridge Company)	O, C, E			Police and Security News

Appendix B.1: Lead Uses (cont.) - Batteries

Major Use Category	Uses/Applications	National Use	Used as a Product in MA	Used in Manufacturing in MA	Availability of Alternatives	Exposure Potential	Stakeholder Input	Other	Source(s)
US consumption of lead for all lead acid batteries was 2.6 billion pounds in 2003 (1.2 billion pounds for grids, posts, etc and 1.4 billion pounds for oxides) **Industrial battery sales reached $493 million in 2003 for North America. Industial batteries account for 17% of the lead-acid battery market.**									USGS www.batteriesdigest.com, ATSDR
Batteries: Automotive	Starting - Lighting - Ignition (SLI) 12V	Automotive battery shipments in N. America in 2001 totaled 106.6 million batteries (86.2 million replacement, 20.4 million OEM) or approx. 2.5 billion pounds of lead There were approximately 17.7 million new vehicles added to the N. American fleet in 2000 The average SLI battery weighs approx. 33 pounds and contains 24 pounds of lead.	Yes MA has 3.9 million registered passenger vehicles (2000 census) which contain approximately 94 million pounds of lead (batteries only).	No Major US lead acid battery manufacturers include Johnson Controls, Exide Technologies, Delphi Corp., Fiamm, and East Penn Manufacturing Co.	I - NiMH batteries (used in hybrid and electric vehicles) Manufacturers: Texaco Ovonic, Panasonic EV, Sanyo, SAFT, GP Batteries Advantages: Higher power density, reduced weight and volume, increased battery life, less material use, potentially recyclable without need for additional smelting I - Lithium-ion (used in hybrid vehicles) Manufacturers: Hitachi/Shin-Kobe, SAFT, Telcordia Advantages: Higher power density, reduced weight and volume, improved longevity, reduced heat generation, low-toxicity materials	O, E - Exposure risks during mining, smelting, manufacturing, EOL management 65% of lead in MSW is from lead-acid batteries		While lead-acid batteries have high recycling rates, 93 million pounds of lead from batteries ends up in landfills each year in N. America. The advent of 42V batteries could result in increased lead use. MA has a waste ban, or restriction, on the disposal and transfer for disposal of lead-acid/automotive batteries at landfills and combustion facilities.	Ecology Center, Environmental Defense, EPA (1989), US Census Bureau
	36/42 Volt Automotive Systems	No (not currently on the market)	No (not currently on the market)	No		O, E - Exposure risks during mining, smelting, manufacturing, EOL management		36/42 Volt systems are an emerging technology that will replace 12V batteries in some SLI applications	Advanced Lead-Acid Battery Consortium (www.alabc.org)
	Hybrid vehicle	No	No	No	CA - NiMH and Lithium-ion batteries	O, E - Exposure risks during mining, smelting, manufacturing, EOL management		NiMH and Lithium-ion batteries currently dominate the hybrid vehicle market however the lead-acid battery industry is attempting to enter this market. Future versions of hybrids may utilize an upgraded version of the SLI battery (42 volt)	European Advanced Lead Acid Battery Consortium
Batteries: Traction	Industrial trucks (forklifts, AGVs, towing vehicles, floor cleaning equipment) Rail and mine vehicles Golf carts, electric cars, marine batteries	Traction or motive power batteries account for 39% of the industrial battery market.	Yes	No	CA - NiMH batteries (used in hybrid and electric vehicles), Lithium-ion (used in hybrid vehicles), Nickel Iron, Sodium Nickel Chloride (Zebra)	O, E - Exposure risks during mining, smelting, manufacturing, EOL management			IC Consultants, ATSDR
Batteries: Stationary batteries including Flooded and Valve Regulated Lead Acid (VRLA)	Standby power and uninterruptible power supply for computer systems and telecommunications, Utility customers (storage for generator, solar & wind applications), load leveling, Remote Area Power Supplies	Stationary batteries account for 61% of the industrial battery market. Telecommunications sector accounted for 55% of sales of industrial lead-acid batteries in North America in 2003 In 2003, sales to the UPS market were $135 million in the US. UPS sales accounted for 30% of the stationary power market in N.America	Yes	No All small and many mid-sized batteries are being manufactured in Asia	CA - Nickel Cadmium, lithium-polymer, NiMH, fuel cells I - Sodium Sulfur	O, E - Exposure risks during mining, smelting, manufacturing, EOL management			www.batteriesdigest.com, BCI, ATSDR
Batteries: Sealed L-A batteries	Power consumer products and tools like drills, flashlights, electric starters for gas lawn mowers, wheelchairs, and children's toy cars		Yes	No	CA - Nickel Cadmium, NiMH and Lithium-ion batteries (Segway uses a nickel based battery)	O, E - Exposure risks during mining, smelting, manufacturing, EOL management			
Batteries: Deep cycle	Marine applications such as lights, trolling motors or winches		Yes	No		O, E - Exposure risks during mining, smelting, manufacturing, EOL management			

Appendix B.1: Lead Uses (cont.) - Casting Extrusion

Major Use Category	Uses/Applications	Used as a Product in MA	Used in Manufacturing in MA	Availabilaity of Alternatives	Exposure Potential	Stakeholder Input	Other	Source(s)
Extrusion								
	building construction	Y			O,C,E			USGS
	organ pipes	Y		CA	O,C			
	pipes (chemical plants, nuclear, hydro, and plating applications)	Y			O,C			USGS
	traps	Y			O,C			
	window cames	Y			O,C,E			IC Consultants
	anodes	Y			O,C			Alchemy castings
	swaging wire	Y			O,C			
	damper for structural vibration	Y			O,C			
	gaskets	Y			O,C			Vulcan Lead, Inc.
	corrosion resistant tags	Y			O,C			Vulcan Lead, Inc.
	acid mist precipitators	Y			O,C			Vulcan Lead, Inc.
Casting								
	hammers	Y		CA (steel)	O,C			Alchemy castings
	anodes	Y			O,C			Alchemy castings
	planters	Y		CA (ceramic)	O,C,E			Alchemy castings
	window boxes	Y		CA (wood, ceramic)	O,C,E			Alchemy castings
	urns	Y		CA (ceramic)	O,C			Alchemy castings
	stepping stones	Y		CA (ceramic)	O,C,E			Alchemy castings
	masks/wall fountains	Y		CA (ceramic)	O,C,E			Alchemy castings
	wall plaques	Y		CA (ceramic)	O,C,E			
	Metal parts: Alloy takes a fine and clear impression of the mold in which it hardens. Used for type, and making metal parts of various musical instruments and for ornaments of intricate design. - Type metal - alloy of lead with antimony, tin, and sometimes copper	Y			O,C			Encyclopedia.com
	Jewelry	Y	Y		O,C,E			
	Tableware - pewter	Y						
Weighting Applications								
	Fishing tackle and sinkers	Y		CA (tin, bismuth, ceramic, plastic, steel, cement, tungsten putty, tungsten/nickel alloy, bismuth/tin alloy, brass, glass) (Ecomass)	O, C, E (ingestion by fish and birds)		Ban on certain lead tackle and sinkers in New York, Maine, New Hampshire, and Vermont.	Minnesota Office of Environmental Assistance, N.H. Wildlife Journal
	Commercial fishing net line weights	Y			O,C,E			Alchemy Castings
	Buoy weights	Y		CA	O,C,E			Alchemy Castings
	Duck decoy weights	Y		CA	O,C,E			Alchemy Castings
	Skydiving weights	Y		CA	O,C,E			
	Dive weights	Y		CA	O,C,E			
	Yacht keel	Y		CA	O,C,E			Alchemy Castings
	Ballast lead (bars)	Y		CA	O,C,E			Alchemy Castings
	Sash weights	Y		CA	O,C,E			Alchemy Castings
	Ice fishing decoys	Y		CA	O,C,E			
	Auto wheel balancing weights. Approximately 43.1 million lbs. in N. America in 2000. 55.1 million lbs. of wheel weights on registered vehicles in US	Y Between 200 and 250 grams per vehicle.	No	CA - steel, tin, ZAMA (an alloy of zinc, aluminum and copper), tungsten, and plastic (PP), plastic coated tin, and plastic beads inside the tire Manufacturers: Hennessy Industries, Perfect Equipment Co., PLOMBCO Honda, Hyundai, Mazda, Nissan, Subaru, Suzuki, and Toyota have vehicles for sale in US with lead-free wheel weights	O, E - 10-13% of lead wheel weights fall off during use = 11.0 million lbs. in US.			Ecology Center

Appendix B.1: Lead Uses (cont.) - Ceramics

Major Use Category	Uses/Applications	National Use	Used as a Product in MA	Used in Manufacturing in MA	Availability of Alternatives	Exposure Potential	Stakeholder Input	Other	Source(s)
Ceramics	Lead glazes. Lead compounds, such as lead oxide and lead carbonate, and lead frits are used in ceramic glazing applications.		Yes		CA Borax frits are often used in the production of earthenware glazes when a lead-free glaze is required. The addition of lead compounds results in higher gloss but lead-free frits can attain higher surface gloss and transparency if the alkali-content is adequately high, the chemical composition is balanced, and the melting point has been correctly adjusted.	O, E, C Ceramics is one of the top ten industries in California in terms of the number of workers reported with blood lead levels at or above 25 µg/dl.		CA Proposition 65 requires hazard warnings on ceramic products that are found to leach lead into food. FDA proposed a ban on the use of lead and cadmium for the lip and rim area of glass tumblers and is considering a heavy metal limit on ceramic drinking vessels.	CA Dept of Health Services DC Chemical Co.
	Ceramic electronics components: Piezoelectric ceramic components Ceramic chip carriers		Yes	No	CA KNbO3 and (Na,K)NbO3	O, E			

Appendix B.1: Lead Uses (cont.) - Electronics

Major Use Category	Uses/Applications	Used as a Product in MA	Used in Manufacturing in MA	Availabilaity of Alternatives	Exposure Potential	Stakeholder Input	Other	Source(s)
Electronics							RoHS (European Union Directive) requirements effective July 2006 for many electronics applications	
	Electronics - surface finish for printed wiring boards	Y	Y	CA (Electroless nickel immersion gold, Organic Solderability Preservatives (OSP), Immersion silver, Immersion Tin, Lead-free Hot Air Solder Leveling, Direct Immersion Gold)	O, C, E			NE Lead-free Electronics Consortium
	Electronics - chemical bath for ENIG PWB finish (lead used as a stabilizer and catalyst)	Y		CA (thallium)	O, C, E			M/A-COM
	Electronics - Component lead finish	Y	Y	CA (Sn, matte Sn, NiPdAu, Au, PdAg, SnCu, NiAu, SnNi, SnAgCu, SnBi)	O, C, E			NE Lead-free Electronics Consortium
	Electronics - hermetic ceramic packages (glass frit)	Y			O, C, E			M/A-COM
	Electronics - passive resistors components (Lead Borosilicate)	Y			O, C, E			M/A-COM
	Electronics - piezo/pyro/ferro electric parts (Lead zirconate-titanate)	Y			O, C, E			M/A-COM
	Electronics - piezo/pyro/ferro electric parts (Lead/lanthanam/zironate/titanate)	Y			O, C, E			M/A-COM
	Electronics - solder bumps on ceramic BGAs and flip chips	Y		CA (eutectic gold-tin)	O, C, E			M/A-COM
	Electronics - solder paste for reflow of surface mount components	Y	Y	CA (tin/silver/copper alloy, tin/silver, tin/bismuth)	O, C, E		U.S. EPA Life Cycle Analysis Project	
	Electronics - solder for wave soldering of through hole components	Y	Y	CA (tin/silver/copper alloy, tin/copper alloy)	O, C, E			

Appendix B.1: Lead Uses (cont.) - Glass

Major Use Category	Uses/Applications	National Use	Used as a Product in MA	Used in Manufacturing in MA	Availability of Alternatives	Exposure Potential	Stakeholder Input	Other	Source(s)
CRT	Funnel glass (22% lead oxide)	Approximately 42,609,000 CRT computer monitors sold in N. America in 2001 CRT's sold by N. American dealers in 2000 = 76,300,000 Average CRT, including TVs and monitors, is an 18.63 inch CRT with lead content from 2.14 lbs to 2.63 lbs. US funnel glass sales were 183,906 tons in 2000.	Yes	No	I - barium, strontium, zirconium CA - LCD, Plasma	O, E - Exposure risks during mining, manufacturing, EOL management			IC Consultants, EIA
	Frit or solder glass (70% lead oxide)	US import of glass frits in 2003 was 59.8 million lbs. lead content	Yes	No		O, E - Exposure risks during mining, manufacturing, EOL management			EIA, USGS
	Leaded panel glass (1-2.5% lead oxide)	US manufacturers produced 90,640 tons of leaded glass in 2000.	Yes	No	CA - No-lead glass panel. Only one of the four US CRT glass manufacturers produces leaded glass panels	O, E - Exposure risks during mining, manufacturing, EOL management			EIA
Other Glass	Addition of lead compounds to silica-based glasses can reduce the softening temperature		Yes		CA - alkali has a similar fluxing effect				
	Crystal and optical glass Leaded glass has an increased refractive index giving it a more attractive appearance (crystal) and making it suitable for certain optical applications Crystal glass contains 24-36% lead oxide; "semi-crystal" glass contains 14-24% lead oxide. Smaller additions of lead are made to some optical glass (binoculars, telescopes, glasses)		Yes		CA Oxides such as barium or zinc can give similar optical properties to glass. Lead-free crystal is being produced for the CA market using barium.				IC Consultants
	Radiation shielding glass		Yes	Yes		O,E			
	Leaded glass is used in certain electrical and electronic devices due to the relatively low specific electrical conductivity and dielectric losses.								

Appendix B.1: Lead Uses (cont.) - Metal Finishing

Major Use Category	Uses/Applications	Used as a Product in MA	Used in Manufacturing in MA	Availabilaity of Alternatives	Exposure Potential	Stakeholder Input	Other	Source(s)
Metal Finishing			Y					National Metal Finishing Resource Center, Hannapel, Jeff, "TRI Reporting Threshold Lowered for Lead and Lead Compounds, Plating & Surface Finishing, September, 2001
	Sources of lead in metal finishing:							
	Plating solutions				O, C, E			
	Lead anodes and cathodes				O, C, E			
	Lead impurities in coatings and base metals				O, C, E			
	Lead cooling coils				O, C, E			
	Metal finishing processes involving lead:							
	Hard chrome plating (slow dissolution of anodes)				O, C, E			
	Decorative chrome plating (slow dissolution of anodes)				O, C, E			
	Lead and tin-lead plating solutions				O, C, E			
	Electrolytic pickling (slow dissolution of anodes)				O, C, E			
	Zinc plating (lead impurities in zinc anodes)				O, C, E			
	Leaded base metals (dissolution of parts)				O, C, E			
	Burnishing of zinc die castings				O, C, E			
	Polishing operations (lead from parts)				O, C, E			
	Wastewater treatment (formatin of lead hydroxide)				O, C, E			
	Sulfuric acid and hardcoat anodizing (slow dissolution of lead cathodes)				O, C, E			

Appendix B.1: Lead Uses (cont.) - Pigments

Major Use Category	Uses/Applications	National Use	Used as a Product in MA	Used in Manufacturing in MA	Availability of Alternatives	Exposure Potential	Stakeholder Input	Other	Source(s)
US consumption of lead for lead oxides used in pigments, paint, glass, etc. was 78.7 million lbs. in 2003 **US production of litharge, red lead and white lead was 2.6 million lbs. in 2003, shipments were 32.6 million lbs.** **US production of lead oxide was 1.4 billion lbs. in 2003.**									**USGS**
Pigments: Paint	White lead (lead carbonate) Pigment for white paint	Used only for certain historic buildings and in artists' colors for restoration work US imports of white lead carbonate in 2003 totaled 2,200 lbs.	No (Very limited usage)	No	CA Titanium dioxide				IC Consultants, USGS
	Red lead, lead tetraoxide (Pb3O4) Used to make a reddish-brown paint that prevents rust on outdoor steel structures	US imports of red and orange lead pigment in 2003 totaled 88,000 lbs.	No (Very limited usage)		CA For rust-proofing primers, alternatives exist such as paints containing zinc compounds.				IC Consultants, USGS
	Blue lead (lead sulfate with lead oxide, zinc oxide and carbon)								Allegheny Environmental Services
	Lead chromates are in yellow, orange and red inorganic pigments for paint and plastic applications. The use of lead in lead chromate pigments represents approximately 1% of total worldwide use of lead, approximately 121.3 million lbs. a year.	US imports of chrome yellow, molybdenum orange pigments, lead-zinc chromates in 2003 totaled 14.8 million lbs. lead content			CA In many applications, lead chromate can be substituted by opaque organic pigments in mixture with other inorganic types, but at high cost and often with loss of brightness, opacity, flow, gloss or other technical properties				IC Consultants, USGS
	Litharge (massicot, lead monoxide) Yellow pigment used in glass or earthenware Litharge is also used to make lead crystal, flint glass and in the vulcanizing of rubber	US imports of litharge in 2003 totaled 4.8 million lbs. lead content							USGS
	Lead flake Exterior primer								
	Lead oleate Paint drier								
	Lead nitrate (Pb(No3)2 Used to make fireworks and other pyrotechnics								
	Lead silicate (PbSiO3) Used to make some types of glass and in the production of rubber and paints Used in cathodic electrodeposition primers in motor vehicles to improve throwing power and corrosion resistance.				CA - Non-lead systems are currently available for use in auto coating applications				
	Lead sulfate (PbSO4) Paint pigment commonly known as sublimed white lead								

Appendix B.1: Lead Uses (cont.) - PVC Rubber

Major Use Category	Uses/Applications	Used as a Product in MA	Used in Manufacturing in MA	Availability of Alternatives	Exposure Potential	Stakeholder Input	Other	Source(s)
Lead Compound Heat Stabilizers in Plastics and Resins	PVC - major products include wire and cable coatings,	Y	#					
	wire and cable insulation and jacketing	Y	#	Chemical substitutes available for all uses: Mixed Metal stabilizers (Calcium-Zinc, Barium Zinc), organotins (methyl tin, octyl tin), magnesium-aluminum carbonates, organic compounds (organosulfide, heterocyclic)	O, U (low), End-of-Life Removal		EPA DfE Project underway to examine life cycle impacts of alternatives for NM-B building wire and communications wire	Crompton (Chemtura) [www.cromptoncorp.com]
	other flexible, plasticized, plastisols (emulsions): including toys, lunch bags, coated fabrics, hoses (note: industry reports lead stabilizers not used in US mfr resilient flooring)	Y		Chemical substitutes: organotin, Mixed metals (calcium/zinc, magnesium/zinc, barium/zinc, zinc), may be used with phosphite or epoxy co-stabilizers,	O, U, E			LEED information outreach forum [http://tsac-pvc.obiki.org/stabilizers.html]
	rigid, semi-rigid: large diameter, non-potable water pipes (use on decline) (note: industry reports lead stabilizers not used in US mfr domestic water/waste pipes or siding)	Y		Chemical substitutes: organotin, organic, calcium zinc, magnesium/zinc, barium/zinc				LEED information outreach forum [http://tsac-pvc.obiki.org/stabilizers.html] 2004 shift toward non-lead stab. In pipes: <http://www.modplas.com/kcorner/showarticle.html?id=270004>
Heat Stabilizer and vulcanizing agent in elastomers	elastomers - major products include wire and cable coatings, auto fluid handling	Y						

Appendix B.1: Lead Uses (cont.) - Sheet Lead

Major Use Category	Uses/Applications	Used as a Product in MA	Used in Manufacturing in MA	Availabilaity of Alternatives	Exposure Potential	Stakeholder Input	Other	Source(s)
Sheet lead	3 Processes to make sheet lead: sand cast sheet, machine cast sheet, and rolled sheet. 24,200 tons used annually in U.S.	Y	Y					Leadsheetassociation.org
	Sound barriers and sound proofing (in walls)	Y			O, C			USGS, IC Consultants, Mars Metal
	Building construction (roofing, flashings, weatherproofings, cornices, parapet walls, gutter linings, cladding)	Y		Yes (Aluminum, rubber backed metal for flashing and weatherproofings. Roofing alternatives are galvanized (zinc coated) steel sheet, zinc, and copper.	O, C, E			USGS, IC Consultants, Mars Metal, Danish Ministry of Environment
	Linings for storage tanks, process vessels, laboratory sinks	Y			O, C, E			USGS, IC Consultants, Mars Metal
	Shielding from nuclear reactors. Lead sheets, lead brick (straight and interlocking), lead blankets	Y			O, C, E			Encyclopedia.com, Mars Metal
	Radiation shielding for laboratories, hospitals, dental offices, and veterinary clinics. Sheet lead as laminated panels, adhesive bonded to such materials as plywood, gypsum board, and other supporting materials. Lead aprons, lead vests, lead collars, lead gonad shields, lead scoliosis shields, lead lined cabinets, lead shot bags (for cracks and crevices), lead curtains, lead lined doors/windows/frames, lead boxes/cans/containers	Y		Lead-free aprons: Bar-Ray Products, Infab Corporation, MarShield, Protech, Pulse Medical, Shielding International. Product information does not disclose the material.	O, C, E			Encyclopedia.com, Mars Metal, Alchemy Castings
	Corrosion protection - Acid Storage and Handling, Autoclaves, Precipitators	Y			O, C, E			Mars Metal
	Vibration absorbers	Y			O, C, E			Mars Metal

Appendix B.1: Lead Uses (cont.) - Miscellaneous

Major Use Category	Uses/Applications	Used as a Product in MA	Used in Manufacturing in MA	Availability of Alternatives	Exposure Potential	Stakeholder Input	Other	Source(s)
Miscellaneous								
	Alloys - Aluminum (lead impurity)	Y			O, C			Environmental Defense
	Alloys - Copper (motor vehicles - bearing shells and bushes)	Y			O, C			Environmental Defense
	Alloys - Steel (motor vehicle parts such as transmission, power steering, etc.)	Y			O, C			Environmental Defense
	Annealing - a process whereby glass, metals, and other materials are treated to render them less brittle and more workable. The materials are heated and then cooled slowly. The wire annealing process typically uses ammonium chloride as the flux and molten lead as the heat sink.	N		CA - as part of TURI's 2000 Cleaner Technology Demonstration Site Program, a lead-free wire annealing process using radio frequency ovens as the heat source and a controlled atmosphere to eliminate oxidation.				
	Antifriction applications - Machine bearings - Babbit metal alloy - lead/copper/antimony	Y						Encyclopedia.com
	Bearing materials -	Y		Yes - Tin based alloys	O, C			IC Consultants, Alchemy Castings
	Billets - Lead acetate	Y			O, C			Brass and bronze
	Bitewings	Y		Yes - Ecomass	O, C			
	Cable sheathing	Y			O, C			IC Consultants
	Candle wicks	Y			O, C		CPSC banned sale of lead core wicks in 2003	
	Catalyst - lead carbonate	Y						National Toxicology Program
	Catalyst - lead chloride	Y						National Toxicology Program
	Catalyst - lead fluoborate	Y						National Toxicology Program
	Catalyst - lead fluoride	Y						National Toxicology Program
	Catalyst - Lead napthenate	Y						National Toxicology Program
	Ceramics - lead oxide	Y			O, C			National Toxicology Program
	Ceramics - lead sulfide	Y			O, C			National Toxicology Program
	Coating - zinc (motor vehicles)	Y			O, C			Environmental Defense
	Coating on paper for photothermography - Lead nitrate	Y			O, C			National Toxicology Program
	Coatings for thermographic copying - Lead carbonate	Y			O, C			National Toxicology Program
	Concrete - Lead is found in trace amounts in sand, stones, and coal fly ash used to make concrete.	Y	Y					
	Curing agent for epoxy resins - Lead fluoborate	Y			O, C			National Toxicology Program
	Drier in paints and varnishes - Lead acetate	Y			O, C			Encyclopedia.com
	Explosives: Detonator - Lead azide - Pb(N3)2	Y			O, C			Encyclopedia.com
	Flame retardant - Lead chloride	Y			O, C			National Toxicology Program
	Fuels for aircraft, racing vehicles, and non-road vehicles such as farm machinery, marine vessels, construction equipment, and recreational vehicles. - Organic lead	Y			O, C			National Toxicology Program
	Glazes - Lead tetraoxide	Y			O, C			National Toxicology Program
	Hair dye (i.e.Grecian Formula) - Lead acetate	Y			O, C			
	Heat stabilizer in nylon - Lead nitrate	Y			O, C			National Toxicology Program
	Heavy machinery (vibration dampening)	Y			O, C			Encyclopedia.com
	Humidity sensor in rockets - Lead sulfide	Y			O, C			National Toxicology Program
	Ingots - Lead actetate	Y			O, C			Brass and bronze
	Insecticide (former use?) - Lead arsenate	Y			O, C			Encyclopedia.com
	Lead foil	Y			O, C			Encyclopedia.com

Appendix B.1: Lead Uses (cont.) - Miscellaneous

Major Use Category	Uses/Applications	Used as a Product in MA	Used in Manufacturing in MA	Availability of Alternatives	Exposure Potential	Stakeholder Input	Other	Source(s)
	Linings - brake - Lead chloride	Y			O, C			National Toxicology Program
	Linings - clutch - Lead chloride	Y			O, C			National Toxicology Program
	Manufacture for munitions - Lead styphnate	N			O			National Toxicology Program
	Manufacture of certain pottery - White lead, a mixture of lead carbonate and lead hydroxide	N			O			Encyclopedia.com
	Manufacture of explosives - Lead nitrate	N			O			National Toxicology Program
	Manufacture of matches - Lead nitrate	N			O			National Toxicology Program
	Manufacture of putty - White lead, a mixture of lead carbonate and lead hydroxide	N			O			Encyclopedia.com
	Manufacture of safety matches and cartridges - Lead thiocyanate	N			O			National Toxicology Program
	Manufacture of sulfuric acid. Used in the "chambers" in the lead-chamber process.	N			O			Encyclopedia.com
	Manufacture other lead compounds - Lead acetate	N			O			Encyclopedia.com
	Metal products: collapsible tubes, annealing, galvanizing, plating, electrowinning	Y			O, C			USGS
	Mordant for cotton dyes - Lead acetate	N			O			National Toxicology Program
	Mordant in textile printing and dyeing - Lead acetate	N			O			Encyclopedia.com
	Ointments - Lead tetraoxide	Y			O, C			National Toxicology Program
	Ornamental ware (pewter)	Y			O, C			IC Consultants
	Photography - Lead iodide	Y			O, C			National Toxicology Program
	Photography -	Y			O, C			National Toxicology Program
	Plasters - Lead tetraoxide	Y			O, C			National Toxicology Program
	Powder: Bright red to orange-red powder (also called minium) used in the manufacture of storage batteries, lead glass, and red pigments.- Red lead, lead tetraoxide (Pb3O4)	Y			O, C			Encyclopedia.com
	Reagent, analytical - Lead acetate trihydrate	Y			O, C			National Toxicology Program
	Solder - Building construction	Y			O, C			USGS
	Solder - metal cans, shipping containers	Y			O, C			USGS
	Stabilizers in plastics - Lead phosphate	Y			O, C			National Toxicology Program
	Stabilizers in plastics - Lead stearate	Y			O, C			National Toxicology Program
	Tattoo inks/pigments	Y			O, C			
	Terne metal (motor vehicle fuel tanks)	Y			O, C			USGS, Environmental Defense
	Thermoelectric materials - Lead iodide	Y			O, C			National Toxicology Program
	Type metal - printing industry	Y			O, C			USGS
	Varnish dryer - Lead napthenate	Y			O, C			National Toxicology Program
	Varnishes - Lead acetate trihydrate	Y			O, C			National Toxicology Program
	Varnishes - Lead tetraoxide	Y			O, C			National Toxicology Program
	Vibration dampers - motor vehicles	Y			O, C			Environmental Defense
	Vulcanizing agent in rubber and plastics - lead oxide	Y			O, C			National Toxicology Program
	Water repellant for industrial uses - lead acetate	Y			O, C			National Toxicology Program

Appendix B.2: Formaldehyde Uses

Major Use Category	Specific Use Type	Uses/Applications	Availability of Alternatives	Exposure Potential	Source(s) of Information	More detail on Use	More detail on Alternatives	More detail on exposure
RESINS	Phenol-formaldehyde resin	General: adhesives and resins			Kirk-Othmer Encyclopedia of Chemical Technology, 1994 and 2004; Chemical Economics Handbook (2004)			
		Wood adhesives (plywood, oriented strand board, hardboard, molded wood, particleboard)	CA	O, C	Kirk-Othmer, Chemical Economics Handbook (2004)	Adhesive for plywood, oriented strand board, hardboard, molded wood, particleboard. Compete with MDI	Polymeric diphenylmethane diisocyanate (pMDI), MDI adhesive, formaldehyde free waste fiber products such as Iosboard, PrimeBoard, Hawaiin DuragreenDuraGreen manufactures panelboard made from sugar can bagasse and PMDI) http://bayermaterialsciencenafta.com/industries/construction/ad_solid_polyiso.html Uses: The above-mentioned Desmodur® and Mondur® grades are ideal for the production of adhesives for timber structures, for example for the bonding of panels and parquet flooring. In addition, heavy-duty floor coverings are frequently bonded with two-component polyurethane adhesives based on Desmodur® and Bayer polyols. Advantages: Adhesion-promoting effect on plastics; Fast, spatial crosslinking; High heat resistance; Rapid crosslinking	http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=10447661&dopt=Abstract
		Insulation (phenolic foam insulation, binders for insulation)	CA	O, C	Kirk Othmer, Chemical Economics Handbook (2004)	PF resins used to bind glass fibers, mineral wool, or shredded waste products such as cotton, wool or polyester for structural and acoustical insulation; glass fiber is 90% of consumption. Glass fiber applications include home and commercial insulation and for industrial, equipment and pipe insulation. Waste fiber is used primarily in acoustical applications such as carpet padding. Mineral wool is used mainly to insulate home and industrial boilers, steam pipes and reactor vessel jackets.	In March 2002, Johns Manville became the first, and today is still the only, fiber glass insulation manufacturer to stop adding formaldehyde to building insulation as a binder. Instead, Johns Manville uses an acrylic binder that eliminates all binder-related emissions of formaldehyde during manufacturing. The acrylic binder also reduces concerns about formaldehyde in the indoor environment once installed.	http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=8865598&dopt=Abstract
		Decorative and Industrial (circuit board and personal computers) laminates	CA	O	Kirk Othmer, Chemical Economics Handbook (2004)	Decorative laminates account for 90% of demand and include wall paneling, cabinet faces, furniture, tables and countertops. In decorative applications pf resin compete with melamine-formaldehyde resins and low pressure laminates of polyester. Industrial applications include gears, bearings, rings, valves, printed circuit boards, panels, and terminal boxes. Epoxy and silicone products compete in the industrial applications.	Glass/lignin laminates result in lower concentrations of volatile compounds than paper/phenolic resin-based laminates. Although this test was conducted on only eight laminate samples of four different laminate types, the results show that, for the samples tested, lass/ligninncontaining epoxy resin laminates emit lower concentrations of volatile compounds than the paper/phenolic resin-based laminates during simulated PC monitor on-time operation at 65EC. The data also suggest that, if these laminates were used as pollution prevention alternatives for paper/phenol circuit board laminates in PC monitors, reductions in VOC emissions from PC monitors could be achieved. Source: EPA: Inside IAQ, http://www.epa.gov/appcdwww/iemb/insideiaq/fw98.pdf	
		Foundry mold binders		O	Kirk-Othmer Encyclopedia of Chemical Technology	Foundries are used for casting metal products. PF resins bond sand for cores used in a mold to produce hollow casting.		
		Molding compounds		O	Kirk-Othmer Encyclopedia of Chemical Technology, 1994 and 2004	Phenolic molding compounds are composites that combine fillers, additives and PF resins. Used for heat resistant components under- the-hood automotive applications, appliances, and housewares and wiring devices in the electrical industry. Automotive and houseware/appliance account for 40% and 33% respectively of pf molding compound demand.		
		Other: clutch facings, disk brake pads, automatic transmission components and brake linings, protective coatings (food containers), rubber processing additives, and abrasives for metal finishings			TURA data 2003			
		Reacting, mixing and blending of resins (see also paraformaldehde)		O				
	Urea-formaldehyde resin	Wood Adhesive (particleboard, medium-density fiberboard, hardwood plywood and waferboard)	CA	O, C	Kirk-Othmer, Chemical Economics Handbook (2004)	UF resins account for 95% of wood adhesives for particleboard used to make cabinets, case goods, doors, countertops, furniture and fixtures, floor underlayment and decking. MDF is used in furniture and case goods and provides better binding strength and stiffness, smoother surface and tight edges. MDF is more resistant to moisture and has less tendency to swell and shrink. Hardwood is used primarily for furniture.	(Phenol, MDI, Soy), Bio products with reduced formaldehyde/VOCs http://www.dow.com/bioprod/index.htm	
		Glass fiber roofing mats		O, C	Kirk-Othmer, Chemical Economics Handbook (2004)		http://www.ci.seattle.wa.us/sustainablebuilding/docs/Roofing.pdf	
		Molding compounds: Ball milling		O	TURAdata 2003 Perstorp Compounds Inc. 2,732,087lbs used	Production Unit: Ball Milling		
		Molding compounds: electrical switches, circuit breakers and other		O	Kirk-Othmer, Chemical Economics Handbook (2004)			
		Cross-linking agent for surface coating including flame retardants	CA	O	Chemical Economics Handbook (2004); Comparison of DMDHEU and M-F as the Binding Agent for a Hydroxy-Functional Organophosphorus Flame Retarding Agent on Cotton, Weidong Wu and Charles Q Yang, Dept. of Textiles, Merchandising and Interiors, University of Georgia, Athens, Journal of Fire Sciences (http://jfs.sagepub.com)			
		Other: Low- pressure laminates, wet strength additives and coatings for paper products, textile treating, cross-linking agents for surface coating		O, C	Kirk Othmer only			

Appendix B.2: Formaldehyde Uses (cont.)

Major Use Category	Specific Use Type	Uses/Applications	Availability of Alternatives	Exposure Potential	Source(s) of Information	More detail on Use	More detail on Alternatives	More detail on exposure
RESINS	Melamine-formaldehyde resin	Wood Adhesive in decorative laminate	CA	C	Kirk-Othmer Encyclopedia of Chemical Technology, 1994 and 2004; Chemical Economics Handbook (2004)			
		Thermoset surface coatings		O	Kirk-Othmer Encyclopedia of Chemical Technology, 1994 and 2004; Chemical Economics Handbook (2004)			
		Molding compounds such as dinnerware (medical products, household fixtures), tire cord and ceiling tiles	Y		TURAdata 2002 Mead Paper Company (Meadwestvaco Corp)	Wet strength additive for friction paper for automatic transmissions. Alternative is Kymene		
		Paper and textile treating		O, C				
		Used as cross-linking agent for flame retardant		O, C	see above and Flame Retardant Chemicals and Environment, Health and Safety Aspects, FireRetard.com			
	Resorcinol-Formalde-hyde resin	Wood adhesive		O	Bordenchem.com			
		Molding compounds: Ball milling		O				
	Polyacetal resin	These are high performance plastics produced from formaldehyde that are used for automotive parts, in building products, and in consumer goods		O	Kirk-Othmer Encyclopedia of Chemical Technology, 1994 and 2004			
	Methylene diisocyanate (MDI)	Rigid urethane foams, Elastic Fibers, Elastomers	CA	O	Kirk-Othmer Encyclopedia of Chemical Technology, 1994 and 2004		(Pmdi)	
		Wood adhesive		O	Particleboard and Medium-Density Fiberboard, Greenseal Report, October 2001	Does not offgas during us. Able to bond to wood particles with higher moisture content. Can be used with agricultural residu products which formaldehyde cannot. MDI manufacturing is a concern for exposure to workers to isocyanates.		
	Electro-less Copper	Electroless copper deposition for composite panel of electronic circuitry	CA	O	TURA Data 2003 , Sanmina Corp. 40,727lbs	electrolytic and electroless deposition of metal onto fiberglass/copper composite. And waste treatment operations		
	Dispersant	Neutralized naphthalene sulfonate polymer for anionic dispersant		O	TURA Data 2003			
DISINFECTANT/STERILANT		Sterilization of heat –sensitive medical instruments and hospital supplies (bedding and blankets),	CA	O				
	Paraformaldehyde	EPA registered disinfectant, sanitizer and fungicide for barber and beauty and for households, ships, bedding, clothing, nonfood/non/feed transporting trucks. "Steri-dri" tubes used as dry sterilant for hairbrushes in hair salons (sublimates to gaseous formaldehdye)	CA	O, C		Also identified for anthrax decontamination		
	Formalin (34-38% formaldehyde)	Microbiologically active against bacteria, fungi, bacterial spores, many viruses	CA	O				
		(8% solution with isopropanol) Bacteriacidal, tuberculocidal and sporicidal		O				
		(6-8% solution) Rated as a sterilant		O				
		(1-8%) Rated as a low to high level disinfectant		O				
	Paraformal-dehyde	Fumigant	CA	O				

Appendix B.2: Formaldehyde Uses (cont.)

Major Use Category	Specific Use Type	Uses/Applications	Availability of Alternatives	Exposure Potential	Source(s) of Information	More detail on Use	More detail on Alternatives	More detail on exposure
PRESERVATIVE (Formalin)		Embalming fluid	CA	O	TURAData 2003	The Champion Company makes a line of formaldehyde free embalming products. Glutaraldehyde 3%, talc silicate, plaster of paris and wood dust are used. http://www.champion-newera.com/; cadaver refrigeration is a process alternative		
		Tissue fixation/Pathology	I	O			Omnifix, Amerifix	
		(Antimicrobials derived from formaldehyde) Inactivation of bacterial endotoxin; Preservation of cosmetics; Metal working fluids; Latex paint and Low VOC paint(50% of formaldehyde is biocide additive); Spin finishes; Textile impregnation; Secondary oil recovery	CA		Paint- http://www.epa.gov/appcdwww/iemb/insideiaq/fw98.pdf			
		Nail finishes; Nail hardeners	CA	O, C				
PRESERVATIVE (Formalin)		*Antimicrobial agent in Cosmetics: Hair preparations; Suntan and dry skin lotions; Makeup; Mouthwashes; Hand cream; Bath products; Mascara; Eye makeup; Cuticle softener; Nail creams; Vaginal deodorants; Shaving cream		O,C		Source WHO, 1999; ATSDR, 1999		
		Antimicrobial in cleaning products: Household cleaning agents; Dishwashing liquids; Fabric softeners; Shoe care agents; Car shampoos and waxes; Carpet cleaning agents		O,C		Source WHO, 1999; ATSDR, 1999		
		Preservatives in products that are formaldehyde releasers: Bromonitropropanediol; Bromonitrodioxane; Chloroallylhexaminium chloride		O,C		WHO 1999 (pg 19) obtained thru Danish Product Register Database (PROBAS)		
		Silage preservatives		O				
MISCELLENEOUS	Textile Coatings	Permanent (Durable) Press Fabric coating, see DMDHEU above		O		According to U.S. Dept. of Labor, OSHA 60-85% of all apparel fabric is finished with a formaldehyde resin		
		Both (DMDHEU) and melamine– formaldehyde are used as the binding agents between Flame Retardants and cotton		O				
	Paraform-aldehyde	Phenol Resin coated fabric used in molding and laminating reinforced plastic products (military -personal and vehicle armor)	Company will check past TURA plans	O, C, E	TURA data 2003 Lewcott Corp. 272,143lbs paraformaldehyde	Protective coatings for military personnel armor (ie. kevlar vests) and vehicle armor. Also blend phenol resins to sell		
	Urea-formaldehyde concentrates	Slow-release fertilizers; precursor for UF resins used in particleboard, plywood	CA	O				
DERIVATIVE CHEMICALS	1,4-butanediol	Used to produce tetrahydrofuran (THF) used for polyurethane elastomers; ?-butyrolactone used to make various pyrrolidinone derivatives; poly(butylenes terephthalate)(PBT) an engineering plastic; polyurethanes		O				
	Hexmethylene-tetramine	Thermosetting catalyst for phenolic resins (principal use). Manufacture of RDX explosive (cylonite) Rubber vulcanization accelerators Unisolated intermediate in the manufacture of nitrilotriacetic acid		O				
	Aminopoly carboxylic acids (EDTA and NTA), salts and organo phosphonates	Chelating agents in industrial and household cleaners and wastewater treatment,		O,E				
		EDTA is also a penetration enhancer in many cosmetic products		C, E	Skin Deep Report, Environmental Working Group, http://www.ewg.org/reports/skindeep/chemhealtheffect.php?chem_id=3572			
	Ethylene glycol			O,C,E				

Appendix B.2: Formaldehyde Uses (cont.)

Major Use Category	Specific Use Type	Uses/Applications	Availability of Alternatives	Exposure Potential	Source(s) of Information	More detail on Use	More detail on Alternatives	More detail on exposure
DERIVATIVE CHEMICALS	Trioxane and Tetraoxane	Used in the production of acetal resin (qv)		O				
	Dimethylol dihydroxy-ethylene urea (DMDHEU)	Used in permanent (durable) press fabrics and as the binding agents between flame retard and cotton	CA	O,C,E				
	Hexamine	Drug derived from formaldehyde used for urinary tract antisepsis, fuel starter		O		U.S. Military Hexamine (heximine) solid fuel tablets have been used by backpackers and in survival kits for years. Hexamine tablets provides a hot, clean burning blue flame. Ideal for cooking and heating. Can be used in a variety of compact pocket stoves such as our Esbit pocket stoves. Tablets can also be used as great fire starters for camp fires and BBQ's. 8 tabs per package (no longer in cardboard tube). Military Spec.		
	Pesticides	Fungicides, Herbicide manufacturing, also Pyridine chemicals for agriculture	CA	O,C,E				
POLYHYDRIC ALCOHOLS (Polyols)		Alkyd resins for use in automobile paint, house paints, artists' oil paints and synthetic lubricant markets		O		Alkyd coatings were developed as long ago as 1926. The resin can be produced from a coal derivative such as phthalic anhydride condensed with glycerine or ethylene glycol. In the manufacturing process, the resin is usually modified by the addition of various other oils or resins. The resulting modified alkyds vary considerably according to [p. 189] the additions. Each modified alkyd resin should be tested for its compatibility with such pigments as lead white and whiting. The resin is soluble in turpentine or mineral spirits and also is available as a water emulsion. Its chief use is in automobile finishes and interior house paints. Alkyd paint mediums for artists have been sold since the 1970s. [Kay, Reed. The Painters Guide to Studio Methods and Materials. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1983.]		
	Pentaerythritol	Used to produce rosin/tall oil esters Used to produce explosives (Pentaerythritol tetranitrate)		O				
	Trimethylol-propane	Used in urethane coatings, Polyurethane foams, Multifunctional monomers		O				
	Neopentyl glycol	Used in plastics produced from unsaturated polyester resins and in coatings based on saturated polyesters		O				
OTHER		(Formaldehyde and paraformaldehyde) Corrosion inhibitor Hydrogen sulfide scavenger		O				
		Leather tanning		O	ATSDR			
		Photographic film production		O	ATSDR			
		Dyes						

Appendix B.3: Perchloroethylene Uses

Major Use Category	Uses/Applications	National Use Data 2004 (355 Million lbs)	Used as a Product in MA	Used in Manufacturing in MA	Availabilaity of Alternatives	Exposure Potential	Stakeholder Input	Other	Source(s)
Chemical Intermediate	Raw material in manufacturing hydrofluorcarbon 134-a.	66% - 234 million lbs	Y		I - Manufacturers are working to find a coolant that is environmentally harmless on all fronts*	E, O			*http://wlapwww.gov.bc.ca/air/ozone/mvac1.html
	Used in synthesis of hydrochlorofluorocarbon 123, 124 and 125.		Y			E, O			http://www.hsis.org/white_papers/perc
Cleaning	Drycleaning	12% - 42.6 million lbs	Y	15,697	CA - Wet cleaning, CO2, Petroleum distillates, methyl siloxane (Green Earth solvent)	O, C, E		1400 dry cleaners in MA. Around 70% use PCE ~980 facilities	
	Automotive Aerosols	12% - 42.6 million lbs	103,529 Aerosol packaging						
	brake and engine cleaners/degreasers		Y	Y	CA - Water based, soy based, acetone based	O, C, E			
	auto body polish		Y			O, C, E			
	tire shine		Y			O, C, E			
	wire drier		Y			O, C, E			
	anti seize products		Y			O, C, E			
	Liquid Wrench (65-80 % PCE)								
	Aerosol specialty products					O, C, E			
	Metal Cleaning/Degreasing	8% - 28.4 million lbs	Y	19,600*	CA - See www.cleanersolutions.org database for alternatives	O, E			*No longer using PCE after working with TURI Lab
Miscellaneous		2% - 7.1 million lbs							
	Chemical maskant formulations			11,184	high solids low volatile organic compound (VOC) maskant - Caspian in conjunction with Malek - CAX waterborne maskant	O, E			http://www.hsis.org/white_papers/perc http://www.p2pays.org/ref/10/09215.htm
	Paint stripping - paint & varnish removers - consumer				CA - See www.cleanersolutions.org/Simple Solution database for atlernatives	O, C, E			www.scorecard.org
	Adhesive formulations				CA nPB based, water	O, C, E			
	Printing inks				CA soy based inks	O, E			
	Solvent for de-inking paper					O, E			www.scorecard.org
	Paper coatings					O, C, E			
	Inulating fluid in electrical transformers					O, E			
	Silicones					O, C, E			
Distributors			154,207						
Consumer product list (Scorecard.org)	Furniture polish/cleaners				CA biobased citrus products	O, C, E			Industrial uses found on scorecard.org under consumer products that may contain tetracholoethylene
	household rug & upholstery cleaners					O, C, E			
	Aerosol paint concentrations					O, C, E			
	waterproofing compounds					O, C, E			
	Oven cleaners					O, C, E			
	Lubricating oils & greases					O, C, E			
	Laundry starch products					O, C, E			
	Non structural caulking compounds & sealants					O, C, E			
	Silver polish, spray					O, C, E			
	Rubber coatings					O, E			OPPT chemical factsheet (Office of Pollution Prevention & Toxics) EPA 749-F-94-020 www.epa.gov/opptintr/chemfact/f_perchl.txt
	shoe polish					O, C, E			PAN Pesticides Database www.pesticideinfo.org
	Pesticides				CA	O, C, E			Did products search for products containing Tetrachloroethylene www.scorecard.org/chemical-profiles/pesticides
	process solvent for desulfurizing coal								Canadian Centre for Occupational Health and Safety, http://www.ccohs.ca/oshanswers/chemicals/chem_profiles/tetrachloroethylene/basic_tetra.html, February 19, 1999
	remove soot from industrial boilers								CCOHS
	used in the treatment of hookworm and some nematode infestations, but has been replaced by drugs which are less toxic and easier to administer.								CCOHS
	used as a heat-exchange fluid								http://www.speclab.com/compound/c127184.htm
	Typewriter correction fluid					O, C, E			same factsheet as above, listed as possible consumer products containing PCE

Appendix B.4: Hexavalent Chromium Uses

Major Use Category	Uses/Applications	Used as a Product in MA	Used in Manufacturing in MA	Availability of Alternatives	Exposure Potential	Stakeholder Input	Examples of MA Businesses Using Cr/ Misc. Notes	Source(s)
Alloy steels			Foundries (2) that were TURA reporters in 2003 used approx. 1.3 million libs. of Cr	CA	O; E		Engineered Materials Solutions, Attleboro; Wollaston Alloys, Braintree	
Tool steels	Knives, metal cutting tools	Y	Y					
High-speed steel	Drill bits	Y	Y					
Stainless steel	Surgical tools, marine propellers, wire, telecommunications equipment, appliances, cutlery, tubing, tanks	Y	Y		O; E		Atlantic Stainless, N. Attleboro	
Bearing steel	Ball bearings, rollers	Y	Y					
Non-ferrous alloys					O; E			
Chromium-Nickel alloy	Spark plugs, tubing	Y	Y				MicroGroup, Medway	
Cobalt/chromium-based alloys	Artificial hips, maxillofacial screws and plates	Y	Y		C?			
Chrome-Molybdenum alloy	Welding rods, bicycle frames	Y	Y					
Superalloys	Turbine engines/aircraft engines	Y	Y				AAA Metals, Hanson	
Alloy cast iron	Pumps, valves, wear plates							
Metal films		Y	Y				Greene Rubber, Woburn (?)	
	Electrodes in high-temperature oxidizing atmospheres						MA/COM	R. Anderson, Ma/COM
	Conductive protective coating for electronics enclosures							
Hard chrome electroplating		Y	Y; Electroplating chemical suppliers that were Chromium compounds TURA reporters used 139,733 lbs. in 2003	CA	O; E		Walton & Lonsbury, Attleboro; Smith & Wesson, Springfield?	
	Cylinder rods, aircraft parts, engraving and printing plates, gun bores, military hardware							
	Ventilation systems, fume hoods, scrubbers, tanks							
	Molds for plastic and rubber industry							
	Shock absorbers, pneumatic struts							
	DIY home plating kits							
Decorative chrome electroplating	Electroplated foil, auto trim, buckles, plumbing fixtures, musical instruments, pens	Y	Y	CA	O; E		Nu-Chrome, Fall River	
	DIY home plating kits							
Black chromium electroplating	Solar collectors, optical instruments, watch cases	Y	Y		O; E			
Chromate conversion anti-corrosion coatings	Zinc-plated sheet steel parts - white goods, electronics, automobiles	Y	Y	CA/I	O; E		Whitman Co., Whitman	
	Metal hardware							
	Auto refinishing							
	Priming paints							
Adhesion coatings	Adhesion layer for paint and powder coating on housings	Y	Y		O; E		MA/COM	R. Anderson, Ma/COM
	Adhesion promoter for bonding copper foil to circuit board polymer laminates							

Appendix B.4: Hexavalent Chromium Uses (cont.)

Major Use Category	Uses/Applications	Used as a Product in MA	Used in Manufacturing in MA	Availability of Alternatives	Exposure Potential	Stakeholder Input	Examples of MA Businesses Using Cr/ Misc. Notes	Source(s)
Pigments - Chrome yellow, orange, red, green		Y	Y; Chromium compounds TURA reporters used 363,839 lbs. in 2003	CA	O		California Products, Andover	
	Building paints							
	Traffic markings						Franklin Paints, Franklin	
	Heavy equipment paints							
	Marine paints (antifouling)						CertainTeed, Norwood	
	Asphalt roofing shingle granules							
	Plastic colorants						Teknor Apex	
	Architectural block, cement, pavers							
	Printing inks							
	Rubber							
	Flooring							
	Ceramics glazes						Gare Inc., Haverhill; Sheffield Pottery, Sheffield	
	Glass							
	Yttrium-aluminum-garnet lasers							
Textiles	Dyes	Y	Y; Chromium compounds TURA reporters used 43,860 lbs. in 2003				Duro Textiles, Fall River	
	Mordants - chemical agent that fixes a dyestuff to a fiber							
Fungicide/algaecides	Wood preservatives - CCA	Y	Y; 7 companies with total sales of $28 million; Chromium compounds TURA reporters used 514,846 lbs. in 2003	CA	O;C;E		Northeast Treaters, Belchertown; Bestway, Lancaster; Universal Forest, Belchertown; SIC 2491	
Tanning (sodium dichromate)	Leather, fur toys	Y	Y; 12 companies with total sales of $126 million	CA	O;C; E		Alliance Leather Finishing, Peabody; Boston Hides & Fur, Chelsea	
Photochemical Processing	Gum bichromate process	Y	Y; Chromium compounds TURA reporters used 29,840 lbs. in 2003				Polaroid, Waltham & New Bedford (specific use uncertain)	
Refractories (furnace linings)	Refractory bricks	N	?				a portion of CrIII used in refractory bricks can convert to CrVI during normal furnace operations.	
	Molding sands	N						
Portland Cement	Trace amounts occur naturally	Y	Y		O			
Electric Power Generation	By-product of coal and oil combustion	Y	Y; Chromium compounds TURA reporters used 144,576 lbs. in 2003	N/A	E; C			
Asbestos Brake Linings	By-product of brake wear	Y	Y					
Notes:								
Cr(VI) can be produced when Cr(III) is heated in the presence of mineral bases and oxygen. Such a change (from CrIII to CrVI) also occurs as a by-product of welding or cutting operations on stainless steel.								
Chromium (VI) exposure can cause lung cancer and contact dermatitis								
2003 TURA Data: Approx. 3 million lbs. per year was used by the 25 TURA filers								
Sources:								
Harris InfoSource Selectory, OSHA, ATSDR/CDC, National Library of Medicine, Chromium (VI) Handbook, USEPA, TURA Data								

Appendix B.5: DEHP Uses

Major Use Category	Uses/Applications	Used in Product in US (lb)**	Used as a Product in MA (lb)	Used in Mfg in MA (lb)	Availability of Alternatives	Exposure Potential	Stakeholder Input	Other	Source(s)
Polymer Uses	**Consumer Products (Approximately 30% of total US consumption of DEHP (2002 data - Chemical Economics Handbook, SRI International)**								
	Toys		**Y**	**N**	**CA** (alternative materials such as EVA, PP, PE, rubber, wood; alternative plasticizers such as other phthalates or adipates)	**O, C**		The European Parliament has permanently banned the use of DEHP, DBP and BBP in toys. Three other plastic softeners, DINP, DIDP and DNOP, will be banned from use in those toys and childcare articles that can be put children's mouths.	* Euractiv website: http://www.euractiv.com/Article?tcmuri=tcm:29-142028-16&type=News * Tukker, presentation at Plasticizers 2004 Conference, Brussels
	Sheet/Film (e.g., food packaging)	15% of total use (figure for all sheet materials, not just for food packaging)	**Y**	**180,603** (used) **734,075** (incorp. in product)	**CA** (alternative materials such as EVA, PE, PPA, PBA, PVdC; alternative plasticizers including di(2-ethylhexyl) adipate, epoxidized soya bean oil, and acetyl tributyl citrate)	**O, C**			* 2003 TURA data * MedScape (http://www.medscape.com/viewarticle/407990_17) * Food Surveillance Info Sheets, MAFF (http://achive.food.gov.uk/maff/archive/food/infsheet/1994)
	Vinyl Shower Curtains		**Y**	**N**	**CA** (alternative materials such as fabrics; alternative plasticizers such as other phthalates, polyester plasticizers, phosphates, benzoates)	**O, C**			Tukker, presentation at Plasticizers 2004 Conference, Brussels
	Vinyl Wall Covering	21% of total use	**Y**	**N**	**CA** (alternative materials such as fabrics; alternative plasticizers such as other phthalates, polyester plasticizers, phosphates, benzoates)	**O, C**			KEMI, 1997 data
	Car Undercoating	1% of total use	**Y**		**CA** (alternative materials such as bitumen/rubber mix, PUR; alternative plasticizers such as other phthalates and benzoates)	**O, E**			* KEMI, 1997 data * Tukker, presentation at Plasticizers 2004 Conference, Brussels
	Footwear	8% of total use	**Y**	**N**	**CA** (alternative materials such as EVA and syndiotactic polypropylene (sPP))	**O, E**			* KEMI, 1997 data * Lawrence Livermore Laboratory report to the US Consumer Product Safety Commission (2001)
	Upholstery		**Y**	**N**	**CA** (alternative materials such as PUR for leather, HDPE , acrylics; alternative plasticizers such as other phthalates, polyester plasticizers, phosphates, benzoates)	**O, C**		PVC-backed upholstery	Tukker, presentation at Plasticizers 2004 Conference, Brussels
	Medical Devices (Approximately 25% of total US consumption of DEHP (2002 data - Chemical Economics Handbook, SRI International)								
	Plastic sheet materials (e.g., bags)	15% of total use (figure for all sheet materials, not just for medical devices)	**Y**	**566,306** (typically containing 20 - 40% DEHP)	**CA** (alternative materials such as EVA, silicone, PE or PUR; alternative plasticizers including butyryl-n-trihexylcitrate, other phthalic acid esters (eg, di-n-octyl phthalate, didecyl phthalate), adipic acid esters (e.g., diethylhexyl adipate), citric acid esters (e.g., acetyltributyl citrate), and tri-(2-ethylhexyl)trimellitate (TOTM))	**O, C**		FDA approval required for any alternative	* 2003 TURA data * KEMI, 1997 data (not limited to medical device uses) * US Food & Drug Administration * MedScape (http://www.medscape.com/viewarticle/407990_17)
	Tubing (e.g., IV tubing)		**Y**	**N**	**CA** (see above, includes glass as alternative material)	**O, C**		FDA approval required for any alternative	

Appendix B.5: DEHP Uses (cont.)

Major Use Category	Uses/Applications	Used in Product in US (lb)**	Used as a Product in MA (lb)	Used in Mfg in MA (lb)	Availability of Alternatives	Exposure Potential	Stakeholder Input	Other	Source(s)
	Industrial/ Commercial Uses (Approximately 45% of total US consumption of DEHP (2002 data - Chemical Economics Handbook, SRI International)								
	Resilient Flooring	15% of total use	**Y**	**1,049,498**	**CA** (alternative materials including cork, asphalt tile; alternative plasticizers such as benzyl phthalates, phosphate esters)	**O, C**	also used in consumer products	Plasticizer consumed in flooring: $57,976,000 delivered in 2002, $71,164,000 delivered in 1997	* 2003 TURA data * US Census Bureau 2002 Economic Census data * KEMI, 1997 data * Ferro website (www.ferro.com)
	Roofing		**Y**	**N**	**CA**	**O, E**		mostly used in areas of extreeme temperature differentials	
	Aluminum Foil Coating/ Laminating		**Y**	**N**	**CA**	**O, C**			
	Paper Coating		**Y**	**N**	**CA**	**O, C**			
	Extrudable PVC Molds/Profiles	1% of total use	**Y**	**648,872**	**CA** (alternative materials such as EVA, silicone, PE or PUR; alternative plasticizers including butyryl-n-trihexylcitrate, other phthalic acid esters (eg, di-n-octyl phthalate, didecyl phthalate), adipic acid esters (e.g., diethylhexyl adipate), citric acid esters (e.g., acetyltributyl citrate), and tri-(2-ethylhexyl)trimellitate (TOTM))	**O, E**			* 2003 TURA data * KEMI, 1997 data * US Food & Drug Administration * MedScape (http://www.medscape.com/viewarticle/407990_17)
	Electronic Component Parts		**Y**	**58,571**	**CA** (alternative materials such as PUR)	**O, E**			* 2003 TURA data * 3M product specs
	Wire/Cable Coating/ Jacketing	15% of total use	**Y**	**21,200** (mfgd) **69,936** (incorp in product)	**CA** (alternative materials such as LDPE, XLPE; alternative plasticizers such as other phthalates, trimellitates; 2-ethylhexyldiphenyl phosphate, cellulose nitrate, cellulose acetatebutyrate, ethylcellulose)	**O, E**			* 2003 TURA data * KEMI, 1997 data * Ferro website (www.ferro.com)
Non-Polymer Uses	Lighting Ballasts and Electric Capacitors		**N**	**N**	**CA** (e.g., mineral oils)	**O, E**		production stopped in 1992	
	Vacuum Pump Oil		**N**	**N**	**CA** (e.g., petroleum based oils, mineral oils)	**O, E**		* Australian Gov't Dept of Environment and Heritage (http://www.npi.gov.au/database/substance-info/profiles/43.html) *"Gardner's Commercially Important Chemicals", Wiley Interscience, 2005	
	Perfumes/ Cosmetics			**N**	**CA** (e.g., acetyl triethyl citrate, acetyl tributyl citrate, acetyl trihexyl citrate, and acetyl trioctyl citrate)	**O, C**		mostly DBP, DEP and DMP	Johnson, Cosmetic Ingredient Review, 2002
	Pesticides			**N**	**CA** (e.g., integrated pest management)	**O, C, E**		inert material in pesticides	
	Printing Inks (e.g., lithographic)	<1% of total use	**Y**	**N**	**CA** (other phthalates)	**O, C, E**			KEMI, 1997 data
	Paints and Lacquers	<1% of total use	**Y**	**N**	**CA** (e.g., benzyl phthalates)	**O, C, E**			* KEMI, 1997 data * Ferro website (www.ferro.com)
	Adhesives and Coatings	2% of total use	**Y**	**13,531**	**CA** (alternative materials such as PUR; alternative plasticizers such as benzyl phthalates)	**O, C, E**			* 2003 TURA data * KEMI, 1997 data * Ferro website (www.ferro.com)
	Ceramics	<<1% of total use	**Y**	**N**	**CA**	**O**		used as binders to increase the flexibiliy of the ceramic mix	* KEMI, 1997 data

**** Based on 2003 KEMI study of EU total uses of DEHP in 1997 - assume equivalent percentages apply in the US**