Chemicals of High Concern

2015 Triennial Update

Chemical-Specific Inclusion Criteria

Appendix I

July 21, 2015

Environmental & Occupational Health Programs
Maine Center for Disease Control and Prevention
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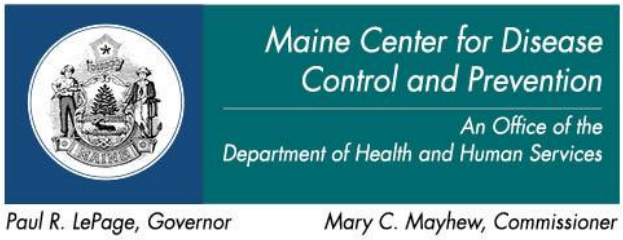

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Summary

This appendix document presents the toxicity and exposure inclusion criteria for each chemical of high concern included in the 2015 CHC list. The chemical-specific inclusion criteria documentation was updated from the 2012 documentation (Appendix III, Deriving Chemicals of High Concern Process Documentation, July 1, 2012) for the 2015 triennial update. Unless specifically noted, the chemical specific toxicity and exposure references from peer-reviewed scientific publications represent findings from preliminary scientific literature searches performed in 2012 and, if applicable, searches performed for the 2015 update. The preliminary literature searches and resulting references are not meant to be comprehensive lists of the entirety of a chemical's available published scientific literature.

Benzene (CAS 71-43-2)

Toxicity criteria:
NTP ROC: Known to be a human carcinogen, IRIS Cancer: Category A known human carcinogen (1986 criteria); Known human carcinogen (1996 criteria), GHS Cancer: Category 1A carcinogen, EU Cancer: Category 1A carcinogen, IARC: Group 1 carcinogenic to humans.

Exposure criteria, biomonitoring:
The presence of benzene in humans was identified in 8 biomonitoring studies.

1. CDC (2015). Fourth National Report on Human Exposure to Environmental Chemicals. Blood Benzene (2001-2006). Centers for Disease Control and Prevention, Atlanta, Ga.
2. Elliott, L., Longnecker, M. P., Kissling, G. E., London, S. J. (2006). "Volatile organic compounds and pulmonary function in the Third National Health and Nutrition Examination Survey, 1988-1994." Environmental Health Perspectives 114(8): 1210-1214.
3. Kim, S. R., Halden, R. U., Buckley, T. J. (2007). "Volatile organic compounds in human milk: Methods and measurements." Environmental Science Technology 41(5): 1662-1667.
4. Lin, Y. S., Egeghy, P. P., Rappaport, S. M. (2008). "Relationships between levels of volatile organic compounds in air and blood from the general population." Journal of Exposure Science and Environmental Epidemiology 18: 421-429.
5. Pellizzari, E. D., Smith, D. J., Clayton, A., Michael, L. C., Quackenboss, J. J. (2001). "An assessment of the data quality for NHEXAS-Part I: Exposure to metals and volatile organic chemicals in Region 5." Journal of Exposure Analysis and Environmental Epidemiology 11: 140-154.
6. Sexton, K., Adgate, J. L., Church, T. R., Ashley, D. L., Needham, L. L., Ramachandran, G., Fredrickson, A. L., Ryan, A. D. (2005). "Children's exposure to volatile organic compounds as determined by longitudinal measurements in blood." Environmental Health Perspectives 113(3): 342-348.
7. Sexton, K., Adgate, J. L., Fredrickson, A. L., Ryan, A. D., Needham, L. L., Ashley, D. L. (2006). "Using biologic markers in blood to assess exposure to multiple environmental chemicals for inner-city children 3 - 6 years of age." Environmental Health Perspectives 114(3): 453-459.
8. Woodruff, T.J., Zota, A.R., Schartz, J.M. (2011). Environmental chemicals in pregnant women in the United States: NHANES 2003-2004. Environmental Health Perspectives 119:878-885.

Exposure criteria, presence in indoor air and/or dust:
The presence of benzene was identified in 9 indoor air and/or dust studies.

1. Adgate, J. L., Church, T. R., Ryan, A. D., Ramachandran, G., Fredrickson, A. L., Stock, T. H., Morandi, M. T., Sexton, K. (2004). "Outdoor, indoor and personal exposure to VOCs in children." Environmental Health Perspectives 112(14): 1386-1392.
2. California Air Resources Board (2005). Indoor Air Pollution in California - Report to the California Legislature. California Environmental Protection Agency.
3. Kim, S. R., Halden, R. U., Buckley, T. J. (2007). "Volatile organic compounds in human milk: Methods and measurements." Environmental Science Technology 41(5): 1662-1667.
4. Liu, J., Drane, W., Liu, X., Wu, T. (2009). "Examination of the relationships between environmental exposures to volatile organic compounds and biochemical liver tests: application of canonical correlation analysis." Environmental Research 109(2): 193-199.
5. Miller, S. L., Branoff, S., Nazaroff, W. W. (1998). "Exposure to toxic air contaminants in environmental tobacco smoke: An assessment for California based on personal monitoring data." Journal of Exposure Analysis and Environmental Epidemiology 8(3): 287-311.
6. Pellizzari, E. D., Smith, D. J., Clayton, A., Michael, L. C., Quackenboss, J. J. (2001). "An assessment of the data quality for NHEXAS-Part I: Exposure to metals and volatile organic chemicals in Region 5." Journal of Exposure Analysis and Environmental Epidemiology 11: 140-154.
7. Serrano-Trespalacios, P. I., Ryan, L., Spengler, J. D. (2004). "Ambient, indoor and personal exposure relationships of volatile organic compounds in Mexico City Metropolitan Area." Journal of Exposure Analysis and Environmental Epidemiology 14: S118-S132.

8. Weisel, C. P., Alimokhtari, S., Sanders, P. F. (2008). "Indoor air VOC concentrations in suburban and rural New Jersey." Environmental Science & Technology 42(22): 8231-8238.
9. Zhu, J., Laifeng, Y., Shoeib, M. (2007). "Detection of dechlorane plus in residential indoor dust in the city of Ottawa, Canada." Environmental Science & Technology 41: 7694-7698.

Exposure criteria, presence in consumer products:
The presence of benzene was identified in consumer products in 7 databases.
Danish EPA, German FEA, ESIS_RAR, EPA inventory use (IUR), HPD_NLM, SPIN, and VCCEP.

Vinyl chloride (CAS 75-01-4)

Toxicity criteria:
NTP ROC: Known to be a human carcinogen, IRIS Cancer: Category A known human carcinogen (1986 criteria); Known human carcinogen (1996 criteria), GHS: Category 1A carcinogen, EU Cancer: Category 1A carcinogen, IARC: Group 1 carcinogenic to humans.

Exposure criteria, biomonitoring:
The presence of vinyl chloride in humans was not identified in biomonitoring studies.

Exposure criteria, presence in indoor air and/or dust:
The presence of vinyl chloride was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of vinyl chloride was identified in consumer products in 4 databases.
Danish EPA, EPA inventory use (IUR), SPIN, and 2012 TSCA Work Plan Consumer Products.

Tetrabromobisphenol A (CAS 79-94-7)

Toxicity criteria:
Present on Washington State's PBT list and confirmed by MECDC with review of peer-reviewed scientific publications identified in the Rationale for Concurrence by Maine Center for Disease Control and Prevention on the Designation of Brominated Flame Retardants as a Priority Chemical, November 22, 2010.

Exposure criteria, biomonitoring:
The presence of tetrabromobisphenol A in humans was identified in 2 biomonitoring studies.

1. Peters, R.J.B. (2005) Man-made chemicals in maternal and cord blood. TNO Report. B&O-A R 2005/129.
2. Thomsen, C., Lundanes, E., Becher, G. (2002). "Brominated flame retardants in archived serum samples from Norway: A study on temporal trends and the role of age." Environmental Science & Technology 36(7): 1414-1418.

Exposure criteria, presence in indoor air and/or dust:
The presence of tetrabromobisphenol A was identified in 1 indoor air and/or dust study.

1. Peters, R.J.B. (2005) Man-made chemicals in maternal and cord blood. TNO Report. B&O-A R 2005/129.

Exposure criteria, presence in consumer products:
The presence of tetrabromobisphenol A was identified in consumer products in 4 databases. Danish EPA, German FEA, ESIS_RAR, and EPA inventory use (IUR).

Dicyclohexyl phthalate; DCHP (CAS 84-61-7)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of dicyclohexyl phthalate in humans was identified in 1 biomonitoring study.

1. CDC (2015). Fourth National Report on Human Exposure to Environmental Chemicals. Urinary Mono-cyclohexyl phthalate (MCHP) (1999 – 2010), Metabolite of Dicyclohexyl phthalate (DCHP). Centers for Disease Control and Prevention, Atlanta, Ga.

Exposure criteria, presence in indoor air and/or dust:
The presence of dicyclohexyl phthalate was identified in 4 indoor air and/or dust studies.

1. Fromme, H., Lahrz, T., Piloty, M., Gebhart, H., Oddoy, A., Ruden, H. (2004). "Occurrence of phthalates and musk fragrances in indoor air and dust from apartments and kindergartens in Berlin (Germany)." Indoor Air 14: 188-195.
2. Otake, T., Yoshinga, J., Yanagisawa, Y. (2001). "Analysis of organic esters of plasticizer in indoor air by GC-MS and GC-FPD." Environmental Science & Technology 35(15): 3099-31002.
3. Roberts, J. W., Wallace, L. A., Camann, D. E., Dickey, P., Gilbert, S. G., Lewis, R. G., Takaro, T. K. (2009) "Monitoring and reducing exposure of infants to pollutants in house dust." Reviews of Environmental Contamination & Toxicology 201: 1-39.
4. Rudel, R. A., Camann, D. E., Spengler, J. D., Korn, L. R., Brody, J. G. (2003). "Phthalates, alkylphenols, pesticides, polybrominated diphenyl ethers, and other endocrine-disrupting Compounds in indoor air and dust." Environmental Science & Technology 37(20): 4543-4553.

Exposure criteria, presence in consumer products:
The presence of dicyclohexyl phthalate was identified in consumer products in 1 database.
EPA inventory use (IUR).

2-Naphthylamine (CAS 91-59-8)

Toxicity criteria:
NTP ROC: known to be a human carcinogen, GHS: Category 1A carcinogen, EU Cancer: Category 1A carcinogen, IARC: Group 1 carcinogenic to humans.

Exposure criteria, biomonitoring:
The presence of 2-naphthylamine in humans was not identified in biomonitoring studies.

Exposure criteria, presence in indoor air and/or dust:
The presence of 2-naphthylamine was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of 2-naphthylamine was identified in consumer products in 1 database.
Danish EPA.

4-Hydroxybiphenyl (CAS 92-69-3)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of 4-hydroxybiphenyl in humans was identified in 2 biomonitoring studies.

1. Frederiksen, H., Nielsen, J.K., Mørck, T.A., Hansen, P.W., Jensen, J.F., Nielsen, O., Andersson, A.M., Knudsen, L.E. (2013). "Urinary excretion of phthalate metabolites, phenols and parabens in rural and urban Danish mother-child pairs." International Journal of Hygiene and Environmental Health 216 (6):772-783.
2. Frederiksen, H., Aksglaede, L., Sorensen, K., Nielsen, O., Main, K.M., Skakkebaek, N.E., Juul, A., Andersson, A.M. (2013). "Bisphenol A and other phenols in urine from Danish children and adolescents analyzed by isotope diluted TurboFlow-LC-MS/MS. International Journal of Hygiene and Environmental Health 216 (6):710-720.

Exposure criteria, presence in indoor air and/or dust:
The presence of 4-hydroxybiphenyl was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of 4-hydroxybiphenyl was not identified in a consumer products database.

Benzidine and its salts (CAS 92-87-5)

Toxicity criteria:
NTP ROC: Known to be a human carcinogen, IRIS Cancer: Category A known human carcinogen (1986 criteria), GHS Cancer: Category 1A carcinogen, EU Cancer: Category 1A carcinogen, IARC: Group 1 carcinogenic to humans.

Exposure criteria, biomonitoring:
The presence of benzidine and its salts in humans was not identified in biomonitoring studies.

Exposure criteria, presence in indoor air and/or dust:
The presence of benzidine and its salts was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of benzidine and its salts was identified in consumer products in 1 database.
Danish EPA.

Propyl paraben (CAS 94-13-3)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of propyl paraben in humans was identified in 4 biomonitoring studies.

1. CDC. (2015). Fourth National Report on Human Exposure to Environmental Chemicals. Urinary n-Propyl paraben (2005 – 2010). Centers for Disease Control and Prevention, Atlanta, Ga.
2. Calafat, A.M., Ye, X., Wong, L.Y., Bishop. A.M., Needham. L.L. (2010). Urinary concentrations of four parabens in the U.S. population: NHANES 2005-2006. Environmental Health Perspectives. 118 (5):679-85.
3. Ye, X., Kuklenyik, Z., Bishop, A. M., Needham, L. L., Calafat, A. M. (2006). "Quantification of the urinary concentrations of parabens in humans by on-line solid phase extraction-high performance liquid chromatography-isotope dilution tandem mass spectrometry." Journal of Chromatography B 844: 53-59.
4. Ye, X., Bishop, A.M., Needham, L.L., Calafat, A.M. (2008). Automated on-line column-switching HPLC-MS/MS method with peak focusing for measuring parabens, triclosan, and other environmental phenols in human milk. Analytica Chimica Acta 622:150-156.

Exposure criteria, presence in indoor air and/or dust:
The presence of propyl paraben was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of propyl paraben was identified in consumer products in 5 databases.
Danish EPA, Dutch (NL) reports, HSDB_NLM, HPD_NLM, and SPIN.

Butyl paraben (CAS 94-26-8)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of butyl paraben in humans was identified in 3 biomonitoring studies.

1. CDC. (2015). Fourth National Report on Human Exposure to Environmental Chemicals. Urinary Butyl paraben (2005 – 2010). Centers for Disease Control and Prevention, Atlanta, Ga.
2. Calafat, A.M., Ye, X., Wong, L.Y., Bishop. A.M., Needham. L.L. (2010). Urinary concentrations of four parabens in the U.S. population: NHANES 2005-2006. Environmental Health Perspectives. 118 (5):679-85.
3. Ye, X., Kuklenyik, Z., Bishop, A. M., Needham, L. L., Calafat, A. M. (2006). "Quantification of the urinary concentrations of parabens in humans by on-line solid phase extraction-high performance liquid chromatography-isotope dilution tandem mass spectrometry." Journal of Chromatography B 844: 53-59.

Exposure criteria, presence in indoor air and/or dust:
The presence of butyl paraben was identified in 1 indoor air and/or dust study.

1. Rudel, R. A., Camann, D. E., Spengler, J. D., Korn, L. R., Brody, J. G. (2003). "Phthalates, alkylphenols, pesticides, polybrominated diphenyl ethers, and other endocrine-disrupting Compounds in indoor air and dust." Environmental Science & Technology 37(20): 4543-4553.

Exposure criteria, presence in consumer products:
The presence of butyl paraben was identified in consumer products in 5 databases.
Danish EPA, Dutch (NL) reports, HPD_NLM, SPIN, and Peer reviewed journals.

2-Aminotoluene (CAS 95-53-4)

Toxicity criteria:
IARC: Group 1 carcinogenic to humans.

Exposure criteria, biomonitoring:
The presence of 2-aminotoluene in humans was not identified in biomonitoring studies.

Exposure criteria, presence in indoor air and/or dust:
The presence of 2-aminotoluene was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of 2-aminotoluene was identified in consumer products in 1 database.
Danish EPA.

Methyl paraben (CAS 99-76-3)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of methyl paraben in humans was identified in 4 biomonitoring studies.

1. CDC. (2015). Fourth National Report on Human Exposure to Environmental Chemicals. Urinary Methyl paraben (2005 – 2010). Centers for Disease Control and Prevention, Atlanta, Ga.
2. Calafat, A.M., Ye, X., Wong, L.Y., Bishop. A.M., Needham. L.L. (2010). Urinary concentrations of four parabens in the U.S. population: NHANES 2005-2006. Environmental Health Perspectives. 118 (5):679-85.
3. Ye, X., Kuklenyik, Z., Bishop, A. M., Needham, L. L., Calafat, A. M. (2006). "Quantification of the urinary concentrations of parabens in humans by on-line solid phase extraction-high performance liquid chromatography-isotope dilution tandem mass spectrometry." Journal of Chromatography B 844: 53-59.
4. Ye, X., Bishop, A.M., Needham, L.L., Calafat, A.M. (2008). Automated on-line column-switching HPLC-MS/MS method with peak focusing for measuring parabens, triclosan, and other environmental phenols in human milk. Analytica Chimica Acta 622:150-156.

Exposure criteria, presence in indoor air and/or dust:
The presence of methyl paraben was identified in 1 indoor air and/or dust study.

1. Rudel, A., Camann, D. E., Spengler, J. D., Korn, L. R., Brody, J. G. (2003). "Phthalates, alkylphenols, pesticides, polybrominated diphenyl ethers, and other endocrine-disrupting Compounds in indoor air and dust." Environmental Science & Technology 37(20): 4543-4553.

Exposure criteria, presence in consumer products:
The presence of methyl paraben was identified in consumer products in 6 databases.
Danish EPA, Dutch (NL) reports, HSDB_NLM, HPD_NLM, SPIN, and Peer reviewed journals.

p-Hydroxybenzoic acid (CAS 99-96-7)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of p-hydroxybenzoic acid in humans was not identified in biomonitoring studies.

Exposure criteria, presence in indoor air and/or dust:
The presence of p-hydroxybenzoic acid was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of p-hydroxybenzoic acid was identified in consumer products in 2 databases.
Danish EPA, Dutch (NL) reports.

Styrene (CAS 100-42-5)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of styrene in humans was identified in 4 biomonitoring studies.

1. CDC. (2015). Fourth National Report on Human Exposure to Environmental Chemicals. Blood Styrene (2001 – 2006). Centers for Disease Control and Prevention, Atlanta, Ga.
2. Elliott, L., Longnecker, M. P., Kissling, G. E., London, S. J. (2006). "Volatile organic compounds and pulmonary function in the Third National Health and Nutrition Examination Survey, 1988-1994." Environmental Health Perspectives 114(8): 1210-1214.
3. Sexton, K., Adgate, J. L., Church, T. R., Ashley, D. L., Needham, L. L., Ramachandran, G., Fredrickson, A. L., Ryan, A. D. (2005). "Children's exposure to volatile organic compounds as determined by longitudinal measurements in blood." Environmental Health Perspectives 113(3): 342-348.
4. Sexton, K., Adgate, J. L., Fredrickson, A. L., Ryan, A. D., Needham, L. L., Ashley, D. L. (2006). "Using biologic markers in blood to assess exposure to multiple environmental chemicals for inner-city children 3 - 6 years of age." Environmental Health Perspectives 114(3): 453-459.

Exposure criteria, presence in indoor air and/or dust:
The presence of styrene was identified in 6 indoor air and/or dust studies.

1. California Air Resources Board (2005). Indoor Air Pollution in California - Report to the California Legislature. California Environmental Protection Agency.
2. Guo, H., Kwok, N. H., Cheng, H. R., Lee, S. C., Hung, W. T., Li, Y. S. (2009). "Formaldehyde and volatile organic compounds in Hong Kong homes: concentrations and impact factors." Indoor Air 19: 206-217.
3. Hodgson, A.T., Rudd, A.F., Beal, D., Chandra, S. (2000). "Volatile organic compound concentrations and emission rates in new and site-built houses." Indoor Air 10: 178-192.
4. Miller, S. L., Branoff, S., Nazaroff, W. W. (1998). "Exposure to toxic air contaminants in environmental tobacco smoke: An assessment for California based on personal monitoring data." Journal of Exposure Analysis and Environmental Epidemiology 8(3): 287-311.
5. Serrano-Trespalacios, P. I., Ryan, L., Spengler, J. D. (2004). "Ambient, indoor and personal exposure relationships of volatile organic compounds in Mexico City Metropolitan Area." Journal of Exposure Analysis and Environmental Epidemiology 14: S118-S132.
6. Weisel, C. P., Alimokhtari, S., Sanders, P. F. (2008). "Indoor air VOC concentrations in suburban and rural New Jersey." Environmental Science & Technology 42(22): 8231-8238.

Exposure criteria, presence in consumer products:
The presence of styrene was identified in consumer products in 7 databases.
Danish EPA, Dutch (NL) reports, German FEA, EPA inventory use (IUR), HPD_NLM, SPIN, and 2012 TSCD Work Plan Consumer Products.

4,4´-Methylenebis(2-Chloroaniline) (CAS 101-14-4)

Toxicity criteria:
IARC: Group 1 carcinogenic to humans.

Exposure criteria, biomonitoring:
The presence of 4,4´-methylenebis(2-chloroaniline) in humans was not identified in biomonitoring studies.

Exposure criteria, presence in indoor air and/or dust:
The presence of 4,4´-methylenebis(2-chloroaniline) was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of 4,4´-methylenebis(2-chloroaniline) was identified in consumer products in 2 databases. Danish EPA and 2012 TSCD Work Plan Consumer Products.

Epichlorohydrin (CAS 106-89-8)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of epichlorohydrin in humans was not identified in biomonitoring studies.

Exposure criteria, presence in indoor air and/or dust:
The presence of epichlorohydrin was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of epichlorohydrin was identified in consumer products in 2 databases.
Danish EPA and SPIN.

1,2-Dibromoethane (CAS 106-93-4)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of 1,2-dibromoethane in humans was not identified in biomonitoring studies

Exposure criteria, presence in indoor air and/or dust:
The presence of 1,2-dibromoethane was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of 1,2-dibromoethane was identified in consumer products in 2 databases.
EPA inventory use (IUR) and VCCEP.

1,3-Butadiene (CAS 106-99-0)

Toxicity criteria:
NTP ROC: Known to be a human carcinogen, GHS Cancer: Category 1A carcinogen, EU Cancer: Category 1A carcinogen, IARC: Group 1 carcinogenic to humans.

Exposure criteria, biomonitoring:
The presence of 1,3-butadiene in humans was identified in 1 biomonitoring study.

1. Schettgen, T., Musiol, A., Alt, E., Ochsmann, E. (2009). "A Method for the quantification of biomarkers of exposure to acrylonitrile and 1, 3-butadiene in human urine by column-switching liquid chromatography- tandem mass spectrometry." Analytical and Bioanalytical Chemistry 393: 969-981.

Exposure criteria, presence in indoor air and/or dust:
The presence of 1,3-butadiene was identified in 3 indoor air and/or dust studies.

1. California Air Resources Board (2005). Indoor Air Pollution in California - Report to the California Legislature. California Environmental Protection Agency.
2. Serrano-Trespalacios, P. I., Ryan, L., Spengler, J. D. (2004). "Ambient, indoor and personal exposure relationships of volatile organic compounds in Mexico City Metropolitan Area." Journal of Exposure Analysis and Environmental Epidemiology 14: S118-S132.
3. Weisel, C. P., Alimokhtari, S., Sanders, P. F. (2008). "Indoor air VOC concentrations in suburban and rural New Jersey." Environmental Science & Technology 42(22): 8231-8238.

Exposure criteria, presence in consumer products:
The presence of 1,3-butadiene was identified in consumer products in 4 databases.
Danish EPA, EPA inventory use (IUR), HPD_NLM, and SPIN.

Toluene (CAS 108-88-3)

Toxicity criteria:
GHS Reproductive: Category 1A.

Exposure criteria, biomonitoring:
The presence of toluene in humans was identified in 7 biomonitoring studies.

1. CDC. (2015). Fourth National Report on Human Exposure to Environmental Chemicals. Blood Toluene (2001 – 2006). Centers for Disease Control and Prevention, Atlanta, Ga.
2. Elliott, L., Longnecker, M. P., Kissling, G. E., London, S. J. (2006). "Volatile organic compounds and pulmonary function in the Third National Health and Nutrition Examination Survey, 1988-1994." Environmental Health Perspectives 114(8): 1210-1214.
3. Kim, S. R., Halden, R. U., Buckley, T. J. (2007). "Volatile organic compounds in human milk: Methods and measurements." Environmental Science Technology 41(5): 1662-1667.
4. Lin, Y. S., Egeghy, P. P., Rappaport, S. M. (2008). "Relationships between levels of volatile organic compounds in air and blood from the general population." Journal of Exposure Science and Environmental Epidemiology 18: 421-429.
5. Sexton, K., Adgate, J. L., Church, T. R., Ashley, D. L., Needham, L. L., Ramachandran, G., Fredrickson, A. L., Ryan, A. D. (2005). "Children's exposure to volatile organic compounds as determined by longitudinal measurements in blood." Environmental Health Perspectives 113(3): 342-348.
6. Sexton, K., Adgate, J. L., Fredrickson, A. L., Ryan, A. D., Needham, L. L., Ashley, D. L. (2006). "Using biologic markers in blood to assess exposure to multiple environmental chemicals for inner-city children 3 - 6 years of age." Environmental Health Perspectives 114(3): 453-459.
7. Woodruff, T.J., Zota, A.R., Schartz, J.M. (2011). Environmental chemicals in pregnant women in the United States: NHANES 2003-2004. Environmental Health Perspectives 119:878-885.

Exposure criteria, presence in indoor air and/or dust:
The presence of toluene was identified in 7 indoor air and/or dust studies.

1. California Air Resources Board (2005). Indoor Air Pollution in California - Report to the California Legislature. California Environmental Protection Agency.
2. Guo, H., Kwok, N. H., Cheng, H. R., Lee, S. C., Hung, W. T., Li, Y. S. (2009). "Formaldehyde and volatile organic compounds in Hong Kong homes: concentrations and impact factors." Indoor Air 19: 206-217.
3. Hodgson, A.T., Rudd, A.F., Beal, D., Chandra, S. (2000). "Volatile organic compound concentrations and emission rates in new and site-built houses." Indoor Air 10: 178-192.
4. Kim, S. R., Halden, R. U., Buckley, T. J. (2007). "Volatile organic compounds in human milk: Methods and measurements." Environmental Science Technology 41(5): 1662-1667.
5. Liu, J., Drane, W., Liu, X., Wu, T. (2009). "Examination of the relationships between environmental exposures to volatile organic compounds and biochemical liver tests: application of canonical correlation analysis." Environmental Research 109(2): 193-199.
6. Serrano-Trespalacios, P. I., Ryan, L., Spengler, J. D. (2004). "Ambient, indoor and personal exposure relationships of volatile organic compounds in Mexico City Metropolitan Area." Journal of Exposure Analysis and Environmental Epidemiology 14: S118-S132.
7. Weisel, C. P., Alimokhtari, S., Sanders, P. F. (2008). "Indoor air VOC concentrations in suburban and rural New Jersey." Environmental Science & Technology 42(22): 8231-8238.

Exposure criteria, presence in consumer products:
The presence of toluene was identified in consumer products in 7 databases.
Danish EPA, German FEA, ESIS_RAR, EPA inventory use (IUR), HPD_NLM, SPIN, and VCCEP.

Hexachlorobenzene (CAS 118-74-1)

Toxicity criteria:
GHS Reproductive: Category 1A, EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of hexachlorobenzene in humans was identified in 7 biomonitoring studies.

1. CDC. (2015). Fourth National Report on Human Exposure to Environmental Chemicals. Serum Hexachlorobenzene (lipid adjusted). Centers for Disease Control and Prevention, Atlanta, Ga.
2. Damgaard, I. N., Skakkebaek, N. E., Toppari, J., Virtanen, H. E., Shen, H., Schramm, K. W., Petersen, J. H., Jensen, T. K., Main, K. M., Group, T. N. C. S. (2006). "Persistent pesticides in human breast milk and cryptorchidism." Environmental Health Perspectives 114(7): 1133-1138.
3. Muckle, G., Ayotte, P., Dewailly, E., Jacobson, S. W., Jacobson, J. L. (2001). "Prenatal exposure of the Northern Québec Inuit infants to environmental contaminants." Environmental Health Perspectives 109(12): 1291-1299.
4. Peters, R.J.B. (2005) Man-made chemicals in maternal and cord blood. TNO Report. B&O-A R 2005/129.
5. Ribas-Fitó, N., Torrent, M., Carrizo, D., Júlvez, J., Grimalt, J. O., Sunyer, J. (2007). "Exposure to hexachlorobenzene during pregnancy and Children's social behavior at 4 years of age." Environmental Health Perspectives 115(3): 447-450.
6. Shen, H., Main, K., Andersson, A., Damgaard, I., Helena, E., Virtanen, H., Skakkebaek, E., Toppari, J., and Schramm, K. (2008). Concentrations of persistent organochlorine compounds in human milk and placenta are higher in Denmark than in Finland. Human Reproduction Vol.23, No.1 pp. 201–210
7. Woodruff, T.J., Zota, A.R., Schartz, J.M. (2011). Environmental chemicals in pregnant women in the United States: NHANES 2003-2004. Environmental Health Perspectives 119:878-885.

Exposure criteria, presence in indoor air and/or dust:
The presence of hexachlorobenzene was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of hexachlorobenzene was not identified in a consumer products database.

Ethyl paraben (CAS 120-47-8)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of ethyl paraben in humans was identified in 3 biomonitoring studies.

1. CDC. (2015). Fourth National Report on Human Exposure to Environmental Chemicals. Urinary Ethyl paraben (2005 – 2010). Centers for Disease Control and Prevention, Atlanta, Ga.
2. Calafat, A.M., Ye, X., Wong, L.Y., Bishop. A.M., Needham. L.L. (2010). Urinary concentrations of four parabens in the U.S. population: NHANES 2005-2006. Environmental Health Perspectives. 118 (5):679-85.
3. Ye, X., Kuklenyik, Z., Bishop, A. M., Needham, L. L., Calafat, A. M. (2006). "Quantification of the urinary concentrations of parabens in humans by on-line solid phase extraction-high performance liquid chromatography-isotope dilution tandem mass spectrometry." Journal of Chromatography B 844: 53-59.

Exposure criteria, presence in indoor air and/or dust:
The presence of ethyl paraben was identified in 1 indoor air and/or dust study.

1. Rudel, R.A., Camann, D. E., Spengler, J. D., Korn, L. R., Brody, J. G. (2003). "Phthalates, alkylphenols, pesticides, polybrominated diphenyl ethers, and other endocrine-disrupting Compounds in indoor air and dust." Environmental Science & Technology 37(20): 4543-4553

Exposure criteria, presence in consumer products:
The presence of ethyl paraben was identified in consumer products in 5 databases.
Danish EPA, Dutch (NL) reports, HPD_NLM, SPIN, and Peer reviewed journals.

2,2',4,4'-tetrahydroxybenzophenone; Benzophenone-2; (Bp-2) (CAS 131-55-5)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of 2,2',4,4'-tetrahydroxybenzophenone in humans was not identified in biomonitoring studies.

Exposure criteria, presence in indoor air and/or dust:
The presence of 2,2',4,4'-tetrahydroxybenzophenone was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of 2,2',4,4'-tetrahydroxybenzophenone was identified in consumer products in 2 databases. Danish EPA and HPD_NLM.

2,4-Dihydroxybenzophenone; Resbenzophenone (CAS 131-56-6)

Toxicity criteria:
EU Endocrine Disruptor Program - Category 1.

Exposure criteria, biomonitoring:
The presence of 2,4-dihydroxybenzophenone; resbenzophenone in humans was not identified in biomonitoring studies.

Exposure criteria, presence in indoor air and/or dust:
The presence of 2,4-dihydroxybenzophenone; resbenzophenone was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of 2,4-dihydroxybenzophenone; resbenzophenone was identified in consumer products in 3 databases.
HSDB_NLM, HPD_NLM, and Peer reviewed journals.

Mono-n-butylphthalate (CAS 131-70-4)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of mono-n-butylphthalate in humans was identified in 5 biomonitoring studies.

1. CDC. (2015). Fourth National Report on Human Exposure to Environmental Chemicals. Urinary Mono-n-butyl phthalate (MnBP) (1999 – 2010), Metabolite of Dibutyl phthalate (DBP) and Benzylbutyl phthalate (BzBP). Centers for Disease Control and Prevention, Atlanta, Ga.
2. Just, A.C., Adibi, J.J., Rundle, A.G., Calafat, A.M., Camann, D.E., Hauser, R., Silva, M.J., Whyatt, R.M. (2012). Urinary and air phthalate concentrations and self-reported use of personal care products among minority pregnant women in New York city. Journal of Exposure Science Environ Epidemiology. 20 (7):625-33.
3. Main, K., Mortensen, G. K., Kaleva, M. M., Boisen, K. A., Damgaard, I. N., Chellakooty, M., Schmidt, I. M., Suomi, A. M., Virtanen, H. E., Petersen, J. H., Andersson, A. M., Toppari, J., Skakkebæk, N. E. (2006). "Human breast milk contamination with phthalates and alterations of endogenous reproductive hormones in infants three months of age." Environmental Health Perspective 114(2): 270-276.
4. Wolff, M. S., Teitelbaum, S. L., Windham, G., Pinney, S. M., Britton, J. A., Chelimo, C., Godbold, J., Biro, F., Kushi, L. H., Pfeiffer, C. M., Calafat, A. M. (2007). "Pilot study of urinary biomarkers of phytoestrogens, phthalates, and phenols in girls." Environmental Health Perspectives 115 (1): 116-121
5. Woodruff, T.J., Zota, A.R., Schartz, J.M. (2011). Environmental chemicals in pregnant women in the United States: NHANES 2003-2004. Environmental Health Perspectives 119:878-885.

Exposure criteria, presence in indoor air and/or dust:
The presence of mono-n-butylphthalate was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of mono-n-butylphthalate was identified in consumer products in 1 database.
Danish EPA.

1,1,3,3-Tetramethyl-4-butylphenol; 4-tert-Octylphenol (CAS 140-66-9)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of 1,1,3,3-tetramethyl-4-butylphenol; 4-tert-octylphenol in humans was identified in 4 biomonitoring studies.

1. CDC. (2015). Fourth National Report on Human Exposure to Environmental Chemicals. Urinary 4-tert-Octylphenol (2005 – 2010). Centers for Disease Control and Prevention, Atlanta, Ga.
2. Chen, G. W., Ding, W. H., Ku, H. Y., Chao, H. R., Chen, H. Y., Huang, M. C., Wang, S. L. (2010). "Alkylphenols in human milk and their relations to dietary habits in Central Taiwan" Food and Chemical Toxicology 48: 1939-1944.
3. Lopez-Espinosa, M. J., Freire, C., Arrebola, J. P., Navea, N., Taoufiki, J., Fernandez, M. K., Ballesteros, O., Prada, R., Olea, N. (2009). "Nonylphenol and octylphenol in adipose tissue of women in Southern Spain." Chemosphere 76: 847-852.
4. Wolff, M. S., Teitelbaum, S. L., Windham, G., Pinney, S. M., Britton, J. A., Chelimo, C., Godbold, J., Biro, F., Kushi, L. H., Pfeiffer, C. M., Calafat, A. M. (2007). "Pilot study of urinary biomarkers of phytoestrogens, phthalates, and phenols in girls." Environmental Health Perspectives 115 (1): 116-121

Exposure criteria, presence in indoor air and/or dust:
The presence of 1,1,3,3-tetramethyl-4-butylphenol; 4-tert-octylphenol was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of 1,1,3,3-tetramethyl-4-butylphenol; 4-tert-octylphenol was identified in consumer products in 3 databases.
Danish EPA, Dutch (NL) reports, and 2012 TSCA Work Plan Consumer Products.

Octamethylcyclotetrasiloxane (CAS 556-67-2)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of octamethylcyclotetrasiloxane in humans was not identified in biomonitoring studies.

Exposure criteria, presence in indoor air and/or dust:
The presence of octamethylcyclotetrasiloxane was identified in 1 indoor air and/or dust study.

1. Lu, Y., Yuan, T., Yun, S. H., Wang, W., Gian Wu, G., Kannan, K. (2010). "Occurrence of cyclic and linear Siloxanes in indoor dust from China, and implications for human exposures." Environmental Science Technology 44(16): 6081-6087.

Exposure criteria, presence in consumer products:
The presence of octamethylcyclotetrasiloxane was identified in consumer products in 7 databases. Danish EPA, HSDB_NLM, EPA inventory use (IUR), HPD_NLM, SPIN, 2012 TSCA Work Plan Consumer Products, and Peer reviewed journals.

Benzene, pentachloro- (CAS 608-93-5)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of benzene, pentachloro- in humans was identified in 2 biomonitoring studies.

1. Damgaard, I. N., Skakkebaek, N. E., Toppari, J., Virtanen, H. E., Shen, H., Schramm, K. W., Petersen, J. H., Jensen, T. K., Main, K. M., Group, T. N. C. S. (2006). "Persistent pesticides in human breast milk and cryptorchidism." Environmental Health Perspectives 114(7): 1133-1138.
2. Peters, R.J.B. (2005) Man-made chemicals in maternal and cord blood. TNO Report. B&O-A R 2005/129.

Exposure criteria, presence in indoor air and/or dust:
The presence of benzene, pentachloro- was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of benzene, pentachloro- was not identified in a consumer products database.

2,2',3,3',4,4',5,5',6,6'-Decabromodiphenyl ether; BDE-209 (CAS 1163-19-5)

Toxicity criteria:
Present on Washington State's PBT list and confirmed by MECDC with review of peer-reviewed scientific publications identified in:

1. Brominated Flame Retardants: A Report to the Joint Standing Committee on Natural Resources, 122nd Maine Legislature, Prepared by the MECDC and the MEDEP, February 2005.
2. Brominated Flame Retardants: A report to the Committee on Natural Resources, 122nd Maine Legislature, Prepared by Prepared by the MECDC and the MEDEP, February 2006.
3. Brominated Flame Retardants: Third annual report to the Maine Legislature, Prepared by the Prepared by the MECDC and the MEDEP, January 2007.

Exposure criteria, biomonitoring:
The presence of 2,2',3,3',4,4',5,5',6,6'-decabromodiphenyl ether; BDE-209 in humans was identified in 1 biomonitoring study.

1. Gomara, B., Herrero, L., Ramos, J. J., Mateo, J. R., Fernández, M. A., Garcıa, J. F., González, M. J. (2007). "Distribution of polybrominated diphenyl ethers in human umbilical cord serum, paternal serum, maternal serum, placentas, and breast milk from Madrid population, Spain." Environmental Science & Technology 41(20): 6961-6968.

Exposure criteria, presence in indoor air and/or dust:
The presence of 2,2',3,3',4,4',5,5',6,6'-decabromodiphenyl ether; BDE-209 was identified in 2 indoor air and/or dust studies.

1. Allen, J. G., McClean, M. D., Stapleton, H. M., Nelson, J. W., Webster, T. F. (2007). "Personal exposure to polybrominated diphenyl ethers (PBDEs) in residential indoor air." Environmental Science & Technology 41(13): 4574-4579.
2. Wilford BH, Shoeib M, Harner T, Zhu J, Jones KC. (2005) Polybrominated diphenyl ethers in indoor dust in Ottawa, Canada: implications for sources and exposure. Environmental Science & Technology 39 (18):7027-35.

Exposure criteria, presence in consumer products:
The presence of 2,2',3,3',4,4',5,5',6,6'-decabromodiphenyl ether; BDE-209 was identified in consumer products in 4 databases.
Danish EPA, ESIS_RAR, EPA inventory use (IUR), and VCCEP.

Methyl tert-butyl ether; MTBE (CAS 1634-04-4)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of methyl tert-butyl ether; MTBE in humans was identified in 4 biomonitoring studies.

1. CDC. (2015). Fourth National Report on Human Exposure to Environmental Chemicals. Blood Methyl-tert-butyl ether (MTBE) (2001 – 2006). Centers for Disease Control and Prevention, Atlanta, Ga.
2. Kim, S. R., Halden, R. U., Buckley, T. J. (2007). "Volatile organic compounds in human milk: Methods and measurements." Environmental Science Technology 41(5): 1662-1667.
3. Lin, Y. S., Egeghy, P. P., Rappaport, S. M. (2008). "Relationships between levels of volatile organic compounds in air and blood from the general population." Journal of Exposure Science and Environmental Epidemiology 18: 421-429.
4. Woodruff, T.J., Zota, A.R., Schartz, J.M. (2011). Environmental chemicals in pregnant women in the United States: NHANES 2003-2004. Environmental Health Perspectives 119:878-885.

Exposure criteria, presence in indoor air and/or dust:
The presence of methyl tert-butyl ether; MTBE was identified in 4 indoor air and/or dust studies.

1. Kim, S. R., Halden, R. U., Buckley, T. J. (2007). "Volatile organic compounds in human milk: Methods and measurements." Environmental Science Technology 41(5): 1662-1667.
2. Serrano-Trespalacios, P. I., Ryan, L., Spengler, J. D. (2004). "Ambient, indoor and personal exposure relationships of volatile organic compounds in Mexico City Metropolitan Area." Journal of Exposure Analysis and Environmental Epidemiology 14: S118-S132.
3. Weisel, C. P., Alimokhtari, S., Sanders, P. F. (2008). "Indoor air VOC concentrations in suburban and rural New Jersey." Environmental Science & Technology 42(22): 8231-8238.
4. Zhu, J., Newhook, R., Marro, L., Chan, C.C. (2005). "Selected Volatile Organic Compounds in Residential Air in the City of Ottawa, Canada." Environmental Science & Technology 39 (11):3964-71.

Exposure criteria, presence in consumer products:
The presence of methyl tert-butyl ether; MTBE was identified in consumer products in 1 database.
EPA inventory use (IUR).

Perfluorooctane sulfonic acid (PFOS) and its salts (CAS 1763-23-1)

Toxicity criteria:
Present on Washington State's PBT list and confirmed by MECDC with review of studies published in peer-reviewed journals.
Animal studies include, but not limited to:

1. Butenhoff, J.L., Ehresman, D.J., Chang, S.C., Parker, G.A., Stump, D.G. (2009). Gestational and lactational exposure to potassium perfluorooctanesulfonate (K+PFOS) in rats: developmental neurotoxicity. Reproductive Toxicology 27 (3-4):319-30.
2. Chang, S.C., Ehresman, D.J., Bjork, J.A., Wallace, K.B., Parker, G.A., Stump, D.G., Butenhoff, J.L. (2009). "Gestational and lactational exposure to potassium perfluorooctanesulfonate (K+PFOS) in rats: toxicokinetics, thyroid hormone status, and related gene expression. Reproductive Toxicology 27 (3-4):387-99.
3. Curran, I., Hierlihy, S.L., Liston, V., Pantazopoulos, P., Nunnikhoven, A., Tittlemier, S., Barker, M., Trick, K., Bondy, G. (2008). "Altered fatty acid homeostasis and related toxicologic sequelae in rats exposed to dietary potassium perfluorooctanesulfonate (PFOS)." Journal of Toxicology and Environmental Health, Part A 71 (23): 1526-41.
4. Johansson, N., Fredriksson, A., Eriksson, P. (2008). "Neonatal exposure to perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) causes neurobehavioural defects in adult mice." Neurotoxicology. 29 (1):160-9.
5. Keil, D.E., Mehlmann, T., Butterworth, L., Peden-Adams, M.M. (2008). "Gestational exposure to perfluorooctane sulfonate suppresses immune function in B6C3F1 mice." Toxicological Sciences 103(1):77-85.
6. Lau, C., Thibodeaux, J.R., Hanson, R.G., Rogers, .J.M., Grey, B.E., Stanton, M.E., Butenhoff, J.L., Stevenson, L.A. (2003). "Exposure to perfluorooctane sulfonate during pregnancy in rat and mouse. II: postnatal evaluation." Toxicological Sciences 74 (2):382-92.
7. Luebker, D.J., Case, M.T., York, R.G., Moore, J.A., Hansen, K.J., Butenhoff, J.L. (2005). "Two-generation reproduction and cross-foster studies of perfluorooctanesulfonate (PFOS) in rats." Toxicology 215 (1-2):126-48.
8. Luebker, D.J., York, R.G, Hansen, K.J., Moore, J.A., Butenhoff, J.L. (2005). "Neonatal mortality from in utero exposure to perfluorooctanesulfonate (PFOS) in Sprague-Dawley rats: dose-response, and biochemical and pharamacokinetic parameters." Toxicology 215 (1-2):149-69.
9. Seacat, A.M., Thomford, P.J., Hansen, K.J., Olsen, G.W., Case, M.T., Butenhoff, J.L. (2002). "Subchronic toxicity studies on perfluorooctanesulfonate potassium salt in cynomolgus monkeys." Toxicological Sciences 68(1): 249-264.
10. Thibodeaux, J.R, Hanson, R.G., Rogers, J.M., Grey, B.E., Barbee, B.D., Richards, J.H., Butenhoff, J.L., Stevenson, L.A., Lau, C. (2003). "Exposure to perfluorooctane sulfonate during pregnancy in rat and mouse. I: maternal and prenatal evaluations." Toxicological Sciences 74 (2):369-81.
11. Yu, W.G., Liu, W., Jin, Y.H., Liu, X.H., Wang, F.Q., Liu, L., Nakayama, S.F. (2009). "Prenatal and postnatal impact of perfluorooctane sulfonate (PFOS) on rat development: a cross-foster study on chemical burden and thyroid hormone system." Environmental Science & Technology 43(21):8416-22.

Human studies include, but not limited to:

1. Andersen, C.S., Fei, C., Gamborg, M., Nohr, E.A., Sørensen, T.I., Olsen, J. (2010). "Prenatal exposures to perfluorinated chemicals and anthropometric measures in infancy." American Journal of Epidemiology 172 (11):1230-7.
2. Darrow, L.A., Howards, P.P., Winquist, A., Steenland, K. (2014). "PFOA and PFOS serum levels and miscarriage risk." Epidemiology 25 (4):505-12.
3. Fei, C., McLaughlin, J.K., Lipworth, L., Olsen, J. (2009). "Maternal levels of perfluorinated chemicals and subfecundity." Human Reproduction 24 (5):1200-5.

4. Fei, C., McLaughlin, J.K., Lipworth, L., Olsen, J. (2010). "Maternal concentrations of perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA) and duration of breastfeeding." Scandinavian Journal of Work, Environment & Health 36 (5):413-21.
5. Joensen, U.N., Veyrand, B., Antignac, J.P., Jensen, M.B., Petersen, J.H., Marchand, P., Skakkebaek, N.E., Andersson, A.M., Le Bizec, B., Jørgensen, N. (2013/2014). "PFOS (perfluorooctanesulfonate) in serum is negatively associated with testosterone levels, but not with semen quality, in healthy men." Human Reproduction 28 (3):599–608.
6. Knox, S.S., Jackson, T., Javins, B., Frisbee, S.J., Shankar, A., Ducatman, A.M. (2011). "Implications of early menopause in women exposed to perfluorocarbons." Journal of Clinical Endocrinology and Metabolism 96 (6):1747-53.
7. Knox, S.S., Jackson, T., Frisbee, S.J., Javins, B., Ducatman, A.M. (2011). "Perfluorocarbon exposure, gender and thyroid function in the C8 Health Project." Journal of Toxicological Sciences 36 (4):403-10.
8. Lopez-Espinosa, M.J., Mondal, D., Armstrong, B., Bloom, M.S., Fletcher, T. (2012). "Thyroid function and perfluoroalkyl acids in children living near a chemical plant." Environmental Health Perspectives 120 (7):1036-41.
9. Olsen, G.W., Butenhoff, J.L., Zobel, L.R. (2009). "Perfluoroalkyl chemicals and human fetal development: an epidemiologic review with clinical and toxicological perspectives." Reproductive Toxicology 27(3-4):212-30.
10. Stein, C.R., Savitz, D.A., Dougan, M. (2009). "Serum levels of perfluorooctanoic acid and perfluorooctane sulfonate and pregnancy outcome." American Journal of Epidemiology 170 (7):837-46.

Exposure criteria, biomonitoring:

The presence of perfluorooctane sulfonic acid (PFOS) and its salts in humans was identified in 5 biomonitoring studies.

1. CDC. (2015). Fourth National Report on Human Exposure to Environmental Chemicals. Serum Perfluorooctane sulfonic acid (PFOS) (1999 – 2010 and 2011– 2012). Centers for Disease Control and Prevention, Atlanta, Ga.
2. Fei, C., McLaughlin, J. K., Tarone, R. E., Olsen, J. (2007). "Perfluorinated chemicals and fetal growth: A study within the Danish National Birth Cohort." Environmental Health Perspectives 115(11): 1677-1682.
3. Haug, L. S., Huber, S., Becher, G., Thomsen, C. (2011). "Characterization of human exposure pathways to perfluorinated compounds - comparing exposure estimates with biomarkers of exposure." Environmental International 37: 687-693.
4. Peters, R.J.B. (2005) Man-made chemicals in maternal and cord blood. TNO Report. B&O-A R 2005/129.
5. Woodruff, T.J., Zota, A.R., Schartz, J.M. (2011). Environmental chemicals in pregnant women in the United States: NHANES 2003-2004. Environmental Health Perspectives 119:878-885.

Exposure criteria, presence in indoor air and/or dust:

The presence of perfluorooctane sulfonic acid (PFOS) and its salts was identified in 3 indoor air and/or dust studies.

1. Bjorklund, J. A., Thuresson, K., DeWit, C. A. (2009). "Perfluoroalkyl compounds (PFCs) in indoor dust: Concentrations, human exposure estimates, and sources." Environmental Science & Technology 43(7): 2276-2281.
2. Haug, L. S., Huber, S., Becher, G., Thomsen, C. (2011). "Characterization of human exposure pathways to perfluorinated compounds - comparing exposure estimates with biomarkers of exposure." Environmental International 37: 687-693.
3. Shoeib, M., Harner, T., Webster, G. M., Lee, S. C. (2011). "Indoor sources of poly- and perfluorinated compounds (PFCS) in Vancouver, Canada: Implications for human exposure." Environmental Science and Technology 45 (19): 7999-8005

Exposure criteria, presence in consumer products:
The presence of perfluorooctane sulfonic acid (PFOS) and its salts was identified in consumer products in 2 databases.
Danish EPA and Peer reviewed journals.

Phenol, 4-octyl- (CAS 1806-26-4)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of phenol, 4-octyl- in humans was not identified in biomonitoring studies.

Exposure criteria, presence in indoor air and/or dust:
The presence of phenol, 4-octyl- was identified in 1 indoor air and/or dust study (preliminary literature search).

1. Rudel, R. A., Camann, D. E., Spengler, J. D., Korn, L. R., Brody, J. G. (2003). "Phthalates, alkylphenols, pesticides, polybrominated diphenyl ethers, and other endocrine-disrupting Compounds in indoor air and dust." Environmental Science & Technology 37(20): 4543-4553.

Exposure criteria, presence in consumer products:
The presence of phenol, 4-octyl- was identified in consumer products in 2 databases.
Dutch (NL) reports and Peer reviewed journals.

2-Ethyl-hexyl-4-methoxycinnamate (CAS 5466-77-3)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of 2-ethyl-hexyl-4-methoxycinnamate in humans was not identified in biomonitoring studies.

Exposure criteria, presence in indoor air and/or dust:
The presence of 2-ethyl-hexyl-4-methoxycinnamate was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of 2-ethyl-hexyl-4-methoxycinnamate was identified in consumer products in 3 databases. Danish EPA, HSDB_NLM, and HPD_NLM.

Silica, crystalline (in the form of quartz or cristobalite dust) (CAS 14808-60-7)

Toxicity criteria:
NTP ROC: known to be a human carcinogen, GHS Cancer: Category 1A carcinogenic, IARC: Group 1 carcinogenic to humans.

Exposure criteria, biomonitoring:
The presence of silica, crystalline (in the form of quartz or cristobalite dust) in humans was not identified in biomonitoring studies.

Exposure criteria, presence in indoor air and/or dust:
The presence of silica, crystalline (in the form of quartz or cristobalite dust) was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of silica, crystalline (in the form of quartz or cristobalite dust) was identified in consumer products in 4 databases.
EPA inventory use (IUR), HPD_NLM, SPIN, and 2012 TSCA Work Plan Consumer Products.

Butylated hydroxyanisole (CAS 25013-16-5)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of butylated hydroxyanisole in humans was not identified in biomonitoring studies.

Exposure criteria, presence in indoor air and/or dust:
The presence of butylated hydroxyanisole was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of butylated hydroxyanisole was identified in consumer products in 3 databases. HSDB_NLM, HPD_NLM, and SPIN.

Hexabromocyclododecane; HBCD (CAS 25637-99-4)

Toxicity criteria:
Present on Washington State's PBT list and confirmed by MECDC with review of peer-reviewed scientific publications identified in:

1. Rationale for Concurrence by Maine Center for Disease Control and Prevention on the Designation of Brominated Flame Retardants as a Priority Chemical, November 22, 2010.

Exposure criteria, biomonitoring:
The presence of hexabromocyclododecane in humans was identified in one biomonitoring study

1. Covaci, A., Gerecke, A. C., Law, R. J., Voorspoels, S., Kohler, M., Heeb, N. V., Leslie, H., Allchin, C. R., Deboer, J. (2006). "Hexabromocyclododecanes (HBCDs) in the environment and humans: A review." Environmental Science & Technology 40(12): 3679-3688.

Exposure criteria, presence in indoor air and/or dust:
The presence of hexabromocyclododecane was identified in 2 indoor air and/or dust studies (preliminary literature search).

1. Peters, R.J.B. (2005) Man-made chemicals in maternal and cord blood. TNO Report. B&O-A R 2005/129.
2. Stapleton, H. M., Allen, J. G., Kelly, S. M., Konstantinov, A., Klosterhaus, S., Watkins, D., McClean, M. D., Webster, T. F. (2008). "Alternate and new brominated flame retardants detected in U.S. house dust." Environmental Science & Technology 42(18): 6910-6916.

Exposure criteria, presence in consumer products:
The presence of butylated hexabromocyclododecane was identified in consumer products in 2 databases. ESIS_RAR and HSBD_NLM.

(1,1,3,3-tetramethylbutyl)-phenol; Octylphenol (CAS 27193-28-8)

Toxicity criteria:
EU Endocrine Disruptor Program: Category 1.

Exposure criteria, biomonitoring:
The presence of (1,1,3,3-tetramethylbutyl)-phenol; octylphenol in humans was not identified in biomonitoring studies.

Exposure criteria, presence in indoor air and/or dust:
The presence of (1,1,3,3-tetramethylbutyl)-phenol; octylphenol was not identified in indoor air and/or dust studies.

Exposure criteria, presence in consumer products:
The presence of butylated (1,1,3,3-tetramethylbutyl)-phenol; octylphenol was identified in consumer products in 1 database.
Danish EPA.

Nickel compounds (CAS N/A)

Toxicity criteria:
NTP ROC: Known to be human carcinogens, IARC: Group 1 carcinogenic to humans.

Exposure criteria, biomonitoring:
The presence of nickel compounds in humans was identified in 5 biomonitoring studies.

1. Bernhard, D., Rossmann, A., Henderson, B., Kind, M., Seubert, A., Wick, G. (2006). "Increased serum Cadmium and Strontium Levels in Young Smokers - Effects on Arterial Endothelial Cell Gene Transcription." Arterioscler Thrombosis Vascular Biology 26:833-838.
2. Bloom, M.S., Louis, G.M., Sundaram, R., Kostyniak, P.J., Jain, J. (2011). "Associations between blood metals and fecundity among women residing in New York State." Reproductive Toxicology 31 (2):158-163.
3. Guan, H., Piao, F. Y., Li, X. W., Li, Q. J., Xu, L., Yokoyama, K. (2010). "Maternal and fetal exposure to four carcinogenic environmental metals." Biomedical and Environmental Sciences 23: 458-465.
4. Health Canada. (2010). Results of the Canadian Health Measures Survey Cycle 1 (2007-2009). 8.1.9 Nickel. http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/chms-ecms/section8-eng.php#n8_1_9
5. Nunes, J. A., Batista, B. L., Rodrigues, J. L., Caldas, N. M., Neto, J. A. G., Barbosa, F. J. (2010). "A simple method based on ICP-MS for estimation of background levels of arsenic, cadmium, copper, manganese, nickel, lead, and selenium in blood of the Brazilian population." Journal of Toxicology and Environmental Health, Part A 73: 878-887.

Exposure criteria, presence in indoor air and/or dust:
The presence of nickel compounds was identified in 2 indoor air and/or dust studies.

1. Lemus, R., Abdelghani, A. A., Akers, T. G., Horner, W. E. (1996). "Health risk from exposure to metals in household." Reviews on Environmental Health 11(4): 179-189.
2. Roberts, J. W., Wallace, L. A., Camann, D. E., Dickey, P., Gilbert, S. G., Lewis, R. G., Takaro, T. K. (2009) "Monitoring and reducing exposure of infants to pollutants in house dust." Reviews of Environmental Contamination & Toxicology 201: 1-39.

Exposure criteria, presence in consumer products:
The presence of nickel compounds were identified in consumer products in 6 databases.
Danish EPA, German FEA, EPA inventory use (IUR), HPD_NLM, 2012
TSCA Work Plan Consumer Products, and Peer reviewed journals.