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This communication is to announce an update to the Massachusetts Department of Environmental Protection (MassDEP) recommended toxicity equivalency factors (TEFs) for dioxin-like compounds (DLC), which include certain polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and polychlorinated biphenyls (PCBs).

MassDEP is now recommending the use of the TEFs derived and adopted by the World Health Organization (WHO) in 2005 (Van Den Berg et al., 2006). This revision aligns MassDEP TEF values with those of the US Environmental Protection Agency (USEPA 2010), California Environmental Protection Agency (OEHHA 2011), and multiple state organizations. These revised TEFs supersede those previously recommended by MassDEP.

Polychlorinated dibenzo-p-dioxins, PCFDs and PCBs constitute a large group of structurally related compounds, some of which are very toxic. As a group many PCDDS, PCDFs and PCBs are lipophilic, persistent, ubiquitous, and bioaccumulate in the environment. Their resistance to degradation and semi-volatility allows them to be transported over long distances. PCDDs and PCDFs are unintentionally formed through thermal processes or as byproducts of certain industrial chemical syntheses. PCBs were produced for use in a variety of applications such as dielectric and heat transfer fluids, plasticizers, wax extenders, and flame retardants.

There are 75 PCDD, 135 PCDF, and 209 PCB chemical structures which vary in the number and position of their chlorine atoms (termed congeners). The most well studied of these is 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD), which is also extremely toxic. Seven of the 75 PCDD, 10 of the 135 PCDF and 12 of the 209 PCB congeners are routinely referred to as “dioxin-like compounds” (DLCs) because these compounds have closely related chemical structures and physio-chemical properties and elicit a common set of toxic responses by binding to a specific cellular receptor protein known as the aryl hydrocarbon receptor (AhR).

Various groups, including MassDEP, have developed various TEFs for DLCs over the past several decades. All express the toxicity of DLCs relative to that of 2,3,7,8-TCDD. The TEFs currently recommended by MassDEP are reported in Table 1.

Due to uncertainty around the potential toxicity of the "Total homologs" ORS concludes that it is appropriate to report any "Total homolog" data reported in 8290A dioxin analytical results where these data are used for risk characterization. However, the "Total homolog" data are not expected to be included in the dioxin TEF calculations.

Table 1. Summary of Toxicity Equivalency Factors (TEFs)

	***DEP 2025 - TEF**
Polychlorinated dibenzo-p-dioxins (PCDDs)	
2,3,7,8-TCDD	1
1,2,3,7,8-PeCDD	1
1,2,3,4,7,8-HxCDD	0.1
1,2,3,6,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDD	0.1
1,2,3,4,6,7,8-HpCDD	0.01
OCDD	0.0003
Polychlorinated Dibenzofurans (PCDFs)	
2,3,7,8-TCDF	0.1
1,2,3,7,8-PeCDF	0.03
2,3,4,7,8-PeCDF	0.3
1,2,3,4,7,8-HxCDF	0.1
1,2,3,6,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDF	0.1
2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDF	0.01
1,2,3,4,7,8,9-HpCDF	0.01
OCDF	0.0003
Non-*ortho*-substituted PCBs	
3,3',4,4'-tetraCB (PCB 77)	0.0001
3,4,4',5-tetraCB (PCB 81)	0.0003
3,3',4,4',5-pentaCB (PCB 126)	0.1
3,3',4,4',5,5'-hexaCB (PCB 169)	0.03
Mono-*ortho*-substituted PCBs	
2,3,3',4,4'-pentaCB (PCB 105)	0.00003
2,3,4,4',5-pentaCB (PCB 114)	0.00003
2,3',4,4',5-pentaCB (PCB 118)	0.00003
2',3,4,4',5-pentaCB (PCB 123)	0.00003
2,3,3',4, 4', 5-hexaCB (PCB 156)	0.00003
2,3,3',4, 4', 5'-hexaCB (PCB 157)	0.00003
2,3',4,4',5,5'-hexaCB (PCB 167)	0.00003
2,3,3',4,4',5,5'-heptaCB (PCB 189)	0.00003

*TEF values from Van den Berg, 2006 (aka, WHO, 2005).

References:

OEHHA (California Office of Environmental Health Hazard Assessment). 2011. Use of the Toxicity Equivalency Factor (TEF WHO-05) Scheme for Estimating Toxicity of Mixtures of Dioxin-Like Chemicals. Technical Support Document for Cancer Potency Factors, Appendix C.

USEPA (U.S. Environmental Protection Agency). 2010. Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds. Risk Assessment Forum, Washington, D.C. EPA/100/R-10/005.

Van den Berg, M., et al. 2006. The 2005 World Health Organization Reevaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-Like Compounds. Toxicological Sciences. 93 (2). 223-241.