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## Maine Compact Fluorescent Lamp Breakage Study Report

February 2008

### Executive Summary

Forty five (45) experimental trials where compact fluorescent lamps (CFLs) were broken in a small/moderate sized room were conducted in May through September of 2007. Eighteen (18) trials, three trials each of six differing scenarios, were originally planned for this study; however, additional trials were added to attempt to more fully address potential cleanup concerns. Broken lamps were either not cleaned up, cleaned up using Maine Department of Environmental Protection (DEP) pre-study cleanup guidance, vacuumed, or cleaned up using variations of the pre-study cleanup guidance. The mercury concentrations at the five foot height (adult breathing zone) and one foot height (infant/toddler breathing zone)<sup>1</sup> above the study room floor were continuously monitored. The most notable finding of the study was how variable the results can be depending on the type of lamp, level of ventilation and cleanup method.

The pre-study cleanup guidance was generally found to be sound, including the advice to not vacuum as part of the cleanup. However as a result of this study, the cleanup guidance was modified. **The new cleanup guidance can be seen in Appendix E.**

Mercury concentration in the study room air often exceeds the Maine Ambient Air Guideline (MAAG) of 300 nanograms per cubic meter (ng/m<sup>3</sup>) for some period of time, with short excursions over 25,000 ng/m<sup>3</sup>, sometimes over 50,000 ng/m<sup>3</sup>, and possibly over 100,000 ng/m<sup>3</sup> from the breakage of a single compact fluorescent lamp. A short period of venting can, in most cases, significantly reduce the mercury air concentrations after breakage. Concentrations can sometimes rebound when rooms are no longer vented, particularly with certain types of lamps and during/after vacuuming. Mercury readings at the one foot height tend to be greater than at the five foot height in non vacuumed situations.

Although following the pre-study cleanup guidance produces visibly clean flooring surfaces for both wood and carpets (shag and short nap), all types of flooring surfaces tested can retain mercury sources even when visibly clean. Flooring surfaces, once visibly clean, can emit mercury immediately at the source that can be greater than 50,000 ng/m<sup>3</sup>. Flooring surfaces that still contain mercury sources emit more mercury when agitated than when not agitated. This mercury source in the carpeting has particular significance for children rolling around on a floor, babies crawling, or non mobile infants placed on the floor.

Cleaning up a broken CFL by vacuuming up the smaller debris particles in an un-vented room can elevate mercury concentrations over the MAAG in the room and it can linger at these levels for hours. Vacuuming tends to mix the air within the room such that the one foot and five foot heights are similar immediately after vacuuming. A vacuum can become contaminated by mercury such that it cannot be easily decontaminated. Vacuuming a carpet where a lamp has broken and been visibly cleaned up, even weeks after the cleanup, can elevate the mercury readings over the MAAG in an un-vented room.

Some container types were found to be better than others for containing mercury emissions from breakage. Of the containers tested, a glass jar with a metal cover and gum seal contained the mercury vapor best. Double re-sealable polyethylene bags, on the other hand, did not appear to retard the migration of mercury adequately to maintain room air concentrations below the MAAG. Other containers fell somewhere in the middle between the glass and double re-sealable polyethylene bags for retarding mercury vapor migration. The significance of this issue is that cleanup material may remain in the home for some period of time and/or be transported inside a closed vehicle, exposing occupants to avoidable mercury vapors when improperly contained.

(These files are in pdf format)

[Report w/o Appendices](#) - (1.53MB)

[Appendix A](#) - Scenario Results Data Tables - (4.35MB)

[Appendix B](#) - Additional Photos - (171KB)

[Appendix C](#) - Temperature Log - (57KB)

[Appendix D](#) - Work Plan QAPP - (104KB)

[Appendix E](#) - Revised Cleanup Guidance - (58KB)

[Appendix F](#) - Protocol for Lumex Mercury Analyzer - (480KB)

[Appendix G](#) - CFLs used in Study - (266KB)

[Appendix H](#) - Vacuum Data - (112KB)

[Appendix I](#) - Lumex Calibration and Background Check - (57KB)

[Appendix J](#) - Temperature Corrected Data - (58KB)

[Appendix K](#) - Wood Floor Measurements - (52KB)

[Full Report](#) - (6.78MB)