



## Heart Disease and Diesel Exhaust

### *21,000 Annual Diesel-Related Premature Deaths: Most from Heart Disease*

Diesel particles are the tiniest of deadly combustion particles. Recent medical investigations suggest that their extremely small size may allow them to pass easily into the bloodstream where they can cause oxidative stress and inflammation that leads to heart disease and premature death.<sup>1</sup> A study conducted for the Clean Air Task Force by EPA's contractor, Abt Associates, following EPA Scientific Advisory Board methodologies, estimates approximately 21,000 deaths a year are due to diesel particles.<sup>2 3</sup>

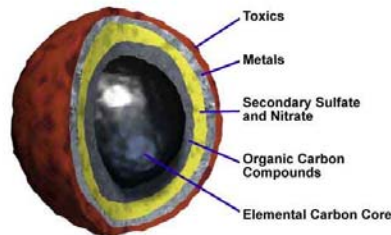
### Medical Studies Link Diesel Particles to Cardiovascular Disease and Death.

- Exposures to particles are associated with elevated risk of premature cardiac death as documented in the two largest air pollution studies ever conducted.<sup>4</sup> Daily exposures to particles are also linked to premature death in the 90-city National Morbidity and Mortality Air Pollution Study<sup>5</sup>
- Workers in the trucking industry have a 32-49% higher risk of heart disease than the general U.S. population according to a 2007 study.<sup>6</sup>
- A link between exposure to particles and vascular inflammation/atherosclerosis has been found in animal studies and could explain how particles are linked to heart attacks.<sup>7</sup>
- Ultrafine particles—as concentrated in fresh diesel exhaust --lead to systemic acute inflammation and exacerbation of cardiovascular disease and atherosclerosis according to recent studies.<sup>8,9</sup>
- Traffic proximity is related to heart attacks and mortality<sup>10,11, 12</sup> A 2007 study of 700 heart attack survivors shows that they were most likely to have been in heavy traffic the hour before they suffered the heart attack, whether in cars, streetcars or buses. Studies find that traffic-related health risks are better correlated to truck rather than car volume and therefore may be more strongly related to diesel engine exhaust.
- Particles elevate cardiac risk for women.<sup>13</sup> Researchers documented a 24% increase in risk of women having a cardiovascular event and an overall 76% increase in risk of death from cardiovascular disease for each 10 ug/m3 of PM2.5 in the ambient air. Within-city risks were higher than the risk between cities suggesting the importance of local sources of particles, such as diesel vehicles.<sup>14</sup>
- Abnormal heart rhythms were found in healthy state troopers exposed to particles In a 2004 study,<sup>15</sup> particles were linked to significant changes in heart rate variability, ectopic (out of place) heart beats and increases in blood inflammatory markers within hours of exposure.<sup>16</sup>
- Formation of blood clots (thromboses), have been documented in laboratory animals exposed to diesel particles.<sup>17</sup>

### What is a Diesel Particle?

Diesel exhaust is a toxic combination of carbon, sulfur and nitrogen particulate matter compounds, trace metals and related gases created from combustion of diesel fuel and the burning of lubricating

oil. Particles are thought to be the most harmful component of diesel exhaust. In general, diesels emit two types of particles—*fine particles*, less than 1 micron (a millionth of a meter) in diameter, and ‘nanoparticles’, otherwise known as *ultrafine particles*, under 10-100 nm (billionths of a meter.) Because they are so small these ultrafine particles can easily invade the body’s circulatory system carrying with them other toxic substances adhered to their carbon cores.



### Who is at Risk?

Everyday, we are surrounded by America’s 13 million diesel engines—America’s industrial workhorses-- powering tractor trailer trucks, transit and school buses, trains, ferries, generators, construction and agricultural equipment. People who live and work around diesel engines face some of the highest health risks. But workers are not the only people exposed to diesel exhaust—we breathe it every day following trucks and buses on city streets, in neighborhoods, and on country roads.<sup>18,19</sup>

Living within approximately 50-100 meters of a busy road may put you at higher risk. For the average risk from diesel soot in your community go to the CATF web at:

<http://www.catf.us/projects/diesel/dieselhealth/>.

### Diesel Filters Mean Reducing Heart Disease.

Installing diesel particulate filters (DPFs) on existing diesel engines can reduce particle emissions by over 90 percent. In fact, Clean Air Task Force field investigations suggest that the filters are so effective that they lower particle emissions to levels found in the outdoor air. In fact a recent study suggests that reducing particulate pollution will lower risk of death and increase life expectancy.<sup>20</sup>



*Mechanic Installing a DPF on a Bus by Simply Replacing an Existing Muffler*

## References

- <sup>1</sup> Nemmar, A., Hoet, P., Vanquickenborne, B., Dinsdale, D., Thomeer, M., Hoylaerts, M., Vanbilloen, H., Mortelmans, L., and Nemery, B. (2002). Passage of inhaled particles into the blood circulation in humans. *Circulation*, v. 105, p. 411-414.
- <sup>2</sup> See Abt Associates analytical reports at: [http://www.catf.us/projects/diesel/dieselhealth/20041216-REMSAD\\_No\\_Diesel\\_Report.pdf](http://www.catf.us/projects/diesel/dieselhealth/20041216-REMSAD_No_Diesel_Report.pdf)
- <sup>3</sup> Abt Associates (2007) estimates 21,000 deaths in 2010 from diesel exhaust, 3,000 of those from lung cancer. Most of the remaining deaths are from diesel pollution –related cardiovascular disease.
- <sup>4</sup> See, e.g., Pope, C.A., Thun, M.J., Namboordiri, M.M. and Dockery, D.W., et al. (1995). Particulate Air Pollution as a Predictor of Mortality in a Prospective Study of U.S. Adults. *American Journal of Respiratory and Critical Care Medicine* v.151, no. 3, P. 669-674. Available online at <http://ajrccm.atsjournals.org/search.shtml> ;Krewski, D., Burnett, R.T., Goldberg, M.S., Hoover, K., Siemiatycki, J., Jerrett, M., Abrahamowicz, A. and White, W.H. (2002) Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Matter and Mortality; Special Report to the Health Effects Institute, Cambridge, MA . Available at: <http://www.healtheffects.org/pubs.htm>
- <sup>5</sup> See e.g., Samet, J.M., Dominici, F., Zeger, S.L., Schwartz, J. and Dockery, D.W. (2000). National Morbidity, Mortality and Air Pollution Study, Part II: Morbidity, Mortality and Air Pollution in the United States; Health Effects Institute Research Report No. 94, Cambridge MA. Available at: <http://www.healtheffects.org/pubs.htm>
- Dockery, D.W., Pope, C.A., Xu, S. and Spengler, J.D., et al (1993). An Association Between Air Pollution and Mortality in Six U.S. Cities. *New England J. Medicine* , v. 329, p. 1753-59. Available online at <http://nejm.org/content/1993/0329/0024/1753.asp>.
- <sup>6</sup> Laden, F., Hart, J., Smith, T., Davis, M., and Garshick, E. (2007) Cause-specific mortality in the trucking industry. *Environmental Health Perspectives*, v. 115, no. 8. p. 1192-1196.
- <sup>7</sup> Sun, Q, et al (2005). Long-term air pollution exposure and acceleration of atherosclerosis in an animal model. *Journal of the American Medical Association*. V. 294, no. 23 p. 3003-3010.
- <sup>8</sup> Araujo, J. et al (2008) Ambient particulate pollutants in the ultrafine range promote early atherosclerosis and systemic oxidative stress. *Circulation Research*, March 14, 2008. Available at: <http://circres.ahajournals.org/cgi/content/abstract/CIRCRESAHA.107.164970v1>
- <sup>9</sup> Utell, M, and Frampton, M. (2000). Acute health effects of ambient air pollution: the ultrafine particle hypothesis. *Journal of aerosol medicine*, v. 13, no. 4, p. 355-359.
- <sup>10</sup> Peters, A., et al (2004). Exposure to traffic and onset of myocardial infarction. *NEJM*, v. 351, no. 17. p. 1721-1730.
- <sup>11</sup> Tonne, C., Melly, S., Mittleman, M., Coull, B., Goldberg, R., Schwartz, J. (2007). A Case–Control Analysis of Exposure to Traffic and Acute Myocardial Infarction. *Environmental Health Perspectives*, v. 115, no. 1, January 2007
- <sup>12</sup> Hoek, G., Brunekreef, B., Goldbohm, S., Fischer, P. and van den Brandt, P. (2002). Association between mortality and indicators of traffic-related air pollution in the Netherlands: a cohort study. *The Lancet* vol. 360, p. 1203-1209. December 19, 2002.
- <sup>13</sup> Miller, K., Siscovick, D., Sheppard, L., Shepherd, K., Sullivan, J., Anderson, G. and Kaufman, J. (2007). Long-term exposure to air pollution and incidence of cardiovascular events in women. *New England Journal of Medicine*, v. 356, No. 5, p. 447-458, February 1, 2007.
- <sup>14</sup> Dockery, D., and Stone, P. (2007) Cardiovascular risks from fine particulate air pollution. Editorial, *New England Journal of Medicine*, v. 356, no 5, p. 511-513, February 1, 2007.
- <sup>15</sup> Riediker, M., Cascia, W., Griggs, T., Herbst, M.m Bromberg, P., Neas, L., Williams, R., and Devlin, R. (2004). Particulate matter exposure in cars is associated with cardiovascular effects in healthy young men. *American Journal of Respiratory and Critical Care Medicine*, v. 169, p. 934-940.
- <sup>16</sup> Riediker, M, Williams, R., Devlin, R., Griggs, T., and Bromberg, P. (2003). Exposure to particulate matter, volatile organic compounds and other air pollutants inside patrol cars. *Environmental Science and Technology*, v. 37, p. 2084-2093.
- <sup>17</sup> Nemmar, A., Hoet, P., Dinsdale, D., Vermeylen, J., Hoylaerts, M., and Nemery, B., Diesel Exhaust Particles in Lung Acutely Enhance Experimental Peripheral Thrombosis, *Circulation*. Vol. 107, (2003), pp.1202-1208.
- <sup>18</sup> Weinhold, B, (2001). Pollutants lurk in vehicles: Don't Breathe and Drive? *Environmental Health Perspectives*, v. 109, no. 9, p. A422-A427.
- <sup>19</sup> Fruin, S (2003). Characterizing Black Carbon Inside Vehicles: Implications for Refined Exposure Assessments for Diesel Exhaust Particulate Matter. Ph.D. Dissertation, University of California, Los Angeles.
- <sup>20</sup> Pope, C.A., Ezzati, M., Dockery, D. (2009). Fine particulate air pollution and life expectancy in the United States. *New England Journal of Medicine*, v. 360, no. 4, January 23, 2009.