Designation: E2292 – 14

Standard Guide for Field Investigation of Carbon Monoxide Poisoning Incidents[1]

This standard is issued under the fixed designation E2292; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide covers collection and preservation of information and physical evidence related to incidents involving the poisoning of individuals by carbon monoxide.

1.2 This guide is not intended to address the medical effects of carbon monoxide exposure.

1.3 This guide is not intended to be a guide for investigating carbon monoxide poisoning caused by hostile fires, or contamination in closed air systems or confined spaces. Guidance on the investigation of carbon monoxide poisonings related to fire can be found in NFPA 921.

1.4 This guide is not intended for an investigation where equipment is removed from the incident site and conducted in a more controlled setting.

1.5 This guide is intended to be used by a wide range of investigators, including first responders, appliance technicians and engineers.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E1459 Guide for Physical Evidence Labeling and Related Documentation

E2713 Guide to Forensic Engineering

2.2 *NFPA Standards:*[3]

NFPA 54 National Fuel Gas Code

NFPA 921 Guide for Fire and Explosion Investigations

2.3 *UL Standards:*[4]

UL 2034 Single and Multiple Station Carbon Monoxide Alarms

3. Significance and Use

3.1 This guide is intended for use by individuals who investigate incidents involving carbon monoxide poisoning. If this guide is followed, the cause for the carbon monoxide poisoning incident may be determined, and corrective action may be identified to prevent future incidents.

3.2 When attempting to identify the source of carbon monoxide, consider that it is produced at some level in virtually every fuel-burning engine, boiler, furnace, burner, stove or fire. All carbon-based fuels (for example, gasoline, diesel fuel, natural gas, propane, coal, wood, paper products, plastics) produce carbon monoxide as a result of incomplete combustion. When there is insufficient air for complete combustion, carbon monoxide can become a major product of combustion. In properly-operating combustion equipment, the level of carbon monoxide produced may be as little as a hundred parts per million or less (that is, 0.01 %). However, combustion with insufficient air can produce carbon monoxide concentrations of 10 000 ppm to 100 000 ppm (that is, 1 to 10 %) or higher.

3.3 Be aware of the effects of carbon monoxide on humans and pets. Carbon monoxide acts as a central nervous system depressant. With increasing concentration or time of exposure, or both, carbon monoxide will cause people to feel sleepy or sick, lose consciousness, and die. Carbon monoxide is especially hazardous because it is colorless and odorless, providing no warning of its presence. When inhaled, carbon monoxide binds with hemoglobin in the blood, creating carboxyhemoglobin (COHb). The affinity of carbon monoxide for hemoglobin is approximately 200 times greater than the affinity of

[1] This practice is under the jurisdiction of ASTM Committee E58 on Forensic Engineering and is the direct responsibility of Subcommittee E58.05 on Industrial Processes.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, http://www.nfpa.org.

[4] Available from Underwriters Laboratories (UL), 2600 N.W. Lake Rd., Camas, WA 98607-8542, http://www.ul.com.

oxygen for hemoglobin. Therefore, the blood can accumulate dangerous levels of COHb, depriving the body of oxygen.

3.4 Since there is the potential for investigators to become victims of elevated carbon monoxide levels themselves, extreme care should be taken to assure the safety of investigators and anyone else at risk of continuing carbon monoxide exposure. Carbon monoxide monitoring and measurement equipment is required to ensure life safety of those present, as well as to determine the cause of the problem and its solution.

4. Equipment

4.1 The following is a listing of basic measurement equipment that may be useful in diagnosing a carbon monoxide problem and determining the source, cause, and validating corrective actions:

4.1.1 *Electronic Carbon Monoxide Monitor*—A properly calibrated direct reading electronic monitor having a range of 0 to 1000 or 2000 ppm (that is, 0.1 to 0.2 %) is preferred in that its output provides almost instantaneous concentration data, and it therefore has the capability to warn the investigator if carbon monoxide levels are reaching dangerous concentrations. The carbon monoxide monitor may also be used to survey different areas of a building to locate the area of highest concentration, helping to identify the source.

4.1.2 *Carbon Monoxide Alarms (compliant with UL 2034)*—These alarms may be used as warning devices (see Section 5). Alarms with digital readouts should not be used as primary investigative monitors since their range is typically limited to ~100 ppm (that is, 0.01 %).

4.1.3 *Combustion Gas Analyzer*—Because malfunctioning combustion equipment is sometimes found to be the source of excessive carbon monoxide, portable gas analyzers are useful to check the combustion products produced by fuel burning equipment. These instruments indicate carbon monoxide as well as other exhaust gases. Combustion gas analyzers are used to determine whether the combustion equipment is operating within its normal limits for carbon monoxide in the exhaust. A measurement range up to 10 % carbon monoxide (100 000 ppm) may be required.

4.1.4 *Manometer*, or equivalent insturment, capable of determining positive and negative pressures in the combustion air supply, exhaust stack, and inside the living space while fuel burning equipment is operating.

4.1.5 *Ventilation Equipment*—A fan, blower, or similar device should be available to provide air movement in the space around equipment between tests. Monitor the carbon monoxide level in the area before running each test.

4.1.6 *SCBA (self contained breathing apparatus)* may be used if entering a highly contaminated area while conducting tests.

4.1.7 All indicating equipment should be calibrated at least annually or per the manufacturer's recommendations, and checked prior to each use. The equipment may be checked against a standard reference gas. Selection of calibration gas concentrations should reflect both low and high range for gas measurement equipment.

5. Safety

5.1 Entering spaces and testing of equipment suspected of causing carbon monoxide poisoning may yield definitive results that cannot be obtained any other way. Testing of equipment that may have injured individuals; however, is a potentially dangerous undertaking, in that the investigator runs

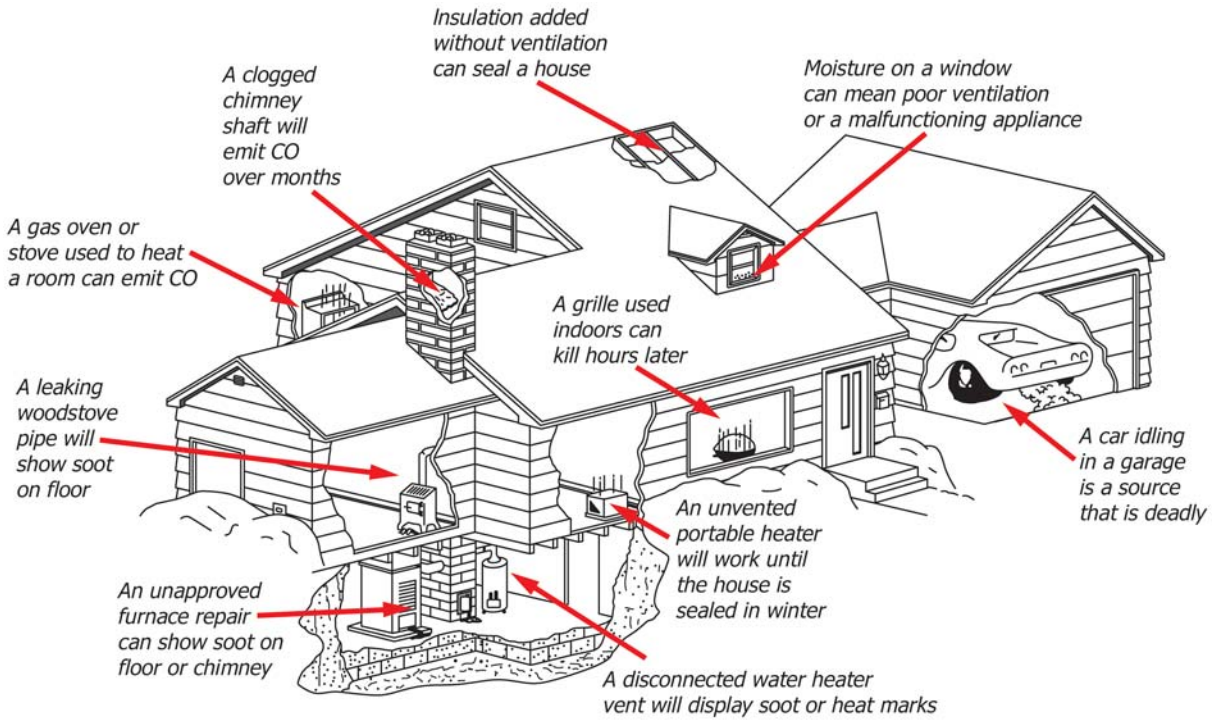

FIG. 1 Common Locations of Carbon Monoxide Build-Up