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SUBJECT: Updated Review of In-Depth Investigations Associated with Carbon Monoxide Poisoning and "Modern" Gas Furnaces and Boilers

PURPOSE

The purpose of this memorandum is to (1) report the results of a review of In-Depth Investigations (IDIs) associated with non-fire-related carbon monoxide (CO) incidents and gas furnaces and boilers and (2) provide an update of previous CO incident reviews involving these types of products.[1,2] The current and previous reviews address assertions by some within the gas appliance industry and voluntary standards community that most of the CO poisoning incidents reported to the CPSC involved older appliances, not "modern" appliances.

BACKGROUND

"Modern" furnaces are furnaces that, based on: (1) their date of manufacture, installation, or certification; or (2) the safety components they were equipped with (*e.g.*, Blocked Vent Shutoff Switches (BVSS)/pressure switches or spill switches/thermal switches designed to shutdown the appliance when the vent became blocked), would have been certified to the 1986 (effective date 1987) or later versions of ANSI Z21.47, *Standard for Gas-Fired Central Furnaces* (Except

[1] "In-Depth Investigations of Carbon Monoxide (CO) Incidents Associated with "Modern" Gas-Fired Furnaces," R. Jordan and S. Vagts (2002).
[2] "In-Depth Investigations Associated with Certain Vented Gas Appliances," R. Jordan and S. Vagts (2002).

Direct Vent Furnaces) or the 1989 (effective date 1992) or later versions of ANSI Z21.64 (Z21.64b-1989), *Standard for Direct Vent Central Furnaces*. ANSI Z21.47 provided coverage for draft hood-equipped furnaces, while ANSI Z21.64 provided coverage for direct vent furnaces. In 1993, ANSI Z21.47 and ANSI Z21.64 were combined into one standard and designated, ANSI Z21.47, *Standard for Gas-Fired Central Furnaces*. These versions of the furnace standards were the first to adopt the current set of construction and performance requirements that address some of the operating, installation, or usage conditions that could result in CO leakage into the living space.

"Modern" boilers are boilers that, based on: (1) their date of manufacture, installation, or certification; or (2) the safety components they were equipped with (*i.e.,* BVSS/pressure switches or spill switches/thermal switches designed to shutdown the appliance when the vent became blocked), would have been certified to the 1989 or later versions of ANSI Z21.13, *Standard for Gas-Fired Low Pressure Steam and Hot Water Boilers*. This version of the boiler standard was the first to adopt the current set of construction and performance requirements that address some of the operating, installation, or usage conditions that could result in CO leakage into the living space.

In 1996, CPSC staff proposed to the ANSI Z21.47 furnace subcommittee that a performance provision be added to the furnace standard, ANSI Z21.47, *Standard for Gas-Fired Central Furnaces,* that would require furnaces to shut down in the event that their vents became disconnected or partially blocked. The standard in effect at that time did not include provisions that protected consumers from those conditions. In 2000, CPSC staff reiterated that proposal and also proposed an additional, alternative provision that would: (1) require a means to prevent a furnace from producing CO levels in excess of 400 ppm (air free)[3], or (2) require the furnace to shut down if CO levels exceeded 400 ppm (air free). To support these proposals, in 1997 and 2000, staff conducted reviews of incidents reported to the CPSC involving CO poisonings associated with gas furnaces and disconnected or blocked vents, and provided the results of those reviews to the furnace subcommittee.[4,5] The reviews demonstrated that disconnected and partially blocked vents were failure conditions that contributed to the CO poisonings.

Representatives from the Gas Appliance Manufacturers Association (GAMA) and other subcommittee members asserted that the incidents discussed in these reviews did not involve "modern" furnaces, but rather, older appliances. They also asserted that "modern" furnaces did not pose the CO exposure risks from the failures or conditions reported in the CPSC incident reviews. Because the 1997 and 2000 IDI reviews focused primarily on vent conditions, not the vintage of the appliance, staff was unable to confirm whether the furnaces involved in those cases met the criteria (described in the following paragraph) for "modern" furnaces. In order to respond to industry's assertions, a review of CO exposure incidents that identified not only vent conditions, but also appliance vintage, was necessary. In 2002, CPSC staff conducted additional IDI reviews with a focus on the vintage of the appliance, in addition to vent and operating conditions, to determine whether "modern" furnaces (or boilers, for that matter) were involved in

[3] "Air-free" is a means to express a flue gas sample of CO that has not been diluted by excess air added to the burners during the combustion process.
[4] "Review of Selected Investigation Reports Involving Vent Disconnection from Gas-Fired Central Furnaces," R. Jordan (1997).
[5] "Review of Selected Investigation Reports Involving Gas-Fired Central Furnaces and Disconnected and Blocked Vents," R. Jordan (2000).

CO poisoning incidents. The results of these reviews demonstrated that "modern" furnaces and boilers had been, and continue to be, involved in CO exposure incidents.[6, 7]

Despite their intended purpose, the performance requirements for furnaces and boilers do not provide consumers protection from CO leakage under a number of conditions that commonly occur in the field and that have been associated with CO deaths, injuries, and potential exposures. These conditions include: disconnected vents, partially blocked vents, over-fired furnace/boilers, and furnace/boilers that have inadequate air for combustion. The safety devices (*e.g.*, Blocked Vent Shutoff Systems and spill switches) required by the ANSI Z21 standards were not designed to respond to these conditions, and thus, they are unable to protect consumers from CO exposure under these conditions. The scenarios described in these incidents underscore the need for requirements that provide more comprehensive protection against CO poisoning for consumers.

METHODOLOGY

This memorandum provides an update of staff's previous reviews of furnaces and boilers and summarizes CO incidents associated with modern furnaces and boilers from the CPSC IDI files for the years 2002 through 2009. For the purposes of this review, CO incidents were comprised of cases in which a gas furnace or boiler reportedly leaked CO into the home or other structure. CPSC staff from the Directorate for Engineering Sciences reviewed the IDIs to compile the information within this memorandum. This review focused on reported conditions associated with furnace or boiler components, installation and operation, as well as deaths and medical treatment information associated with the incidents.

The incidents included in this review were from the CPSC's In-Depth Investigation (INDP) File. Data from the CPSC INDP files are not a statistical sample, and national totals may not be derived from the number of incidents investigated. However, the data does provide minimum case count examples of actual incidents and anecdotal information. See Appendix A for the codes and keywords used in the database searches. The initial database search identified 435 IDIs from January 2002 through December 2009, involving carbon monoxide poisonings or exposures associated with gas furnaces and boilers. After the initial database search, staff screened the incidents to determine if they were within scope. Incidents were considered out of scope or indeterminate for the following reasons:

- Furnace or boiler was converted to or from solid fuel or oil to natural or liquefied petroleum (LP) gas;
- Furnace was not a gas-fired central furnace;
- Furnace or boiler was manufactured prior to 1987;
- The furnace's age or vintage could not be determined or estimated from available information;
- The incident was associated with a fire or a gas leak; or
- No evidence was provided within the investigation that CO leakage or exposure was related to furnace or boiler malfunction or failure.

[6] "In-Depth Investigations of Carbon Monoxide (CO) Incidents Associated with "Modern" Gas-Fired Furnaces," R. Jordan and S. Vagts (2002).
[7] "In-Depth Investigations Associated with Certain Vented Gas Appliances," R. Jordan and S. Vagts (2002).

In addition to screening out incidents that were not relevant, staff also verified the occurrence of reported conditions that were associated with CO leakage into the home or other structure. This memorandum only includes CO leakage-related information that was corroborated by at least one authoritative, investigating source. Acceptable sources included: the fire department, gas utilities, HVAC or plumbing service technician, forensic engineer, medical records, product manufacturer, housing authority, police, and local, state, or federal health officials. This review includes cases that were collected through the following means:

- Investigative reports collected by CPSC field investigators from the sources; or
- Investigative findings recorded by CPSC field investigators through telephone or in-person interviews of the sources; or
- Investigative findings of the sources reported to CPSC field investigators through interviews or investigative reports of third parties.

In addition to counting the number of CO-related deaths associated with each incident, staff also provides counts of the number of probable CO injuries, as well as the number of potential CO exposures related to each incident. Staff collected information on the type of medical treatment that each consumer received that was associated with CO exposure reported in the incidents. Based on the available information, each consumer's condition or disposition during or following the incident was characterized as either:

- Diagnosed injury,
- Given medical treatment for physical symptoms of CO exposure, or
- On-Site at time of the incident (no medical treatment given, requested, or cited).

"Probable injuries" were defined as consumers who were cited as having been either diagnosed with CO poisoning or given medical treatment for physical symptoms of CO exposure. This memorandum only includes a count of probable injuries that were corroborated by at least one authoritative, medical source. "Potential exposures" were defined as exposures to consumers who were on-site at the time of the incident but were not diagnosed with, or given medical treatment for, CO exposure. This memorandum only includes a count of potentially exposed consumers, whose exposure was corroborated by at least one authoritative technical or medical source.

Acceptable sources included: hospital/medical center records; doctors, nurses, and other health care professionals; emergency medical technicians (EMTs), fire fighters, and other first responders; federal, state, and local health officials. To be characterized as having sustained a carbon monoxide poisoning injury, the consumer would have had to have a carboxyhemoglobin (COHb) level above 10 percent or received supplemental hyperbaric oxygen (HBO) in a pressurized chamber (*i.e.*, hyperbaric chamber). To be characterized as having a high likelihood of CO exposure, a consumer would have had to exhibit at least one of the following physical symptoms OR received one of the following medical treatments or test results:

- loss of consciousness,
- loss of responsiveness,

- nausea/vomiting,
- disorientation,
- dizziness,
- headaches,
- received supplemental normobaric oxygen.

Staff counted the number of consumers who were on-site at the time of the incident and: (i) received medical treatment as a result, or (ii) did not receive medical treatment. Staff believes it was important to include this category because it provides an indication of the potential CO poisoning risk to consumers presented by the conditions that led to the incident. These conditions and the presence of other consumers on-site during the incident could have resulted in more deaths and injuries. The ultimate goal of the Vented Gas Appliance CO Sensor project is to reduce the number of CO-related deaths and injuries associated with these types of products (*i.e.*, furnaces and boilers) and to reduce the risk of CO poisoning incidents associated with them.

This memorandum only includes medical treatment information that was corroborated by at least one medical source, and which satisfied the following criteria:

- Medical reports were collected by CPSC field investigators from the medical source, or
- Medical findings or treatments were recorded by CPSC field investigators through telephone or in-person interviews of the medical sources, or
- Medical findings or treatments of the medical sources were reported to CPSC field investigators through interviews or investigative reports of third parties or consumers.

RESULTS

In-scope CO incidents

CPSC's epidemiology database was queried through the EPIdemiology Retrieval (EPIR) using the search criteria listed in Appendix A, resulting in identification of a total of 435 IDIs involving CO poisoning and either gas furnaces or boilers (Table 1). The screening criteria described under the Methodology section were applied to determine which cases were within the scope of this study. As shown in Table 1, the product vintage could not be determined in three-fifths (261 out of 435) of the IDIs, and as a result, ES staff was unable to determine whether the appliances involved in those incidents were "modern" units or older units. This is a common problem encountered with IDIs involving CO poisoning and gas furnaces or boilers. Thus, valuable incident data from cases in which the vintage could not be determined were not included in this review.

Table 1. CO Incidents Involving All Furnaces and Boilers (2002–2009)

Year of Incident	Total Number of Incidents	Incidents without Furnace/Boiler Vintage Info	Incidents with Furnace/Boiler Vintage Info	Incidents with Out-of-Scope Vintage Info	Incidents with In-Scope Vintage Info
2002	73	57	16	7	9
2003	41	25	16	9	7
2004	71	35	36	21	15
2005	56	32	24	15	9
2006	45	28	17	6	11
2007	71	42	29	17	12

Table 1. CO Incidents Involving All Furnaces and Boilers (2002–2009)

Year of Incident	Total Number of Incidents	Incidents without Furnace/Boiler Vintage Info	Incidents with Furnace/Boiler Vintage Info	Incidents with Out-of-Scope Vintage Info	Incidents with In-Scope Vintage Info
2008	44	25	19	10	9
2009	34	17	17	6	11
Totals	**435**	**261**	**174**	**91**	**83**

*** Note.** Data from the CPSC In-depth Investigation File are not a statistical sample and national totals may not be derived from the number of incidents investigated. The data does provide examples of actual incidents and anecdotal information.

Many of the IDIs reviewed did not include details concerning the product's manufacturer, model number, dates of manufacture, certification, or installation of the furnace or boiler. The IDIs also often do not include a report or statement from an authoritative technical source confirming that a furnace or boiler was the source of the CO production. Finally, many of the IDIs did not include photographs of key components, such as the vent pipe, pressure switch, or the unit's rating plate. In the absence of other specific forms of information on appliance vintage, photographs of these components, at times, have helped determine appliance vintage. Of the 435 IDIs initially identified, only about one-fifth of them (83 out of 435) were found to be within scope (see Table 1A).

Table 1A. In-Scope Incidents (2002–2009)

Year of Incident	Total Number of Incidents	Incidents with In-Scope Vintage Info
2002	73	9
2003	41	7
2004	71	15
2005	56	9
2006	45	11
2007	71	12
2008	44	9
2009	34	11
Totals	**435**	**83**

CO Deaths, Probable Injuries, and Potential Exposures

As shown in Table 2, there were a total of 44 CO-related deaths and 207 probable CO-related injuries involving "modern" gas furnaces and boilers during the review period from 2002–2009. It is important to note that these deaths and probable injuries are a subset of all the furnace and boiler CO incidents and likely do not reflect all of the cases involving "modern" furnaces and boilers but only those cases that included adequate descriptive information from which appliance vintage could be determined. In addition to counting deaths and probable injuries, staff also considered potential CO exposures. For purposes of this review, "potential CO exposures" were a count of consumers who were on-site at the time of the incident, and therefore, were potentially at risk of being exposed to, and affected adversely by, leakage of CO from the appliance. This category was included because it provides a means to measure other potential impacts of the

incident and potential benefits of the Vented Appliance CO Sensor project. Only information that was corroborated by authoritative medical sources was included.

Table 2. CO Deaths, Injuries, and Potential Exposures Associated with "Modern" Gas Furnaces and Boilers (2002–2009)[8,9] *

	2002	2003	2004	2005	2006	2007	2008	2009	2002–2009	
									Totals	Averages
Incidents	**9**	**7**	**15**	**9**	**11**	**12**	**9**	**11**	**83**	**10.4**
Deaths	9	4	7	4	8	4	4	4	44	5.5
Probable Injuries	3	16	82	51	11	8	9	27	207	25.9
Potential Exposures	27	15	111	67	302	48	144	56	770	96.3

*** Note.** Data from the CPSC In-depth Investigation File are not a statistical sample and national totals may not be derived from the number of incidents investigated. The data does provide examples of actual incidents and anecdotal information.

Failure modes that led or contributed to CO leakage and associated deaths, injuries, and potential exposures

As shown in Table 3, the investigating authorities were able to determine the primary failure modes that led to or contributed to CO leakage from the furnace or boiler in 73 out of 83 cases. The reported failure modes included: disconnected or breached vents; blocked vents, heat exchangers (HEX), or chimneys; depressurization of the space or back drafting of exhaust products; improper venting; and miscellaneous failure modes. The failure mode was unknown in 10 of the incidents.

Table 3. Failure Modes that Led or Contributed to CO Incidents Associated with "Modern" Furnaces and Boilers (2002–2009).*

Primary failure mode reported	Incidents Citing the Failure Mode		Deaths	Probable Injuries	Potential Exposures
	#	%	#	#	#
Vent, Chimney, or Heat Exchanger Breach or Disconnect	16	19.3%	8	41	62
Vent, Chimney, or Heat Exchanger Blockage	15	18.1%	10	55	96
Depressurization or Back drafting	3	3.6%	1	8	11
Improper Venting	3	3.6%	0	2	21
Miscellaneous	14	16.9%	4	26	104
Multiple Failure Modes	22	26.5%	12	60	181

[8] A spike in the number of injuries reported in 2004 occurred because out of a total of 20 in-scope incidents, two occurred in commercial/institutional settings, each involving more than 10 injuries (10 injuries associated with IDI No 041025HNE1836 and 28 injuries associated with IDI No. 041026HWE3016).

[9] A spike in the number of injuries reported in 2005 occurred because out of a total of 10 in-scope incidents, two occurred in commercial/institutional settings, each involving more than 10 injuries (19 injuries associated with IDI No. 050321HCN0534 and 15 injuries associated with IDI No. 051206HNE0282).

Table 3. Failure Modes that Led or Contributed to CO Incidents Associated with "Modern" Furnaces and Boilers (2002–2009).*

Primary failure mode reported	Incidents Citing the Failure Mode		Deaths	Probable Injuries	Potential Exposures
	#	%	#	#	#
Unknown	10	12.0%	9	15	295
Totals*	**83**	**100.0%**	**44**	**207**	**770**

*** Note.** Data from the CPSC In-depth Investigation File are not a statistical sample and national totals may not be derived from the number of incidents investigated. The data does provide examples of actual incidents and anecdotal information.

For the purposes of this study, a disconnected vent or chimney described the condition cited in the IDI report in which there was either a partial or complete separation between two adjoining sections of vent pipe or chimney or between a section of vent pipe and the adjoining flue outlet of a furnace or boiler. A breached vent, chimney, or heat exchanger described a condition cited in the IDI report in which a hole or some other opening was present in the wall of the component. These components (*i.e.*, vents, chimneys, and heat exchangers) and conditions (*i.e.* disconnect and breach) were grouped under the broader category "Vent, Chimney, or Heat Exchanger Breach or Disconnect" because despite the various causes that led to the condition, they all created a leakage path that allowed CO to enter the living space. When complete or partial blockage of vents, chimneys, and heat exchangers was reported, these components were grouped under the broader category, "Blocked Vents, Chimneys, or Heat Exchangers." Again, despite the various causes, locations, and degrees of blockage of these components, they all caused or contributed to leakage of CO into the living space.

"Depressurization" described the conditions reported in the IDI reports in which air was exhausted from the home or other structure through exhaust fans or other mechanical means, possibly at greater rates or larger volumes than air infiltration into the home or air exhausted through the vent system of the furnace or boiler, causing a negative pressure locally at the appliance flue collector or burner compartment. "Back-drafting" described a condition reported in the IDI in which exhaust product flow reversed back through the appliance flue collector or burner compartment and into the living space, instead of through the vent system to the outdoors. This condition may or may not have been a consequence of depressurization. "Improper Venting" described conditions cited in the IDI reports in which the vent system was installed in a manner that was in violation of the instructions and requirements of the appliance manufacturer, the vent manufacturer, and/or the local building codes. "Miscellaneous" failure modes included reported conditions that did not meet the descriptive criteria of the preceding failure modes. Incidents in which the cause of the failure mode was not reported were classified as Unknown. When more than one cause for CO leakage was reported, the incident was classified as having had "Multiple" failure modes.

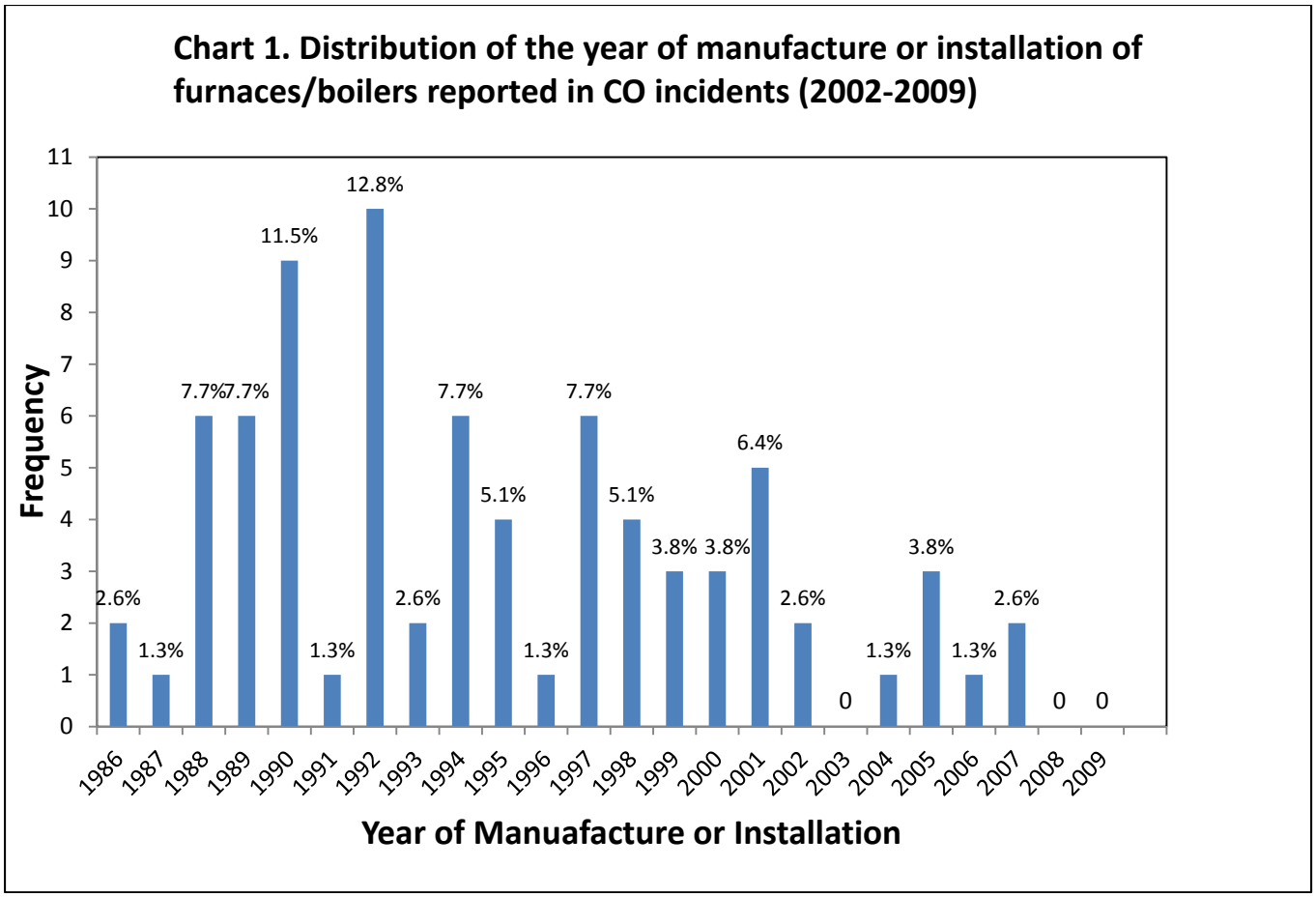
Disconnected/breached vents, chimneys, or heat exchangers were reported most frequently, accounting for 19.3 percent of the primary failure modes cited (16 out of 83 cases), followed by blocked vents, air intakes, heat exchanger, or chimneys, which were cited in 18.1 percent of the cases (15 out of 83 cases). Scenarios in which a vent/flue damper failed to open were also

counted among the blocked vent cases. There were 8 deaths and 41 injuries associated with the cases that cited a disconnected or breached vent as the primary failure mode. The cases that involved a blocked vent as the primary failure mode accounted for 10 deaths and 55 injuries. Overall, disconnected and blocked vents were cited as the primary failure mode in more than a third of the cases (*i.e.*, 31 out of 83 or 37%) involving "modern" furnaces and boilers and were associated with 41 percent of the deaths (*i.e.*, 18 out of 44 deaths) and 46 percent of the injuries (96 out of 207 injuries). Of the 22 cases involving multiple failure modes, disconnected vents were cited as one of the failure modes 12 times, improper venting was cited 11 times, blocked vents were cited 6 times, and depressurization only once. Miscellaneous failure modes were cited as one of the failure modes in 19 of the 22 multiple failure mode cases.

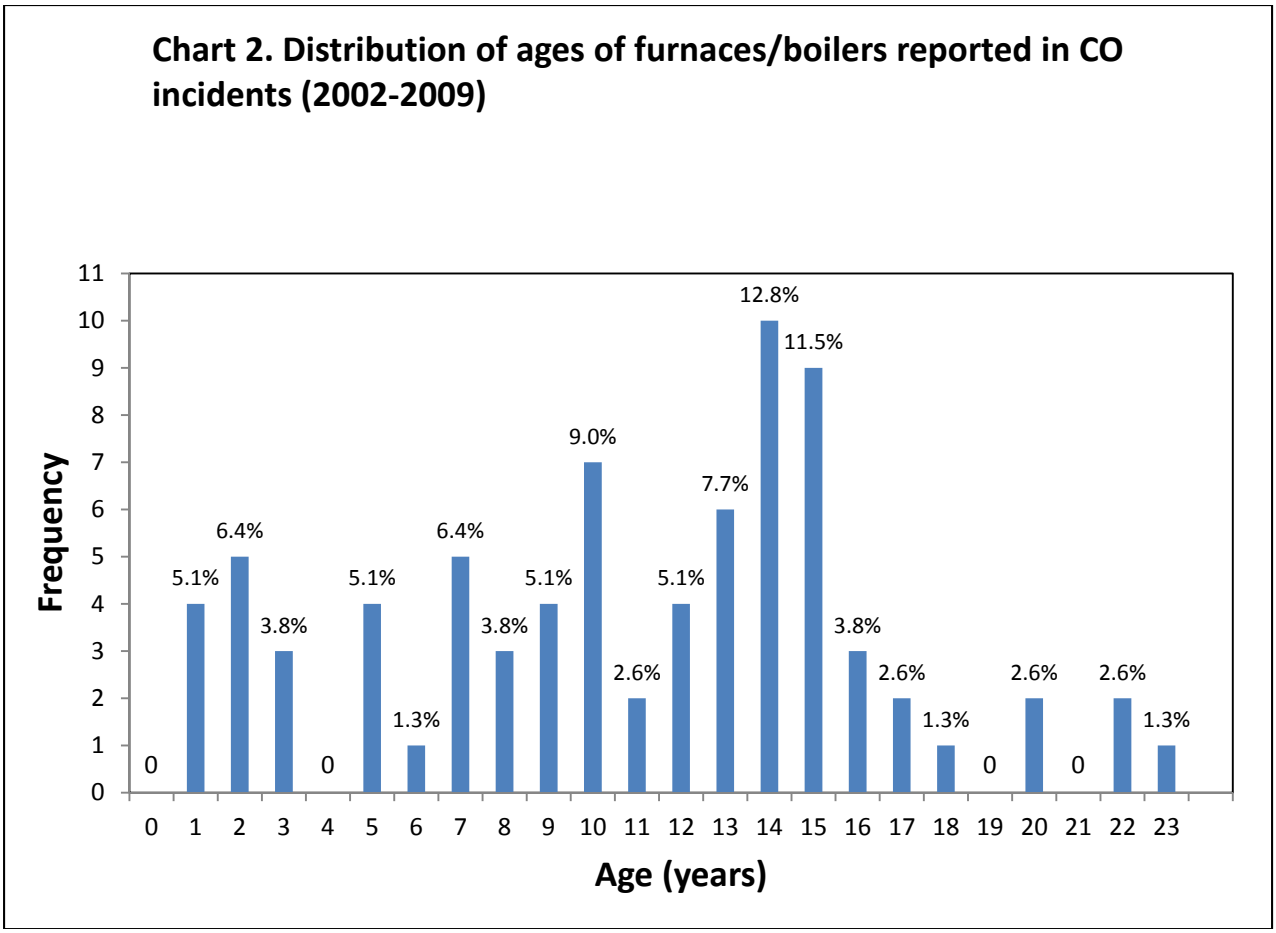
Failure mechanisms that led to or contributed to production of elevated CO levels.
Although the incident reports often identified the leakage path of CO into the living space, they rarely provided information about the failure mechanism/s that either led to or contributed to a furnace or boiler producing elevated levels of CO. Only 19 out of the 83 incident reports included this type of information. When the failure mechanisms were reported, they were almost evenly divided between inadequate/blocked combustion/ventilation air (10 citations) and over-firing (7 citations). There were two reports of the appliance having been converted improperly to or from natural or LP-gas. In two of the cases, more than one failure mode was reported.

Determination of the vintage of furnaces and boilers involved in CO incidents
The vintage of the appliances involved in each incident was based on the reported age, date of manufacture, or date of installation; or the reported age or date of construction of the residence or building structure the appliance was installed in. In some incidents, when the age of the appliance or its date of manufacture or installation were not reported, the vintage was based on whether the appliance was reported to have been equipped with component/s or materials indicative of a "modern" furnace or boiler design. Components indicative of a "modern" furnace or boiler design included blocked vent shutoff switches (BVSS), flame rollout switches, spill switches, and blower door interlock switches (for central furnaces only). Materials indicative of a "modern" furnace or boiler design included polyvinyl chloride (PVC) used for vent pipe and other forms of plastic used for inducer motors.

The information provided in the incident reports was sufficient to determine the year of manufacture or installation and age of furnaces and boilers in 78 of the 83 incidents. For those incidents in which the year of manufacture or installation of the product could be determined, the distribution is provided in Chart 1. The distribution of product age at the time of the incident is provided in Chart 2. Neither chart reflects distribution data for products involved in incidents in which the year of manufacture or installation or age of a product was not reported.



As shown in Chart 1, the years of manufacture or installation of the appliances involved in these incidents ranged from 1986 to 2007. The age of these appliances ranged from less than 1 year to 23 years old. The average appliance age was 12 years old, with a mode of 14 years old. The median appliance age was 11 to 12 years old.



Despite the gas appliance industry's expected life of 15 to 20 years for furnaces and boilers, Chart 2 shows that the majority (86 percent) of the CO incidents occurred in appliances that were reported to have been 15 years old or less at the time of the incident. Thus, although the life expectancy of a furnace or boiler may be at least 15 years, this data shows that failure modes and conditions that allow CO leakage into a living space can occur well before the appliance exceeds its expected lifespan. For this data set, the average age of appliances involved in a CO incident was 9.6 years.

CONCLUSION

This study demonstrates that CO deaths and injuries continue to occur involving "modern" furnaces and boilers. It also confirms and underscores staff's concern that the current ANSI standards do not adequately protect consumers from common appliance failure modes and conditions that allow leakage of CO into a living space. The cases involving disconnected vents demonstrate that consumers who experience this mode of failure can be exposed to hazardous levels of CO. There are no provisions in the furnace or boiler standards to address this failure scenario. The cases involving blocked vents demonstrate that "modern" furnaces or boilers equipped with a pressure sensing means (e.g., measuring the static pressure within the vent) or a temperature sensing means (*e.g.*, measuring the temperature of exhaust gases spilling past a measurement point in a draft hood) do not always protect against real world conditions, such as a disconnected or partially blocked vent, that can lead to leakage of hazardous levels of CO into the living space.

APPENDIX A

The queries below were submitted through the EPIR application. Query results were manually reviewed to include carbon monoxide poisoning hazards and to exclude out-of-scope cases.

Date of Queries: 01/20/2010
Incident dates: 01/01/2002–12/31/2009
Product Codes: 310, 308
Narrative contained: CO or POISONING or MONOXIDE

In-Scope In-Depth Investigations Task Numbers for Gas Furnaces and Boilers by Year of Incident*							
2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
021023HCC2052	030220HCC1343	040219HWE6010	050113HCN0349	060124CCC3269	091029CNE4785	080207HCC1400	090114CNE4072
040518HCC3321	030430HNE7897	040409HCC2461	050131HNE2063	060628CNE1156	071017HCC2029	080306CCC3461	090120HNE4081
020401CBB3159	031030HCC2058	040316HCN0436	050131HNE2065	080102HCC2273	080104HCC1271	080903HCC3832	090209CNE4172
020904CCN0791	031203HCC1225	040322HCN0450	050209HNE2094	091023HCC3035	070816HCC1689	081007HCC1011	090311HCC2443
021217HCC2221	031216HWE5012	041026HWE3016	050421HNE2312	060330HWE5240	090430HCC1643	081114HCC1167	090331HCC1559
021024HCC3031	031219HWE5017	040928HCN1014	060420HCC2503	060502HCC3476	071207CWE7124	081113CCC3129	090603HCC2672
020906HCN0799	031215HNE1162	041018HCN0063	051206HNE0282	061116HCC2085	071231HCC2239	090611HNE4490	090602HNE4467
021029HNE7539		041020HNE1825	070917HCC2830	061115HCC1090	080104HCC1276	090116HCC3256	090924HCC3982
021017HCN0033		041021HNE1830	060117HWE5081	070105HCC2177	080114HCC2357	080814CCC1836	091119HCC2155
		041025HNE1836		061213HCC2142	080814HCC2899		091123HCC3100
		070718HCC3576		061221HCC2152	080107HCC2303		091207HCC2207
		041123HNE1902			080130HCC3379		
		050107HCC1319					
		041228HCC2232					
		041129HNE1914					

***Note.** The In-Depth Investigation may not have been conducted the same year that the incident occurred.