



UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

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SUBJECT : Incidents, Deaths, and In-Depth Investigations Associated with Carbon Monoxide
and Engine-Driven Tools, 1990-2003

This memorandum summarizes carbon monoxide (CO) incidents from the Consumer Product Safety Commission (CPSC) databases that were associated with engine-driven generators and other engine-driven tools for the years 1990 through 2003¹. Other engine-driven tools include tools such as power lawn mowers, garden tractors, portable pumps, power sprayers and washers, snowblowers, and floor buffers. This memorandum summarizes the characteristics of CO poisoning deaths reported to the CPSC associated with engine-driven tools. This memorandum also provides a more detailed summary of fatal CO poisoning incidents associated with engine-driven tools found in CPSC's In-depth Investigation (INDP) File.

See Appendix A for the codes and keywords used in the database searches. The following CPSC databases were searched: In-depth Investigation (INDP) File, Injury or Potential Injury Incident (IPII) File, and Death Certificate (DCRT) File. It should be noted that reporting may not be complete and this memorandum reflects only those incidents entered into the CPSC databases before March 1, 2004. All CO incidents found during the database search that were associated with at least one CO fatality or a non-fatal exposure to CO that resulted in one or more individuals attending a medical facility for treatment were included. Appendix B provides a listing of the incidents referenced within this memorandum. Since the writing of the previous memo, two deaths associated with lawn mowers were removed². After the previous memo was written these deaths were further investigated and it was determined that the deaths were possible suicides.

¹ This analysis was prepared by the CPSC staff, has not been reviewed or approved by, and may not necessarily reflect the views of, the Commission.

² Vagts S. "Incidents, Deaths, and In-Depth Investigations Associated with Carbon Monoxide and Engine-Driven Tools, 1990-2002." Washington, D.C.: U.S. Consumer Product Safety Commission. 2003.

Sixteen incidents associated with both an engine-driven tool and a non-engine driven tool source of CO (such as a gas space heater or water heater) were considered out of scope for this memo since the exact source of the CO could not be determined¹. Incidents associated with multiple engine-driven tools (such as a generator and a lawn mower) were included within this memo. Incidents associated with generators that were specifically reported as integral parts of recreational vehicles (RVs), motor homes, or boats were not included within this memo. For example, generators that were reported as mounted to the bottom of an RV were not included nor were boat generators that were installed by the boat manufacturer. Since incidents in recreational vehicles and boats can be associated with either a portable generator or an integral generator, only those incidents that specifically stated that the generator was part of the RV, motor home, or boat were excluded. For one fatal incident in a boat and two separate fatal incidents in a motor home, it could not be specifically concluded that the generator was an integral part of the boat or motor home². In addition, a non-fatal incident in a camper and a non-fatal incident in a boat were associated with generators where it could not be specifically determined if the generator was an integral part³. Therefore these five incidents were included within this memo.

Table 1 shows the number of carbon monoxide exposure incidents and deaths in the CPSC files associated with generators and other engine-driven tools that occurred between January 1, 1990 and December 31, 2003. From 1990 through 2003, 251 incidents were found in the CPSC databases that were associated with engine-driven tools and a potential carbon monoxide exposure. The term potential is used to categorize these incidents since the CO exposure could not be confirmed for some of the non-fatal incidents. Incidents were associated with portable generators, garden tractors, lawn mowers, snowblowers, floor buffers, portable pumps, power washers and sprayers, other engine-driven power tools, and multiple engine-driven tools. The category 'other engine-driven power tools' includes gas floor and concrete cutters. The category 'multiple engine-driven tools' includes an incident that involved both a generator and a power lawn mower.

Table 1: Number of Non-fire CO Potential Exposure Incidents and Deaths Reported to the CPSC Associated with Engine -Driven Tools, 1990-2003.

Product	Number of Incidents	Number of Deaths
Total	251	258
Generator	212	228
Garden Tractor & Lawn Mower	21	19
Snowblower	5	5
Floor Buffer	3	0
Pumps	3	2
Power Washer & Sprayer	3	1
Other Engine-Driven Power Tools or Internal Combustion Engine (non-vehicular)	3	2
Multiple Engine-Driven Tools	1	1

¹ 0021038891, 0156001192, 0227037489, 0302000494, 030219HEP9015, 9845030920, 9926010886, B9529423A, G9130305A, N0120209A, X0231359A, X0310578A, X0331336A, X9122456A, X9176126A, and X9621373A.

² 9522020180, G9160205A, and N9470214A.

³ X99B3684B and 010301HEP9009

Two hundred and twelve of the 251 incidents reported to the CPSC were associated with generators. From 1990 through 2003, 258 deaths were associated with engine-driven tools and 228 (88%) of the deaths were associated with a generator. Throughout the remainder of this memo, incidents associated with all engine-driven tools will be reported as a group. In addition, since the majority of incidents were associated with portable generators, characteristics of these incidents will be reported separately.

The number of deaths occurring during each incident reported to the CPSC was examined (Table 2). Twenty-one percent of the CO exposure incidents reported to the CPSC and associated with an engine-driven tool were not associated with a CO poisoning fatality. Of those incidents that did involve at least one death (198 incidents), 77% of the total incidents involved a single fatality. Seventy-four percent of fatal generator incidents involved a single fatality. Of the 29 fatal incidents associated with ‘all other engine-driven tools’, all but one incident were associated with a single fatality. The one incident that was related to multiple CO fatalities associated with an ‘all other engine-driven tool’ was related to a sump pump.

Table 2: Number of Carbon Monoxide Poisoning Incidents reported to the CPSC by Number of Deaths per Incident, 1990-2003.

Number of Deaths Reported in Incident	Total		Generator		All Other Engine-Driven Tools	
Total Incidents	251	(100)	212	(100)	39	(100)
0	53	(21)	43	(20)	10	(26)
1	153	(61)	125	(59)	28	(72)
2	36	(14)	35	(17)	1	(3)
3	3	(1)	3	(1)	0	(0)
4	6	(2)	6	(3)	0	(0)

Note: Numbers in parenthesis represent percentages. Totals may not add up to 100% due to rounding.

Due to the difficulties in defining a CO poisoning injury or confirming a CO exposure, the remainder of this memorandum will focus only on CO poisoning incidents that were related to a death associated with an engine-driven tool. Throughout this memorandum, the number of deaths represents the actual number of deaths that have been entered into the CPSC databases by March 1, 2004. The count is the unweighted, actual number of CO poisoning deaths in the CPSC files associated with generators and other engine-driven tools.

The number of deaths associated with engine-driven tools and reported to the CPSC was summarized by year of the death (Table 3). It should be noted that Table 3 represents deaths reported to the CPSC as of March 1, 2004. Some deaths are reported to the CPSC shortly after an incident occurred, while other deaths are reported to the CPSC months or years after an incident occurred. Therefore counts for more recent years may not be as complete as reporting for earlier years. It should also be noted that death certificates from the year 1999 and later are coded with the new revision of the International Classification of Disease (ICD-10). With the revision of the ICD coding system, the types of death certificates purchased by the CPSC changed. These changes could affect the number of deaths associated with engine-driven tools that are reported to the CPSC. Prior to 1999, these deaths were normally coded with an ICD-9 e-code (868.2) that contained deaths associated mainly with motor vehicle exhaust and therefore these death certificates were not routinely purchased by the CPSC. Occasionally some death certificates that are related to these products are reported to the CPSC under other e-codes, usually under the unknown CO codes (E-codes 868.8 and 868.9). For death certificates from 1999 and later, CPSC began purchasing ICD-10 codes that contain all unintentional CO poisoning deaths associated with all sources of carbon monoxide.

Table 3: Number of Non-fire CO Poisoning Deaths Reported to the CPSC Associated with Engine-Driven Tools By Year, 1990-2003.

Year	Total	Generators	All Other Engine-Driven Tools
Total	258	228	30
1990	18	18	0
1991	8	7	1
1992	7	7	0
1993	13	10	3
1994 ⁺	10	7	3
1995 ⁺	12	11	1
1996	20	17	3
1997	20	18	2
1998	14	13	1
1999*	11	6	5
2000	26	20	6
2001**	21	18	3
2002	41	40	1
2003	37	36	1

Note1: 1999 was the year the new ICD-10 system was implemented (*).

Note2: The number of deaths associated with engine-driven products in 1994 and 1995 differ from those reported in the annual estimate report^{4,5}. This is due to the exclusion of products that were integral parts of boats (+).

Note3: Two deaths associated with lawn mowers were removed. After the previous memo was written these deaths were investigated and it was determined that the deaths were possible suicides (0119024542 and 0127534843) (**).

⁴ Ault K. "Estimates of Non-fire Carbon Monoxide Poisoning Deaths and Injuries," Washington, D.C.: U.S. Consumer Product Safety Commission. 1997.

⁵ Mah J. "Non-Fire Carbon Monoxide Deaths Associated with the Use of Consumer Products, 1998 Annual Estimates." Washington, D.C.: U.S. Consumer Product Safety Commission. 2001.

Deaths associated with engine-driven tools were further examined by the season when the incident occurred (Table 4). Seasons were defined as winter (December, January, and February), spring (March, April, and May), summer (June, July, and August), and fall (September, October, and November). About 40 percent of the deaths associated with an engine-driven tool occurred in the winter.

Table 4: Number of Non-fire CO Poisoning Deaths Reported to the CPSC and Associated with Engine-Driven Tools by Season, 1990-2003.

Season Incident Occurred	Number of Deaths Reported to the CPSC					
	All Engine-Driven Tools		Generators		All Other Engine-Driven Tools	
Total	258	(100)	228	(100)	30	(100)
Winter	103	(40)	89	(39)	14	(47)
Spring	42	(16)	37	(16)	5	(17)
Summer	59	(23)	51	(22)	8	(27)
Fall	54	(21)	51	(22)	3	(10)

Note: Numbers in parenthesis represent percentages. Totals may not add up to 100% due to rounding.

Incidents involving deaths were further examined in Table 5 by the location where the death occurred. The majority of CO poisoning deaths (72%) reported to the CPSC and associated with engine-driven tools occurred at the home, which includes single family homes, apartments, and mobile homes. The location home also includes garages or sheds at the home or residence. The temporary shelter category includes trailers, horse trailers, motor homes, recreational vehicles, vans, cabins, and campers. The category ‘other’ involved incidents occurring in some of the following locations: bar, building, church, greenhouse, mineshaft, public place, and storage shed (offsite from home).

Table 5: Number of Non-fire CO Poisoning Deaths Reported to the CPSC and Associated with Engine-Driven Tools by Location, 1990-2003.

Location	Number of Deaths Reported to the CPSC					
	All Engine-Driven Tools		Generators		All Other Engine-Driven Tools	
Total	258	(100)	228	(100)	30	(100)
Home	186	(72)	157	(69)	29	(97)
Temporary Shelter	44	(17)	44	(19)	0	(0)
Boat	7	(3)	7	(3)	0	(0)
Other	11	(4)	11	(5)	0	(0)
Not Reported	10	(4)	9	(4)	1	(3)

Note: Numbers in parenthesis represent percentages. Totals may not add up to 100% due to rounding.

The age and sex of the deceased was examined in Tables 6 and 7. Table 6 shows that adults aged 25 years and older account for about 80% of CO poisoning deaths reported to the CPSC and associated with all engine-driven tools. Adults age 25 years and older account for about 80% of CO poisoning deaths associated with generators and accounted for all deaths associated with other engine-driven tools. Males account for 75% of the deaths associated with all engine-driven tools and 72% of the deaths associated with generators. Only one female death was associated with a product categorized as ‘all other engine-driven tool’, which was a sump pump.

Table 6: Non-Fire Carbon Monoxide Poisoning Deaths Associated with Engine-Driven Tool and Reported to the CPSC by Age of Victim, 1990-2003.

Age	Number of Deaths Reported to the CPSC					
	All Engine-Driven Tools		Generators		All Other Engine-Driven Tools	
Total	258	(100)	228	(100)	30	(100)
Under 5	6	(2)	6	(3)	0	(0)
5 – 14	17	(7)	17	(7)	0	(0)
15 – 24	18	(7)	18	(8)	0	(0)
25 – 44	81	(31)	74	(32)	7	(23)
45 – 64	82	(32)	67	(29)	15	(50)
65 and over	46	(18)	38	(17)	8	(27)
Unknown	8	(3)	8	(4)	0	(0)

Note: Numbers in parenthesis represent percentages. Totals may not add up to 100% due to rounding.

Table 7: Non-Fire Carbon Monoxide Poisoning Deaths Associated with Engine-Driven Tools and Reported to the CPSC by Sex of Victim, 1990-2003.

Sex	Number of Deaths Reported to the CPSC					
	All Engine-Driven Tools		Generators		All Other Engine-Driven Tools	
Total	258	(100)	228	(100)	30	(100)
Male	193	(75)	164	(72)	29	(97)
Female	65	(25)	64	(28)	1	(3)

Note: Numbers in parenthesis represent percentages. Totals may not add up to 100% due to rounding.

In-Depth Investigations Associated with Engine-Driven Tools

Data from the CPSC’s In-depth Investigation File are not a statistical sample and national totals may not be derived from the number of incidents investigated. Data provide examples of actual incidents and anecdotal information. Incidents in the CPSC In-depth Investigation File were examined to obtain more detailed information about the scenario related to CO incidents associated with engine-driven tools. Not all information examined is available for each investigation.

CPSC staff further investigated 148 of the 251 incidents referenced within this memorandum. In-depth investigations associated with engine-driven tools were requested more frequently in recent years. For example, 86% of the incidents associated with engine-driven tools that were reported to the CPSC were investigated in the year 2003 and only 10% of the incidents were investigated in

1990. Of the 148 in-depth investigations, 116 involved at least one-fatality. These 116 in-depth investigations of fatal incidents associated with a CO poisoning death involved 152 deaths. One hundred and thirty-eight of these deaths were associated with a generator and 14 deaths were associated with other engine-driven tools.

Pre-existing health conditions affecting the heart, lungs, liver, and circulatory system can lower a victim's tolerance of carboxyhemoglobin (COHb) in the bloodstream, increasing the risk of a fatal CO exposure. Although this information was not available for all investigated deaths, 19 of the 152 CO deaths investigated and associated with engine-driven tools involved individuals who were noted as having secondary health conditions not related to CO poisoning at the time of death.

Alcohol and recreational drug use can act as a central nervous system depressant causing dulled reactions, which could likely impair a person's ability to react appropriately to a CO hazard, thus potentially prolonging exposure and increasing the chance of a fatal outcome. Although this information was not available for all investigated deaths, 33 of the 152 deaths investigated noted that the victim had used alcohol or recreational drugs during the time period surrounding the incident.

In-Depth Investigations Associated with a Fatal CO Poisoning and a Generator

The 138 fatalities, which involved 102 in-depth investigations of fatal generator incidents, will be explored more thoroughly. The characteristics of age and sex of victim, location of death, and number of fatalities per incident were similar in the total group of deaths reported to the CPSC associated with generators to those that were reported to the CPSC and further investigated. About 80% of the deaths reported to the CPSC involved adults aged 25 years and older, about 75% of the deaths investigated involved adults 25 years and older. Males accounted for 72% of the reported CO deaths associated with generators and 68% of deaths investigated. The location of the death was also similar for those cases that were investigated versus all CO poisoning deaths reported to the CPSC associated with a generator. The majority of deaths investigated (72%) occurred in the home while 69% of deaths reported to the CPSC occurred in the home. Twenty percent of the deaths investigated by the CPSC occurred in a temporary shelter while 19% of the total deaths that were associated with a generator and reported to the CPSC occurred in a temporary shelter. Incidents investigated that involved at least one death were similar to reported generator incidents that involved at least one death in that 74% of all the fatal incidents reported involved a single fatality while 73% of the investigated deaths involved a single fatality.

Information that was provided within an in-depth investigation that could not be obtained as regularly from an Injury or Potential Injury Incident (IPII) File and Death Certificate (DCRT) File source document included information about the specific location of the generator, the venting of the generator, the rating of the generator, the fuel used with the generator, the reason the generator was being used, whether the generator was owned by the deceased or a member of the deceased's household, the concentration of the CO at the location where the generator was used, and the carboxyhemoglobin (COHb) levels of the deceased.

The main reasons reported for using a generator were to provide electricity to a location that did not have electricity due to a temporary situation or to provide power to a temporary location. Forty-seven of the investigated deaths were associated with generators used during a temporary power outage stemming from a weather problem or a problem with power distribution. Thirty-four of the investigated deaths were associated with generators being used to supply power to a temporary shelter, storage-shed (offsite from the home), or boat that did not have electricity. Eighteen of the

investigated deaths were associated with generators being used in a situation where the utility company, often because of an overdue payment, turned off the power. Thirteen of the investigated deaths were associated with locations where the electricity was off due to another reason, such as recent fire at the location, the home was abandoned, the home was a new home which did not have electricity at the time of the incident, the residents of the home requested that the electricity be turned off, or a home was undergoing a remodeling project. Thirteen of the deaths investigated were associated with incidents where the electricity was off at the location but the reason why was unknown. Eleven of the deaths investigated were associated with a generator being used in a more permanent situation, such as supplying power to a home or mobile home that did not normally have electricity or to provide power to a garage of a home. Two deaths were associated with incidents where the user was repairing a generator or preparing the generator for use due to forecasted bad weather.

In-depth investigations of CO deaths that occurred in the home were further classified by the specific location of the generator (Table 8). The category ‘living space’ included rooms reported as bedrooms, bathrooms, dens, living rooms, landings, offices, rear rooms, enclosed porches, and converted garages. The category ‘outside home’ included incidents where the generator was placed outside the home but near an open window of the home. Although this information was not available for all incidents, 26 of the deceased individuals were found in the same room or space of the home as the generator and 68 of the deceased individuals were found in different rooms or spaces of the home. In some cases, individuals were found in rooms located above the basement or in rooms next to or above the garage where the generator was located. Almost all investigations of deaths that occurred in temporary shelters stated that the generator was inside the temporary shelter.

Table 8: In-Depth Investigations Associated with Generators and a CO Poisoning Death in the Home by Location of the Generator, 1990-2003.

Generator Location	Number of Deaths
Total	100
Basement/Crawl Space	39
Garage/Enclosed Carport	26
Living Space	21
Inside House, no further information reported	6
Closet	2
Doorway	2
Outside Home	2
Shed	2

It is very difficult to conclude from the investigations the reason a generator was placed indoors and if the consumer was aware of the carbon monoxide hazard associated with the use of a generator in an enclosed space. The reason a generator was run in a certain location was provided in only 20 deaths. The most common reason mentioned for using the generator indoors was that the user feared that someone might steal the generator (10 deaths). Other reasons for using the generator indoors included: if used outdoors the cord that lead to the home prevented outside access doors from closing (2 deaths), to muffle the sound (2 deaths), didn’t want the neighbors to know their electricity had been turned off (2 deaths), complaints of property owner (1 death), to fix the generator (1 death), did not think about operating it outside (1 death), and when the generator was run outside it

would stall so the user would operate it inside for sometime and then put it back outside (1 death). There was not much information available as to whether a user was aware of the CO hazard associated with using a generator indoors. Some investigations reported that family, friends, or landlords stated that they had forewarned the user of the potential CO hazard, but otherwise there was no way to assess whether the majority of users were or were not aware of the CO issue.

Many of the death investigations (68 of the 138 deaths investigated) did not contain information about the exact venting of the generator. In 45 of the 70 deaths investigated where information on the venting was available, no type of venting of the generator was reported. There were 25 investigations that reported that some type of venting was employed. Nineteen investigated deaths reported an open window, an open door, an open garage door, or a combination of these. In one investigated death the generator was located in the garage; the garage car door was open until the generator was turned off. Then the garage door was closed. The deceased was found in the loft of the garage. Two investigated deaths were associated with a generator that was placed outside the home near an open window. Two investigated deaths were associated with a portable generator used on a boat and the users attempted to vent the generator by modifying the exhaust system in place for an installed generator. In one investigated death the associated generator was operated outdoors for sometime then it would stall and would be operated in the doorway for a period of time.

The size of the generator and the fuel used with the generator were both examined. The size of the generator was examined by the wattage rating (Table 9). In most cases, the running wattage rating was used to categorize a case but in some instances, a wattage rating was obtained but it could not be determined whether this rating was the rated running wattage or maximum/surge wattage. For 25 incidents in which the in-depth investigation provided the make, model, and/or engine size of the associated generator but not the wattage rating, CPSC staff used the identifying information to ascertain the power rating. When the wattage rating of the generator was known (82 investigated deaths), 33 investigated deaths were associated with a generator in the 5 kilowatt rating range. Almost all of the generators were referred to as gas or gasoline generators. One generator was identified as a propane generator.

Table 9: Wattage Rating Reported in In-Depth Investigations Associated with Generators and a CO Poisoning Death, 1990-2003.

Wattage Rating (in kilowatts)	Number of Deaths
Total	138
Under 1	3
1-1.9	6
2-2.9	8
3-3.9	19
4-4.9	8
5-5.9	33
6-6.9	4
Greater than 7	1
Not Reported	56

In many of the investigations (76 of the 138 fatalities), it could not be determined whether the generator was owned by the deceased or a member of the deceased's household, borrowed, or rented

it. In the investigations of 37 of the deaths, the deceased or a member of the deceased household owned the generator. In investigations of 19 of the deaths, it was determined that the generator was borrowed. In investigations of 6 of the deaths, the generator was rented.

Carboxyhemoglobin (COHb) levels were provided in the investigations for 86 of the 138 fatalities. Table 10 provides a breakdown of the COHb levels. In healthy adults, a COHb level of 40 to 50% approximately correlates with symptoms of ‘confusion, unconsciousness, coma, possible death’, a level of 50 to 70% approximately correlates with symptoms of ‘coma, brain damage, seizures, death’, and a level greater than 70% is ‘typically fatal’⁶. The majority of individuals with reported COHb levels (74 of the 86) had levels greater than 50% COHb.

Table 10: Carboxyhemoglobin Levels Reported in In-Depth Investigations Associated with Generators and a CO Poisoning Death, 1990-2003.

COHb Level	Number of Deaths
Total	138
Less than 30%	2
30-39.9%	2
40-49.9%	8
50-59.9%	12
60-69.9%	29
70-79.9%	27
80-89.9%	5
90-99.9%	1
Not Reported	52

Twenty-three investigations (associated with 28 deaths) provided ambient levels of carbon monoxide at the location. Some values were measured only after the location had been vented and/or the generator had been shut down, often because the generator had run out of fuel, for some time prior to the measurement. Eighteen of the investigations had maximum CO levels that measured greater than 150 PPM. The five investigations that did not have maximum CO levels greater than 150 PPM reported that the location had been vented prior to the CO levels being measured or the CO level was measured hours after the incident. Fifteen investigations had maximum CO levels that measured greater than 300 PPM. Thirteen investigations had maximum CO levels that measured greater than 450 PPM. Ten investigations had maximum CO levels that measured 600 PPM or greater.

In-Depth Investigations Associated with a Fatal CO Poisoning and an ‘All Other Engine-driven Tool’

Fourteen of the 30 deaths associated with other engine-driven tools were investigated further. All 14 of the incidents investigated involved a single fatality. Thirteen of the investigated deaths were associated with a garden tractor or a power lawn mower, although one investigation involved both a generator and a power lawn mower. One investigation was associated with a gas concrete cutter. All the deceased associated with these investigations were male and half of the investigations

⁶ Burton LE. Toxicity from Low Level Human Exposure to Carbon Monoxide. Washington, D.C.: U.S. Consumer Product Safety Commission. 1996.

(7 out of 14) involved individuals between the ages of 45-64. Three fatal investigations involved deaths of individuals in the 25-44 age group and four fatal investigations involved deaths of individuals in the 65 plus age group. For all 14 of the deceased, the carboxyhemoglobin level was provided (Table 11). Ambient CO levels were only provided in two of the investigations. One investigation reported an ambient CO level of 20 PPM in the garage and a maximum of 80 PPM in the house. These measurements were taken after venting. The other investigation reported a maximum ambient CO level of 740 PPM with the doors open.

Table 11: Carboxyhemoglobin Levels Reported in In-Depth Investigations Associated with Other Engine-driven Tools and a CO Poisoning Death, 1990-2003.

COHb Level	Number of Deaths
Total	14
40-49.9%	3
50-59.9%	3
60-69.9%	3
70-79.9%	4
80-89.9%	1

All 13 of these investigations associated with a lawn mower or garden tractor occurred in an enclosed space at the home, with eight investigations occurring in the garage of the home and five in the shed of the home. Eleven of these investigations provided details as to why the lawn mower or garden tractor was being used within an enclosed space. The majority of these investigations (10 out of 11) involved the victim working on or repairing a garden tractor or power lawn mower within an enclosed space. The one death associated with the concrete cutter occurred in the basement of the home.

Conclusion

Between 1990 and 2003 there have been 258 CO poisoning deaths reported to the CPSC that were associated with engine-driven tools. The majority of these deaths (228) were more specifically associated with generators. Other engine-driven tools that were associated with a much smaller number of deaths included garden tractors, lawn mowers, snow blowers, pumps, power washers or sprayers, and other engine-driven power tools. The majority of fatal incidents reported to the CPSC involved a single fatality and the majority of the reported deaths occurred while an individual was at home.

Adults aged 25 years and older accounted for about 80% of CO poisoning deaths reported to the CPSC associated with a generator and the majority (72%) was male. Sixty-nine percent of the deaths reported to the CPSC associated with a generator occurred at home. Generators were commonly placed in the basement or garage of the home. Generators were often used as alternative sources of electricity due to temporary power outages or as power sources for temporary shelters. Generators were often used with little or no ventilation. It is difficult to conclude from the information available why a generator was used indoors or if a user was aware of the potential CO hazard.

Adults aged 25 years and older accounted for all of the CO poisoning deaths reported to the CPSC associated with engine-driven tools, excluding generators. Males accounted for all but one of

the 30 deaths reported to the CPSC associated with other engine-driven tools. Deaths associated with garden tractors and lawn mowers were often associated with an individual repairing or working on the product within an enclosed space.

Reference:

Ault K. "Estimates of Non-fire Carbon Monoxide Poisoning Deaths and Injuries," Washington, D.C.: U.S. Consumer Product Safety Commission. 1997.

Burton LE. Toxicity from Low Level Human Exposure to Carbon Monoxide. Washington, D.C.: U.S. Consumer Product Safety Commission. 1996.

Mah J. "Non-Fire Carbon Monoxide Deaths Associated with the Use of Consumer Products, 1998 Annual Estimates." Washington, D.C.: U.S. Consumer Product Safety Commission. 2001.

Vagts S. "Incidents, Deaths, and In-Depth Investigations Associated with Carbon Monoxide and Engine-Driven Tools, 1990-2002." Washington, D.C.: U.S. Consumer Product Safety Commission. 2003.

APPENDIX A

The queries below were submitted through the EPIR application. Query results were manually reviewed to include only carbon monoxide poisoning hazards and to exclude duplicates and out-of-scope cases, which were cases that did not involve an incident that was associated with a non-fire carbon monoxide exposure and an engine-driven tool.

Date of Queries: 03/01/2004

Incident dates: 1/1/90 – 12/31/03

Product Codes: 113, 606, 809, 820, 887-888, 1062, 1400-1464

Narrative/Text contains: 'CO_' or 'CARB' or 'MONO'

APPENDIX B

Document Number	Investigation Task Number	Document Number	Investigation Task Number
0004000376	021031HCC3059	9013006955	910410CCC2398
0005025284	020228HCC2282	9017047646	
0012022297	021107HCC1123	9042017400	
0022034412	010628HCC2616	9042106564	
0023012228	021023HCC1078	9051043586	
0026039416	021121HCC2124	9142077948	
0032013569		9226020857	
0037071040	011126HCC1143	9226038194	
0039010605	021227HCC2232	9230007048	
0039088650	021023HCC2060	9310002249	
0039100337	021227HCC2234	9313014903	
0042046788	021227HCC1229	9320007144	
0102000958	020529HCC3217	9326022187	
0118012182	020306HCC2308	9336032211	
0118044256	030213HCC2329	9339053906	
0122008422	020426HCC2439	9353000172	
0122025070	020425HCC2431	9401016379	
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0324018248	031224HCC1285	9748014763	970926HCC3355
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0326038216	030411HCN0468	9842061749	
0347032769		9847053849	990804HCC2585
0349002370		9854013955	
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Document Number	Investigation Task Number
9913038317	011001HCC1002
9918038664	010323HCC2334
9919012287	000426HCC2482
9920022797	
9921010087	000223HCC2319
9922031694	010319HCC2323
9926005556	020423HCC2423
9942009102	011001HCC1004
9951051013	010928HCC1895
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F9185005A	910812CWE5005
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Document Number	Investigation Task Number
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NEISS	980901HEP5441

Document Number	Investigation Task Number	Document Number	Investigation Task Number
NEISS	981118HEP1681	X0410275B	040126HBB1362
NEISS	990903HEP1683	X0410275C	040126HBB1363
NEISS	010301HEP9009	X90A0170A	
NEISS	020724HEP9004	X9252562A	920610HCC2178
NEISS	020705HEP9005	X92A0491A	921204HCC1954
NEISS	021219HEP9012	X9355499A	
NEISS	030403HEP9018	X9432156A	
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NEISS	031009HEP9007	X9453145A	
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Note: Since the previous memo was written some incidents were further investigated and determined to be out of scope. Two deaths associated with lawn mowers were removed. These deaths were investigated and determined to be possible suicides (0119024542 and 0127534843).