U.S. CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, D.C. 20207

August 30, 2000

Mr. Robert Stack
Standards Engineer
Canadian Standards Association-International
8501 East Pleasant Valley Road
Cleveland, Ohio 44131

Re: Review of Selected Investigation Reports Involving Gas-Fired Central Furnaces and Disconnected and Blocked Vents

Dear Mr. Stack:

At the September 1997 meeting of the ANSI Z21.47 Central Furnace Subcommittee, the U.S. Consumer Product Safety Commission (CPSC) staff presented the results of a review of CPSC In-Depth Investigation (IDI) reports involving carbon monoxide (CO) poisoning incidents resulting from disconnected vents on gas-fired central furnaces. The results of the incident review supported staff's proposal that the central furnace standard, ANSI Z21.47, be revised to include performance requirements to protect consumers from the risk of carbon monoxide exposure if the vent pipe becomes disconnected.

CPSC staff has completed an update of the 1997 review of incident reports. The update includes 14 additional incidents (not included in the previous review) which resulted in 5 deaths and 21 injuries. The failure scenarios in the reports are often corroborated by authorities such as a gas utility, fire department, and medical personnel. This lends support to staff's position that a disconnected vent pipe poses a risk of CO exposure to consumers that should be addressed by appropriate performance requirements in the furnace standard. The enclosed tables (Enclosure 1, Review of Selected Furnace Investigations Involving Disconnected Vent Pipes (1989-2000)) summarize the results of staff's review of individual incidents investigated during the period January 1, 1989 through June 30, 2000.

Staff conducted a similar review of incident reports involving blocked furnace vents. The purpose of this review was to help staff assess the adequacy of existing requirements addressing blocked vents in two areas: (1) partial vent blockage; and (2) total vent blockage. This review identified 38 incidents which resulted in 13 deaths and 25 injuries. One incident report (IDI #911114CCC2078) indicated that the furnace vent pipe was partially blocked. The majority of the reports only describe the vent condition as being "blocked" or "plugged," but do not indicate the degree of blockage. Staff's position is that any degree of vent blockage that allows combustion products into the living space, instead of being vented to the outdoors, presents a risk of CO exposure to consumers that should be addressed by appropriate performance requirements in the furnace standard. The enclosed tables (Enclosure 2, Review of Selected Furnace Investigations Involving Blocked Vent Pipes (1991-2000)) summarize the

results of the review of cases investigated during the period January 1, 1991 through June 30, 2000.

Staff is aware of the position of those in the gas furnace industry who state two failures are necessary before a CO hazard exists. One of those failures causes the furnace to generate elevated levels of CO. The other failure creates a leakage path for combustion products from the furnace into the living space. The incidents included in the enclosed reviews provide information that clearly demonstrates that disconnected, totally blocked, or partially blocked vent pipes caused the leakage path. The furnace standard includes performance requirements that limit the concentrations of CO produced in an air free sample of flue gases. While these requirements might assure that CO emissions from a newly certified furnace do not exceed a specified concentration, they do not: (1) provide assurance that furnace CO emissions will not or cannot exceed the standard limits once installed in the field; and (2) provide a means, once the furnace is in the field, to shut down if CO emissions exceed the standard limits. The CO emissions requirements currently in the standard, while important, by themselves are not adequate to protect against many of the failures that occur in the field and that have been reported in CPSC incidents.

Finally, it should be noted that the IDIs in each review are a subset of a convenience sample (i.e. not statistically selected) and may not include all such incidents that occur. Purged copies of the investigation reports are also enclosed for distribution at the September 14, 2000, Central Furnace Subcommittee meeting.

The positions represented herein are those of the CPSC staff. This information has not been reviewed by the Commissioners. If you have any questions, please call me at (301) 504-0508, extension 1295.

Sincerely,

Ronald A. Jordan

Ronald A. Jordan
Project Manager, Fire/Gas Codes &
Standards
Directorate for Engineering Sciences

Enclosures

ENCLOSURE 1

Page 1 of 4 **REVIEW OF SELECTED FURNACE INVESTIGATIONS INVOLVING DISCONNECTED VENT PIPES (1989-2000)**

Vent Failure Mode/Condition & Result

Investigation Case Number	Incident Date	Vent Failure Mode/Condition (IDI page, exhibit, or attachment number)	CO exposure? (yes/no)	CO concentration (in ppm)	Number of Deaths	Number of Injuries	Total Number of Victims
900618CCC2498	05/03/90	disconnected elbow pipe from furnace (p. 1; 2)	no		0	0	0
940208CCC1264	01/18/94	joint on the exhaust outlet of a gas furnace broke (p. 4)	yes (p 1; 4)	n/r	1	0	1
940310CWE5011	02/08/94	the flue pipe for the furnace seperated in the attic (p. 1; 2)	yes (p. 1)	n/r	0	1	1
970321CWE5014	10/09/96	hi -temp plastic vent became separated (p. 3, 6)	no		0	0	0
970306HCC7405	01/28/96	"open" vent pipe and vents blocked with paper (p. 2, Attch 2, p.2; Attch 3, p 2)	Yes (p. 1, 2, Attch's. 1& 2)	5300; 10 (p. 2, Attch 2 p. 1, Attch 3, p. 1)	2	0	2
980106CCC1765	10/02/97	disconnected vent to furnace activated CO alarm (p. 3)	Yes (p 3)	30, 40 (p 3)	0	0	0
980122HWE4201	12/17/97	loose vent pipes to furnace (p. 2; exhbt. 7, p. 3; exhbt. 8)	yes (p. 3, exhbt. 7)	150, 133, 127, 60, 44, and lower (p. 3 exhbt. 7)	0	2	2
980219CCC3617	01/09/98	vent became disconnected under home (p. 2; exhbt. 1a; exhbt. 1b, exhbt. 2)	Yes (p. 2, exhbt's. 1a, 1b, 2)	180, 160, 157, 130, 118 (exhbt's. 1a, 1b, 2)	1	1	2
980302HCC3660	05/08/97	vents disconnected in multiple locations; after roof repairs (p. 2; Attch. 3, p. 1)	Yes (p. 1, Attch. 3)	n/r	1	2	3
980507CWE7147	04/06/98	vent elbow became partially disconnected, @ 3 in. gap (p. 1, 2)	Yes (p. 1, exhbt. 1)	25, 22 (p. 1, exhbt. 1)	0	5	5
990315HEP3042	03/12/99	"disconnected furnace pipe" (p. 3, 5)	Yes (p. 3; 5)	76 (p. 3; 5)	0	1	1
990319CNE5111	02/26/99	section of exhaust vent to furnace fell off (p. 2; 3, 4; Exhbt. 1, p.2; Exhbt 2, p 1, 4, 5. Ehbt. 3, p 2)	Yes (p. 1; 2, 3; Exhbt. 1, p 2; Exhbt. 2, p 1,2,3; Exhbt. 3, p 2)	250, 48, 40 (p. 2, 3; Exhbt 2 p 1, 2 Exhbt. 3, p 2)	0	4	4
991014HAA0022	09/1999	hi-temp plastic vent seperated at joints (p. 2; 3, 4; Attch. 8, photos #3 & #4)	possible; similar symptoms (p. 1, 2, 3)	240 (p. 3)	0	0	0
000207HAA0390	02/04/00	furnace-disc. Vent, possibly intentional (p. 2; Exhbt. 1, p.8, 15)	Yes (p. 1, 2;exhbt. 1)	450; 440 (p. 1, 2, exhbt. 1 p 2, 4, 6, 8, 10, 13)	0	5	5
				Totals	5	21	26

n/r="not reported

Note 1: Investigations were systematically selected for review from the CPSC In-Depth Investigation File based on the following criteria: Narrative fields included keywords CARB, MONO, VENT, CONNECT, SEP, FLU, or PIP. Product Codes included 310, 322, 371, 372, 373, 374, 384, or 389; Date of incident was between 1/1/89 and 6/30/00.

Note 2: These investigations are a subset of a convenience sample (i.e. not statistically selected) of gas furnace-related incidents and may not be representative of all such incidents that occur. These investigations were chosen to illustrate the hazards associated with disconnected vent pipes and cannot be used to determine the relative frequencies of hazard patterns.

Note 3: Investigations presented here should be considered in addition to those included in the "Review of Selected Furnace Investigations Involving Disconnected Vent Pipes (1989-1996)" submitted to IAS, September 1999.

Source: U.S. Consumer Product Safety Commission / EPHA CPSC In-Depth Investigation File

REVIEW OF SELECTED FURNACE INVESTIGATIONS INVOLVING DISCONNECTED VENT PIPES (1989-2000)

Description of Vent Failure Mode/Condition

Investigation Case Number	Location of Vent Disconnect	Verified or Investigated by Authorities? (Yes/No)	Code for investigating Authorities (1, 2, 3, 4, 5, 6)	Other potential contributing factors
900618CCC2498	n/r	yes	6 (p. 2, 4, 5, 6)	vent failure caused by corrosion attributed to improper/inadequate vent installation
940208CCC1264	n/r	yes	2, 4 (p. 4)	n/r
940310CWE5011	in the attic (p. 1)	yes	2, 5 (p. 1, 2)	n/r
970321CWE5014	at a joint (p. 3, 6)	Yes	6 (p. 2, 3, 4, 5, 6)	The change in exhaust pressure caused by the disconnect allegedly cut furnace off (p. 3)
970306HCC7405	n/r	Yes	1, 2, 6 (p. 1, Attch's 2 & 3)	vents also blocked with paper
980106CCC1765	n/r	yes	6 (p. 3, exhbt. 1)	holes in heat exchanger & upper collector box may have been ultimate cause of CO leakage
980122HWE4201	n/r	Yes	6, 2 (p. 2, 3, 4, exbt's 7 & 8)	n/r
980219CCC3617	at joint(s) (exhbt. 3)	Yes	1, 2 (p. 1, 2, 3, exhbt's 1a & 2)	lack of maintenance, dirty filter
980302HCC3660	n/r	Yes	2, 6 (p. 1, 2, Attch. 3)	n/r
980507CWE7147	at elbow (p. 1, 2)	Yes	1, 2, 6 (p. 1, 2)	opening in former return air duct may have helped circulate CO throughout home (pg. 1 & 2)
990315HEP3042	n/r	Yes	1, 2 (p. 3, 4, 5)	n/r
990319CNE5111	at vent collar on top of furnace (Exhbt. 1, p.	Yes	1, 2, 6 (p. 1, 2, 3, 4, 5, exhbt's 1, 2 & 3	dirty filter, dirty burner, unsealed return air compartment (p. 2, 3, 4, Exhbt's 2 & 3) (Note: The HVAC contractor believed CO generation due to other contributing factors listed, not disconnected vent (see pg. 4 of IDI)
991014HAA0022	at a 90 deg. Elbow (Attch. 8, photo #4)	Yes	6	n/r
000207HAA0390	n/r	Yes	1, 2, 6	furnace ill-maintained, residents may have disconnected vent intentionally for more heat (p. 2)

n/r="not reported"

Code for investigating Authorities
1=utilities
2=police or fire department
3=hospital
4=toxicolgy lab or coroner's office
5=code official
6=service technician

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REVIEW OF SELECTED FURNACE INVESTIGATIONS INVOLVING DISCONNECTED VENT PIPES (1989-2000)

Description of Vent

Investigation Case Number	Vent Type	Vent Material	Connection Type	Fitting Type	Vent Configuration	Diameter (inches)	Length (feet)
900618CCC2498	vent-to-chimney	metal	metal pipe interface	90 deg. Elbow	horizontal and vertical	4	horizontal-97 in., vertical-63 in.
940208CCC1264	n/r	plastic (PVC)	n/r	n/r	n/r	n/r	n/r
940310CWE5011	n/r	n/r	n/r	n/r	n/r	n/r	n/r
970321CWE5014	HTPV, single pipe	HTPV	n/r	n/r	horizontal	3	12
970306HCC7405	n/r	metal (likely)	n/r	n/r	n/r	n/r	n/r
980106CCC1765	n/r	n/r	n/r	n/r	n/r	n/r	n/r
980122HWE4201	n/r	n/r	n/r	n/r	n/r	n/r	n/r
980219CCC3617	single	double wall metal (b-vent)	metal pipe interface	n/r	horizontal	n/r	n/r
980302HCC3660	n/r	metal (likely)	n/r	n/r	n/r	n/r	n/r
980507CWE7147	n/r	metal (likely)	n/r	elbow	n/r	n/r	n/r
990315HEP3042	n/r	n/r	n/r	n/r	n/r	n/r	n/r
990319CNE5111	n/r	metal (double wall b-vent and single wall)	n/r	90 deg. Elbow		n/r	n/r
991014HAA0022	single	HTPV	n/r	joints	horizontal & vertical	3 or 4	21 in. vertical, 85 in. horizontal
000207HAA0390	single	n/r	n/r	n/r	n/r	n/r	n/r

n/r="not reported

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REVIEW OF SELECTED FURNACE INVESTIGATIONS INVOLVING DISCONNECTED VENT PIPES (1989-2000)

Description of Furnace

Investigation Case Number	Age of Furnace	Year Installed	Fuel Type	BTU Input ting (Btu/hr)	Efficiency Rating (%)	Furnace Category	Furnace Configuration	BVSS? (yes/no)	Other product(s) mentioned? (yes/no) Type of product(s)
900618CCC2498	7 (p 3)	1987 (p 1)	natural gas	90,000	81	I or III	horizontal	n/r	no
940208CCC1264	n/r	n/r	LP-gas (converted from natural gas)	n/r	n/r	n/r	n/r	n/r	no
940310CWE5011	@15 (p 1)	@1979 (p 1)	n/r	n/r	n/r	n/r	n/r	n/r	no
970321CWE5014	3 to 4 (p 2)	n/r	n/r	n/r	@mid-80	n/r	horizontal	probable	
970306HCC7405	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	no
980106CCC1765	@10 (p 2, exhbt 4A)	1987	natural gas (likely)	n/r	n/r	n/r	n/r	n/r	
980122HWE4201	@20 (p 2, 4)	n/r	natural gas	75,000 to 80,000	n/r	n/r	upright	n/r	no
980219CCC3617	n/r	n/r	natural gas (likely)	n/r	n/r	n/r	horizontal	n/r	no
980302HCC3660	n/r	n/r	natural gas	n/r	n/r	n/r	n/r	n/r	no
980507CWE7147	@8 (p 1)	@1990	natural gas	n/r	n/r	n/r	n/r	probable	no
990315HEP3042	n/r	n/r	n/r	n/r	n/r	n/r		n/r	no
990319CNE5111	n/r	@1980 (p 1)	natural gas	50,000	n/r	I or III	upright	n/r	yes, gas range, gas water heater no impact on CO
991014HAA0022	6 (p 1)	1993 (p 1)	natural gas	100,000	78	III	upright based on age)	yes	gas water heater, no impact on CO
000207HAA0390	n/r	n/r	natural gas	n/r	n/r	n/r		n/r	yes, gas water heater gas range no impact on CO (p 2)

n/r="not reported

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Note 3: Investigations presented here should be considered in addition to those included in the "Review of Selected Furnace Investigations Involving Disconnected Vent Pipes (1989-1996)"

submitted to IAS, September 1999.
Source: U.S. Consumer Product Safety Commission / EPHA CPSC In-Depth Investigation File

ENCLOSURE 2

REVIEW OF SELECTED FURNACE INVESTIGATIONS INVOLVING BLOCKED VENT PIPES (1991-2000)

Investigation Case Number	Incident Date	*Vent Failure Mode/Condition & Result* Vent Failure Mode/Condition (Total or Partial Blockage?)	CO exposure? (yes/no)	CO concentration (in ppm)	No. of Deaths	No. of Injuries	Total No. of Victims
910731HCC1346	02/08/91	blocked chimney to furnace (p. 1, 2, Exhbt. 1; Exhbt. 2)	yes (p. 1, 2, Exhbt's. 1, 2 & 3)	n/r	1	0	1
911023HBB1458	10/22/91	uncapped chimney (and possibly heat exchanger) became blocked from falling debris, clogged filter to furnace (p. 1; Exhbt. 1)	yes (p. 1; Exhbt. 1)	n/r	2	2	4
911030HCN0324	10/06/91	blocked chimney and flue to furnace (p. 1; Attch. 1, Attch. 2)	yes (p. 1, Attch. 2)	no trace found (p. 1)	0	6	6
911114CCC2078	03/13/90	90-95% blockage in vent to furnace due to mouse nest (p. 1, Attch. 1)	yes (p. 1, Attch. 1)	n/r	2	0	2
911119HCC0040	12/30/90	vent clogged by snow and ice (p. 2, Exhbt. 3, p. 2)	yes (p. 2, Exhbt. 3)	852, 825 (p. 2, Exhbt. 3, p. 2)	1	0	1
911217HCN0633	11/14/91	blocked chimney to furnace (Attch. 1)	yes (Attch. 1)	n/r	0	2	2
920124HCC2066	12/28/91	soot blocked the flue to furnace (also holes in pipes) (p. 1, 3)	yes (p. 1, 2, 3, 4, Exhbt. 1)	420, 380, 4 (p. 4, Exhbt 1, p. 2)	0	2	2
920610HCC2180	06/19/92	furnace exhibited several problems, including blocked flue (p. 3, exhbt. 1, p. 5, exhbt. 2, p. 2,3, Exhbt's. 3 & 4)	yes (p. 3; exhbts. 1,2,3,4)	n/r	2	0	2
921118HCC1906	01/02/90	furnace flue pipe closed as a result of windy conditions (p. 3)	yes (Attch. 1)	n/r	1	1	2
930524CCC3372	12/02/92	vent of RV's propane furnace blocked w/insects nest (p. 3, 7th Exhbt., Final Summary)	yes (p. 3; 6th, 7th, 8th, 9th exhbts.)	n/r	1	0	1
930608HCC2180	05/16/93	clay liner in chimney collapsed, blocking furnace exhaust (p. 1, Attch. 2)	yes (p. 1, Attch. 2)	111, 86, 56 (p. 1, Attch. 2)	0	6	6
931115CEP9003	11/02/93	furnace vent clogged, covered with mis-sized mesh cover (p. 2)	yes (p. 2)	n/r	0	1	1
940124CEP9003	10/09/94	vent of gas furnace in mobile home was frozen shut (p. 4)	yes (p. 2, 3, 4)	n/r	0	2	2
940331CEP9001	02/26/94	gas furnace flue was plugged (p. 1)	yes	n/r	0	2	2
940520CCC1486	01/01/94	furnace flue and water heater flue were "stopped up"	yes (p. 1, Attch. 1, p. 2, Attch. 2, p. 3, 4)	n/r	1	0	1
951113CCN0239	11/12/95	blocked furnace flue and cracked furnace vent pipe (p. 1, 2)	yes (p. 1, 2)	n/r	0	14	14
960411CCC6140	01/19/96	vent pipe clogged w/various debris (p. 2, 4, 5)	yes (p. 2, 5)	n/r	1	0	1
960812CCC5476	09/19/95	vent pipe for furnace and H20 heaters was crushed by debris from inside chimney (p. 2, 3, Attch. 2, p. 1, 3, Attch. 3)	yes (p. 2, 3, Attch.2, p.1, 3, Attch. 3)	600 to 700 (p. 3, Attch. 2, p. 3)	1	0	1
960816CCC7391	05/04/96	intake and exhaust pipes covered by tin foil used to winterize trailer (p. 1, 2, 3)	yes (p. 1, 2, 3, Exhbt. 1)	1,2 (after leaving trailer door open (p45 mins. (p. 2)	1	0	1
970312CCC2009	01/23/97	metal cap fell into flue vent due to snow & ice and blocked vent (cover)		20, 30, 153, 7000 (p. 1, 2)	0	0	0
970515HCC2172	04/30/96	multiple fuel-burning appls., incl. furnace vented to clogged vent (p. 1)	Yes (p. 1, 3)	n/r	1	0	1
971001HCC2004	12/24/96	blocked vent to furnace and disconnected vent to H20 heater (p. 1)	yes	14, 38, 53, 634 (p. 2)	1	2	3
971208CCC2152	11/03/97	birds nest blocked chimney and furnace vent (p. 1)	Yes (p. 1, 2)	n/r	0	4	4
980123CEP9003	11/24/97	chimney collapsed, blocking vent to furnace (p. 6, 8)	Yes	250 (p. 6, 8)	0	10	10
981008HEP5442	10/04/98	furnace vent in chimney blocked by debris (p. 5)	Yes (p. 3, 5)	175 (p. 3)	0	1	1
981022CCN0030	10/22/98	main flue clogged and cracked heat exchanger (cover)	yes	100's, 9999 (p. 3)	3	0	3
981222HCC2121	03/26/98	furnace vent blocked by insect nest (p. 2, 3)	yes	220 (p. 2, exhbt. 2, pg. 2, exhbt. 4, pg. 2)	1	2	3
990104HEP6001	12/30/98	furnace flue collapsed (p. 1, 2)	Yes	n/r	0	1	1
990108HWE7257	11/03/98	gauge screen installed in vent became sooted and clogged (p. 2)	Yes (p. 2, exhbt 3)	n/r	1	1	2
990113CBB2191	01/02/99	rodent nest partially blocked vent, improper rise over run (p. 1, 2, exhbt. 1, pg. 13)	Yes (p. 1, 2, exhbt. 1)	n/r	1	1	2
990331HCC0384	02/03/99	chimney collapsed with gas heating and/or water heater vent (p. 1)	Yes (p. 1, exhts. 1 & 2)	600, 30 (p. 1, exhbt. 2, pg. 4)	2	0	2
990428HEP6401	04/12/99	clogged chimney to furnace (p. 3)	Yes (p. 3, 4)	17, 34 (p. 3)	0	1	1
000201HEP9006	06/25/00	blocked chimney to furnace (p. 1, Attch. 2, pg. 2, 4)	Yes (p. 1, Attch. 2, pg. 2)	188 (cover)	0	0	0
000201HEP9007	12/01/99	blocked chimney to furnace (p. 2)	Yes (p. 1, 2, Attch. 1)	80 (p. 2, Attch. 1)	0	1	1
000202HEP9001	01/31/00	blocked chimney to furnace (p. 1, 5)	Yes (p. 1, 2, 5)	300 (p. 7)	0	1	1
000329HCC2395	01/25/00	blocked flue in mobile home furnace (p. 1)	Yes	n/r	1	0	1
000421HCC2463	03/11/00	chimney to furnace blocked after roof repairs (p. 1, 3, 4, Attch. 1, pg. 1, 5)	Yes (p. 1, 3, 4, Attch. 1, pg. 1, 5, Attch. 2)	2000, 1980, 400, 350, 50 (p. 3, Attch. 1, pg. 2, 3, 5)	1	0	1
000425HCC2466	01/10/99	ice and snow on roof blocked vent to furnace (p. 1, 2, attch. 2, pg. 2, 4)	Yes (p. 1, 2, attch. 1, attch. 2)	1000, 550, 213, 210 (p. 1, 2, attch 1, pg 1)	1	0	1
				TOTALS	13	25	38

n/r = not reported

Note 1: Investigations were systematically selected for review from the CPSC In-Depth Investigation File based on the following criteria: Narrative fields included keywords CARB, MONO, VENT, FLU, FIR, BLOCK, CLOG, OBST, STUCK; Product Codes included 310, 322, 371, 372, 373, 374, 384, or 389; Date of incident was between 1/1/89 and 6/30/00.

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Source: U.S. Consumer Product Safety Commission / EPHA CPSC In-Depth Investigation File

ENCLOSURE 2

REVIEW OF SELECTED FURNACE INVESTIGATIONS INVOLVING BLOCKED VENT PIPES (1991-2000)

Description of Vent Failure Mode/Condition

Investigation Case Number	Location of Vent Blockage	Verified or Investigated by Authorities?	Code for investigating Authorities (1, 2, 3, 4, 5, 6)	Other potential contributing factors
910731HCC1346	n/r	yes	1; 2; 4 (p. 1; 2; Exhbt's 1, 2, & 3)	none mentioned
911023HBB1458	n/r	yes	1, 2 (p. 1; Exhbt 1)	dirty filter, cutout in return duct; windows in house sealed w/plastic
911030HCN0324	n/r	yes	1; 2; 5 (p. 1; Attch 1; Attch 2)	water heater was a possible source per gas co (p 1)
911114CCC2078	at an elbow (p. 1; Attch 1)	yes	1, 2 (p. 1; Attch 1)	LP-gas regulator vent plugged (Attch 1)
911119HCC0040	at outlet (p. 2; Exhbt 3; p. 2)	yes	1, 2 (p. 2; Exhbt. 3)	none mentioned
911217HCN0633	n/r	yes	2 (Attch. 1)	none mentioned
920124HCC2066	n/r	blockage was not		holes in vent pipe
920610HCC2180	n/r	yes	1, 2; 4 (p. 2; 3, 4; exhbt's 1, 2, 3, 4)	dirty filter, burner, and pilot (p 3 & exhbt 1, p. 5)
921118HCC1906	@ the vent outlet (p. 3)	yes	2, 4 (p. 3, 4, attch 1)	none mentioned
930524CCC3372	n/r	yes	2; 4 (p. 2; 3, 4 2nd, 4th, 6th, 7th, 8th, 9th Exhbts.)	unit shut down in past due to complaints of noise (p. 2); the victim may have re-connected the unit (p. 2)
930608HCC2180	within chimney (p. 1 Attch 2)	yes	1, 2 (p. 1; Attch's 1 & 2)	gas water heater common vented w/furnace through chimney (p. 1; Attch 2)
931115CEP9003	n/r	yes	1, 2	none mentioned
940124CEP9003	n/r	yes	1, 6 (p. 4; 5)	pilot light went out (p. 4)
940331CEP9001	n/r	yes	1	furnace was in need of cleaning (cover, p. 1)
940520CCC1486	n/r	yes	1, 2, 4 (Attch. 1, p. 2; Attch 2, p. 4)	gas water heater flue also blocked (p. 1; Attch 1, p. 2)
951113CCN0239	n/r	yes	2 (p. 1, 2, 4)	furnace vent pipe also cracked (cover, 1, 2)
960411CCC6140	n/r	yes	1, 2 (p. 1, 4, 7)	failure to have furnace maintained
960812CCC5476	n/r	yes	1, 2, 4 (p. 2, 3; Attch. 2, Attch. 3)	
960816CCC7391	at exhaust vent outlet and intake vent inlet (p. 1, 2, 3)	yes	2 (p. 1, 2, 3)	
970312CCC2009	rain cap (i.e. Vent terminal) (p. 1; 2)	Yes	2 (p. 1, 2)	n/r
970515HCC2172	"@a vent connector connection to chimney (p. 1, 2, 3, exh. 4 (p. 8)	Yes	2 (p. 1, 2, 3, exh. 4)	burnt wires, common venting
971001HCC2004	"@15 ft. to 20 ft. from top cap (p. 2)	Yes	1; 2, 4 (p. 1, 2)	disconnected water heater vent
971208CCC2152	n/r	yes	6 (p. 1)	n/r
980123CEP9003	n/r	yes	1, 2 (p. 6, 7, 8)	
981008HEP5442	n/r	Yes	1 (p. 3, 4)	n/r
981022CCN0030		Yes	1, 2 (p. 1, 2, 3)	cracked heat exchanger
981222HCC2121	n/r	Yes	1, 2, 6; 4 (p. 1, 2, 3, exhbt. 2, pg. 2; exhbt. 3, pg. 1, exhbt	clogged/leaky heat exchanger. **Clogged burner air shutter**
990104HEP6001	n/r	yes	6 (p. 2)	
990108HWE7257	n/r	Yes	1, 2, 4 (p. 1, exhbt. 2; exhbt. 3)	n/r
990113CBB2191	n/r	Yes	2, 6 (p. 2, ehbt. 1, pg. 13)	improper rise over run for vent; un-insulated exposed vent
990331HCC0384	n/r	yes	5 (p. 1)	n/r
990428HEP6401	n/r	yes	1 (p. 4)	n/r
000201HEP9006	n/r	yes	1, 2 (p. 1)	n/r
000201HEP9007	n/r	yes	1, 2 (p. 2; attch. 1)	n/r
000202HEP9001	n/r	yes	1, 2 (p. 1, 2, 3, 5, 6)	n/r
000329HCC2395	n/r	yes	2 (p. 1)	n/r
000421HCC2463	n/r	yes	1, 2 (p. 1, 2, 3, 4; Attch 1, pg. 1, 2, 3, 4)	n/r
000425HCC2466	vent exhaust @ roof top (p. 1, 2)	yes	1, 2 (p. 1, 2; attch 1, pg 1)	n/r

Code for investigating Authorities
1=utilities
2=police or fire department
3=hospital
4=toxicolgy lab or coroner's office
5=code official
6=service technician

n/r="not reported

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ENCLOSURE 2

REVIEW OF SELECTED FURNACE INVESTIGATIONS INVOLVING BLOCKED VENT PIPES (1991-2000)

	Description of Vent						
Investigation Case Number	Vent Type	Vent Material	Connection Type	Fitting Type	Vent Configuration	Diameter (inches)	Length (feet)
910731HCC1346	vent-to-chimney	metal (likely)	n/r	n/r	n/r	n/r	n/r
911023HBB1458	n/r	metal	n/r	n/r	horizontal & vertical	n/r	n/r
911030HCN0324	vent-to-chimney	metal (likely)	n/r	n/r	n/r	n/r	n/r
911114CCC2078	vent-to-chimney	metal (likely)	n/r	elbow	horizontal & vertical	n/r	n/r
911119HCC0040	vent-to-chimney	metal (likely)	n/r	n/r	n/r	n/r	n/r
911217HCN0633	vent-to-chimney	metal (likely)	n/r	n/r	n/r	n/r	n/r
920124HCC2066	n/r	metal	n/r	n/r	n/r	n/r	n/r
920610HCC2180	n/r	metal (likely)	n/r	n/r	n/r	n/r	n/r
921118HCC1906	n/r	metal	n/r	n/r	n/r	n/r	n/r
930524CCC3372	n/r	n/r	n/r	n/r	n/r	n/r	n/r
930608HCC2180	vent-to-chimney; common venting	metal (likely)	n/r	n/r	n/r	n/r	n/r
931115CEP9003	vent-to-chimney (likely)	metal (likely)	n/r	n/r	n/r	n/r	n/r
940124CEP9003	n/r	n/r	n/r	n/r	n/r	n/r	n/r
940331CEP9001	n/r	n/r	n/r	n/r	n/r	n/r	n/r
940520CCC1486	n/r	n/r	n/r	n/r	n/r	n/r	n/r
951113CCN0239	vent-to-chimney	metal	n/r	n/r	n/r	n/r	n/r
960411CCC6140	vent-to-chimney; common vent	metal	n/r	n/r	n/r	n/r	n/r
960812CCC5476	vent-to-chimney; common vent	metal	n/r	n/r	n/r	n/r	n/r
960816CCC7391	single vent intake; single vent exhaust	n/r	n/r	n/r	n/r	n/r	n/r
970312CCC2009	Class B	metal	n/r	n/r	n/r	n/r	n/r
970515HCC2172	vent-to-masonry chimney	metal (likely)	common venting	n/r	n/r	n/r	n/r
971001HCC2004	vent-to-masonry chimney	metal (likely)	n/r	n/r	n/r	n/r	n/r
971208CCC2152	vent-to-masonry chimney	metal (likely)	n/r	n/r	n/r	n/r	n/r
980123CEP9003	vent-to-masonry chimney	metal (likely)	n/r	n/r	n/r	n/r	n/r
981008HEP5442	vent-to-masonry chimney	metal (likely)	n/r	n/r	n/r	n/r	n/r
981022CCN0030	n/r	metal (likely)	n/r	n/r	n/r	n/r	n/r
981222HCC2121	n/r	metal (likely)	n/r	n/r	n/r	n/r	n/r
990104HEP6001	n/r	n/r	n/r	n/r	n/r	n/r	n/r
990108HWE7257	n/r	n/r	n/r	n/r	n/r	n/r	n/r
990113CBB2191	horiz. Run single wall; vert. Run doubl	metal (likely)	tee	n/r	15 ft. horizontal; 6 to 8 ft. vertical	n/r	21 to 23 ft.
990331HCC0384	vent-to-masonry chimney	metal (likely)	n/r	n/r	n/r	n/r	n/r
990428HEP6401	vent-to-masonry chimney	metal (likely)	n/r	n/r	n/r	n/r	n/r
000201HEP9006	vent-to-masonry chimney	metal (likely)	n/r	n/r	n/r	n/r	n/r
000201HEP9007	vent-to-masonry chimney	metal (likely)	n/r	n/r	n/r	n/r	n/r
000202HEP9001	vent-to-masonry chimney	metal (likely)	n/r	n/r	n/r	n/r	n/r
000329HCC2395	n/r	metal	n/r	n/r	n/r	n/r	n/r
000421HCC2463	vent-to-masonry chimney	metal (likely)	n/r	n/r	n/r	n/r	n/r
000425HCC2466	single vent	metal	n/r	n/r	n/r	n/r	n/r

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ENCLOSURE 2

REVIEW OF SELECTED FURNACE INVESTIGATIONS INVOLVING BLOCKED VENT PIPES (1991-2000)

Investigation Case Number	*Description of Furnace* Age of Furnace	Year Installed	Fuel Type	BTU Input Rating (Btu/hr)	Efficiency Rating (%)	Furnace Category	Furnace Configuration	BVSS? (yes/no)	Other product(s)? (yes/no); Type
910731HCC1346	n/r	n/r	natural gas	n/r	n/r	n/r	n/r	n/r	no
911023HBB1458	7 (p. 1)	1984	natural gas	75000	n/r	I or III	upright	n/r	yes; gas range & water heater; both ckecked out OK by gas co. (Exhbt.1)
911030HCN0324	n/r	n/r	natural gas	n/r	n/r	n/r	n/r	n/r	yes; gas water heater; reference to heater may have been same as furnace
911114CCC2078	n/r	n/r	LP-gas	n/r	n/r	n/r	horzontal	n/r	yes; space heater
911119HCC0040	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	no
911217HCN0633	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	no
920124HCC2066	@25 (p. 3)	@1966 (p. 3)	n/r	n/r	n/r	n/r	n/r	n/r	no
920610HCC2180	"20 to 30 (p.	n/r	natural gas	n/r	n/r	n/r	n/r	n/r	no
921118HCC1906	@11 (p. 2)	1981 (p. 2)	LP-gas	n/r	n/r	n/r	n/r	n/r	no
930524CCC3372	@21 (p. 3)	1971 (p. 3)	LP-gas	n/r	n/r	n/r	n/r	n/r	no
930608HCC2180	n/r	n/r	natural gas	n/r	n/r	n/r	n/r	n/r	yes; gas water heater
931115CEP9003	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	no
940124CEP9003	n/r	n/r	natural gas	n/r	n/r	n/r	n/r	n/r	no
940331CEP9001	n/r	n/r	ural gas (likely)	n/r	n/r	n/r	n/r	n/r	no
940520CCC1486	n/r	n/r	ural gas (likely)	n/r	n/r	n/r	n/r	n/r	yes; possible maintenance neglect (p. 2)
951113CCN0239	15 to 20 (p.	n/r	ural gas (likely)	n/r	n/r	n/r	n/r	n/r	no
960411CCC6140	10+ (p. 6)	n/r	n/r	n/r	n/r	n/r	n/r	n/r	yes; gas water heater
960812CCC5476	n/r	n/r	natural gas	n/r	n/r	n/r	n/r	n/r	yes; gas water heater
960816CCC7391	@4 (p. 2; 3)	@1992 (p. 2; 3)	LP-gas	n/r	n/r	n/r	n/r	n/r	no
970312CCC2009	n/r	n/r	natural gas	n/r		n/r	n/r	n/r	no
970515HCC2172	n/r	1980/1982 (p. 4)	LP-gas	n/r		n/r	n/r	n/r	yes; LP-gas water heater; wood stove
971001HCC2004	n/r	n/r	natural gas	n/r		n/r	n/r	n/r	yes; natural gas water heater
971208CCC2152	n/r	n/r	n/r	n/r		n/r	n/r	n/r	no n/r
980123CEP9003	n/r	n/r	n/r	n/r		n/r	n/r	n/r	yes; gas water heater; gas stove
981008HEP5442	n/r	n/r	natural gas	n/r		n/r	n/r	n/r	no
981022CCN0030	18	n/r	LP-gas	82,000	80	n/r	n/r	n/r	no
981222HCC2121	@25 (p. 2)	n/r	natural gas	80,000	n/r	n/r	n/r	n/r	yes; gas water heater; gas range
990104HEP6001	@30 (p. 2)	n/r	natural gas	n/r	n/r	n/r	n/r	n/r	no
990108HWE7257	n/r	n/r	natural gas	n/r	n/r	n/r	n/r	n/r	no
990113CBB2191	@30 (p. 2)	n/r	propane	n/r	n/r	n/r	I for crawl space	n/r	no
990331HCC0384	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	yes; gas water heater
990428HEP6401	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	
000201HEP9006	@20	n/r	natural gas	n/r	n/r	n/r	n/r	n/r	yes; gas water heater, gas range
000201HEP9007	@25 (p. 2)	n/r	natural gas	n/r	n/r	n/r	n/r	n/r	no
000202HEP9001	n/r	n/r	natural gas	n/r	n/r	n/r	n/r	n/r	no
000329HCC2395	@20	n/r	natural gas	n/r	n/r	n/r	n/r	n/r	no
000421HCC2463	@20	n/r	n/r	n/r	n/r	n/r	n/r	n/r	no
000425HCC2466	n/r	n/r	natural gas	n/r	n/r	n/r	n/r	n/r	no

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