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Joint Industry Programme on carbon monoxide issues

A review of carbon monoxide incident information for 1998/9 produced from the full investigation of incidents which had resulted from the use of piped natural gas and LPG within Great Britain

Prepared by
Advantica Technologies Limited
(*formerly* BG Technology)
for the Health and Safety Executive

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A review of carbon monoxide incident information for 1998/9 produced from the full investigation of incidents which had resulted from the use of piped natural gas and LPG within Great Britain

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This report has been written by Advantica Technologies Limited as part of the Joint Industry Programme (JIP) Addressing Carbon Monoxide (CO) Issues, within the Incident Data project area. The aim of this project is to identify common causes of CO incidents related to appliance and system design, installation and maintenance. This information can then be used to further improve customer safety, to target expenditure on CO incident prevention and to identify further research work.

As part of this project a national data collection scheme for piped natural gas and L.P.G. CO incidents, which occur within Great Britain, has been established by Advantica. This has been with the support of the HSE and the gas industry. Information for incidents since 1996/97, which was prior to the setting up of the JIP, has been obtained from industry reports and has already been reported as part of the JIP

This is the third report of a series that are to be published. It covers the financial reporting period 1998/99. The incidents are only described by postcode to ensure anonymity. During this period the majority of the incidents reported were domestic incidents. There were four non-domestic incidents reported and three LPG incidents.

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CONTENTS

SUMMARY

This report is the third in a series that has been prepared as part of the Joint Industry Programme (JIP) Addressing Carbon Monoxide (CO) Issues and within the Incident Data project area. It covers the period 1998/99. The aim of this project is to identify common causes of CO incidents related to appliance and system design, installation and maintenance. This information can then be used to improve customer safety, target expenditure on CO incident prevention and identify further research work. As part of this project a national data collection scheme for piped natural gas and LPG CO incidents, which occur within Great Britain, has been established. This has been with the support of the HSE and the gas industry. This information has been collected together by Advantica for analysis. Information for incidents since 1996/97, which was prior to the setting up of the JIP, has been obtained from industry reports and has already been reported as part of the JIP. Historical data has also been used within the report from previously unpublished internal company reports to show incident trends. The results of this report are summarised below: -

The number of domestic related CO poisoning deaths reported, at 23 during 1998/99, was in line with previous trends.

The majority of all CO incidents involved domestic open flued appliances.

Central heating appliances were responsible for the majority of fatal and non-fatal casualties.

The total FPPY figure of 0.49×10^{-6} is within, what would normally be considered as, the "broadly accepted region" of HSE's criteria for the tolerability of risk. However societal concerns over gas safety override averaged numerical considerations.

The appliance types that were above the HSE's criteria for the tolerability of risk are single-point water heaters (2.6×10^{-6}) and warm air units (1.6×10^{-6}).

The majority of casualties were located in the bedroom and the living room.

There was an above average risk of a CO incident in domestic properties built before 1946 and also in tenanted accommodation that was privately owned.

Flueing and ventilation faults were common in many domestic incidents.

Whilst it has often been suggested that annual appliance servicing could help prevent the majority of domestic incidents it has not possible to support or refute that conclusion from the data presented in this report.

There were 3 LPG and 4 non-domestic incidents reported during 1998/99.

1 INTRODUCTION

This report covers accidental CO poisoning incidents resulting from the use of piped natural gas for the period April 1st 1998 to March 31st 1999. Data for incidents up to 1995 comes from Advantica's own incident recording system. From 1996 the information is obtained from incident reports and investigation forms completed on behalf of gas suppliers. If any additional reports should be received after publication of this report they will be included within updated annual statistical tables in future reports.

Domestic incidents are covered in the main part of the report with LPG incidents and business incidents reported in Appendix 3 and 4 respectively. Suspected intentional incidents have not been included in the analysis.

Information for this report comes via the Downstream Incident Data Report (DIDR) - Form 551/7. Tables and plots of actual fatalities and incidents and also plots relating to the risk associated when using gas appliances expressed in terms of fatalities per person per year (FPPY), as incidents per person per year (IPPY) and as casualties per person per year (CPPY) are given. The definitions and use of IPPY and CPPY values are described in Appendix 1. Fatality, casualty and incident trend data are presented for incidents that occurred between 1991/92 and 1998/9.

Note: Some inconsistencies may appear in some parts of the report because all the required information may not have been completed on the DIDR forms e.g. in Table 7 the numbers of casualties, as represented by their location, differs from the total number reported in Table 1. Some information was completed as "unknown" or "other" and in some instances the tick box was not completed (field empty).

Appendix 2 gives details of each of the CO poisoning incidents for 1998/9.

The order used in this report follows the layout used in the DIDR - Form 551/7.

Note: Included on the DIDR form are 3 sections to complete related to the installation - to current standards, to standards current at time of installation, not to any appropriate standards or unsure/don't know, of the following:-

- the appliance
- the flue
- the permanent ventilation

For "the appliance" items that are standards related, include the correct room/location, proximity to walls, fire resistance and electrical safety. Each of the three items are dealt with separately on the DIDR form and within this report.

2 ANALYSIS OF REPORTED DATA

2.1 TOTAL INCIDENT DETAILS - ANALYSIS OF SECTION 1 OF DIDR

Transco issued 371 Incident Notification Forms during the reporting period. These gave details of CO Poisoning Reports under their companies internal reporting procedures.

There were 107 domestic incidents that met the requirements for reporting on the DIDR form with the majority of these being notified directly to Transco, via the operation of the national gas emergency service, and advised by Transco's internal procedures. In addition there were some incidents reported directly to gas suppliers by, for example, coroners or the police that did not get entered onto Transco's reporting system. All reports were fully analysed for this report and every effort was made to obtain as many completed DIDR forms, for this report, as possible. However due to the voluntary nature of the reporting scheme it is likely that a very small number of reports were not supplied. If any additional reports should be received after publication of this report they will be included within updated annual statistical tables in future reports. Each form is treated as a separate DIDR incident and will be referred to as an "incident" throughout the rest of this report. The incident risk data and trend data has been combined with the casualty details described in section 2.2.

The date of occurrence of each domestic incident has been plotted by month in Figure 1, for the 12 month period April 1998 to March 1999.

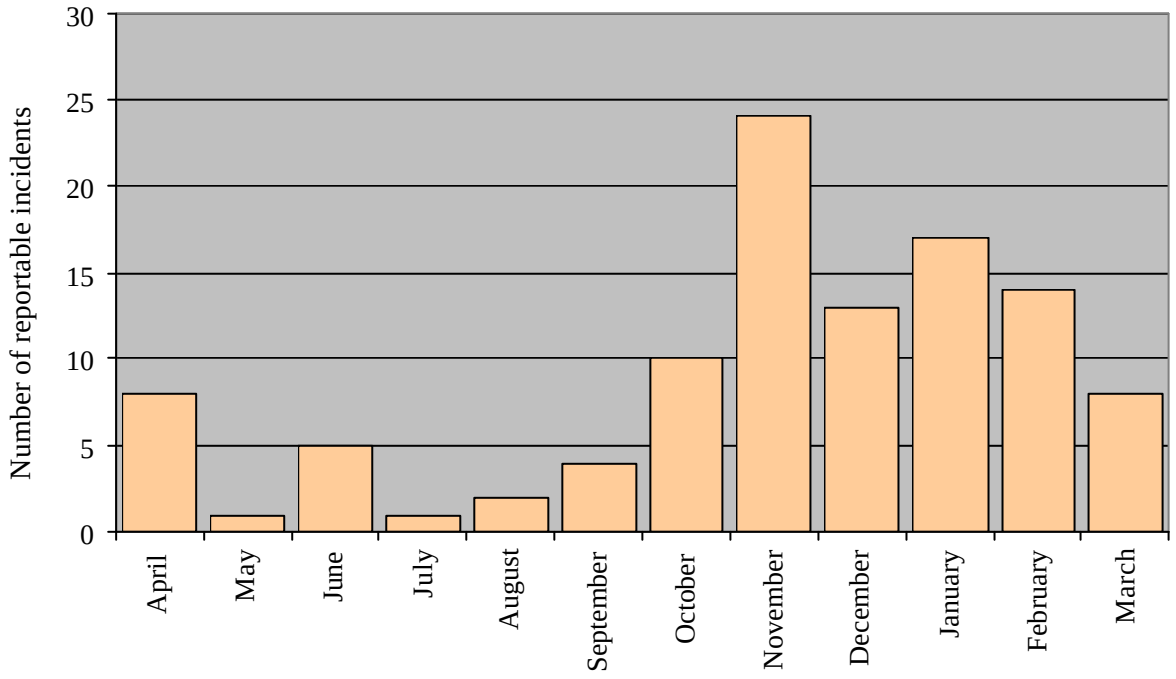

Figure 1 - Profile of incident occurrences over the year

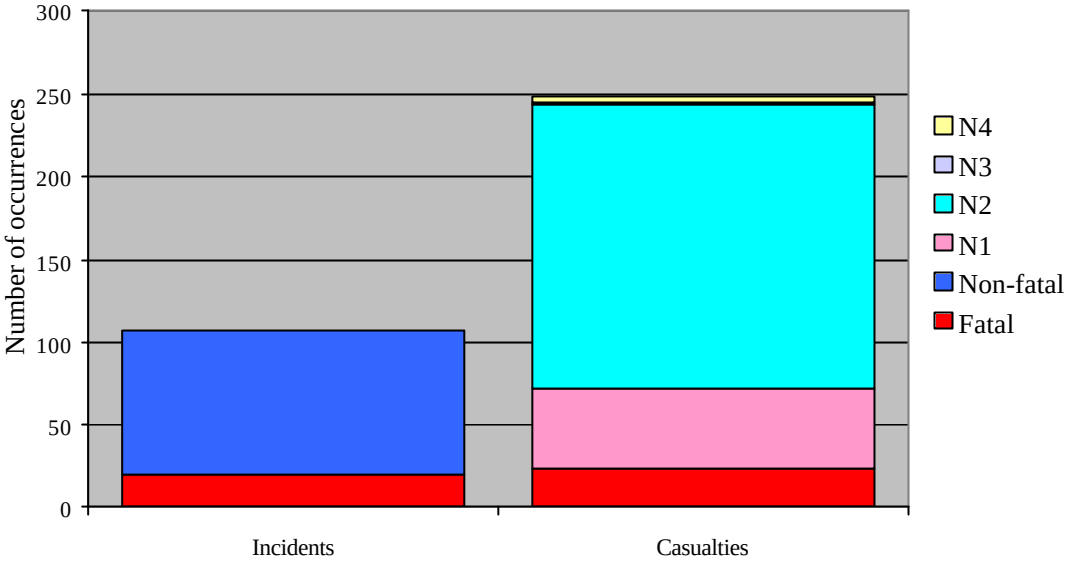

Figure 2 - Incident analysis

Figure 2 gives the number of reported domestic occurrences of CO incidents and CO casualties that took place during the year 1998/99. Further information on casualty groups are given in section 2.2 of this report.

Details of the LPG incidents that occurred during the year are given in Appendix C and details of Business incidents are given in Appendix D.

2.2 TOTAL CASUALTY DETAILS - ANALYSIS OF SECTION 2 OF DIDR

The total number of people, reported by the DIDR form, to have been injured by piped natural gas for the period 1998/99, by CO poisoning, is presented below in Table 1.

Table 1 - Classification of non-fatal casualties

Classification	N1	N2	N3	N4	Total
Number of casualties	49	171	2	3	231

Table 1 indicates the breakdown of the non-fatal casualties by casualty classification N1 to N4 used on the DIDR form. The four classifications are:-

N1 - requiring immediate hospitalisation for more than 24 hours
N2 - requiring immediate hospitalisation for less than 24 hours
N3 - requiring other medical treatment
N4 - receiving no medical treatment
Note: There were some non-fatal casualties that were unclassified.

Figure 2, in section 2.1, gives the number of occurrences of incidents and casualties that took place during the year.

Using this data a corresponding risk data analysis has been carried out. The results from this are given in Table 2. The table also includes details of the number of fatalities and the number of incidents reported on the DIDR form.

Table 2 - The number of CO incidents and casualties, used for the risk analysis, with the corresponding risk values

Total number of incidents	Total number of fatal casualties	Total number of nonfatal casualties	Over-all IPPY ($x10^{-6}$)	Over-all FPPY ($x10^{-6}$)	Over-all CPPY ($x10^{-6}$)
107	23	231	2.3	0.49	4.9

In the calculation of FPPY, CPPY and IPPY the following statistics were used for this report.

a) The number of domestic customers i.e. the number of households using piped natural gas for 1998/99 - 19.80 million - see report section 7, reference 7.1.3.

b) The average number of people per household in Great Britain for 1998/99 = 2.37 - see report section 7, reference 7.1.4.

Note: In the calculation of FPPY, CPPY and IPPY [a x b] replaces [Number of people at risk x Appliance Population]. Definitions are given in Appendix A.

Overall trends are given in Table 3 and plotted in Figures 3 and 4.

Table 3 - Trend data

Year	91/92	92/93	93/94	94/95
"A"	29	38	29	31
"B"	0.68	0.9	0.65	0.69
"C"	139	174	167	189
"D"	3.3	4.1	4.4	4.2
"E"	77	87	86	102
"F"	1.8	2	1.9	2.3

YEAR	95/96	96/97	97/98	98/99
"A"	-	25	22	23
"B"	-	0.54	0.48	0.49
"C"	-	121	224	231
"D"	-	2.63	4.92	4.9
"E"	-	67	97	107
"F"	-	1.46	2.13	2.3

Notes to Table 3:
A = Total number of deaths due to CO poisoning in each financial year
B = FPPY (Average fatalities per person per year are $x10^{-6}$). The FPPY was calculated by the same method as that used for Table 2.
C = Total number of non-fatal casualties due to CO poisoning in each financial year.
D = CPPY (Average non-fatal casualties per person per year are $x10^{-6}$). The CPPY was calculated by the same method as that used for Table 2.
E = Total number of incidents due to CO poisoning in each financial year.
F = IPPY (Average incidents per person per year are $x10^{-6}$). The IPPY was calculated by the same method as that used for Table 2.
Following the restructuring of British Gas insufficient information was collected to enable the statistics for 1995/96 to be calculated.

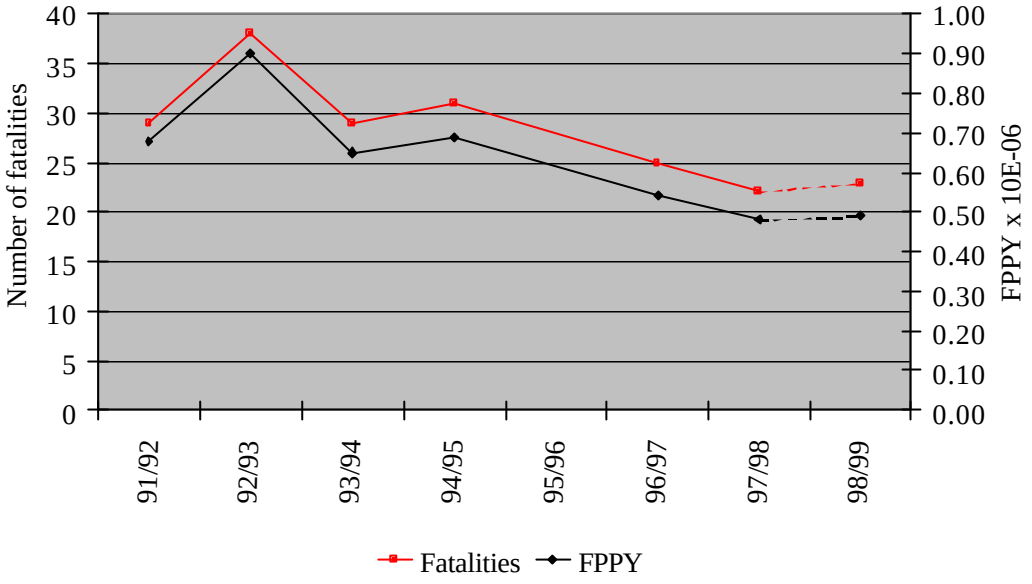

Figure 3 - Graph of fatality trends

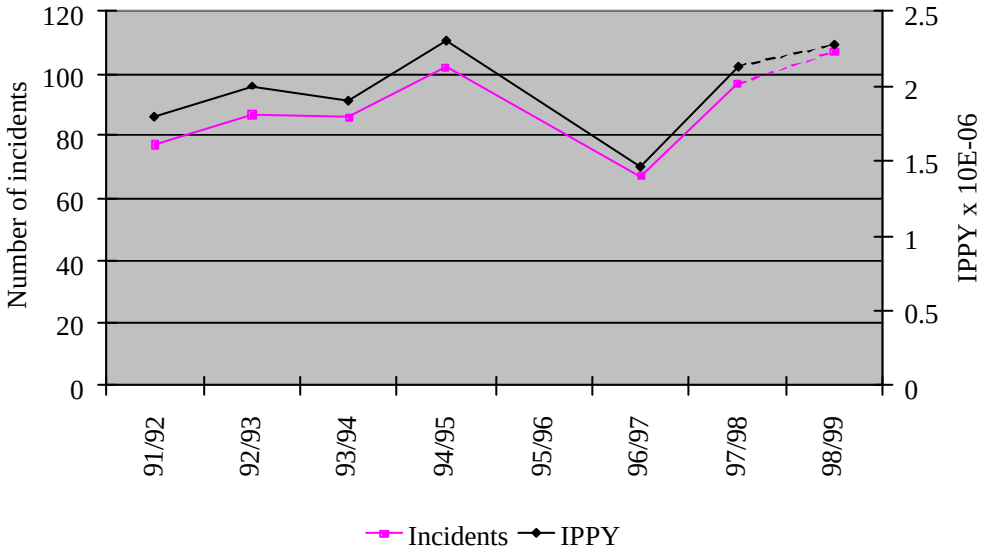

Figure 4 - Graph of incident trends

The age and numbers of the combined totals of the fatal and all non-fatal casualties are given in Figure 5.

Note: this was for all incidents where the casualty age details had been completed.

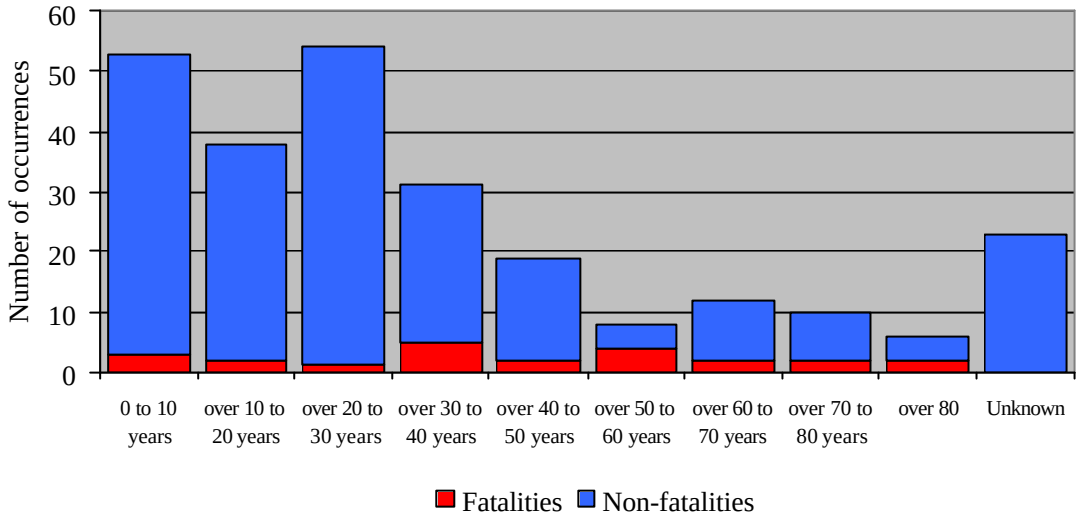

Figure 5 - Casualty age profile

2.3 PROPERTY DETAILS - ANALYSIS OF SECTION 3 OF DIDR

Figure 6 is shown below. It indicates that the highest proportion of incidents occurred in houses (71%), followed by flats (25%).

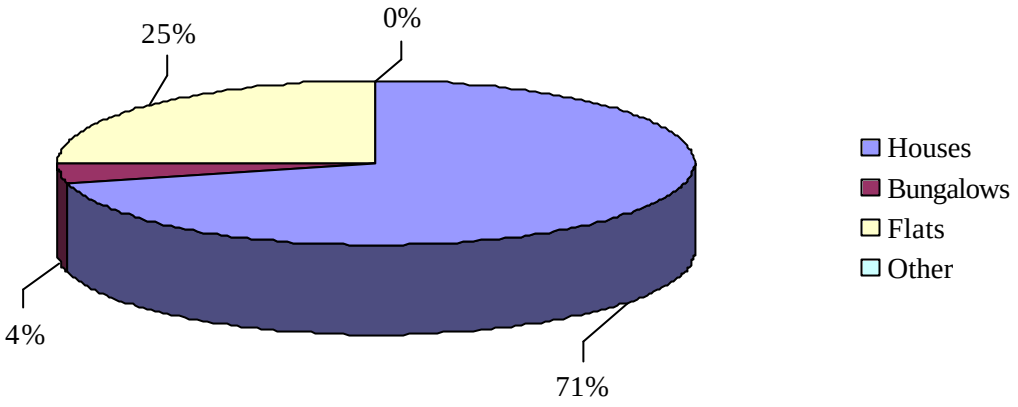

Figure 6 - Property types

Table 4 shows the number of and percentage of each style of property, within each property type, in which incidents took place during the year. There were no incident properties categorised as "other". The table indicates that the highest proportion of incidents occurred in terraced houses (45%), followed by semi-detached houses (17%).

Table 4 - Breakdown of incident sites by property style

Bungalow	Nos (%)	Flat	Nos (%)	House	Nos (%)
Detached	2 (1.9)	Bed sit	1 (0.9)	Detached	9 (8.4)
Semi-detached	1 (0.9)	Conversion	8 (7.5)	Semi-detached	18 (16.8)
Terraced	1 (0.9)	Maisonette	2 (1.9)	Terraced	48 (44.9)
		PBB (4 storeys or less)	15 (14.0)	Townhouse	1 (0.9)
		PBB (5 storeys or more)	1 (0.9)		

The Living in Britain 1998 General Household Survey from the ONS gives a breakdown of types of accommodation in Britain. The analysis is given below where it is compared to the incident statistics.

Table 5 - Comparison of DIDR incident stats with accommodation stats

Property style	Accommodation Stats for GB (%)	Incident Stats (%)
Detached house/bungalow	23	10
Semi-det house/bungalow	33	18
Terraced house/bungalow	26	46
Purpose built flat or maisonette	14	15
Converted flat or maisonette/rooms	4	10

The age bands of the properties in which incidents took place are shown on Figure 7.

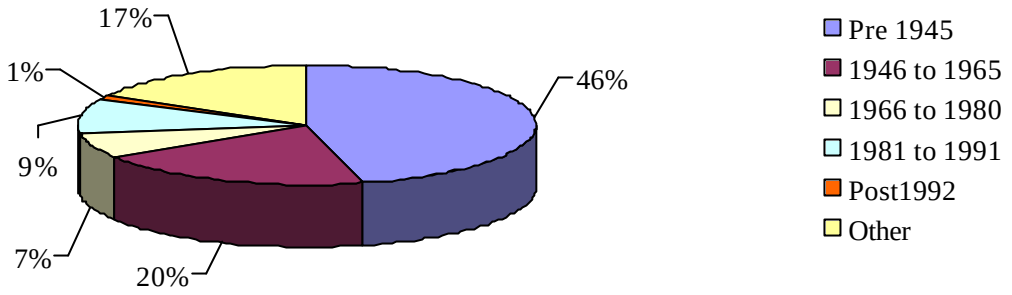

Figure 7 - Property construction period

The two largest sectors are properties built before 1945 at 46% and those between 1946 and 1965 at 20%. The age was unspecified for 17% of the incidents. Where the age was specified (89 properties) the pre 1945 group is the majority at 55%. The next largest group was 24% for those built between 1946 and 1965. The remainder, built from 1966, totalled 21%. The Living in Britain publication, 1998 edition, from the Office for National Statistics (ONS) states that for Britain 40% of all dwellings were built before 1945, 23% were built in the period 1945 to 1964 and 37% were built during or after 1965.

Figure 8 gives the occupancy types of the properties shown on the DIDR forms. The percentage owner occupied was 61% and 36% were tenanted. Empty fields or unrecognised values made up the remainder. Of the tenanted properties group 31% were single occupancy and 5% were multiple occupancy. The percentage of the tenanted sector that were council owned is 14%, privately owned was 17% and 4% were owned by a housing association, the remainder were classified as other/unknown.

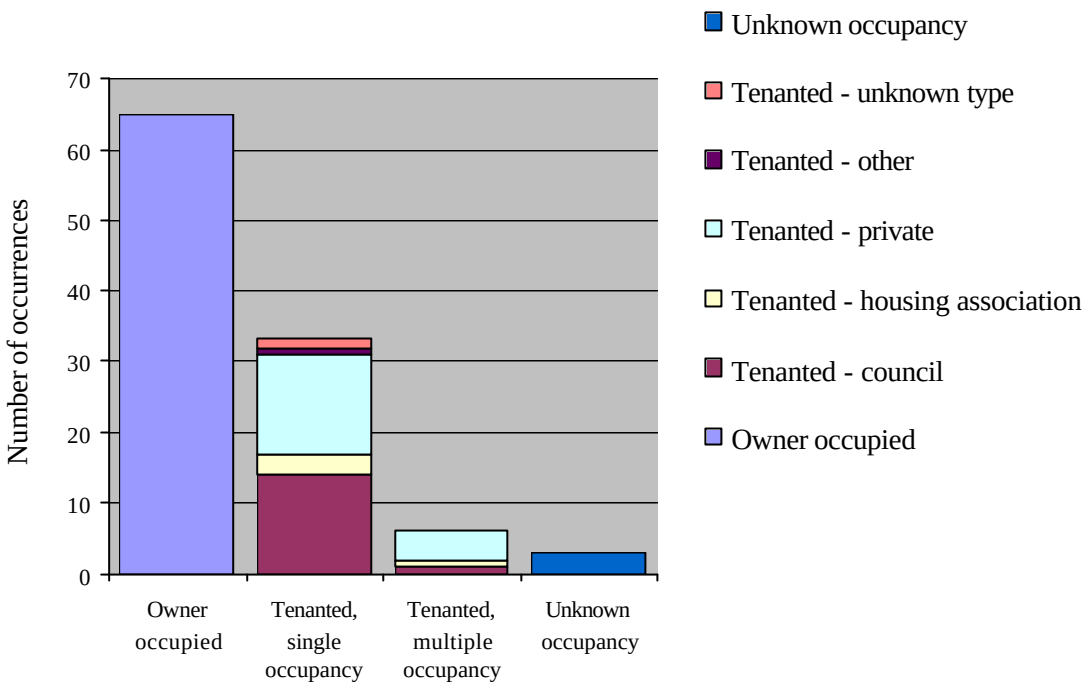

Figure 8 - Occupancy type

The Living in Britain 1998 General Household Survey from the ONS gives the owner occupied tenure group as 69% and the tenanted sector as 30%. This covers renting from the local authority at 16%, privately at 9% and from a housing association at 5%.

Table 6 shows the analysis of the glazing and ground floor details for the incident sites. These are also described graphically in Figures 9 and 10.

Table 6 - Construction details of the incident property

Glazing details	%	Ground floor details	%
Single	32	Solid	38
Double	32	Suspended	24
Partial double	12	Partial solid	6
Undefined	23	Undefined	31

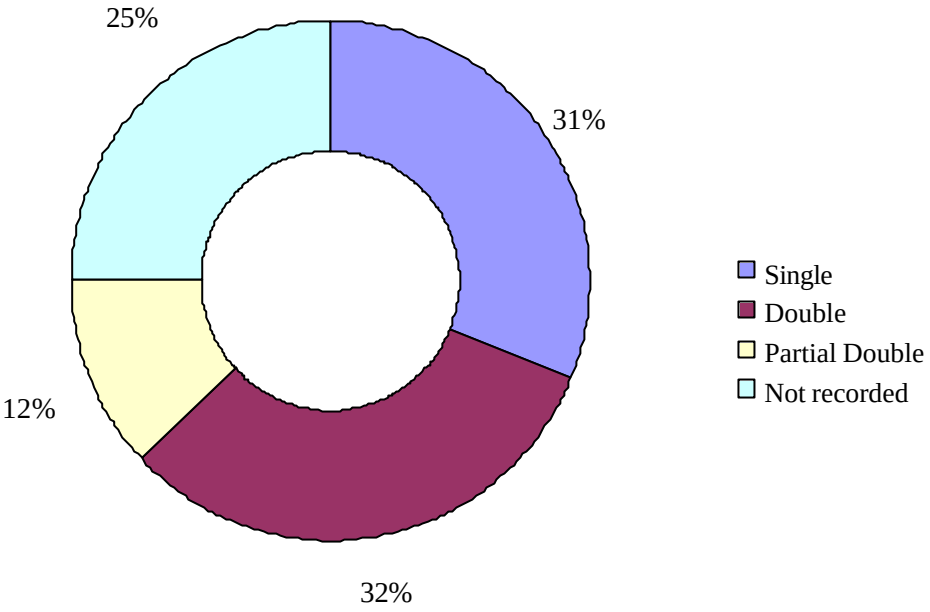

Figure 9 - Glazing details

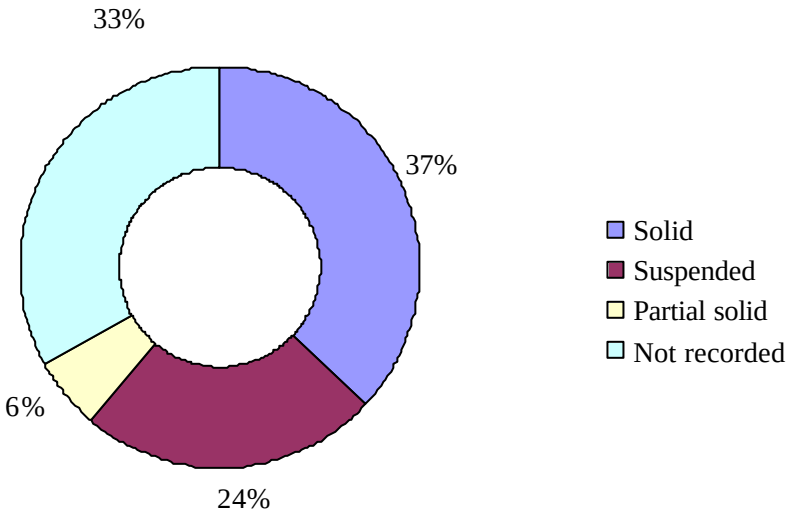

Figure 10 - Ground floor construction

2.4 CASUALTY & APPLIANCE LOCATION - ANALYSIS OF SECTION 4 OF DIDR

The location of the incident appliance and the casualties are given below in Table 7.

Table 7 - Appliance and casualty locations

Location	Number of appliances at each location	Number of casualties at each location	Number of casualties reported in the same room as the appliance
Attic	0	0	-
Bathroom	5	8	2
Bedroom	3	85	5
Bedsit	1	1	1
Cellar	1	0	-
Dining Room	3	6	-
Utility	3	0	-
Garage	0	0	-
Hall	11	5	2
Kitchen	47	33	23
Landing	2	1	-
Living room	23	72	24
Shower-room	0	1	-
Other	7	4	6
Empty Field	1	10	11

Of the 107 incident sites the majority of incident appliances were located in rooms (64%), 33% were described as being located in compartments and the remainder were not coded. This is shown on Figure 11.

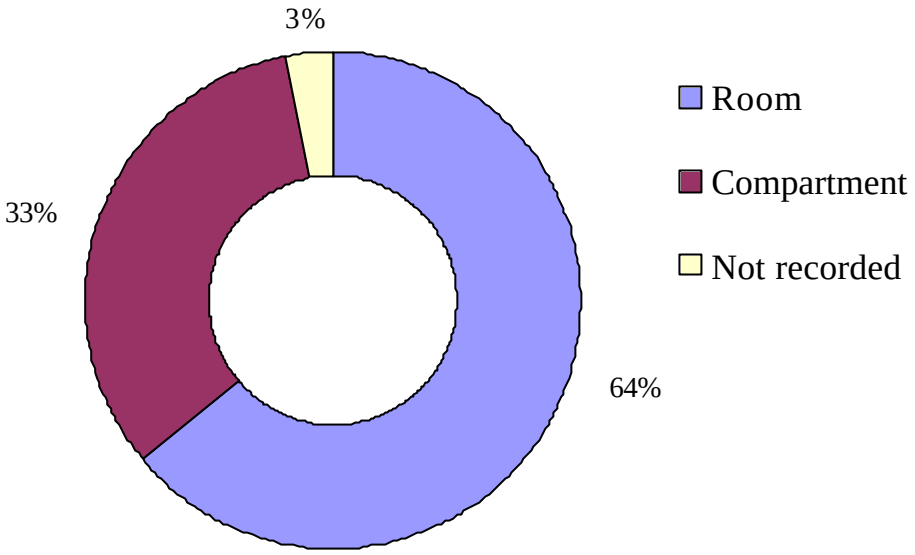

Figure 11 - Appliance location

There were 2 appliances located in a room below ground level. At 99 (93%) incidents the casualties were in the same property as the incident appliance. Four incidents had casualties in adjacent properties and 4 were not coded. This is shown on Figure 12.

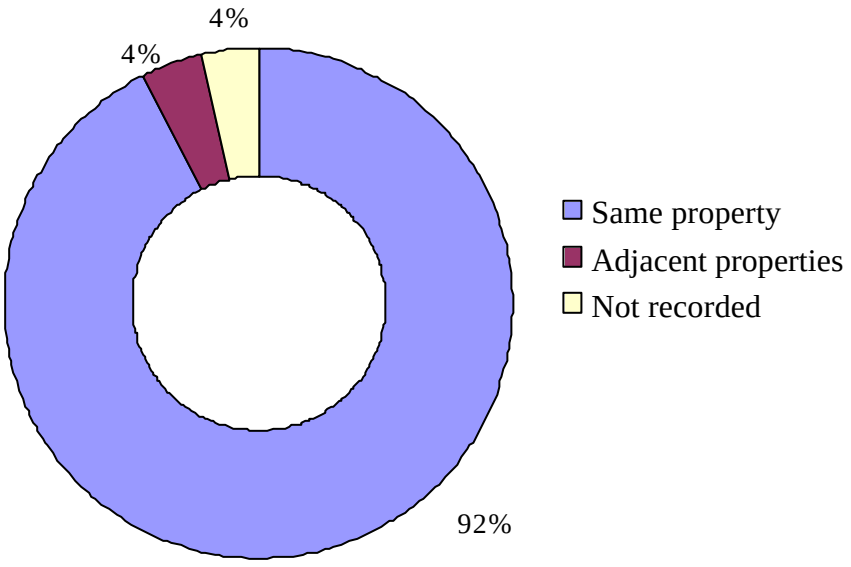

Figure 12 - Casualty/Appliance location

2.5 INCIDENT APPLIANCES - ANALYSIS OF SECTION 5 OF DIDR

2.5.1 Incidents during 1998/99

Details of the CO poisoning incidents for 1998/99, by appliance type, are given in Table 8 and in Figure 13.

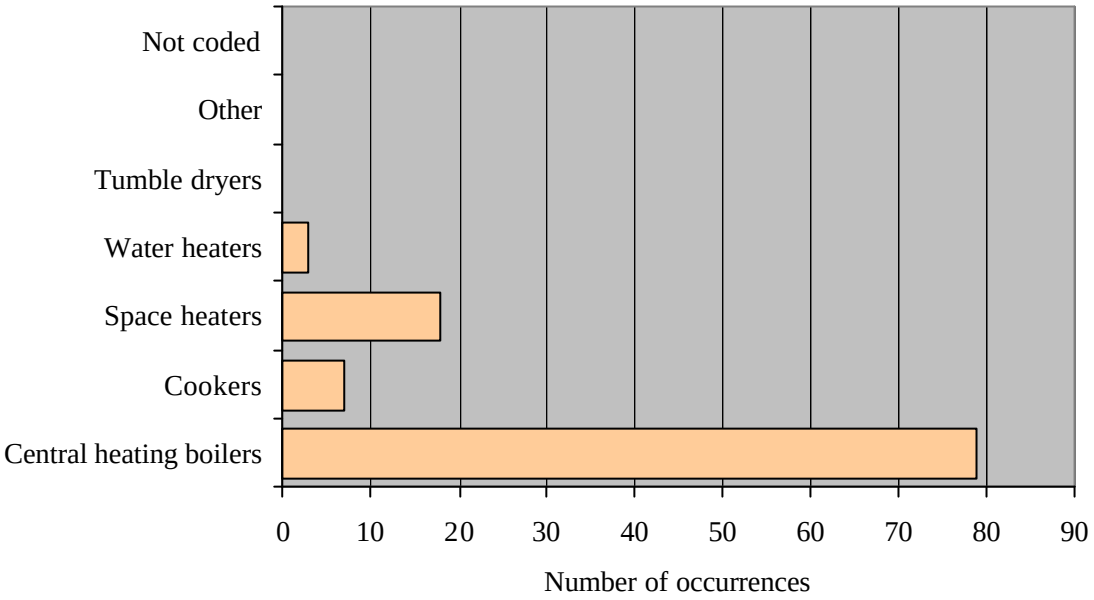

Figure 13 - Incidents by appliance type

TABLE 8 - Incidents by appliance types

Appliance	Incidents (All) - Total	Incidents - Fatal	Casulaties - Non fatal	Casualties - Fatal
Central Heating Boilers				
Back unit	7	2	10	6
Floor standing	19	1	51	1
Floor standing combi	1	0	2	0
Thermal storage unit	0	0	0	0
Wall mounted	31	3	83	3
Wall mounted combi	18	1	45	1
Warm air unit	3	2	5	2
Total	**79**	**9**	**196**	**13**
Cookers				
Free standing	7	4	9	4
Built-in oven	0	0	0	0
Built-in hob	0	0	0	0
Total	**7**	**4**	**9**	**4**
Space Heaters				
Balanced flue g .f.	0	0	0	0
Cabinet heater	0	0	0	0
Decorative g .f.	2	0	2	0
Flueless heater	0	0	0	0
Inset live fuel effect g	0	0	0	0
Rad. & rad. con. g .f.	16	5	17	5
Wall heater	0	0	0	0
Total	**18**	**5**	**19**	**5**
Dryers				
Tumble Dryers (total)	**0**	**0**	**0**	**0**
Water Heaters				
Bulk storage	0	0	0	0
Circulator	1	0	3	0
Multi-point	0	0	0	0
Single-point	2	1	4	1
Total	**3**	**1**	**7**	**1**
OTHER	**0**	**0**	**0**	**0**
Table total	**107**	**19**	**231**	**23**

Notes: Appendix B gives details, by appliance type, for each incident. In the above table and following tables g .f. has been used as an abbreviation for gas fire.

There were no reports of any condensing appliances having been involved in any incidents during this reporting period.

The breakdown of the types of central heating units involved in incidents is given in Figure 14.

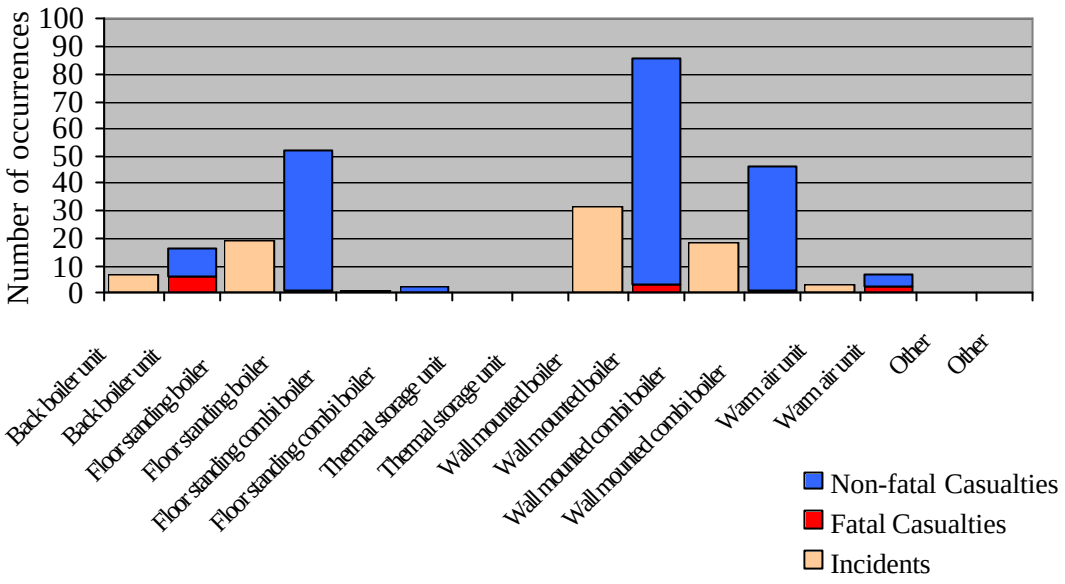

Figure 14 - Central heating boilers

Figure 15 shows the fatality trends associated with appliance type since 1991/92. It should be noted that it is likely that there have been changes to the profile of gas appliances in use, within Britain, between 1991/92 and 1998/99. The FPPY risk values shown in Table 12 take account of these changes.

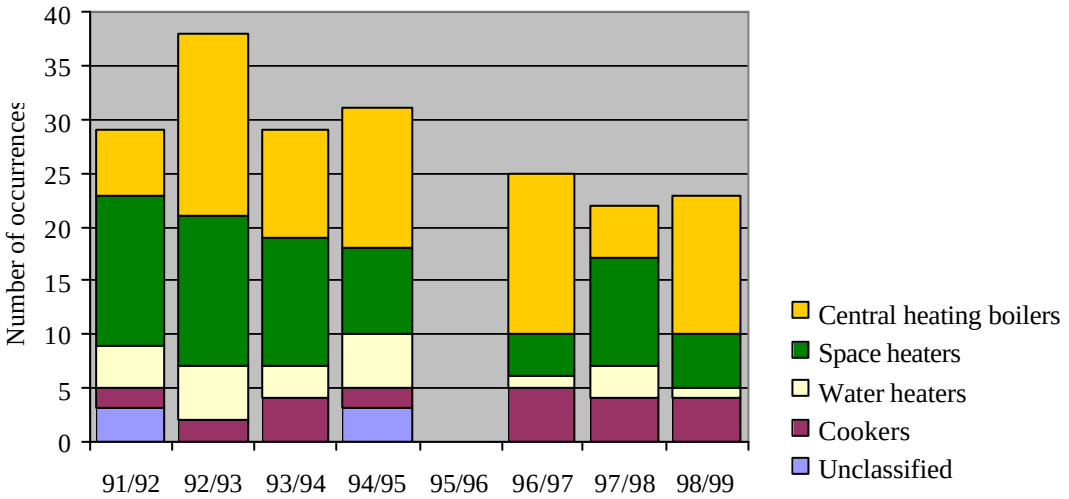

Figure 15 - Fatalities by appliance type

The age of the appliances involved in incidents during the reporting period has been given under the main appliance groups in Table 9. It is also described in Figure 16.

Table 9 - Age of incident appliances

Appliance Type	Age (years)					
	0 –5	6 - 10	11 - 15	16 - 20	Over 20	Unknown
Central heating boilers	4	9	9	5	4	48
Cookers	1	0	0	0	1	5
Space heaters	3	0	0	2	2	11
Dryers	0	0	0	0	0	0
Water heaters	1	0	1	0	0	1
TOTAL	9	9	10	7	7	65

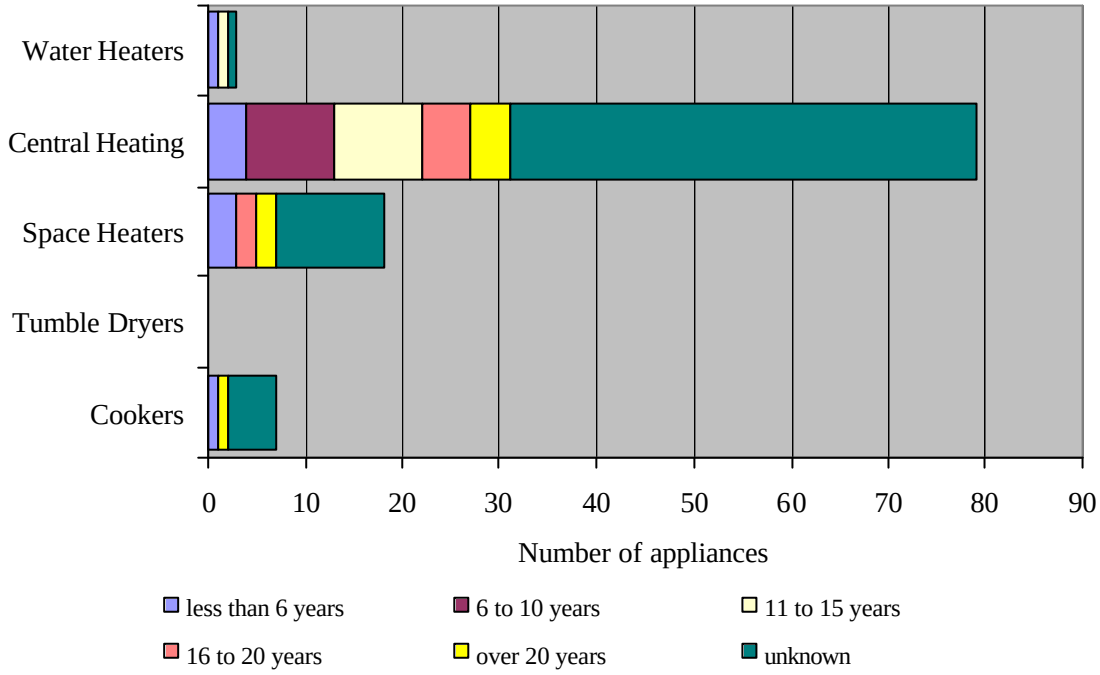

Figure 16 - Appliance age distribution

2.5.2 Notes relating to individual appliance types and models

The following information is extracted from the incident details given in Table 8 and Appendix B:

2.5.2.1 Central Heating

Central heating appliances featured in 79 incidents, which is approximately three quarters of all CO poisoning occurrences during the reporting year. The number of fatalities at 13 was just over half (56%) of the total recorded, with the number of nonfatal casualties being 196 (85%).

Wall hung boilers were involved in 39% of central heating incidents, with floor standing boilers and wall mounted combi boilers being the next highest groups at 24% and 23% respectively. Back boiler units were responsible for the majority of fatalities, at 6, with wall mounted boilers being responsible for 3 fatalities. Access was not obtained for 2 incidents resulting in incomplete details being entered on the DIDR form

Back boiler units

There were 7 back boiler incidents, 2 of which were fatal, with there being 6 fatalities in total. Nonfatal casualties totalled 10. In 3 cases the appliance was in need of servicing. In four incidents the ventilation was not to standard and in 3 cases there were significant flueing faults with the flue installation not to any standards. Two of the appliances were Baxi Bermuda units and the others were all different models.

Floor standing boilers

Floor standing boiler incidents totalled 19, with 1 fatality and 51 non-fatal casualties. Eight of the appliances were Potterton Kingfisher models and 3 were Potterton Diplomats. In 14 incidents the flame picture was defective and in 12 incidents Linting had taken place. In 13 cases the flue was not to standard, with the terminal siting being poor in 12 instances. In 11 installations the ventilation was not to standard. Weather was thought to have contributed to the poor performance of the appliance in 11 of the incidents. In nearly half of the cases the appliance was in need of servicing and in 1 incident the appliance had been labelled as being unsafe, but it was still in use. An open flued boiler was fitted in a bathroom at one incident site.

Note: Some appliance models may appear under several different manufacturers' names within Appendix B. For example Apollo boilers have been entered under Thorn, Myson and Potterton Myson.

Floor standing combi boilers

There was 1 incident featuring a floor standing boiler, the model being a IMI Powermax. There were 2 casualties. The appliance was producing high levels of CO and the failure of a section of flue ducting lead to the CO entering the property.

2.5.2.1.4 Thermal storage units

There were no recorded incidents involving these appliances.

Wall mounted boilers

Wall mounted boilers were involved in 31 incidents, with 3 fatalities and 83 non-fatal casualties. Twenty-two of the appliances were open flued, natural draught and 4 were room sealed natural draught. Four were room sealed, fanned flue and in one case the flue type was not recorded.

Thorn Apollo models and Glow Worm Fuelsaver models both featured in 11 incidents. Faulty case sealing, the removal of the cover or a damaged case led to the incidents occurring in all but one of the room sealed appliance installations. Weather was a factor in 14 incidents, with ventilation faults, flueing faults, linting and defective flame picture numbers being similar.

Wall mounted combi boilers

Combi boilers were involved in 18 incidents one of which resulted in 1 fatality. There were 45 non-fatal casualties. All appliances were open flued, natural draught models. Two open flued models were fitted in bathrooms. Vaillant models featured 11 times with the T3 model 6 times and the GB model 4 times. Flues were not to standard in 15 cases and there were 12 flueing installation faults. Ventilation was not to standards 13 times. The weather also featured in 10 incidents.

Warm air units

There were 3 incidents with warm air units and they were all on open flued, natural draught models. Of the 3 incidents 2 were fatal, with a fatality in each, and there were a total of 5 nonfatal casualties. Faults within the appliances appear to have led to the production of CO and its entry to the property.

2.5.2.2 Cookers

There were 7 incidents, with 4 fatalities and 9 non-fatal casualties, involving cookers and in each case it was the grill burner that led to the production of CO. Of the 7 incidents 4 were fatal incidents. The appliance model was different in each incident. In one incident the grill was being used to provide heat for the property and in two further cases it appears likely that the grill had been left on for an extended period of time. In one incident a CO alarm was activated and the customers were able to respond.

2.5.2.3 Space Heaters

Space heaters, either decorative type or radiant convector heaters, were involved in 18 incidents. In 5 cases the incidents were fatal, with 5 fatalities. There were 19 non-fatal casualties. In 11 incidents the flue was found to have a blockage and in 11 cases linting had taken place. Misplaced radiants or incorrectly positioned coals were the cause of CO production in 4 incidents. In 1 instance the appliance had not been connected to a flue.

2.5.2.4 Tumble Dryers

There were no appliances reported during the year in association with CO incidents.

2.5.2.5 Water Heaters

Water heating appliances featured in 3 incidents of which 2 involved single point water heaters and the other a circulator. One single point water heater incident was a fatal incident with 1 fatality. The other two incidents led to 7 non-fatal casualties. All three appliances required a service and had blocked heat exchangers.

2.5.3 Appliance risk values

Details relating to the risk values by appliance type are shown below in Table 10. In terms of the risk of a fatal incident (FPPY) only the single point water heaters and the warm air units have a risk value greater then the recommended level of 1×10^{-6}.

The appliances in descending order of risk are as follows: Single-point water heaters (2.6×10^{-6}) and Warm air units (1.6×10^{-6}).

Table 10 - Risk values by appliance type

Appliance	Population ($x10^6$)	FPPY ($x10^{-6}$)	CPPY ($x10^{-6}$)	IPPY ($x10^{-6}$)
Central Heating Boilers				
Back boiler unit	3.22	0.79	1.3	0.92
Floor standing	3.07	0.14	7	2.6
Floor standing combi	0.28	-	3	1.5
Thermal storage unit	-	-	-	-
Wall mounted	7.19	0.18	4.9	1.8
Wall mounted combi	3.14	0.13	6	2.4
Warm air unit	0.51	1.6	4.1	2.5
Cookers				
Free standing	9.14	0.18	0.41	0.3
Built-in oven	-	-	-	-
Built-in hob	-	-	-	-
Space Heaters				
Balanced flue g .f.	-	-	-	-
Cabinet heater	-	-	-	-
Decorative g .f.	2.13	-	0.4	0.4
Flueless heater	-	-	-	-
Inset live fuel effect g .f.	-	-	-	-
Rad. & rad. Con. g .f.	7.42	0.28	1	0.91
Wall heater	-	-	-	-
Dryers				
Tumble dryers	-	-	-	-
Water Heaters				
Bulk storage	-	-	-	-
Circulator	-	-	-	-
Multi-point	-	-	-	-
Single-point	0.16	2.6	10.5	5.3

Note: Population figures provided by GfK Marketing Services Ltd. (Reference 7.1.1). Population figures were not available for all appliance types and therefore risk values could not always be calculated.

2.5.4 Trends (1989/90 -1998/99)

Trends regarding CO Poisoning incident fatalities by appliance type are given below in Table 11 and are also shown in Figure 15, which is in section 2.5.1 of the report. This table has been completed as fully as possible using information that was available from the 98/99 DIDR forms and from historical records held by Advantica (Reference 7.1.2).

Table 11 - Trend data of the number of fatalities due to CO incidents, by appliance type

Appliance	Year							
	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99
C/H Boilers -Total	**6**	**17**	**10**	**13**	**-**	**15**	**5**	**13**
Back unit	-	-	-	1	-	3	-	6
Floor standing	-	-	-	6	-	2	2	1
Floor standing combi	-	-	-	-	-	-	-	-
Thermal storage unit	-	-	-	-	-	-	-	-
Wall mounted	-	-	2	1	-	5	2	3
Wall mounted combi	2	4	2	2	-	3	1	1
Warm air unit	-	1	1	2	-	1	-	2
Cookers -Total	**2**	**2**	**4**	**2**	**-**	**5**	**4**	**4**
Free standing	-	-	-	-	-	5	4	4
Built-in oven	-	-	-	-	-	-	-	-
Built-in hob	-	-	-	-	-	-	-	-
Space Heaters -Total	**14**	**14**	**12**	**8**	**-**	**4**	**10**	**5**
Balanced flue g .f.	-	-	-	-	-	-	-	-
Cabinet heater	-	-	-	-	-	-	-	-
Decorative g .f.	-	-	-	-	-	-	-	-
Flueless heater	-	-	-	-	-	-	-	-
Inset live fuel effect g .f.	-	-	-	-	-	-	-	-
Rad. & rad. con. g .f.	-	-	-	-	-	3	10	5
Wall heater	-	-	-	-	-	-	-	-
Dryers	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Water Heaters -Total	**4**	**5**	**3**	**5**	**-**	**1**	**3**	**1**
Bulk storage	-	-	-	-	-	-	-	-
Circulator	-	-	-	-	-	-	-	-
Multi-point	-	-	-	-	-	-	-	-
Single-point	-	-	-	-	-	1	3	1
Other	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**
TOTAL -All Appliances	**29**	**38**	**29**	**31**	**-**	**25**	**22**	**23**

Trends in terms of the risk of a fatality by appliance type, expressed as FPPY values are shown below in Table 12. This table has also been completed as fully as possible using information that was available from the 98/99 DIDR forms and from historical records held by Advantica.

Table 12 - Trend data of fatalities per person per year (FPPY)

Appliance	Year							
	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99
C/H Boilers -Total	**0.14**	**0.38**	**0.17**	**0.27**	**-**	**0.38**	**0.12**	**0.31**
Back unit	-	-	-	-	-	0.39	-	0.79
Floor standing	-	-	-	-	-	0.23	0.26	0.14
Floor standing combi	-	-	-	-	-	-	-	-
Thermal storage unit	-	-	-	-	-	-	-	-
Wall mounted	-	18.3	37.5	0.65	-	0.27	0.11	0.18
Wall mounted combi	0.64	1.1	0.54	0.54	-	1.1	0.17	0.13
Warm air unit	-	0.67	0.7	1.38	-	0.76	-	1.6
Cookers -Total	**0.1**	**0.06**	**0.01**	**0.07**	**-**	**0.16**	**0.13**	**0.12**
Free standing	-	-	-	-	-	0.24	0.19	0.18
Built-in oven	-	-	-	-	-	-	-	-
Built-in hob	-	-	-	-	-	-	-	-
Space Heaters -Total	**0.43**	**0.42**	**0.36**	**0.24**	**-**	**-**	**-**	**-**
Balanced flue g .f.	-	-	-	-	-	-	-	-
Cabinet heater	-	-	-	-	-	-	-	-
Decorative g .f.	-	-	-	-	-	-	-	-
Flueless heater	-	-	-	-	-	-	-	-
Inset live fuel effect g .f.	-	-	-	-	-	-	-	-
Rad. & rad. con. g .f.	-	-	-	-	-	0.16	0.54	0.28
Wall heater	-	-	-	-	-	-	-	-
Dryers	-	-	-	-	-	-	-	-
Water Heaters -Total	**0.5**	**1.3**	**0.9**	**1.47**	**-**	**-**	**-**	**-**
Bulk storage	-	-	-	-	-	-	-	-
Circulator	-	-	-	-	-	-	-	-
Multi-point	-	-	-	-	-	-	-	-
Single-point	-	-	-	-	-	3.81	8.78	2.6
Other	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
TOTAL -All Appliances	**0.29**	**0.34**	**0.28**	**0.29**	**-**	**-**	**-**	**-**

Note: In Table 12 all the FPPY values are $x10^{-6}$

2.6 SAFETY DEVICES - ANALYSIS OF SECTION 6 OF DIDR

A total of 16 safety devices were noted as being fitted within the incidents investigated. Eight were downdraught detectors, two were vitiation devices and four were CO chemical spot detectors. The remaining two were powered CO alarms of which one was mains powered and one was battery powered. In 3 cases the safety devices were found to be non-operational. This was for one downdraught detector, one spot detector and one battery powered alarm.

2.7 FLUE DETAILS - ANALYSIS OF SECTION 7 OF DIDR

The majority of appliances were open flued, individual, natural draft (83 incidents - 78%). There were also 10 individual room sealed flues, 5 of which were fanned, and 9 flueless appliances. Flueing details are given in Figure 17.

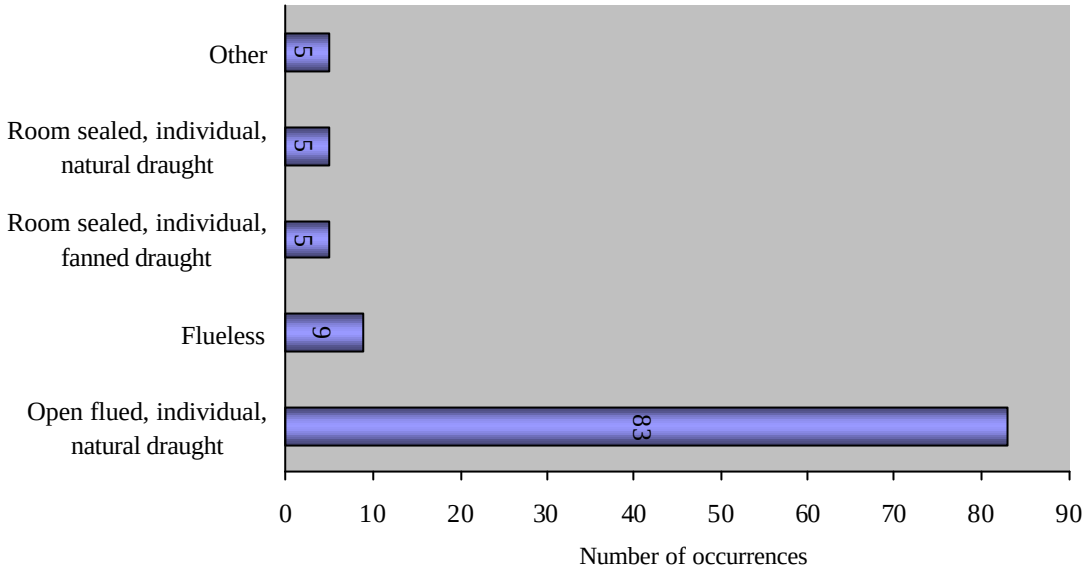

Figure 17 - Incidents by flue type

The analysis of flues to standard is given in Figure 18. There were 50 incidents (46%) where the flue was not to any appropriate standards, 34 (32%) of flues to current standards, 9 (8%) to standards applicable at the time of installation and 14 (13%) which were not known.

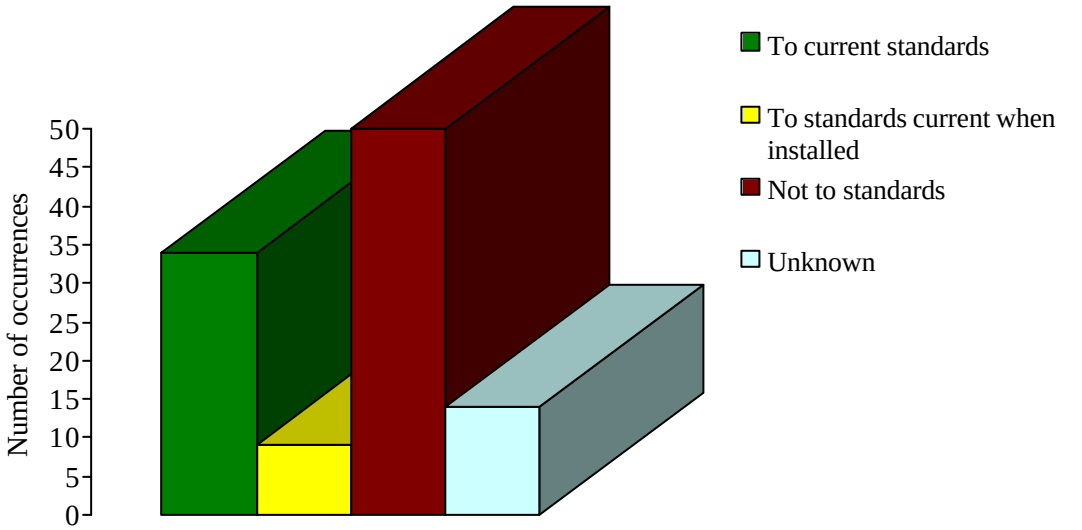

Figure 18 - Flues to standard

The number of flueing faults found are given in Table 13 (report section 2.9). A breakdown of the flueing faults, by appliance type, is given in Appendix B. Details of the flue compliance to standards, for each incident appliance, are also given in Appendix B.

Flue liners were fitted in 14 cases. In 7 cases the liner was fitted with the appliance and in 7 cases it was not known.

2.8 PERMANENT VENTILATION - ANALYSIS OF SECTION 8 OF DIDR

Permanent ventilation was required in 76 (71%) of the incidents and was not required in 31 (29%) of cases. Where ventilation was required it had been provided in 64 of the cases (84%) and when provided it was only to current standards in 21 installations (33%). It was not to standards current when installed in 39 installations (61%).

Where permanent ventilation was required and air vents were fitted they were still effective in 49 (64%) of incidents and partially effective in 8 (10%) of the incidents. In 7 incidents the ventilation was totally ineffective. Of those with totally or partially ineffective ventilation, 6 were blocked intentionally and 5 unintentionally.

Incident appliances were fitted in compartment/cupboards in 35 incidents. The compartment/cupboard was to standards applicable at the time of installation in 9 (26%) instances. It was not to standards in 25 (71%) instances. In one case it was unknown whether the compartment/cupboard met standards.

Extract fans, recirculating fans and cooker hoods were reported to have been in use during one incident.

The number of overall ventilation faults found are given in Table 13 (report section 2.9). A breakdown of the ventilation faults, by appliance type, is given in Appendix B.

2.9 ON-SITE CHECKS - ANALYSIS OF SECTION 9 OF DIDR

The following details in Table 13 are for all incident appliances. They give the total numbers of faults found upon incident appliances. In Appendix B a breakdown of the information from the DIDR is given by appliance type. The number of faults, by the main fault groups listed below, are given in Figure 19. In Figure 20 each individual fault is shown, for comparison purposes.

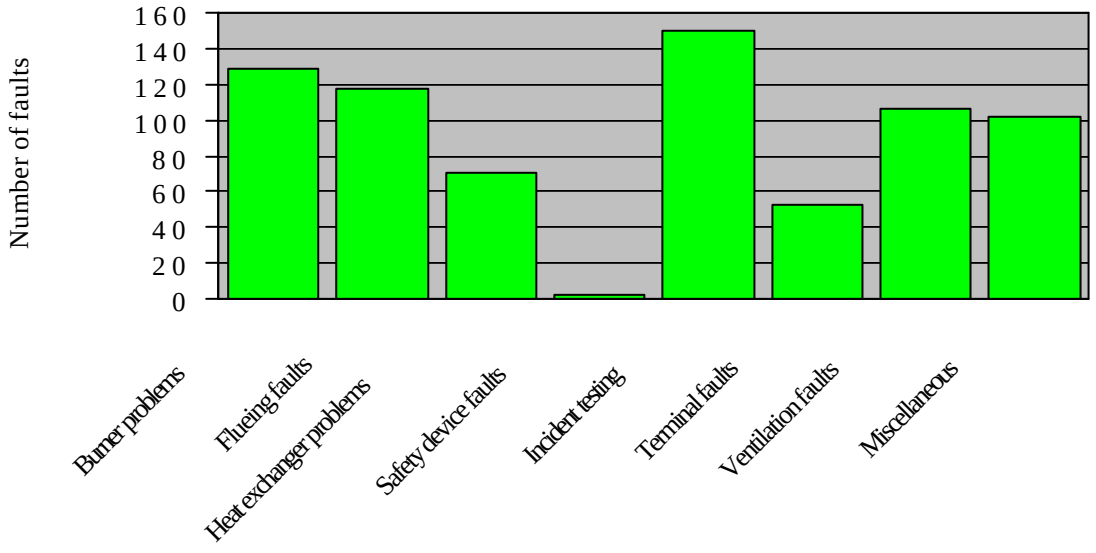

Figure 19 - Main fault groups

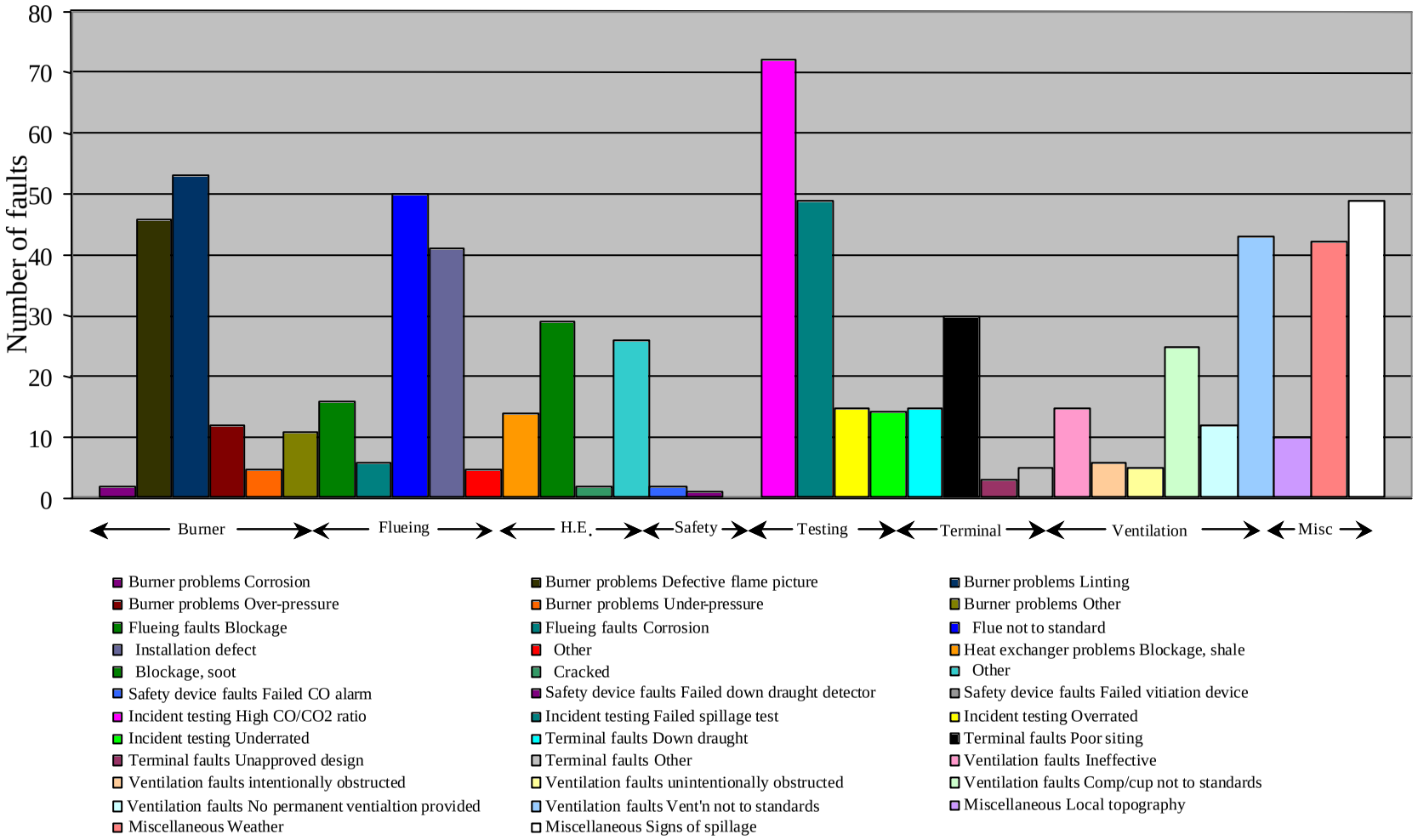

Figure 20 - Individual faults

Table 13 - Incident appliance faults

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	2	High CO/CO2 ratio	72
Defective flame picture	46	Failed spillage test	49
Linting	53	Overrated	15
Over-pressure	12	Underrated	14
Under-pressure	5	**Terminal**	
Other	11	Down draught	15
Flue		Bad siting	30
Blockage	16	Unapproved design	3
Corrosion	6	Other	5
Flue not to any standard	50	**Ventilation**	
Installation defect	41	Air vent/vents ineffective	15
Other	5	Air vents obstructed - intentionally	6
Heat exchanger		Air vents obstructed - unintentionally	5
Blockage - shale	14	Compartment/cupboard not to any standards	25
Blockage - soot	29	No permanent ventilation provided	12
Cracked	2	Ventilation provided was not to any standard	43
Other	26	**Miscellaneous**	
Safety device		Local topography	10
Failed CO alarm	2	Weather	42
Failed down draught detector	1	Signs of spillage	50
Failed vitiation device	0		

Note: In Table 13 the numbers quoted are the number of appliances found with the fault listed.

In the majority of cases (73) CO was proven to be able to enter the incident property when tested in the as-found condition and to be the likely cause of the incident. Of these cases there were 86% where a sufficient concentration of CO was shown to have been produced by the incident appliance which would have resulted in the level of COHb found in the victims. Additionally in the majority of these cases (70%) it was indicated that the concentration of CO could be achieved in the available time.

A safety warning notice had been attached to the incident appliance or at the gas meter prior to the incident on 8 occasions.

2.10 INSTALLATION DETAILS - ANALYSIS OF SECTION 10 OF DIDR

Incident appliances were installed new at 46 sites (43%). They were second hand at 5 sites (5%) of sites and it was unknown if the appliance was fitted as new or second hand for the remaining 56 (52%) incident locations. The time period when the incident appliance was fitted, before the incident, is given in Table 14 along with the number of appliances in each age group.

Table 14 - Installation period for incident appliances

Appliance type	Age (years)						Total
	0 - 5	6 - 10	11 - 15	16 - 20	Over 20	Unknown	
New	9	4	16	3	8	6	46
Second-hand	2	1	0	0	0	2	5
Unknown	3	3	1	1	3	45	56
Total	**14**	**8**	**17**	**4**	**11**	**54**	**107**

The incident appliance was known to have been installed by a CORGI registered fitter (or equivalent) in 12 instances (11%) and by DIY persons in 4 incidents (4%). Unknown persons fitted the remaining 91 (85%).

In the majority of incidents (61) the appliance was fitted to standards (57%). The appliance was not installed correctly and to the standards applicable at the time of installation in 35 (33%) of the 108 incidents recorded. It was unknown in a further 11 incidents (10%).

2.11 INCIDENT APPLIANCE HISTORY - ANALYSIS OF SECTION 11 OF DIDR

2.11.1 Servicing information

The DIDR returns show that there were 26 incident appliances covered by a regular service contract at the time of the incident. In 49 cases there was no regular service contract and in 32 cases the remaining incidents the situation was unknown.

2.11.2 Last working visit information

Analysis of the number of tick boxes completed for the "last working visit" is given in Table 15.

Table 15 - Details of the last working visit

Last working visit by:	Number of tick-boxes completed
CORGI fitter	45 (42%)
Non-CORGI fitter	4 (4%)
Other	3 (3%)
Unknown	55(51%)

2.11.3 Reason for the visit

Analysis of the number of tick boxes completed for the "reason for the visit" is given in Table 16.

Table 16 - Reason for the last working visit

Reason for visit:	Number of tick-boxes completed
Breakdown	15 (14%)
Report of fumes	1 (1%)
Safety check/inspection	11 (10%)
Service	25 (23%)
To install the incident appliance	6 (6%)
Other	6 (6%)
Unknown	43(40%)

2.11.4 Time period from the last working visit

Analysis of the number of tick boxes completed for the time period involved between the last working visit and the incident are given in Table 17.

Table 17 - Interval between the last working visit and the incident

Time between the last working visit and the incident	Number of tick-boxes completed
Less than 6 months	30 (28%)
6 months to 1 year	19 (18%)
1 year to 2 years	10 (9%)
More than 2 years	6 (6%)
Unknown	40 (37%)
Not applicable	2 (2%)

2.11.5 Fumes history

Prior to the incident, the incident "appliance" had been inspected following reports of fume spillage in 8 incidents. There were 6 reports of incident installations being inspected following reports of fume spillage. The occupants reported experiencing symptoms typically associated with CO poisoning at 29 incident sites.

3 GENERAL DISCUSSION

This is the third analysis of CO incident information provided by the use of the DIDR form within the gas industry.

The types of incidents featured in 1998/99 were much the same as in previous years. The majority of incidents involved open flue appliances with only 10 involving room sealed appliances. Central heating appliance incidents resulted in over 80% of the casualties, the next highest group were space heaters at approximately 9%. In terms of fatalities, central heating appliances also led to the majority at 13, with space heaters next at 5, followed by cookers 4 and water heaters at 1.

In addition to the domestic incidents reported above there were three LPG domestic reported incidents, covered in Appendix C, including one which took place in a small hotel/inn and 4 business incidents reported in Appendix D.

3.1 TOTAL INCIDENT DETAILS

The number of domestic CO incidents fully investigated, reported and analysed for use in this report was 107.

In the previous annual report for 1997/98 there were 97 CO incidents that were analysed. In other years it has varied between 64 and 102.

The majority of the incidents took place during the heating season, which is in line with previous records.

Study of the postcode areas in which the incidents occurred show that three featured with 2 counts each. The postcodes are TQ1 (Torquay), WV3 (Wolverhampton) and AB1 (Aberdeen), all other postcode areas appeared only once. It should be noted however that the number of incidents is small, compared to the number of homes in Great Britain.

3.2 TOTAL CASUALTY DETAILS

As was the case in the previous year's report the total number of fatalities reported was only slightly different from the previous year at 23 (22 in 97/98). Non-fatal casualties recorded were similar to 1997/8 totals, 231 versus 224. Serious casualties in group N1 was 49, with N2 numbers being 171 (1997/87 numbers were 16 and 174) indicating increased reporting of incidents where casualties spent over 24 hours in hospital.

The total FPPY figure of 0.49×10^{-6} is almost the same as the previous year and falls within, what would normally be considered as, the "broadly accepted region" of HSE's criteria for the tolerability of risk. However, societal concerns over gas safety override averaged numerical considerations. Values of Overall IPPY and CPPY values are also similar to the previous years values.

3.3 PROPERTY DETAILS

Incidents took place more often in terraced and semi-detached properties during the period 1996/97 to 1998/99. The majority of incidents took place in terraced houses (45%). Incidents in semi-detached houses (17%) and low level purpose built flats (14%) took place in far lower numbers. Like last year the incidents that took place across all property types is not in broad agreement to the proportions of each type of property within Britain (Table 5).

The variations noted in 1997/98 are still present. Incidents in converted flats or maisonette/rooms occur at 2.5 times that expected from comparison with accommodation statistics. The number of incidents in terraced houses/bungalows has increased with 76% more incidents taking place in this group than would be expected if the results were independent of property type. Detached and semi-detached properties featured below expected levels by 43% and 54%

Where the age was specified for the incident property it is the older properties (pre 1945) which are seen to feature more often in incidents at 55%, with those built between 1946 and 1965 the next highest group at 24%. As in the above case the proportion of incidents is not inline with the age profile of properties in Great Britain. The proportion of incidents taking place in older properties is 15% more than expected and those built after 1965 are reduced by a similar amount. This trend was also noted in the report for 1997/98.

From the figures on occupancy quoted in section 2.3 it can be seen that there were more incidents within owner occupied properties than in tenanted properties. But when a relative risk analysis is carried out it indicates that tenanted/privately owned accommodation is the area of greatest relative risk and that owner occupied and tenanted/council and housing association properties show the lowest relative risk.

Comparison of the relative risk factors (based on a division of the percentage split of DIDR reported incidents for that group by the national percentage of occurrences of that group - 100 being the overall average factor, and using the figures quoted in section 2.3) shows that the tenanted/housing association group has the safest relative risk factor of 80. This was calculated as follows ((4/5) x 100) = 80. Owner occupied properties have a relative risk factor of 88, the tenanted/council group has a relative risk factor of 87 and tenanted/privately owned accommodation is the area of greatest relative risk with a factor of 189. This is a significant increase in the relative risk factor over other types of accommodation. The last two annual statistical reports also indicated that tenanted/privately owned accommodation was the highest risk area.

3.4 CASUALTY & APPLIANCE LOCATION

The majority of appliances that led to incidents were located in the kitchen of the incident sites. The next most common area was in the living room. These are as expected for the typical majority of domestic gas appliances.

However, the greatest numbers of casualties were located in the bedroom and living room followed by the kitchen. Almost all those in the bedroom were affected by appliances located in other rooms, as were 67% of those in the living room.

As would be expected the great majority of incidents took place with the casualties and incident appliance in the same property. In only 4 incidents were the casualties not in the same property as the appliance was fitted.

3.5 INCIDENT APPLIANCES

The total number of incidents was made up of 79 incidents involving central heating boilers, 18 incidents involving space heaters, 7 involving cookers and 3 involving water heaters. These figures are very similar to those of the last reported period. Central heating boilers were involved in the majority of CO incidents and were responsible for the majority of casualties.

The fatality trend tables indicate that natural gas appliances are responsible for a broadly similar number of fatalities over the eight-year period. This year and the two previous years do show a trend of a small reduction in the number of fatalities. This period back boiler units were responsible for most fatalities (6) followed by radiant & radiant convector gas fires with 5 fatalities. Free standing cookers were the next highest group (4), followed by wall mounted boilers (3).

Single point water heaters continue to appear to present a greater risk than other appliance types and have risk values well above what would normally be considered as, the "broadly accepted region" of HSE's criteria for the tolerability of risk (1×10^{-6}). These appliances are and have been recognised as a major problem in the past. It can now be seen from the appliance survey carried out by GfK Marketing Services that the numbers of these appliances in use appears to have increased over the last 3 years. This would indicate that newer and more safer appliances are being fitted. The number of people at risk from single point water heaters and their FPPY value may be expected to remain high whilst older appliances without safety controls are still in use.

The majority of non-fatal casualties involved central heating boilers. The number of non-fatal casualties associated with all central heating boilers is about 15 times the number of fatalities that took place. This is a reduction on last year where the same ratio was nearly forty. The ratio for central heating boilers is still far greater than for all the other appliance groups. Looking at other appliance risk values it can be seen that warm air units are also above the "accepted" value during this period and have been so in a previous year. Even when not above the value they have tended to have higher risk values than most other appliances.

The majority of non-fatal casualties continue to be related with central heating boilers. Wall mounted boilers incidents were responsible for the highest number of casualties, followed by floor standing boilers and wall mounted combi boilers. They were not the highest risk though, when looking at CPPY values, where single-point water heaters at 10.5 are highest followed by floor standing boilers at 7. The IPPY values follow a similar trend.

In line with last year's results many installations feature incorrect ventilation, poor flueing and a lack of servicing. As is the situation in a number of cases, the appliance itself was not at fault, rather the installation.

In all incidents involving cookers it was the grill burner that was the cause of the CO production. In several cases the grill was in use for extended periods of time.

3.6 SAFETY DEVICES

There were a number of safety devices noted at incident sites and in the majority of cases they appeared to be working. The numbers in use however are still small by comparison with the numbers of gas appliances.

The effectiveness of CO alarms was shown in one incident where four people were alerted to high levels of CO and were able to respond before the situation became life threatening.

3.7 FLUE DETAILS

As in previous years the majority of incidents involved open flue appliances (78%). Approximately 46% of all flues were not installed to appropriate standards and in 38% of all incidents the flue had an installation defect. Flue blockage had taken place in 16 (15%) of the incidents.

Faulty case seals and casing faults were the cause in the majority of incidents on room sealed central heating boilers.

3.8 PERMANENT VENTILATION

In many incidents, during the reporting, period the permanent ventilation required had not been provided, or if it was provided it had not been to current standards or had become restricted. Such factors can affect flue performance and in combination with other faults are generally acknowledged to contribute towards the causes of CO incidents.

As a common fault at incident sites this is an item that can be improved by continued customer awareness campaigns and during routine servicing.

3.9 ON-SITE CHECKS

When investigated it was found that often there were similar faults on the appliance i.e. the appliance was spilling products and had a high CO/CO2 ratio, the heat exchanger was partially or fully blocked, there was a defective flame picture and linting had also taken place, were the most common. To a lesser extent almost all of the faults listed on the DIDR form have taken place somewhere and have been discovered during an investigation.

3.10 INSTALLATION DETAILS

In just over half the incidents the appliances had been installed correctly and to the relevant standards. In the majority of cases where the appliance was not fitted to standard it was by an "unknown person". In only 5 incidents was it known that the appliances had been installed second-hand and in only 4 incidents was it reported that the appliance was fitted by DIY persons. In the majority of incidents, information was not forthcoming on whether the appliance was bought new or who fitted the appliance.

3.11 INCIDENT APPLIANCE HISTORY

Where information was provided it shows that 26 incident appliances were regularly serviced. Of this 23 had been regularly serviced by CORGI registered fitters, 2 by non-CORGI registered fitters and in 1 case the affiliations of the fitter were unknown. A combination of factors were present at most incident sites, with several separate occurrences probably leading to the production of CO. In 8 incidents the appliance had been inspected following reports of fumes spillage and at 29 incidents it is reported that the occupants had experienced symptoms typically associated with CO poisoning.

3.12 WEATHER FACTORS

In a number of incidents it was noted that adverse weather had been an influencing factor which contributed to the poor performance of the incident appliance. There were 42 counts of this on the site check table. This is perhaps borne out by a study of the dates on which the incidents took place. For example in November, there were 15 incidents which happened in one week with 4 incidents on one day alone. Similar groupings occur during other months.

Perhaps appliance and installation designs should be studied to make them more tolerant to adverse weather conditions?

4 SUMMARY

4.1 The number of domestic related CO poisoning deaths reported, at 23 during 1998/99, was in line with previous trends.

4.2 The majority of all CO incidents involved domestic open flued appliances.

4.3 Central heating appliances were responsible for the majority of fatal and non-fatal casualties.

4.4 The total FPPY figure of 0.49×10^{-6} is within, what would normally be considered as, the "broadly accepted region" of HSE's criteria for the tolerability of risk. However societal concerns over gas safety override averaged numerical considerations.

4.5 The appliance types that were above the HSE's criteria for the tolerability of risk are single-point water heaters (2.6×10^{-6}) and warm air units (1.6×10^{-6}).

4.6 The majority of casualties were located in the bedroom and the living room.

4.7 There was an above average risk of a CO incident in domestic properties built before 1946 and also in tenanted accommodation that was privately owned.

4.8 Flueing and ventilation faults were common in many domestic incidents.

4.9 Whilst it has often been suggested that annual appliance servicing could help prevent the majority of domestic incidents it has not possible to support or refute that conclusion from the data presented in this report.

4.10 There were 3 LPG and 4 non-domestic incidents reported during 1998/99.

5 CONCLUSIONS

Analysis of the CO incident statistics, collected from the Downstream Incident Data Report form, has produced results in line with previous years results. The analysis identifies the most common faults found at incidents. This information can be used to improve customer safety, target expenditure on CO incident prevention and further research work.

6 RECOMMENDATIONS

6.1 The continuing importance of collecting and analysing incident statistics needs to be stressed. Without this data the risks associated with appliances, installations etc, cannot be accurately assessed and acted upon.

6.2 The data should be made available to all interested parties, i.e. those concerned with the safety, transportation and supply of gas and also those involved in the installation and maintenance of gas appliances.

7 DATA USED AND REFERENCES

7.1 DATA USED

7.1.1 Appliance Population Statistics - Statistics for Great Britain provided by GfK Marketing Services Ltd., Sheer House, Station Approach, West Byfleet, Surrey KT14 6NL.

7.1.2 Historical Incident Data - Advantica database.

7.1.3 Number of Natural Gas Customers - Best estimates, for Great Britain, obtained from Lattice Group plc company records.

7.1.4 Population & Housing Statistics for Great Britain - The size of the average household has been calculated from figures produced by the Office for National Statistics and published in the Annual Abstract of Statistics.

7.2 REFERENCES

7.2.1 Definitions of FPPY, CPPY and IPPY - Advantica Reports.

APPENDIX A DEFINITIONS AND THE USE OF FPPY, IPPY AND CPPY VALUES

a) Fatalities Per Person Per Year (FPPY)

FPPY is a measure of the risk of death from owning a specific appliance type.

FPPY is defined as:-

$$FPPY = \frac{\text{Number of Fatalities}}{\text{Number of people at risk x Appliance Population}}$$

Notes:

1) In the report the number of people at risk is taken as the average number of people per household (2.37 in 1998/99). - provided from Government Statistics - see report section 7.

2) The "Overall FPPY" is calculated, as above, except that "Appliance Population" is replaced by the number of customers - see report section 7.

3) The appliance population figures used have been taken from information provided by GfK Marketing Services - see report section 7.

b) Incidents Per Person Per Year (IPPY)

IPPY is a measure of the risk of having an accident with a specific appliance type.

IPPY is defined as:-

$$IPPY = \frac{\text{Number of Incidents}}{\text{Number of people at risk x Appliance Population}}$$

c) Casualties Per Person Per Year (CPPY)

CPPY is a measure of the risk of being injured by owning a specific appliance type.

CPPY is defined as:-

$$CPPY = \frac{\text{Number of Casualties}}{\text{Number of people at risk x Appliance Population}}$$

APPENDIX B TABLES, BY APPLIANCE TYPE, SHOWING THE NUMBER OF FAULTS AND INDIVIDUAL INCIDENT DETAILS

Table B1 shows the tables included in this appendix. They have been completed for the appliance groups only where there were relevant incident appliances to describe.

The nomenclature adopted allows data to be presented for any of the appliance groups. This has the advantage that tables with the same code may be readily identified, which can aid the comparison on a year-by-year basis. However, groups may not have been implicated in incidents in any particular year, so they are indicated in this appendix as "no reported incident".

The appliance groups have been ordered in the same way as section 2.5.2 of the report.

Table B1 – Summary of incident fault analysis and summary tables presented

Appliance group	Appliance sub-group	Code	Incidents	Appendix tables
Central Heating Boilers	Back unit	1.1	7	B.1.1a & b
	Floor standing	1.2	19	B.1.2a & bi-iii
	Floor standing combi	1.3	1	B.1.3a & b
	Thermal storage unit	1.4	0	*No reported incident*
	Wall mounted	1.5	30	B.1.5a & bi-iv
	Wall mounted combi	1.6	18	B.1.6a & bi & bii
	Warm air unit	1.7	3	B.1.7a & b
Cookers	Free standing	2.1	6	B.2.1a & b
	Built-in oven	2.2	0	*No reported incident*
	Built-in hob	2.3	0	*No reported incident*
Space Heaters	Balanced flue g .f.	3.1	0	*No reported incident*
	Cabinet heater	3.2	0	*No reported incident*
	Decorative g .f.	3.3	2	B.3.3a & b
	Flueless heater	3.4	0	*No reported incident*
	Inset live fuel effect g .f.	3.5	0	*No reported incident*
	Rad. & rad. con. g .f.	3.6	17	B.3.6a & bi & bii
	Wall heater	3.7	0	*No reported incident*
Dryers	Tumble Dryers	4.1	0	*No reported incident*
Water Heaters	Bulk storage	5.1	0	*No reported incident*
	Circulator	5.2	1	B.5.2a & b
	Multi-point	5.3	0	*No reported incident*
	Single-point	5.4	2	B.5.4a & b

In addition, these codes have been used within the tables in this appendix :

Table B2 – Appliance location and flue type codes

Appliance location	Code	Flue type	Code
Other	0	Other	0
Attic	1	RS/Indiv/Natural draught/BF	1
Bathroom	2	RS/Indiv/Fanned draught	2
Bedroom	3	RS/Shared/Se-duct	3
Bedsit	4	RS/Shared/U-duct	4
Cellar	5	Open/Indiv/Natural draught	5
Dining Room	6	Open/Indiv/Fanned/Integral	6
Utility Room	7	Open/Indiv/Fanned/Add on	7
Garage	8	Open/Shared/Natural draught	8
Hall	9	Open/Shared/Fanned draught	9
Kitchen	10	Closed	10
Landing	11	Flueless	11
Living Room/Lounge	12	Unbalanced	12
Shower room	13		

B.1 CENTRAL HEATING BOILERS

B.1.1 BACK BOILER UNIT

Table B.1.1a - Central heating boilers : back boiler unit : Summary fault analysis

number of incidents=7

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	0	High CO/CO_2 ratio	2
Defective flame picture	2	Failed spillage test	2
Linting	3	Overrated	0
Over-pressure	0	Underrated	1
Under-pressure	0	**Terminal**	
Other	0	Down draught	0
Flue		Bad siting	0
Blockage	1	Unapproved design	0
Corrosion	0	Other	2
Flue not to any standard	3	**Ventilation**	
Installation defect	3	Air vent/vents ineffective	0
Other	2	Air vents obstructed - intentionally	0
Heat exchanger		Air vents obstructed - unintentionally	0
Blockage - shale	0	Compartment/cupboard not to any standards	0
Blockage - soot	3	No permanent ventilation provided	1
Cracked	0	Ventilation provided was not to any standard	4
Other	1	**Miscellaneous**	
Safety device		Local topography	0
Failed CO alarm	0	Weather	2
Failed down draught detector	0	Signs of spillage	4
Failed vitiation device	0		

Table B.1.1b - Central heating boilers : back boiler unit : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
LU4	0 (3)		12	Unknown			Glow Worm 45F	5	Boiler needed servicing - producedCO. CO spillage into builders opening of chimney. It entered a bedroom via pipe duct.
PR8	0 (2)	30	12	Unknown	Current. When installed		Glow Worm Capricorn 246N	5	Cause was not established. No CO was detected during build up tests. No sp illage or obvious signs of spillage.
CF5	1 (0)	14	12	CORGI	Current. When installed	Current	Baxi Bermuda 401	5	Not known
S43	5 (0)	6	12	CORGI	Current. When installed	Current	Baxi VP	5	The BBU had been installed to a poured concrete flue liner. A small section of flexible flue liner connected the boiler into the flue, the terminal also had a small section of flexible flue liner connected to it from the top of the flue. The concrete liner had eroded. This caused debris to fall down the flue liner and build up, eventually blocking the flue. Flue products then entered the property & vitiation took place.
NG8	0 (2)	30	12	Unknown			Baxi Bermuda	5	The boiler was spilling low levels of CO into the lounge and with vitiation these levels would have increased. The fire had been removed from the BBU and the flue collection area removed from above the boiler.
TQ1	0 (1)		12	Unknown			Thorn Housewarmer S	5	The BBU was in need of adequate servicing and was producing high levels ofCO. Flueing & ventilation were substandard. Under certain weather conditions spillage was likely to have taken place.
DL17	0 (2)	20	12	Unknown			Glow Worm Galaxy 246N	5	A BBU/fire was in very poor condition & required servicing. It was not installed correctly & flueing & ventilation were substandard. Under certain weather conditions flue reversal was taking place & products of combustion could have entered the propety.

B.1.2 FLOOR STANDING BOILER

Table B.1.2a - Central heating boilers : floor standing boiler : Summary fault analysis

number of incidents=19

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	0	High CO/CO_2 ratio	16
Defective flame picture	14	Failed spillage test	9
Linting	12	Overrated	3
Over-pressure	2	Underrated	4
Under-pressure	1	**Terminal**	
Other	3	Down draught	3
Flue		Bad siting	12
Blockage	1	Unapproved design	1
Corrosion	2	Other	2
Flue not to any standard	13	**Ventilation**	
Installation defect	7	Air vent/vents ineffective	4
Other	0	Air vents obstructed - intentionally	1
Heat exchanger		Air vents obstructed - unintentionally	1
Blockage - shale	6	Compartment/cupboard not to any standards	7
Blockage - soot	8	No permanent ventilation provided	3
Cracked	0	Ventilation provided was not to any standard	11
Other	5	**Miscellaneous**	
Safety device		Local topography	4
Failed CO alarm	1	Weather	11
Failed down draught detector	0	Signs of spillage	9
Failed vitiation device	0		

Table B.1.2bi - Central heating boilers : floor standing boiler : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
WR3	0 (1)	15	0	Unknown	Current	Current	Worcester Delglo 2	5	High readings of CO were found in the flue gases. On the day of the incident wind conditions could have affected the flue performance causing it to downdraught. It is therefore likely that high levels of CO could have leaked back into the property.
G61	0 (1)	33	10	CORGI			Glow Worm 45-60 CF	5	Downdraught caused by severe gales. Lack of a proper service.
PA13	0 (4)	12	6	Unknown	Current		Vaillant VKS 29E	5	The appliance was producing high levels of CO and required servicing.
KA7	0 (4)	12	7	Unknown			Ideal Mexico Super CF80	5	The appliance required servicing and the flue/ventilation were sub-standard.
CF34	0 (1)	15	10	Unknown			Ideal Mexico Super CF55	5	The wall adjacent boiler terminal was fitted against a wall which faced northwest. On the day of the incident the external twin walled flue pipe and terminal was subject to north-westerley winds gusting up to 40mph and a temperature of 2-6 deg.C, with a strong chill factor. Due to a lack of proper servicing this boiler was producing 8000ppm CO. A combination of the above weather conditions, the lack of ventilation and the wall adjacent termination was the likely cause of the CO poisoning.
BH25	0 (6)	38	10	Unknown	Current. when installed		Potterton Diplomat 55/68C	5	The flue terminal was wall adjacent & the appliance had poor combustion performance. Wind against the flue terminal and wall likely to cause flue down draft. Likely that the flue spilt products throughout its life.
ST28	0 (4)	19	0	DIY			Potterton Kingfisher CF60	5	The boiler was installed with a flue system that composed of a short convectional flue terminating in a room sealed natural draught terminal. The combustion was unsatisfactory and on the morning of the incident the flue failed to operate. Gaps in the ceiling allowed CO to pass to the bedrooms above.

Table B.1.2bii - Central heating boilers : floor standing boiler : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
S5	0 (3)	18	9	Unknown			Glow Worm 45-60B	5	The boiler required servicing and was producing high levels of CO. Some products of combustion were spilling from the combustion chamber into the compartment due to the partial restriction of the heat exchanger. It was possible for CO to enter the property and a build up could occur. The flue terminal position and flue configuration could have contributed to periods of downdraught in the flue.
W4	0 (1)		3				Potterton Kingfisher RS50	1	The boiler was producing high levels of CO due to restriction on air inlet duct. Due to misaligned gasket seal the combustion products entered the property. The flue terminal position was sub-standard. The appliance had been labellled as unsafe, but was still in use.
SS15	0 (3)		10	Unknown			Potterton Kingfisher II 60 CF	5	Boiler in poor condition, dirty heat exchanger, poor flame picture. Low level wall adjacent terminal, affected by temperature and still conditions.
RM15	0 (4)	8	9	Unknown	Current. when installed		Potterton Kingfisher II CF	5	Boiler in poor condition, inadequate ventilation and compartment ventilation, metal ridge tile adaptor rusted badly and caused considerable blockage in the flue. Poor flame picture.
SL2	1 (0)		9	Unknown			Potterton Diplomat C40/12	5	Extremely sooty boiler with inadequate ventilation and compartment ventilation.
SM1	0 (4)		6	Unknown		Current	Potterton Diplomat CF50/15	5	Poor condition, high CO. Unsatisfactory flue installation / configuration. Wind affected. Inadequate vent and compartment ventilation. Very small compartment.

Table B.1.2biii - Central heating boilers : floor standing boiler : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
HP12	0 (3)		2	Unknown		Current	Potterton Kingfisher CF55	5	Poor condition, high CO. Unsatisfactory flue installation, wind affected. Short wall adjacent terminal. Appliance installed in a bathroom.
BR6	0 (5)	15	10	Unknown			Potterton Kingfisher CF50	5	Poor condition, inadequate ventilation, very poor condition flue liner, affected by extremely cold still conditions.
W2	0 (1)		0	Unknown	Current		Potterton Kingfisher CF220	7	An open flued boiler on a fan dilution flue system had not been adequately serviced or maintained. Following blockage of the heat exchanger CO contaminated combustion products were discharged into the basement area and then into an adjacent property.
WV3	0 (1)		0	Unknown	Current		Ideal Concord Super 50-300 SER2	8	Corrosion of 3 steel rivets allowed the flue pipe to detach from between the outlet & brick chimney. The flue products then went into the boiler room. Boiler was producing high levels of CO. Previous cable duct work resulted in ducts not being resealed allowing fumes into building.
BB11	0 (2)		5	Unknown		Current	Potterton Kingfisher 45	5	Boiler was producing high levels of CO due to lack of servicing. The flue was substandard & spillage was taking place. Under certain weather conditions the boiler performance was lik ely to deteriorate further with increased spillage.
TQ1	0 (3)		10	Unknown		Current	Glow Worm Hideaway 60	5	Combustion products from boiler were not being adequately removed to outside air by flue system. The flue terminal was not to standard.

B.1.3 FLOOR STANDING COMBI

Table B.1.3a - Central heating boilers : floor standing combi : Summary fault analysis

number of incidents=1

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	0	High CO/CO_2 ratio	1
Defective flame picture	0	Failed spillage test	0
Linting	0	Overrated	1
Over-pressure	1	Underrated	0
Under-pressure	0	**Terminal**	
Other	1	Down draught	0
Flue		Bad siting	0
Blockage	0	Unapproved design	0
Corrosion	0	Other	0
Flue not to any standard	0	**Ventilation**	
Installation defect	1	Air vent/vents ineffective	0
Other	1	Air vents obstructed - intentionally	0
Heat exchanger		Air vents obstructed - unintentionally	0
Blockage - shale	0	Compartment/cupboard not to any standards	1
Blockage - soot	0	No permanent ventilation provided	0
Cracked	0	Ventilation provided was not to any standard	1
Other	0	**Miscellaneous**	
Safety device		Local topography	0
Failed CO alarm	0	Weather	0
Failed down draught detector	0	Signs of spillage	0
Failed vitiation device	0		

Table B.1.3b - Central heating boilers : floor standing combi : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
NE2	0 (2)	4	2	CORGI	Current		IMI Power Max 135 (now RSA Waterheating)	2	Appliance found to be producing high levels of co, section of outlet flue duct disconnected in roof void allowing products of combustion to leak into property.

B.1.4 THERMAL STORAGE UNITS – NO REPORTED INCIDENT

B.1.5 WALL MOUNTED BOILER

Table B.1.5a - Central heating boilers : wall mounted boiler : Summary fault analysis

number of incidents=30

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	0	High CO/CO_2 ratio	24
Defective flame picture	13	Failed spillage test	17
Linting	16	Overrated	4
Over-pressure	2	Underrated	3
Under-pressure	1	**Terminal**	
Other	0	Down draught	7
Flue		Bad siting	9
Blockage	3	Unapproved design	1
Corrosion	3	Other	0
Flue not to any standard	11	**Ventilation**	
Installation defect	12	Air vent/vents ineffective	5
Other	2	Air vents obstructed - intentionally	2
Heat exchanger		Air vents obstructed - unintentionally	2
Blockage - shale	6	Compartment/cupboard not to any standards	8
Blockage - soot	10	No permanent ventilation provided	4
Cracked	0	Ventilation provided was not to any standard	13
Other	7	**Miscellaneous**	
Safety device		Local topography	5
Failed CO alarm	0	Weather	14
Failed down draught detector	1	Signs of spillage	15
Failed vitiation device	0		

Table B.1.5bi - Central heating boilers : wall mounted boiler : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
M74	0 (1)	11	10	Unknown	Current		Thorn Apollo Fanfare 15/30	2	Incident due to corroded fanned flue, the combustion was already unsatisfactory. It appeared that when the incident was simulated the lack of case seal reduced the available oxygen for combustion and the CO levels in the flue gas increased dramatically.
NG7	0 (7)	10		Unknown			Glow Worm Fuelsaver MK2 CF50	5	The gas fired boiler could have provided the source of CO. The inferior flue terminal position coupled with most of the flue being external could have resulted in periods where the flue stalled and or downdraught occurred. Both or either resulting in CO being released into the house. The frequency of occurrance and the duration of such stalling or downdraught would depend on the ambient temperature, strength & direction of the wind.
AB1	0 (2)	12	9	Uknown			Glow Worm Fuel Saver 40 MK2	5	Casualties were overcome by CO fumes and collapsed in the living room.
NE65	0 (1)	20	10	Unknown			Glow Worm Space Saver 45/60	5	The boiler provided a source of CO due to incomplete combustion taking place as a result of a partially restricted heat exchanger from shale/debris. The boiler was in need of servicing. Spillage of products of combustion from the appliance due to flue downdraught conditions led to a build up of CO in the property. The flue was incorrectly configured and terminated with an incorrectly positioned and damaged CG1 terminal. With out-buildings and a banking in close proximity. Compartment ventilation was inadequate and wrongly confirgued with mixed ventilation from outside and inside the property provided to the compartment
SR1	0 (2)	0		Unknown			Thorn Apollo 15/30C	5	Boiler provided source of CO due to incomplete combustion taking place as a result of a restricted heat exchanger and flame impingement. An incorrectly configured open flue system and termination position was subject to down draught conditions. Inadequate combustion/cooling ventilation was provided.
RH11	0 (1)	18	10	Unknown		Current	Ideal Concord, WCF40	5	Incident due to a lack of maintenance. The boiler was producing high levels of CO. The heat exchanger was severely restricted with soot and combustion was spilling into the property from the base of the combustion chamber.
AB2	0 (1)	6	7	Unknown		Current	Thorn Apollo 50C	5	Boiler needed servicing. Flue sub-standard and may have spilled.

Table B.1.5bii - Central heating boilers : wall mounted boiler : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
WA2	0 (3)	10	11	Unknown	Current		Thorn Apollo 15/30C	5	Central heating boiler needed servicing.
FK1	0 (2)		0	Unknown	Current		Glow Worm Fuel Saver Mark2 30R	5	The central heating boiler was producing high levels of CO.
PO39	1 (0)	15	10	Unknown	Current when installed	Current	Thorn Apollo 15/30C	5	Towel placed in flue ways - products of combustion were unable to vent to atmosphere via the flue due to a towel being posisioned within the draft diverter/secondary flue. The towel position also caused poor combustion to exist due to restriction of the primary flue.
AB1	0 (3)		10	Unknown	Current		Glow Worm Fuel Saver Mark2 40CF	5	The central heating boiler was producing high levels of CO.
ST7	0 (2)		10	Unknown	Current		Glow Worm Fuel Saver MK2 50	5	The open flued central heating boiler was producing high levels of CO. Products of combustion were spilling into the atmosphere on the day of the investigation. No ventilation had been provided & no regular maintenance had been undertaken on the boiler.
ST1	0 (4)		10	Unknown			Glow Worm Fuel Saver MK2 50	5	The boiler was producing high levels of CO into the secondary flue. It needed servicing. The flue and ventilation configurations were also incorrect.
B62	0 (3)		9	Unknown			Glow Worm Fuel Saver MK2 40R	5	Boiler produced high levels of CO. Terminal postition sub-standard and under certain weather conditions may have caused spillage. The ventilation was sub-standard. A lack of servicing contributed to incident.

Table B.1.5biii - Central heating boilers : wall mounted boiler : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
TF4	0 (4)		10	Unknown		Current	Glow Worm Fuel Saver MK2 40R	5	The boiler was producing high levels of CO which entered the property due to a soot blocked heat exchanger. It was in need of servicing. The flueing was sub-standard.
SW17	1 (0)		10	Unknown	Current		Myson Apollo 15/30C	1	Boiler in poor condition & producing high levels of CO. The appiance had been modified. It was a room sealed appliance which suffered from pilot outage due to over heating of the high level stat. The case had been removed to keep it alight.
SE10	0 (4)		10	Unknown	Current		Potterton Netaheat 10-16	2	Flue outlet of a fanned, balanced flue boiler blocked by a wasp nest. A distorted back panel allowed products into the room.
NN16	0 (2)		6	Unknown	Current	Current	Myson Apollo 35/50	5	Boiler in poor condition and was producing high levels of CO. Flue performance affected by prevailing wind conditions and the operation of the chimney serving a gas fire.
LU5	0 (4)		10	Unknown			Potterton Prima 60C	5	Boiler in poor condition. Inadequate ventilation and compartment ventilation. Terminal position to standard, but affected by the wind. Spinning type air flow vent extracted air from the room in gusty conditions.
BR7	0 (1)		9	Unknown			Myson Apollo 30CC	5	Poor condition. Inadequate ventilation and compartment ventilation. Flue to standard, but terminal fitted in a wall adjacent position.
SA12	0 (2)	20	9	DIY	Current		Thorn Apollo	5	The boiler was sooted and was producing high levels of CO which entered the property due to flue blockage. The ventilation and flue terminal were substandard
SS0	0 (5)		10	Unknown	Current	Current	Glow Worm Fuel Saver 50R MK2	5	The boiler is thought to have been affected by the weather, with a passive stack & thermal inversion to the property. This resulted in CO entering the property.

Table B.1.5biv - Central heating boilers : wall mounted boiler : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
SW3	0 (6)		10	CORGI	Current	Current	Maxol Micro Turbo 50 MDF	2	High levels of CO were being produced by the boiler as it was overrated. The products entered the property due to a displaced flue joint probably caused during property refurbishment. There was also a lack of purpose provided ventilation and a substandard flue
BN1	0 (3)	23	10	Unknown			Potterton Netaheat 10/16	2	On the day following a boiler service a thermostat capillary tube was found to be trapped in the case seal which allowed products into the property
DN36	0 (2)		10	Unknown	Current		Glow Worm Fuel Saver 40 MK 2	5	The boiler was in need of servicing and was producing high levels of CO. The flue was not clearing all the flue products. The use of a gas fire caused the boiler performance to deteriorate.
B79	0 (4)	14	10	Unknown	Current when installed		Thorn Apollo 15/30B	5	The boiler was producing high levels of CO due to blockage of the heat exchanger. Spillage into the inner case entered the property due to incorrect location of the inner case seal
SS2	0 (5)		9	Unknown	Current	Current	Ideal460 WRS	1	The boiler had a distorted back panel which did not seal fully to the case. It is likely that under certain weather conditions combustion products could leak from the boiler into the rooms atmosphere.
DN16	0 (1)	15	10	Unknown	Current		Glow Worm Fuel Saver 30-40B	1	The front panel had been removed from the boiler and under certain weather conditions combustion may have deteriorated and combustion products entered the property
EH12	1 (0)	11	3	Unknown			Thorn Apollo 40C	5	An open flued boiler installed in a non standard location in a compartment in a bedroom required servicing. It was producing high levels of CO. The ventilation and flueing were substandard. Under certain weather conditions downdraught & spillage into the bedroom would be likely. There was evidence of intermittent spillage.
L20	0 (1)		10	Unknown	Current		Glow Worm Space Saver 38	1	Products of combustion entered the property via the case seals. It is likely that combustion would deteriorate & spillage increase under certain weather conditions.

B.1.6 WALL MOUNTED COMBI BOILER

Table B.1.6a - Central heating boilers : wall mounted combi boiler : Summary fault analysis

number of incidents=18

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	1	High CO/CO_2 ratio	16
Defective flame picture	7	Failed spillage test	9
Linting	9	Overrated	3
Over-pressure	3	Underrated	4
Under-pressure	2	**Terminal**	
Other	2	Down draught	3
Flue		Bad siting	8
Blockage	1	Unapproved design	0
Corrosion	0	Other	1
Flue not to any standard	15	**Ventilation**	
Installation defect	12	Air vent/vents ineffective	5
Other	0	Air vents obstructed - intentionally	3
Heat exchanger		Air vents obstructed - unintentionally	1
Blockage - shale	1	Compartment/cupboard not to any standards	8
Blockage - soot	6	No permanent ventilation provided	3
Cracked	0	Ventilation provided was not to any standard	13
Other	8	**Miscellaneous**	
Safety device		Local topography	1
Failed CO alarm	1	Weather	10
Failed down draught detector	0	Signs of spillage	11
Failed vitiation device	0		

Table B.1.6bi - Central heating boilers : wall mounted combi boiler : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
LA9	0 (2)		10	Unknown			Vaillant VCW GB 280H	5	Spillage was likely to have been caused by the undersized terminal restricting the flow of products of combustion.
G77	0 (5)	12	10	Unknown			Vokera 20-80CF Flowmatic	5	The appliance required servicing and the flue/ventilation were sub-standard.
SW11	0 (2)		2	Unknown			Vokera 18-72 DMCF	5	The cause of the incident was an opened flue combination boiler installed in a bathroom in the flat below. The boiler was producing high levels of CO which travelled up the cavity of the property to the flat above. Contributing factors were a wall faced terminal and a partially blocked flue.
TS6	0 (2)	8	10	Unknown			Saunier Duval SD223C	5	The gas fired boiler provided the source of carbon monoxide.
BL3	0 (3)	14	10	Unknown			Vaillant VCW 20/IT3WH	5	The boiler was producing CO & spilling products of combustion into the property. The flu was incorrectly installed and terminated. There was no combustion ventilation provided. The boiler required servicing.
KA3	0 (2)		7	Unknown			Vaillant VCW 25/1 T3WH	5	Blockage of the heat exchanger and debris on the burner caused the appliance to produce high levels of CO in its flue gases. The flue was short and had incorrect terminal position making the flue likely to be subject to downdraught.
B43	0 (2)	8	10	Unknown	Current		Ferroli 76CF	5	The open flued combination boiler was producing high levels of CO. The heat exchanger showed signs of sooting. The burner injector and burner gauze were heavily linted. It was possible that the flue was not efficient in removing the products of combustion to the atmosphere safely.
SA7	0 (4)		10	Unknown			Vaillant VCW G3 240 OF	5	The boiler gas valve operator was functioning incorrectly due to a kink in a flexible section of the negative pressure control line between the gas valve operator and diaphragm pump. This caused boiler to fire at a high burner pressure and at high heat input.
LE2	0 (1)	8	10	Unknown	Current	Current	Ferroli 77CF	5	Wind may have led to down draught taking place from boiler even though flue met the appropriate B.S.. appliance required servicing as combustion deteriorated with use.

Table B.1.6bii - Central heating boilers : wall mounted combi boiler : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
N14	0 (3)		10	Unknown			Vaillant VCW 20/1 T3 WH	5	Boiler in poor condition, inadequate ventilation and compartment ventilation, terminal position was wall adjacent and short. The flue was run horizonatlly in a void and dipped downwards.
N13	0 (2)		0	Unknown			Vaillant VCW 20/1 T3 WH	5	Boiler in poor condition. Heat exchanger dirty. Restriction in heat exchanger allowed products to spill from the base of the heat exchanger. Poor flame picture, flue not to standard & ventilation inadequate.
E17	0 (3)		10	Unknown		Current	Vaillant VCW GB 240H	5	Boiler in poor condition & producing high CO. It was badly over-rated flue poorly positioned & weather sensitive.
SE18	0 (5)		10	Unknown			Vaillant VCW T3W CF	5	Boiler in poor condition & producing high CO. Poor, short, wall adjacent flue. Inadequate ventilation.
DY8	0 (2)	9	10	Unknown			Ferroli 77CF	5	The flue products contained CO due to a need for servicing. Both flueing & ventilation were substandard.
SN1	0 (1)	16	9	Unknown			Vaillant VCW 20/1 T3 WH	5	The flue products contained a high level of CO due to a need for servicing. The flueing and ventilation were substandard. It is likely that under certain weather conditions spillage was taking place.
S75	0 (4)	6	9	Unknown			Vaillant Compact VCW GB 240H	5	The boiler was producing high levels of CO due to a need for servicing. The ventilation and flue were substandard and under certain weather conditions spillage may have taken place.
TW3	1 (0)	7	2	Unknown			Vaillant VC/ VCW GB 240	5	The boiler was in need of servicing & was producing high levels of CO. It had been incorrectly installed in a bathroom. Flueing & ventilation were substandard. Spillage was taking place. The flue system may have increased the poor performance & spillage under certain weather conditions.
BB1	0 (2)	2	11	Unknown			Worcester 9.24 Electronic OF	5	The boiler flue was substandard & high levels of CO were being produced due to linting. Spillage was taking place & signs showed this to be a regular occurence.

B.1.7 WARM AIR UNIT

Table B.1.7a - Central heating boilers : warm air unit : Summary fault analysis

number of incidents=3

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	0	High CO/CO_2 ratio	0
Defective flame picture	1	Failed spillage test	2
Linting	0	Overrated	0
Over-pressure	0	Underrated	1
Under-pressure	0	**Terminal**	
Other	0	Down draught	0
Flue		Bad siting	1
Blockage	0	Unapproved design	0
Corrosion	0	Other	0
Flue not to any standard	2	**Ventilation**	
Installation defect	1	Air vent/vents ineffective	0
Other	0	Air vents obstructed - intentionally	0
Heat exchanger		Air vents obstructed - unintentionally	0
Blockage - shale	0	Compartment/cupboard not to any standards	1
Blockage - soot	0	No permanent ventilation provided	1
Cracked	2	Ventilation provided was not to any standard	1
Other	0	**Miscellaneous**	
Safety device		Local topography	0
Failed CO alarm	0	Weather	0
Failed down draught detector	0	Signs of spillage	0
Failed vitiation device	0		

Table B.1.7b - Central heating boilers : warm air unit : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
WD3	0 (4)	27	10	Unknown			McClary 40/60D	5	It was not possible to conclusively identify cause. Suspect it was due to a cracked heat exchanger on the warm air unit.
ST2	1 (0)	30	10	Unknown	Current		Crane Heatinaire G23/4TC	5	The warm air unit was producing high levels of CO. It had holes in the heat exchanger which allowed the CO to be dispersed within the property. The circulator was also found to be spilling CO. Flue termination to this appliance was sub-standard and the flue was not efficient in removing products of combustion to the outside atmosphere. The warm air unit was the main contributor to the incident.
KY6	1 (1)	9	10	CORGI		Current	Johnson & Starley JT 19-25 MK2 MAF	5	The blanking plates of the unused plenum openings of a warm air unit had not been correctly sealed. This caused air movement within the compartment, around the appliance and its flue. This led to high levels of CO being produced which was circulated with the heating air to the property.

B.2 COOKERS

B.2.1 FREE STANDING

Table B.2.1a - Cookers : free standing : Summary fault analysis

number of incidents=6

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	0	High CO/CO_2 ratio	3
Defective flame picture	4	Failed spillage test	0
Linting	1	Overrated	0
Over-pressure	0	Underrated	0
Under-pressure	0	**Terminal**	
Other	4	Down draught	0
Flue		Bad siting	0
Blockage	0	Unapproved design	0
Corrosion	0	Other	0
Flue not to any standard	1	**Ventilation**	
Installation defect	0	Air vent/vents ineffective	0
Other	0	Air vents obstructed - intentionally	0
Heat exchanger		Air vents obstructed - unintentionally	0
Blockage - shale	0	Compartment/cupboard not to any standards	0
Blockage - soot	0	No permanent ventilation provided	0
Cracked	0	Ventilation provided was not to any standard	0
Other	0	**Miscellaneous**	
Safety device		Local topography	0
Failed CO alarm	0	Weather	0
Failed down draught detector	0	Signs of spillage	0
Failed vitiation device	0		

Table B.2.1b - Cookers : free standing : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
BH5	0 (2)		10	Unknown			New World NW 35A	11	The grill on the cooker was in a poor state of adjustment. Flame contact with the grill fret caused high levels of CO to be produced when the grill was in operation. The grill was being used to heat the holiday flatlet. The grill was able to produce in excess of 2000ppm of CO. The cooker was producing high levels of CO and was in a dangerous condition.
PL25	1 (0)		10	Unknown			New World Nova	11	A fire resulted whilst cooking sausages under the grill. This led to the production of fatally high levels of CO.
S3	0 (5)	5	10	Unknown			Leisure 50	11	The cooker's grill was producing CO which activated a CO alarm fitted in the lounge. The high levels of CO were due to flame impingement onto a distorted grill fret.
UB6	1 (0)		10	Unknown			Main Mayflower	11	A cooker grill was producing low levels of CO. The grill was in poor condition and was also distorted.
NE3	1 (0)	30	10	Unknown			Cannon A134	11	The cooker grill was producing high levels of CO and may have been left operating for an extended period of time.
OL10	1 (0)		10	Unknown			Valor Corvette 11	11	A cooker grill was producing high levels of CO. It had a number of defects and was in need of servicing.

B.2.2 BUILT-IN OVEN – NO REPORTED INCIDENT

B.2.3 BUILT-IN HOB – NO REPORTED INCIDENT

B.3 SPACE HEATERS

B.3.1 BALANCED FLUE GAS FIRE – NO REPORTED INCIDENT

B.3.2 CABINET HEATER – NO REPORTED INCIDENT

Table B.3.3a - Space heaters : decorative gas fire : Summary fault analysis

number of incidents=2

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	0	High CO/CO_2 ratio	2
Defective flame picture	0	Failed spillage test	0
Linting	1	Overrated	0
Over-pressure	0	Underrated	0
Under-pressure	0	**Terminal**	
Other	0	Down draught	1
Flue		Bad siting	0
Blockage	0	Unapproved design	0
Corrosion	0	Other	0
Flue not to any standard	1	**Ventilation**	
Installation defect	1	Air vent/vents ineffective	0
Other	0	Air vents obstructed - intentionally	0
Heat exchanger		Air vents obstructed - unintentionally	0
Blockage - shale	0	Compartment/cupboard not to any standards	0
Blockage - soot	0	No permanent ventilation provided	0
Cracked	0	Ventilation provided was not to any standard	0
Other	0	**Miscellaneous**	
Safety device		Local topography	0
Failed CO alarm	0	Weather	1
Failed down draught detector	0	Signs of spillage	1
Failed vitiation device	0		

Table B.3.3b - Space heaters : decorative gas fire : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
NE27	0 (1)	2	12	CORGI	Current	Current	Verine Verifire VF 3/16 NG	5	The combustion products contained high amounts of CO due to the type and design of the fire. High winds at the time of the incident may have caused intermittent downdraught.
B45	0 (1)	2	12	CORGI			Flavel Emerglow Classic	5	The gas fire needed servicing and was producing high levels of CO. The flue termination was substandard and under certain weather conditions CO may have entered the property.

B.3.3 FLUELESS HEATER – NO REPORTED INCIDENT

B.3.4 INSET LIVE FUEL EFFECT GAS FIRE – NO REPORTED INCIDENT

B.3.5 RADIANT AND RADIANT CONVECTOR GAS FIRE

Table B.3.6a - Space heaters : radiant and radiant convector gas fire : Summary fault analysis

number of incidents=17

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	1	High CO/CO_2 ratio	5
Defective flame picture	3	Failed spillage test	11
Linting	10	Overrated	3
Over-pressure	3	Underrated	1
Under-pressure	1	**Terminal**	
Other	0	Down draught	1
Flue		Bad siting	0
Blockage	11	Unapproved design	1
Corrosion	1	Other	0
Flue not to any standard	4	**Ventilation**	
Installation defect	4	Air vent/vents ineffective	0
Other	0	Air vents obstructed - intentionally	0
Heat exchanger		Air vents obstructed - unintentionally	0
Blockage - shale	0	Compartment/cupboard not to any standards	0
Blockage - soot	0	No permanent ventilation provided	0
Cracked	1	Ventilation provided was not to any standard	0
Other	3	**Miscellaneous**	
Safety device		Local topography	0
Failed CO alarm	0	Weather	3
Failed down draught detector	0	Signs of spillage	10
Failed vitiation device	0		

Table B.3.6bi - Space heaters : radiant and radiant convector gas fire : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
LS27	0 (1)	20	12	Unknown			Main Sheraton	5	The fire created the source of carbon monoxide. The masonary flue was totally blocked at its base, therefore all the products of combustion were issueing back into the room.
BB3	0 (4)		12	Unknown	Current		Main (Parkinson Cowan) Fireflame Delux	5	The fire failed a spillage test due to the coals being out of position. Coal no. 8 was upside down. The fire passed a spillage test when the flue spigot restrictor was removed and the coals were reset. The fire was fitted to a brick chimney.
LL13	1 (0)		12	DIY			Glow Worm High Speed G5	5	Blocked flue.
AB21	0 (1)	14	12	CORGI	Current		Glow Worm Flickerflame OF	5	Leakage of fumes from glass rope seal at the rhs of glass panel. Deformed firebox due to constant use of the fire.
WF17	1 (0)	20	12	Unknown	Current when installed		Robinson Willey Firegem Visa	5	The fire created CO due to the masonary flue being completely blocked at its base. All the products of combustion were issueing back into the room.
SK13	0 (1)	24	12	Unknown	Current		New World HGS740	5	Soot and debris had blocked the brick chimney and catchment space.
L49	1 (0)		12	Unknown	Current		Baxi Belmont	5	Incorrectly positioned radiants causing flame impingement and restricting the flue passage.
L69	0 (1)		12	Unknown	Current		Flavel Windsor	5	Fire needed servicing, flue partially blocked.

Table B.3.6bii - Space heaters : radiant and radiant convector gas fire : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
SK3	0 (2)	0	12	CORGI			Potterton Brava 2	5	Weather/wind conditions over chimney stack, incorrect seal on closure plate.
WV2	0 (1)	6	12	Unknown			Valor Sunfire	5	The gas fire was producing high levels of CO due to radiants not being located correctly. The flue was blocked and during the test high levels of CO were able to build up in the lounge atmosphere.
N20	0 (1)		12	Unknown	Current		Valor Homeflame	5	Fire in poor condition and poorly installed. Combustion products leaked into the room through a missing seal around the glass. Poor combustion exacerbated by misplaced log effect.
SE4	0 (3)		3	Unknown			Valor Majestic	5	Fire fitted to a blocked flue.
NW2	1 (0)		4	DIY			Valor Copperglow	0	Fire fitted with no flue.
BD5	0 (1)	4	12	Unknown	Current		Valor New Firelite	5	High levels of CO were being produced by the appliance due to a lack of servicing. The poor weather may have led to spillage
CT9	1 (0)		12	Unknown	Current		Main Windsor	5	Fire was producing high levels of CO due to a lack of maintainance. The chimney was blocked by soot & flue debris causing flue products to enter the property
	0 (1)	33					Icebreaker K14T		Flue blockage resulted due to injection of cavity wall insulation material. The fire produced low levels of CO when on full setting which discharged into the property.

B.3.6 WALL HEATER – NO REPORTED INCIDENT

B.4 DRYERS

B.4.1 TUMBLE DRYERS – NO REPORTED INCIDENT

B.5 WATER HEATERS

B.5.1 BULK STORAGE – NO REPORTED INCIDENT

B.5.2 CIRCULATOR

Table B.5.2a - Water heaters : circulator : Summary fault analysis

number of incidents=1

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	0	High CO/CO_2 ratio	1
Defective flame picture	0	Failed spillage test	0
Linting	0	Overrated	0
Over-pressure	0	Underrated	0
Under-pressure	0	**Terminal**	
Other	1	Down draught	0
Flue		Bad siting	0
Blockage	0	Unapproved design	0
Corrosion	0	Other	0
Flue not to any standard	0	**Ventilation**	
Installation defect	0	Air vent/vents ineffective	0
Other	0	Air vents obstructed - intentionally	0
Heat exchanger		Air vents obstructed - unintentionally	0
Blockage - shale	1	Compartment/cupboard not to any standards	0
Blockage - soot	0	No permanent ventilation provided	0
Cracked	0	Ventilation provided was not to any standard	0
Other	0	**Miscellaneous**	
Safety device		Local topography	0
Failed CO alarm	0	Weather	1
Failed down draught detector	0	Signs of spillage	1
Failed vitiation device	0		

Table B.5.2b - Water heaters : circulator : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
TS4	0 (3)	0	9	CORGI	Current	Current	Johnson & Starley Janus Hijan 3	8	The circulator was producing high levels of CO due to blockage of the heat exchanger. Severe wind conditions may have led to spillage. Although the appliance had been checked, following complaints & faults, it did not appear to have been properly serviced.

B.5.3 MULTI-POINT – NO REPORTED INCIDENT

B.5.4 SINGLE-POINT

Table B.5.4a - Water heaters : single-point : Summary fault analysis

number of incidents=2

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	0	High CO/CO_2 ratio	2
Defective flame picture	2	Failed spillage test	0
Linting	2	Overrated	1
Over-pressure	1	Underrated	0
Under-pressure	0	**Terminal**	
Other	0	Down draught	0
Flue		Bad siting	0
Blockage	0	Unapproved design	0
Corrosion	0	Other	0
Flue not to any standard	0	**Ventilation**	
Installation defect	0	Air vent/vents ineffective	1
Other	0	Air vents obstructed - intentionally	0
Heat exchanger		Air vents obstructed - unintentionally	1
Blockage - shale	0	Compartment/cupboard not to any standards	0
Blockage - soot	2	No permanent ventilation provided	0
Cracked	0	Ventilation provided was not to any standard	0
Other	2	**Miscellaneous**	
Safety device		Local topography	0
Failed CO alarm	0	Weather	0
Failed down draught detector	0	Signs of spillage	0
Failed vitiation device	0		

Table B. 5.4b - Water heaters : single-point : incident summary

Post Code	Number of casualties: fatal (non-fatal)	Appliance age (yrs)	Appliance location	Installer	Flue to standards	Ventilation to standards	Appliance make & model	Flue type	Fault
BL1	0 (4)	8	10	CORGI	Current		Vaillant MAG 125/7	11	Poor state of service. Heat exchanger, pilot & burner required cleaning.
CR0	1 (0)	15	2	Unknown	Current when installed	Current	Main Mitre	11	The water heater was in poor condition and was producing high levels of CO into the bathroom.

APPENDIX C DETAILS OF LPG INCIDENTS THAT TOOK PLACE DURING 1998/99, AND AN ANALYSIS OF THE DATA.

There were three LPG incidents reported using the DIDR Form 551/7 during the period 1998/99. Two of these incidents occurred in static caravans (incidents A & B) which were located at caravan parks and the other incident (C) occurred in a small hotel/inn.

The incidents happened at different times of the year. The caravan incidents occurred in July and August. The commercial premises incident occurred in November.

In all of the incidents there were relatively large numbers of casualties compared to those summarised earlier in this report. In one caravan incident there was a total of six non-fatal casualties and in the other there were eight non-fatal casualties. Ages of the casualties ranged from 1 year to 52 years old and there were no fatalities in either of these two caravan incidents. The commercial incident was a fatal incident with 2 deaths and 6 non-fatal casualties and the victims ages were between 26 and 30 years old. Details of these incidents and casualties are given in Table C1.

Table C1 - The number of CO incidents and casualties

Incident	Post code	Appliance involved	Number of fatal casualties	Number of non-fatal casualties			
				N1	N2	N3	N4
A	DD11	Multi-point water heater	0	0	6	0	0
B	PE25	Rad & rad conv gas fire	0	0	8	0	0
C	SY95	Floor standing boiler	2	2	0	4	0

Both caravans were tenanted properties and in incident 'C' the property was owner occupied. At incident A the appliance was installed in a compartment/cupboard and it failed the flue flow and continuity check. The appliances involved were positioned in a room in the other two incidents. In incident 'A' a battery powered CO detector had been installed in the kitchen of the caravan and was subsequently found to be operational.

Details of the appliance and casualty locations are given in Table C2.

Table C2 - Appliance and casualty locations.

Incident	Appliance location	Casualty locations	Flue type
A	Hall	Unknown	5
B	Lounge	Bedroom & lounge	10
C	Laundry store room	Bedroom	5

Note: Flue Type codes are given at the start of Appendix B

Details of the incident appliance make and model are given in Table C3.

Table C3 – Appliance and standards details.

Incident	Appliance make & model	Appliance age (years)	Installer	Appliance installed To Standards	Flue To Standards	Ventilation To Standards
A	Poloma PH-5-3f	9	Unknown	Current	No	No
B	Stoves Newholmes Clipper l	15	Unknown	Current	Current	Current
C	Stelrad Mexico Super CF 125	15	Unknown	Current	No	No

The following faults and causes were reported at each incident :

Incident A – There was a fault with the flue, which was the established cause of the incident. There had been work carried out on the flue between 6 and 12 months before the incident.

Incident B – There was a fault with the appliance burner and it was also corroded. There was also sub-standard servicing on the appliance. It had been the subject of a safety check/inspection within 6 months of the incident.

Incident C – The report was not conclusive as to the cause, but it was identified that there were flue installation faults, the terminal position was poor and the weather may have been a contributing factor in producing downdraught. Vitiation, in the small room in which the boiler was located and which had undersized ventilation, could have led to high levels of CO production. The ceiling was not fully sealed and was identified as a route to the rooms where the casualties were located.

The following details in Table C4 give the total numbers of faults found at the installations involved.

Table C4 - Incident appliance faults

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	1	High CO/CO_2 ratio	1
Defective flame picture	0	Failed spillage test	1
Linting	0	Overrated	0
Over-pressure	0	Underrated	0
Under-pressure	1	**Terminal**	
Other	1	Down draught	1
Flue		Bad siting	1
Blockage	0	Unapproved design	0
Corrosion	0	Other	0
Flue not to any standard	2	**Ventilation**	
Installation defect	2	Air vent/vents ineffective	1
Other	0	Air vents obstructed - intentionally	0
Heat exchanger		Air vents obstructed - unintentionally	0
Blockage - shale	0	Compartment/cupboard not to any standards	1
Blockage - soot	0	No permanent ventilation provided	0
Cracked	0	Ventilation provided was not to any standard	2
Other	0	**Miscellaneous**	
Safety device		Local topography	0
Failed CO alarm	0	Weather	1
Failed down draught detector	0	Signs of spillage	3
Failed vitiation device	0		

APPENDIX D DETAILS OF NON-DOMESTIC CO INCIDENTS THAT TOOK PLACE DURING 1998/99, AND AN ANALYSIS OF THE DATA.

During the reporting year 1998/99 there were 4 CO incidents reported using the DIDR form that involved piped natural gas within business properties. Incident A occurred in an office, incident B in a shop, incident C at a commercial premise and the remaining incident took place in a pub. Incident D was caused by fumes from a boiler installation supplying the flat above the pub. The appliance was located in a compartment at the bottom of the stairway.

Incident A occurred in July 1998, B during December and C and D in February 1999. Details of these incidents and the resulting casualties are given in Table D1 below. It can be seen that in each incident there was only one casualty who required treatment for less than 24 hours in hospital. Property A was tenanted, single occupancy and council owned. The building was built pre 1945. In incident B the premises were built in 1956. No details regarding the property were given for incident C. Property D was an owner occupied property, built pre 1945, and consisted of a flat above a pub.

Table D1 – The number of CO incidents and casualties

Incident	Post code	Appliance involved	Number of fatal casualties	Number of non-fatal casualties			
				N1	N2	N3	N4
A	G69	Floor standing boiler	0	0	1	0	0
B	LS17	Floor standing boiler	0	0	0	0	1
C	WR1	Boiler	0	0	1	0	0
D	KY1	Wall mounted combi	0	0	1	0	0

In both Incidents A & B the incident appliance was located in a room and the casualties were in the same property. In incident D the appliance was fitted in a compartment, with inadequate labels, at the bottom of a stairway and the casualty was located in the bar of the pub. None of the appliances in these three incidents were fitted with any safety devices and no CO alarms were installed.

Details of the appliance and casualty locations are given in Table D2.

Table D2 - Appliance and casualty locations.

Incident	Appliance location	Casualty locations	Flue type
A	Kitchen	Office	1
B	Cellar	First floor office	5
C	Cellar	Unknown	Unknown
D	Bottom of stairs	Public bar	5

Note: Flue Type codes are given at the start of Appendix B

In Incidents A and D, CO was shown to be able to enter the incident property when the appliance was tested in situ. Neither appliance was covered by a regular service contract.

Details of the incident appliance make and model are given in Table D3.

Table D3 – Appliance and Standards details

Incident	Appliance make & model	Appliance age (years)	Installer	Appliance installed To Standards	Flue To Standards	Ventilation To Standards
A	Ideal E Type RS60	Unknown	Unknown	Yes	Unsure/ Don't know	Not required
B	Potterton C70/21BE	24	Unknown		Current when installed	Not required
C	Unknown		Unknown			
D	Vokera Mynute CF 24-96 Flowmatic	Unknown	CORGI	Yes	No	No

The following faults and causes were reported at each incident :

Incident A - the Ideal boiler had a blocked heat exchanger, corrosion on the burner and other defects. It was producing high levels of CO and was in need of servicing.

The appliance involved in incident B was a Potterton C70/21BE floor standing boiler and had been installed 24 years before the incident. It was found to produce high levels of CO and failed a spillage test. The appliance was in poor condition and had a blockage in the heat exchanger. There was a lack of ventilation to the appliance and it also had a long exposed flue. The weather was thought to have contributed to the incident. It was reported to have been serviced between 1 and 2 years before the incident, by a CORGI registered fitter.

In incident C there were no details given relating to the appliance. The reason for the incident occurring was given as flue blockage caused by a birds nest. No on-site investigation was carried out as the blockage was removed before access could be arranged.

In incident D the flueing and ventilation were substandard and the appliance was in need of servicing. It was also over-rated and failed a spillage test. The heat exchanger was blocked and evidence of downdraughting was found. The weather and local topography were also considered to have contributed to the poor performance of the appliance. It was reported to have been serviced less than six months before the incident by a CORGI registered engineer.

The following details in Table D4 are for all business incidents and give the total numbers of faults found at the installations involved.

Table D4 – Incident appliance faults

Fault group	Number of faults	Fault group	Number of faults
Burner		**Incident testing**	
Corrosion	2	High CO/CO_2 ratio	2
Defective flame picture	2	Failed spillage test	2
Linting	2	Overrated	1
Over-pressure	1	Underrated	0
Under-pressure	0	**Terminal**	
Other	0	Down draught	1
Flue		Bad siting	2
Blockage	1	Unapproved design	0
Corrosion	0	Other	0
Flue not to any standard	1	**Ventilation**	
Installation defect	0	Air vent/vents ineffective	1
Other		Air vents obstructed - intentionally	0
Heat exchanger		Air vents obstructed - unintentionally	0
Blockage - shale	2	Compartment/cupboard not to any standards	1
Blockage - soot	2	No permanent ventilation provided	0
Cracked	0	Ventilation provided was not to any standard	1
Other	2	**Miscellaneous**	
Safety device		Local topography	1
Failed CO alarm	0	Weather	2
Failed down draught detector	0	Signs of spillage	3
Failed vitiation device	0		

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