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A review of carbon monoxide incident information, for 2004/05, 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**
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RR542
Research Report

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A review of carbon monoxide incident information, for 2004/05, 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 as a continuation of the work established during the Joint Industry Programme (JIP) Addressing Carbon Monoxide Issues, within the Incident Data project area. The aim of this work 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 the JIP project a national data collection scheme for piped natural gas and LPG Carbon Monoxide (CO) incidents, which occur within Great Britain, was established by Advantica. This was with the support of the HSE and the gas industry. This report provides information collected via the national data collection scheme.

This is the ninth report of a series that has been published since its first report for 1996/97, and covers the financial reporting period 2004/05. The incidents are only described by postcode to ensure anonymity. During this period details of 27 domestic piped natural gas incidents were submitted to Advantica and constitute the main part of the report. Details of an LPG incident, an incident in commercial premises, and 1 domestic incident not included in the previous year's report are presented in appendices.

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EXECUTIVE SUMMARY

This report has been written by Advantica as a continuation of the work established during the Joint Industry Programme (JIP), Addressing Carbon Monoxide (CO) Issues, within the Incident Data project area. It covers the period 2004/05. The aim of this work 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 the JIP project, a national data collection scheme for CO incidents, arising from the use of piped natural gas and LPG which occur within Great Britain, was established by Advantica. This was with the support of the HSE and the gas industry. This report provides information collected via the national data collection scheme and analysed by Advantica.

This is the ninth report of a series that commenced with the publication of its first report for incidents that occurred in 1996/97, and it covers the financial reporting period 2004/05. The incidents are only described by postcode to ensure anonymity. For the period covered, details of 27 domestic piped natural gas incidents were submitted to Advantica, and analysis of this data constitutes the main part of the report. Details of an LPG incident, an incident in leisure area of commercial premises related to use of natural gas, and 1 domestic natural gas incident submitted too late for inclusion in the previous report are included in appendices of the report.

The results of the 27 natural gas incidents in the main part of the report are summarised below: -

The number of domestic related CO poisoning deaths reported, at 7 during 2004/05, was the lowest recorded since the DIDR system was introduced in 1996/97.

The over-all FPPY figure of 0.15×10^{-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. This was also the lowest value recorded since the DIDR system was introduced in 1996/97.

A single incident involving a multi-point water heater resulting in 1 fatality puts this appliance type well above the HSE's criteria for the tolerability of risk (2.66×10^{-6}).

In variation with previous years, the proportion of incidents were almost evenly split between owner occupied and tenanted properties.

Terraced properties had a higher propensity for incidents than other property styles.

The most common room location for casualties was the living room/lounge followed by the bedroom.

The majority of CO incidents involved appliances fitted with open, individual, natural draught flues.

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

The most common incident causes were a lack of servicing and ventilation faults.

Flue and ventilation faults were concurrent in many domestic incidents.

There was 1 LPG incident reported during 2004/05 giving rise to a single fatality.

1 INTRODUCTION

This report covers accidental CO poisoning incidents resulting from the use of piped natural gas for the period 1st April 2004 to 31st March 2005. The information, commencing with the same periods from 1996/97 onwards, is obtained via the DIDR (Downstream Incident Data Report, Form 551/7) form. The information gathering process relies on a DIDR to be completed for each reportable CO incident, by investigators working on behalf of gas suppliers, and sent to Advantica. If any additional reports should be received after publication of this report they will be included in updated annual statistical tables within future reports. It should be noted that suspected intentional incidents have not been included in this report.

The information provided in the DIDR forms is analysed and presented in this report. Tables and plots are given of actual fatalities and incidents. Also plots related to the risk associated with the use of 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 provided. The definitions and use of FPPY, IPPY and CPPY values are described in Appendix A. Fatality, casualty and incident trend data are also presented within this report for incidents that occurred from 1996/97 to 2004/05. Appendix B gives details for 2004/05, within appliance groups, of each of the CO poisoning incidents.

Domestic incidents are covered within the main body of this report, whilst details of an LPG incident and an incident arising from the use of a modular natural gas boiler in a hotel are given in Appendices C and D respectively. Appendix E presents details of a domestic natural gas incident that could not be included in the previous report due to late submission of information. Appendix F contains data collected for this report on the age profiles of piped natural gas appliances used within Great Britain.

Some inconsistencies may appear within some parts of the report because all of the required information may not have been completed on the DIDR forms. Some information was completed as “unknown” or “other” and in some instances the tick box was not completed (field empty).

The order used in this report follows the layout used in the DIDR - Form 551/7. The form scrutinises each installation under 3 sections with the following headings:

- The incident appliance
- The appliance flue
- The permanent ventilation provisions

Each of these three items is dealt with separately on the DIDR form and within this report. Each item listed could be installed: to current standards, to standards current at the time of installation, not to any appropriate standards or unsure/don’t know. For the “incident appliance”, elements that are standards-related for the installation include the correct room/location, proximity to walls, fire resistance and electrical safety.

2 ANALYSIS OF REPORTED DATA

2.1 INCIDENT DETAILS - ANALYSIS OF SECTION 1 OF DIDR

Transco issued 167 Incident Notification Forms during the reporting period. These gave details of suspected CO Poisoning Reports under their internal reporting procedures.

There were 27 domestic incidents that were reported on DIDR forms that met the criteria for inclusion in the processing of data for the 12 months under examination, and this data constitutes the main section of this report. The majority of these were notified directly to Transco as part of 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 were not 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 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 have been combined with the casualty details and are described within 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 2004 to March 2005.

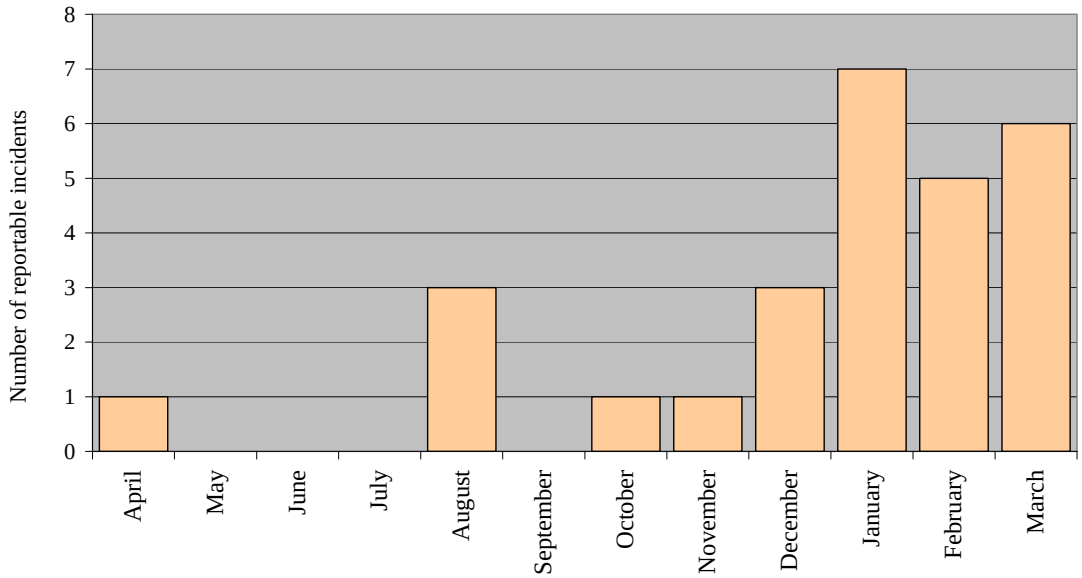

Figure 1 - Profile of monthly incident occurrences over the period

Figure 2 gives the number of reported domestic occurrences of CO incidents and CO casualties that were incurred during the year 2004/05. Further information on casualty groups is given within the notes to Table 1, in section 2.2 of this report.

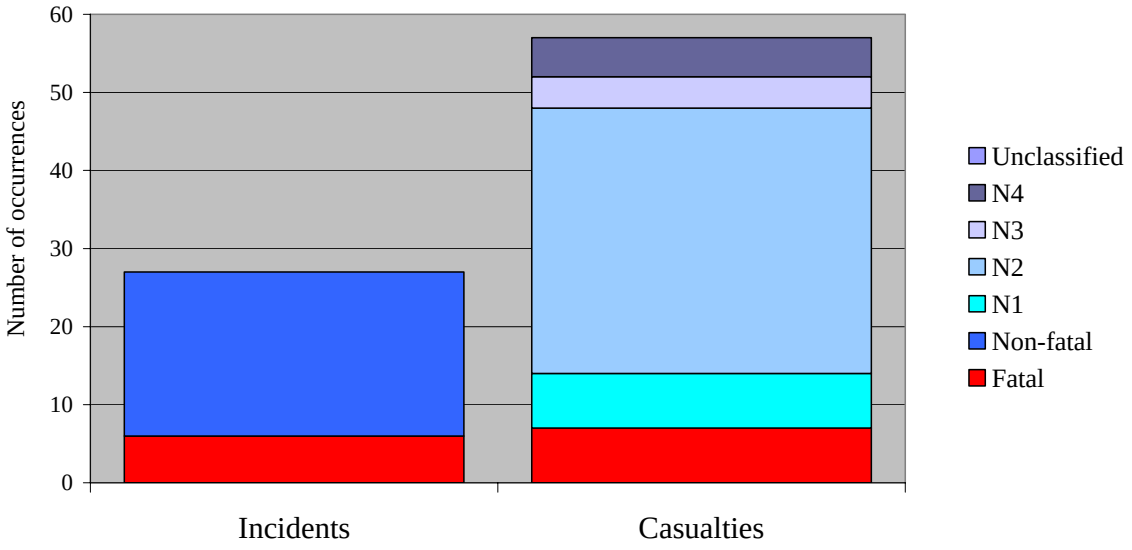

Figure 2 - Incident analysis

Details of an LPG incident that occurred during the reporting period are given in Appendix C and details of a non-domestic incident are given in Appendix D. There was 1 fatality in the LPG incident and only non-fatal casualties in the non-domestic. Since the issue of the 2003/04 report a DIDR form for a domestic natural gas incident in the time period covered in it has been received. Details from this are presented in Appendix E of the report and statistics for 2003/04 in Table 3 and Figure 4 have been updated to include information provided.

2.2 CASUALTY DETAILS - ANALYSIS OF SECTION 2 OF DIDR

The total number of people reported by the DIDR system to have been injured in domestic CO poisoning incidents, associated with use of piped natural gas within the defined reporting period 2004/05, is presented below in Table 1.

Table 1 - Classification of non-fatal casualties

Classification	***N1***	***N2***	***N3***	***N4***	***Total***
Number of casualties	7	34	4	5	50

Notes to Table 1:
The classifications N1 to N4, as used on the DIDR form, are:-

N1 - requiring immediate hospitalisation for more than 24 hours
N2 - requiring immediate hospitalisation for less than 24 hours, and/or hospital tests
N3 - requiring other medical treatment (e.g. GP or Paramedic)
N4 - receiving no medical treatment (e.g. treatment refused)

Figure 2, in section 2.1, shows the number of occurrences of incidents and casualties that took place during the year. Using this information 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 that are embraced for compilation of the main section of this report.

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 non-fatal casualties*	*Over-all IPPY ($x10^{-6}$)*	*Over-all FPPY ($x10^{-6}$)*	*Over-all CPPY ($x10^{-6}$)*
27	7	50	0.57	0.15	1.05

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 2004/05 = 20.83 million - see section 7.1.2.

b) The average number of people per household in Great Britain for 2004/05 = 2.29 - see section 7.1.3.

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 and Figure 4 have been updated to include the 3 non-fatal casualties arising in the 2003/04 incident outlined in Appendix E.

Table 3 – Yearly Trend data

Trend category	*Reporting year*			
	96/97	*97/98*	*98/99*	*99/00*
Total number of deaths (A)	23	22	24	24
FPPY (B)	0.50	0.48	0.51	0.53
Total non-fatal casualties (C)	132	208	248	132
CPPY (D)	2.87	4.57	5.28	2.92
Total number of incidents (E)	70	89	112	64
IPPY (F)	1.52	1.95	2.39	1.41

Trend category	*Reporting year*				
	00/01	*01/02*	*02/03*	*03/04*	*04/05*
Total number of deaths	16	13	12	8	7
FPPY (B)	0.35	0.28	0.25	0.17	0.15
Total non-fatal casualties	233	109	69	82	50
CPPY (D)	5.14	2.34	1.44	1.69	1.05
Total number of incidents	95	55	39	37	27
IPPY (F)	2.09	1.18	0.81	0.79	0.57

Notes to Table 3:
A = Total number of deaths due to CO poisoning in each financial year
B = FPPY (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 (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 (Incidents per person per year are $x10^{-6}$). The IPPY was calculated by the same method as that used for Table 2.

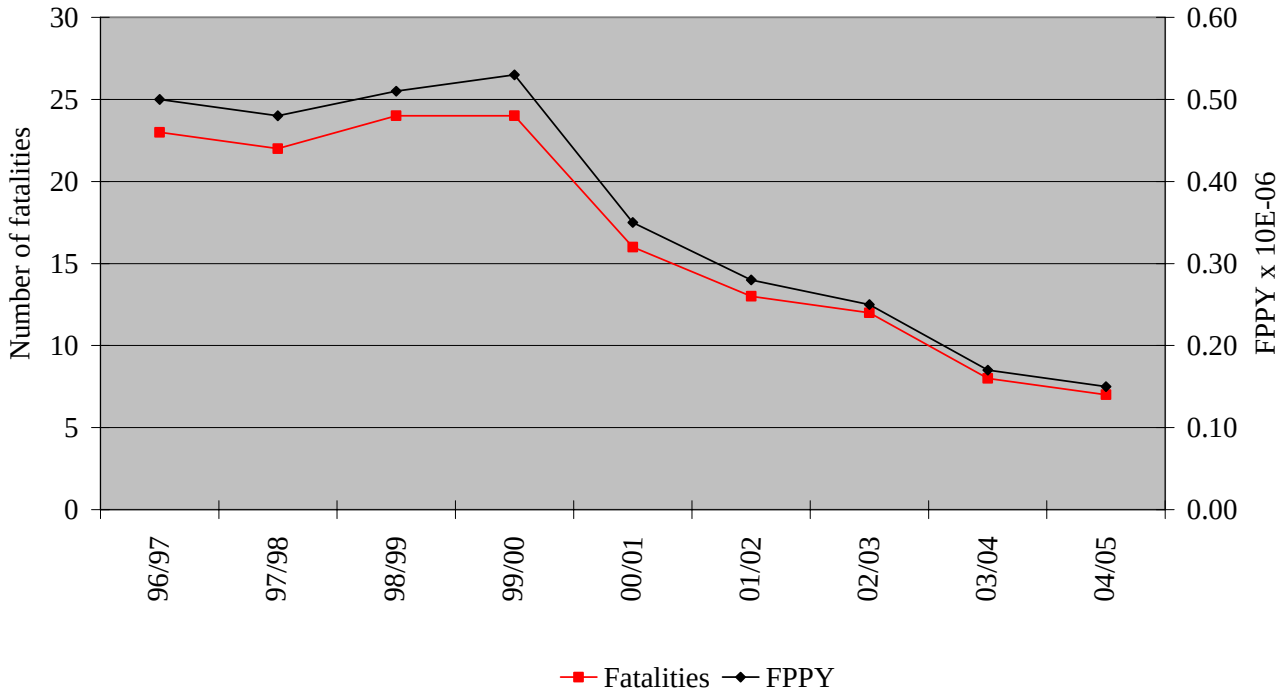

Figure 3 - Graph of fatality trends

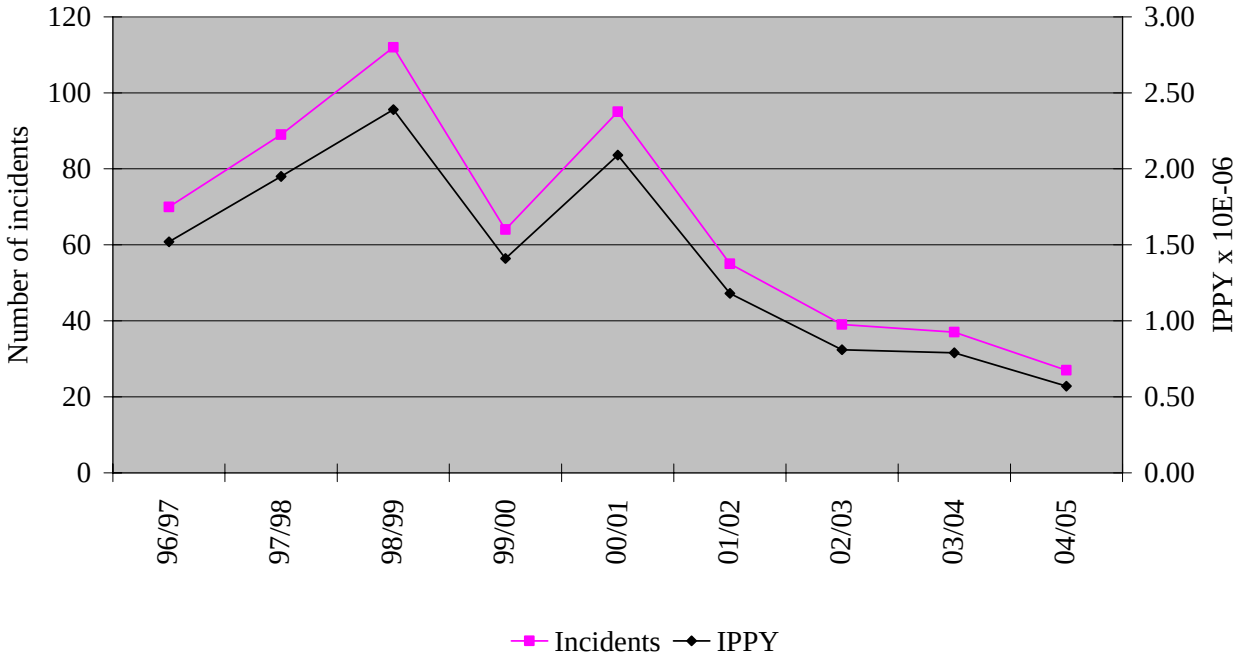

Figure 4 - Graph of incident trends

The age group, along with the numbers of fatal and non-fatal casualties, are given in Figure 5. The combined totals for all casualty groups are compared to the mid-2004 population estimates for GB, projected by the Office for National Statistics, in Table 4.

Table 4 – Comparison of age profiles

Age group	*Incident stats (%)*	*Age stats for GB (%)*
0 - 10	12.3	11.6
11 - 20	14.0	13.0
21 - 30	14.0	12.4
31 – 40	26.3	15.0
41 - 50	10.5	14.1
51 - 60	8.8	12.7
61 - 70	5.3	9.6
71 - 80	3.5	7.2
>80	0	3.7
unclassified	5.3	-

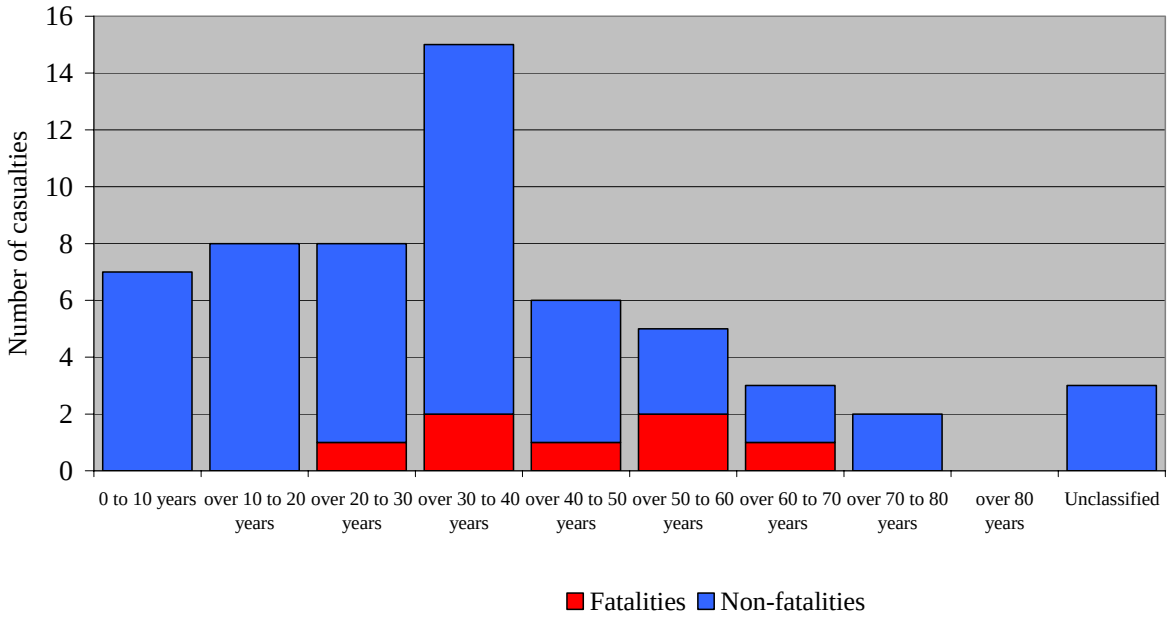

Figure 5 - Casualty age profile

2.3 INCIDENT LOCATION DETAILS - ANALYSIS OF SECTION 3 OF DIDR

Table 5 and Figure 6 indicate the tenure of the properties derived from the DIDR forms. This shows a slightly higher representation for owner occupied properties than tenanted properties. There were no empty fields or unrecognised values. A break down of tenanted properties exhibits 26% (7) were single occupancy and 22% (6) were multiple occupancy. Dwelling stock tenure data for March 2005 for Great Britain, published by the Office of the Deputy Prime Minister, gives a breakdown of the occupancy groups. These statistics are reproduced in Table 5 for comparison.

Table 5 - Breakdown of incident sites by occupancy

		Incident stats % (Nos)	*Occupancy stats for GB (%)*
Owner occupied group		51.9 (14)	70.2
Tenanted group:		48.1 (13)	29.8
	Privately owned	25.9 (7)	10.8
	Council owned	22.2 (6)	10.6
	Registered social landlord	0 (0)	8.4
	unclassified	0 (0)	-

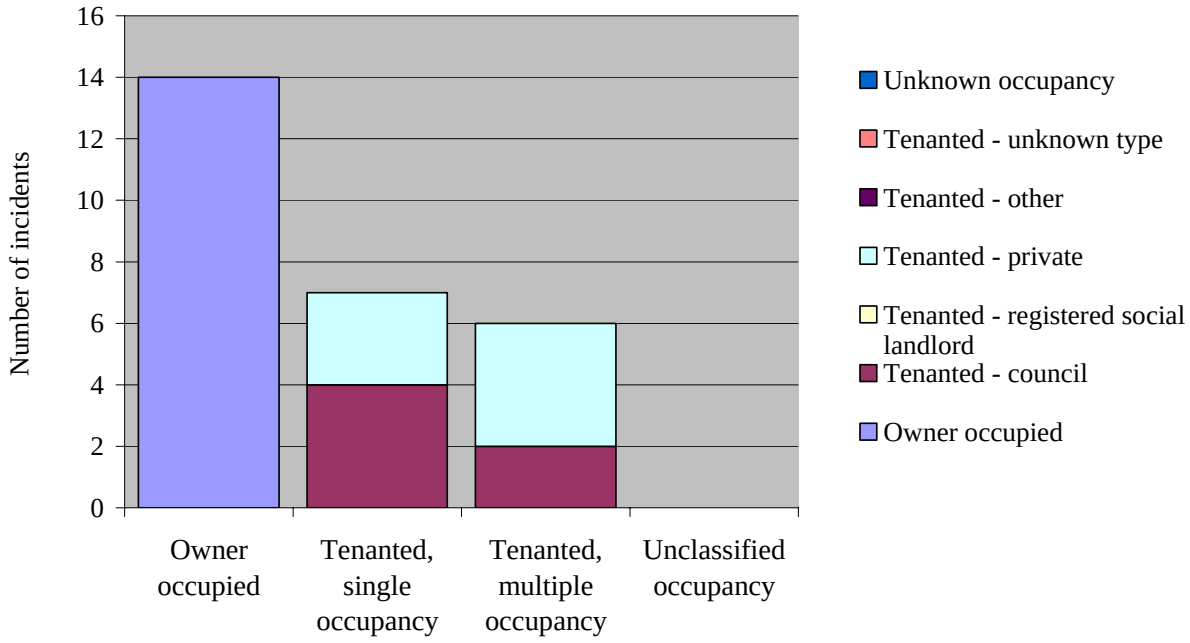

Figure 6 - Occupancy type

Figure 7 provides details of the breakdown of incidents by property type. It indicates that the highest proportion of incidents occurred in houses (74%), followed by flats (18%).

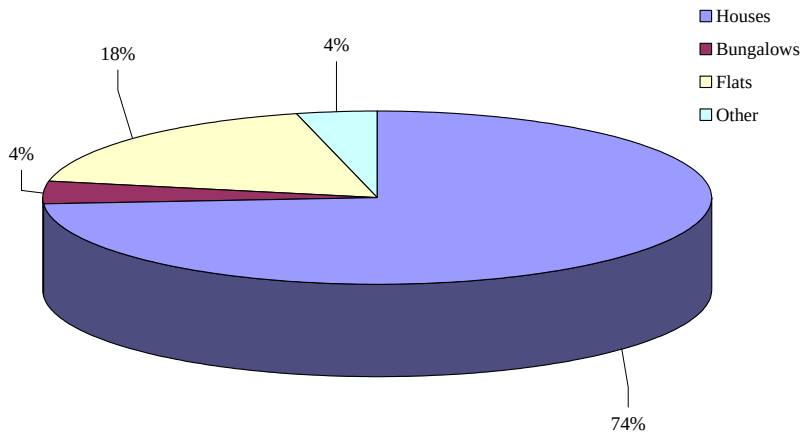

Figure 7 - Property types

Table 6 shows the number and percentage of type of accommodation, within each property type, in which incidents took place during the year. The table indicates that the highest proportion of incidents occurred in terraced houses (55.6%), followed by semi-detached houses (18.5%).

Table 6 - Breakdown of incident sites by property style

Bungalow	***Nos (%)***	***Flat***	***Nos (%)***	***House***	***Nos (%)***
Detached	1 (3.7)	Bed sit	1 (3.7)	Detached	0 (0)
Semi-detached	0 (0)	Conversion	0 (0)	Semi-detached	5 (18.5)
Terraced	0 (0)	Maisonette	1 (3.7)	Terraced	15 (55.6)
		PBB (4 storeys or less)	3(11.1)	Townhouse	0 (0)
		PBB (5 storeys or more)	1 (3.7)		
TOTAL	1 (3.7)	TOTAL	6(22.2)	TOTAL	20 (74.1)

Note to Table 6: In the table PBB stands for purpose built block.

Provisional data for England, estimated from the 2005/06 Survey of English Housing, gives a breakdown of the types of accommodation. The analysis is given below in Table 7 where it is compared to the incident statistics.

Table 7 - Comparison of DIDR incident stats with accommodation stats

Property style	***Incident stats (%)***	***Accommodation stats for England (%)***
Detached house/bungalow	3.7	22
Semi-det house/bungalow	18.5	33
Terraced house/bungalow	55.6	27
Purpose built flat or maisonette	18.5	13
Converted flat or maisonette/rooms	3.7	4

The age bands of the properties in which incidents took place are shown in Figure 8 and given in Table 8.

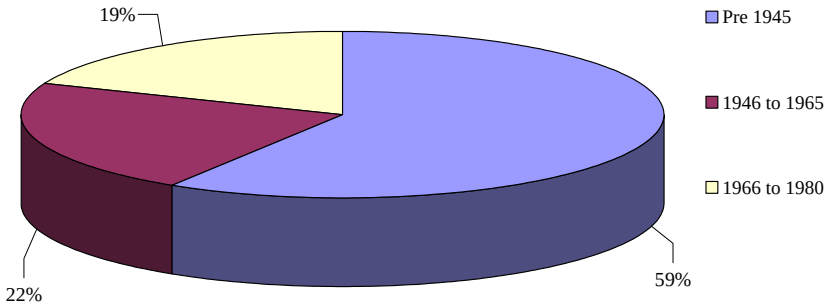

Figure 8 - Property construction period

All the incident properties fall into 3 age bands. The largest at 59% is the stock built before 1945, the middle at 22% is the 1946-1965 category and the remainder at 19% falls into the from 1966 band. Dwelling stock age distribution figures issued by the Office of the Deputy Prime Minister for March 2005, estimated from the Survey of English Housing, are included in Table 8 for comparison with the incident data.

Table 8 - Comparison of incident stats with construction period stats

Construction periods	*Incident stats (%)*	*Construction period stats for England (%)*
From 1966	19	40
1946 to 1965	22	22
Before 1945	59	38

Table 9 shows the figures derived for the glazing and ground floor construction details at the incident sites. These are also illustrated graphically in Figures 9 and 10. The Office of the Deputy Prime Minister has issued glazing figures for 20024/05 from the Survey of English Housing and these details are also included in Table 9.

Table 9 - Construction details of incident properties

Glazing details	*Incident stats (%)*	*Glazing stats for England (%)*	*Ground floor details*	*Incident stats %*
Single	19	16	Solid	52
Double	81	71	Suspended	22
Partial double	0	13	Partial solid	15
Unclassified	0	-	Unclassified	11

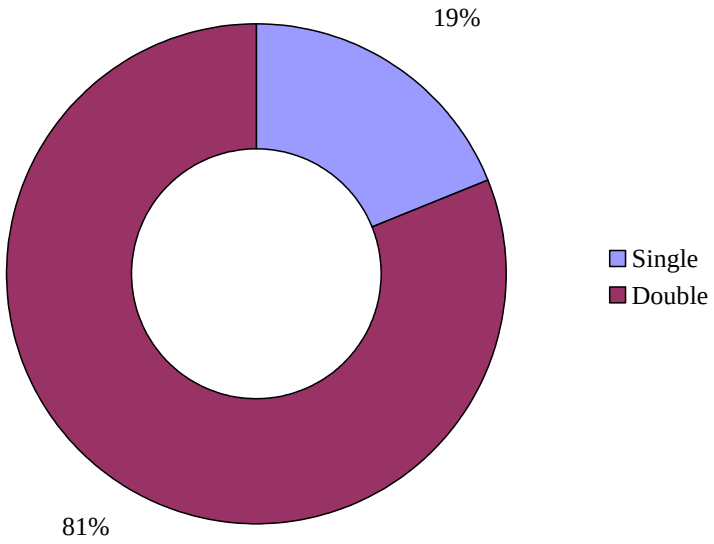

Figure 9 - Glazing details

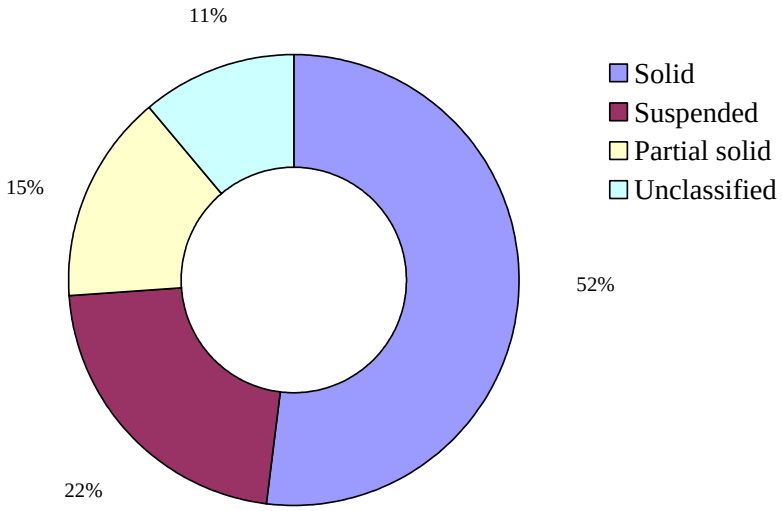

Figure 10 - Ground floor construction

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 10.

Table 10 - 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	0
Bathroom	2	5	2
Bedroom	2	5	2
Bedsit	2	6	4
Cellar	2	0	0
Dining Room	2	2	1
Utility	1	0	0
Garage	0	0	0
Hall	3	0	0
Kitchen	4	4	1
Landing	0	1	0
Living room/lounge	4	20	0
Shower-room	0	0	0
Other	5	2	0
Unclassified	0	12	0

A breakdown of the 27 incident sites shows 14 (52%) of the incident appliances were located in rooms, and 6 (22%) were marked as being located in compartments. The remaining 7 incident locations were given as other - 3 were described as fitted in the internal space between the kitchen and the bathroom, 2 were fitted in the cellar, 1 was in the basement and the last was in an adjacent property. The information given on appliance locations is shown in Figure 11.

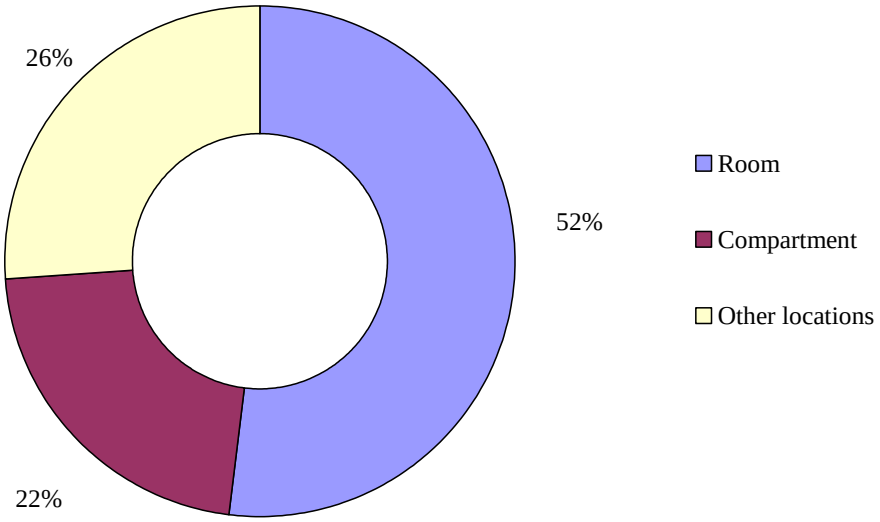

Figure 11 - Appliance location

The DIDR form has a section for entering details for an incident site where appliances, other than the incident appliance, were found to be producing CO into the property or which had "sub-standard faults". There were 4 incident sites where an additional appliance was highlighted to have "sub-standard" faults. It was further confirmed that 1 of the 4 was introducing CO into the property. At 1 site a boiler not subject of the incident had been previously condemned as unsafe and disconnected

Details of incident appliance locations, by floor, are given in Table 11.

Table 11 – Location of the incident appliances

Floor on which the appliance was situated	*Number of incident appliances*
Fourth	0
Third	0
Second	0
First	5
Ground	19
Below ground	3
Unclassified	0

The casualties were located in the same property as the incident appliance in 26 (96%) of the 27 incidents. In the 1 exception the incident was caused by an appliance located in an adjacent property. The information on casualty/appliance locations is depicted in Figure 12.

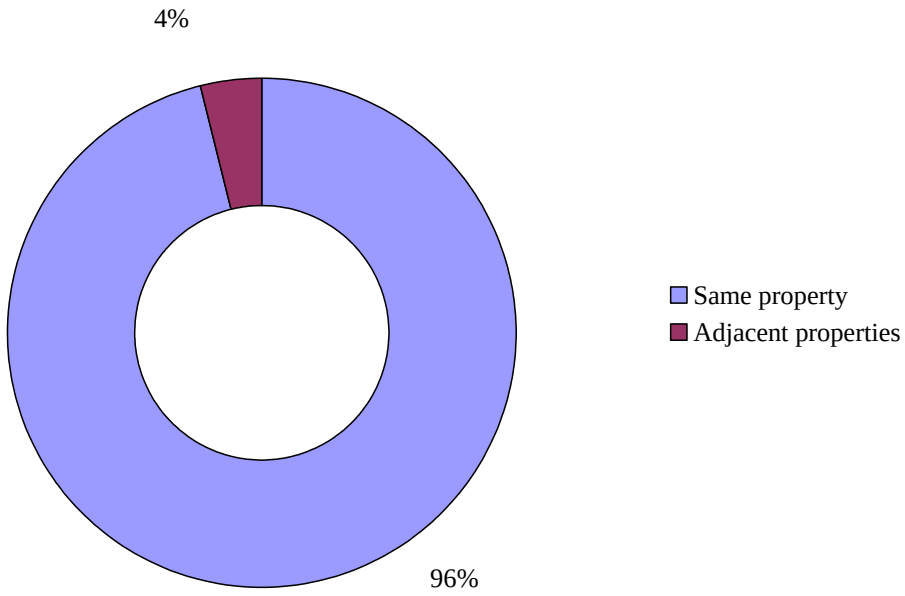

Figure 12 - Casualty/Appliance location

2.5 INCIDENT APPLIANCE DETAILS - ANALYSIS OF SECTION 5 OF DIDR

2.5.1 Incidents during 2004/05

Details of the CO poisoning incidents classified by appliance type, for 2004/05, are given in Table 12 and summarised in Figure 13.

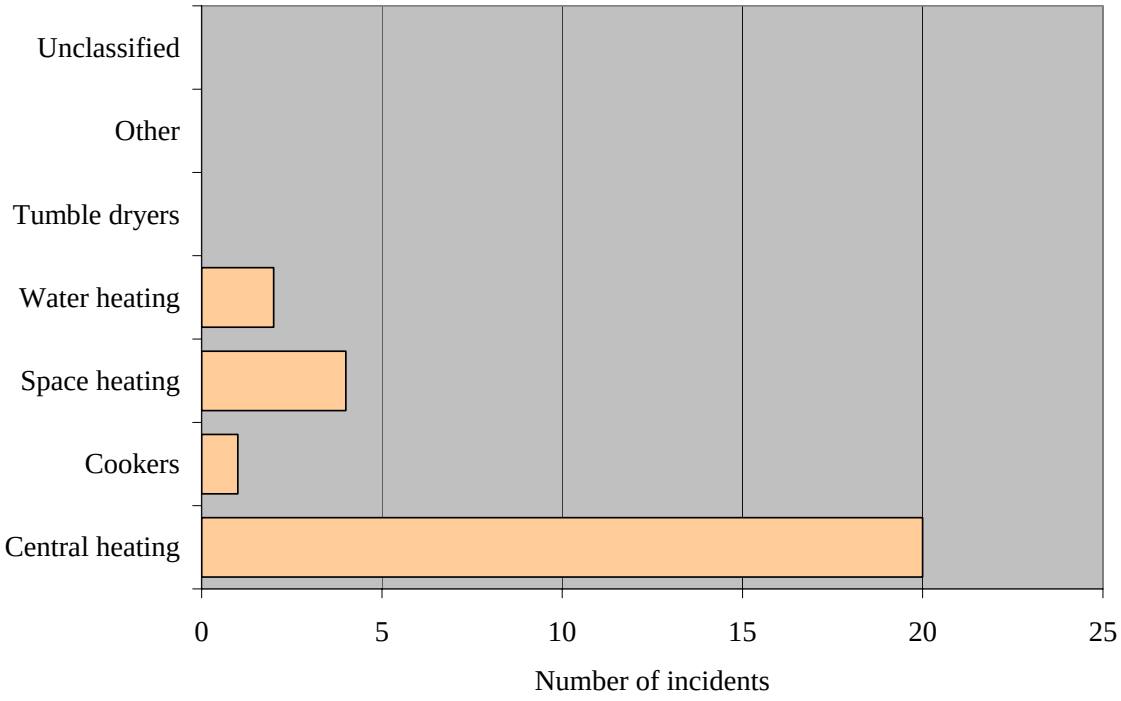

Figure 13 - Incidents by appliance type

TABLE 12 - Incidents by appliance type

Appliance	*Incidents - Total*	*Incidents - Fatal*	*Casualties – Non-fatal*	*Casualties - Fatal*
Central Heating				
Back boiler unit	3	1	2	1
Floor standing	6	0	15	0
Floor standing combi	0	0	0	0
Thermal storage unit	0	0	0	0
Wall mounted	4	0	5	0
Wall mounted combi	6	2	17	2
Warm air unit	1	0	4	0
Total	**20**	**3**	**43**	**3**
Cookers				
Free standing	1	1	0	1
Built-in oven	0	0	0	0
Built-in hob	0	0	0	0
Total	**1**	**1**	**0**	**1**
Space Heaters				
Balanced flue fire	0	0	0	0
Cabinet heater	0	0	0	0
Decorative fire	0	0	0	0
Flueless heater	0	0	0	0
Inset live fuel effect fire	1	0	2	0
Rad. & rad. con. fire	3	1	2	2
Wall heater	0	0	0	0
Total	**4**	**1**	**4**	**2**
Tumble Dryers				
Tumble Dryers (total)	**0**	**0**	**0**	**0**
Water Heaters				
Bulk storage	0	0	0	0
Circulator	1	0	2	0
Multi-point	0	0	0	0
Single-point	1	1	1	1
Other	0	0	0	0
Total	**2**	**1**	**3**	**1**
“Other” Appliances				
Other	**0**	**0**	**0**	**0**
Grand Total	**27**	**6**	**50**	**7**

Note to Table 12: Appendix B gives details, by appliance type, for each incident.

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

A breakdown of the types of central heating boiler units involved in incidents and the associated fatal and non-fatal casualties is presented in Figure 14.

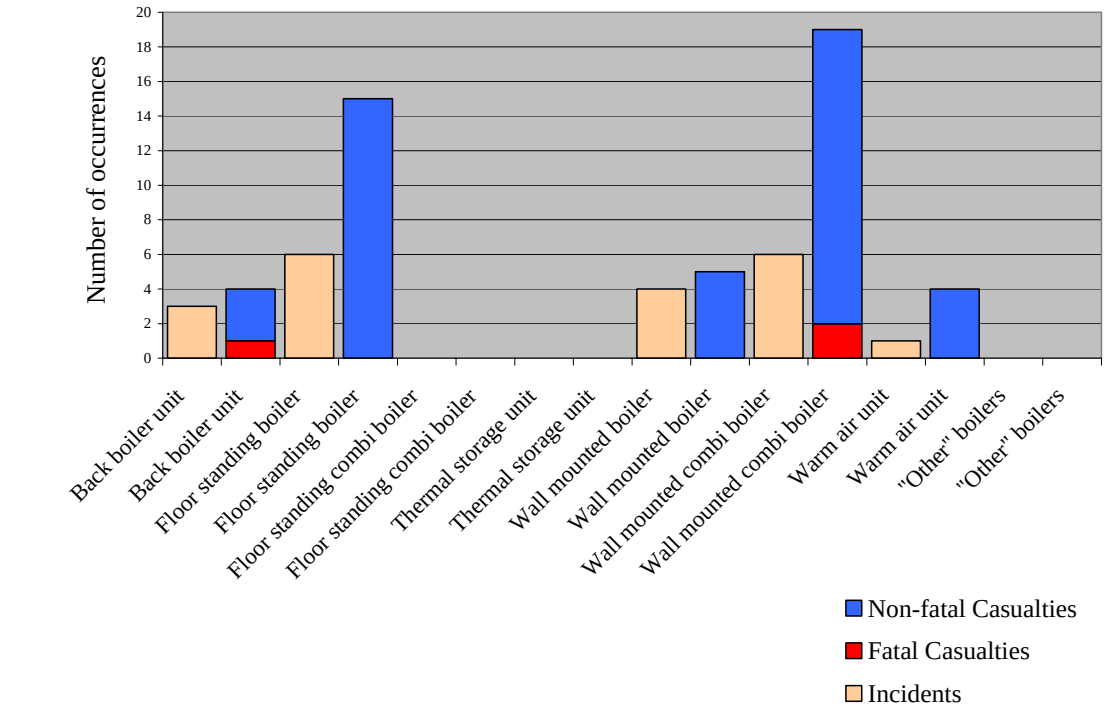

Figure 14 - Central heating boilers

Figure 15 shows the yearly fatality trends associated with appliance type since 1996/97. Annual gas appliance distribution surveys in Great Britain have established that the profile of gas appliances in use is changing over time. The FPPY risk values shown in Table 17, section 2.5.4, take account of these changes over the years between 1996/97 and 2004/05.

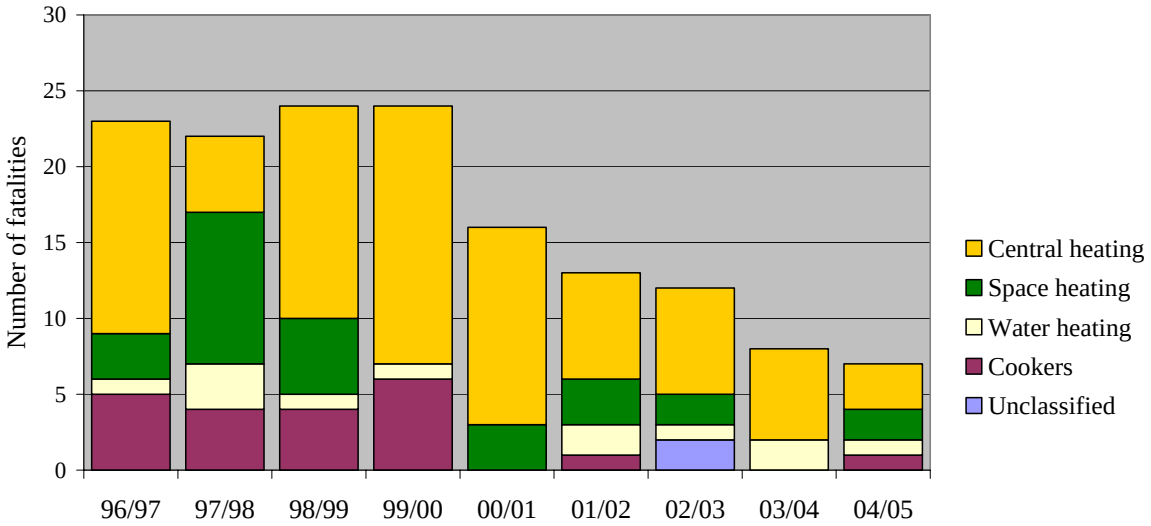

Figure 15 - Fatalities by appliance type

The age of the appliances involved in incidents during the reporting period is given under the main appliance groups in Table 13. It is also shown in Figure 16. Appendix E contains data commissioned for this report on population and age profile of piped natural gas appliances used within Great Britain.

Table 13 - Age of incident appliances

Appliance Type	*Age (years)*					
	0 –5	*6 - 10*	*11 - 15*	*16 - 20*	*Over 20*	*Unknown*
Central heating	0	2	4	4	2	8
Cookers	0	0	1	0	0	0
Space heaters	0	0	0	0	1	3
Tumble dryers	0	0	0	0	0	0
Water heaters	0	0	0	0	0	2
Grand Total	**0**	**2**	**5**	**4**	**3**	**13**

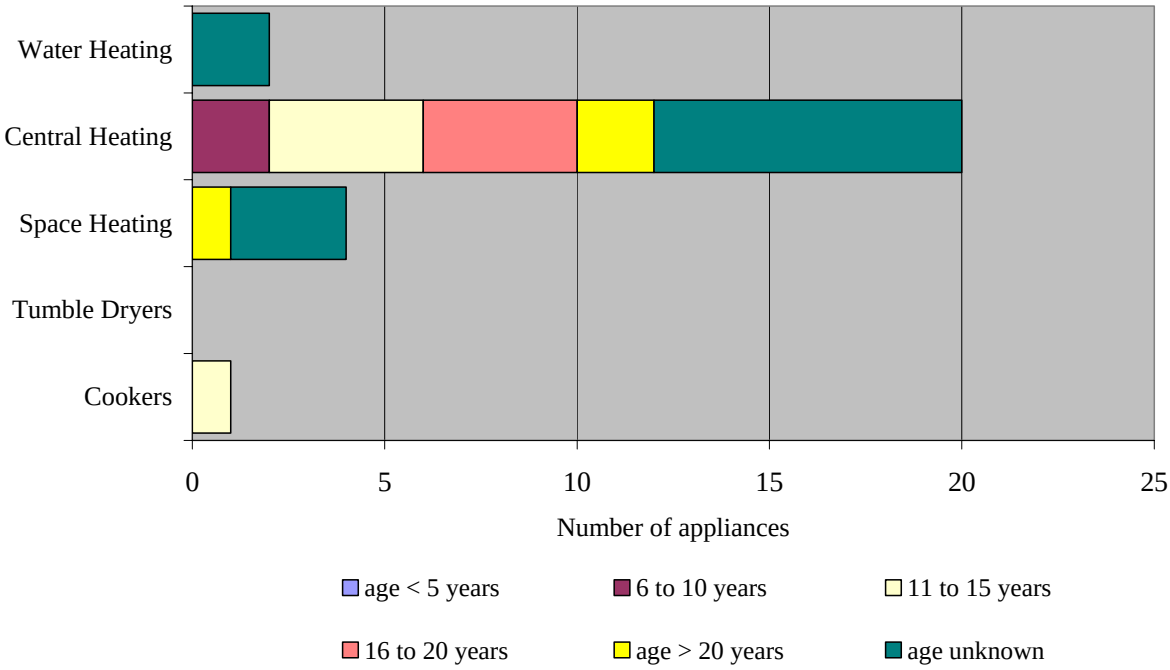

Figure 16 - Appliance age distribution

2.5.2 Notes relating to individual appliance types and models

The following information is derived from the incident details given in Table 12, section 2.5.1, and Appendix B:

2.5.2.1 Central Heating

Central heating appliances featured in 20 of 27 incidents. This is equivalent to 74% of all the CO poisoning incidents reported during the year. The number of fatalities reported at 3 is 43% of the total recorded, and the corresponding numbers for non-fatal casualties are 43 and 86% respectively.

Wall mounted combi boilers and floor standing boilers were each involved in 6 (30%) of the central heating incidents. The next highest group at 4 (20%) was the wall mounted unit. Wall mounted combi boilers were implicated in 2 fatalities in separate incidents. In the case of the third fatality the appliance type was a back boiler unit.

Back boiler units

Back boiler unit incidents totalled 3, with 1 fatality and 2 non-fatal casualties. The makes and models involved were a Baxi 401, a Glow-worm 45, and a Baxi Bermuda 552. All the boilers featured open individual natural draught flues, and they were all installed in owner occupied properties. The location for 2 appliances was given as the dining room and the other was the living room/lounge.

In the case of the Baxi 401, the installation was marked as not to any appropriate standards as was the flue. The ventilation was given to be to current standards. The result of the flue flow and continuity check was pass. On-site checks revealed high burner pressure, high CO/CO_2 ratio, blockage/soot in the heat exchanger, and flue installation fault. No service history information was provided and the cause of the incident was deemed to be lack of service.

Details in the case of the Baxi Bermuda 552 are very sparse. The appliance was fitted in a pre-1945 terraced property. The installation was not to any appropriate standards. No further details in any of the sections covering the flue, ventilation, on-site checks, service history or causes of incident were provided.

The Glow-worm 45 was the appliance where the fatality was sustained. The installation was carried out by a CORGI registered technician and was cited to be to current standards though the flue termination was not freely exposed. The ventilation was given as not to any appropriate standards. No results of on-site checks were given, and service history was also lacking. A chemical spot detector type CO alarm was in use. The incident was caused due to a flue terminal fault and a lack of servicing.

Floor standing boilers

Floor standing boiler incidents totalled 6, with no fatal and 15 non-fatal casualties. In terms of tenure, 4 were owner occupied, 1 was tenanted multi-occupancy council owned and the other was similar but privately owned. One appliance had an open, shared, fanned draught flue, and the flue type on the remainder was open, individual, natural draught. Two of the 6 appliances were Caradon Ideal Mexico CF models, 2 were Potterton Kingfisher CF models, 1 was a Stelrad Mexico Super, and the remaining 1 was a Clyde CKCIP.

The boilers were fitted in diverse locations, 2 were in the cellar, 1 in the kitchen, I in the hall, 1 in a bedsit, and the last was in the basement of a multi-storey block. The identity of the installer was not known at any location.

Five of the appliances were described as installed not to any appropriate standards, and 1 to current standards. Reasons for non-compliance were related to:

Ventilation – not to any standards in all cases, and in 2 it was also defined to be inadequate. In 1 case where it was required to be 102 cm^2 the provision was only 19 cm^2.

Flue – not to any standards at 4 sites, to current standards at 1, and 1 was marked as unsure/don't know. The flue at 1 site was described as incorrect, at 1 a section of the flue liner was not in the chimney.

An overview summary of the on-site checks is given in Table B.1.2a. A defective flame picture was observed at 2 sites and a high CO/CO_2 ratio at 3 sites. The heat exchanger was blocked by soot at 1 site. Presence of shale in the burner and the bottom of combustion chamber was detected at 1 site. There were signs of spillage on the inside and outside of the appliance at 3 sites.

The nature of the flue related faults was given as terminal subject to chilling in 1 case and in another the external fall was described to be excessive. At 1 site the flue was found to be leaking through the chimney inspection plates.

The incident summary Table B.1.2b shows the incident causes. The most frequent cause, cited in 4 cases is a ventilation related fault, followed by a flue/terminal fault which was recorded at 3 sites. The appliance was also in need of servicing at 2 of the 6 sites. At 1 site the cause of the incident was given as "chilling of the external flue".

Floor standing combi boilers

There were no recorded incidents involving these appliances.

Thermal storage units

There were no recorded incidents involving these appliances.

Wall mounted boilers

Wall mounted boilers were involved in 4 incidents, with 5 non-fatal casualties and no fatalities. Three appliances had room sealed, individual, natural draught balanced flues and the last had an open, individual, natural draught flue. Of the 3 balanced flue boilers 1 was located in the kitchen, 1 was a cupboard installation in a bed-sit, and the third was located in an adjacent property. The appliance with the open flue was located in the kitchen.

The installation was to current standard in 1 case, not to any standards in 2 cases, and in 1 case the assessment was not characterised. The flue was classified not to any standard in all installations. Ventilation was not required in 3 cases, and it was deemed to be to current standards in the case of the open flue appliance.

The make of the appliances involved was Baxi and Glow-worm. The 2 models from Baxi were the Solo WM 50/4 RS and the WM 3813 RS. The Glow-worm models were the Fuelsaver 30R MkII and the Economy 40.

The Baxi Solo was at postcode SG1, a cupboard installation in a bed-sit in a terraced house owned by a private landlord. No information was provided in the on-site checks section of the DIDR form. The causes of the incident were given as appliance fault and installation fault, though no explanation was offered.

The Glo-worm Fuelsaver at postcode WS15, was sited in the kitchen of a first floor tenanted flat in a multi-storey privately owned property. This was the only installation in this group that was categorised to be to current standards. On-site checks revealed burner linting and corrosion, and signs of spillage inside the casing. There had been a previous report of fumes. Causes of the incident were appliance fault, flue installation fault and lack of servicing.

The second Baxi at postcode WV6 was in the kitchen of an owner occupied semi-detached house. The incident cause "other" was "an extension had been built over the flue terminal so the boiler was discharging into the property". Previously the flue position was not to current standards as it was too close to the drain pipe in an external corner. On-site tests found high burner pressure and it was also overrated, though CO/CO_2 ratio was measured to be correct.

The second Glow-worm at postcode ST6 was fitted in an owner occupied terraced property and the casualties were suffered in an adjacent property. The flue terminal was fitted in a covered passageway, too close to the ceiling, with the effect that the higher zones of the passageway were prone to contamination from products of combustion. On-site checks discovered high CO/CO_2 ratio, burner corrosion and heat exchanger blockage with shale. Apart from bad terminal siting, the other cause given for the incident was a lack of servicing. This was supported by the presence of green and white verdigree on the close-finned aluminium heat exchanger.

An overview of all the faults recorded for wall mounted boilers is given in Table B.1.5a. This shows flue related problems to be the most common.

Wall mounted combi boilers

Combi boilers were involved in 6 incidents. The related casualty count was 17 non-fatal, and 2 fatal. All of the appliances were open flue, individual, natural draught models. Vaillant models featured in 4 of the 6 incidents, with one each from Vokera and Worcester range. Three appliances were fitted in the internal space between the kitchen and the bathroom, and there was 1 each in the utility room, the bedroom and the bathroom.

The installation at 5 sites was not to any standard and 1 was not qualified. The flue was not to any appropriate standards in 5 cases, again there was no deliberation on 1. Ventilation details were only provided for 5 sites and was required at all. Out of these there were 3 sites where the ventilation was not to any appropriate standards, 1 was to current standards, and no ventilation was provided at the last.

At site NR2, a service visit had been made by a CORGI registered fitter in the 6 months prior to the incident. In spite of this on-site checks revealed linting on the burner, soot/blockage in the heat exchanger, high CO/CO_2 ratio, and burner light back. Poor level of service was pronounced as one of the causes for the incident.

At LL13 the appliance was fitted in the utility room of an owner occupied semi-detached house. Here the ventilation that previously existed due to draughty windows/doors became inadvertently restricted due to installation of UPVC double glazing. This resulted in down draught and spillage when a coal fire in the middle room was lit due to prevailing cold weather.

At NR3 the appliance was fitted in a cupboard/compartment in a first floor bedroom of an owner occupied terraced property. The installation was declared non-compliant due to inadequate ventilation, incorrect flue terminal height above roof and undersized gas supply. On-site checks found shale in the heat exchanger, debris below burner, and excessive gas pressure.

At B67 in a tenanted terraced property the boiler was fitted in the space between the kitchen and the bathroom. Reasons the installation was non-compliant were the method of flue connection to boiler and no permanent ventilation.

The appliance at WV2 was also fitted in the space between the kitchen and the bathroom of an owner occupied terraced property. The installation was non-compliant due to incorrect flue installation/termination. On-site checks revealed a series of defects associated with lack of servicing.

The appliance at B70 was installed on the ground floor in the bathroom of a tenanted terraced house. The air vent was adjudged to have been intentionally blocked. On-site checks revealed defective flame picture, heat exchanger blockage/soot, high CO/CO_2 ratio and signs of spillage inside and outside the casing.

A summary of the on-site checks for the wall mounted combi boilers is given in Table B.1.6a. There was high CO/CO_2 ratio at 5 sites, signs of spillage inside the casing at 4 locations, and burner over-pressure at 3. Lack of servicing, flue/terminal faults and ventilation faults are recurrent items in the causes of incidents.

Warm air units

There was 1 incident involving a warm air unit and it resulted in 4 non-fatal casualties and no fatalities. The make of the related appliance was Johnson and Starley, and the actual model was JT19-25 Mk2. The installation was adjudged to be not to any standards. The site was a ground floor flat in a council owned multi-storey property and the appliance was fitted in a compartment in the hall.

Reasons given for the installation to be non-compliant were inadequate compartment low level ventilation and inadequate vertical flue rise off main warm air unit.

High CO/CO_2 ratio was displayed in on-site tests, and there was manifestation of blockage/soot in the heat exchanger. Signs of spillage were also evident outside the appliance and inside the casing. An overview of the faults is given in Table B.1.7a.

"Other" boilers

There were no recorded incidents involving these appliances.

2.5.2.2 Cookers

A free standing cooker was subject of an incident where 1 fatal casualty occurred.

The cooker was located in the ground floor kitchen of a tenanted council owned maisonette. Its make and model was New World Debut. The ventilation provided was deemed to be not to any standard, and to exacerbate matters had been unintentionally obstructed.

Landlord's safety check/inspection of the appliance had been carried out in the preceding 6 months. One of the causes of the incident was stated to be customer misuse of appliance. It was intimated that 4 burners on the cooker could have been left on for up to 17 hours. The burners were emitting CO at a level of 4 ppm. An on-site vitiation test replicating conditions as found by first call emergency services revealed that flame lift off due to oxygen depletion was achieved in 2 hours with 4 burners firing at maximum setting.

2.5.2.3 Space Heaters

There were 4 incidents that featured space heaters. Three of the appliances were located in the living room/lounge and 1 was in a bedroom. In terms of type, 3 were radiant/radiant convector gas fires and the fourth was an inset live fuel effect fire. At site HD4, the fire was fitted in a bedroom with no associated flue or chimney; the flue type on the rest was open, individual, natural draught. The total casualty count at these incidents was 2 fatal and 4 non-fatal. Information on the location of the non-fatal casualties was not given.

Inset live fuel effect fires

The fire, a Eurotech Superior Convector, was fitted in a tenanted, terraced, privately owned property. The installation was not to any appropriate standards, it was not adequately secured into position, and the fire surround was not adequately sealed. The standard of installation of the flue or ventilation was not given. On-site checks showed burner pressure was low but the rating was high. A CORGI registered fitter had carried out a safety check 6-12 months prior to the incident. Lint/dust were found within the appliance and lack of service was given as the cause of the incident.

Radiant & radiant convector gas fires

In the first incident, the make of the fire was Valor, and it was fitted in a tenanted council owned semi-detached house. The installation was to current standards as was the flue. In on-site checks, burner pressure, rating and CO/CO_2 ratio were all correct, and the spillage test was satisfactory. A CORGI registered fitter had checked the appliance 1-2 years earlier due to report of fumes. The cause of the incident was not established.

In the second incident, the make of the fire was Main Heating, The site was a tenanted council owned semi-detached house. The standard of installation was not given but the flue was to current standards. On-site checks detected high burner pressure, and there were signs of linting. The centre 2 radiants were not burning correctly, exhibiting yellow tipping to the flames. A safety check had been carried out by a CORGI registered fitter in the previous 12 months, and the cause of the incident was identified to be lack of service.

The last incident occurred in living accommodation above an owner occupied Chinese take-away food outlet. The appliance involved was a Robinson Willey Firegem Visa and the incident gave rise to 2 fatal casualties. The casualties were located in a bedroom where the open flue fire had been installed without any flue arrangement and in the absence of any chimney.

Apparently the business had changed hands in the last few months. The previous owner had not used the living accommodation. A boiler used to provide heating for radiators had been condemned unsafe and disconnected. The gas fire had been fitted several years ago and had never been inspected by a qualified fitter as its existence went unnoticed.

2.5.2.4 Tumble Dryers

There were no recorded incidents involving these appliances.

2.5.2.5 Water Heaters

There were 2 incidents related to water heaters. One of the appliances involved was a circulator and the other was a single-point unit. In the case of the circulator there were 2 non-fatal casualties, the single-point heater incident entailed 1 fatal and 1 non-fatal casualty.

Circulator

The appliance, a Main Solent 673, was in use in a tenanted council owned semi-detached house. It was installed in a compartment within the hall. The installation was not to any standards, there was no high level compartment ventilation. The flue - open, shared, natural draught type was to current standards. A battery powered CO detector was fitted in the kitchen.

On-site checks revealed many abnormalities associated with lack of service. The burner had signs of corrosion, the flame picture was defective, and the pressure and CO/CO_2 ratio were high. The heat exchanger was blocked by shale and soot.

The interval between the last service visit and the incident was given as over 2 years. The causes of the incident were identified as appliance fault, ventilation fault, and lack of servicing.

Single-point

The incident was related to an Ascot G5101/1 water heater. The site was a tenanted, privately owned, terraced house and the appliance was fitted in the bathroom on the first floor. The flueless appliance was installed to standards at the time of installation. The 2 casualties (1 fatal) were located in the same room as the appliance.

On-site checks identified defective flame picture, heat exchanger blockage with shale, high CO/CO_2 ratio, and lack of permanent ventilation. Signs of spillage outside the appliance and inside the casing were also present. In general the appliance was described to be in extremely poor state of repair.

The causes of the incident were judged to be ventilation related, lack of service, and customer misuse of appliance. The latter was supported by the presence of an attached hose leading to the bath, suggesting operation of the appliance for extended periods in contravention of user instructions, in a room with inadequate ventilation.

The installation of this type of appliance has been illegal in UK since 1984.

2.5.2.6 "Other" appliances

There were no recorded incidents in this category.

2.5.3 Appliance risk values

Details relating to the risk values, for the 2004/05 reporting period, by appliance type are given in Table 14. In terms of the risk of a fatal incident (FPPY) only single-point water heaters had a risk value greater than the recommended level of 1 x 10^{-6}.

The two worst appliances, in descending order of risk, are as follows: single-point water heaters (2.66 x 10^{-6}) and back boiler unit type central heating boilers (0.16 x 10^{-6}).

Table 14 - Risk values by appliance type

Appliance	*Population[1] ($x10^6$)*	*FPPY ($x10^{-6}$)*	*CPPY ($x10^{-6}$)*	*IPPY ($x10^{-6}$)*
Central Heating				
Back boiler unit	2.65	0.16	0.33	0.49
Floor standing	1.96	-	3.34	1.34
Floor standing combi	-	-	-	-
Thermal storage unit	-	-	-	-
Wall mounted	5.39	-	0.41	0.32
Wall mounted combi	7.25	0.12	1.02	0.36
Warm air unit	0.36	-	4.88	1.22
Cookers				
Free standing	7.77	0.06	-	0.06
Built-in oven	1.23	-	-	-
Built-in hob	5.51	-	-	-
Space Heaters				
Balanced flue fire	-	-	-	-
Cabinet heater	-	-	-	-
Decorative fire	-	-	-	-
Flueless heater	-	-	-	-
Inset live fuel effect fire	3.25[2]	-	0.27	0.13
Rad. & rad. Con. fire	6.38	0.14	0.14	0.21
Wall heater	-	-	-	-
Tumble Dryers				
Tumble dryers	-	-	-	-
Water Heaters				
Bulk storage	-	-	-	-
Circulator	0.31[2]	-	2.82	1.41
Multi-point	0.31	-	-	-
Single-point	0.16	2.66	2.66	2.66

Notes to Table 14:

1 - Population figures provided by GfK Marketing Services Ltd. (Reference 7.1.1).

2 - Population figures for this appliance are taken from "Assessment of the size and composition of the UK gas appliance population", DTI, GAC3407.

Population figures were not available for all appliance types and therefore risk values could not always be calculated.

2.5.4 Trends (1996/97 to 2004/05)

Trend data showing the number of incident occurrences, by each appliance type, is given in Table 15.

Table 15 - Trend data of incident occurrences

Appliance	***Year***								
	96/97	**97/98**	**98/99**	**99/00**	**00/01**	**01/02**	**02/03**	**03/04**	**04/05**
Central Heating Boilers	58	63	83	52	79	36	29	31	20
Cookers	5	6	7	6	3	4	3	0	1
Space Heaters	5	15	19	4	10	8	4	3	4
Water Heaters	1	5	3	2	1	7	2	2	2
Other	1	0	0	0	2	0	1	0	0
Grand Total	**70**	**89**	**112**	**64**	**95**	**55**	**39**	**36**	**27**

Trends of CO fatalities, by appliance type, are given in Table 16 and are also shown in Figure 15. This is within section 2.5.1 of the report. This table has been completed as fully as possible using information from the DIDR forms.

Table 16 - Trend data of the number of fatalities due to CO incidents, by appliance type

Appliance	*Year*								
	96/97	**97/98**	**98/99**	**99/00**	**00/01**	**01/02**	**02/03**	**03/04**	**04/05**
C/H Boilers -Total	**14**	**5**	**14**	**17**	**13**	**7**	**7**	**6**	**3**
Back boiler unit	3	-	6	-	-	-	1	1	1
Floor standing	2	2	3	1	4	1	5	1	-
Floor standing combi	-	-	-	-	-	-	-	-	-
Thermal storage unit	-	-	-	-	-	-	-	-	-
Wall mounted	4	2	2	8	4	5	-	4	-
Wall mounted combi	3	1	1	8	3	-	1	-	2
Warm air unit	1	-	2	-	2	1	-	-	-
Other	1	-	-	-	-	-	-	-	-
Cookers -Total	**5**	**4**	**4**	**6**	**-**	**1**	**-**	**-**	**1**
Free standing	5	4	4	6	-	1	-	-	1
Built-in oven	-	-	-	-	-	-	-	-	-
Built-in hob	-	-	-	-	-	-	-	-	-
Space Heaters -Total	**3**	**10**	**5**	**-**	**3**	**3**	**2**	**-**	**-**
Balanced flue fire	-	-	-	-	-	-	-	-	-
Cabinet heater	-	-	-	-	-	-	-	-	-
Decorative fire	-	-	-	-	-	-	-	-	-
Flueless heater	-	-	-	-	-	-	-	-	-
Inset live fuel effect fire	-	-	-	-	-	-	-	-	-
Rad. & rad. con. fire	3	10	5	-	3	3	2	-	2
Wall heater	-	-	-	-	-	-	-	-	-
Tumble Dryers	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Water Heaters -Total	**1**	**3**	**1**	**1**	**-**	**2**	**1**	**2**	**1**
Bulk storage	-	-	-	-	-	-	-	-	-
Circulator	-	-	-	-	-	-	1	-	-
Multi-point	-	-	-	-	-	-	-	2	-
Single-point	1	3	1	1	-	2	-	-	1
Other	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
Grand Total	**23**	**22**	**24**	**24**	**16**	**13**	**12**	**8**	**7**

Trends in terms of the risk of a fatality by appliance type, expressed as FPPY values, are shown in Table 17. This table has also been completed as fully as possible using information from the DIDR forms.

Table 17 - Trend data of fatalities per person per year (FPPY)

Appliance	*Year*								
	96/97	**97/98**	**98/99**	**99/00**	**00/01**	**01/02**	**02/03**	**03/04**	**04/05**
C/H Boilers -Total	**0.36**	**0.12**	**0.34**	**0.43**	**0.33**	**0.17**	**0.16**	**0.13**	**0.07**
Back boiler unit	0.39	-	0.79	-	-	-	0.13	0.12	0.16
Floor standing	0.23	0.26	0.41	0.17	0.67	0.14	0.72	0.15	=
Floor standing combi	-	-	-	-	-	-	-	-	-
Thermal storage unit	-	-	-	-	-	-	-	-	-
Wall mounted	0.22	0.11	0.12	0.56	0.28	0.31	-	0.26	-
Wall mounted combi	1.1	0.17	0.13	0.96	0.31	-	0.10	-	0.12
Warm air unit	0.76	-	1.60	-	0.73	0.41	-	-	
Cookers -Total	**0.16**	**0.13**	**0.12**	**0.18**	**-**	**0.03**	**-**	**-**	**0.03**
Free standing	0.24	0.19	0.18	0.29	-	0.05	-	-	0.06
Built-in oven	-	-	-	-	-	-	-	-	-
Built-in hob	-	-	-	-	-	-	-	-	-
Space Heaters -Total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Balanced flue fire	-	-	-	-	-	-	-	-	-
Cabinet heater	-	-	-	-	-	-	-	-	-
Decorative fire	-	-	-	-	-	-	-	-	-
Flueless heater	-	-	-	-	-	-	-	-	-
Inset live fuel effect fire	-	-	-	-	-	-	-	-	-
Rad. & rad. con. fire	0.16	0.54	0.28	-	0.19	0.20	0.14	-	0.14
Wall heater	-	-	-	-	-	-	-	-	-
Tumble Dryers	-	-	-	-	-	-	-	-	-
Water Heaters -Total	**-**	**-**	**-**	**-**	**-**	**-**		**1.10**	**0.56**
Bulk storage	-	-	-	-	-	-	-	-	-
Circulator	-	-	-	-	-	-	1.06	-	-
Multi-point	-	-	-	-	-	-	-	3.65	-
Single-point	3.81	8.78	2.60	2.77	-	5.8	-	-	2.66
Other	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Note to Table 17: In the table all the FPPY values are x10^{-6}

2.6 APPLIANCE INSTALLATION DETAILS - ANALYSIS OF SECTION 6 OF DIDR

Incident appliances were installed new at 11 sites (41%). There were no reports of any second hand appliances, however in the majority of locations 16 (59%), it was unknown if the appliance was fitted as new or second hand. The period that the incident appliance was fitted, prior to the incident, is given in Table 18 along with the number of appliances in each age group.

Table 18 - Installation period for incident appliances

Appliance type	*Age (years)*						*Total*
	0 - 5	*6 - 10*	*11 - 15*	*16 - 20*	*Over 20*	*Unknown*	
New	0	2	4	1	1	3	11
Second-hand	0	0	0	0	0	0	0
Unknown	0	0	3	2	1	10	16
Grand Total	**0**	**2**	**7**	**3**	**2**	**13**	**27**

Information relating to the type of installer used and if the appliance met the installation standards is given in Table 19.

Table 19 – Appliance installation details

Installer details	*To current standards*	*To standards current at time of installation*	*Not to any appropriate standards*	*Unsure/don't know*	*Total*
CORGI or equivalent	1	0	1	2	**4**
Non-CORGI	0	0	0	0	**0**
DIY	0	0	0	0	**0**
Unknown	1	2	17	3	**23**
Grand Total	**2**	**2**	**18**	**5**	**27**

Reasons given for non-compliance with the appliance installation standards were related to:

Flue pipe – incorrect installation, incorrect type, section of flue liner in chimney missing, faulty connection to boiler, inadequate vertical rise off warm air unit, no flue provision.

Flue terminal – incorrect height above roof, terminal not freely exposed, extension built over terminal, position too close to drain pipe in external corner, terminal fitted in covered passageway too close to ceiling.

Ventilation – inadequate permanent ventilation at several sites, no high level compartment ventilation, inadequate low level compartment ventilation.

Miscellaneous – undersized gas supply, gas fire not adequately secured in position, fire surround not fully sealed.

2.7 FLUE DETAILS - ANALYSIS OF SECTION 7 OF DIDR

The majority of appliances, 20 (80%) were fitted with open, individual, natural draught flues (includes the incident with the open flue gas fire without any flue provision). There were also 3 (12%) appliances with room sealed, individual, natural draught, balanced flues, and 2 were flueless.. Flue type details are given in Figure 17.

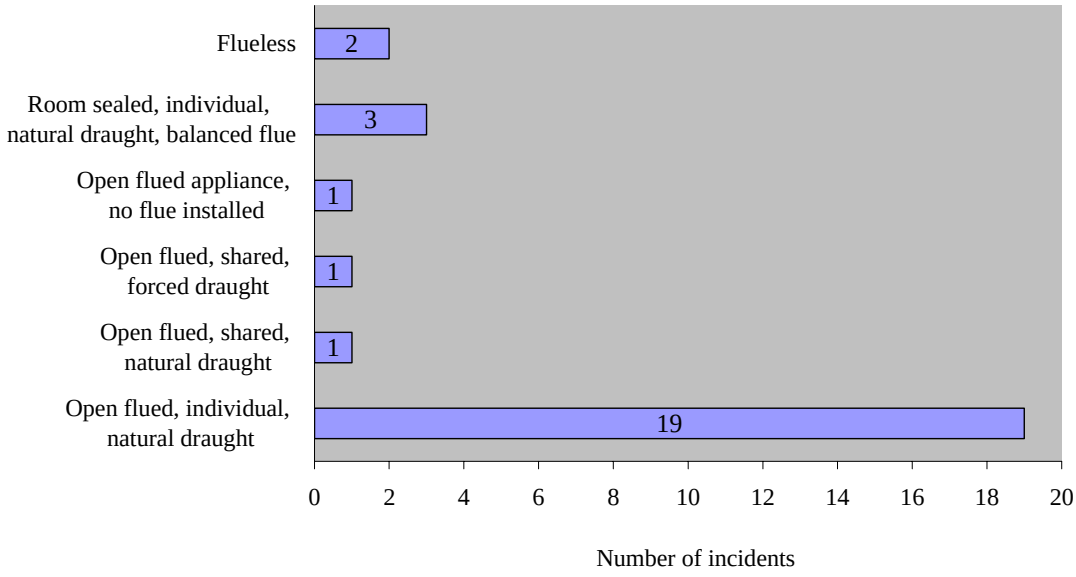

Figure 17 - Incidents by flue type

The analysis of flue installations to standard is given in Figure 18. There were 14 (56%) incidents where the flue was not to any appropriate standards, at 5 (20%) sites the flue was to current standards, and at 6 (24%) sites the investigator was unsure/didn't know or no information was supplied.

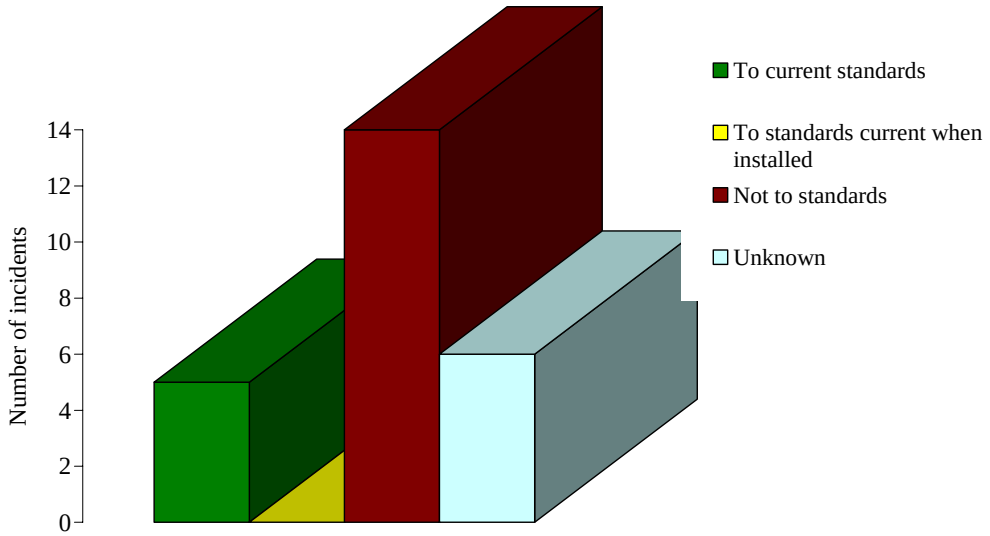

Figure 18 – Incidents by flue standards

The “flue flow and continuity check” was satisfactory at 12 sites and inadequate at 4. The investigator was unable to carry out this test at 2 sites, and there was no information for 4 sites. The flue was said to be susceptible to “chilling” at 3 incident sites.

Flue liners were reported to have been fitted to 7 incident appliances. In 2 of these cases the liner was fitted at the same time as the appliance, it was not known when the liner was fitted in the remaining 5. The liner was said to be fitted within a purpose built chimney at 5 sites, the chimney at 1 site was partially lined, and it was not fitted within a purpose built chimney at the last site.

The numbers of flue faults found are given in Table 22 (see section 2.10). A breakdown of the flue 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.

> Note: The “flue flow and continuity check” is a visual test generally carried out using a smoke pellet to observe that the flue passes the smoke produced to atmosphere via the flue terminal and with no leakage from the flue. Flues susceptible to “chilling” are likely to have long lengths of external flue, mounted on external walls in positions vulnerable to cold or high winds.

2.8 PERMANENT VENTILATION - ANALYSIS OF SECTION 8 OF DIDR

Permanent ventilation was designated required at 19 (70%) of the incident sites, and there were 8 sites for which this information was not provided. Of the 19 where ventilation was required, 17 (89%) were confirmed to have ventilation provided. The analysis of ventilation provided to standard is given in Figure 19. When provided it was to current standards at 3 (18%) installations, and it was not to any appropriate standards at 13 (76%) locations, and 1 site was not classified.

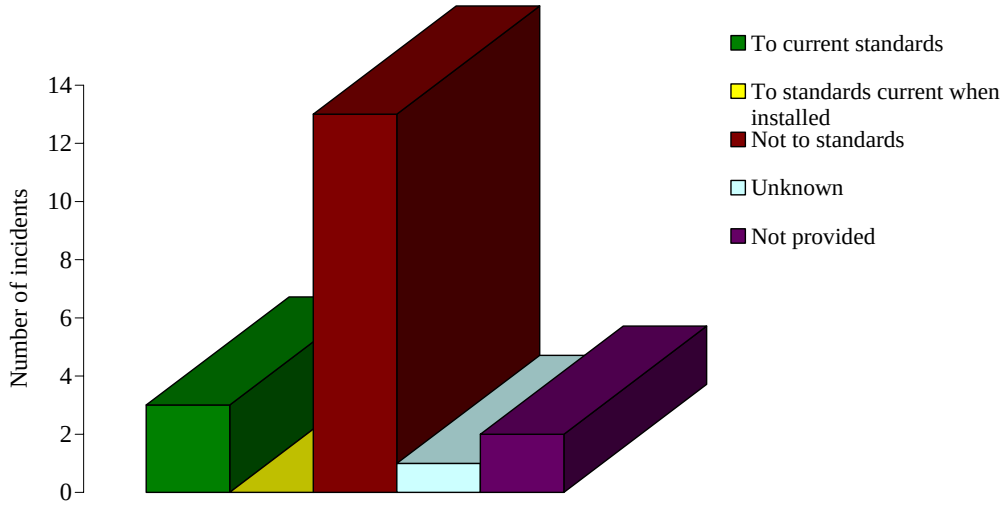

Figure 19 - Ventilation to standard

Where air vents were fitted, and the information was supplied, the air vents were said to be effective and unobstructed at 11 of the incident sites. Details of the remaining 6, partially or totally obstructed are given below in Table 20.

Table 20 - Obstructed ventilator details

Number of vents partially obstructed	5
Number of vents totally obstructed	1
Number of partially or totally obstructed vents intentionally blocked	1
Number of partially or totally obstructed vents unintentionally blocked	5
Number of vents where the method of blockage was not given/unknown	0

Incident appliances were fitted in compartment/cupboards at 6 incident sites. The compartment/cupboard was to standards applicable at the time of installation at 3 locations and not to standards at the remaining 3. The analysis of compartment/cupboards provided to standard is given in Figure 20.

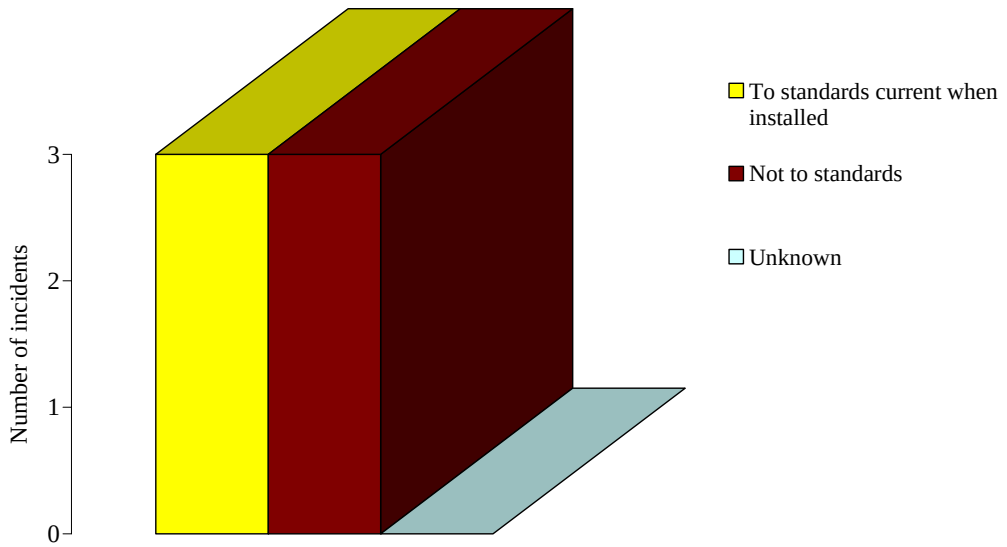

Figure 20 – Compartment/cupboards to standard

There were no reports where either an extract fan, recirculating fan, tumble dryer or cooker hood had been in use at the time of an incident. In the 20 cases where entries in the section on ventilation details on the DIDR form were made, there was only 1 site where an extract fan was noted. The aggregate numbers of types of ventilation faults found are given in Table 22 (see section 2.10). A breakdown of the ventilation faults, by appliance type, is given in Appendix B.

2.9 SAFETY DEVICES - ANALYSIS OF SECTION 9 OF DIDR

Safety devices were recorded to be in use at 6 sites. There were 4 CO alarms deployed, the type is shown in Table 21. At 1 site the CO alarm was paired with a down draught detector and at another it was paired with a vitiation device.

Table 21 - Safety devices fitted at incident sites

Installed safety devices	*Total number fitted*
CO alarm – chemical spot detector	1
CO alarm – battery powered detector	2
CO alarm – type unknown	1
Down draught detector	3
Vitiation device	2

The 4 sites where CO alarms were reported were as follows: 1 was an owner occupied terraced house and the appliance was a back boiler unit, 2 was a tenanted council owned terraced house with a radiant and radiant convector fire, 3 was a tenanted privately owned bedsit with a free standing boiler in a compartment, and 4 was a tenanted privately owned semi-detached house where the appliance was a circulator water heater.

One of the fatalities recorded in this report was suffered was at the above site fitted with the back boiler unit. The casualty, the incident appliance, and the CO alarm were in the same room, but the status of the CO alarm was not given.

2.10 ON-SITE CHECKS - ANALYSIS OF SECTION 10 OF DIDR

The details given in Table 22 are for all of the incident appliances. The information given is the total number of faults found on all of the incident appliances. In Appendix B a breakdown of the information from the DIDR form is given by appliance type. The numbers of faults by main fault groups, are itemised in Figure 21. A breakdown of the type of fault within each main group is presented in Figure 22.

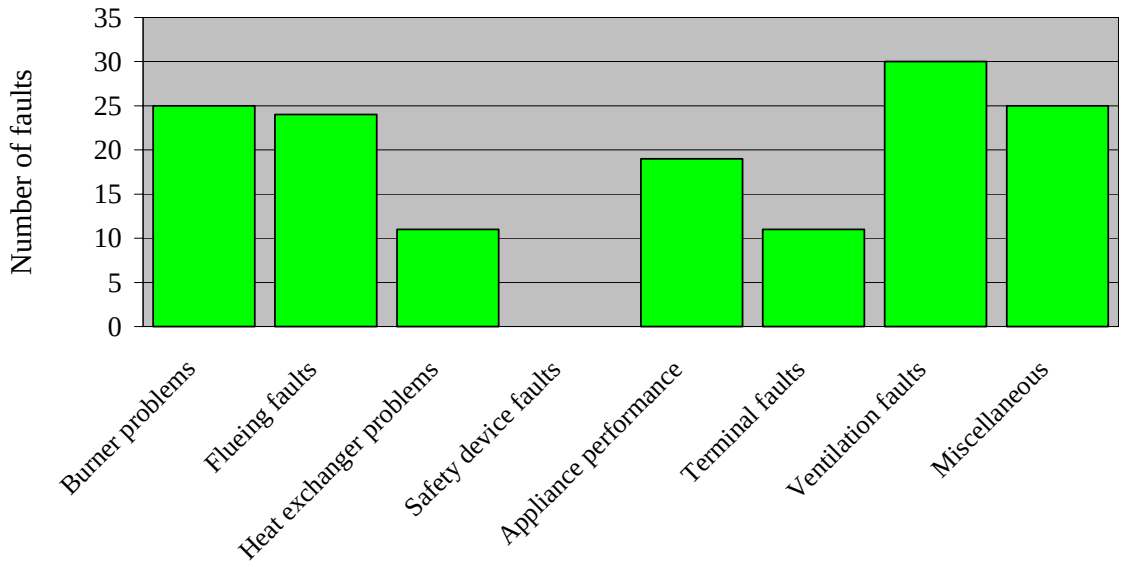

Figure 21 - Main fault groups

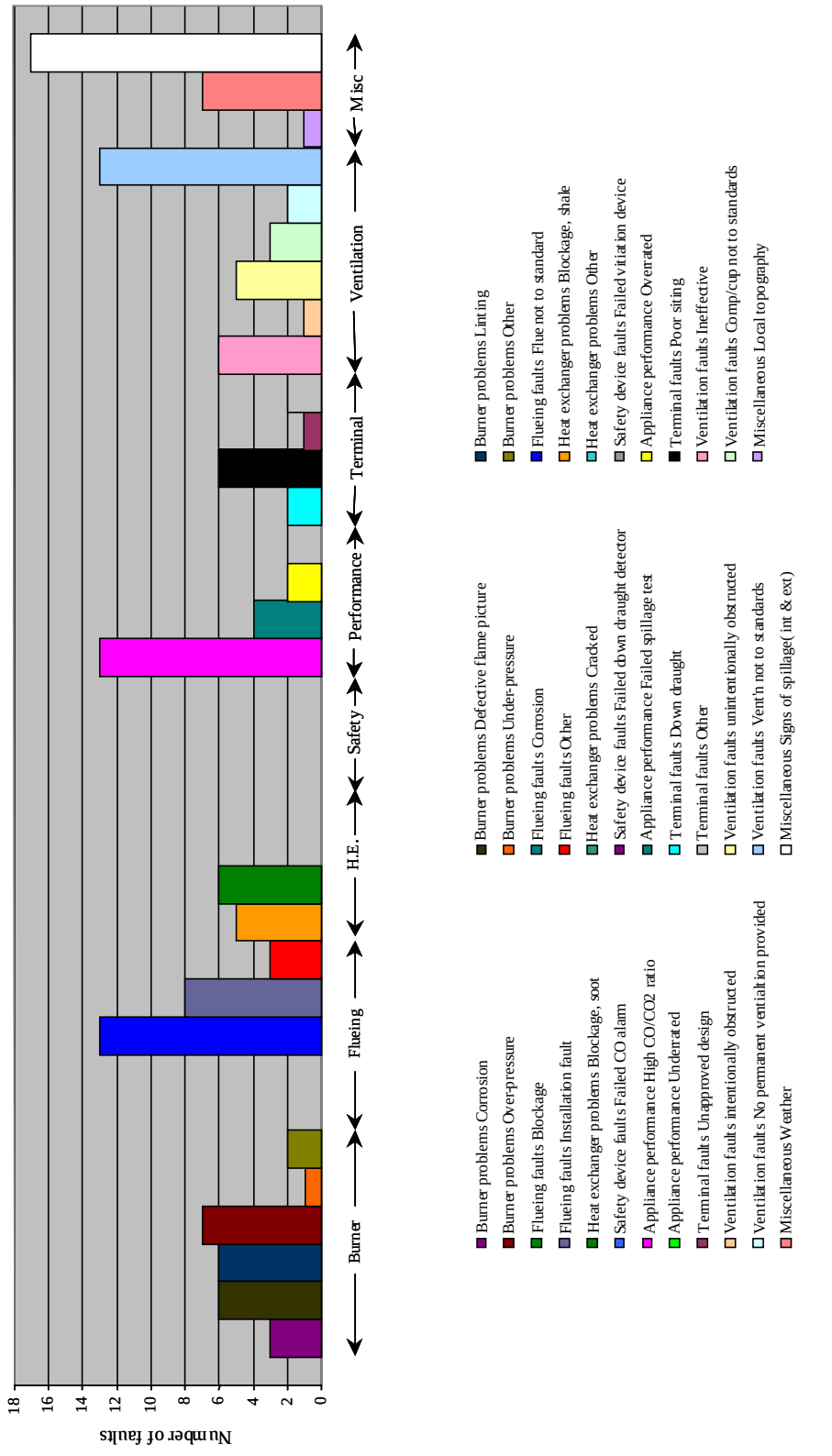

Figure 22 - Individual faults

Table 22 - Incident appliance faults

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

Note to Table 22:
The numbers quoted are the number of appliances found with the fault listed.
The details of the burner "other" comments are as follows: Leaking (floor standing boiler), lightback (wall mounted combi).
The details of the flue "other" comments are as follows: Excessive external fall (floor standing boiler), leaking through inspection plates (floor standing boiler), open flue appliance without any flue.
The detail of the terminal "other" comments is as follows: Chilling (floor standing boiler), extension built over terminal (wall mounted boiler).

There were 7 cases where additional information was given of signs that the appliance required servicing.

The burner pressure test results indicated that 10 were correctly set, 7 were set high, 1 was set low, 2 were not tested, and information was not provided for 6. The appliance rating test results were lean in numbers, 2 appliances were set high, 4 were correctly set, tests were not possible at 3, and no information was given on the remaining 17. The CO/CO_2 test results indicated that 13 appliances had a high reading, 6 had a correct reading, tests were not possible at 2, and in 5 cases no information was given.

In 10 (37%) incidents CO from the incident appliance was proven to be able to enter the incident property when tested in the as-found condition. At the same number of sites a sufficient concentration of CO was measured to have been produced by the incident appliance such that were an occupant exposed to the combustion products it would replicate the test results of the level of COHb found in the victim/victims. In 8 (30%) incidents it was also indicated that the concentration of CO could be achieved in the available time.

2.11 INCIDENT APPLIANCE SERVICE HISTORY - ANALYSIS OF SECTION 11 OF DIDR

The information provided, related to the service contract details, is given in Table 23.

Table 23 - Details of the service history

Servicing details	*Number of tick-boxes completed*
On a regular service contract	5 (19%)
Not on a regular service contract	16 (59%)
Unknown if on a regular service contract	6 (22%)

Analysis of the number of tick boxes completed for the "last working visit" is given in Table 24.

Table 24 - Details of the reasons given for the last working visit

	Reasons for the visit							
Last working visit by:	***Breakdown***	***Report of fumes***	***Safety check / inspection***	***Service***	***To install the incident appliance***	***Other***	***Unknown***	***Total***
CORGI registered installer	0	2	5	6	0	1	1	15
Non-CORGI registered installer	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	12	11
TOTAL	**0**	**2**	**5**	**6**	**0**	**1**	**13**	**27**

Analysis of the number of tick boxes completed, for the time period involved between the last working visit and the incident, is given in Table 25.

Table 25 - 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	4 (15%)
6 months to 1 year	3 (11%)
1 year to 2 years	4 (15%)
More than 2 years	3 (11%)
Unknown	10 (37%)
Not applicable	3(8%)

At 1 site a boiler had been condemned unsafe and disconnected. This led to use of a gas fire in the bedroom and resulted in 2 fatalities. The open flue gas fire had escaped inspection otherwise it too would have been disconnected as no flue arrangement had been made.

A breakdown of the 5 sites where regular servicing on contract basis was confirmed is given in Table 26.

Table 26 - Details of those on a regular service contract

	Reasons for the visit							
Last working visit by:	***Breakdown***	***Report of fumes***	***Safety check / inspection***	***Service***	***To install the incident appliance***	***Other***	***Unknown***	***Total***
CORGI registered installer	0	1	2	1	0	0	1	5
Non-CORGI registered installer	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0
TOTAL	0	1	2	1	0	0	1	5

2.12 HISTORICAL INFORMATION - ANALYSIS OF SECTION 12 OF DIDR

No safety warning notices had been attached to any of the incident appliances, or at the gas meter, prior to any incident. It was reported that the incident appliance had been inspected, prior to the incident, due to reports of fume spillage at 1 site. There was 1 report of an incident installation having been inspected following reports of fume spillage. The occupants reported experiencing symptoms, typically associated with CO poisoning, at 6 incident sites. There were no reports indicating that any incident appliances/installations had been previously disconnected following reports of fume spillage.

2.13 INCIDENT CAUSE/CAUSES - ANALYSIS OF SECTION 13 OF DIDR

Details of the reported cause/causes of all the incidents are summarised in Table 27. There were multiple entries on some DIDR forms in this section. This results in the total number of causes given exceeding the total number of incidents. Within section 2.10 it is reported that the weather is thought to have contributed to the poor performance of the appliance in 7 incidents and that the local topography featured in 1 incident.

Table 27 – Incident causes

Incident cause (s)	***Total number recorded***
Appliance fault	9
Appliance installation fault	4
Customer misuse of the appliance	2
Flue/terminal fault	9
Lack of servicing	15
Sub-standard compartment	0
Sub-standard servicing	0
Ventilation fault	11
Not known/not yet established	1
Other	6

Note to Table 27:
The causes indicated under "other" were as follows: Chilling of external flue, poor level of service carried out, 4 cooker burners left on for up to 17 hours, down draught and spillage caused inadvertently due to installation of UPVC double glazing, extension built over flue terminal so boiler discharging into property, no chimney or flue fitted to open flue fire.

3 GENERAL DISCUSSION

This is the ninth annual analysis of CO incident data by Advantica from information provided by the adoption of the DIDR form within the gas industry.

The types of incidents featured in 2004/05 were similar to previous years. The majority of incidents (20 out of 27) involved open, individual, natural draught flue appliances. The next largest groups consisted of 3 room sealed, individual, natural draught, balanced flue appliances. Central heating appliance incidents resulted in 81% (46 out of 57) of the total number of fatal and non-fatal casualties. The next highest appliance group in terms of casualties was space heaters at 11%.

There were 6 incidents with fatal casualties, the total fatality count for the year was 7. Central heating appliances were implicated in 3 separate incidents each with 1 fatality. A single gas fire incident was responsible for 2 fatalities. In the 2 remaining fatal incidents, the appliance in 1 was a free standing cooker, and in the other it was a single-point water heater. Out the 6 incident sites with fatalities there were 2 that had non-fatal casualties as well.

In addition to the 6 domestic natural gas incidents with fatalities, an further fatal casualty was recorded in an incident related to use of LPG in a caravan. There were no non-fatal casualties associated with this case. Further information on this incident is given in Appendix C.

A CO related incident around the swimming pool area of a hotel resulting from the use of natural gas in a boiler located in the plant room below is covered in Appendix D. This incident resulted in 6 members of public being exposed to CO, though details regarding the extent of the injury were not provided.

Details of an incident that did not feature in last year's report are given in Appendix E. This incident resulted in 3 non-fatal casualties. Figures for 2003/04 in Table 3 (section 2.2) have been updated accordingly.

Additional information was also obtained on the age of appliances used within Great Britain. This is presented in Appendix F.

3.1 INCIDENT DETAILS

The number of domestic natural gas CO incidents fully investigated, reported and analysed in this report was 27. The majority of these incidents took place during the heating season, which is in line with previous records. Figure 1 shows a very similar profile in each of the previous reports issued.

A study of the postcode regions in which the incidents occurred showed that the West Midlands with 9 had the highest proportion. Other areas with multiple incidents were Yorkshire with 5, South Wales with 4, and there were 2 each in the counties of Hampshire and Norfolk.

The total number of domestic natural gas incidents at 27, was the lowest reported since these records started. For the years 1996/97 to 2004/05 the total number of incidents reported falls within a band of 69.5±42.5 (27-112). Examination of Figure 4 shows continuation of the general downward trend in the number of reportable CO incidents being investigated from year 2000/01 onwards. The incident total for the reporting period is the lowest on record, and doubts remain as to whether all the submissions had been made by the cut-off date for this analysis.

The value of the over all IPPY for 2004/05 was also the lowest recorded as part of this series of reports, at 0.57 x 10^{-6}, and it falls well below the band of 1.59±0.80 x 10^{-6} obtained between the years 1996/97 and 2003/04.

3.2 CASUALTY DETAILS

The total number of fatalities reported, at 7, was also the lowest since these records started. The previous minimum had been 8 in 2003/04. For the years 1996/97 to 2003/04 the number reported had been 16.0±8.0 (8-32). The data shown in figure 3 indicates a noticeable reduction in the number of annual CO fatalities that are being reported on the DIDR forms over the last 5 reporting years. The over-all FPPY value of 0.15 x 10^{-6} is the lowest figure calculated since the commencement of this series of reports in 1996/97. This value of FPPY 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 risk considerations.

The total number of non-fatal casualties recorded, at 50, is again the lowest on record, and suggests that the increase shown in last year's figures was a blip. Between 1996/97 and 2003/04 the non-fatal casualty range had been 158.5±89.5 (69-248). If the figures for the 4 reporting periods from 01/02 to 04/05 are examined, the downward trend is only interrupted by the number for the 03/04 period. The lowest total number of casualties leads to the lowest calculated value for the over-all CPPY (1.05 x 10^{-6}) since the start of the reporting periods from 1996/97 onwards. The most serious casualties (in group N1, where casualties spent over 24 hours in hospital) were recorded at 7 persons for 2004/05. This demonstrates a number right at the bottom of the range recorded over the preceding 8 years of 28, 20, 49, 16, 47, 18, 13 and 13.

The ratio of the number of non-fatal casualties against fatalities has ranged between 5.5 and 14.6 over the previous 8 years. For 2004/05 the ratio was 7.1. The value is towards the low end of the band, and also low when compared with the corresponding figure of 10.3 for the previous year when both categories of casualty numbers were higher. The highest ratios are obtained in the years when the number of non-fatal casualties has exceeded 200. The numbers of non-fatal casualties reported is, in general terms, dependent on the number of DIDR forms submitted and this is in turn dependent on the number of CO incidents reported. When the ratio of the number of non-fatal casualties against the number of DIDR forms submitted is examined for the last 8 years it shows a range of 1.77 to 2.45. The ratio for 2004/05 was 1.85. Current indications are that not all incident reports for the 2004/05 period have been made available in time to be included for the statistics presented in this report.

The casualty age profile, shown in Figure 5, may be examined by comparing fatal and non-fatal numbers in isolation with earlier years. Whilst the non-fatal age distribution shows similarity with the figures given in the previous 8 reports of this series, the low number of fatal casualties reported gives a scatter and making a comparison is not worthwhile. There were no fatalities in the 0-20 years age grouping (there were 3 in this age band in the previous year), and 4 of the 7 deaths were in the 20-50 year band.

Looking at the demographics for Great Britain for mid 2004, obtained from the Office for National Statistics, it is once again borne out that those aged between 31-40 feature in a significantly higher proportion of incidents than their representation of the population. The age bands 41-50 appear in a lower proportion of incidents, and those in the 51-60 and 61-70 depict a significantly lower and declining trend of featuring in incidents when compared to their proportion of population.

The overall conclusion is that that during 2004/05 a lower number of incidents were fully investigated and reported on the DIDR form than in any of the previous periods. These incidents resulted in below average numbers of fatal and non-fatal casualties. This conclusion needs to be qualified because it is not absolutely certain whether all the incidents over the period covered by this report have been captured in time.

3.3 INCIDENT LOCATION DETAILS

Examination of Table 5 (section 2.3) giving occupancy statistics reveals a fairly even split in the number of incidents between owner occupied properties and tenanted properties. In general, in previous reports there were usually at least twice as many incidents in owner occupied properties as opposed to tenanted properties, the exceptions being 1997/98 and 2002/03 where the diversity was not as wide. The proportion of incidents in owner occupied properties at 52% is well below the corresponding occupancy statistics at 70% for Great Britain. In contrast the proportion of incidents in tenanted properties at 48% is higher than the 30% occupancy figure. Within the tenanted group the incident number split between privately owned (7) and council owned (6) maybe broadly regarded to be even. When the tenanted group numbers are examined along the lines of single and multiple occupancy the respective split is 7 and 6. At 22% the proportion of incidents in multiple occupancy properties is outside the range of between 30% and 40% that has been seen several times in previous reports of this series.

When a relative risk analysis is carried out, it emerges that tenanted/privately owned accommodation is the area of greatest relative risk. Tenanted/privately owned accommodation also featured as the highest relative risk category in all the previous CO analysis reports. For 2004/05 no incidents were recorded in the tenanted/registered social landlord group, and the owner occupied property emerged as the lowest risk factor sector.

Relative risk factors (the overall average factor is based on multiplication by 100 of the number obtained by division of percentage split of DIDR reported incidents for that group by the national percentage occurrence of that group) show that the tenanted/council group has a relative risk factor of 209. Using the figures quoted in Table 5 (section 2.3) this figure was calculated as follows ((22.2/10.6) x 100) = 209. In comparison the tenanted/privately owned accommodation has a relative risk factor of 240. No incidents were reported in the tenanted/registered social landlord group. The risk factor calculated for owner occupied properties comes out at 74.

Incidents took place more often in terraced properties, than in other property styles, during the period 1996/97 to 2003/04, and this trend continued during 2004/05. The proportion of incidents taking place in each property type is much the same as previous results with 74% in houses, 22% in flats and 4% in bungalows.

As in previous years, the number of incidents that took place across all property styles is not in agreement with the proportions of each type of property in the housing stock in Great Britain. This is shown in Table 7 (section 2.3). Terraced properties (27% of accommodation) had the highest proportion of incidents (55.6%), displaying a wide gap of 28.6% above that expected from a comparison with the proportions of each type of property within Great Britain. Looking at previous years this property style has since 1997/98 always featured in more incidents than that expected from a comparison with accommodation statistics. This year, at 28.6% it is comprehensively above the previous high of 21.2% recorded in 2003/04. Comparable values for 2001/02 and 2002/03 were 16% and 15.3% respectively.

Incidents in detached and semi-detached properties have generally featured below expected levels over the past 8 reporting years. For the period of this report a detached property was subject of only I incident. For detached and semi-detached properties the level of incidents during 2004/05 was again below that expected from a comparison with accommodation statistics, by 18% and 14%. The reasons why different property styles are generally always above or below expected levels are unclear.

Where the age of the incident property was specified, and then compared to the age profile of properties in England, it indicates that properties built before 1945 featured in 58% of incidents with the build proportion at 38%. This is the sixth time within the 9 reports that the period before 1945 has featured in more incidents than expected, previously by between 11% and 24%. The proportion of incidents for build period from 1946 to 1965 at 23% is nearly in absolute alignment with the build number of 22%. This is in contrast to the 2002/03 figures where this sector was disproportionately higher with 38% of incidents.

The glazing details of properties in England are compared to the incident details in Table 9 (section 2.3). It indicates that the number of incidents that take place in single and double glazed properties is broadly in line with what would be expected. The inference is that the relative risk factor is independent of glazing details. It is interesting to note that according to the 2004/05 ODPM Survey of English Housing, 71% of all housing stock is fully double-glazed.

3.4 CASUALTY & APPLIANCE LOCATION

In variance with previous years, there was no single eminent location for appliances that featured in incidents. There were 4 incidents involving appliances located in the kitchen of the property, and the same number of incidents arose due to appliances located in the living room/lounge. These locations are very much in accordance with standard practice for the majority of domestic gas appliances. The location of 5 appliances was classified as “other”. The highest number of casualties was assigned to the living room/lounge followed by the bedsit where there were 3 contributing incidents. In previous years the highest number of casualties have been located in the bedroom followed by the living/room lounge. Further examination of Table 10 shows that only a fraction of the casualties were reported in the same room as the appliance. This confirms the fact that, in general, appliances located in other rooms are liable for the bulk of the casualties assigned to the bedroom and the living room/lounge.

There was one incident report which showed that the incident took place with the casualties and incident appliance located in different properties. The case related to a terraced property where the flue of a wall mounted boiler was terminated in a covered passageway between the houses.

Analysis of the floor on which incident appliances were located shows that the majority (19 out of 27) were on the ground floor. This ties in with the layout of the housing stock, as in general the kitchen and the living room/lounge is on the ground floor where the appliance is most likely to be located. Information relating to the proportion of national appliance population installed in compartments is not available, but it is likely to be a significantly lower percentage than the number of incident appliances located in compartments (22%).

3.5 INCIDENT APPLIANCE DETAILS

The total number of 27 incidents was made up of 4 categories of appliances, 20 were central heating boilers, 4 were space heaters, 2 were water heaters, and 1 was a cooker. The numbers featuring in each appliance type are given in Table 15 (section 2.5.4). A cooker has reappeared in the statistics after being absent for the only time ever in the 2003/04 data. There was however a significantly lower “total” number of incidents reported during 2004/05 compared to previous years. As previously reported central heating boilers were involved in the majority of CO incidents and were accountable for the majority of fatal and non-fatal casualties.

The fatality trend table (Table 16, section 2.5.4) demonstrates that natural gas appliances have been implicated in a declining number of fatalities over the 9 reporting periods. In 2004/05 the total count at 7 is the lowest on record and compares with 8 witnessed in 2003/04. Wall mounted combi boilers were responsible for 2 fatalities (2 incidents), open flue radiant convector fire for 2 similarly (1 incident), and there was 1 each involving a back boiler unit, a floor standing cooker, and a single-point water heater.

The number of fatalities related to each appliance type has varied each year and from 2000/01 onwards the total number has declined consistently. Some high volume appliances, i.e. floor standing boilers, floor standing combi boilers and wall mounted boilers were not implicated in fatal incidents. There were also no reports of any incidents related to the use of multi-point water heaters, which has previously featured with high FPPY values. The reason for the sharp drop in the total number of fatalities in 2004/05 and the general overall yearly decline is not yet apparent.

Boilers, gas fires, cookers, and water heaters are the 4 appliance types that feature in fatal incidents for the current year. A solo incident involving a single-point water heater and giving rise to 1 fatality resolves to an FPPY value of 2.66×10^{-6} for this appliance type. The 2 types of boilers involved in fatalities (back boiler unit, wall mounted combi) have FPPY values significantly below what would normally be considered as the "broadly accepted region" of HSE's criteria for the tolerability of risk (1×10^{-6}). An examination of Table 17, within section 2.5.4, shows the risk value of boilers associated with incidents covered in this report to be in a narrow range of $0.12\text{-}0.16 \times 10^{-6}$. Wall mounted boilers implicated in 4 fatalities, and floor standing in 1, in the previous report of this series are conspicuous for their absence.

The majority of non-fatal casualties (43 out of 50) continue to be related with central heating boilers. The number of non-fatal casualties associated with all central heating boilers is 14 times the corresponding number of fatalities sustained. During the previous 8 reporting years this ratio has averaged just below 15. Since the fatality count at 3 is low the proximity of the casualty ratio to the average ratio suggests a matching trend in the non-fatal casualty number. The previous lows were 8 in 1996/97 and 7 in 1999/00.

Wall mounted combi boiler incidents were accountable for the highest number of non-fatal casualties, followed by floor standing boilers and wall mounted boilers. However looking at the CPPY values in Table 14, warm air units were the highest risk at 4.88×10^{-6}, followed by floor standing boilers at 3.34×10^{-6}. The "highest risk" appliances in the previous year were the floor standing boiler and the wall mounted boiler respectively.

For 2004/05, single-point water heaters were the highest IPPY risk (2.66×10^{-6}), followed by the circulator (1.41×10^{-6}). Each of these appliances was involved in a single incident, however the high values are directly attributable to the relatively small appliance population.

There were no reports of any incidents involving condensing appliances or tumble dryers during this reporting period, nor in the previous 8 years already reported, even though they are now becoming more common in domestic properties. Condensing boilers have modern safety features and controls with a room sealed balanced flue. The accumulative operating hours would tend to be low and if correctly installed and serviced it is unlikely that they will feature in CO incident reports for some years. Tumble dryers also have modern safety controls, a low gas input rate and only a small installed population. They are also unlikely to feature in CO incident reports if recommended installation and service requirements are followed.

In line with previous results, many installations feature sub-standard flue and ventilation arrangements in conjunction with a lack of servicing. Data on the age of incident appliances is often not specified but where provided, it was mainly for central heating boilers. To address this issue GfK were requested to provide information via their annual survey. This information has been included in this report within Appendix F. Although the age bands are not consistent for each appliance group, GfK were able to obtain informative data for some of the appliances.

Central heating appliances appear to be spread right across the age bands, except for combi boilers. Being a newer product these are relatively younger in age. Cookers and space heaters also appear to be spread right across the age bands, with considerable numbers of space heaters over 8 years old. Information on water heating appliances has been the most difficult to obtain and little data has been provided. The age was unknown in the majority of cases.

3.6 APPLIANCE INSTALLATION DETAILS

According to Table 18 – Installation period for incident appliances (section 2.6), 11 out of 27 appliances were confirmed to be new at installation, however this figure needs be viewed in the context that information about the remaining units was unavailable. This table includes more data than that given in Table 13 – Age of incident appliances (section 2.5.1). The limited data available shows that no appliance in the 0-5 years age band was involved in an incident. Disregarding the unknown age column, the 11-15 years age band shows the highest number of incidents.

The appliance had been installed either to current standards or to standards current at time of installation in only 4 out of 27 cases. There were 18 appliances not fitted to any standard, of these 17 were undertaken by an “unknown person”, and surprisingly 1 was marked to be by a CORGI installer. In 2 incidents where the installer was deemed to be CORGI registered the “Unsure/don’t know” box was ticked where an assessment of the standard of appliance installation is made on the DIDR form. In 23 incidents out of the 27 analysed for this report, information on the category of the person who carried out the installation was not provided.

3.7 FLUE DETAILS

Excluding the 2 flueless appliances, the majority of incidents at 80% (20) involved open flued, individual, natural draught appliances (includes the incident where an open flue appliance was fitted without a flue). This replicates what has been seen in previous years. At 56% (14) over half of all the flues fitted/omitted were marked as not installed to appropriate standards, furthermore in 32% (8) of all incidents where a flue was fitted, the flue had an installation defect. There were no reported instances of flue blockage or failed continuity check. This may partly be due to inability or redundancy to carry out on-site checks as dictated by the specifics of the incident appliance. There were 6 flue terminals reported to be badly sited and 2 flues that were liable to suffer from downdraught problems. Basic flue and terminal installation faults should be picked up during routine servicing of open flued appliances, so this is an area where the gas operative requires continued diligence.

The weather was thought to contribute to the poor performance of the appliance in 7 of the 27 incidents and the flue was susceptible to chilling at 3 sites. All of these were central heating boilers, 2 being floor standing and 1 was a wall mounted combi. The 3 sites where the flue was susceptible to chilling were also sites where the weather was deemed to contribute to the poor performance of the appliance.

Weather related factors are common in CO incident reports and are probably related to the fact that most incidents occur during the cold and/or windy months of the year. In fact peak numbers of incidents have previously been noted on some of the coldest, calmest days of the year. Additionally when a cold northerly or easterly wind is experienced there is often an increase in the numbers of CO incidents.

3.8 PERMANENT VENTILATION

This section of the DIDR form was only completed for 20 incidents, and details in many of these were sparse. Out of the 20 returns, 19 forms were marked to show that permanent ventilation was required (omission was a balanced flue cupboard installation), and it was confirmed as provided in 17 cases. The installation was assessed to be not to standard in 13 (68%) and had become ineffective due to restriction in 6 (32%). Such factors can also affect flue performance and, in combination with other faults, are generally acknowledged to contribute towards the causes of CO incidents. Details of the numbers of ventilation faults noted at incidents are given in Table 22, within section 2.10. It has been noted in previous reports that incident appliances installed in compartments feature in a higher percentage of incidents than would be expected with respect to their population. The results of this analysis show that of the 6 incident appliances located in compartments, only 3 complied with the applicable standards.

Ventilation is a common fault found at incident sites, it is an element that can be improved by continued customer awareness campaigns and during routine servicing. The typical faults found should be apparent during routine servicing by gas operatives and are relatively simple to identify and rectify. In order for open flued appliances to be used safely their operation needs to be checked annually and any deficiencies in ventilation brought up to current standards.

3.9 SAFETY DEVICES

In the 2003/04 report of this series the only safety devices that had been recorded were 2 downdraught detectors. For this report 6 sites reported safety devices of which 4 were CO alarms. Of the 4 sites with CO alarms 1 had a downdraught detector, and another a vitiation device in supplement.

The number of CO alarms reported in a low overall total of incidents is interesting. It remains to be seen if this is pointing towards more widespread use of the device as a result of public service TV/radio broadcasts warning of the dangers of CO .

3.10 ON-SITE CHECKS

A combination of factors were present at most incident sites, often several separate occurrences were the cause for the production of CO, particularly a combination of flue and ventilation faults. It was found that there were often similar faults on the appliances e.g. the appliance had a high CO/CO_2 ratio and was spilling products. There was also a defective flame picture, the burner pressure was incorrect and there was a blockage in the heat exchanger and/or flue. These were the most common faults noted from the on-site checks. Such faults would be addressed during routine servicing if it was carried out at recommended intervals. There were signs of spillage on the outside of the appliance, which would be apparent to the occupants, at 7 (26%) of the sites.

Details of the numbers of faults noted at incidents are given in Table 22, within section 2.10. To a greater or lesser extent, almost all of the faults listed on the DIDR form have featured somewhere and have been observed during an investigation. It can be concluded that the need for annual servicing and promotion of awareness of the signs of poor operation of gas appliances are matters that need to be continually brought to the attention of gas consumers.

3.11 INCIDENT APPLIANCE SERVICE HISTORY

From the information provided only 5 of the 27 incident appliances were covered by a regular service contract. Based on this small batch of data, and assuming it is a representative sample of the market, it would appear that only about 1 in 5 of the appliances are regularly serviced. In this category, 3 of the last 5 visits were for safety check/service reasons whilst the other one was due to report of fumes, and the reason for 1 was not stated. It is noticeable that there was no callout as a result of a breakdown of an appliance and all work was carried out by a CORGI registered engineer.

In the case of appliances where no service contract was in place (15), the reason for the last visit was given in 8 incidents. All the calls were identified to be by CORGI fitters, 6 were for safety check/service reason, 1 due to report of fumes, and the reason for 1 was not given. There could be several reasons for the shortfall in service history information, one being that the person with the information is not available at the time of the inspection. It is likely that a lot of the work carried out is so irregular that many customers only arrange for the work to be done as and when required, and by whoever is locally recommended or contactable. With few appliances having a logbook it is difficult for a history to be maintained of when and who carried out work on an appliance.

3.12 HISTORICAL INFORMATION

Details entered in this section indicate that only a small proportion of incidents featured incident “appliances” or incident “installations” which had previously been inspected following reports of fume spillage. When questioned, occupants at 6 (22%) of incident sites said that they had experienced symptoms typically associated with CO poisoning. It would be expected that, at most CO incidents, the levels of CO produced by the incident appliance would build up progressively over a period of time. The reasons and situations why occupants seem to be only seriously affected above a threshold value, and on a particular day, are beyond the scope of this report, but what is apparent is that many typical faults and servicing issues are recurrent at most incident sites and that, by addressing these, many incidents could be avoided.

3.13 INCIDENT CAUSE/CAUSES

An analysis of the incident causes as given on the DIDR forms, highlights that the most frequent causes identified in descending order were a lack of servicing, flue/terminal faults, and ventilation faults. This finding is in general consistent with figures reported in the previous annual statistical reports. Lack of servicing was quoted at 15 sites, ventilation faults were cited at 11, and a flue/terminal fault was marked out at 9 sites. There were 5 sites where a ventilation fault and a flue/terminal fault featured in combination as the cause of the incident. Appliance fault was marked out for 9 sites, and the weather was identified as having contributed to the poor performance of the appliance at 7 sites. The incident cause/causes information confirms the details already given in previous sections of this report. There is no doubt that a substantial number of CO incidents could be prevented by regular, thorough safety checks and/or servicing.

4 SUMMARY

4.1 The number of domestic natural gas CO poisoning deaths reported, at 7 during 2004/05, was the lowest recorded since the DIDR system was introduced in 1996/97.

4.2 The over-all FPPY figure of 0.15×10^{-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 numerical considerations. This was also the lowest value recorded since the DIDR system was introduced in 1996/97.

4.3 The only appliance type that was above the HSE's criteria for the tolerability of risk was a single-point water heater (FPPY value 2.66×10^{-6}).

4.4 During 2004/05 the number of incidents was almost evenly split between owner occupied and tenanted properties. Over the same period the calculated risk factor for a CO incident is relatively higher for a tenanted property than for an owner occupied property.

4.5 Incidents took place more often in terraced properties than in other property types.

4.6 The most common room for casualties was the living room/lounge followed by the bedsit type of accommodation.

4.7 The majority of CO incidents involved appliances fitted with open, individual, natural draught flues.

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

4.9 The most widespread incident cause was a lack of servicing followed by a ventilation related fault.

4.10 Flue and ventilation faults were concurrent at many CO incident sites.

4.11 There was 1 LPG incident in a mobile caravan, involving 1 fatality, over the term of this report.

4.12 There was 1 natural gas incident in commercial premises where 6 members of public were exposed to CO.

5 CONCLUSIONS

Analysis of the CO incident statistics, collected from the Downstream Incident Data Report form, has produced results in line with the previous 8 reports. The analysis has identified the most common faults found at CO incident sites. This information can be used to improve customer safety, target expenditure on CO incident prevention and provide focus for further research work.

6 RECOMMENDATIONS

6.1 There is a continuing need to collect and analyse information from CO incidents. Without this information the safe operation of gas appliances cannot be quantified nor can any repetitive occurrences be quickly identified. Furthermore the risks associated with long term use of gas appliances, and the impact of changes in installation standards can only be evaluated by using the findings of this information and further assess if any change in procedures is warranted.

6.2 The data should be made available to all interested parties, i.e. those concerned with the transportation, supply and use of gas. In particular, those engaged in the installation and maintenance of gas appliances need to be regularly informed.

7 DATA USED AND REFERENCES

7.1 DATA USED

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

7.1.2 Number of domestic natural gas customers – number supplied by Xoserve (Domestic Supply Point counts, April 2005 - 20,830,816).

7.1.3 Population & Housing Statistics for Great Britain/England - 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. Housing data has been obtained from the Survey of English Housing and other data published by the Office of the Deputy Prime Minster.

7.2 REFERENCES

7.2.1 Definitions of FPPY, CPPY and IPPY (see Appendix A) – From Advantica historical 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 (2.29 in 2004/05) and is obtained 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) Non-fatal 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 B/A1 shows the breakdown of tables included in this Appendix. They have only been completed for the appliance groups where there were relevant incident appliances to describe. The appliance groups have been ordered in the same way as that used in Table 12, (section 2.5.1. of the report) and within section 2.5.2 of the report.

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. This can aid the comparison on a year-by-year basis. However some appliance groups may not have been implicated in incidents in any particular year and so they are indicated in this appendix as “no reported incident”.

In the tables, details are given for each appliances’ flue and ventilation provisions and whether they were to “current” standards, or to standards “current when installed”. Where there is no entry in the table then the provision was either “not to any appropriate standards”, the investigator was unsure/didn’t know if the item was to standards, or the investigator did not make an entry on the DIDR form.

Note: Some appliance models may appear under several different manufacturers’ names within Appendix B. For example Apollo boilers have previously been entered into the database under both Thorn and Myson makes.

Table B/A1 – Summary of incident fault analysis and summary tables presented

Appliance group	*Appliance sub-group*	*Code*	*Incidents*	*Appendix tables*
Central Heating Boilers	Back boiler unit	1.1	3	B.1.1a & b
	Floor standing	1.2	6	B.1.2a & b
	Floor standing combi	1.3	0	No reported incident
	Thermal storage unit	1.4	0	No reported incident
	Wall mounted	1.5	4	B.1.5a & b
	Wall mounted combi	1.6	6	B.1.6a & b
	Warm air unit	1.7	1	B.1.7a & b
	Other	1.8	0	No reported incident
Cookers	Free standing	2.1	1	B.2.1a & b
	Built-in oven	2.2	0	No reported incident
	Built-in hob	2.3	0	No reported incident
	Other	2.4	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	0	No reported incident
	Flueless heater	3.4	0	No reported incident
	Inset live fuel effect g .f.	3.5	1	B.3.5a & b
	Rad. & rad. con. g .f.	3.6	3	B.3.6a & b
	Wall heater	3.7	0	No reported incident
	Other	3.8	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	1	B5.4a & b
	Other	5.5	0	No reported incident
Other	Other	6.1	0	No reported incident

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

Table B/A2 – Appliance location and flue type codes

Appliance location	*Code*	*Flue type*	*Code*
Other	0	Other	0
Bathroom	2	RS/Indiv/Natural draught/BF	1
Bedroom	3	RS/Shared/Se-duct	3
Bedsit	4	RS/Shared/U-duct	4
Dining Room	6	Open/Indiv/Natural draught	5
Utility Room	7	Open/Indiv/Fanned/Integral	6
Garage	8	Open/Indiv/Fanned/Add on	7
Hall	9	Open/Shared/Natural draught	8
Kitchen	10	Open/Shared/Fanned draught	9
Landing	11	Closed	10
Living Room/Lounge	12	Flueless	11
Shower room	13	Unbalanced	12
		RS/Indiv/Fanned draught/depressurised case	21
		RS/Indiv/Fanned draught/pressurised case	22

Table B/A3 – Cause of incident codes

Cause of incident	*Code*
Other	0
Appliance fault	1
Appliance installation fault	2
Customer misuse of the appliance	3
Flue/terminal fault	4
Lack of servicing	5
Sub-standard compartment	6
Sub-standard servicing	7
Ventilation fault	8
Not known/not yet established	9

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 = 3

Fault group	*Number of faults*		*Fault group*	*Number of faults*
Burner			**Appliance performance**	
Corrosion	0		High CO/CO_2 ratio	1
Defective flame picture	0		Failed spillage test	1
Linting	1		Overrated	0
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	1		**Ventilation**	
Installation fault	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	1
Other	0		**Miscellaneous**	
Safety device			Local topography	0
Failed CO alarm	0		Weather	0
Failed down draught detector	0		Signs of spillage – outside the appliance	1
Failed vitiation device	0		Signs of spillage – inside the casing	1

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*	*Incident cause(s)*
PO15	(1)	15	6	Unknown		Current	Baxi 401	5	5
CF39	1	23	6	CORGI			Glow-worm 45	5	4,5
CF39	(1)	12	12	Unknown			Baxi Bermuda 552	5	-

B.1.2 FLOOR STANDING BOILER

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

Number of incidents = 6

Fault group	*Number of faults*		*Fault group*	*Number of faults*
Burner			**Appliance performance**	
Corrosion	0		High CO/CO_2 ratio	3
Defective flame picture	2		Failed spillage test	2
Linting	1		Overrated	0
Over-pressure	0		Underrated	0
Under-pressure	0		**Terminal**	
Other	1		Down draught	0
Flue			Bad siting	1
Blockage	0		Unapproved design	0
Corrosion	0		Other	1
Flue not to any standard	4		**Ventilation**	
Installation fault	3		Air vent/vents ineffective	3
Other	2		Air vents obstructed - intentionally	0
Heat exchanger			Air vents obstructed - unintentionally	3
Blockage - shale	0		Compartment/cupboard not to any standards	0
Blockage - soot	1		No permanent ventilation provided	0
Cracked	0		Ventilation provided was not to any standard	6
Other	0		**Miscellaneous**	
Safety device			Local topography	0
Failed CO alarm	0		Weather	2
Failed down draught detector	0		Signs of spillage – outside the appliance	1
Failed vitiation device	0		Signs of spillage – inside the casing	2

Table B.1.2b - Central heating boilers : Floor standing boiler : Incident summary

Post Code	*Number of casualties: fatal*	*Appliance age (yrs)*	*Appliance location*	*Installer*	*Flue to standards*	*Ventilation to standards*	*Appliance make & model*	*Flue type*	*Incident cause(s)*
DA15	(4)	20	9	Unknown			Potterton Kingfisher CF40	5	5
BD23	(2)	17	0	Unknown			Ideal Mexico CF80	5	0,4,8
LS13	(2)		0	Unknown			Ideal Mexico CF120	5	1,4,8
SE1	(2)		0	Unknown			Clyde CKCIP	9	4,8
BA11	(3)		4	Unknown			Stelrad Mexico Super CF55	5	8
B36	(2)		10		Current		Potterton Kingfisher CF60	5	5

Note: The appliance location at BD23 given as "other" was cellar.
The appliance location at LS13 given as "other" was cellar.
The appliance location at SE1 given as "other" was basement.
The incident cause at BD23 given as other was "chilling of the external flue".

B.1.3 FLOOR STANDING COMBI – NO REPORTED INCIDENT

B.1.4 THERMAL STORAGE UNIT– 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 = 4

Fault group	*Number of faults*		*Fault group*	*Number of faults*
Burner			**Appliance performance**	
Corrosion	2		High CO/CO_2 ratio	1
Defective flame picture	0		Failed spillage test	0
Linting	1		Overrated	1
Over-pressure	1		Underrated	0
Under-pressure	0		**Terminal**	
Other	0		Down draught	1
Flue			Bad siting	1
Blockage	0		Unapproved design	0
Corrosion	0		Other	1
Flue not to any standard	3		**Ventilation**	
Installation fault	1		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	2
Failed down draught detector	0		Signs of spillage – outside the appliance	0
Failed vitiation device	0		Signs of spillage – inside the casing	1

Table B.1.5b - Central heating boilers : Wall mounted boiler : Incident summary

Post Code	*Number of casualties: fatal*	*Appliance age (yrs)*	*Appliance location*	*Installer*	*Flue to standards*	*Ventilation to standards*	*Appliance make & model*	*Flue type*	*Incident cause(s)*
SG1	(1)	13	4	Unknown			Baxi Solo WM 50/4 RS		1,2
WS15	(1)		10	Unknown		Current	Glow-Worm Fuelsaver 30R MK11	5	1,2,5
WV6	(1)	20	10	Unknown			Baxi WM3813 RS	1	0,4
ST6	(2)	7	0	CORGI			Glow-worm Economy 40	1	4,5

Note: The appliance location at ST6 given as "other" was adjacent property.
The incident cause for WV6 given as "other" was "extension built over flue terminal so boiler was discharging into property".

B.1.6 WALL MOUNTED COMBI BOILER

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

Number of incidents = 6

Fault group	*Number of faults*		*Fault group*	*Number of faults*
Burner			**Appliance performance**	
Corrosion	0		High CO/CO_2 ratio	5
Defective flame picture	2		Failed spillage test	1
Linting	2		Overrated	0
Over-pressure	3		Underrated	0
Under-pressure	0		**Terminal**	
Other	1		Down draught	1
Flue			Bad siting	3
Blockage	0		Unapproved design	1
Corrosion	0		Other	0
Flue not to any standard	5		**Ventilation**	
Installation fault	2		Air vent/vents ineffective	2
Other	0		Air vents obstructed - intentionally	1
Heat exchanger			Air vents obstructed - unintentionally	1
Blockage - shale	2		Compartment/cupboard not to any standards	1
Blockage - soot	2		No permanent ventilation provided	1
Cracked	0		Ventilation provided was not to any standard	3
Other	0		**Miscellaneous**	
Safety device			Local topography	1
Failed CO alarm	0		Weather	3
Failed down draught detector	0		Signs of spillage – outside the appliance	2
Failed vitiation device	0		Signs of spillage – inside the casing	4

Table B.1.6b - 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*	*Incident cause(s)*
NR2	(1)	14	0	Unknown			Vaillant VCW GB 240H	5	0,1,8
LL13	(3)	9	7	CORGI			Worcester Bosch 240 C/B	1	0,5,8
NR3	1		3	Unknown			Vokera Maxin 24 CF	5	1,2,4,8
B67	(5)		0	Unknown			Vaillant VCW 20/1 T3WH	5	1,4,8
WV2	(3)	15	0	Unknown		Current	Vaillant VCW GB 240H	5	1,4,5
B70	1 (5)	15	2	Unknown			Vaillant VCW GB 240H	5	2,5

Note: The appliance location at NR2 given as "other" was lobby between kitchen and bathroom.
The appliance location at B67 given as "other" was internal space between bathroom and kitchen.
The appliance location at WV2 given as "other" was passageway between bathroom and kitchen.
The incident cause for NR2 given as "other" was "poor level of service"
The incident cause for LL13 given as " other" was "downdraught and spillage caused by coal fire in middle room being lit. Recently changed front and back room to UPVC glazing".

B.1.7 WARM AIR UNIT

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

Number of incidents = 1

Fault group	*Number of faults*		*Fault group*	*Number of faults*
Burner			**Appliance performance**	
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	0		Down draught	0
Flue			Bad siting	1
Blockage	0		Unapproved design	0
Corrosion	0		Other	0
Flue not to any standard	0		**Ventilation**	
Installation fault	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	1		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 – outside the appliance	1
Failed vitiation device	0		Signs of spillage – inside the casing	1

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*	*Incident cause(s)*
WW3	(4)		9	Unknown	Current		Johnson & Starley JT 19-25 Mk2	5	5,8

B.1.8 OTHER – NO REPORTED INCIDENT

B.2 COOKERS

B.2.1 FREE STANDING

Table B.2.1a – Cookers : Free standing : Summary fault analysis

Number of incidents = 1

Fault group	*Number of faults*		*Fault group*	*Number of faults*
Burner			**Appliance performance**	
Corrosion	0		High CO/CO_2 ratio	0
Defective flame picture	0		Failed spillage test	0
Linting	0		Overrated	0
Over-pressure	0		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 fault	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	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 – outside the appliance	0
Failed vitiation device	0		Signs of spillage – inside the casing	0

Note: No faults were marked on the DIDR form.

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*	*Incident cause(s)*
CF14	1	14	10	Unknown	N/A		New World Debut	11	0,3

Note: Incident cause "other" was given as "4 burners on cooker could have been on for up to 17 hours. Burners producing 4 ppm CO. Flame lift off due to oxygen depletion was achieved in 2 hours with 4 burners firing in tests replicating incident conditions".

B.2.2 BUILT-IN OVEN – NO REPORTED INCIDENT

B.2.3 BUILT-IN HOB – NO REPORTED INCIDENT

B.2.4 OTHER – 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

B.3.3 DECORATIVE GAS FIRE – NO REPORTED INCIDENT

B.3.4 FLUELESS HEATER – NO REPORTED INCIDENT

B.3.5 INSET LIVE FUEL EFFECT GAS FIRE

Table B.3.5a - Space heaters : Inset live fuel effect gas fire : Summary fault analysis

Number of incidents = 1

Fault group	*Number of faults*		*Fault group*	*Number of faults*
Burner			**Appliance performance**	
Corrosion	0		High CO/CO_2 ratio	0
Defective flame picture	0		Failed spillage test	0
Linting	0		Overrated	1
Over-pressure	0		Underrated	0
Under-pressure	1		**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 fault	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 – outside the appliance	0
Failed vitiation device	0		Signs of spillage – inside the casing	0

Table B.3.5b - Space heaters : Inset live fuel effect 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*	*Incident cause(s)*
S6	(2)		12	Unknown			Eurotech Fires Superior Convector ILFE	5	5

B.3.6 RADIANT AND RADIANT CONVECTOR GAS FIRE

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

Number of incidents = 3

Fault group	*Number of faults*		*Fault group*	*Number of faults*
Burner			**Appliance performance**	
Corrosion	0		High CO/CO_2 ratio	0
Defective flame picture	0		Failed spillage test	0
Linting	1		Overrated	0
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 fault	0		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	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 – outside the appliance	1
Failed vitiation device	0		Signs of spillage – inside the casing	0

Table B.3.6b - 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*	*Incident cause(s)*
LS16	(1)		12	Unknown	Current		Valor New Firelite	5	9
LS16	(1)		12	CORGI	Current		Main Heating Charm ASD	5	5
HD4	2	23	3	Unknown			Robinson Willey Firegem Visa	N/A	0.5

Note: At HD4 the appliance was an open flue radiant/convector fire that was fitted in a bedroom with no chimney or flue arrangement.

B.3.7 WALL HEATER – NO REPORTED INCIDENT

B.3.8 OTHER – NO REPORTED INCIDENT

B.4 TUMBLE 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			**Appliance performance**	
Corrosion	1		High CO/CO_2 ratio	1
Defective flame picture	1		Failed spillage test	0
Linting	0		Overrated	0
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 fault	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	1
Blockage - soot	1		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 – outside the appliance	0
Failed vitiation device	0		Signs of spillage – inside the casing	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*	*Incident cause(s)*
PO13	(2)		9	Unknown			Main Solent 673	1	1,5,8

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 = 1

Fault group	*Number of faults*		*Fault group*	*Number of faults*
Burner			**Appliance performance**	
Corrosion	0		High CO/CO_2 ratio	1
Defective flame picture	1		Failed spillage test	0
Linting	0		Overrated	0
Over-pressure	0		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 fault	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	1
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 – outside the appliance	1
Failed vitiation device	0		Signs of spillage – inside the casing	1

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*	*Incident cause(s)*
B10	1 (1)		2	Unknown	Current		Ascot G510/1	11	3,5,8

B.5.5 OTHER – NO REPORTED INCIDENT

B.6 OTHER APPLIANCES

B.6.1 NO REPORTED INCIDENT

APPENDIX C DETAILS OF LPG INCIDENTS DURING 2004/2005 AND ANALYSIS OF THE DATA

A single LPG incident was reported using the DIDR Form 551/7 during the period 2004/2005.. In 2003/2004 the LPG incident count was 2 with both incidents within properties. In 2002/2003, 10 incidents were reported, and incidents within vehicles outnumbered those in properties.

C.1 DETAILS OF INCIDENTS WITHIN VEHICLES

The incident took place in a mobile caravan in November 2004. The appliance involved was a cabinet heater and resulted in a single male fatality. Further details of this incident are given below in Table C1A.

Table C1A - CO incidents and casualties

Incident	*Post code*	*Appliance involved*	*Numbers of fatal casualties*	*Numbers of non-fatal casualties*			
				N1	N2	N3	N4
A	LL28	Cabinet heater	1	0	0	0	0

Note: Non-fatal casualty codes are explained in section 2.2

The casualty and the appliance were in the same confined space. Details of the appliance and casualty locations are given in Table C1B.

Table C1B - Appliance and casualty locations

Incident	*Appliance location*	*Casualty locations*	*Flue type*
A	Caravan	Caravan	N/A

The incident appliance make and model, and installation details are given in Table C1C.

Table C1C – Appliance and standards details

Incident	*Appliance make & model*	*Appliance age (years)*	*Installer*	*Appliance installation to standards*	*Flue installation to standards*	*Ventilation installation to standards*
A	Carver Trumatic SB 1800	Unknown	N/A	Current at time of installation	Current at time of installation	Current at time of installation

The following faults and relevant observations were reported:

The heater was not adequately secured to the floor. No CO alarm was fitted.

There was no information available on the service history of the appliance. Presence of dust, lint and debris indicated that the appliance was in need of servicing.

On-site checks revealed the gas pressure to be set too high. It was not possible to conduct CO/CO_2 ratio or appliance rating tests.

Table C1D gives an overview of the total numbers of faults found, at the involved location, and table C1E gives the reported incident cause/causes.

Table C1D - Incident appliance faults

Number of incidents = 1

Fault group	*Number of faults*		*Fault group*	*Number of faults*
Burner			**Incident testing**	
Corrosion	0		High CO/CO_2 ratio	0
Defective flame picture	0		Failed spillage test	0
Linting	1		Overrated	0
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	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	0		Signs of spillage – outside the appliance	0
Failed vitiation device	0		Signs of spillage – inside the casing	0

Table C1E – Incident causes

Incident cause (s)	*Total number recorded*
Appliance fault	0
Appliance installation fault	0
Customer misuse of the appliance	0
Flue/terminal fault	0
Lack of servicing	1
Sub-standard compartment	0
Sub-standard servicing	0
Ventilation fault	0
Not known/not yet established	0
Other	1

Note: Incident cause " other" was given as " gas supply pressure fault".

APPENDIX D DETAILS OF NON-DOMESTIC PIPED NATURAL GAS CO INCIDENTS DURING 2004/2005

This section gives details of an incident that occurred around the swimming pool area of a hotel. The appliance involved was a modular boiler and there were no fatal casualties.

D.1 DETAILS OF INCIDENTS

The incident took place during January 2005 around the swimming pool area located directly above a basement boiler room. The property had a solid ground floor, double-glazed windows and the year of construction was given as 1966-1980. Further details of this incident and casualties are given below in Table D1A.

Table D1A - CO incidents and casualties

Incident	*Post code*	*Appliance involved*	*Numbers of fatal casualties*	*Numbers of non-fatal casualties*			
				N1	N2	N3	N4
A	EH12	4 module boiler each with a modulating pre-mix burner	0	6 members of public - no details provided			

Note: Non-fatal casualty codes are explained in section 2.2

The casualties were based in the leisure swimming pool area of the same property as the plant room. Details of the appliance and casualty locations are given in Table D1B.

Table D1B - Appliance and casualty locations

Incident	*Appliance location*	*Casualty locations*	*Flue type*
A	Basement plant room	Swimming pool area directly above plant room	Fan dilution

The incident appliance make and model (non condensing), and installation details where known, are given in Table D1C.

Table D1C – Appliance and standards details

Incident	*Appliance make & model*	*Appliance age (years)*	*Installer*	*Appliance installation to standards*	*Flue installation to standards*	*Ventilation installation to standards*
A	Hamworthy Wessex 200	17	Unknown	Not to any	Not to any	To current standards

The reason given for non-compliance of the installation was “fan dilution exhaust placed close to louvered plant room entry doors located within restricted basement stairwell”.

The incident appliance was covered by a regular maintenance contract, and a CORGI engineer had attended a breakdown less than 6 months ago.

The following faults and relevant observations were reported:

The main cause for the incident was given as maladjusted regulator. This was supported by on-site checks revealing high gas pressure, high rating, high CO/CO_2 ratio, and defective flame picture. Blown gas burners on 2 boilers were also logged.

Table D1D gives the total numbers of faults found at the site, and table D1E gives the reported incident cause/causes.

Table D1D - Incident appliance faults

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	1		Failed spillage test	0
Linting	0		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	0
Other	1		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	1
Failed CO alarm	0		Weather	1
Failed down draught	0		Signs of spillage – outside the appliance	0
Failed vitiation device	0		Signs of spillage – inside the casing	0

Table D1E – Incident causes

Incident cause (s)	*Total number recorded*
Appliance fault	0
Appliance installation fault	0
Customer misuse of the appliance	0
Flue/terminal fault	0
Lack of servicing	1
Sub-standard compartment	0
Sub-standard servicing	0
Ventilation fault	0
Not known/not yet established	0
Other	1

Note: Incident cause "other" was given as "maladjusted regulator".

APPENDIX E DETAILS OF DOMESTIC NATURAL GAS INCIDENTS WHICH DID NOT APPEAR WITHIN THE EIGHT PREVIOUS ANNUAL REPORTS

The 1 incident covered in this section did not feature in last year's report as the information was not received in time.

E.1 DETAILS OF INCIDENTS

The incident took place in March 2004 in a detached owner occupied property built in 1979. The appliance involved was a floor standing boiler fitted in a compartment/cupboard. There were 3 non-fatal casualties. Further details of the incident and casualties are given in Table E1A.

Table E1A - CO incidents and casualties

Incident	*Post code*	*Appliance involved*	*Numbers of fatal casualties*	*Numbers of non-fatal casualties*			
				N1	N2	N3	N4
A	LS18	Floor standing boiler	0	0	3	0	0

Note: Non-fatal casualty codes are explained in section 2.2

The appliance and the casualties were not located in the same room in the house. Details of the appliance and casualty locations are given in Table E1B.

Table E1B - Appliance and casualty locations

Incident	*Appliance location*	*Casualty locations*	*Flue type*
A	Kitchen	Bedroom	Open-individual-natural draught

The incident appliance make and model, and installation details where known, are given in Table E1C.

Table E1C – Appliance and standards details

Incident	*Appliance make & model*	*Appliance age (years)*	*Installer*	*Appliance installation to standards*	*Flue installation to standards*	*Ventilation installation to standards*
A	Potterton Kingfisher	19	Unknown	Not to any	Not to any	Not to any

The following faults and relevant observations were reported:

The cupboard/compartment did not meet the standards at the time of installation. There was no service contract in place, and the last service visit was over 2 years before the date of the incident. It was not identified if this was by a CORGI registered fitter.

The ventilation was partially blocked unintentionally. One of the causes of the incident was given to be lack of servicing.

Table E1D gives the total numbers of faults found, at the installation involved, and table E1E gives the reported incident cause/causes.

Table E1D - Incident appliance faults

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	1
Linting	0		Overrated	0
Over-pressure	0		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	1		**Ventilation**	
Installation defect	0		Air vent/vents ineffective	0
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	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	0		Signs of spillage – outside the appliance	1
Failed vitiation device	0		Signs of spillage – inside the casing	1

Table E1E – Incident causes

Incident cause (s)	*Total number recorded*
Appliance fault	0
Appliance installation fault	1
Customer misuse of the appliance	0
Flue/terminal fault	0
Lack of servicing	1
Sub-standard compartment	0
Sub-standard servicing	0
Ventilation fault	1
Not known/not yet established	0
Other	0

APPENDIX F DETAILS OF THE AGES OF APPLIANCES IN USE

Information has been collected by GfK[7.1.1] to show the age of appliances that are in use within Great Britain. This information is provided in the following tables and is described by either the number of households owning an appliance, or as the total numbers in use.

Table F1A – Central Heating Appliances

Appliance	***Age bands (years)***								
	0-2	3-5	6-8	7-10	11-14	15-17	18-20	>20	unknown
Back boiler unit	44	74	88	80	69	61	50	51	3043
Combi	1882	1920	990	781	243	245	141	83	968
Floor standing	101	170	161	194	187	221	300	402	1145
Wall mounted	592	889	617	671	403	598	509	335	772
Warm air unit	40	61	41	37	14	18	19	37	91

Note: The numbers given are numbers of households owning (x1000).
BBU and FS numbers are for Q1 2004, the rest are for Q1 2005

Table F1B – Cooking Appliances

Appliance	***Age bands (years)***				
	0-2	3-5	6-8	>9	unknown
Free standing	2109	1985	1219	2515	639
Built-in oven	368	270	224	320	0
Built-in hob	1510	1299	873	1628	0

Note: The numbers given are numbers of households owning (x1000) and the data is for Q1 2004

Table F1C – Space Heating Appliances

Appliance	***Age bands (years)***							
	0-1	1-2	2-3	3-4	4-6	6-8	>8	unknown
Cabinet heater	8	5	3	8	31	15	58	0
Living flame	322	334	312	214	657	370	1281	249
Rad. & rad. Con. fire	393	376	255	313	745	552	3137	840
Wall heater	50	29	32	26	76	31	381	153

Note: The numbers given are the numbers in use (x1000) and the data is for Q1 2002.

Table F1D – Water Heating Appliances

Appliance	***Age bands (years)***				
	0-1	1-2	2-3	>3	unknown
Multi-point	2	-	-	9	233
Single-point	-	-	-	3	153

Note: The numbers given are the numbers in use (x1000) and the data is for Q1 2002.

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A review of carbon monoxide incident information, for 2004/05, produced from the full investigation of incidents which had resulted from the use of piped natural gas and LPG, within Great Britain

This report has been written by Advantica as a continuation of the work established during the Joint Industry Programme (JIP) Addressing Carbon Monoxide Issues, within the Incident Data project area. The aim of this work 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 the JIP project a national data collection scheme for piped natural gas and LPG Carbon Monoxide (CO) incidents, which occur within Great Britain, was established by Advantica. This was with the support of the HSE and the gas industry. This report provides information collected via the national data collection scheme.

This is the ninth report of a series that has been published since its first report for 1996/97, and covers the financial reporting period 2004/05. The incidents are only described by postcode to ensure anonymity. During this period details of 27 domestic piped natural gas incidents were submitted to Advantica and constitute the main part of the report. Details of an LPG incident, an incident in commercial premises, and 1 domestic incident not included in the previous year's report are presented in appendices.

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