

Appendix A

Report on Risk Assessment of Chimney Liners

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CRE Group Limited

Report on risk assessment of chimney liners

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1. Introduction

1.1 This report has been produced for CRE Group Limited in connection with the Group's contract with DETR.

1.2 The overall objective was to produce a comparative risk assessment of various types of chimney liners based on available data, tests undertaken by CRE and the opinions of various technical experts involved by CRE in this project.

1.3 The risk assessment relates only to the risks of carbon monoxide poisoning arising from the use of solid fuel appliances. In particular, it does not consider the risk of:

- other causes of death/injury (such as fire) arising from defective liners
- the use of particular types of liners with gas appliances.

Similarly, no consideration is given to other consequences (eg maintenance/repair costs) of defective liners.

1.4 This report has been prepared by Watson Wyatt Partners on an agreed basis to meet the specific purposes of CRE Group Limited, and must not be relied upon for any other purpose. This report must be considered in its entirety as individual sections, if considered in isolation, may be misleading. Draft versions of this report should not be relied upon by any person for any purpose. No reliance should be placed on any advice not given in writing. If reliance is placed contrary to the guidelines set out above, Watson Wyatt Partners disclaim any and all liability which may arise.

2 Summary

2.1 The available data was not adequate to undertake a full risk assessment. We have tried to pull together all the various comments made by industry experts and estimates given to make up for lack of hard data. As a result only very broad conclusions should be regarded as credible.

2.2 Taking account of:

- the relative incident rates for lined and unlined flues
- the comments regarding age (section 4.6)
- the increasing number of closed appliances

the conclusion must be that the number of deaths from CO is likely to increase over time rather than reduce unless changes are made.

2.3 In order to justify specific action on liners with high sand content already in use the technical experts would need to assess the risk relative to other concrete liners to be significant. Assuming that the majority of these particular liners being used with closed appliances do in fact crack the expected number of deaths is one per annum. This is roughly equivalent to assuming a risk for these liners ten times that of other lined (non-prefabricated) flues.

3 Approach

3.1 The majority of deaths and injury arising from CO poisoning involve 'closed' solid fuel appliances. Although it is difficult to establish the use of open fires (many used only occasionally) the other experts involved were of the opinion that closed appliances represented the major risk. This report therefore concentrates on closed appliances as open fires are unlikely to generate significant extra risk if closed appliances do not do so.

3.2 The approach has two steps:

- firstly to analyse the available data to establish the risk associated with different types of liners (including unlined)
- secondly to take account of the CRE tests and opinions of technical experts regarding the relative performance of concrete liners with a high sand content.

3.3 Apart from the inadequacies of the data referred to in the next section, meaningful analysis is difficult since:

- as far as we are aware no deaths have occurred involving the liners with high sand content to date. Given the small number of such liners installed this is not significant but means no direct statistical comparison with other liners is possible
- deaths may occur from causes (eg poor installation, poor maintenance, appliance misuse) totally unrelated to the type of liner in use
- a liner may be defective or cracked but not give rise to a life threatening situation unless another cause (unswept, blockage) is present.

4 Data

4.1 All the available data relies to some extent on surveys, analysis of data which is incomplete or assumptions. However, the accuracy of the detail may not affect the overall conclusions significantly. A draft version of the data and assumptions below were circulated to the technical experts involved to ensure that it did not contradict their practical experience.

4.2 The main sources of data and other information were:

- press release of the CO and Gas Safety Society dated 10 February 1999
- analysis of deaths and 'near misses' provided by the Solid Fuel Association ("SFA")
- conversations with Clay Pipe Development Association and various manufacturers
- various documents supplied by CRE Group including letters from manufacturers indicating sales figures and material compositions.

The following paragraphs set out how we have derived estimates for the various numbers required from the above. Particular note should be taken of the sometimes very broad assumptions made.

Deaths (and injuries)

4.3 Between 1995 and 1997 the CO Gas Safety Society recorded 73 deaths and 135 near misses resulting from CO from solid fuel. 60% of near misses (gas and SF) resulted in hospitalisation:

- owing to the method of recording numbers are more likely to be understated
- there is insufficient data to detect any trend over time
- the recorded number of deaths from closed appliances was 65.

4.4 The only breakdown given is by type of housing and type of appliance:

- 20% of deaths are recorded as council housing
- The SFA suggested 25% of solid fuel users are council
- 16% of housing stock (or 21% including housing associations) is council
- the death rate is probably not statistically significant by type of housing.

4.5 The SFA has provided a more detailed analysis of roughly the same number of deaths over a slightly different period. However, the breakdown by appliance differs between

the two analyses. The Society figures attribute 40% to room heaters whereas the SFA figures attributed 60% of deaths and 50% of near misses to room heaters. This is only relevant if the proportion of different types of appliances being sold is changing (see trends).

4.6 The analysis of individual cases gives the following breakdown by chimney type.

Flue type	Number of deaths	Number of near misses
Lined flue	5	16
Prefabricated flues	6	13
Unlined brick stack	29	37
Brick stack with no type of inner recorded	23	37

4.7 The difficulty here is the treatment of the last category. The following table assumes that some (but less than a proportionate number) of the unknown were lined.

Flue type	Deaths	%	Near misses	%
Lined flue	7	11	21	20
Prefabricated flues	8	13	17	17
Unlined brick stack	48	76	65	63
	63		103	

4.8 A possible explanation of the different split for deaths and near misses? A high proportion of deaths are elderly people. A lined chimney implies newer housing which implies younger occupants who are more likely to notice problems and are able to get out. Therefore, the analysis of deaths may understate the relative proportion of lined chimneys giving rise to potential fatalities?

Number of closed appliances

4.9 Based on the SFA figures there were an average of 730,000 closed appliances in use in the period 1995-97.

Chimney type

- 4.10 Ideally we would like to know the distribution by type of chimney given that a closed SF appliance is being used.
- 4.11 As different types were installed at different times we can start with the age of the housing stock. From DETR figures for 1996.

	Date of construction				
	-1919	1919 – 1944	1945 – 1964	Post 1964	
England	24	19	21	37	100
Wales	32	14	22	32	100
Scotland	21	15	28	36	100

- 4.12 The above figures include purpose built flats (mainly post-war) which could be excluded from the English figures.
- 4.13 The figures therefore suggest 36% of houses were built after 1964 and regulations regarding linings.
- 4.14 Many houses built in this last period did not have chimneys. Assuming 80% without chimneys would give the proportion of unlined chimneys of around 87% allowing for some lining of previously unlined. (However, this ignores the possibility that people who buy a house with a chimney may be more likely to use it?).
- 4.15 Figures for sales of various manufacturers give different views of size of market for concrete flues. We assume roughly 20,000 concrete flues per year since 1992. This would imply 200,000 – 250,000 in total as sales started in the mid 1980s.
- 4.16 Estimated sales of 20,000 concrete flues per annum accords reasonably well with other statistics. Clay sales are estimated at 15,000 per annum with under 40% market share. The remainder is pre-fabricated particularly in conversions. This suggests the concrete share of the market is just under half the market of 40,000 to 44,000. New buildings are 150,000 to 180,000 per annum of which 20% to 25% have chimneys which suggests a new market of around 35,000.
- 4.17 Prior to the introduction of concrete liners the smaller market may have been split roughly 60/40 between clay and prefabricated.

5 Results

5.1 We have 730,000 closed appliances in 1995 to 1997. Based on the figures in section 3 the distribution by type of chimney could be:

Unlined	635,000
Clay	50,000
Prefabricated	30,000
Concrete	15,000
	<hr/>
	730,000

	Deaths per 000	Near misses per 000	Total recorded incidents
Unlined	0.025	.034	.059
Other	.053	.133	.186

5.2 The problem here is the effect of 'prefabricated liners' which may be distorting the figures for 'other'. These prefabricated liners account for half the deaths and near misses whereas discussions with various people and the analysis above would suggest that these liners make up considerably less than half of this category.

5.3 Based on the above numbers for other:

expected deaths from concrete flues	0.8 p.a.
expected injuries (hospitalisation)	2 p.a.

5.4 If we accept the analysis above and separated pre-fabricated liners from the 'other' category then the figures would become 0.54 per annum and 1.6 per annum respectively for other (excluding pre-fabricated).

5.5 In view of the amount of estimation involved in producing the above figures it would not be sensible to read too much into them. However, simple statistical tests of significance indicate that the different rates of total recorded incidents between unlined and 'other' (either definition) is extremely unlikely to be due to random variation alone.

Age of chimney

5.6 One major concern we have over the above comparisons is the different age of chimneys involved. An unlined chimney is on average 70 years old whereas a lined one will be perhaps 15 years old and a concrete chimney an average of six years.

Logic says the risk will be high initially (poor installation etc), reduce sharply and then increase with age.

Construction

- 5.7 All of the above ignores the actual cause of the incident. The SFA analysis shows that in 50% of the incidents the state of the flue was not an issue. If the main reason is poor installation, misuse, lack of sweeping and maintenance, how much difference does it make what the flue is made of?
- 5.8 The technical experts will assess the relative risk of liners with high sand content to other concrete liners based on the tests carried out and their experience. However, we can calculate how much additional risk these particular liners need to pose to give rise to an increased number of CO deaths.
- 5.9 It is estimated that there are less than 3,000 concrete liners with high sand content being used on closed solid fuel appliances. The expected number of deaths arising from 3,000 concrete liners is 0.16 per annum (based on section 4.3) or 0.11 per annum (based on section 4.4).

Given that construction is a factor of only half the deaths it is necessary to assume that liners with a high sand content are ten times as likely to give rise to a potentially dangerous incident to cause one death

$$[0.08 + 10 \times 0.08] = 1 \text{ per annum.}$$

- 5.10 It is estimated by a major maintenance company that 5% to 10% of all liners in existence are cracked and of these, two-thirds would fail a smoke test. This suggests that of the 65,000 lined flues above closed appliances 3,250 could be 'defective' (ie fail a smoke test). If all the deaths with lined flues arose from these defective flues and were mainly due to the 'defective' condition the death rate would be about 0.5 per thousand 'defective' flues. This estimate is based on five deaths from lined flues over three years. It may be that the flue was irrelevant to the fatality but given the accuracy of the underlying data the above estimate is sufficient to indicate the scale of the risk.
- 5.11 My understanding of the results of the tests carried out by CRE is that the liners with high sand content cracked sufficiently at high temperatures to fail a smoke test. Whether a particular flue is subjected to this type of temperature will depend on many factors including the type of fuel used. If 2,000 of the existing liners with high sand content became 'defective' it would, based on the above, result in one death per annum.

Trends

- 5.12 Based on SFA figures, the number of closed appliances in use is increasing and may be 900,000 in 1999/2000. Concrete liners make up an increasing proportion of the market. The previous calculations refer to the estimated 3,000 liners with high sand content already installed and makes no allowance for any further sales of such liners.

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