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FIRE INCIDENTS INVOLVING EXPLOSIONS

by

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Summary

The numbers of fire incidents involving explosions, estimated from 1 in 2 samples of all reports, were 426 in 1961 and 498 in 1962. Of those, the numbers in which water or space heating equipment was the heat source were 144 in 1961 and 192 in 1962.

A more detailed analysis was undertaken of the 249 incidents which occurred in the sample for 1962.

Space and water heating equipment were revealed as the main sources of danger.

The principal causes of explosions in 1962 were gas (town) leaks (40 incidents), domestic back boilers (18 incidents) and foreign matter on coal fires (17 incidents).

About one-third (78) of the incidents involved casualties.

FIRE INCIDENTS INVOLVING EXPLOSIONS

Introduction

The number of fires in which explosions occur is only a small fraction of the total fire incidence, but since a large proportion of these may be expected to result in casualties and serious damage, a study has been made of the reports received in 1961 and 1962; a more detailed examination was made of the 1962 reports.

Explosions in general 1961 and 1962

In 1 in 2 samples of all reports there were 213 explosions in 1961 and 249 in 1962. These figures indicate an annual frequency of about 400-500.

Table 1

Heat source in relation to fuel used by appliances

Heat source	Fuel used by appliance							Total
	Acetylene	L.P.G.	Solid fuel	Electricity	Gas (town)	Oil	Not stated or not applicable	
Lighting	-	1	-	-	1	1	-	2
Cooking	-	8	3	2	16	6	3	38
Water heating								
- central heating	-	-	7	-	2	12	-	21
- other	-	1	13	1	8	-	1	24
Space heating								
- radiant heater, fire, radiator, etc.	-	-	91	4	-	6	1	102
- other	-	1	-	-	-	20	-	21
Localised heating, welding etc.	7	2	-	1	3	7	-	20
Drying or heat treatment	-	1	3	7	12	2	3	28
Electrical supply								
- H.T. cables (over 1000 volts)	-	-	-	3	-	-	-	3
- Wire and cable (other than lead to apparatus)	-	-	-	14	-	-	-	14
- Transformer	-	-	-	5	-	-	-	5
- Other	-	-	-	14	-	-	-	14
Miscellaneous								
- Smokers materials	-	-	-	-	-	1	4	5
- Matches	-	-	-	-	-	-	26	26
- Chemicals, fireworks, etc.	-	-	-	-	-	-	17	17
- Other and unknown	-	2	6	10	-	1	103	122
TOTAL	7	15	123	61	42	56	158	462

Table 1 shows the number of incidents attributed to various heat sources in relation to the fuel used for the two years 1961, 1962 combined. It would appear that one of the greatest sources of danger is the solid fuel fire. Most of the explosions in this group are due either to foreign bodies (e.g. a tin of cat food) stones, slate etc., contained in coal or to back boilers. Other principle sources are electrical supply apparatus and matches (usually associated with gas accumulations). The proportions of fires involving explosions from each of the heat sources appear to have been very similar in the two years considered.

Fires in which explosions occurred, 1962

The 249 fire incidents in 1962 in which explosions occurred were analysed in greater detail. This analysis is largely concerned with the fuel and appliance involved in the explosion, which are not necessarily always the same as the fuel used and the source of heat. Since comparatively small numbers are involved, like causes, like fuels, etc. have been grouped.

Causes of explosions in different occupancies

Table 2

Causes of explosions in different occupancies

Cause of explosion	Occupancy			Total
	Industry (incl. building)	Private occupancies	Other and unknown	
Gas leaks, gaseous mixtures ignited	20	31	12	63
Boilers, flues, foreign objects on fire	1	47	1	49
Petrol, oil ignited	7	8	5	20
Mechanical heat, electrical faults, overheating	14	6	11	31
Other	13	16	12	41
Unknown	14	13	18	45
TOTAL	69	121	59	249

It is apparent that explosions due to boilers, flues, etc., are associated with private occupancies, whereas those due to mechanical heat and allied causes are more to be expected in industrial hazards. The largest single causes of explosions was the leakage of town gas which gave rise to 40 of the incidents.

Appliances and fuels involved in explosions

Table 3

Appliances and fuels involved in explosions

Appliance	Fuel associated with explosion						Total
	Oil, petrol volatile liquids	Gases, gaseous mixtures	Solid fuel	Gas (town)	L.P.G. acetylene	Other and unknown	
Boilers (not tar), water heaters	6	1	24	5	-	2	38
Bottles, cylinders, containers	3	3	-	2	16	2	26
Chimney, flue, fire in grate, slow combustion stove	3	2	18	6	-	1	30
Industrial machinery	5	8	1	3	2	7	26
Cooking, bakers oven	1	1	1	18	1	1	23
Other space heating	11	1	2	3	1	-	18
Supply apparatus, wire and cable, etc.	3	2	-	8	3	9	25
Other and unknown	8	5	2	12	5	31	63
TOTAL	40	23	48	57	28	53	249

Table 3 indicates the appliances which provide the major explosion risks, and shows that solid fuel domestic equipment is the chief of these. There were 24 incidents in solid fuel fired boilers, 18 of which were domestic back boilers. Foreign matter on coal fires caused 17 explosions. Gas cooking appliances caused 18 incidents, these being mainly through gas accumulations resulting from leaks.

In most incidents the explosion occurred and a fire followed, but in a small proportion the fire occurred first and the explosion resulted from the heat produced. In Table 4, the fuel associated with the explosions is related to the order in which events occurred.

Table 4

Order of events with different fuels

Fuel associated with explosion	First occurrence			Total
	Explosion	Fire	Not stated or not determined	
Oil, petrol, volatile liquids	29	4	7	40
Gases, gaseous mixtures, fumes	19	2	2	23
Solid fuel	46	1	1	48
Gas (town)	46	8	3	57
L.P.G. acetylene	12	11	5	28
Other and unknown	34	3	16	53
TOTAL	186	29	34	249

With most fuels it can be seen that the explosion is more likely to be the first occurrence; the possible exception is with L.P.G. and acetylene. In some of these incidents the explosion results from heat produced from fires near to L.P.G. and acetylene cylinders.

Casualties

Table 5

Casualties, classified according as to the first occurrence in a given incident

Casualties	First occurrence			Total
	Explosion	Fire	Not stated or not determinable	
Fire Brigade Non-fatal	-	12	-	12
Others Fatal (not suicide)	7	2	1	10
Non-fatal	117	14	19	150
TOTAL	124	28	20	172
Incidents				
Number of fires involving:-				
Fatal casualties only	3	-	1	4
Fatal and non-fatal casualties	4	2	-	6
Non-fatal casualties only	50	5	13	68
TOTAL FIRES INVOLVING CASUALTIES	57	7	14	78
TOTAL FIRES INVOLVING EXPLOSIONS	186	29	34	249

Casualties occurred in about one-third of the total incidents. There were several multiple casualty incidents, two of which involved fire brigade casualties. The most serious incidents in terms of numbers of casualties are listed below in Table 6.

Table 6

Explosion incidents involving seven or more casualties

Hazard	Brief details of incident	No. of casualties	Remarks
Telephone exchange, Birmingham	Coal gas leak ignited by unknown source	18	1 Fatality
Car Manufacturer, Glamorgan	Coal gas accumulation ignited by a spark	15	-
Scrap Metal Merchant, Birmingham	Sparks from oxy-acetylene equipment fell onto waste material	15	4 F.B. casualties
Newsagent, Glasgow	Dropped light landed in rubbish near paraffin drum	8	All F.B. casualties
Haulage Contractor, London	Cause unknown	8	-
School Laboratory, Burnt Oak	Chemical experiment involving a phosphorus-sugar mixture	7	-

In the two incidents involving fire brigade casualties, the explosions occurred during fire fighting operations. There were 10 accidental fatalities and 2 suicides in explosion incidents in 1962 in the 1 in 2 sample of reports.

Fire-fighting, fuel and extent of damage

The majority of incidents did not entail much fire-fighting. Besides 16 late calls, in 88 other incidents the fire was either extinguished before the arrival of the brigade or was allowed to burn out before the arrival of the brigade. In only 10 incidents did the fire take over half-an-hour to control.

Fires involving oil, petrol and volatile liquids were most likely to have fire damage predominant, because in these incidents flammable liquids present would be likely to assist in the spread of fire. With town gas and solid fuel the explosion damage was more likely to be predominant.

Incidents in which explosion damage was predominant were more likely to spread in terms of extent of total damage.

Further details of these features of fires involving explosions are given in the Appendix.

Conclusion

Space heating apparatus (particularly solid fuel) and water heating are revealed as being the main sources of danger.

About one-third of the incidents involve casualties, a far higher proportion than in fire incidents in which no explosions occur.

Explosions resulting from mechanical heat and sparks are closely allied with industrial hazards; whereas boilers, flues and similar causes normally occur in private occupancies. With solid fuel and town gas the explosion is likely to occur first and fire follows, but with some fuels (e.g. acetylene) the explosion is more likely to result from a fire.

Town gas explosions usually produce more explosion than fire damage, whereas explosions in oil and other flammable liquids usually cause scattering of flammable substances which assists the fire to spread.

Incidents in which explosion damage is predominant tend to result in greater damage than those in which fire damage is the more important. In about two-fifths of the incidents the fire is small and is extinguished before the arrival of the fire brigade

APPENDIX

Table 7

Fuel and predominant damage

Fuel associated with explosion	Predominant type of damage			Total
	Explosion	Fire	Neither	
Oil, petrol, volatile liquids	13	19	8	40
Gases, gaseous mixtures, fumes	9	6	8	23
Solid fuel	25	17	6	48
Gas (town)	38	10	9	57
L.P.G., acetylene	12	7	9	28
Other and unknown	30	9	14	53
TOTAL	127	68	54	249

Table 8

Extent and predominant damage

Predominant type of damage	Extent of total damage		Total
	Confined to room of origin	Not confined to room of origin	
Explosion	78	49	127
Fire	51	17	68
Neither	41	8	49*
TOTAL	170	74	244*

*Does not include 5 fires where the extent was "not stated".

Table 9

Fire-fighting and fire control times

Fires extinguished by fire brigade controlled in	
Over 30 minutes	10
11-30 minutes	39
Up to 10 minutes	87
Out on arrival of fire brigade	87
Late call	16
Allowed to burn out	1
Extinguished by fireman at his own house	1
Control time not stated	8
TOTAL	249