

F. R. Note No. 470

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND FIRE OFFICES' COMMITTEE  
JOINT FIRE RESEARCH ORGANIZATION

This report has not been published and should be considered as confidential advance information. No reference should be made to it in any publication without the written consent of the Director, Fire Research Station, Boreham Wood, Herts. (Telephone: ELStree 1341 and 1797).

AN ANALYSIS OF FIRES INVOLVING LIQUID PETROLEUM GAS

by

Jane M. Mather

Reports from the N.F.S. and Fire Brigades in the  
United Kingdom, 1947-1952 and 1957

Summary

The frequencies of fires involving liquid petroleum gas during the year 1957 have been compared with data from previous years.

The contracting industry appeared as a new hazard, and fires in which a liquid petroleum gas apparatus was the source of ignition were on the increase.

A fire involving liquid petroleum gas was more likely to occur in the English and Welsh Counties and in Scotland than in the English County Boroughs during 1957.

There has been a decrease in the numbers injured in standardised fires where liquid petroleum gas was the material first ignited.

August 1961

Fire Research Station,  
Boreham Wood,  
HERTS.

# AN ANALYSIS OF FIRES INVOLVING LIQUID PETROLEUM GAS

by

Jane M. Mather

Reports from the N.F.S. and Fire Brigades in the  
United Kingdom, 1947-1952 and 1957

Fires in which liquid petroleum gas was the material first ignited or in which apparatus using liquid petroleum gas fuel was the source of ignition, or both, are the subject of this analysis. Conditions in the year 1957 are studied, both in relation to previous periods; and on a regional basis.

## CONDITIONS IN 1957 AS COMPARED WITH PREVIOUS PERIODS

The annual incidence of fires involving liquid petroleum gas since 1947 has been set out in Table I. The incidents have been grouped according to whether they occurred in buildings or in the open. The statistics for the years 1947-1949 are not strictly comparable with later years as not all of the brands of liquid petroleum gas were analysed. The totals for the years 1953-1956 and the year 1958 have been estimated from the samples used in the compilation of the Annual Tables. Comparative figures for the total number of reported fires in each year have also been set out. Rising trends are apparent both in the total numbers of fires and in the numbers of fires involving liquid petroleum gas.

TABLE I

Incidence of Liquid Petroleum Gas Fires

		1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958
In Buildings	Fires involving liquid petroleum gas	24	33	33	57	67	73	88	96	112	100	132	184
	Total fires (thousand)	37	37	40	44	42	47	44	46	50	51	51	52
Not in Buildings	Fires involving liquid petroleum gas	11	21	24	39	52	51	48	50	84	84	79	124
	Total fires (thousand)	36	28	59	28	30	45	43	39	71	72	69	50

Likely reasons for the numbers of fires attributed to liquid petroleum gas increasing from year to year are:

- (1) They may be following the general trend; (if this were the only reason the proportion of liquid petroleum gas fires would be steady).
- (2) There may be an increase in the use of liquid petroleum gas, in addition to the general trend of fire incidence. This would happen if it were replacing other fuels as a source of energy or if new equipment requiring its use had come into existence.
- (3) liquid petroleum gas apparatus may be becoming more dangerous.

These possible causes are considered further in the following sections.

### 1. Liquid petroleum gas fires related to all fires

Fires involving liquid petroleum gas have been analysed in two parts; fires in which liquid petroleum gas <sup>was</sup> the material first ignited regardless of the source of ignition, and fires in which liquid petroleum gas apparatuses were the source of ignition of material other than the gas itself.

TABLE II

## Frequencies of Liquid Petroleum Gas Fires in Buildings

	1947-1949	1950-1952	1957
Fires in which liquid petroleum gas was the material first ignited per 1,000 fires of all types - all sources of ignition.	0.693	0.128	1.294
Standard error	0.078	0.092	0.159
Liquid petroleum gas fires in which the gas was not the material first ignited per 1,000 fires of all types. Source of ignition: liquid petroleum apparatus.	0.096	0.353	1.294
Standard error	0.029	0.052	0.159

1.1. The year 1957 can be compared with the period 1950-1952 using Table II.

Fires in which liquid petroleum gas apparatus ignited some other material formed a significantly increasing proportion of the total number of fires. This implies a real increase (i.e. more than a chance increase) in the numbers of fires in which liquid petroleum gas apparatus ignited some material other than the gas.

On the other hand there was no change which cannot be attributed to chance fluctuations in the proportion of fires where liquid petroleum gas was the material first ignited.

1.2. A similar comparison between the periods 1950-1952 and 1947-1949 can be made taking account of the non-comparability of the figures for the period 1947-1949; but in this instance, it cannot be said with any certainty that there was more than a chance increase in the numbers of fires in either category.

1.3. The above analysis is strictly only applicable to fires in buildings, because the yearly totals for fires not in buildings fluctuate widely reflecting weather conditions. Nevertheless, the movements which occur in fires involving liquid petroleum gas in buildings could be expected in similar fires not in buildings.

## 2. Occupancies with increasing fire incidence

2.1. The increase in fires where the liquid petroleum gas apparatus ignited material other than the gas itself occurred in certain hazards as shown in Table III. The hazards in which this increase is apparent are private residential houses and flats, industry, and - a new hazard - the contracting industry which has been placed in the miscellaneous groups in the years previous to 1957.

TABLE III

Fires in which materials other than liquid petroleum gas were ignited first, the flame of the liquid petroleum gas apparatus being the source of ignition

Hazard	1947	1948	1949	1950	1951	1952	1957
<u>In buildings</u>							
Private residential houses and flats.	1		2	3	5	8	25
Canteens, coffee stalls, restaurants		2	3	2	1	2	1
Guest house, hotel, public house					2	1	2
Holiday huts				1			
Farm and quarry buildings	1	2					3
Factories, workshops, stores etc.				5	3	4	11
Contracting industry					3	7	(19 5)
Miscellaneous							
Total - in buildings	2	4	5	11	14	22	66
<u>Not in buildings</u>							
Road vehicles							
Caravans	4	3	3	8	7	7	10
Canteens, coffee stalls, kitchens		2		1	5	4	4
Fish and chip vans			2	4	5	2	1
Other road vehicles	1		1			1	1
Craft on inland waters and in harbour				2	2	4	2
Factory yard, railway siding				2	1		9
Contracting industry							(1 3)
Miscellaneous		1			1	1	
Total - not in buildings	5	6	6	17	21	19	31
Total	7	10	11	28	35	41	97

The increase in fires where liquid petroleum gas apparatuses are the sources of ignition is thus concentrated in dwellings, in industry, and in the contracting industry. Assuming that liquid petroleum gas apparatuses are not becoming more dangerous in themselves, this increase in fire incidence implies either that liquid petroleum gas is replacing other fuels, or that certain equipment requiring its consumption is being worked proportionately more frequently than the other types of apparatus consuming the gas.

2.2. Table IV (which relates to fires in which liquid petroleum gas was the material first ignited to the hazard involved) shows no feature that cannot be attributed to chance yearly fluctuations in any of the hazards other than in the miscellaneous groups. The contracting industry is thus the only hazard in which there may have been an increase in the incidence of fire where liquid petroleum gas was the material first ignited. An increase of this nature would result from an increasing number of cylinders and connexions being at risk, on the assumption that there has not been an increased propensity to leak on the part of cylinders and connexions belonging to the contracting industry.

The two assumptions made in this Section are justified in Section 3.

TABLE IV

Fires in which liquid petroleum gas was the material first ignited

Hazard	1947	1948	1949	1950	1951	1952	1957
<u>In buildings</u>							
Private residential houses and flats	20	23	23	32	39	34	31
Canteens, coffee stalls, restaurants		3	2	1	2	5	5
Guest house, hotel, public house	1	2				1	6
Holiday huts		1	2	1			
Farm and quarry buildings				1		2	11
Factories, workshops, stores etc.				10	7	6	10
Contracting industry	1		1	1	5	3	7
Miscellaneous							6
Total - in buildings	22	29	28	46	53	51	66
<u>Not in buildings</u>							
<u>Road vehicles</u>							
Caravans	4	3	5	9	17	18	20
Canteens, coffee stalls, kitchens	1	6	2	8	5	6	7
Fish and chip vans			5	1	2	4	3
Other road vehicles		1	1		1		1
Craft on inland waters and in harbour	1	5	3	3	3	1	3
Factory yard, railway siding				1	2		7
Contracting industry			2		1	3	1
Miscellaneous							6
Total - not in buildings	6	15	18	22	31	32	48
Total	28	44	46	68	84	83	114

### 3. Liquid petroleum gas fires related to total gas deliveries

3.1. The hypothesis was set up that liquid petroleum gas connexions and cylinders were not becoming more dangerous, in terms of quantity of gas consumed, from one period to the next. The numbers of fire incidents in which there were cylinder leaks, and the numbers in which there were connexion leaks, were standardised on liquid petroleum gas deliveries (unit, a thousand tons) for the year 1957 and for the periods 1950-1952 and 1947-1949. A cylinder leak is defined as a leak either at the cylinder union or at the cylinder valve. A connexion leak is one which occurs in the tubing, pipes or joints of the installation or equipment.

Table V shows that the hypothesis cannot be rejected. It is, however, 95 per cent certain that the number of fires due to cylinder leaks per quantity of gas consumed decreased in 1957 as compared with 1950-1952.

It has therefore been established that cylinders and connexions were no more likely to leak in the latter than in the former period; the cylinders, in fact, were almost certainly less likely to leak. The surmise (Section 2.2) that the contracting industry had increased its consumption of the gas would therefore appear to be confirmed. This is in line with an article in the Guardian referring to the period 1957-1961.

3.2. A second hypothesis was set up, namely, that liquid petroleum gas apparatuses were not becoming more dangerous in terms of gas consumed. The incidence of fire where liquid petroleum gas apparatus was the source of ignition is shown in Table V standardised on liquid petroleum gas deliveries for the year 1957 and for the periods 1950-1952 and 1947-1949. The hypothesis does not hold between the year 1957 and the period 1950-1952. Liquid petroleum gas deliveries were, however, conspicuously higher in 1957 (73,000 tons) than in the period 1950-1952 (average approximately 39,000 tons per annum). The pattern of usage, nevertheless, may not have altered, which would imply that some or all of the apparatuses became more fire-prone. On the other hand, if the pattern of usage in fact altered, between the two periods it is conceivable that those apparatuses accounting for the greater part of the increased consumption of the gas have the highest fire risk. This pattern of usage is considered again in Section 4.

TABLE V  
Frequencies of Liquid Petroleum Gas Fires  
Standardised on Gas Deliveries

	1947-1949	1950-1952	1957
Gas deliveries (thousand tons)	60	116	73
Total fires involving liquid petroleum gas	146	339	211
Fires due to cylinder leaks	56	109	44
Fires due to tubing leaks	30	58	35
Fires where liquid petroleum gas apparatus was the source of ignition	68	185	159
Total fires involving liquid petroleum gas per 1,000 tons gas delivered	2.43	2.92	2.89
Fires due to cylinder leaks per 1,000 tons gas delivered	0.93	0.94	0.6
Standard error	0.12	0.12	0.09
Tubing leaks per 1,000 tons gas delivered	0.5	0.5	0.48
Standard error	0.09	0.07	0.08
Fires where liquid petroleum gas apparatus was the source of ignition per 1,000 tons gas delivered	1.133	1.594	2.178
Standard error	0.137	0.117	0.173

#### 4. Fires in relation to source of ignition

4.1. Table VI gives the frequencies of fires by hazard in relation to the source of ignition in 1957. A significant feature of the Table is that cutting guns, torches and boilers caused fires almost exclusively in the particular hazards where an increase in the incidence of liquid petroleum gas fires has been noted above; that is to a large extent in private residences and in industry, and to a lesser extent in contracting. This feature supports the hypothesis that there was a changing pattern of usage. In effect, the rising consumption of liquid petroleum gas appears to have been highly correlated with an increasing use of the gas in the operation of cutting guns, torches and boilers.

TABLE VI

## Fires in Relation to Hazard and Source of Ignition

UNITED KINGDOM 1957		Liquid petroleum gas apparatus/equipment								Other source of ignition - liquid petroleum gas first ignited									
Hazard	Source of ignition	Cutting-gun	Torch - e.g. painter	Cooker, stove, ring	Light	Pilot light	Heater	Boiler	Unknown	Total	Fire in grate	Slow combustion stove	Match, lighter	Cooker, stove	Oil stove	Electric fire	Miscellaneous	Unknown	GRAND TOTAL
		Private residence			19	20			1	1		41	4	1	4	4			
Industry		19	3			2		3		27		1	2				1	1	32
Canteen, cafe, stalls, fish and chip, hotel, public house etc.		1	1	14		3		1		20	1		3	2			1	3	30
Contractors		3		14		1	2	5	2	27			1						28
Caravan				12	2				1	15		4	9		2				30
Miscellaneous		2	7	6	2	3	6	3		29		1	3			1			34
Total		25	30	66	4	9	9	13	3	159	5	7	22	6	2	1	2	7	211

Table VII gives the frequencies of fires by hazard in relation to the material first ignited. There are no differences between hazards with regard to cylinder and connexion leakages causing fires, which cannot be attributed to chance fluctuations.

TABLE VII

Frequency in Relation to Material First Ignited

UNITED KINGDOM - 1957		Liquid petroleum gas leakage					Other involving liquid petroleum gas					Not involving liquid petroleum gas		GRAND TOTAL		
Material first ignited	Hazard	Rubber tube	Cylinder valve	Cylinder union	Cylinder (unspecified)	Joint, connexion etc.	Total - leaks	Change	Escaping gas	Knock over	Incorrect use	Unknown	Total - liquid petroleum gas		Rubber tube	Other
		Private residence		3	2	7	9	3	24	4	2		1	1	32	1
Industry			1	3	1	3	8						15		17	32
Canteen, cafe, stalls, fish and chip etc.		3	3	2		4	12		2	1			15	1	5	21
Hotel, public house		2				1	3	1	2				6		3	9
Contractor		3	1	2	2		8						8	4	16	28
Caravan		3	2	1		5	11	2	4			3	20		10	30
Miscellaneous		3	2	3	3	2	13		2			3	18	2	14	34
<b>Total</b>		<b>17</b>	<b>11</b>	<b>18</b>	<b>15</b>	<b>18</b>	<b>79</b>	<b>7</b>	<b>12</b>	<b>5</b>	<b>4</b>	<b>7</b>	<b>114</b>	<b>8</b>	<b>89</b>	<b>211</b>

4.2. Table VIII confirms the view that the increased consumption of liquid petroleum gas can be accounted for by an increased usage of cutting guns, torches and boilers consuming this fuel, together with the emergence of the contracting industry as a major consumer of the gas.

TABLE VIII

Frequencies of fires when liquid petroleum gas apparatuses were the source of ignition of materials other than the gas itself

Source of Ignition	1947-49 Annual average	1950-52 Annual average	1957	
			Excluding contracting industry	Contracting industry
Cooker, stove, ring	6	20	26	9
Heater	2	3.3	5	1
Cutting gun, torch	0.3	8.3	36	3
Boiler	1	3	( 6	5
Miscellaneous)			( 4	2
<b>Total</b>	<b>9.3</b>	<b>34.6</b>	<b>97</b>	<b>20</b>



In Section 3.2 it was shown that the apparatuses, as a whole, were more likely to be the source of ignition of a fire in 1957 than in 1950-1952. The pattern of usage altered in the intervening years, cutting guns, torches and boilers, becoming more prolific. As the fire incidence of cooking appliances was not likely to have increased, these apparatuses (cutting guns, torches and boilers) must have a higher fire incidence than cookers, rings and heaters in order to account for the overall increase in fire incidence apparent in 1957.

In order to examine the relative fire incidence of liquid petroleum gas apparatuses the assumption was made that cylinders are equally likely to leak, causing a fire, whether they be attached to a cooker or a cutting gun. A comparison can then be made between the two with regard to fire-risk. For every eight occasions a leak from the attachment to the apparatus results in a fire, a cutting gun will on average start a fire on sixty-eight occasions, in comparison to a cooker which will be the source of ignition on only eleven occasions, on average. These ratios are shown below together with those for torches and boilers:

Cutting guns	8 : 68
Torches	8 : 22
Boilers	8 : 44
Liquid petroleum gas cookers, stoves and rings	8 : 11

#### REGIONAL DIFFERENCES IN 1957

In studying the regional differences in fire incidence it has been assumed that liquid petroleum gas cylinders and connexions behave in the same way in every region of the country when related to a particular hazard together with a particular apparatus. For instance, a cylinder attached to cooking apparatus in a private house is assumed to have an equal chance of leaking at either the union or the valve whether the house be in Scotland or in England.

Table IX shows fires in which liquid petroleum gas was involved grouped on a regional basis, and according to whether they occurred in buildings or elsewhere. If there were no regional differences it would be expected that the number of fires involving liquid petroleum gas standardised by total fires would not vary. The Table, however, shows that where fires have occurred in buildings the English and Welsh County Boroughs have had significantly fewer fires involving liquid petroleum gas than have the English and Welsh Counties and Scotland. There are no significant differences between regions in fires not in buildings.

TABLE IX

## Frequencies of Fires by Region

	REGION	Liquid petroleum gas fires	Total fires	Liquid petroleum gas fires per 100,000 fires	Standard error (S)	1.96 (S)	Interval
IN BUILDINGS	England and Wales - Counties	83	28,007	296	33	65	231-361
	England and Wales - County Boroughs	24	15,815	152	31	61	91-213
	England and Wales - Total	107	43,822	244	24	47	197-291
	Scotland	22	6,017	366	78	153	213-519
	United Kingdom -						
	- Total	132	50,694	260	23	45	215-305
NOT IN BUILDINGS	England and Wales - Counties	46	47,275	97	14	27	70-124
	England and Wales - County Boroughs	23	17,017	135	28	55	80-190
	England and Wales - Total	69	64,292	107	13	25	82-132
	Scotland	9	3,437	262	87	171	91-433
	United Kingdom						
	- Total	79	68,590	115	13	25	90-140

Tables X, XI, XII and XIII give the details of fire incidence by region both in buildings and outside. The frequencies by hazard involved in relation to the source of ignition are shown in Tables X and XII, whilst the hazard involved in relation to the material first ignited is shown in Tables XI and XIII.

No firm conclusions can be drawn from these Tables. The details are, however, not inconsistent with the view that regional differences resulted from the substitution of liquid petroleum gas where town gas and electricity were not easily available.

TABLE X

## Frequencies by Hazard Related to Source of Ignition

IN BUILDINGS	UNITED KINGDOM - 1957	Source of ignition - Liquid petroleum gas apparatus							Other source of ignition					GRAND TOTAL	
		Region	SOURCE OF IGNITION HAZARD	Cutting gun	Torch - e.g. painter	Cooker, stove, ring	Pilot light	Heater	Boiler	Unknown	Total	Fire in grate (Slow combustion stove)	Match, lighter		Cooker, stove
ENGLAND AND WALES COUNTIES	Private house, flat, outhouse				5	8		1	1		15	3	3	1	
	Farmer's residence			5					5		1	1		1	8
	Farm buildings	1				3			4						4
	Industry	5	2		2				9		1				10
	Railway										1				1
	Contractors - Construction/ Demolition	1				2	2	1	6						6
	Contractors - Workman's hut			11	1				13						13
	Canteen, cafe, sports club			1	1				2				1		3
	Hotel, public house, School	1		1	1				2	1		1		2	6
	Office		1		1				2						2
	Warehouse						1		1						1
	Electricity Authority (storeroom)												1		1
	Services			1					1						1
	Public Services		1						1						1
	Butcher			1					1						1
Film Studio			1					1						1	
	Total	8	10	29	5	7	3	2	64	4	6	3	2	4	83
ENGLAND AND WALES COUNTY BOROUGHES	Private house, flat, outhouse		6						6						6
	Industry	4					1		5	1				1	7
	Railway		1						1						1
	Contractors - Construction/ Demolition	2					1		3						3
	Contractors - Workman's hut			2					2						2
	Canteen, cafe, sports club			1	1				2						2
	Office		1						1						1
	Shop (retail)		1						1						1
Tobacconist's kiosk						1		1						1	
	Total	6	9	3	1	1	2		22	1				1	24
SCOTLAND	Private house, flat, outhouse		7	6					13			1			14
	Farmer's residence									2		1			3
	Industry		1						1						1
	Contractors - Construction/ Demolition						1		1						1
	Contractors - Workman's hut			1					1						1
	Canteen, cafe, sports club				1				1						1
Hotel, public house		1						1						1	
	Total		9	7	1		1		18	2		2			22
NORTH IRELAND	Private house			1					1					1	2
	Hotel			1					1						1
	Total			2					2					1	3
U.K.	TOTAL - United Kingdom	14	28	41	7	8	6	2	106	7	6	5	2	6	132

TABLE XI

Frequencies by Hazard Related to Material First Ignited

IN BUILDINGS	UNITED KINGDOM - 1957	Liquid petroleum gas leakage					Other fires where liquid petroleum gas was the material first ignited					Fires where liquid petroleum gas was not the material first ignited		GRAND TOTAL		
		Region	HAZARD	Rubber tube	Cylinder valve	Cylinder union	Cylinder (unspecified)	Joint, connexion etc.	Total - leaks	Change	Escaping gas	Incorrect use	Unknown		Total-liquid petroleum gas	Rubber tube
ENGLAND AND WALES COUNTIES	Private house, flat, outhouse	1	1	2	4	1	9	1	2	1		13	1	9	23	
	Farmer's residence	1	1	1	3		6	1				7		1	8	
	Farm buildings					1	1					1		3	4	
	Industry		1	1		1	3				3	6		4	10	
	Railway									1		1			1	
	Contractors - Construction/ Demolition				1		1					1	1	1	4	6
	Contractors - Workman's hut	3		1	1		5					5	2	6	13	
	Canteen, cafe, sports club		1				2	3				3			3	
	Hotel, public house	1				1	2	1	2			5		1	6	
	School													2	2	
	Office	1					1					1			1	
	Warehouse													1	1	
	Electricity Authority (storeroom)				1		1					1			1	
	Services	1					1					1			1	
	Public Services				1		1					1			1	
Butcher													1	1		
Film Studio											1			1		
	Total	8	4	5	11	6	34	3	6	4		47	4	32	83	
ENGLAND AND WALES COUNTY BOROUGHES	Private house, flat, outhouse													6	6	
	Industry				1	1	2			1		3		4	7	
	Railway													1	1	
	Contractors - Construction/ Demolition												1	2	3	
	Contractors - Workman's hut		1				1					1		1	2	
	Canteen, cafe, sports club	1					1					1		1	2	
	Office													1	1	
	Shop (retail)													1	1	
Tobacconist's kiosk				1		1					1		1	1		
	Total	1	1	1	1	1	5			1		6	1	17	24	
SCOTLAND	Private house, flat, outhouse	1		2	1	1	5	1				6		8	14	
	Farmer's residence			1			1	1			1	3		1	3	
	Industry													1	1	
	Contractors - Construction/ Demolition													1	1	
	Contractors - Workman's hut													1	1	
	Canteen, cafe, sports club		1				1					1			1	
Hotel, public house													1	1		
	Total	1	1	3	1	1	7	2			1	10		12	22	
NORTH IRELAND	Private house				1	1	2					2			2	
	Hotel	1					1					1			1	
	Total	1			1	1	3					3			3	
U.K.	TOTAL - United Kingdom	11	6	9	14	9	49	5	6	5	1	66	5	61	132	

TABLE XII

Frequencies by Hazard Related to Source of Ignition

NOT IN BUILDINGS	UNITED KINGDOM - 1957	Source of ignition - Liquid petroleum gas apparatus									Other source of ignition				GRAND TOTALS	
		Cutting gun	Torch - e.g. painter	Cooker, stove, ring	Light	Pilot light	Heater	Boiler	Unknown	Total	Slow combustion stove	Match, lighter	Oil stove	Miscellaneous		Unknown
Region	HAZARD	SOURCE OF IGNITION														
ENGLAND AND WALES COUNTIES	Caravan, hut			10	2					1	13	3	6	2		24
	Industry	5							2		7	1	1		1	9
	Railway															1
	Contractors - Construction/ Demolition												1			1
	Roadway				1	1			1		3					3
	Canteens, stalls, kitchens			3							3					3
	Fish and chip van			1							1					1
	Public house (outside)									1	1					1
	Services									1	1					1
	Craft									1	1					1
Postal Authority										1					1	
	Total	5		14	3	1			6	1	30	4	9	2	1	46
ENGLAND AND WALES COUNTY BOROUGHES	Caravan, hut			1							1	1	2			4
	Industry	3									3					3
	Railway					1					1					1
	Roadway		1								1					1
	Canteens, stalls, kitchens			5							5		3			8
	Car							1			1					1
	Travelling Amusements				1						1					1
	Craft			1							1		1			2
	Private house (outside)		1								1					1
	Contractors - Construction/ Demolition								1		1					1
	Total	3	2	7	1	1	1	1		16	1	6				23
SCOTLAND	Caravan, hut			1							1		1			2
	Farm			1							1					1
	Industry	2									2					2
	Fish and chip van			1							1				1	2
	Craft	1		1							2					2
	Total	3		4						7		1			1	9
NORTH IRELAND	Fish and chip van			1							1					1
U.K.	TOTAL - United Kingdom	11	2	26	4	2	1	7	1	54	5	16	2	1	1	79

TABLE XIII

Frequencies by Hazard in Relation to Material First Ignited

NOT IN BUILDINGS	UNITED KINGDOM - 1957	Liquid petroleum gas leakage					Other fires where liquid petroleum gas was the material first ignited					Fires where liquid petroleum gas was not the material first ignited		GRAND TOTAL	
		Rubber tube	Cylinder valve	Cylinder union	Cylinder (unspecified)	Joint, connexion etc.	Total - leaks	Change	Escaping gas	Incorrect use	Unknown	Total - liquid petroleum gas	Rubber tube		Other
Region	HAZARD	MATERIAL FIRST IGNITED													
ENGLAND AND WALES COUNTRIES	Caravan, caravan hut	3	2			5	10	2	3		1	16		8	24
	Industry			2		1	3				5		4	9	
	Railway		1				1				1			1	
	Contractors - Construction/ Demolition			1			1				1			1	
	Roadway		1	1		1	3				3			3	
	Canteens, stalls, kitchens												1	2	3
	Fish and chip van													1	1
	Public house (outside)													1	1
	Services													1	1
	Craft													1	1
Postal Authority										1	1		1	1	
	Total	3	4	4		7	18	2	3	2	2	27	1	18	46
ENGLAND AND WALES COUNTY BOROUGHES	Caravan, caravan hut			1			1		1		1	3		1	4
	Industry													3	3
	Railway												1		1
	Contractors - Construction/ Demolition													1	1
	Roadway	1					1				1				1
	Canteens, stalls, kitchens	2	1	1		1	5		2		7		1	8	
	Gar													1	1
	Travelling Amusements										1	1			1
Craft				1		1				1	1	1		2	
Private house (outside)						1				1	1			1	
	Total	3	1	3	1	1	9		3		2	14	2	7	23
SCOTLAND	Caravan, caravan hut										1	1		1	2
	Farm													1	1
	Industry										1	1		1	2
	Fish and chip van			1			1				1	2			2
Craft			1			1				1	2			2	
	Total			2			2			2	2	6		3	9
NORTH IRELAND	Fish and chip van					1	1					1			1
	TOTAL - United Kingdom	6	5	9	1	9	30	2	6	4	6	48	3	28	79

## INJURY

In 1957 there was a decrease in the number of people sustaining injuries in each 100 fires involving liquid petroleum gas where the gas was the material first ignited; but no definite conclusions can be drawn concerning the numbers injured in fires where liquid petroleum gas apparatus ignited material other than the gas itself. (Table XIV). There were no fatal casualties in these fires.

Twenty-three of the thirty-five people injured when the gas was the material first ignited received their injuries in the home; fifteen of these twenty-three people were living in caravans. Table XV records ten people injured in private houses and flats, but two of these were workmen who were injured removing a cylinder from which burning gas was issuing. These two men had been using a torch fuelled by liquid petroleum gas.

Gas escaping from either a leak or an open tap, and building up to a large quantity before being ignited <sup>or/then</sup> (causing an explosion) is the most common cause of injury in the home (Table XVI).

The number of persons injured per 100 fires resulting from leakage of the gas was lower in 1957 than in 1950-1952, and as the majority of the injuries occurred in the home, it is concluded that serious leakage of liquid petroleum gas in the home was less frequent in that year than in the earlier period.

Leakage from cylinders almost certainly decreased during the intervening years (Section 3.1) which implies greater care in the handling, maintenance and storage of the cylinders. The relevance of this with regard to casualty incidence can be appreciated when the properties of liquid petroleum gas are considered. In particular, liquid petroleum when released, produces a highly flammable gas, which is heavier than air, and not readily dispersed. Leakage in an enclosed space could therefore result in an explosion of extreme violence once the gas reached even a small ignition agent. The reduction in the incidence of injury could, therefore, have resulted from several factors, either singly or in combination, such as an improvement in cylinder fittings, more care in the use of fittings and replacement of cylinders, and the location of cylinders outside caravans.

TABLE XIV

Frequencies of Nos. Injured Standardised  
on Fires Involving Liquid Petroleum Gas

Material first ignited	Liquid petroleum gas		Other (Gas apparatus - source of ignition)	
	1947-1952	1957	1947-1952	1957
Numbers injured	216	35	13	4
Fires involving liquid petroleum gas	353	114	132	97
Numbers injured per 100 fires	61.2	30.7	9.8	4.1
Standard error	2.6	4.3	2.8	2.1

TABLE XV

Nos. Injured According to Hazard  
and Material First Ignited - 1957

Hazard \ Material first ignited	Liquid petroleum gas	Other	Total
Caravan	15	0	15
Private Residence	10	0	10
Industry	1	2	3
Contractors	1	2	3
Miscellaneous	8	0	8
Total	35	4	39

TABLE XVI

Nos. Injured in the Home Related to the Source of  
Ignition and the Material First Ignited - 1957

Source of ignition \ Material first ignited	Escaping gas from leak	Escaping gas from open tap on cooker	Escaping gas from change of cylinder	Total
Domestic fire, slow combustion stove, oil heater	12		1	13
Match, lighter	6	2		8
Stove (using liquid petroleum gas)		2		2
Total	18	4	1	23

## CONCLUSIONS

Liquid petroleum gas deliveries were conspicuously higher in 1957 (73,000 tons) than in the period 1950-1952 (average approximately 39,000 tons per annum). This increased consumption can be accounted for by two factors: firstly, by an increased usage of cutting guns, torches and boilers consuming this fuel; secondly, by the emergence of the contracting industry as a major consumer of the gas.

The fire incidence, where a liquid petroleum gas consuming apparatus was the source of ignition, has also been affected by the changing pattern of usage, being on the increase. Cutting guns, torches and boilers are more prone to be the source of ignition of a fire than are cookers, stoves and rings.

The incidence of fires in buildings involving liquid petroleum gas was higher in the English and Welsh Counties and in Scotland than in the English and Welsh County Boroughs. The Regional differences are not inconsistent with the view that liquid petroleum gas is used instead of town gas and electricity where the latter are not easily available.



The number of persons injured per 100 fires resulting from leakage of liquid petroleum gas was lower in 1957 than in 1950-1952. The majority of these casualties occurred in the home. In addition, there were no fatal casualties in 1957. There has therefore been a decrease in the seriousness of leakage in the home. Increased safety-precautions and greater care in the maintenance of cylinder fittings could be responsible for this improvement.

#### References

- (1) MILLAR, D. W. Fires involving liquid fuel gas apparatus attended by the N.F.S. and Fire Brigades in the United Kingdom 1947-1951. Joint Fire Research Organization F.R. Note No. 35/1952.
- (2) HINTON, J. E. L. An analysis of fires involving liquid fuel gas during the years 1947-1952. Reports from the N.F.S. and Fire Brigades in the United Kingdom 1947-1952. Joint Fire Research Organization F.R. Note No. 77/1953.
- (3) Statistical Digest (Annual). Ministry of Power. H.M. Stationery Office, London.
- (4) The Problems of Liquefied Petroleum Gases. The Journal of the British Fire Services Association. 1961, 6, (1), 3-6.
- (5) Liquid petroleum gas in public works contracts. The Guardian, June 6, 1961.