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## THE BEHAVIOUR OF AUTOMATIC FIRE DETECTION SYSTEMS

by

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FIRE
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SUMMARY

An examination has been made of the frequency and reasons for the occurrence of false calls made by automatic fire detection systems. These appear to be about 11 times as frequent as calls to genuine fires. About one quarter of false calls are attributed to ambient conditions, one half to mechanical and electrical problems and about 17 per cent to failure in or misuse of the communications systems. Where automatic systems are installed about 68 per cent of calls to genuine fires are made by them.

KEY WORDS: Detector fire, Alarm, Alarm false, Automatic



MINISTRY OF TECHNOLOGY AND FIRE OFFICES' COMMITTEE
JOINT FIRE RESEARCH ORGANIZATION

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## INTRODUCTION

It has been suspected for some time that the frequency of false alarms originating from automatic fire detection equipment is large in comparison with that of calls to genuine fires, and such information as could be obtained from fire protection experts in other countries has tended to indicate that this is a universal experience. There has, however, been little quantitative information available on either the frequencies of false alarms or their causes. At the request of the Home Office, the Fire Research Station undertook a study to provide further information, based on reports received from fire brigades on all fire incidents in premises fitted with automatic detection equipment and on all false alarms given by them. The study covered a period of one year (1968) and involved the brigades in completing the special report form reproduced in Appendix 1. It was intended to provide information on the operation of all automatic detection systems in buildings, whether linked directly to the brigade or not.

## THE INFORMATION RECEIVED

The investigation was primarily concerned with occurrence of false alarms to fire brigades, and for this purpose a false alarm was defined as any fire call to premises equipped with an automatic alarm system at which there was, in fact, no fire. Thus it included all false calls received and was not confined to those incidents in which a mechanical or electrical fault occurred in the equipment. It did not, however, include fault signals correctly given by the equipment (i.e. automatic indications that a fault had developed).

The main groups of detector systems in use are those actuated by heat and those actuated by smoke. In addition it appears from the fire brigade returns that there are appreciable numbers of 'smoke and heat' systems, and of buildings in which a mixture of systems exist together. Brigades also submitted returns for buildings in which sprinkler systems actuated alarms at the brigades and for some with manually operated alarms.

Among the items requested in the form were the name of the maker of the equipment involved and the trade name of the system. It was intended that makers should be given information on the incidents involving their own equipment. In the event this proved to be extremely difficult because of confusion between the two questions, and because of the large number of systems which appeared to incorporate equipment of several different makes. Where possible, however, lists of incidents (necessarily incomplete) were sent to the makers concerned.

No information was obtained on the age and condition of the installations.

## RESULTS OF ANALYSIS

### CALLS RECEIVED

The calls received through the operation of various types of equipment are summarised in Table (i) from which it will be seen that, taking all types of equipment together, false calls outnumbered actual fire calls in the ratio of about 11 : 1. There were differences between the ratios for different types of equipment which ranged from about $4\frac{1}{2}$ : 1 to about 23 : 1. It is of interest to note that sprinklers produced more than 10 false calls for each genuine fire and that even with manual alarm systems the ratio was about $4\frac{1}{2}$ : 1.

Table (i) Summary of calls received

| Type of system | No.of calls to fires | | No. of false calls | Ratio of false calls : fire calls |
|---|---|---|---|---|
| | By system installed | By other means | | |
| All types | 489 | 288 | 5440 | 11.1 |
| Heat | 193 | 105 | 2146 | 11.1 |
| Smoke | 101 | 37 | 1429 | 14.1 |
| Sprinkler | 101 | 125 | 1048 | 10.4 |
| Manual | 55 | 10 | 243 | 4.4 |
| Mixed | 18 | 6 | 137 | 7.6 |
| Heat and smoke | 18 | 2 | 410 | 22.8 |
| Unspecified | 3 | 3 | 27 | 9.0 |

Note: There was also one false call from gas detector equipment

The numbers of false calls and fire calls received from different types of equipment are given for each type of occupancy (by Standard Industrial Classification Orders) in Tables 1(a)-1(g) in Appendix 2.

### REASONS FOR FALSE CALLS

The reported reasons for false calls are given for each type of equipment in Table 2 of Appendix 2. Table (ii) is an overall summary for all types of equipment.

Table (ii) Summary table of reasons for false calls

| Reason for false call | Totals (all types of equipment | |
|---|---|---|
| | No. | Per cent |
| Total (all reasons) | 5441 | 100 |
| Ambient conditions (Total) | 1410 | 25.9 |
| Extraneous heat and smoke | 951 | 17.5 |
| High ambient temperature | 233 | 4.3 |
| Condensation, snow, rain, etc. | 153 | 2.8 |
| Low ambient temperature | 37 | 0.7 |
| Steam, vapour | 29 | 0.5 |
| Draught, high wind | 7 | 0.1 |
| Mechanical and electrical (Total) | 2507 | 46.1 |
| Defective wiring on control unit | 602 | 11.1 |
| Defective head | 539 | 9.9 |
| Surge in mains | 411 | 7.6 |
| Miscellaneous (e.g. broken pipe) | 293 | 5.4 |
| Direct impact on head | 244 | 4.5 |
| Vibration of system | 215 | 4.0 |
| Shock (e.g. falling weight) | 151 | 2.8 |
| Voltage drop, power cut | 42 | 0.8 |
| Defective push button, etc. | 10 | 0.2 |
| Communication (Total) | 901 | 16.6 |
| Testing, maintenance not notified | 478 | 8.8 |
| G.P.O. activity | 335 | 6.2 |
| Defect in connection to brigade | 88 | 1.6 |
| Unspecified and unknown | 623 | 11.5 |

The reasons shown in the tables have been grouped together to indicate the relative importance of the ambient conditions in which the equipment will have to work, mechanical and electrical faults due to either defects in the equipment or accidental damage, and failure in the communication system. There may be some ambiguity of classification within the three groups (e.g. 'steam, vapour' could possibly have been regarded as 'extraneous heat and smoke' or possibly as 'high ambient temperature'), but the distinction between the main groups themselves is clear.

The occurrence of extraneous heat and smoke is the most important item among the ambient conditions and this could arise from carelessness within the premises, from bad siting of equipment or from unforeseen circumstances.

Under the heading of mechanical and electrical causes the most important are defective wiring and defective heads. These would appear to be equipment faults but other items listed in this group could be due to carelessness within the premises or to external conditions which the equipment is not designed to withstand.

The main communication fault appears to be testing or maintenance without previous notification to the fire brigade.

CONNECTIONS TO BRIGADES

The types of connections to brigades for equipment from which false calls were received are shown in Table 3 of Appendix 2. The most frequent type in each of the systems was the individual direct line. As may be seen from the summary in Table (iii), these and the 999 automatic dialler together made up about 80 per cent of the connections.

Table (iii) Types of connection to brigades for equipment from which false calls received

| Type of connection | No. of false calls |
|---|---|
| Total (all types) | 5441 |
| Individual direct line | 3976 |
| 999 Automatic dialler | 374 |
| Commercial central alarm station | 320 |
| Exchange telephone (manual) | 289 |
| V.F. Remote control, System A | 137 |
| Shared direct line (e.g. alarm company's multi-channel | 111 |
| Fire telephone | 52 |
| Mixed | 17 |
| Other and unspecified | 165 |

FAILURES AND DELAYS

In addition to information on false calls and successful calls to fires, brigades recorded those occasions on which they had been called to fires of which they had not received notification through the operation of the alarm system installed in the premises. Detailed figures are given in Table 4 of Appendix 2. In some incidents the alarm systems did not operate at all and these have been regarded as 'failures', although they include a high proportion in which the fire was dealt with quickly, before the automatic system had time to operate. In other cases the alarm system operated, but only after the brigade had been notified by other means; these have been classified as 'delays'. An overall summary of the reasons is given in Table (iv).

Table (iv) Reason for failure or delay - call received by other means

| Suspected reason for failure or delay | Failure | Delays |
|---|---|---|
| Total (all reasons) | 154 | 134 |
| Insufficient heat or smoke | 111 | - |
| Disconnection or maintenance | 20 | 3 |
| Manual system operated before automatic | - | 19 |
| Failure of connection to brigade | 7 | 2 |
| Ventilation or currents at ceiling level | 6 | - |
| Failure of detector head(s) | 5 | - |
| Failure of control equipment | 5 | - |
| Unknown or unspecified | - | 110 |

TIMES OF CALLS

Since automatic detectors are likely to be of most value when there are few human observers about, it is of interest to see how the frequencies of fire calls and false callse are distributed throughout the day. Detailed information on this is given for the various types of system in Tables 5(a)-5(g) in Appendix 2. Table (v) summarises these figures for all types of equipment and shows the frequencies as 3 hourly totals. The frequencies of false calls are also shown with the total incidents in Fig.1. Although the two graphs are of similar shape they are not completely parallel and indicate that the ratio of false to total calls is slightly higher during the day than during the night.

Table (v) Times of fire calls and false calls

| Time of call | Total incidents | False calls | Fire calls by:- | |
|---|---|---|---|---|
| | | | Automatic system | Other means |
| Midnight - 02.59 | 435 | 370 | 38 | 27 |
| 03.00 - 05.59 | 405 | 359 | 24 | 22 |
| 06.00 - 08.59 | 705 | 634 | 41 | 30 |
| 09.00 - 11.59 | 1333 | 1199 | 87 | 47 |
| 12.00 - 14.59 | 1187 | 1042 | 100 | 45 |
| 15.00 - 17.59 | 1060 | 921 | 92 | 47 |
| 18.00 - 20.59 | 647 | 536 | 74 | 37 |
| 21.00 - 23.59 | 408 | 351 | 32 | 25 |
| Unspecified | 37 | 28 | 1 | 8 |

The time distributions of calls to fires by the automatic systems and by other means are shown graphically in Fig.2. Again the graphs are of the same general form, but the relative effectiveness of the automatic systems appears to be greater during the day time than at night.

## DISCUSSION

It is clear that the ratio of false calls to actual fire calls given by automatic systems of all types is high; on average about 11 : 1. Nevertheless this is not, in itself, an indication of gross overall inefficiency. By reducing the sensitivity of detecting devices it would be possible to eliminate a large number of false calls, but if this were carried too far the number of failures to detect real fires would increase to an unacceptable level. Ideally the sensitivity level would be selected, on economic grounds, so that the (optimal) level would minimise the sum of the costs and losses. The costs would include the costs of installation and maintenance of the equipment and the cost of dealing with both genuine and false calls, while the losses would include both the direct and the consequential losses by fire. Not only is this beyond the scope of the present note, but a considerable amount of economic information (not at present available) would be necessary to make this ideal assessment. Meanwhile it is relevant to note that selection of the sensitivity level is mainly related to the ambient conditions in which the equipment has to operate, and that these conditions were believed to be responsible for only about one quarter of the false calls received during the investigation.

Among the mechanical and electrical faults, which together appear to account for almost half of the false calls, some (such as defective wiring on control units and defective heads) should be susceptible to reduction by improved inspection and maintenance; others (impact, shock, etc.) require attention to works discipline.

An appreciable reduction in communication faults would appear to be possible given adequate attention to testing and maintenance procedure, in particular notification of brigades that these activities are taking place.

It appears that the majority of failures to detect fires result from the evolution of insufficient heat or smoke and this would be expected if many fires are detected in their very early stages by factory personnel. It is surprising, therefore, to find that proportionately more fires fall into this category at night time than during the day.

## CONCLUSIONS

The ratio of false calls to genuine fire calls given by automatic systems of all types is about 11 : 1.

About one quarter of the false calls received are attributed to ambient conditions, almost one half to mechanical and electrical problems and approximately 17 per cent arise from the communication system.

The majority of connections to brigades are by individual direct line and 999 automatic diallers.

About 68 per cent of calls to genuine fires are made by automatic systems, where these are installed, and the remainder by other means. The automatic system does not operate on about 53 per cent of occasions on which calls are received by other means, but in about 73 per cent of these 'failure to operate' there is insufficient heat or smoke produced by the fire; in many instances this is likely

to be because the fire is dealt with promptly when discovered by human observers. The reasons for delays in the operation of the automatic system which result in a call being received by other means are generally not known.

ACKNOWLEDGMENT

Thanks are due to the fire brigades in England and Wales and in Scotland who provided the information on which this report is based.

APPENDIX 1 Form No.AFD/1

MINISTRY OF TECHNOLOGY AND FIRE OFFICES' COMMITTEE
JOINT FIRE RESEARCH ORGANIZATION

Report on Fires or False Alarms in Buildings Equipped with Automatic Fire Detection Systems

This report is intended to provide information on the operation of automatic fire detection systems in buildings whether the detection system is linked to the brigade directly or not.

Please complete and tick appropriate boxes for all fires in such premises, whether the system signals an alarm or not, and for all false alarms, i.e. warnings of fire where no fire exists. Do not use for fault signals only. Incidents in buildings in which an automatic sprinkler system activates an alarm at the brigade should be included.

NOTE Part IV should be wholly or partly completed only where actually relevant.

Brigade ..... Report No. .....

PART I - Details of incident

1. Nature of incident
   (a) Fire - call received by automatic alarm ☐ K433 No. .....
   (b) Fire - call received by other means ☐ K433 No. .....
   (c) False alarm ☐

2. Name of occupier and address .....
   .....
   Risk Category of Area .....

3. Trade or business .....

4. Date of incident ..... 5. Time of call .....

PART II - Details of system

6. Name of maker ..... (e.g. A.F.A., Gent etc)

7. Trade name of system .....

NOTE Specify names of system and detector if necessary to define completely.

8. Type of system
   (a) Heat ☐ Temperature setting or B.S.3116 classification, if known .....
   (b) Smoke ☐
   (c) Alarm operated by sprinkler system ☐
   (d) Other ☐ (Specify) .....

9. Type of wiring
   (a) Metal sheathed cable ☐
   (b) Cable in conduit ☐
   (c) Other ☐ (Specify) .....

10. Type of connection to brigade
   (a) 999 Automatic dialler ☐
   (b) Individual direct line ☐
   (c) Shared direct line (e.g. alarm company's multi-channel) ☐
   (d) V.F. Remote Control, System A ☐
   (e) Commercial central alarm station ☐
   (f) Fire telephone ☐
   (g) Exchange telephone (manual) ☐
   (h) Other (specify) ☐
   .....
   .....

PART III - Details of building compartment in which alarm arises.

11. (a) Approx. height ..... ft (b) Width .....ft

(c) Length ..... ft

12. Shape of ceiling

(a) Flat ☐

(b) Flat with joists showing ☐ (approx. spacing ..... ft)

(c) Northlight ☐

(d) Ridge ☐

(e) Clerestory ☐

(f) Other (specify) .....

PART IV - Details of failure or delay in giving alarm.

13. Suspected reason for failure (or delay) of system

| | Delay | Failure |
|---|---|---|
| (a) Failure of detector head/heads | ☐ | ☐ |
| (b) Failure of wiring to head/heads | ☐ | ☐ |
| (c) Ventilation currents at ceiling level | ☐ | ☐ |
| (d) Obstructions at ceiling level | ☐ | ☐ |
| (e) Failure of control equipment | ☐ | ☐ |
| (f) Failure of connection to brigade | ☐ | ☐ |

If (f), specify briefly if possible .....

.....

| | | |
|---|---|---|
| (g) Disconnection, e.g. for maintenance | ☐ | ☐ |

If (g), specify briefly if possible .....

.....

14. Suspected reason for false alarm

(a) Extraneous heat ☐ Specify .....

(b) Extraneous smoke ☐ Specify .....

(c) High ambient temperature ☐

(d) Low ambient temperature ☐

(e) Vibration of system ☐

(f) Shock on system, e.g. weight falling on floor above ☐

(g) Direct impact on head ☐ Specify .....

(h) Testing/maintenance without warning brigade ☐

(i) Defective head ☐

(j) Defective wiring or control unit ☐ Specify .....

(k) Defective connection to brigade ☐ Specify .....

(l) G.P.O. activity ☐

15. Interference with system

(a) Accidental ☐

(b) Suspected malicious ☐

(c) Unknown ☐

16. Other remarks (Please add any other information you consider relevant)

APPENDIX 2

Table 1(a) Heat detectors - fire calls and false calls by occupancy

| S.I.C. order | Classification | Total incidents | False calls | Fire calls by: Automatic system | Fire calls by: Other means |
|---|---|---|---|---|---|
| All | Totals | 2444 | 2146 | 193 | 105 |
| I | Agriculture, forestry, fishing | 1 | 1 | - | - |
| III | Food, drink, tobacco | 123 | 111 | 8 | 4 |
| IV | Chemicals, allied industries | 147 | 117 | 14 | 16 |
| V | Metal manufacture | 73 | 62 | 8 | 3 |
| VI | Engineering, electrical goods | 226 | 204 | 18 | 4 |
| VII | Shipbuilding, marine engineering | 20 | 16 | 2 | 2 |
| VIII | Vehicles | 104 | 96 | 6 | 2 |
| IX | Metal goods not elsewhere specified | 51 | 45 | 3 | 3 |
| X | Textiles | 149 | 123 | 19 | 7 |
| XI | Leather, leather goods, fur | 3 | 2 | 1 | - |
| XII | Clothing, footwear | 25 | 20 | 5 | - |
| XIII | Bricks, pottery, glass, cement, etc. | 52 | 50 | 1 | 1 |
| XIV | Timber, furniture, etc. | 44 | 38 | 2 | 4 |
| XV | Paper, printing, publishing | 196 | 166 | 20 | 10 |
| XVI | Other manufacturing industries | 64 | 54 | 9 | 1 |
| XVII | Construction | 18 | 17 | 1 | - |
| XVIII | Gas, electricity, water | 30 | 29 | 1 | - |
| XIX | Transport, communication | 124 | 112 | 9 | 3 |
| XX | Distributive trades | 376 | 341 | 21 | 14 |
| XXI | Insurance, banking, finance | 42 | 39 | 1 | 2 |
| XXII | Professional, scientific services | 233 | 206 | 17 | 10 |
| XXIII | Miscellaneous services | 180 | 144 | 19 | 17 |
| XXIV | Public administration, defence | 125 | 116 | 7 | 2 |
| - | Dwellings, unknown, unclassified | 38 | 37 | 1 | - |

Table 1(b) Smoke detectors - fire calls and false calls by occupancy

| S.I.C. order | Classification | Total incidents | False calls | Fire calls by: Automatic system | Fire calls by: Other means |
|---|---|---|---|---|---|
| All | Totals | 1567 | 1429 | 101 | 37 |
| I | Agriculture, forestry, fishing | 3 | 3 | - | - |
| II | Mining, quarrying | 2 | 2 | - | - |
| III | Food, drink, tobacco | 107 | 103 | 2 | 2 |
| IV | Chemicals, allied industries | 52 | 51 | 1 | - |
| V | Metal manufacture | 27 | 24 | 3 | - |
| VI | Engineering, electrical goods | 112 | 93 | 14 | 5 |
| VII | Shipbuilding, marine engineering | 16 | 16 | - | - |
| VIII | Vehicles | 69 | 55 | 11 | 3 |
| IX | Metal goods not elsewhere specified | 30 | 25 | 5 | - |
| X | Textiles | 52 | 44 | 5 | 3 |
| XII | Clothing, footwear | 33 | 32 | 1 | - |
| XIII | Bricks, pottery, glass, cement, etc. | 7 | 7 | - | - |
| XIV | Timber, furniture, etc. | 10 | 9 | 1 | - |
| XV | Paper, printing, publishing | 68 | 57 | 8 | 3 |
| XVI | Other manufacturing industries | 35 | 30 | 5 | - |
| XVII | Construction | 11 | 9 | 2 | - |
| XVIII | Gas, electricity, water | 43 | 42 | 1 | - |
| XIX | Transport, communications | 123 | 118 | 3 | 2 |
| XX | Distributive trades | 288 | 272 | 11 | 5 |
| XXI | Insurance, banking, finance | 95 | 84 | 10 | 1 |
| XXII | Professional, scientific services | 142 | 132 | 6 | 4 |
| XXIII | Miscellaneous services | 62 | 54 | 4 | 4 |
| XXIV | Public administration, defence | 156 | 146 | 5 | 5 |
| - | Dwellings, unknown, unclassified | 24 | 21 | 3 | - |

Table 1(c) Sprinklers - fire calls and false calls by occupancy

| S.I.C. order | Classification | Total incidents | False calls | Fire calls by: Automatic system | Fire calls by: Other means |
|---|---|---|---|---|---|
| All | Totals | 1274 | 1048 | 101 | 125 |
| I | Agriculture, forestry, fishing | 2 | 2 | - | - |
| III | Food, drink, tobacco | 63 | 53 | 6 | 4 |
| IV | Chemicals, allied industries | 86 | 65 | 12 | 9 |
| V | Metal manufacture | 16 | 14 | - | 2 |
| VI | Engineering, electrical goods | 52 | 44 | 4 | 4 |
| VII | Shipbuilding, marine engineering | 3 | 3 | - | - |
| VIII | Vehicles | 47 | 33 | 2 | 12 |
| IX | Metal goods not elsewhere specified | 13 | 12 | - | 1 |
| X | Textiles | 187 | 134 | 22 | 31 |
| XI | Leather, leather goods, furs | 9 | 9 | - | - |
| XII | Clothing, footwear | 31 | 29 | 1 | 1 |
| XIII | Bricks, pottery, glass, cement, etc. | 26 | 24 | - | 2 |
| XIV | Timber, furniture, etc. | 69 | 53 | 6 | 10 |
| XV | Paper, printing, publishing | 162 | 135 | 16 | 11 |
| XVI | Other manufacturing industries | 76 | 60 | 9 | 7 |
| XVIII | Gas, electricity, water | 5 | 5 | - | - |
| XIX | Transport, communication | 61 | 60 | - | 1 |
| XX | Distributive trades | 261 | 231 | 8 | 22 |
| XXI | Insurance, banking, finance | 8 | 7 | - | 1 |
| XXII | Professional, scientific services | 19 | 19 | - | - |
| XXIII | Miscellaneous services | 28 | 25 | - | 3 |
| XXIV | Public administration, defence | 35 | 17 | 15 | 3 |
| - | Dwellings, unknown, unclassified | 15 | 14 | - | 1 |

Table 1(d) Manual alarms - fire calls and false calls by occupancy

| S.I.C. Order | Classification | Total incidents | False calls | Fire calls by: Installed system | Fire calls by: Other means |
|---|---|---|---|---|---|
| All | Totals | 308 | 243 | 55 | 10 |
| III | Food, drink, tobacco | 18 | 16 | 2 | - |
| IV | Chemicals, allied industries | 9 | 7 | 1 | 1 |
| V | Metal manufacture | 2 | 1 | 1 | - |
| VI | Engineering, electrical goods | 10 | 7 | 3 | - |
| VII | Shipbuilding, marine engineering | 2 | 2 | - | - |
| VIII | Vehicles | 13 | 9 | 3 | 1 |
| IX | Metal goods not elsewhere specified | 3 | 3 | - | - |
| X | Textiles | 56 | 26 | 29 | 1 |
| XII | Clothing, footwear | 1 | 1 | - | - |
| XIII | Bricks, pottery, glass, cement, etc. | 2 | 2 | - | - |
| XIV | Timber, furniture, etc. | 2 | 2 | - | - |
| XV | Paper, printing, publishing | 14 | 11 | 3 | - |
| XVI | Other manufacturing industries | 26 | 17 | 9 | - |
| XVIII | Gas, electricity, water | 15 | 13 | 1 | 1 |
| XIX | Transport, communication | 19 | 18 | - | 1 |
| XX | Distributive trades | 35 | 33 | 1 | 1 |
| XXI | Insurance, banking, finance | 4 | 4 | - | - |
| XXII | Professional, scientific services | 48 | 43 | 2 | 3 |
| XXIII | Miscellaneous services | 14 | 14 | - | - |
| XXIV | Public administration, defence | 9 | 8 | - | 1 |
| - | Unknown, unclassified | 6 | 6 | - | - |

Table 1(e) Detectors of mixed types - fire calls and false calls by occupancy

| S.I.C. Order | Classification | Total incidents | False calls | Fire calls by: Automatic system | Fire calls by: Other means |
|---|---|---|---|---|---|
| All | Totals | 161 | 137 | 18 | 6 |
| III | Food, drink, tobacco | 7 | 6 | - | 1 |
| IV | Chemicals, allied industries | 10 | 7 | 2 | 1 |
| VI | Engineering, electrical goods | 8 | 8 | - | - |
| VIII | Vehicles | 2 | 1 | 1 | - |
| IX | Metal goods not elsewhere specified | 1 | 1 | - | - |
| X | Textiles | 12 | 8 | 3 | 1 |
| XI | Leather, leather goods, fur | 2 | 2 | - | - |
| XIV | Timber, furniture, etc. | 12 | 6 | 6 | - |
| XV | Paper, printing, publishing | 9 | 9 | - | - |
| XVI | Other manufacturing industries | 12 | 10 | 1 | 1 |
| XVIII | Gas, electricity, water | 2 | 1 | 1 | - |
| XIX | Transport, communication | 16 | 14 | 1 | 1 |
| XX | Distributive trades | 24 | 21 | 3 | - |
| XXI | Insurance, banking, finance | 3 | 3 | - | - |
| XXII | Professional, scientific services | 22 | 22 | - | - |
| XXIII | Miscellaneous services | 5 | 5 | - | - |
| XXIV | Public administration, defence | 4 | 3 | - | 1 |
| - | Dwellings, unknown, unclassified | 10 | 10 | - | - |

Table 1(f) Heat and smoke detectors - fire calls and false calls by occupancy

| S.I.C | Classification | Total incidents | False calls | Fire calls by: Automatic system | Fire calls by: Other means |
|---|---|---|---|---|---|
| All | Totals | 430 | 410 | 18 | 2 |
| III | Food, drink, tobacco | 10 | 10 | - | - |
| IV | Chemicals, allied industries | 7 | 7 | - | - |
| V | Metal manufacture | 17 | 17 | - | - |
| VI | Engineering, electrical goods | 31 | 31 | - | - |
| VII | Shipbuilding, marine eingeering | 3 | 3 | - | - |
| VIII | Vehicles | 1 | 1 | - | - |
| IX | Metal goods not elsewhere specified | 7 | 6 | 1 | - |
| X | Textiles | 10 | 10 | - | - |
| XI | Leather, leather goods, fur | 1 | 1 | - | - |
| XII | Clothing, footwear | 6 | 6 | - | - |
| XIV | Timber, furniture, etc. | 2 | 2 | - | - |
| XV | Paper, printing, publishing | 10 | 9 | - | 1 |
| XVI | Other manufacturing industries | 12 | 10 | 2 | - |
| XVII | Construction | 8 | 7 | 1 | - |
| XVIII | Gas, electricity, water | 29 | 27 | 2 | - |
| XIX | Transport, communication | 16 | 14 | 1 | 1 |
| XX | Distributive trades | 135 | 130 | 5 | - |
| XXI | Insurance, banking, finance | 30 | 26 | 4 | - |
| XXII | Professional, scientific services | 30 | 30 | - | - |
| XXIII | Miscellaneous services | 28 | 27 | 1 | - |
| XXIV | Public administration, defence | 32 | 31 | 1 | - |
| - | Dwellings, unknown, unclassified | 5 | 5 | - | - |

Table 1(g) Detectors of unrecorded type - fire calls and false calls by occupancy

| S.I.C. Order | Classification | Total incidents | False calls | Fire calls by: Automatic system | Fire calls by: Other means |
|---|---|---|---|---|---|
| All | Totals | 33 | 27 | 3 | 3 |
| I | Agriculture, forestry, fishing | 1 | 1 | - | - |
| IV | Chemicals, allied industries | 2 | 1 | 1 | - |
| VI | Engineering, electrical goods | 4 | 1 | 2 | 1 |
| X | Textiles | 3 | 2 | - | 1 |
| XV | Paper, printing, publishing | 2 | 2 | - | - |
| XVI | Other manufacturing industries | 2 | 2 | - | - |
| XIX | Transport, communication | 2 | 2 | - | - |
| XX | Distributive trades | 7 | 6 | - | 1 |
| XXI | Insurance, banking, finance | 1 | 1 | - | - |
| XXII | Professional, scientific services | 2 | 2 | - | - |
| XXIII | Miscellaneous services | 1 | 1 | - | - |
| XXIV | Public administration, defence | 4 | 4 | - | - |
| - | Dwellings, unknown, unspecified | 2 | 2 | - | - |

Table 2 Reasons for false calls

| Reported reason for false call | Total (all types) | | Type of system | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Per cent | Heat | Smoke | Sprinkler | Manual | Mixed | Heat and smoke | Gas | Unspecified |
| Totals | 5441 | 100 | 2146 | 1429 | 1048 | 243 | 137 | 410 | 1 | 27 |
| Ambient conditions (Totals) | 1410 | 25.9 | 561 | 631 | 55 | 8 | 12 | 137 | 0 | 6 |
| Extraneous heat and smoke | 951 | 17.5 | 306 | 523 | 24 | 3 | 5 | 87 | - | 3 |
| High ambient temperature | 233 | 4.3 | 180 | 10 | 15 | 1 | 2 | 25 | - | - |
| Condensation, snow, rain, etc. | 153 | 2.8 | 44 | 78 | 9 | 3 | 3 | 15 | - | 1 |
| Low ambient temperature | 37 | 0.7 | 16 | 6 | 5 | 1 | 2 | 6 | - | 1 |
| Steam, vapour | 29 | 0.5 | 13 | 10 | 2 | - | - | 3 | - | 1 |
| Draught, high wind | 7 | 0.1 | 2 | 4 | - | - | - | 1 | - | - |
| Mechanical and electrical (Totals) | 2507 | 46.1 | 931 | 513 | 695 | 140 | 38 | 179 | 1 | 10 |
| Defective wiring on control unit | 602 | 11.1 | 258 | 153 | 97 | 26 | 17 | 49 | - | 2 |
| Defective head | 539 | 9.9 | 170 | 282 | 13 | 2 | 4 | 67 | - | 1 |
| Surge in mains | 411 | 7.6 | 12 | - | 392 | 2 | 3 | 2 | - | - |
| Miscellaneous (e.g. broken pipe) | 293 | 5.4 | 93 | 21 | 91 | 64 | 2 | 16 | 1 | 5 |
| Direct impact on head | 244 | 4.5 | 168 | 9 | 32 | 22 | 6 | 6 | - | 1 |
| Vibration of system | 215 | 4.0 | 109 | 26 | 38 | 15 | 2 | 25 | - | - |
| Shock (e.g. by falling weight) | 151 | 2.8 | 102 | 11 | 24 | 7 | 2 | 4 | - | 1 |
| Voltage drop, power cut | 42 | 0.8 | 17 | 8 | 6 | 1 | 2 | 8 | - | - |
| Defective push button, etc. | 10 | 0.2 | 2 | 3 | 2 | 1 | - | 2 | - | - |
| Communication (Totals) | 901 | 16.6 | 394 | 158 | 227 | 38 | 33 | 45 | 0 | 6 |
| Testing, maintenance not notified | 478 | 8.8 | 170 | 70 | 175 | 26 | 16 | 18 | - | 3 |
| G.P.O. activity | 335 | 6.2 | 186 | 70 | 35 | 10 | 15 | 19 | - | - |
| Defect in connection to brigade | 88 | 1.6 | 38 | 18 | 17 | 2 | 2 | 8 | - | 3 |
| Unspecified and unknown | 623 | 11.5 | 260 | 127 | 71 | 57 | 54 | 49 | - | 5 |

Table 3 Type of connection to brigade for equipment from which false calls were received

| Type of connection to F.B. | Total (all types) | | Type of system | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Per cent | Heat | Smoke | Sprinkler | Manual | Mixed | Heat and smoke | Gas | Unspecified |
| Totals | 5441 | 100 | 2146 | 1429 | 1048 | 243 | 137 | 410 | 1 | 27 |
| Individual direct line | 3976 | 73.2 | 1614 | 992 | 811 | 152 | 87 | 309 | 1 | 10 |
| 999 Automatic dialler | 374 | 6.9 | 146 | 112 | 78 | 9 | 10 | 18 | - | 1 |
| Commercial central alarm station | 320 | 5.9 | 126 | 70 | 65 | 22 | 24 | 11 | - | 2 |
| Exchange telephone (manual) | 289 | 5.3 | 94 | 109 | 38 | 22 | 2 | 23 | - | 1 |
| V.F. Remote control, System A | 137 | 2.5 | 36 | 50 | 7 | 4 | 4 | 36 | - | - |
| Shared direct line (e.g. alarm company's multi channel) | 111 | 2.0 | 62 | 18 | 15 | 10 | 4 | 2 | - | - |
| Fire telephone | 52 | 0.1 | 18 | 27 | 2 | 3 | - | 1 | - | 1 |
| Mixed | 17 | 0.03 | 8 | 2 | 1 | 4 | 1 | 1 | - | - |
| Other and unspecified | 165 | 3.0 | 42 | 49 | 31 | 17 | 5 | 9 | - | 12 |

Table 4 Suspected reason for failure or delay in alarm equipment where call to fire was received by other means

| Suspected reason for failure or delay | Total failures and delays all types | Type of system | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Heat | | Smoke | | Sprinkler | | Manual | | Mixed | | Heat and smoke | | Unspecified | |
| | | F | D | F | D | F | D | F | D | F | D | F | D | F | D |
| Totals | 288 | 61 | 44 | 12 | 25 | 74 | 51 | 1 | 9 | 3 | 3 | 2 | - | 1 | 2 |
| Insufficient heat or smoke | 111 | 45 | - | 4 | - | 58 | - | 1 | - | 1 | - | 1 | - | 1 | - |
| Disconnection or maintenance | 23 | 10 | 2 | 2 | - | 7 | 1 | - | - | 1 | - | - | - | - | - |
| Manual system operated before automatic | 19 | - | 11 | - | - | - | 6 | - | 2 | - | - | - | - | - | - |
| Failure of connection to brigade | 9 | 1 | - | - | - | 4 | 2 | - | - | 1 | - | 1 | - | - | - |
| Ventilation or currents at ceiling level | 6 | 3 | - | 2 | - | 1 | - | - | - | - | - | - | - | - | - |
| Failure of detector head/heads | 5 | 1 | - | 3 | - | 1 | - | - | - | - | - | - | - | - | - |
| Failure of control equipment | 5 | 1 | - | 1 | - | 3 | - | - | - | - | - | - | - | - | - |
| Unknown or unspecified | 110 | - | 31 | - | 25 | - | 42 | - | 7 | - | 3 | - | - | - | 2 |

Table 5(a) Heat detectors - times of calls

| Time of call | Total incidents | False calls | Fire calls by: Automatic system | Fire calls by: Other means |
|---|---|---|---|---|
| All times | 2444 | 2146 | 193 | 105 |
| Midnight - 00.59 | 52 | 37 | 8 | 7 |
| 01.00 - 01.59 | 40 | 35 | 5 | - |
| 02.00 - 02.59 | 38 | 33 | 3 | 2 |
| 03.00 - 03.59 | 48 | 38 | 4 | 6 |
| 04.00 - 04.59 | 60 | 48 | 5 | 7 |
| 05.00 - 05.59 | 38 | 31 | 5 | 2 |
| 06.00 - 06.59 | 63 | 51 | 9 | 3 |
| 07.00 - 07.59 | 78 | 69 | 5 | 4 |
| 08.00 - 08.59 | 130 | 122 | 5 | 3 |
| 09.00 - 09.59 | 208 | 187 | 15 | 6 |
| 10.00 - 10.59 | 187 | 170 | 11 | 6 |
| 11.00 - 11.59 | 197 | 184 | 6 | 7 |
| 12.00 - 12.59 | 141 | 128 | 6 | 7 |
| 13.00 - 13.59 | 174 | 155 | 14 | 5 |
| 14.00 - 14.59 | 209 | 191 | 17 | 1 |
| 15.00 - 15.59 | 184 | 168 | 13 | 3 |
| 16.00 - 16.59 | 131 | 117 | 7 | 7 |
| 17.00 - 17.59 | 98 | 84 | 12 | 2 |
| 18.00 - 18.59 | 97 | 81 | 12 | 4 |
| 19.00 - 19.59 | 69 | 57 | 7 | 5 |
| 20.00 - 20.59 | 70 | 55 | 9 | 6 |
| 21.00 - 21.59 | 35 | 28 | 4 | 3 |
| 22.00 - 22.59 | 33 | 25 | 6 | 2 |
| 23.00 - 23.59 | 48 | 41 | 5 | 2 |
| Unspecified | 16 | 11 | - | 5 |

Table 5(b) Smoke detectors - times of calls

| Time of call | Total incidents | False calls | Fire calls by: Automatic system | Fire calls by: Other means |
|---|---|---|---|---|
| All times | 1567 | 1429 | 101 | 37 |
| Midnight - 00.59 | 28 | 27 | 1 | - |
| 01.00 - 01.59 | 34 | 31 | 1 | 2 |
| 02.00 - 02.59 | 35 | 33 | - | 2 |
| 03.00 - 03.59 | 26 | 26 | - | - |
| 04.00 - 04.59 | 33 | 31 | 2 | - |
| 05.00 - 05.59 | 34 | 30 | 1 | 3 |
| 06.00 - 06.59 | 32 | 32 | - | - |
| 07.00 - 07.59 | 45 | 41 | 2 | 2 |
| 08.00 - 08.59 | 99 | 95 | 4 | - |
| 09.00 - 09.59 | 115 | 107 | 7 | 1 |
| 10.00 - 10.59 | 114 | 106 | 7 | 1 |
| 11.00 - 11.59 | 126 | 112 | 13 | 1 |
| 12.00 - 12.59 | 92 | 84 | 6 | 2 |
| 13.00 - 13.59 | 93 | 85 | 8 | - |
| 14.00 - 14.59 | 110 | 97 | 8 | 5 |
| 15.00 - 15.59 | 124 | 114 | 8 | 2 |
| 16.00 - 16.59 | 75 | 64 | 9 | 2 |
| 17.00 - 17.59 | 79 | 70 | 7 | 2 |
| 18.00 - 18.59 | 63 | 55 | 5 | 3 |
| 19.00 - 19.59 | 50 | 46 | 4 | - |
| 20.00 - 20.59 | 42 | 38 | 2 | 2 |
| 21.00 - 21.59 | 40 | 37 | - | 3 |
| 22.00 - 22.59 | 32 | 29 | 2 | 1 |
| 23.00 - 23.59 | 36 | 31 | 3 | 2 |
| Unspecified | 10 | 8 | 1 | 1 |

Table 5(c) Sprinklers - times of calls

| Time of call | Total incidents | False calls | Fire calls by: Automatic system | Fire calls by: Other means |
|---|---|---|---|---|
| All times | 1274 | 1048 | 101 | 125 |
| Midnight - 00.59 | 57 | 49 | 2 | 6 |
| 01.00 - 01.59 | 49 | 39 | 5 | 5 |
| 02.00 - 02.59 | 49 | 41 | 7 | 1 |
| 03.00 - 03.59 | 51 | 48 | 2 | 1 |
| 04.00 - 04.59 | 35 | 34 | 1 | - |
| 05.00 - 05.59 | 35 | 31 | 1 | 3 |
| 06.00 - 06.59 | 47 | 40 | 2 | 5 |
| 07.00 - 07.59 | 44 | 39 | 3 | 2 |
| 08.00 - 08.59 | 66 | 54 | 2 | 10 |
| 09.00 - 09.59 | 57 | 49 | 2 | 6 |
| 10.00 - 10.59 | 57 | 45 | 6 | 6 |
| 11.00 - 11.59 | 71 | 59 | 4 | 8 |
| 12.00 - 12.59 | 68 | 49 | 10 | 9 |
| 13.00 - 13.59 | 48 | 40 | 6 | 2 |
| 14.00 - 14.59 | 73 | 62 | 3 | 8 |
| 15.00 - 15.59 | 66 | 45 | 12 | 9 |
| 16.00 - 16.59 | 67 | 52 | 4 | 11 |
| 17.00 - 17.59 | 67 | 54 | 5 | 8 |
| 18.00 - 18.59 | 37 | 24 | 8 | 5 |
| 19.00 - 19.59 | 59 | 46 | 6 | 7 |
| 20.00 - 20.59 | 47 | 41 | 3 | 3 |
| 21.00 - 21.59 | 48 | 42 | 2 | 4 |
| 22.00 - 22.59 | 31 | 27 | 3 | 1 |
| 23.00 - 23.59 | 39 | 33 | 2 | 4 |
| Unspecified | 6 | 5 | - | 1 |

Table 5(d) Manual alarms - times of calls

| Time of call | Total incidents | False calls | Fire calls by: Installed system | Fire calls by: Other means |
|---|---|---|---|---|
| All times | 308 | 243 | 55 | 10 |
| Midnight - 00.59 | 5 | 3 | 2 | - |
| 01.00 - 01.59 | 1 | - | 1 | - |
| 02.00 - 02.59 | 5 | 4 | 1 | - |
| 03.00 - 03.59 | 5 | 4 | 1 | - |
| 04.00 - 04.59 | 5 | 4 | 1 | - |
| 05.00 - 05.59 | 2 | 2 | - | - |
| 06.00 - 06.59 | 7 | 6 | 1 | - |
| 07.00 - 07.59 | 14 | 10 | 4 | - |
| 08.00 - 08.59 | 17 | 13 | 3 | 1 |
| 09.00 - 09.59 | 20 | 17 | 2 | 1 |
| 10.00 - 10.59 | 29 | 26 | 3 | - |
| 11.00 - 11.59 | 27 | 23 | 3 | 1 |
| 12.00 - 12.59 | 12 | 8 | 3 | 1 |
| 13.00 - 13.59 | 25 | 18 | 4 | 3 |
| 14.00 - 14.59 | 19 | 15 | 4 | - |
| 15.00 - 15.59 | 22 | 19 | 3 | - |
| 16.00 - 16.59 | 21 | 15 | 6 | - |
| 17.00 - 17.59 | 11 | 10 | 1 | - |
| 18.00 - 18.59 | 10 | 6 | 3 | 1 |
| 19.00 - 19.59 | 16 | 12 | 3 | 1 |
| 20.00 - 20.59 | 10 | 7 | 3 | - |
| 21.00 - 21.59 | 7 | 5 | 2 | - |
| 22.00 - 22.59 | 10 | 8 | 1 | 1 |
| 23.00 - 23.59 | 6 | 6 | - | - |
| Unspecified | 2 | 2 | - | - |

Table 5(e) Detectors of mixed types - times of calls

| Time of call | Total incidents | False calls | Fire calls by: Automatic system | Fire calls by: Other means |
|---|---|---|---|---|
| All times | 161 | 137 | 18 | 6 |
| Midnight - 00.59 | 5 | 3 | - | 2 |
| 01.00 - 01.59 | 6 | 5 | 1 | - |
| 02.00 - 02.59 | 4 | 3 | 1 | - |
| 03.00 - 03.59 | 2 | 2 | - | - |
| 04.00 - 04.59 | 3 | 3 | - | - |
| 05.00 - 05.59 | 3 | 2 | 1 | - |
| 06.00 - 06.59 | 2 | 2 | - | - |
| 07.00 - 07.59 | 3 | 3 | - | - |
| 08.00 - 08.59 | 6 | 6 | - | - |
| 09.00 - 09.59 | 3 | 2 | 1 | - |
| 10.00 - 10.59 | 7 | 7 | - | - |
| 11.00 - 11.59 | 15 | 12 | 2 | 1 |
| 12.00 - 12.59 | 14 | 8 | 4 | 2 |
| 13.00 - 13.59 | 7 | 6 | 1 | - |
| 14.00 - 14.59 | 11 | 9 | 2 | - |
| 15.00 - 15.59 | 10 | 9 | - | 1 |
| 16.00 - 16.59 | 20 | 20 | - | - |
| 17.00 - 17.59 | 9 | 8 | 1 | - |
| 18.00 - 18.59 | 6 | 5 | 1 | - |
| 19.00 - 19.59 | 6 | 6 | - | - |
| 20.00 - 20.59 | 3 | 2 | 1 | - |
| 21.00 - 21.59 | 7 | 6 | 1 | - |
| 22.00 - 22.59 | 2 | 1 | 1 | - |
| 23.00 - 23.59 | 6 | 6 | - | - |
| Unspecified | 1 | 1 | - | - |

Table 5(f) Heat and smoke detectors - times of calls

| Time of call | Total incidents | False calls | Fire calls by: Automatic system | Fire calls by: Other means |
|---|---|---|---|---|
| All times | 430 | 410 | 18 | 2 |
| Midnight - 00.59 | 7 | 7 | - | - |
| 01.00 - 01.59 | 8 | 8 | - | - |
| 02.00 - 02.59 | 10 | 10 | - | - |
| 03.00 - 03.59 | 4 | 4 | - | - |
| 04.00 - 04.59 | 6 | 6 | - | - |
| 05.00 - 05.59 | 9 | 9 | - | - |
| 06.00 - 06.59 | 12 | 11 | 1 | - |
| 07.00 - 07.59 | 21 | 21 | - | - |
| 08.00 - 08.59 | 17 | 17 | - | - |
| 09.00 - 09.59 | 31 | 31 | - | - |
| 10.00 - 10.59 | 29 | 28 | 1 | - |
| 11.00 - 11.59 | 31 | 27 | 4 | - |
| 12.00 - 12.59 | 22 | 19 | 3 | - |
| 13.00 - 13.59 | 31 | 30 | 1 | - |
| 14.00 - 14.59 | 34 | 34 | - | - |
| 15.00 - 15.59 | 29 | 28 | 1 | - |
| 16.00 - 16.59 | 31 | 29 | 2 | - |
| 17.00 - 17.59 | 13 | 13 | - | - |
| 18.00 - 18.59 | 19 | 16 | 3 | - |
| 19.00 - 19.59 | 27 | 26 | 1 | - |
| 20.00 - 20.59 | 10 | 9 | 1 | - |
| 21.00 - 21.59 | 7 | 7 | - | - |
| 22.00 - 22.59 | 11 | 10 | - | 1 |
| 23.00 - 23.59 | 9 | 9 | - | - |
| Unspecified | 2 | 1 | - | 1 |

Table 5(g) Detectors of unrecorded type - times of calls

| Time of call | Total incidents | False calls | Fire calls by: Automatic system | Fire calls by: Other means |
|---|---|---|---|---|
| All times | 33 | 27 | 3 | 3 |
| Midnight - 00.59 | 1 | 1 | - | - |
| 01.00 - 01.59 | - | - | - | - |
| 02.00 - 02.59 | 1 | 1 | - | - |
| 03.00 - 03.59 | 3 | 3 | - | - |
| 04.00 - 04.59 | 3 | 3 | - | - |
| 05.00 - 05.59 | - | - | - | - |
| 06.00 - 06.59 | 1 | 1 | - | - |
| 07.00 - 07.59 | - | - | - | - |
| 08.00 - 08.59 | 1 | 1 | - | - |
| 09.00 - 09.59 | 1 | 1 | - | - |
| 10.00 - 10.59 | 3 | 3 | - | - |
| 11.00 - 11.59 | 5 | 3 | - | 2 |
| 12.00 - 12.59 | - | - | - | - |
| 13.00 - 13.59 | 3 | 3 | - | - |
| 14.00 - 14.59 | 1 | 1 | - | - |
| 15.00 - 15.59 | - | - | - | - |
| 16.00 - 16.59 | 2 | 1 | 1 | - |
| 17.00 - 17.59 | 1 | 1 | - | - |
| 18.00 - 18.59 | 2 | 1 | 1 | - |
| 19.00 - 19.59 | 2 | 1 | 1 | - |
| 20.00 - 20.59 | 2 | 2 | - | - |
| 21.00 - 21.59 | 1 | - | - | 1 |
| 22.00 - 22.59 | - | - | - | - |
| 23.00 - 23.59 | - | - | - | - |
| Unspecified | - | - | - | - |

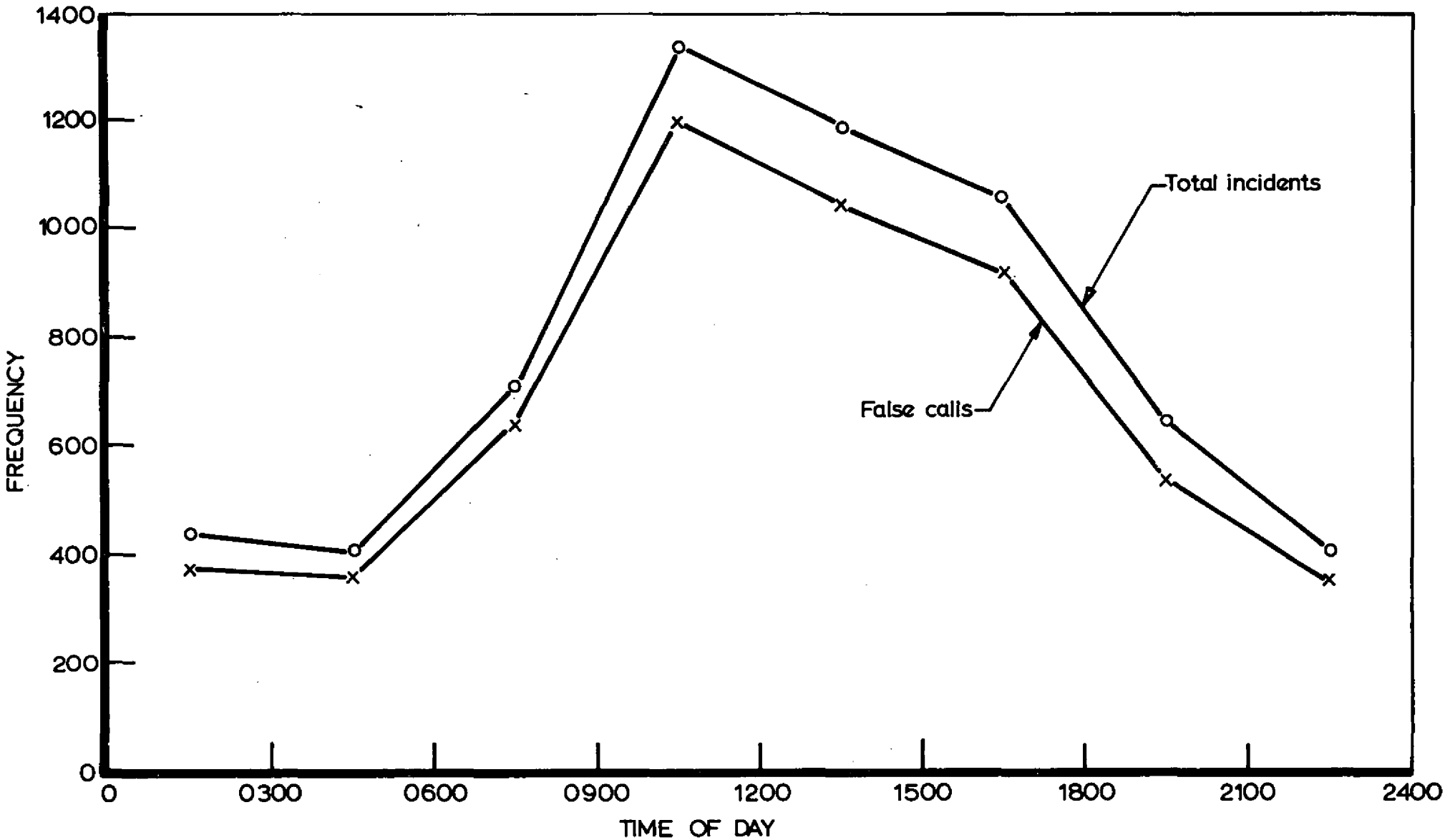


FIG. 1. THREE-HOURLY FREQUENCIES OF INCIDENTS AND FALSE CALLS

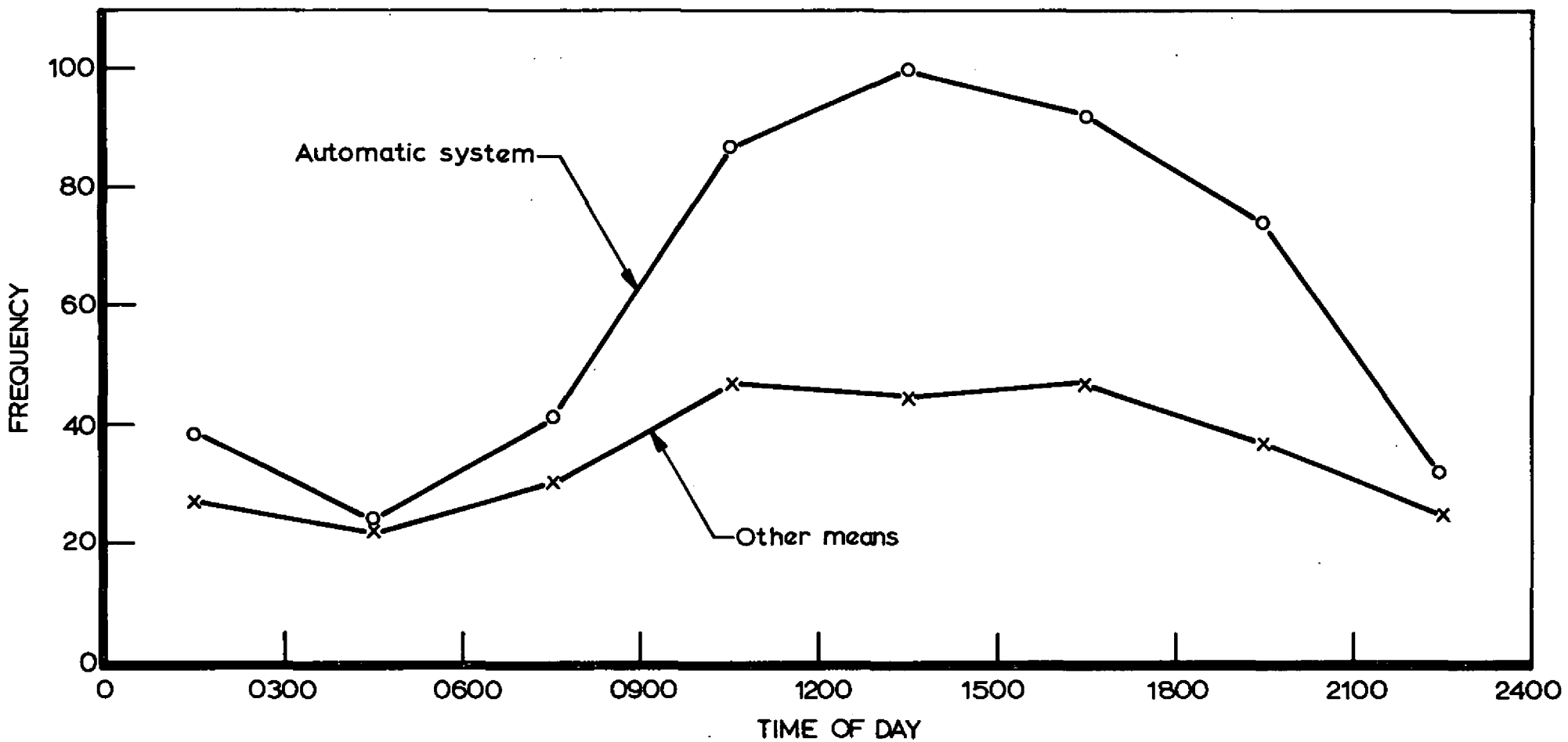


FIG. 2. THREE-HOURLY FREQUENCIES OF FIRE CALLS