Nowson



₽¥

IN CONFIDENCE

F.R. Note No.250/1956 Research Programme Objective G 3/1S

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)

#### THE CONDITION OF FIRE EXTINGUISHERS INSTALLED IN CERTAIN CLASSES OF BUILDINGS

by

Mrs. J.E.L. Hinton and D.W. Millar

#### Summary

Through the co-operation of eight Fire Brigades a survey has been made of the condition of extinguishers in use. The majority of the premises in which the extinguishers were installed were those controlled by Local Authorities.

The proportion of soda-acid extinguishers, the most common type in use, found fit for use on inspection, in general varied between 80 and 90 per cent while the proportion serviceable of the other two main types of extinguisher, the carbon dioxide operated water extinguisher and the chemical foam extinguisher were at least 90 per cent.

The proportion of soda-acid extinguishers requiring recharging other than routine recharging varied between 10 and 20 per cent with the exception of one large Brigade in which the average proportion was 3 per cent. The proportion of soda-acid extinguishers repaired in this Brigade was 7 per cent compared with proportions of below 1 per cent in almost all the other Brigades taking part in the survey. The proportion of these extinguishers requiring replacement were generally small, about 2 to 3 per cent.

August, 1956

Statistical Unit, 19 Cornwall Terrace, Regents Park, London, S.W.1. (Telephone: Museum 5030)

<sup>©</sup> BRE Trust (UK) Permission is granted for personal noncommercial research use. Citation of the work is allowed and encouraged.

### THE CONDITION OF FIRE EXTINGUISHERS INSTALLED IN CERTAIN CLASSES OF BUILDINGS

by

### Mrs. J.E.L. Hinton and D.W. Millar

#### INTRODUCTION

There is comparatively little information available on the serviceable life and reliability of fire extinguishers installed in buildings. The Joint Fire Research Organization has been fortunate in securing, through the Home Office, the co-operation of certain Fire Brigades in carrying out a survey of the condition of extinguishers in certain premises in their areas.

Many Fire Brigades inspect extinguishers as a matter of routine, but confine their attentions mainly to places of public entertainment and to premises under the control of Local Authorities, for example council offices, local authority stores, schools, libraries, hospitals, clinics and similar institutions. At the request of the occupants Fire Brigades also inspect the fire precautions in commercial and industrial premises, but in this survey there was little information returned from such premises.

Eight Fire Brigades co-operated in the survey, three county Brigades and five county borough Brigades. Each Brigade completed forms which showed for each premises the function of the building, the numbers of each type of extinguisher installed, the numbers considered fit for use on inspection, and the numbers which required recharging, repair or replacement. Some information was also given on the make, age and nature of defect of those extinguishers considered to be defective.

The types of extinguisher distinguished were:-

I. Soda-acid extinguishers

II. Water extinguishers (pressure operated)

III. Chemical foam extinguishers

IV. Air foam extinguishers

V. Carbon tetrachloride extinguishers (hand operated)

VI. Carbon tetrachloride extinguishers (pressure operated) VII. Carbon dioxide extinguishers

VIII. Other types of extinguisher.

The Brigades co-operating in the survey carried out their inspections during the period 1st September, 1953 to 31st August, 1954. Some Brigades visited premises more than once during the year. In these cases, as far as possible, only the first visit has been counted so that all Brigades are on a comparable basis. The premises visited were classified as follows:-

1. Cinemas, theatres; other places of public entertainment

2. Council offices, libraries, etc.

3. Council depots, stores, etc.

4. Schools, hospitals, clinics and similar institutions.

5. Other premises, including commercial and industrial.

Some Brigades merely inspected extinguishers and reported on their condition; the maintenance and repair of the extinguishers being the responsibility of the different local authorities within the Brigade area. Other Brigades were responsible also for the maintenance and repair of the extinguishers.

Where it is known that routine recharging was carried out and reported by a Brigade the figures have been omitted from the data, so that figures for 'recharges reflect the proportion of extinguishers accidentally discharged, or in the opinion of the inspecting officer, requiring recharging to make them fully fit for use. To put all Brigades on a comparable basis some slight adjustments were also made to the numbers reported as defective but reparable.

#### RESULTS AND DISCUSSION

The numbers of extinguishers found fit for immediate use, and the numbers recharged, replaced or found defective but reparable arc shown in Tables 1a-h for each of the eight Brigades.

The types of extinguisher most frequently installed were soda-acid, pressure operated water, chemical foam and hand-operated carbon tetrachloride. The information for each of these types of extinguisher has been tabulated in a slightly different form in Tables 2a-d which show the differences between premises and between Brigades in the numbers and proportions found fit for use, recharged, replaced, and found defective but reparable. It can be seen from Tables 1 and 2 that there is considerable variation in the proportionate numbers for a given type of extinguisher both between premises within a Brigade and between different Brigades. There are also differences between different types of extinguisher. The variations in the proportions are greater than would be expected from chance fluctuations which suggests that many circumstances, for example, differences in standards between inspecting officers and between Brigades, frequency of inspection and quality of maintenance combine to affect the numbers in the various categories. Analysis of the data can therefore be in only rather broad terms.

#### Differences in serviceability between Brigades.

There are two notable differences in proportions, the proportion of sodaacid extinguishers found fit for immediate use in Brigade E varied in the different premises about an average of 58 per cent compared with the general run of 80 to 90 per cent in other Brigades, while the proportion for Brigade D at 98 per cent was higher than the general average. In most Brigades some form of inspection of extinguishers had started three or four years before the survey was made, whereas in Brigade E, and also in Brigade C the commencement of inspection coincided more or less with the start of the survey.

Several Chief Officers expressed the opinion that little or no maintenance had been carried out on extinguishers before regular inspections by their Brigades commenced, and this may help to explain the difference between Brigade E and other Brigades in the survey. The defective extinguishers in this Brigade were all 20-25 years old and this was the general age of the extinguishers in use at the time of the survey. The age of the extinguishers was probably connected with the lack of previous maintenance but was not necessarily a contributory factor to the high proportion defective. On the other hand the survey data for Brigade C show that an average of 84 per cent of the soda-acid extinguishers in this Brigade were fit for immediate use, a proportion in agreement with the general experience of the other Brigades in the survey. The numbers in the various classes of premises in Brigade C are admittedly small and there is some variation between premises within the Brigade. The high proportion serviceable in Brigade D is due to the fact that in the majority of buildings included in the survey the fire extinguishers had been newly installed or replaced since 1948. There was also a scheme of regular inspection and maintenance of extinguishers in schools and other local authority premises, and in licenced premises.

The effect of inspection and maintenance upon extinguisher serviceability

While it is reasonable to assume that regular inspection and maintenance improve the serviceability of extinguishers, there is little clear-cut evidence of this in the figures which are often inconsistent. The differences between Brigades D and E and the other Brigades are a case in point.

One contrast which might be expected is a higher proportion of extinguishers serviceable, that is fit for immediate use, in places of public entertainment (Class A premises) in which frequent inspection is likely to be carried out by both the local staff and the Fire Brigades. Except in Brigade E, where there 10Cal puari and a state with a place of a state of the st

were very few extinguishers installed, and Brigade C, this is broadly true for soda-acid extinguishers, although it can be seen from Table 2a that not every Brigade recorded 100 per cent serviceability in Class A premises.

A comparison between proportions serviceable in the Brigades which both inspected and maintained extinguishers, and in those which only carried out inspections does not show any differences. The only Brigade which was appreciably different from the others was Brigade G, which generally relied on "spot check" rather than regular inspections. The proportion of extinguishers found serviceable was about 10 per cent lower in this Brigade than in the general run of Brigades.

#### The serviceability of different types of extinguisher

There are general indications of differences in serviceability between the different types of extinguisher. The proportion of soda-acid extinguishers serviceable varies between 80 and 90 per cent while the corresponding proportion in carbon dioxide operated water extinguishers is rather higher, 90 per cent or more. The other main types of extinguisher in use are the chemical foam extinguisher, at least 90 per cent of which are serviceable in most Brigades, and the hand operated C.T.C. extinguisher. There is some variation in the serviceability of the latter type of extinguisher, the proportion serviceable in Brigade B being 87 per cent and that in Brigade F being 96 per cent.

Three kinds of unserviceability were distinguished:-

- a. the extinguisher required recharging,
- b. the extinguisher was defective but reparable, and
- c. the extinguisher required replacement.

Some adjustments have been made to allow for routine recharges and other differences in classification between Brigades. The estimated proportion of soda-acid extinguishers requiring recharging varied in most Brigades between 10 and 20 per cent; a notable exception was Brigade B with an average proportion of 3 per cent. The proportion of soda-acid extinguishers repaired was 7 per cent in Brigade B and below 1 per cent in all other Brigades except Brigade E, while the proportion replaced varied between 1 per cent in Brigade B and over 19 per cent in Brigade E. These variations probably reflect differences in the standards adopted by the inspecting officers to some extent, as well as major differences between Brigades.

#### Defects in extinguishers

The reported defects in extinguishers which were replaced or repaired have been tabulated according to the Brigade in Table 3 and according to the age of the extinguisher in Table 4. The defects reported have been grouped into classes, the first of which enumerates the extinguishers which required pressure or discharge tests. The most common defect was corrosion or perforation of the container. It is assumed that associated with this defect are those extinguishers which required pressure tests. In Brigade B the proportion of extinguishers corroded to some extent was 4 per cent of all extinguishers examined, and in Brigade F about 2 per cent.

Brigade B was the only Brigade which returned "required discharge test" and also "washer required in cap" as defects. The former defect is presumably associated with the possibility of corrosion affecting the charge in the case of pressure operated extinguishers, or damage to the mechanism affecting the performance of the extinguisher; "washer required in cap" is thought to be associated mainly with a certain type of conical sodaacid extinguisher.

Faults concerning discharge tubes or nozzles, or plungers, were few, about 3 per cent in Brigade E, less than  $\frac{1}{2}$  per cent in Brigade B and negligible elsewhere. There were also a very few extinguishers with broken acid bottles, corroded or defective pump actions and other miscellaneous defects.

- 3 -

The variation in serviceability with the age of the extinguisher

Some information was returned on the ages of defective extinguishers. The figures are shown in Table 4 according to the type of defect for all Brigades except Brigade E, which has been excluded from the main body of the table since all its 84 defective extinguishers were either 20 or 25 years old or of unknown age. The age distribution for the main group of defects, corroded or perforated extinguishers together with those requiring pressure tests, is shown below in Table 6. About one-seventh of these defective extinguishers were at least 24 years old. The peak frequency of some 35 per cent of those of known age was in the group 12-15 years.

Table 6

### AGE DISTRIBUTION OF CORRODED EXTINGUISHERS

Age	Number	Proportion per cent
0-3 4-7 8-11 12-15 16-19 20-23 24-27 28-31 32-35 Over 35	5 35 27 126 47 70 40 5 2 2	1.4 9.8 7.5 35.1 13.1 19.5 11.1 1.4 0.6 0.6
Unknown age	33	-

To show how liability to defect varies with age, knowledge of the proportions at risk in the various age groups is necessary. In order to lighten the task of the Fire Brigades carrying out the inspection, the ages of non-defective extinguishers were not collected in the original reports but it .happened that in Brigade B information on the ages of extinguishers had been kept by an inspecting officer for 11 of the 26 local authority areas in the county. A sample believed to be representative, was taken of three of these areas and the age distribution recorded. The actual sample is almost certainly not representative of the age distribution for the whole of Brigade B or any other Brigade, since there was a very high proportion of new extinguishers under 3 years of age. The rate of defect with age can be calculated only within this group of three areas in Brigade B. The

figures are shown in Table 5 and Fig. 1. The proportion of defective extinguishers increases sharply in the age groups over 8 years old, but there is insufficient evidence to infer any relation between proportion defective and age. Nnowledge of such a relation is required to make any well-founded statement about the probable life of extinguishers. From the distributions of ages of corroded or otherwise defective extinguishers (Tables 6 and 4 respectively) few extinguishers more than 28 years old appear to remain serviceable. This may be because there are few extinguishers more than 28 years old in service, due perhaps to policies of replacement. It can be seen from Table 5(1) which shows the age distributions of a group of serviceable and non-serviceable extinguishers known to contain an exceptionally high proportion of recently installed extinguishers, that about 5 per cent of those serviceable are between 28 and 32 years old. The age obviously depends on the amount of maintenance carried out as well as the soundness of the extinguisher when new, but a conservative estimate of the life of a well maintained extinguisher is of the order of 25 years.

#### CONCLUSIONS

There are variations in proportions serviceable both between and within Brigades and these probably reflect differences in standards of inspection and maintenance. The proportion serviceable for soda-acid extinguishers was between 80-90 per cent while the proportion of chemical foam extinguishers serviceable was over 90 per cent. There is some indication, mainly from comparisons between premises within Brigades, that inspection which is presumably linked with maintenance to a greater or lesser extent, increases the proportion of extinguishers serviceable in comparison with no inspection.

The proportion of soda-acid extinguishers which required recharging because of accidental discharging, evaporation of water, or defective charges varied in most Brigades between 10 and 20 per cent with the exception of Brigade B where the proportion was 3 per cent. The proportions of soda-acid extinguishers repaired were 7 per cent in Brigade B and below 1 per cent in all other Brigades except Brigade E. The proportions of extinguishers replaced varied between 1 per cent in Brigade B, nearly 9 per cent in Brigade G and over 19 per cent in Brigade E.

The direct evidence to the improvement in serviceability brought about by inspection and maintenance is somewhat inconsistent but there can be no doubt that regular maintenance is ver, important.

The classes of premises referred to by numbers in the following Note: tables are: -

> Cinemas, theatres, other places of public entertainment Council offices, libraries, etc. 1.

2.

3. Council depots, stores etc.

4. Schools, hospitals, clinics and similar institutions

. **5**• Other premises, including commercial and industrial.

- 5 -

### Table 1a

CONDITION OF EXTINGUISHERS INSTALLED IN CERTAIN CLASSES OF BUILDINGS

Brigade	'A	•	•
Dr - Baac	**		

	Type	e of			Nun	ber o	f extingu	isher	°s		
	and cla prem:	ass of iscs	Number examined	F imme	it for diate use	Rech	argel	Rej	placed	Defec rep	tive but arable
	Туре	Class	No.	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per: cent
	Soda acid	2 4	103 457	63 419	61.2 91.7	33 27	32.0 5.9	7. 10	6.8 2.2	- 1	0.2
		Total	- 560	482	86,1	60	10.7	17	3.0	1	0.2
<i></i>	Water (pres- sure	2 4	60 742	55 . 724	91.7 97.6	5 17	8.3 2.3	- 1		-	-
	ated)	·Total	802	779	97.1	22	2.7-	1	0.1	!	-
	Chem- ical	2.4	2 · 11	2 -9	. 81.8	- 2	18.2			- -	-
	foam '	Total	13	11	84.6	2	15.4	-	_	i <u>-</u> `	- 1
	C.T.C. (hand	2	3. 14	1 - 10	, <del>≭</del> 71∙4	2 4.	.¥ 28.6	-	· · ·	-	
	ated)	Total	17	11	64.7	6	35.3	-		· · ·	
	Carbon di-	2	,``3 12	3 10	100.0 83.3	- 2	16.7		-		· · · · · · · · · · · · · · · · · · ·
•	oxide	Totil	<u>_</u> 15	13	86.7	. 2.	13.3	-			_ ` `
5		Percen	tages not.	calcu	lated - le	ss th	an 6 exti	nguis	shers exar	nined.	
' <del>.</del>	···. · · · · · ·		-		•		• • •	•	• •	•••	
			н. н Настана Настана	.,	••	•	•••	. ,			• • • • • • •
•	:	, <b>,</b> , , , , , , , , , , , , , , , , ,	• • •			•			-		
• • •		· · · ·	· · · · ·	<u>.</u>				k	· · ·	• •• ·	، ، ، ، ، ، ، ، ، ، ، ، ، ، ، ، ، ، ،

r ·

# Table 1b

# CONDITION OF EXTINGUISHERS INSTALLED IN CERTAIN CLASSES OF BUILDING

. .

• 31

Brigade B

Type of Number of extinguishers										
and cla premi	lisher Iss of Ises	Number examined	F: imme	it for liate use	R	echarged	R	eplaced	Defe re	ctive but parable
. Туре	Class	No.	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Soda- acid	1 2 3 4 5	919 206 4 5617 312 7058	905 188 3 4 945 265	98.5 91.3 <sup>★</sup> 88.0 84.9	7 7 1 182 4	0.8 3.4 # 3.2 1.3	4 1 - 52 7	0.4 - 0.5 - 0.9 2.2	3 10 - 438 36	0.3 5.0 7.8 11.5
Waten	10002	10,0		0,1						
(pres- sure oper- ated)	4	112	109	97•3	3	2.7	-	· · · _	. –	-
Chem- ical foam	1 2 3 4 5	315 6 12 998 130	310 5 10 955 111	98.4 83.3 83.3 95.6 85.4	- - - 11 - 11	16.7 - 1.1 8.5	2 - - 5 -	0.6	3 - 2 27 8	1.0 16.7 2.7 6.2
	Total	1 4 6 1	1 391	95.2	23	1.6	7	0.5	40	2.7
Air foam	4 5	12 · 1 ·	10. 1	83.3 <del>x</del>	-	8.3	_ ·		1	8.3
· · · · · · · · · · · · · · · · · · ·	Total	13 ·	11	84.6	.1	7.7		-	1	7.7
C.T.C. (hand oper- ated)	1 3 4 5	9 1 37 14	9 1 31 12	100.0 # 83.8 85.7	- 4	- 10.8 7.1	- - 1 1'	2.7 7.1	- - 1 -	2.7
I	Total	61	53	-86.9	5	8.2	2	3.3	1	1.6
C.T.C. (pres- sure oper- ated)	1	, 1	1	/#			<b>-</b> .	-	-	-
Carbon di- oxide	- 1 4 5	1 . 9 24	1 9 24	₩ 100.0 100.0	- - -		-			
	Total	34	34	100.0	-	_	-	_		
Other types	5	8	8	100 <b>.</b> Ò		_	<b>_</b> ,	-	-	_
Type not stated	4 5	11 3	11 2	100₊0 <u>≭</u>	- 1	, <del></del> H	-	-		-
	Total	14,	13	92.9	1	7.1	-	<b>–</b> <sup>*</sup> .	-	-

### Table 1c

### CONDITION OF EXTINGUISHERS INSTALLED IN CERTAIN CLASSES OF BUILDINGS

Brigade C

Type	e of visher			Nu	mber	of extingu	ishe	rs		1
and cla	ses	Number examined	F imme	Pit for diate use	Re	charged	R	eplaced	ed Defectiv reparal	
Туре	Class	No.	No. No. Per cent No. Per cent No. Per c		Per cent	No.	Per cent			
Soda- acid	1 3 4 5	28 2 35 48	22 1 26 46	78.6 * 74.3 95.3	1 1 8 2	3.6 # 22.9 4.2	5	17.9 - - -	- - 1 -	- 2,9
	Total	. 113	95	84.1	12	10.6	5	4.4	··· 1··	. 0.9 .
Chem- ical	4 5	2 25	<b>1</b> 25		1 -	X -	-		-	
foam	Total	27	26	96.3	1	3.7	_	-	-	_
C.T.C. (hand oper- ated)	5.	2	2		· _	-	-		-	· · ·
Carbon _di-	1	1 2	- 1	- H	1	H -	-	, <del>,</del> 	-	. –
oxide	Total	3	1	H	1	H H	1	Ħ		<u>-</u>

Note. There was also an hotel (Class 5) in which 25 extinguishers were installed. On inspection these were found to be useless as the wrong type of acid bottle had been supplied. These extinguishers have not been included in the table.

### Table 1d

# CONDITION OF EXTINGUISHERS INSTALLED IN CERTAIN CLASSES OF BUILDING

Brigade D

Type	of	[		: Nu	unber	of extingu	isher	:s		• •
and cla prend	Lisner C3 of . Ses 1	Number examined	F: imme	it for diate use	Re	charged	Re	placed	Defec	tive but arable
Type	Class	No.	No.'	Per cent	No.	per cent	No.	Per. cent	No.	Per cent
Soda- acid	1 3 4 5	202 1 397 76	199 1 390 <sup>+</sup> 73	98.5 ₅ 98.2 96.1	2 - 6 -	1.0 _ 1.5 _	- - 1	- - 1.3	1 - 1 2	0.5 0.3 2.6
	Total	676	663	98.1	ß	1.1	1	0.1	_ 4	0.6
Water (pres- sure	. 1 4 5	3 7 254	3 7 253	ж 100₊0 _100₊0	- ,	- - -		- - -	- - 1	
oper- ated)	Total	264	263	99.6		-	_	_	1	0.4
Chem- ical foam ···	1 3 4 5	34 3 42 254	34 3 38 253	100.0 * 90.4 100.0	- - 1 -	- - 2.4 -	- - 1 -	- - 2.4 -	- 2 1	- - 4.8 -
	Total	333	328	98.5	. 1	0.3	1	0.3	<u> </u>	0.9
Air foam	5	34	33.	97.1	<b></b>	· · ·	-	-	1	2.9
C.T.C. (hand oper-	1 4 5	42 8 11	42 8 11	100.0 100.0 100.0			-		-	
ated)	Total	61	61	100.0	-				( ( <b>–</b> (	
C.T.C. (pres- sure	1 5	1 14	1 14	ж 100.0	-	-	-	-		
ated)	Total	15	15	100.0		!	_ 			-
Carbon di-	1 5	8 4	8 4	100.0 Ħ	-	-		-	-	_ _ _
	Total	12	12	100.0		-	{ _	-		-

+ Including 5 new extinguishers charged for the first time

 $\neq$  Including 1 new extinguisher charged for the first time

# Table 1e

# CONDITION OF EXTINGUISHERS INSTALLED IN CERTAIN CLASSES OF BUILDING

Brigade E

Туре	e of	-		N	lumber	of exting	uishe	rs	,	
and cla premi	ses	Number examined	F imme	'it for diate use	R	echarged	R	eplaced	Defe re	ctive but parable
Type	Class	No:	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Soda acid	1 2 3 4 5	12 162 12 100 17	6 106 6 . 50 8	50.0 65.4 50.0 50.0 47.1	5 9 32 8	41.7 5.6 25.0 32.0 47.1	1 35 3 18 1	8.3 21.6 25.0 18.0 5.9	- 12 - -	- 7•4 - -
	Total	303	176	58.1	57	18.8	. 58	<sup>1</sup> 19 <b>.</b> 1	12	4.0
Water (pres	2	. 5	.2	¥	3	¥	-	_	-	<u> </u>
Chem- ical foam	2 3 4	3 1 11	.2 - 5	<b>*</b> - 45•5	1 1 6	. <del>×</del> × 54•5		-	-	·           · ·
	Total	15	7	46.7	8	53.3	-	_	-	_
C.T.C. (hand oper-	2	12 5	- 4	- - - <del>-</del>	-	. –   Ħ	11	91.7	1	8.3
ated)	Total	17	4	23.5	: 1	5.9	11	64.7	· 1	. 5.9
C.T.C. (pres sure oper	2 4 5	1 2 2	- - 2	- - -	1   -   -	H H - -	- 2 -	- ¥ -	-	-
ateu)	Total	- 5	2	ж	. 1	; ж	2	ж	-	-

### Table 1f

### CONDITION OF EXTINGUISHERS INSTALLED IN CERTAIN CLASSES OF BUILDING.

Brigade F

Type	e of ,		 		Numbe	r of extin	guish	ers		
and cla premi	usner .se of .ses	Number examined	F imme	it for diate use		Recharged		Replaced	Def r	ective but eparable
Туре	Class	No.	No.	Per cent	No.	Per cent	No.	Per cent	No.	Þer cent
Soda- acid	1 2 3 4	8 245 115 79	8 191 ' . 89 78	100.0 78.0 77.4 98.7	- 48 21 1	19.6 18.3 1.3	- 6 2 -	2.4 1.7 -	- - 3 -	- 2.6 -
	Total	4 <b>4</b> ₊7	366	81.9	70	15.7	8	1.8	3	0.7
Water (pres- sure oper-	2 3 4	24 82 46	22 68 45	91.7 82.9 97.8	2 12 1	8.3 14.6 2.2	- 1 -	- 1.2 -	, - 1 -	- 1.2 -
ated)	Total	152	135	88.8	<b>1</b> 5	9.9	1	0.7	1	0.7
Chem ical foam <sup>-</sup>	2 3 4	23 162 7	23 139 7	100.0 85.8 100.0	- 16 -	9•9	- - 4 -	- 2.5 -	- 3 -	- 1.8 -
	Total	192	169	88.0	16	8.3	4	2.1	3	1.6
C.T.C. (hand oper- ated).	'1 2 3 4	5 68 116 <b>15</b>	5 65 113 13	ж 95.6 97.4 86.7	- 2 1 2	2.9 0.9 13.3	- 1 2 -	- 1.5 1.7	-	
	Total	204	196`	96.1	5	2.5	3	.1.5	-	-

# Table 1g

# CONDITION OF EXTINGUISHERS INSTALLED IN CERTAIN CLASSES OF BUILDING

Brigade G

Typ-	• O1			Nu	mber	of extingu	isher	s	· · ·		
and cla press	as of. Ses	Number examined	f imne	it for diate use	Re	charged	ed Replac		Defective bu reparable		
Туре'	Class -	No.	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	
Soda- acid	- 1 2 4 5	88 4 75 29	78 4 52 9	88.6 * 69.3 31.0	8 - 12 14	9.1 16.0 48.3	2 - 9 5	2.3 12.0 20.7	- - 2	- - 2,7 -	
1. 	Total	; 196 .	143	73.0	34.	17.3	17	8.6	2	1.1	
Water (pres- sure "	1	18 31	18 20	100.0 64.5	- 11		-		-		
cper- ated)	Total	49	38	77.6	11	22.4	_	• .		_	
Chem- ical foam	- 1 4 5	18 27 2	17 24 1	94.4 88.9 *	1 2 1	.5.6 7.4 . <del>x</del>	_ 1 _	- 3.7 -	-		
· · ·	Total	• 47.	42	89.4	4-	8.4	1	2.2	-	-	
C.T.C. (hànd cper- ated)	1 4	28 6	23	82.1 100.0		3.6	4	14.3	-		
	Total	34	29	85.3	1	2.9	4	11.8	- :		
C.T.C. (pres- sure oper- ated)	1	. 1	1	1		· · .	-				

### Table ih

# CONDITION OF EXTINGUISHERS INSTALLED IN CERTAIN CLASSES OF BUILDING

Brigade H

Type	e of			, j,	lumber	of exting	uishe	rs	1	
and cla premi	ss of	- Numbér examined	i imme	it for diate use	F	lecharged	R	eplaced	Defe re	ctive but parable
Type	Class	No.	No.	Per cent	No.	Per cent	nt No. Per cent		No.	Per cent
Soda- acid	1 2 3 4 5	40 112 24 111, 2	40 100.0 108 96.4 19 79.2 81 73.0 		- 3 5 30 1	_ 2.7 20.8 27.0 ¥	- - - - 1	- - - - -	- 1 -	0.9 - -
- -	Total	289	248	85.8	39	13.4	1	0.4	1	0.4
Chem- ical foam	1 2 3 4	4 4 23 10	4 3 15 8	# # 65.2 80.0	1 8 2,	¥ 34.8 20.0	_ ' _ _	- - -	· · ·	- - -
· ·	Total	41	30	73.2	11	26.8	-	-	'-	
C.T.C. (hand oper-	- 1 - 3 - 4	5 6 2	5 6 2	ж 100.0 ж		`_ _ _	-		-	- 1
ated)	Total	13	13	100.0		_ ·	-	-	-	
Carbon di- oxide	1 2 3 4	2 6 2 13	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		-		-  -	- - - -	-	- - -
	Total	23	23	100.0	-		-	-	-	-

### Table 2a

# CONDITION OF EXTINGUISHERS INSTALLED IN CERTAIN CLASSES OF BUILDINGS

Extinguisher type I - soda-acid

		· · ·		Numb	er of e	extingui	shers			
Brigade	premises	Examined	Fit fo mediat	t im- e use	Recha	urged	Repla	ced	Defec ba repara	tive t able
		No.	No.	Per oept	No.	Per cent	No.	Per cent	No.	Per cent
A	2 4	103 457	63 419	61.2 91.7	33 27	32.0 5.9	7 10	6.8 2.2	<del>.</del> 1	_ 0.2
	Total	560	.482	86.1	60	10.7	17	· 3.0	1	0.2
B	1 2 3 4	919 206 4 5 617	905 188 3 4 945	98.5 91.3 * 88.0	7 7 1 182	0.8 3.4 <del>x</del> 3.2	4 1 - 52	0.4 0.5 -	3 10 - 438	0.3 5.0 - 7.8
	5	312	265	84.9		1.3	7	2.2	36	11.5
· · · ·	Total	7 058 .	6 306	89•4	201	2.8	64	0.9	487	6.9
С	1 3 4 5	28 2 35 48	· 22 1 26 46	78.6 # 74.3 .95.8	1 1 8 2	3.6 * 22.9 4.2	5 - - `	17.9 - -	- - 1 -	- 2.9
	Total	113	· 95	84.1	12	10.6	5 `	4•4	1	0.9
D	1 3 4	202 1 397	199 <u>)</u> 1 390	98.5 # 98.2	2 - 6	1.0 - 1.5		-	- 1	0.5
Í		(0	663	96.1	-	-	1	1.3	2	2.6
	10 tai	070		90.1		1.2			- 4	0.0.
Е	1 2 3 4 5	12 162 12 100 17	6 106 6 50 8	50.0 65.4 50.0 50.0 47.1	5 9 32 8	41.7 5.6 25.0 32.0 47.1	1 35 3 18 1	8.3 21.6 25.0 18.0 5.9	- 12 - - -	- 7•4  -
	Total	303	176	58.1	57	18.8	58	19.1	12	. 4.0
F	1 2 3 4	8 245 115 79	8 191 89 78	100.0 78.0 77.4 98.7	- 48 21 1	19.6 18.3 1.3	- 6 2 -	_ 2.4 1.7 _	- - 3	_ _ 2.6 _
	Total	447	366	81.9	70	15.6	8	1.8	3	0.7
G	1 2 4 5	88 4 75 29	78 4 52 9	88.6 * 69.3 31.0	8 - 12 14	9.1 	2 - 9 6	2.3 - 12.0 20.7	- - . 2 -	2.7
	Total	196	143	73.0	34	17.3	17	8.6	2	1.0
Н	1 2 3 4 5	40 112 24 111 2	40 108 19 81 -	100.0 96.4 79.2 73.0	- 3 30 1	- 2.7 20.8 27.0 <del>x</del>	- - - - 1	_ _ _ 光	- 1 - -	0.9 -
	Total	289	248	85.8	39	13.5	1	0.3	1	0.3

\* Not applicable - based on small numbers

. ...

### Table 2b

• •

CONDITION OF EXTINGUISHERS INSTALLED IN CERTAIN CLASSES OF BUILDINGS

Extinguisher type II - water pressure operated

•	álasa of	Number of extinguishers									
Brigade 	premises	Examined	Fit f media	or im- te use	Rechar	ged	Repla	ced	Defect but repara	ive ble	
		No.	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	
A	2 . 4	60 742	`55 724	91.7 97.6	5 17	8.3 2.3	- - -	_ 0.1	-	· _	
	Total	802	.779	97.1	22	2.7	1	0.1	_	-	
. B	4 '	112	109	97•3	3	2.7	-	-	_	-	
·	Total	112	109	97•3	3	2.7			÷		
D	1 4 5	3 7 15	3 ' 7 15	<b>≭</b> 100₊0 100₊0	-	-	- -	-	-	- - -	
	Total	<sup>•</sup> 25	. 25	100.0	-	-	-	-	-		
E	. 2 .	5	2	¥	3	)	- ·	-			
	Total	- 5	2	¥	3	X		-	-	· · ·	
F	2 3 4	24 82 46	22 68 45	91.7 82.9 97.8	2 12 1	8.3 14.6 2.2	- 1 -	- 1.2 -	- 1 -	- 1.2	
-	Total	152	135	88.8、	15	9.9	1	0.7	1	0.7	
, G	1 4	18 31	18 20	100.0 64.5	11	35.5	-		-	- -	
	Total	· 49.	38	77.6	11	22.4	-	-	-	·	

\* Not applicable - based on small numbers

### Table 2c

# CONDITION OF EXTINGUISHERS INSTALLED IN CERTAIN CLASSES OF BUILDINGS

# Extinguisher type III - chemical foam

-				Numb	er of er	ctinguis	hers ·							
Brigade	premises	Examined	Examined Fit for im- mcdiate use Recharged		ined Fit for im- mcdiate use Recharged Replaced			Examined Fit for im- modiate use Recharged Replaced			lced	Defect but repara	fective but parable	
÷ .		No	No.	Per cent	No.	Per   cent	No.	Per cent	No.	Per cent				
A	2 . 4	2 11	2 9	ж 81.8	- 2	18.2	-	-	-	-				
	Total	13	11	84.6	2	15.4			-	· _·				
. В	1 2 3 4 5	315 6 12 998 130	310 . 5 . 10 955 111 .	98•4 83•3 83•3 95•6 85•4	- 1 - 11 11	- 16.7 - 1.1 8.5	2 - 5 -	0.6 - 0.5	3 - 2 27 8	1.0 				
	Total	<b>1</b> 461	1 391	95.1	23 .	1.6	7	0.5	40 .	2.8				
C	4	2 25	1 _ 25 ·	¥ 100₊0	· 1 -	н ж –	-		-	, <b>-</b>				
	Total	27	26	96.3	1	3.7	-	-	_	-				
D	1 3 4 5	34 3 42 254	34: 3 38 253	.100.0 * 90.4 100.0	- 1	- 2.4	- - 1 -	- 2.4	- - 2 1	- - - - - - -				
	Total	333	328	98.5	1	0.3	. 1	0.3	3	1.0				
Е	2 3 4	3 . 1 . 11	2 - 5	# - 45•5	1 1 6	ж ! ж 54•5		-	-					
÷	Total	15	7.	46.7	8	53.3	-	-	-	-				
F	2 3 4	23 162 7	23 139 7	100.0 85.8 100:0	16	9 <b>.</b> 9	- 4 : -	2.5	- 3 -	- 1:8				
	Total	192	169 -	88.0	16	8.3	4.	2.1	- 3	1.6				
G	1 4 5	18 27 2	17 · 24 1	94.4 88.9 ж	1 2 1	5.6 7.4 H	- 1 	3.7	-	-				
	Total	47	4.2	89.4	4	8.5	1	2.1	. –	-				
Н	1 2 3 4	4 4 23 10	4 3 15 8	н 165.2 80.0	- 1 8 2	- # 34.8 20.0	-	-	-	-				
	Total	41	30	73.2	11	26.8		_	-	1 1 1 1				

\* Not applicable - based on small numbers

.

•

# Table 2d

CONDITION OF EXTINGUISHERS INSTALLED IN CERTAIN CLASSES OF BUILDINGS

Extinguisher type - C.T.C. hand operated

		Number of extinguishers									
Brigade	premises	Examined	Fit for im- mediate use		Rechar	ged	Replaced		Defective but reparable		
•		No.	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	
Δ	2 4	3 · 14	1. 10	71∙4	2. 4	. <b>∺</b> 28.6	- -	-	-	-	
	Total	17	<u>,</u> 11	64•7	6	35.3		-	_	-	
В	1 3 4 5	9 1 37 14	9 1 31 12	100.0 # 83.8 85.7	- - 1	- 10.8 7.1	- - 1 1	- 2.7 7.1		- 2.7	
	Total	. 61	53	86.9	5	8.2	2	3.3	1	1.6	
C	5	2	2	· Ħ	-	_	<b>-</b>	-		<del>.</del>	
	Total	2	<sup>;</sup> 2	¥		_	-		-		
	1 4 5	42 8 11	42 8 11	100.0 100.0 100.0	-	-	· · - ·		-	- - -	
	Total	61	61	100.0		_	-	-	_ `	_	
E	2 3 4	1.2 12 5	- 1 4	 * <del>X</del> X	- 1 1	- Ж Я	11 - -	91.7 - -	1 . – –	8.3	
	Total	19	5	26.3	2	10.5	11	57.9	1	5.3	
F	1 2 3 4	5 68 116 15	5 65 113 13	ж 95.6 97.4 86.7	- 2 1 2	2.9 0.9 13.3	- 1 2 -	- 1.5 1.7	-	-	
	Total	204	196	96.1	5	2.5	3	1.5	<b>.</b>	-	
Н	1 3 4	5 6 2	5 6 2	ж 100.0 ж	-	-	-		-	-	
	Total	13	13	100.0	_	-	<b>–</b> .	-		<b></b>	

\* Not applicable - based on small numbers

•

<u>Table 3</u>

# CONDITION OF EXTINGUISHERS INSTALLED IN CHRITAIN CLASSES OF BUILDINGS

Defects in extinguishers which were replaced or repaired

·								- 	Numbers
Reported defects				Briga	.de				
	A	В	С	D	E	Ĩ <sup>ŋ</sup>	G	H	Total
Required pressure test Failed pressure test Required discharge test	- 9 -	232 - 81	-	2 - 	-	6 11 -	5 - -	. – 1 –	245 21 81
Total	9	313	-	2	-	17	5	1	347
Corroded container Perforated body Inner container perforated	4 2 -	70 - 37 9	1 5 -	4 - -	55 2 -	1 1 -	7 1 5	- - -	142 48 14
Total	6	116	6	4	57	2	13	-	204
Cap damaged Washer required in cap Washer required in cap and	-	· 60		_2 _	-	- -	- 	-	2 60
pressure test	-	43	-	_		-	-		43
Total		103	-	2	-	-	-	- !	105
Discharge nozzle broken off) Discharge tube perished ) Clips required on discharge)	1	. 29	-	· _	12	_	3	1	46
Bent or broken plunger	-	. 6	<b>–</b> .	1		<b>-</b>	-	-	7
or washer required	-	• 3	-	-	-	-	. –	-	· .3
Total .	-	9	-	1	-	-	-	-	10
Broken acid bottle, acid bottle and cage required Pump action corroded and	-	. 8	、1	-	_	. <b>_</b>	_	-	9
Animed, derective pump action Miscellaneous defects	- 3	3 19		- 1	11 4	-	2 1	-	16 28
Total extinguishers with - specified defects	、19	600	7	<b>1</b> 0	84	19	24	. 2	765
Unknown defect	-	2	-	-	-	4	-	-	6
Total defects	19.	602	7	10	84	23	24	2	771
Total extinguishers examined	1 409	8 762	145	1 156	347	, 995	327	366	13 507

# Table 4

.

, •× , - .

د

# CONDITION OF EXTINGUISHERS INSTALLED IN CERTAIN CLASSES OF BUILDINGS

# The ages of defective extinguishers which were replaced or repaired, in relation to the type of defect

			·								Num	pers
Reported defects		Age of extinguishers in years To										
	0-3	4-7	8-11	12-15	15-19	20-23	24-27	28-31	32-35	Over 35	Un- known	TO DAT
All brigades excluding Brigade E						- An anna an Anna Anna Anna Anna Anna An						
Required pressure test Failed pressure test Required discharge test	1 - 1	12 - 5	12 - 1	88 - 5	30 - 12	56 - 6	25 2 28	4 - -	2 - 1	2	13 19 20	245 21 81
Total	2	18	13	94	42	62	55	4	3	2	52	347
Corroded body and container Perforated body Inner container perforated	3 - 1	18 3 2	13 2 -	10 20 8	12 4 1	10 4 -	12 2 1	1 - -	-	-	8 11 1	87 46 14
Total	4	23	15	38	17	14	15	1	-	-	20	147
Damaged Cap Washer required in Cap	-	- 1 3	1	- 17 7	- 14 17	- 9 12	- 1 -	- 1 -	- 1 -	-	2 16 3	2 60 43
Total	-	4	1	24	31	21	1	1	1	-	21	105
Discharge noz le broken off ) Discharge tube perished ) Clips required on discharge tubing)	6	-	-	2	9	-	1	-		-	·16	34
Bent or broken plunger Plunger, or plunger cap and washer required	-	2 1	-	-	-	-	1 -	-	-	-	3 2	7 3
Total	-	3	-	-	-	1	1		-	-	5	10
Broken acid bottle, acid bottle and cage required Pump action corroded and jauned, defective	3	2	1	-	•	1	1	-	-	-	1	9
pump action	2	2 3	-	- 3	-	-	-	-	-	-	3 15	5 24
Total extinguishers with specified defects	17	55	30	161	100	* 99	74	6	4	2	133	681
Unknown defects	-	-	-	-	-	-	-	-	-	-	-5	. 6
TOTAL excluding Brigade E	17	55	30	161	100	<del>.</del> 99	74	6	4	2	139	687
Erigade E						-						
Corroded body and container	-	-	-	- ·	-	43 1	8 1	-	-	-	4	55 2
Discharge tube perished ) Clips required on discharge tubing) Pump action corroded and jammed. defective	-	-	-	-		3	-	-	-	-	9	12
pump action	-	-	-	-	-	-	- 1	-	-	-	11 3	11 4
TOTAL Brigade E	-	-	-	-		47	10	-	-	-	27	84
POTAL ALL BRIGADES	17	55	30	161	100	146	84	5	4	2	166	771

AGE DISTRIBUTIONS OF SODA-ACID EXTINGUISHERS IN SCHOOLS AND HOSPITALS IN A CERTAIN AREA OF BRIGADE B - ,

All extinguishers I. Number of . extinguishers lige group 0- 3 4- 7 8-1 i 561 230 11 12-15 75 16-19 164 20-23 63 73 24-27 62 28-31 32-35 10 Over 35 --1 24.9

### II. Defective extinguishers

ge group	Number of extinguishers
0-3 4-7 8-11 12-15 16-19 20-23 24-27 28-31 32-35	- 3 1 14 20 9 21 7 6
Over 35	·
	81

III.

lige group

### Proportion defective in each age group

70

0-3			_
4-7			1:3
8 <b>-1</b> 1			9.1
12 <b>-</b> 15		1	8.7
16-19		· · 1	2.2
20-23		1	4.3
24-27		. 2	28.8
28-31		1	1.3
32-35		• • • •	0.0
	,		

Over 35



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

BRARY REFERENCE ONLY

No Agg FR N251

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).

THE FIRE HAZARD OF A 1.5 KW ELECTRIC NIGHT STORAGE HEATER

### by

J.H. McGuire and Margaret Law

### Summary

The fire risk due to placing fibre insulation board in contact with the front surface of a night storage heater has been investigated. It is concluded that convective cooling of the heater surface must not be restricted and the use of a guard is recommended.

File No. F 1040/31/48 July, 1956. Fire Research Station, Boreham Wood, Herts.

}

THE FIRE HAZARD OF A 1.5 KW ELECTRIC NIGHT STORAGE HEATER

#### by

### J.H. McGuire and Margaret Law

# Introduction

The Joint Fire Research Organization has received reports of a number of fires attributed to the ignition of materials that were close to night storage heaters. All were discovered in the early morning and resulted in severe damage. Although the causes of most of these fires were described as unknown the possibility of their being due to the use of the heaters stimulated an investigation into the possible fire hazard. The opportunity was therefore taken of visiting the scene of one such fire, which occurred in a furniture shop, and of obtaining a substantially undamaged heater with which the following tests were carried out.

### <u>Test 1</u>

A piece of  $\frac{1}{2}$  inch fibre insulation board 21 in x 26 in. was fixed so as to cover the front face of the heater. A 26 S.W.G. chromel-alumel thermocouple, connected to a recorder was placed between the heater and the fibre-board at the centre of the panel.

Eight hours after switching on the supply mains (200 volts 50c/s AC) smoke was emitted from the fibre board and after 11 hours 35 minutes an area of the exposed face of the fibre board, about 2/3 of the way up was discoloured. After 11 hours 40 minutes the fibre board was charred through and ignited. Flame spread rapidly and the test was terminated. A temperature record of the test is given in Figure 1.

### <u>Test 2</u>

After the heater had been switched on for a long period (in excess of 2 days) various pieces of  $\frac{1}{2}$  in. fibre board were successively fixed to the centre of the front panel, leaving a sufficient time interval between each experiment to allow the heater to regain equilibrium conditions. The equilibrium temperature rise at the centre of the front panel was  $110^{\circ}$ C. The results of the experiments are given in Table 1.

Table

Size of Fibreboard

· • • •

24

#### Result

3 in. x 3 in.

6 in. x 6 in.

After 3 days the colour of the inner face of the fibreboard had turned to a light brown

After  $28\frac{1}{2}$  hours the centre of the inner face of the fibreboard had turned brown. The equilibrium temperature rise at this point, attained after 1 hour, was  $200^{\circ}C$ . Table 1 (cont'd)

Size of							
Fibreboard	Result						
9 in. x 9 in.	After $22\frac{1}{2}$ hours the inner face of the fibre- board was dark brown, and was charred and cracked. The equilibrium temperature rise, attained after 1 hour, was 260°C.						
12 in. z 12 in.	After 50 minutes the outer face of the fibre- board was discolouring. After 56 minutes it was glowing and after 63 minutes the fibre- board was charred through.						
21 in. x 26 in.	After 15 minutes smoke was emitted and the fibreboard caught fire after 44 minutes.						

#### <u>Test 3</u>

The front panel of the heater was again insulated by  $\frac{1}{2}$  in. fibre insulation board and the heater was switched on for  $\bar{9}$  hours per day for 3 days. The temperature rise at the centre of the front panel was the same on the second and third days and reached a maximum value of 260°C, smoke being evolved and the fibreboard The temperature record of this test becoming severely blackened. is given in Figure 2.

### <u>Conclusions</u>

If a sheet of  $\frac{1}{2}$  in. thick fibre insulation board covers the whole of the front face of the heater, the temperature rise of the fibreboard can be expected to exceed 150°C within 6 hours of switching on. Within 12 hours the fibreboard will most probably ignite.

If the area of the heater covered by fibreboard is less than 3 in. square, then no hazard exists.

Since the power input to the heater is independent of the temperature the separation of the heater from combustible material by any insulating medium would be ineffective in reducing the fire hazard. The only solution would seem to be that of separating combustible materials while allowing free convection from the heater and it is suggested that the heater should be surrounded by a rigid guard with a mesh not exceeding 3 in. x 3 in.

A minimum separation of  $1\frac{1}{2}$  in. between the guard and all faces of the heater should be suitable.



.

.



...

TEMPERATURE RISE --- oc



TEMPERATURE RISE AT CENTRE OF FRONT PANEL WHEN COVERED WITH FIG.2. FIBREBOARD AND HEATED FOR 9 HOURS PER DAY.

1/2274 F.R. 251