

FIRE JOURNAL

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NATIONAL FIRE PROTECTION ASSOCIATION

About Membership

Since its inception in 1896, the National Fire Protection Association (NFPA) has been a nonprofit, voluntary membership organization. It is recognized internationally as a clearinghouse for information on fire prevention, fire-fighting procedures, and means of fire protection, and as an authoritative source for fire loss experience.

Membership is open to all those interested in promoting the science and improving the methods of fire protection and prevention in all or any of its many facets. More than 20,000 individuals, firms, corporations, and societies currently hold an NFPA Associate Membership and over 200 international, national, and regional professional and trade organizations are Organization Members of the Association. Annual dues for Associate Members are \$20.00, of which \$8.00 is for subscription to FIRE JOURNAL. Annual dues for Organization Members are \$150.00.

FIRE JOURNAL is only one of the publications supplied to all Associate and Organization Members as part of their membership benefits. Full details on membership services are available from the Association, 60 Battery March Street, Boston, Massachusetts 02110.

Publisher's Notes

Members of the National Fire Protection Association receive FIRE JOURNAL as part of their membership service, bimonthly. It is *not* available on a subscription basis. Membership in the Association is open to all interested in the Association's objectives.

Accounts of fires are based on the most reliable data available to the Association, but the Association as a body is not responsible for the accuracy of the information. Those having further data on any of the fires reported are urged to submit such information.

Signed articles herein express the views of the authors, which are not necessarily those of the editors or of the Association.

Comments on the content of FIRE JOURNAL are welcomed. We also call readers' attention to the page "Letters to the Association."

Fire Journal

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*To Promote the Science and Improve the Methods of
Fire Prevention and Protection*

*A Membership Publication of the
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International*

60 Batterymarch Street, Boston, Mass. 02110, U.S.A.

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Continuing the theme of the 1968 covers — NFPA activities to solve the fire problem — artist Fred Shannon illustrates international cooperation of the Association in fire protection.

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Final Exams



Unflunkable . . . the final exams at the Ansol Fire School are just unflunkable. So are the students. They have to be. Our fire protection systems aren't any good without people who know how to use them. And fire protection is too important for any kind of failure.

So Ansol manufactures both the extinguishing agents and the extinguishers themselves, to assure quality control and the operational integrity of the equipment. Then at the Fire School, we also train the people who will use this equipment and train others to use it. While we're teaching them, their good and bad lessons are teaching us what it takes to make fire protection systems that won't fail, no matter who's using them.

By the time the students take their final exams, they're putting us to a final test, too. Because every one of them knows enough to challenge everything we've taught them.

Wherever the chance of fire is the greatest, you'll find the fire protection systems that have been proven by test. Ansol—the company that never stops learning.

THE ANSUL COMPANY, MARINETTE, WISCONSIN 54143



The U.S.A. Fire Research and Safety Act of 1968

ON March 1, 1968, the President of the United States signed the *Fire Research and Safety Act of 1968* (Public Law 90-259). Title I of the *Act* establishes a fire research and safety program, for which the Congress authorized to be appropriated \$5 million for the period ending June 30, 1970. Title II provides for establishment of a National Commission on Fire Prevention and Control. The Commission is to report to the President and to the Congress, not later than two years after having been duly organized, on its findings following "a comprehensive study and investigation to determine practicable and effective measures for reducing the destructive effects of fire throughout the country." The Commission shall cease to exist 30 days after the submission of its report. Funds to support the Commission's work were also authorized to be appropriated in the *Act*.

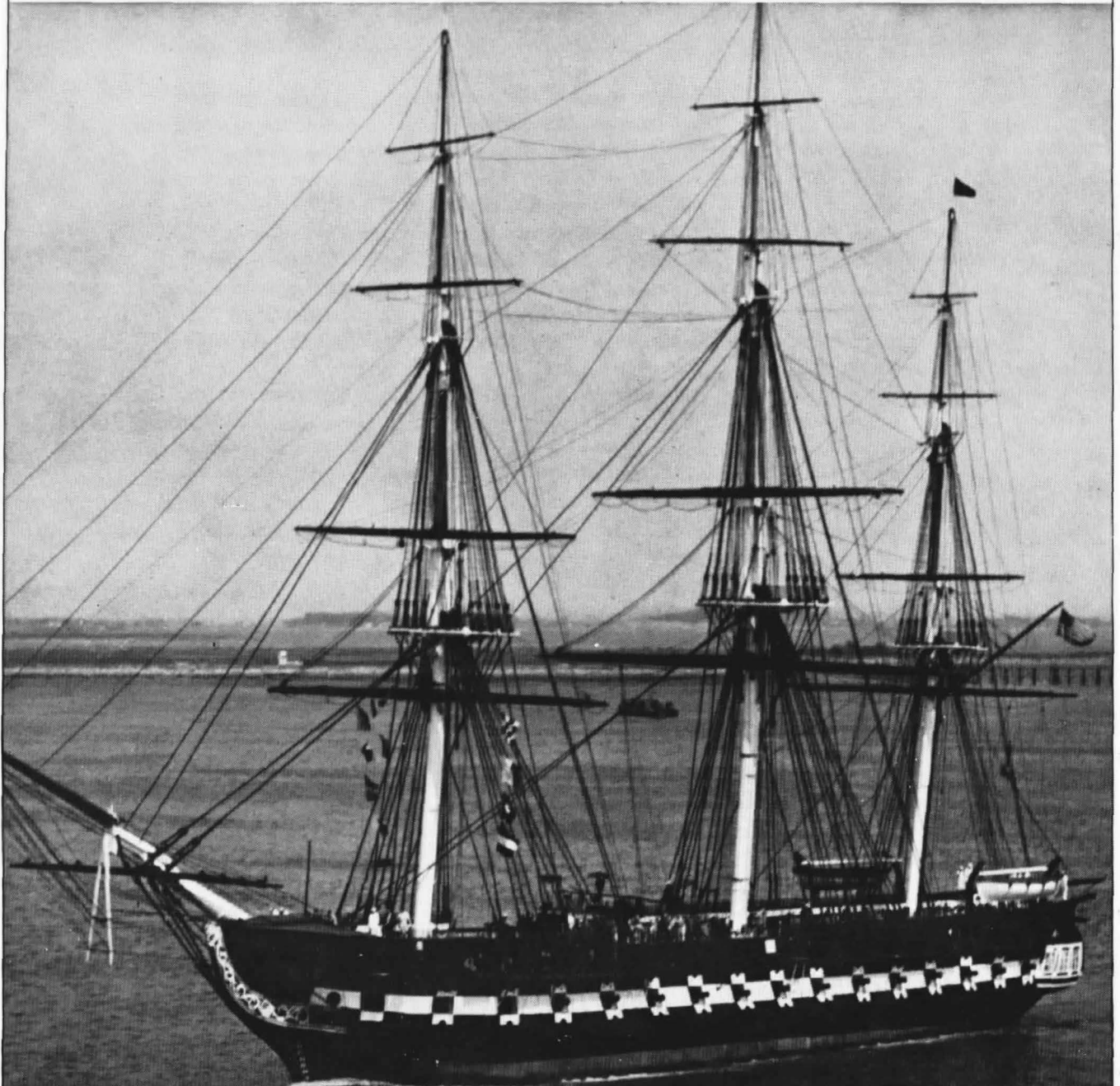
It is no secret to most of our readers that the NFPA Board of Directors was opposed to Title I of the *Act* as it was originally prepared (Bill S.1124 and H.R. 6637), while supporting Title II (first submitted separately as S.J. Res. 46). These positions reflected the Board's view that study by the Commission should precede the suggested multimillion-dollar spending program (originally \$10 million the first year and open-ended thereafter for four years), and that the objectives of Title I should be tied down to more specific goals, recognizing those programs already in existence (see *Special Report to NFPA Members, Current U.S. Federal Government Proposals on Fire Research and Safety*, April 1967, and Statement by Charles S. Morgan presented to the Committee on Banking and Currency of the House of Representatives, April 21, 1967).

Briefly, as signed by the President, Title I of the *Act* authorizes the National Bureau of Standards to establish a Fire Research and Safety Center for administering the program and authorizes the Secretary of Commerce to conduct, directly or through contracts or grants:

- 1) Investigation of fires to determine their causes, frequency of occurrence, severity, and other pertinent factors;
- 2) Research into the causes and nature of fires and development of improved methods and techniques for fire prevention, fire control, and reduction of death, personal injury, and property damage;
- 3) Educational programs to inform the public on fire hazards and fire safety techniques and to encourage avoidance of such hazards and use of such techniques;
- 4) Fire information reference services, including the collection, analysis, and dissemination of data, research results, and other information derived from this program or from other sources and related to fire protection, fire control, and reduction of death, personal injury, and property damage;
- 5) Educational and training programs to improve, among other things, the efficiency, operation, and organization of the fire services and the capability of controlling unusual fire-related hazards and fire disasters;
- 6) Projects demonstrating improved or experimental programs for (a) fire prevention, fire control, and reduction of death, personal injury, and property damage; (b) application of fire safety principles in construction; or (c) improve-

(Continued on page 53)

Oliver Wendell Holmes saved her once.



In 1830, O.W. Holmes penned his famous "Old Ironsides" in an effort to save U.S.S. Constitution from destruction. His efforts helped.

And now, the proud ship (the oldest Naval ship afloat) lies at harbor in Charlestown, Massachusetts. A fitting monument to a great period of American history.

Today, we protect Old Ironsides from another kind of destruction with a Grinnell fire protection system.

Holmes helped save her once.

We hope we never have to.



GRINNELL

Write: Grinnell Company, Inc., 260 West Exchange St., Providence, Rhode Island 02901

THE MAJOR FIRES OF 1967

In 1967 there was a 34 per cent decrease in the fires that killed three or more persons. There was a 10 per cent decrease in the fires that caused \$250,000 or more damage; but the total loss from those fires increased 25 per cent.

THE 253 multiple-death fires (in which three or more people were killed) caused the death of 1,120 persons in the United States and Canada during 1967. These totals are considerably lower than those for 1966 (1,442 killed in 340 fires). The 1967 loss of life from multiple-death fires is the lowest since the NFPA Fire Record Department in 1962 started its studies of this category of fires. Of the 1,120 people killed, 480 were children. In the United States there were 205 multiple-death fires and 918 deaths, and in Canada there were 48 fires and 202 deaths.¹

Seven multiple-death aircraft fires killed 32 people, an increase over 1966 (five aircraft incidents and 28 deaths). In 1967 there were three multiple-death fires aboard ships, which killed ten people. The loss of life aboard the U.S.S. *Forrestal* is not included in these figures because the ship was not within the continental limits of the United States at the time of the fire, which took the lives of 131 men.

In 1967 dwelling fires continued to lead the list, but the toll was the lowest since the beginning of the study. No fire in one- and two-family dwellings killed ten or more. Two dwelling fires killed nine people each; three fires killed eight each. A total of 593 people, including 359 children, perished in 152 multiple-death dwelling fires.

In 1967 there were 471 fires in the United States and Canada that caused \$250,000 or more property damage each. The total damage from these fires was \$443,471,000,² as compared with \$334,272,700 damage from 514

large-loss fires in 1966. Three fires (the Apollo spacecraft, McCormick Place, and the Cities Service refinery) contributed \$148,000,000 to the total loss from large-loss fires, raising the figure far above previous years.

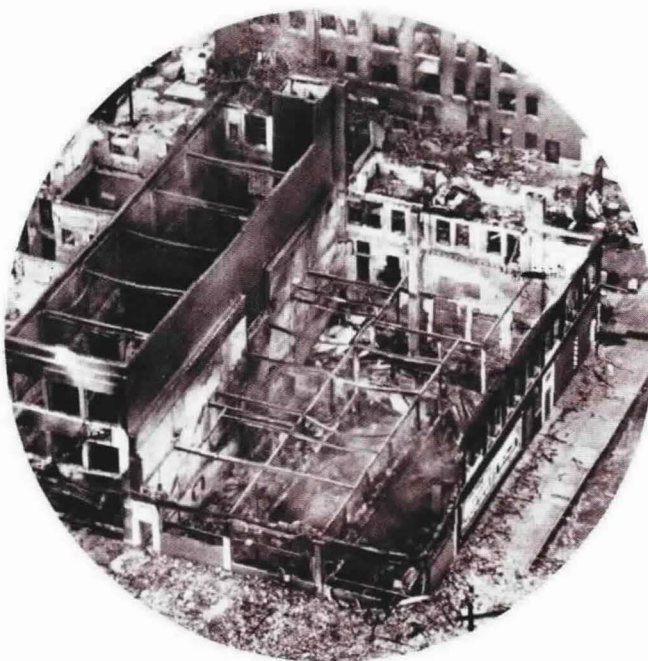
A tabulation of the large-loss fires by occupancy begins on page 10. See page 101 for a tabulation of the multiple-death fires.

TEN OR MORE VICTIMS

THERE were seven fires in which 10 or more people were killed (the total number of victims in those seven fires was 126). The largest loss-of-life fire occurred in a prison barracks building, killing 38 prisoners. Only one of the seven fires occurred in residential property — an

Fires set by rioters presented new fire-fighting problems in many cities. This burned-out block of apartment houses and business establishments in Detroit, Michigan, shows the extent of damage inflicted in some of the riot-torn areas.

WIDE WORLD



¹ The preliminary estimates of the total fire deaths in 1967 were 12,200 for the United States and 666 for Canada.

² The property damage figures are based on current estimates for individual fires and are still subject to change, because final settlements have not been reached for many of them.



A fire started by prisoners during a riot quickly consumed this wooden prison barracks in Berrydale, Florida, leaving 38 prisoners dead — the largest loss of life in a single fire in the United States or Canada in 1967. The metal cage in the foreground was the guard station.

MILTON, FLA., *Press Gazette*

apartment house in Canada, where fire killed 13 persons. Inadequate exits, combustible interior finish, and lack of sprinkler protection were contributing factors in a fire at Dale's Penthouse Restaurant, Montgomery, Alabama, which killed 25 persons.³ A starch dust explosion at the International Latex Corporation and an explosion of a projectile at the Lone Star Army Ordnance Plant each caused the death of 11 people. Of the 19 people who died when an aircraft crashed and set fire to buildings in Kenner, Louisiana, 13 were killed by fire. A coal mine explosion in Natal, British Columbia, left 15 people dead.

Prison Barracks

The worst loss of life in the United States and Canada in 1967 occurred on July 16 in Berrydale, Florida. The 51 prisoners who were housed in a one-story wooden barracks building started a riot. One guard gave his keys to another, who left to open the arms cabinet in the prison office, which was in a separate building. While he was absent the inmates set the building afire. The fire spread quickly, with heat and smoke drawn through the building by a large window fan. The remaining guard did not have his keys to release the prisoners from the building. When the second guard returned the doors were opened, but by that time 35 of the prisoners had already died in the fire. Of the 16 who managed to escape, three died later.

Apartment Building

The largest loss-of-life-fire in residential property occurred during the night in a three-story apartment house in La Sarre, Quebec, on December 16. Both families in the building — three adults and ten children — died when the fire swept through the three apartments. One family occupied the first story; the other family, the third story. The second story was vacant. It is believed that an oil-fired water heater exploded, causing the fire. The building was fully involved when the fire department arrived.

Chemical Plant

Eleven persons perished in Hawthorne, New Jersey, on February 17 when a starch dust explosion in a roaster triggered a violent dust explosion that destroyed the building of origin. The ensuing fire heavily damaged or destroyed seven other interconnected buildings. The building of fire origin and one other building were sprinklered, but the force of the explosion ruptured the sprinkler piping, greatly reducing the effectiveness of the sprinklers. The large quantities of water required to control the fire in the other buildings further reduced the effectiveness of the automatic sprinklers. A masonry fire wall between the two sprinklered buildings was opened up by the force of the explosion. The damage was \$3,500,000.

Ordnance Plant

An explosion at the Lone Star Army Ordnance Plant, Texarkana, Texas, on February 15 killed 11 people and seriously injured two others. The operations in the bay (a section of a building designed and constructed to confine an explosion to that one section) consisted of seating fuses into 105-mm projectiles and tightening the fuses with air impact wrenches. Something caused one of the projectiles to explode. The damage to the building was relatively light: Roof sections were blown off and the conveyer equipment that carried the projectiles was wrecked. A small fire following the explosion was confined to the bay and a small section of an adjoining bay to which it spread through a conveyer opening.

Aircraft Crash

On March 30 a Delta DC-8 jet airliner that was being used for training missions in the area of New Orleans International Airport lost power and crashed into a motel complex in Kenner, Louisiana, killing the six persons on the aircraft and 13 people on the ground. The six aboard the aircraft were crash victims; the 13 on the ground died in the ensuing building fires. The pilot, following routine FAA training procedures, cut two of the four engines to simulate an emergency landing. He

³ Ernest E. Juillerat and Robert E. Gaudet, "Fire at Dale's Penthouse Restaurant," *FIRE JOURNAL*, Vol. 61, No. 3 (May 1967), p. 5.



A jet engine and other debris from the DC-8 aircraft that crashed into a motel in Kenner, Louisiana, after fire-fighting operations were completed. Nine guests in the section of the motel in the background were among the 13 people killed in the ensuing fire.

TERRY FRIEDMAN

was banking for his approach to the airport when the crash occurred. The aircraft apparently struck the ground and crashed through two private homes before cartwheeling into the motel, where it broke up and burned. The building damage amounted to \$647,200. The aircraft damage was due primarily to impact.

Mine Disaster

On April 3 an explosion ripped the Balmer North Mine in Natal, British Columbia, killing 15 coal miners and injuring ten others. The explosion occurred at shift change time, when many of the workers were out of the mine. The cause of the explosion remains unknown, although after the explosion high concentrations of methane gas were found to exist in a 40-foot-high mined-out vault. Possibly a spark from a falling rock

triggered the explosion in the methane, which had accumulated in the vault.

THE LARGEST OF THE LARGE - LOSS FIRES

DURING 1967 there were 95 fires in the United States and 12 fires in Canada that caused property damage of over \$750,000. The fires killed 62 people. (In 1966, 74 people perished in the 104 fires that caused over three-quarters of a million dollars' damage each.) The largest percentage of these fires (29 per cent) occurred in industrial property, followed by 19 per cent in storage occupancies and 16 per cent in mercantile property.

The largest dollar-loss fire in 1967 occurred on January 28 when a fire in an Apollo space capsule did \$75,000,000 damage. The worst loss in history in a single building fire occurred on January 16 when McCormick Place, a large exhibition hall in Chicago, was destroyed.⁴

Three other fires each caused over five million dollars' property damage. An explosion and fire at the Cities Service Refinery in Lake Charles, Louisiana, caused \$20,500,000 damage. A fire at the Rossville Development Corporation textile complex in Rossville, Georgia, destroyed about one-quarter of the plant and did damage in excess of \$12,000,000.⁵ The other fire occurred at the Morgan Station of the New York General Post Office (see this issue, page 20).

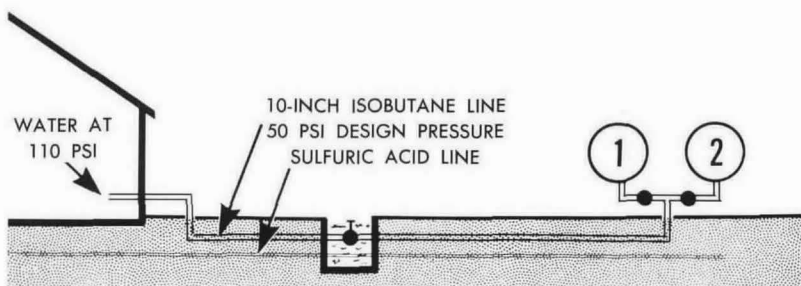
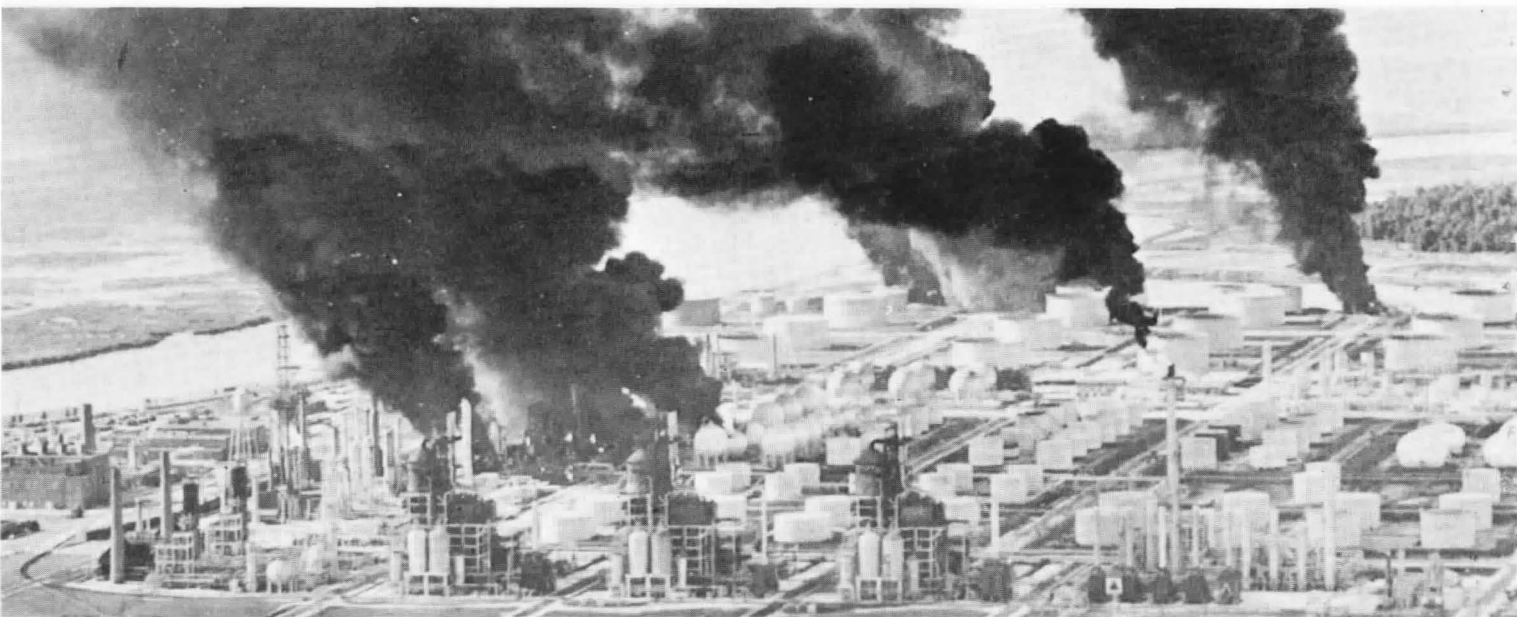
⁴ Ernest E. Juillerat and Robert E. Gaudet, "Chicago's McCormick Place Fire," *FIRE JOURNAL*, Vol. 61, No. 1 (May 1967), p. 14.

⁵ Carl E. Peterson and Robert E. Gaudet, "Carpet Mill Partially Destroyed," *FIRE JOURNAL*, Vol. 62, No. 1 (January 1968), p. 15.

Chicago's huge McCormick Place exhibition hall lies in ruins after the disaster distinguished as the worst property loss to a building from fire in history. The unprotected noncombustible building, thought by some to present no particular fire hazard, on January 16 suffered damage of \$52,500,000.

WIDE WORLD





The above aerial view of the Cities Service refinery, Lake Charles, Louisiana, gives an idea of the size of the complex. The \$20,-500,000 fire on August 8 began with an explosion in the area shown burning at left. Secondary explosions caused other fires throughout the complex.

WIDE WORLD

Space Capsule

Three United States Astronauts were killed in a fire that swept the Apollo Command Module 012 at the John F. Kennedy Space Center, Florida, on January 28, 1967. The damage is estimated at \$75,000,000. A simulated launch was under way at the time, with the atmosphere inside the module 100 per cent oxygen at 16.7 psia. The capsule contained a considerable amount of combustible material. An electric arc is believed to have initiated the fire, which spread very quickly through the capsule. Internal pressure created by the fire prevented the interior capsule door from being opened from the inside until the capsule had ruptured, relieving the internal pressure.

Oil Refinery

At the Cities Service Refinery in Lake Charles, Louisiana, a 10-inch isobutane underground pipeline ran to an alkylation unit from two remote spherical tanks. The line operated under 50-psi design pressure. A valve in the line was in an open pit, which was filled with water from recent rains. The bolts in the bonnet of the valve

had badly corroded because of vapors from a leaky sulfuric acid line that ran underground near by. On August 8 workmen saw bubbles in the water that covered the valve in the pit and realized that the valve was leaking. They proceeded to clear the isobutane line by flushing water at 110 psi through it from the alkylation unit to Sphere No. 1 (see the diagram above). When a workman had determined that the isobutane had been flushed from the line and that the line was filled with water, he closed the valve to Sphere No. 1 and started to open the valve to Sphere No. 2. The 110-psi water pressure against the closed valve at Sphere No. 1 caused the bonnet to fly off the weakened valve in the pit and a geyser of water to rise into the air. When the workman saw the geyser, he thought he had done something wrong and reversed his procedure, closing the valve at Sphere No. 2 and reopening Sphere No. 1. When he did this, the isobutane back-pressured from Sphere No. 1 and discharged from the damaged valve in the pit. An estimated 500 barrels of isobutane escaped to ignite explosively, killing seven workmen and starting a fire that burned for two weeks, until the fuel had been consumed. The property damage amounted to \$20,500,000.

Riots and Civil Disorder

During recent years a new type of fire emergency has arisen in some of the larger cities in the United States — fires of incendiary origin, the product of civil disorders and riots. In 1967 there were major incidents in several cities.⁶ The most serious incidents occurred in Detroit, Michigan, and Newark, New Jersey. In Detroit the rioting lasted for eight days and left 538 business establishments totally destroyed and 549 others seriously damaged. There were two fire fighters among the dead. The fire loss is estimated at \$3,433,000. In Newark more than 100 buildings were set afire in five days of rioting. One fire fighter was killed in Newark. The fire loss is estimated at \$1,252,000.

The list below shows by major occupancy classification the fires that caused \$750,000 or more damage in 1967. Where more than one occupancy was involved, the tabulation gives the occupancy of fire origin.

	<i>No. of Fires</i>	<i>Dollar Loss</i>
Public assembly	9	\$60,201,000
Educational	10	13,076,000
Residential	3	3,953,000
Mercantile	17	17,990,000
Office and laboratory	3	12,500,000
Communications and utilities	2	1,750,000
Raw materials	2	1,788,000
Industrial	31	77,019,000
Storage	20	28,668,000
Transportation	4	88,532,000
Outdoors	1	2,729,000
Buildings under construction	2	5,000,000
Other	3	5,789,000
TOTAL 107		\$318,999,000

Of the 107 fires and explosions causing \$750,000 or more damage each, 94 originated in buildings. The causes are listed as follows:

Causes of the Largest Fires

Defective heating equipment	6
Smoking or matches	2
Electrical faults	6
Rubbish — ignition unknown	4
Mishandling of flammable liquids	3
Cutting and welding	3
Other flame or sparks	3
Lightning	1
Incendiary	7
Spontaneous heating	5
Explosion	3
Fireworks	1
Miscellaneous known cause	1
Undetermined cause	49
TOTAL 94	

Discovery

The following tables outline the way and the promptness of discovery and the operating status of the 94 buildings that suffered over \$750,000 damage each.

Operating Status

Full operation	38
Partial operation	8
Not operating	40
No one present	28
Watchman present	6
Janitor present	6
Unknown or unreported	8
	<u>94</u>

Promptness of Detection

Prompt (within two minutes of inception)	20
Delayed	63
Unknown or unreported	11
	<u>94</u>

How the Fire was Detected

Occupant	46
Neighbor or passer-by	28
Automatic system	6
Explosion	4
Unknown or unreported	10
	<u>94</u>

AUTOMATIC SPRINKLER PROTECTION

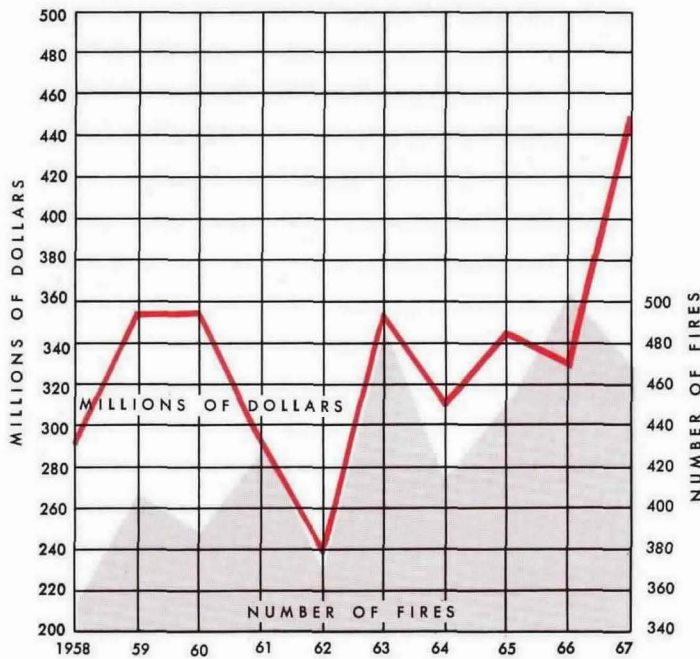
Of the buildings involved in major fires, eight had complete sprinkler protection and four had partial systems.

The fires in the four buildings with partial protection originated in unsprinklered areas. In a high school in Hammond, Indiana, sprinklers in the attic of the classroom section prevented the fire that destroyed the adjoining unsprinklered gymnasium from entering the attic. In a Bloomington, Indiana, junior high school, sprinklers over the stage operated but were overpowered when a fire that originated in the auditorium destroyed most of the building. The fire that destroyed a Boston department store originated in the second story and eventually reached the basement, which was the only sprinklered area. The McCormick Place fire did not extend to a vehicle tunnel, maintenance shops, and other sprinklered areas.

The sprinkler system operated satisfactorily in only one of the eight cases of complete sprinkler protection: After a dust explosion in a wood-fiber feed bin in a hard-board plant in Towanda, Pennsylvania, 250 sprinklers opened and extinguished the ensuing fire.

In a wood furniture plant in Fort Smith, Arkansas, accumulations of flammable vapors and paint residues were believed responsible for a fast-spreading fire that opened more sprinklers on the dry-pipe system than could be supplied by the available water.

⁶ NFPA *Firemen Magazine*, Vol. 34, Nos. 9 and 10 (September and October 1967).



In two incidents the valves on the sprinkler systems were closed. In one case, a public warehouse in Wilmington, Delaware, the valves had been closed until repairs could be made to the system; in the other case, a meat-processing plant in Indianapolis, Indiana, the valves had been shut for an undetermined reason.

An explosion during the initial stages of the fire damaged the sprinkler system in two buildings that suffered large loss — a chemical plant starch dust explosion in Hawthorne, New Jersey, and a metal furniture plant flammable vapor explosion in Newark, New Jersey.

Storage on wooden racks prevented the water from sprinklers from reaching the fire in a textile plant in Rossville, Georgia. The fire, which spread unchecked, was marked by events that caused the fire pumps to fail and the sprinkler water to become depleted.

In a plywood storage warehouse at Tupper Lake, New York, several branch lines and cross mains had become plugged with scale, preventing water from reaching the opened sprinklers. ▴

1967 Large-Loss Fires by Occupancies (\$250,000 or More Damage Each)

ALL OCCUPANCIES

	Total No. Fires	Total No. Killed	Total No. Injured	Total Prop- erty Damage Loss in Thousands
United States	395	84	871	\$404,482
Canada	76	5	55	38,989
TOTAL	471	89	926	\$443,471

EDUCATIONAL — SUMMARY

	Total No. Fires	Total Killed No.	Total No. Injured	Total Prop- erty Damage Loss in Thousands
United States	31	2	68	\$21,915
Canada	4	0	0	2,112
TOTAL	35	2	68	\$24,027

PUBLIC ASSEMBLY — SUMMARY

	Total No. Fires	Total No. Killed	Total No. Injured	Total Prop- erty Damage Loss in Thousands
United States	48	1	97	\$73,251
Canada	3	0	0	1,587
TOTAL	51	1	97	\$74,838

EDUCATIONAL — SPECIFIC OCCUPANCY BREAKDOWN

	No. Fires	No. Killed	No. Injured	Property Damage in Thousands
Elementary schools	10	1	40	\$ 5,344
Junior high schools	6	0	11	5,114
Residential school	1	0	0	500
Senior high schools	16	1	17	12,256
Educational, miscellaneous	2	0	0	813

PUBLIC ASSEMBLY — SPECIFIC OCCUPANCY BREAKDOWN

	No. Fires	No. Injured	No. Killed	Property Damage in Thousands
Bowling establishments	9	0	14	\$ 3,485
Churches, chapels	7	0	19	3,297
City clubs	2	0	2	524
Country clubs	4	0	13	2,006
Exhibition halls	5	1	0	54,837
Gymnasiums	1	0	2	300
Legitimate theaters	1	0	0	303
Motion picture studios	1	0	4	1,500
Motion picture theaters	1	0	0	300
Museums, art galleries	2	0	3	875
Night clubs	2	0	0	514
Passenger terminal	1	0	0	310
Restaurants	11	0	26	4,573
Taverns	4	0	14	2,014

INSTITUTIONAL — SUMMARY

	Total No. Fires	Total No. Killed	Total No. Injured	Total Prop- erty Damage Loss in Thousands
United States	2	0	0	\$689
Canada	0	0	0	0
TOTAL	2	0	0	\$689

INSTITUTIONAL — SPECIFIC OCCUPANCY BREAKDOWN

	No. Fires	No. Killed	No. Injured	Property Damage in Thousands
Hospital	1	0	0	\$350
Prisons	1	0	0	339

THE MAJOR FIRES OF 1967

• 11

RESIDENTIAL — SUMMARY

	<i>Total No. Fires</i>	<i>Total No. Killed</i>	<i>Total No. Injured</i>	<i>Total Prop- erty Damage Loss in Thousands</i>
United States	12	4	27	\$ 5,405
Canada	11	3	7	5,766
TOTAL	23	7	34	\$11,171

OFFICE, LABORATORY, COMMUNICATION, UTILITY, AND RAW MATERIAL — SUMMARY

	<i>Total No. Fires</i>	<i>Total No. Killed</i>	<i>Total No. Injured</i>	<i>Total Prop- erty Damage Loss in Thousands</i>
United States	18	2	22	\$18,087
Canada	7	0	3	3,587
TOTAL	25	2	25	\$21,674

RESIDENTIAL — SPECIFIC OCCUPANCY BREAKDOWN

	<i>No. Fires</i>	<i>No. Killed</i>	<i>No. Injured</i>	<i>Property Damage in Thousands</i>
Apartment — 3 to 20 units	1	0	0	\$ 552
Apartment — over 20 units	1	0	3	255
Dormitories	3	0	4	1,150
Dwelling	2	0	1	609
Fraternity, sorority houses	1	0	2	250
Hotel (year-round use)	9	3	24	4,434
Hotel (seasonal use)	2	4	0	2,500
Mobile homes	1	0	0	386
Motel — 3 to 20 units	1	0	0	250
Motel — over 20 units	2	0	0	785
Motel, miscellaneous	1	3	2	275

OFFICE, LABORATORY, COMMUNICATION, UTILITY, AND RAW MATERIAL — SPECIFIC OCCUPANCY BREAKDOWN

	<i>No. Fires</i>	<i>No. Killed</i>	<i>No. Injured</i>	<i>Property Damage in Thousands</i>
Banks	2	0	9	\$ 515
Electric power-generating plants	2	0	0	631
Fruit-vegetable-packing	2	0	1	1,066
Gas distribution system	1	0	7	750
General business offices	5	0	6	1,597
Glass manufacture	1	0	0	250
Laboratory (medical)	1	2	0	1,000
Laboratory (physical materials-testing)	1	0	0	1,500
Log storage pile	1	0	0	400
Medical office	1	0	0	385
Mining, miscellaneous	1	0	0	250
Petroleum natural gas wells	2	0	2	780
Post office	1	0	0	10,000
Pottery-china- manufacturing	1	0	0	250
Poultry, egg production	2	0	0	1,300
Radio site	1	0	0	1,000

MERCANTILE — SUMMARY

	<i>Total No. Fires</i>	<i>Total No. Killed</i>	<i>Total No. Injured</i>	<i>Total Prop- erty Damage Loss in Thousands</i>
United States	78	12	214	\$39,397
Canada	22	0	10	9,496
TOTAL	100	12	224	\$48,893

INDUSTRIAL — SUMMARY

	<i>Total No. Fires</i>	<i>Total No. Killed</i>	<i>Total No. Injured</i>	<i>Total Prop- erty Damage Loss in Thousands</i>
United States	114	31	170	\$105,074
Canada	17	0	3	8,825
TOTAL	131	31	173	\$113,899

MERCANTILE — SPECIFIC OCCUPANCY BREAKDOWN

	<i>No. Fires</i>	<i>No. Killed</i>	<i>No. Injured</i>	<i>Property Damage in Thousands</i>
Appliance stores	2	0	0	\$1,208
Bookstore	1	0	2	667
Clothing accessory store	1	1	52	460
Clothing stores	6	0	4	3,005
Department stores	12	0	2	6,829
Drugstores	5	5	16	1,987
Fireworks sales	1	0	0	250
Furniture stores	11	0	5	5,264
Hardware stores	2	0	0	544
Hobby, toy store	1	0	0	400
Lumber stores, retail	11	1	17	5,140
Motor vehicle repairs	4	1	6	1,327
Music stores	2	0	2	624
Specialty shop	1	0	0	250
Supermarkets, grocery stores	21	4	58	9,506
Variety stores	11	0	35	8,470
Mercantile, miscellaneous	8	0	25	2,962

INDUSTRIAL — SPECIFIC OCCUPANCY BREAKDOWN

	<i>No. Fires</i>	<i>No. Killed</i>	<i>No. Injured</i>	<i>Property Damage in Thousands</i>
Basic iron and steel	7	0	0	\$ 2,767
Basic nonferrous metal	2	6	22	2,650
Basic metal products	11	0	5	4,943
Canning, preserving of fruits and vegetables	2	0	2	1,650
Chemicals (basic industrial)	7	12	20	7,184
Chemicals (hazardous)	1	0	0	250
Dairy products	2	0	0	1,390
Distilling, rectifying blending spirits	1	0	0	550
Drugs, cosmetics, pharmaceuticals	3	0	3	800
Electrical appliances	3	0	0	1,748

	No. Fires	No. Killed	No. Injured	Property Damage in Thousands		No. Fires	No. Killed	No. Injured	Property Damage loss in Thousands
Food industries, miscellaneous	7	0	3	\$3,679	Flammable liquids	2	0	22	\$1,750
Footware	1	0	2	250	Foodstuff (packaged)	1	0	2	415
Furniture, fixtures, bedding, signs	10	0	6	5,428	Foodstuff (canned or bottled)	1	0	0	416
Grain mill products	4	0	1	3,050	Furniture	4	0	2	1,200
Laundry, dry cleaning plants	2	0	7	740	Freight terminal	1	0	5	2,418
Machinery (non- electrical)	3	0	0	1,235	General warehouses	8	0	11	4,216
Machinery (electrical)	1	0	0	325	Glass, glass products	1	0	0	400
Motor vehicle-manufac- turing and assembling	2	0	0	905	Grain (in bulk)	11	1	15	4,469
Paint, paint products	1	1	1	500	Hardware	3	0	5	991
Paper, pulp, paperboard	3	0	3	1,300	Heavy machinery and equipment	1	0	1	2,500
Paper, pulp, paperboard products	4	0	2	2,103	Leather, leather products	1	0	0	790
Petroleum refineries	3	10	47	25,000	Livestock	1	0	4	350
Plastic products	7	0	5	7,102	LP-Gas bulk plant	1	0	5	271
Printing, publishing	3	0	0	976	Lumberyard, building materials	7	1	14	4,847
Rubber, rubber prod- ucts	2	0	0	580	Marinas, boat, ship storage	2	0	2	850
Rugs and carpeting	4	0	1	14,135	Mercantile stock (mainly food)	3	0	5	1,354
Saw, planing, wood mills	19	2	30	10,588	Mercantile stock (nonfood)	1	0	0	338
Ship-building, repairing	2	0	0	787	Metal parts	1	0	9	991
Slaughtering, preparing, preserving of meat	2	0	0	2,205	Metal products	1	0	0	445
Sugar factories and refineries	1	0	2	324	Paper storage (rolled)	1	0	1	330
Tanneries, leather-finish- ing	2	0	0	795	Paper, paper products	7	0	4	4,059
Vegetable and animal oil products	1	0	3	350	Plastic, plastic products	2	0	0	807
Wearing apparel	2	0	0	594	Piers and wharves	3	0	1	3,189
Wood, cork products	1	0	0	388	Tobacco	1	0	0	1,183
Wooden, cane containers	1	0	1	857	Vehicles	1	0	0	300
Other manufacturing	4	0	7	5,771	Wearing apparel, finished textiles	1	0	0	502
					Wood products	1	0	0	258
					Other storage	2	0	0	500

SPECIAL PROPERTIES — SUMMARY

	Total No. Fires	Total No. Killed	Total No. Injured	Total Prop- erty Damage Loss in Thousands
United States	73	2	89	\$46,883
Canada	12	0	32	7,616
TOTAL	85	2	121	\$54,499

STORAGE — SUMMARY

SPECIAL PROPERTIES — SPECIFIC OCCUPANCY BREAKDOWN

	No. Fires	No. Killed	No. Injured	Property Damage loss in Thousands
Agricultural products (loose or bagged)	2	0	0	\$1,070
Agricultural products (packaged)	4	0	1	4,808
Agricultural supply	1	0	3	1,350
Aircraft hangars	2	0	0	4,000
Barns, stables	2	0	2	600
Basic metal forms	1	0	0	273
Cold storage	1	0	3	334
Drugs, cosmetics, phar- maceuticals	1	0	0	1,575
Fire station	1	0	4	350

STORAGE — SPECIFIC OCCUPANCY BREAKDOWN

	No. Fires	No. Killed	No. Injured	Property Damage in Thousands
Aircraft, multiengine jet or turbine, noncombat	1	13	11	\$ 647
Buildings under construction	6	0	2	6,251
Brush, grass	2	5	10	3,127
Construction equipment	1	4	2	1,104
Railroad cars (freight)	1	0	16	250
Riots and civil disorder	2	3	117	4,686 [*]
Space vehicles	1	3	0	75,000
Trucks (flammable liquid, chemical)	3	2	17	2,151
Vacant buildings	2	0	9	565

^{*} While many cities experienced riots and civil disorders, in most instances the fire damage figures were not separated from the over-all damage estimates.

(Continued on page 101)

"Explosion-Safe" Refrigerators

JOHN R. LEACH, *Chief, Safety and Fire Protection Section*

National Institutes of Health, Department of Health, Education and Welfare

THE increased demand for additional refrigerated space in modern research laboratories has stressed the need for a commercially available refrigerator that provides a sufficient margin of safety at lower cost than a fully "explosionproof" box. While Underwriters' Laboratories, Inc., lists refrigerators approved for Class I, Groups C and D locations, most research laboratories contain a great many ignition sources, the majority of which cannot be made explosionproof. In addition, a research lab may require routine use of chemicals or flammable liquids that are not included in the limited number of flammable liquids in Groups C and D.

The need for a safe yet not necessarily explosionproof refrigerator has long been recognized. Safety and fire protection engineers have sometimes suggested modifications of domestic refrigerators to minimize the potential hazard — changes that were moderate in cost and did offer a measure of protection, in that they eliminated some of the potential ignition sources from the interior. However, certain features that would have been desirable from a protection standpoint were impossible because of restrictions imposed by the basic design of the refrigerator.

In 1963, when the National Institutes of Health began a major laboratory expansion program, it was decided to prepare specifications incorporating all the necessary and desired features. Engineering personnel, in cooperation with the safety staff, developed initial specifications including the following requirements besides those for normal refrigeration:

Editor's Note: Readers should pay particular attention to the italicized statement on page 14. Laboratory refrigerators are used for the storage of flammable liquids in open, lightly stoppered, or easily breakable containers, and thus the refrigerated compartments are customarily classified as Class I, Division 1 locations. In recognition of this classification, all electrical ignition sources were removed from the refrigerated compartment of the refrigerator described in this article. It should be remembered, however, that the refrigerator as a whole has not been tested by a nationally recognized testing laboratory for use in hazardous locations, and that it was not designed for use in an area or room classified as a Class I location.

1) Since the majority of the new labs require one undercounter model, this was established as the basic size.

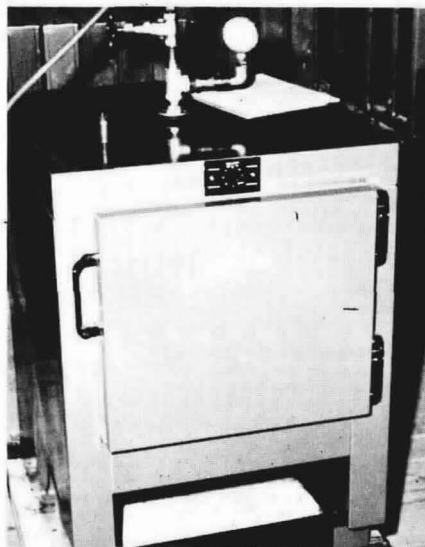
2) All ignition sources were removed from the refrigerated compartment. The starting relay and temperature controls were located within the insulated space between the inner refrigerated compartment and the outer shell, and in a box hermetically sealed. The capillary tube was sealed at the point where it enters the refrigerated compartment.

3) The refrigerated compartment was equipped with a door sill or threshold capable of containing accidental spillage of liquid contents.

4) A self-closing door was specified, to function as an explosion-venting medium and, subsequently, as a means of containment and extinguishment.

5) The materials used in construction were to be the equivalent of porcelain steel. (So-called "self-extinguishing" plastics were excluded because of their tendency to produce large quantities of smoke when they are involved in fire.)

6) The overload relays actuated by motor current



Prototype of the "explosion-safe" refrigerator. The pipe and gage assembly on top used in the testing procedure and the front grill have been temporarily removed.

and case temperature were to be located within the hermetically sealed compressor case. The cooling fan motor on the condenser unit was to be of a shaded pole induction type and equipped with nonferrous blades.

7) All these special features were to be provided at a minimum cost increase.

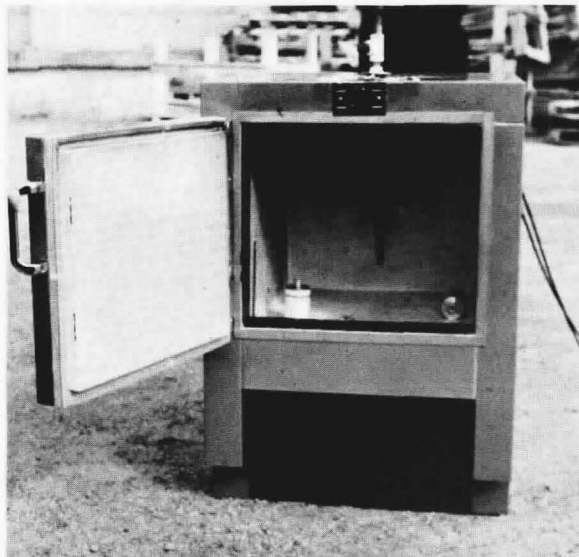
Of the several companies that responded to the invitation to bid, one was awarded a contract for the initial lot of 50 boxes. Preproduction models were made available by the manufacturer, both for quality control tests and for evaluation of the effectiveness of the features from the fire safety standpoint, although performance in the latter type of test was not a condition of the contract.

Three basic tests were performed to evaluate the incorporated safety features. Since the tests were intended to serve as indicators, rather than as a basis for formal specifications, no attempt was made to compile extensive data.

The first test was to determine if the box would contain liquid above the threshold level. There was no evidence of leaking five minutes after water had been added through an adapter to a level two inches above the threshold.

The second test involved ignition of ethyl ether vapors within the box to simulate ignition by exothermic reaction, since normal ignition sources had been eliminated from the refrigerated compartment. Ether, in the amount necessary to reach the midpoint of the explosive range, was allowed to vaporize. The vapors were mechanically distributed throughout the compartment and then ignited by an open spark gap fed through a sealed adapter. The spring-loaded door, set on the lightest tension, served to vent the explosion overpressure promptly and to close with sufficient speed to confine and extinguish the burning fiber waste that had been placed in the box. There was no damage to the box. The total time from ignition to extinguishment was five seconds. Two additional explosions were conducted in the same box, and after the second explosion some chipping of the porcelain was noted on the inner corners of the door panel. This, in all probability, was due to the flexing action of the panel.

The final test was not necessarily related to the special features. Rather, its purpose was to determine the behavior characteristics of the box when it was involved in a fire of external origin. A wood crib was constructed on each side of the box. Two loosely capped cans of ethyl ether were placed in the compartment just before ignition of the cribs. The total burning time was approximately 25 minutes. Occasional brisk gusts of wind served to accelerate the burning of the upwind crib. The white metal door handle melted off within five minutes. The hinges remained intact for 12½ minutes



The original refrigerator after three "explosions" of ethyl ether. The only visible damage is minor chipping of the porcelain inner door face.

after ignition. The door remained in place, serving to confine the contents for another five minutes. There was visual evidence of the ignition of the refrigerant in the final few minutes of burning, with no violent rupture of the refrigeration system.

While the tests were considered as preliminary only, and while they were not conducted under rigidly controlled conditions, they indicated that the particular features considered desirable in fact provide a definite measure of protection. This protection is considered adequate only for the average laboratory. *The box is not intended to replace the requirement for use of explosionproof refrigerators in those applications which fall within the intent and definition of Class I, Groups C and D locations.* However, as was stated earlier, the existence of a host of various ignition sources in the usual laboratory obviates the value of a fully "explosionproof" box, with its substantially higher cost. Because the test results indicated that the basic design considerations were valid, orders were placed for the modified boxes. While they have now been used for three years and subsequent orders have been placed, as with almost any other "new" equipment, experience dictated certain changes.

Meetings were held with members of the scientific staff to determine if there were any additional use requirements. The specifications were modified as a result of those discussions, suggestions by the manufacturer, and judgments by engineering and safety personnel. The modifications did not involve changes in the basic concepts, but, rather, improvements on the original design features.

(Continued on page 19)

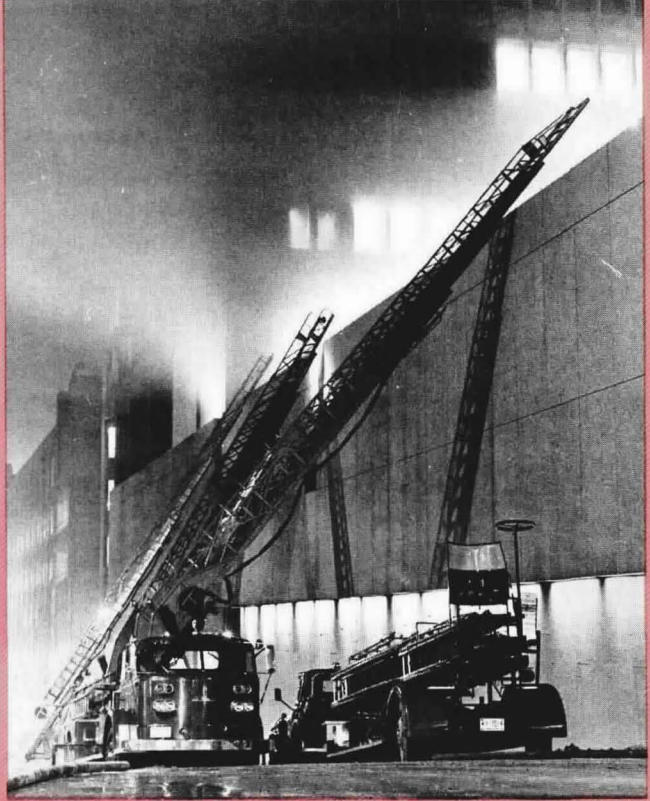
Château Champlain

Fire

DONAL M. BAIRD

Director, Fire Protection Engineering

Canadian Underwriters' Association



BEWILDERMENT might well be the word to describe the feelings of the owners of a beautiful new hotel that has just suffered severe fire damage although considerable effort was expended to provide fire protection. As is often the case, in retrospect it is easy to see what went wrong so that fire could cause about one and a half million dollars' damage to the Château Champlain Hotel complex in Montreal, December 30, 1967. Here

is a clear illustration of the damage potential of even moderate fire loads in the contents of fire-resistive buildings if automatic protection or sufficient cutoffs have not been provided.

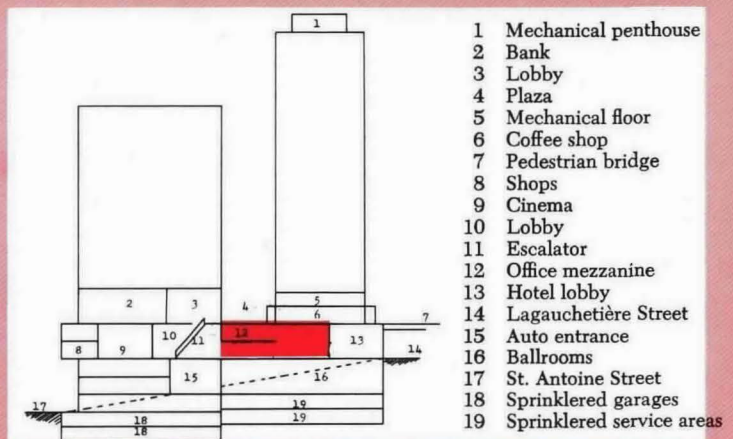
In the one-year-old hotel, built as part of a single development complex with a shopping plaza and office building known as Place du Canada, modern fire-resistive construction prevented a great calamity. How-

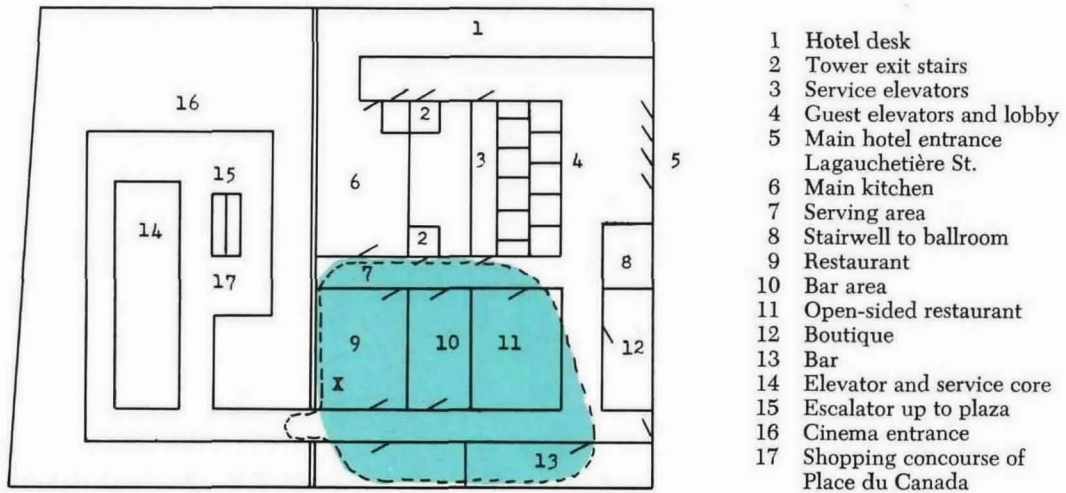
Below left: The Place du Canada-Château Champlain complex from the east. The hotel is on the right. The light-colored facing is on the floor where the fire occurred. The shopping area is at left, under the office building, and the restaurants and the lobby of the hotel are at right. The two openings in the wall are part of the ballroom ventilation system. Some smoke ventilation was achieved through windows of the bank at the left above the plaza.

Below right: An approximate schematic diagram of the hotel-office building complex. The fire area is shaded.

Top photo: Aerial ladders provided additional access to the open plaza from the east side. Note the windowless wall of the hotel lobby and shopping level. Below it is the wall of the ballroom. Above is the office building.

TOP PHOTO: JOHN DAGGETT





An approximate sketch plan, not drawn to scale, of the ground floor of Château Champlain — Place du Canada. The dotted line encloses the area of severe fire damage. The X marks the point where the fire originated.

ever, the unexpectedly large amount of fuel in the furnishings and finish of a restaurant, a briefly delayed alarm, open communication between public rooms, and inability to ventilate the fire permitted major fire, smoke, and water loss. The fast-moving fire incinerated the contents of the luxurious ground-floor restaurants and bars, and heavy smoke spread into the upper levels of the hotel tower and the adjoining shopping plaza. Water from the fire-fighting operations cascaded into basement-level ballrooms and machinery and service areas. The over 200 guests were evacuated through the smoke-filled lobby. A number of guests, staff, and fire fighters had to be hospitalized for smoke inhalation.

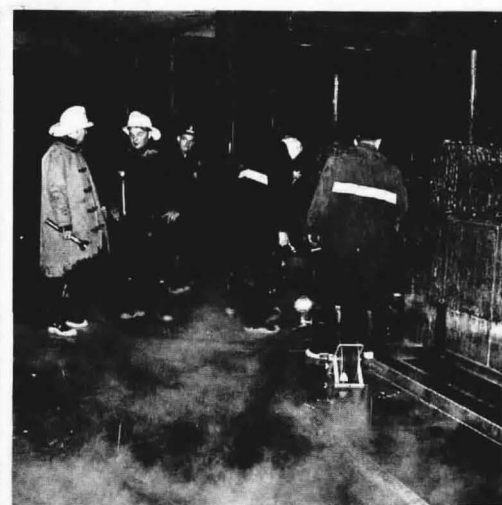
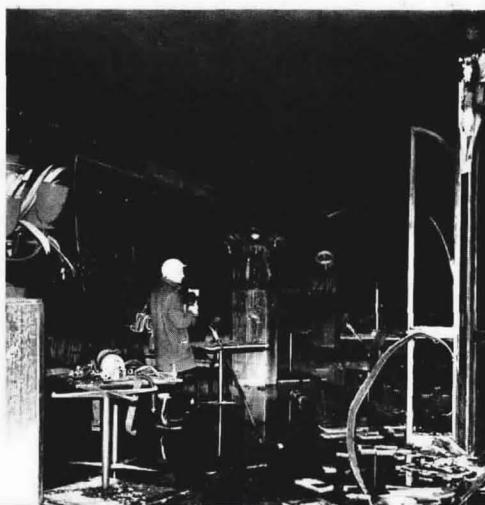
THE Place du Canada-Château Champlain complex — which is typical of many urban-center projects — con-

sists of two high towers rising out of a low, block-square structure having an open pedestrian plaza on its roof (see the preceding page) and a retail commercial or shopping area and hotel lobby on the floor immediately below (see the top photo, preceding page). The complex is located on a hillside, so that the shopping level is a ground floor on the northern La Gauchetière Street side, while on the south side it is three stories up from St. Antoine Street. Although there is communication at several levels, the base structure is actually divided in two. The northern half is the hotel complex; the southern half, the office building-shopping center group. The hotel is owned by Canadian Pacific Hotels, Ltd., and the office building group is owned in part by another subsidiary of the Canadian Pacific Railway organization. The whole project covers a ground area of 68,150 square feet.

Left: Fire-resistive building — no sprinklers required. This picture shows the promenade adjoining the restaurants in the Château Champlain. Note that the wall paneling has been consumed.

Center: The restaurant adjoining the lobby with half wall. Note the melted plastic shrubbery running down the wall.

Right: Here the fire stopped, at a point adjacent to the lobby, where fire streams could reach it in early stages. GAZETTE PHOTO SERVICE



The 38-story hotel tower occupies the northwest corner, the main lobby being located in the shopping level just below the tower, the main entrance on La Gauchetière Street. Also at ground level, adjoining the lobby on the east, are the hotel's principal restaurants and bars, with the main kitchen to the south, behind the elevator and service core. A main promenade from the hotel lobby passes the restaurants and proceeds south without cutoff into the Place du Canada shopping area, with its small shops, an 815-seat cinema, and the elevator bank servicing the 29-story office building. Also in common is the automobile entrance to the parking levels, a passage running through the building below the shopping level.

The entire joint project is new, the hotel having been opened just a year before the fire, and the office group some months later. The hotel is the showplace of the Canadian Pacific Hotel chain, its luxurious appointments recapturing some of the grandeur of former great hotels, in combination with modern facilities and decor.

THE Château Champlain is a structural steel tower rising 480 feet above street level, consisting of four basement levels; the lobby, restaurant, and shopping level; and 37 stories of tower, topped with a two-story penthouse. The floors are of poured concrete six to 18 inches thick, and the columns are protected by vermiculite plaster on metal lath, as are the ceilings. The walls are of precast panels welded in place. The corridor partitions on the guest-room floors are terra-cotta with plaster applied directly; the partitions, gypsum on metal; the doors, wood, except for Class B doors on the stair shafts. The tower contains five passenger elevators and four service elevators, back to back in a single shaft of six-inch concrete blocks. The top of the shaft has a fusible link-operated vent; and the elevators are returned to the ground floor in a fire. The elevators and the shaft conform to local building code requirements. Two stair shafts run from basement to penthouse with exits directly to the outside at basement level. There is one service shaft with six-inch concrete-block walls and metal access doors. An asbestos-sprayed steel grid cuts the shaft every five stories. The main ventilation shaft is cut at each floor by a fire damper. The guest rooms and the various public areas have individual air conditioning using outside ventilation.

The two lower basement levels accommodating workshops and other service areas are protected by automatic sprinklers, as are the below-ground parking garage levels in the Place du Canada building.

THE fire protection in the hotel includes two standpipes on six-inch risers at either side of the service core, with a 75-foot line of 1½-inch hose and an outlet for 2½-inch fire department hose at each floor level. The supply is from two street mains, with two 500-gpm fire pumps, a jockey pump, and a fire department siamese on either side of the building. There are also 2½-gallon hand extinguishers, kitchen hood grease extraction systems, and a local alarm system interlocked with heat detectors throughout the hotel in rooms, corridors, and shafts. There is no automatic relay to a central station or the city fire alarm, local alarm panels being located at several points in the building.

In accordance with City of Montreal code requirements, all combustible interior finish in the public rooms, including the wood paneling and the draperies, was fire retardant-treated.

There was fairly extensive use of wood in the bars and restaurants. That part of the main promenade in the hotel was also finished with wood paneling. The flame spread ratings of the paneling were reportedly no higher than 75. The furniture in the restaurants made extensive use of wood and plastic foam-cushioned upholstery — a substantial fire load.

The Place du Canada office building has 29 stories with a mechanical services penthouse and four lower levels rated as basements. It is of reinforced concrete construction, clad with precast curtain panels. The partitions are of six- or eight-inch concrete block or plasterboard on metal studs. The ceilings are of non-combustible tile on metal channels. There is a smoke detection and local alarm system as well as standpipes. The shopping arcade, which communicates with the hotel lobby area by way of the main promenade, has a central court in which an open escalator communicates with the office building's main lobby at the plaza level above. That part of the main promenade in the Place du Canada office building was plaster-finished.

On the whole, the complex appeared to have accommodated fire protection needs well, more than meeting minimum local code requirements — as is typical of many of the larger, better-built commercial complexes today. There were, however, open communication over an extensive floor area without smoke or fire barriers, total lack of windows or other means of emergency ventilation on the floor on which the fire occurred, and a substantial fire load in an area without automatic sprinklers.

Just off the lobby of the hotel there were two restaurants, a partly open sidewalk café-style room with only a low partition separating it from the adjoining passageway, and an elaborate entertainment and dining restau-



A guest emerging from the smoke-filled lobby of the hotel. Some guests had to be carried.

JOHN DAGGETT

rant to the south of it known as Le Tournebroche. The restaurants were closed, and the only occupants of the lobby and the main kitchen were night staff, when a heat detector in Le Tournebroche sounded an alarm at 2:19 am.

According to evidence at the City Fire Commissioner's hearing, a railway police officer on duty in the hotel and the night manager investigated, finding flames about a foot high running up the paneled wall of Le Tournebroche where a food display was located on a table. The officer said he asked the manager to call the Fire Department while he enlisted the aid of two bell-boys to place a 1½-inch standpipe hose line in action from the east corridor. According to the officer, they were immediately driven back by the rapidly increasing volume of fire, and the officer had to flee toward the shopping area as heat and smoke spread through restaurant openings to the wood-paneled main promenade.

At 2:24 am the Montreal Fire Department received simultaneous alarms by telephone and street box. The first-due companies responded to the lower-level Windsor Street-side (west) entrance, in accordance with an arrangement with the hotel. The street box struck was at the upper side of the block, adjacent to the hotel entrance.

The crew of Pump 25, first due, went up through the building to be met by heavy smoke and heat coming down the promenade. They stretched in a 500-foot line of 2½-inch hose to work on the fire. With virtually no combustibles in that part of the promenade in the

office-building half of the complex, there was no appreciable fire extension into the Place du Canada commercial center, but heat, smoke, and water caused considerable damage. Maintenance staff who promptly shut down the ventilation system on receiving a smoke alarm prevented major smoke penetration into the office building.

Fire fighters arriving at the main hotel entrance met a withering blast of heat and dense smoke from the lobby area. The restaurants and bars and the main promenade had become totally involved with extreme rapidity. Although the essential fire-resistive construction assured the integrity of the structure and imposed general limits on the fire spread, the Fire Department was faced with a hot fire and unventilated gases adjoining the access core of a high-rise hotel.

Additional alarms were transmitted at 2:35, 2:40, 2:58, and 3:50 am (the purpose of the last two was principally to obtain manpower relief and to assist in a floor-by-floor room check of the hotel). Fire Department Director Elphège Hamel took command.

The fire could be attacked only from the promenade in the office building shopping center, from the hotel lobby, and from the street entrance in the northeast corner. The lack of windows or other means to ventilate the fire meant that the fire fighters had great difficulty penetrating to the seat of the fire with nine streams, all from the street. Standpipes were not used.

Smoke penetrated the hotel exit stairways and, by means of the elevator shaft, the upper levels of the hotel. All the elevators were stopped at the lobby floor and firemen assisted the guests down the stairs and out through the smoke-filled lobby. Fire fighters did not take advantage of the fact that the exits connected directly out of doors through basement levels, according to building code requirements.

The fire was knocked down in less than an hour, but by then the contents of the restaurant and bar area were completely burned out, the finish in the promenade was consumed, the lobby was black with soot, and smoke had penetrated widely through nine upper floors. An automatic vent system at the top of the elevator shaft, which complied with the building code but was heat-actuated rather than smoke-actuated, did not open. The many air conditioning systems in the building were not a significant factor in smoke spread.

On the basement level just below the fire area, reached by an open spiral staircase from the lobby, were the grand ballroom and associated public meeting rooms. Large quantities of water ran off into those rooms, and also down the promenade into the shopping center, damaging machinery and hardwood floors in spite of the work of three salvage companies, who laid 121 covers.

AFTER inquiry into the cause of the fire, the finding of City Fire Commissioner John MacDougall was that it had probably been caused by "a candle in a styrofoam base." A waiter thought he had blown out the two candles in a table holding a food display, but it is likely that one continued to burn until it set fire to the styrofoam and sugar icing of a cake display, the tablecloth, the table, and other combustibles.

LIKE most major fires, this one serves only to point up well-known fire protection principles. Probably the fire load of the contents, including the interior finish, of many unsprinklered fire-resistive or noncombustible commercial complexes remains underestimated as to its potential for smoke, water, and fire damage – and the lack of ready means for venting fires in such complexes can raise considerably the damage potential from all three causes. The owners of the Château Champlain felt they

had gone a long way in fire safety. A closer scrutiny of fire load, smoke spread, and other features is expected during the remodeling of the damaged areas. Automatic sprinklers may be the only practical protection for those areas.

In less than a decade, Montreal has acquired 10 miles of interconnected shopping malls, pedestrian thoroughfares, and other related facilities that are located either underground or in virtually windowless structures. Many cities face similar problems. The increased height, area, and complexity of structures, particularly in light of their artificial ventilation and lack of ready access from the street, demand greater consideration of means to fight fires; and, while the limitations of public fire departments in such circumstances must be recognized in the design of the structures, fire departments have an obligation to work intensely on preplanning. $\triangle$

"Explosion-Safe" Refrigerators (continued from page 14)



Third-generation box. The door trays are removable. The tube at rear leads to a condensation collector. The handle at the top of the door is normally recessed under a counter top.

Since the basic specifications dealt with under-the-counter models, increases in cubic capacity led the list. Foamed-in-place insulation reduced the distance between the inner and outer shells. The inefficient small

freezing compartment was eliminated, resulting in a single-temperature box. The compressor unit was located at the upper rear corner, creating an unbroken bottom pan. With the temperature controls located adjacent to the compressor, the only part of the refrigerating system within the refrigerated compartment was the temperature-sensing capillary. The opening in the refrigerated compartment through which the capillary passes was sealed. The threshold, originally specified at two inches, was decreased to a point where the bottom pan would contain slightly over one liter of liquid. A shell-type condenser was used, thus eliminating the cooling fan. The door with spring-loaded hinge was designed to be reversible, either left or right hand, and a manual hold-open device, which could be deactivated when the door was closed, was included.

This third-generation box has a usable capacity of slightly over six cubic feet, as compared to the original four cubic feet, in a slightly reduced external volume. While tests similar to those described earlier have not yet been conducted, it is felt that the results will be comparable.

Experience with this box has indicated a real need for establishment of a classification to meet the requirements of the average laboratory. Only when such a classification has been made available will manufacturers be able to submit production models to recognized laboratories for approval. $\triangle$

Fire at Morgan Station Post Office New York City

CARL E. PETERSON, *Technical Editor*

NFPA Fire Record Department

WITHOUT a doubt, for the Post Office Department the busiest time of the year is the Christmas season. In buildings throughout the country the mail is piled higher than usual, aisle space is almost nonexistent, and more employees than normal crowd the work areas to sort the tons of mail the Post Office must handle. Under such circumstances a fire can least be afforded; but under such conditions a disastrous fire is most likely to occur.

On December 15, 1967, fire struck the Morgan Station of the General Post Office in New York City. Previous fire drill practices paid large dividends, in that about 1,800 people working in the building at the time were evacuated without any major injuries. The property damage, however, is expected to exceed 10 million dollars.

THE Morgan Station building was fire-resistive, with concrete-encased steel structural members and reinforced concrete floors. Although the building was structurally designed for ten stories with a basement and partial subbasement, only one-third of the building had the full ten stories, with the remainder of the building six stories. Eight hundred feet long by 200 feet wide, the building occupied a full New York City block. Brick-faced supporting columns and metal curtain walls between the columns formed the exterior walls.

This report is based on information obtained by the author, who visited the scene of the fire. The assistance of the New York City Fire Department, the Post Office Department, and others is gratefully acknowledged.

The various floor areas were undivided except for a few masonry walls that cut off areas for offices and other small rooms in parts of the building.

The distance from one floor slab to the next ranged from 18 to 24 feet. There were no ceilings. Likewise, there was no interior finish on the walls. In most areas the floors had been covered with wood blocks, wood parquet flooring, or tile to provide a better working surface.

A vast system of conveyers moved the mail bags through the basement and first five stories of the post office. The conveyers, which were rubber-belted and ranged in width from 36 to 48 inches, had metal sides 30 inches high to contain the mail bags. Most of the belts traveled at a speed of about 100 feet a minute.

The conveyers passed from one story to another at several locations. There was no protection of the floor openings where the conveyers passed through, resulting in many unprotected floor openings, which in a few cases exceeded 500 square feet in area.

There were also close to 400 other unprotected floor openings in the building, including many four-foot-square drop holes used for passing mail bags from one story to a conveyer or floor below. The drop holes were covered with steel plates when not in use.

The exits included eight enclosed stairways located on the perimeter of the building. Seven discharged to the street, the eighth to the front lobby. There were also two banks of three elevators each near the front entrance, and there were numerous freight elevators.

The Morgan Station handled parcel post mail, much of which was destined for or arriving from foreign

countries, and large bulk mailings of circulars and catalogues. The mail was received into the building from three sources. Two sides of the first story were devoted to truck docks. The second story had about two-thirds of its floor area devoted to six railroad sidings with a total capacity of 34 railroad cars. The third source of mail was a 48-inch-wide conveyer that ran through a tunnel under Ninth Avenue from the General Post Office a block away.

Once in the building, the mail was all shunted to the basement, where it was sorted by bag and placed on an appropriate conveyer that carried it to the third or fourth story. On those floors the mail was sorted according to destination, rebagged, and sent by way of spiral chutes to the first or second story for reshipment. The fifth story was used for United States Customs inspections and some sorting of circulars and catalogues, the sixth story for maintenance and supply. The seventh to tenth stories were used as offices by other Federal agencies.

THE Morgan Station building had been built by the General Services Administration for use by the Post Office Department. As a Federal building it was not required to conform to city building codes or fire protection regulations.

There was a smoke detection system in the air ducts but no other smoke or fire detection system in the building. The system did not function until after the Fire Department had been called and was not an important factor in discovery of the fire. There was also a stand-pipe system in the building with connections for small (1½-inch) hose and for 2½-inch fire department hose. In the basement there were only 1½-inch connections, and those connections had a different hose thread from that used by the Fire Department. Most of the very limited amount of sprinkler equipment in the building was on the sixth floor, in storage areas. There were no sprinklers in any of the fire areas.

THE fire originated in a basement conveyer tunnel on one side of the building. The tunnel was 24 feet wide and had two 48-inch-wide conveyers running parallel to each other six feet apart and five feet above the floor. Two metal air-moving ducts, each about two feet square, were installed parallel to and about four inches above the floor, at right angles to the conveyers. After passing under the conveyers, the ducts ran vertically, then passed back over the conveyers about four feet above them. The distance between the ducts narrowed from approximately 12 inches to two inches as they ran vertically. The ducts were individually wrapped in an

insulating material that had an outer layer of asphalt-impregnated paper.

At approximately 5:00 pm employees in the basement smelled smoke and, after investigating, reported that the trouble had been caused by dust in and around a unit heater motor near the air-moving ducts. Between 7:00 and 7:30 pm smoke was observed in debris under the ducts. Employees removed the debris and thought that they had extinguished the fire. While the actual cause of the fire has not been determined, authorities theorize that an employee had been smoking in the tunnel and had carelessly discarded his cigarette.

At approximately 9:00 pm heavy smoke and flames were seen in the conveyer tunnel. The Fire Department was called at 9:07 pm. Apparently the fire had not been completely extinguished after discovery and had continued to smolder in the paper on the duct insulation. As the fire developed it became more intense, involving the vertical and overhead sections of duct insulation. The flames then began to set mail bags afire as the conveyer carried them through the fire area.

The mail bags were carried 225 feet through the tunnel before being deposited on other conveyers, which carried the mail 70 feet to a conveyer-switching area. There the mail was shunted to one of four conveyers that carried it to the upper stories. One of those four conveyers terminated in the second story; the other three terminated in the third story. A manually operated deflector shifted the mail from one of the conveyers in the third story to a separate conveyer that ran between the third and fourth stories. As the burning mail bags were deposited in the second, third, and fourth stories of the building, the fire gained a strong hold in those areas.

Throughout the building there was a vast system of lookout tunnels suspended from the ceilings. The tunnels, approximately four feet wide by ten feet high, had lookout ports at regular intervals. From the tunnels postal inspectors could oversee the mail-handling operations, to insure the security of the mail. The tunnels were not a factor in the fire except that one was at least partially responsible for keeping the fire out of the first floor. The group of four conveyers that carried the mail from the basement to the second and third stories passed through the first story but were not cut off from it. One of the lookout tunnels was adjacent to the first-floor ceiling opening where the conveyers entered the second story. The lookout tunnel acted as a draft curtain, effectively preventing the spread of heat coming from the fire in the basement and preventing the fires on the conveyer system from entering the first story (see the right-side photo, next page). A wall on the other side of the conveyer separated a truck-loading dock from the work area.

The fire also entered the subbasement through a floor opening that was used for take-up weights under one of the conveyers to keep the conveyer belt tight. The weights had been in a small enclosed room of the subbasement, but the door to the room had been removed. Thus the fire spread to a large pile of material stored in cardboard cartons outside the room.

FIRE fighters started their attack in the basement, concentrating on the tunnel area, where the smoke condition was most serious. Operations were slow because of the remoteness of the area from outside doorways. Although the Fire Department on arrival shut down the conveyer systems, the fire had already been transmitted by way of the conveyer system to the upper stories. Because of the size of the building, the Fire Department did not immediately become aware of the fires on the upper floors.

With approximately 1,800 people in the building at the time, the Fire Department had to curtail some of its fire-fighting activities to search the building and perform the necessary rescue. Most of the occupants escaped using the eight interior stairways and the various elevators. When the electric power failed, some people in the upper stories waiting for elevators became trapped and had to be led down stairways by fire fighters or rescued over ladders.

The size of the building slowed fire-fighting operations. Extremely long lines of hose were required to reach various parts of the building. Bags containing mail were piled as high as ten feet, making it difficult for hose streams to reach many areas. In the third and fourth stories, much of the conveyer equipment was

suspended from the ceilings, presenting a danger from falling material.

As the fire gained headway in the upper stories, the fire-fighting strategy had to be changed to exterior attack with master stream devices. Conventional monitor nozzles were effective only in the first two stories because of the height of the stories. Above the second story, effective streams were obtained from the larger monitor nozzles of New York City's super pumper system and from conventional ladder pipes.

Fire fighters were able to operate into some areas from the enclosed stairways, but extreme precautions were necessary to ensure that the fire would not overpower one group of them on a lower level and sweep into the stairway enclosure, trapping another group operating at an upper level of the same stair shaft.

Attack was continued from stair enclosures and through windows for several hours before the fire was contained enough, and the residual heat confined in the building by the fire-resistive construction was sufficiently reduced, to permit fire fighters to penetrate to the upper floors and complete extinguishment.

The fire was considered under control at 6:07 am the following morning, just nine hours after the initial alarm. Fire fighters were on the scene until Sunday, December 17, when the last units picked up at noon.

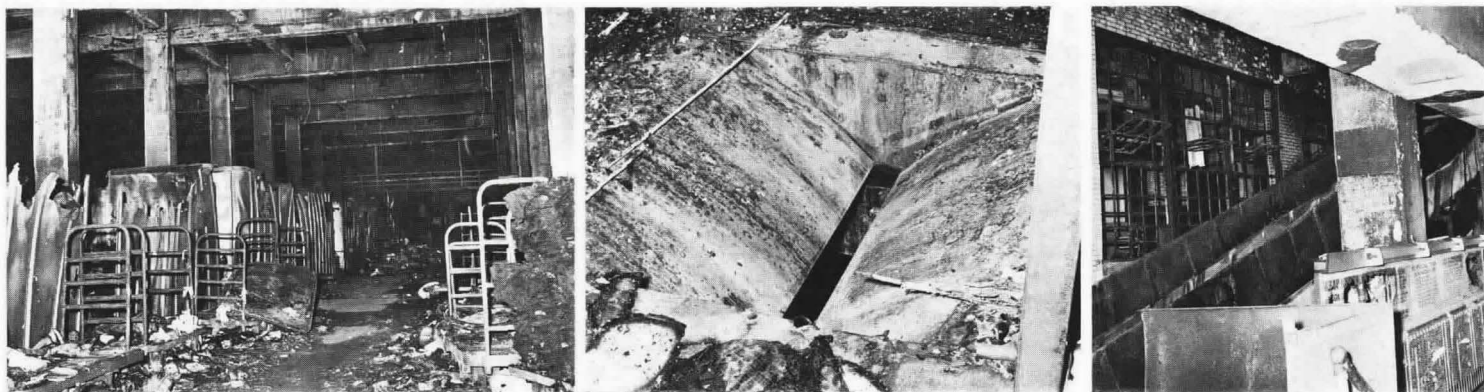
THE 33-year-old building withstood the fire with very little structural damage. The concrete that encased the steel columns did spall, but in no case was the spalling severe enough to expose the structural steel. In a few areas there was spalling of the concrete on the under-

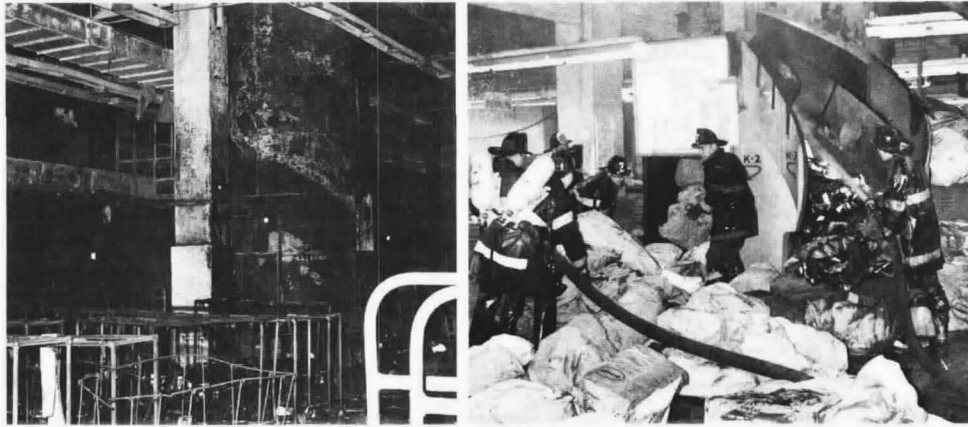
Left: One of the railroad sidings in the second story. The containerized truck vans are on railroad flat cars. The building construction here is typical of that throughout the building. The complete destruction of the material gives evidence of the extent of fire in this area.

Center: This drop hole, used in passing mail bags from one story to a conveyer or chute below, is typical of many of the unprotected floor openings in the building. Note the metal plates, which cover the hole when it is not in use. Normally they open upward; these were deformed by the heat of the fire.

Right: Two of the four conveyers that ran from the basement to the upper stories are shown passing through the first story. The two other conveyers are directly below these. Across the upper right of the photo is the lookout tunnel, which acted as a draft curtain to prevent the fire from sweeping into the first story. The wall in the background separated a truck-loading dock from the work area.

NEW YORK CITY FIRE DEPARTMENT





Spiral chutes were used throughout the building to move mail bags from the upper stories to floors below. Here we see one such chute, which ran from the fifth story to the first story: left, where it passed through the third story, and, right, where it emptied on the first story.

LEFT: NYC FIRE DEPT.
RIGHT: WIDE WORLD

side of the floors, which exposed the reinforcing mesh in the concrete. The only place where the floor cracked through completely was in the basement directly over the area of most severe fire in the subbasement.

The damage to the contents of the building, however, was quite severe. The second, third, and fourth stories experienced the most concentrated fire damage: The second and third stories sustained, respectively, 70 and 55 per cent burnout, and the contents of the fourth story about 25 per cent destruction.

The fire damage in the basement was confined to the conveyer tunnel and the conveyer-switching area. The remainder of the basement and the first story suffered smoke and water damage but little fire damage.

Although the fire extended to the fifth story through a conveyer floor opening and through several former drop holes that had been covered with heavy wood planking, it was well contained at those points, with resulting damage of about 5 per cent, mainly in a locker room. The sixth through tenth stories suffered only smoke damage.

It is estimated that 24 per cent of the 14 million pieces of mail in the building was destroyed. Even though hundreds of thousands of gallons of water were used to extinguish the fire, almost all the destruction of mail was the result of fire damage rather than water damage. The mail damaged solely by water was salvageable. Most of the conveyer equipment and other mail-handling equipment will have to be replaced, because a large percentage of it was located in the second, third, and fourth stories.

Probably the exact amount of damage will never be known, because there were many thousands of packages destroyed for which a claim will not be made — packages destroyed so completely that no value could be assigned. Fortunately the Post Office had other facilities available to keep the mail moving.

Except for the size of the building, this fire was not unique. Disastrous fires continue to occur where buildings are constructed with unprotected floor openings and large open areas and without automatic sprinkler protection. △

Taken on the second story, these two photos show typical conveyer equipment used throughout the building. Left: Mail was automatically transferred from one of the conveyers at right, coming from the basement, to the conveyer at left, for distribution throughout the second floor. Right: Two of the conveyers pass unprotected through the second story to an upper story. All the rubber belts on the conveyers have burned away.

NYC FIRE DEPT.



Looking at Fire Hazards



THE HEIGHT OF FLAMES ABOVE A ROOF

A fire developing within a building grows slowly at first, until it produces sufficient hot gases for the "flashover" and the breaking of windows. Flames and hot gases then vent themselves through the broken windows, while the undersides of floors and roofs are intensely attacked. It may take an hour or more, depending on the construction, before the flames pierce the vertical cutoffs, but when the roof finally has been pierced, the direction of the flow of gases is changed. Fresh air now comes in through the broken windows, while flames and hot gases pass through the roof opening or openings.¹

The maximum height of flames above the roof of a burning building exposing a nearby taller building is an important factor in evaluating the expected severity of

¹ The fire department may, in a comparatively early stage of a fire, make openings in the roof to vent the smoke and hot gases. At an early stage of a fire the flaming is minor, and usually it is under the control of the fire fighters. This type of situation, which constitutes only a slight exposure to surrounding property, will *not* be considered here.



On March 4, 1966, this one-story wooden fruit packing-house in Elfers, Florida, burned to the ground, and with it a nearby dwelling and a restaurant. Five barrels of "separator oil" (used for separating dry from fresh fruit) ruptured in the latter stages of the fire, and the mushroom-like cloud of flame and smoke shown here was the spectacular result. The cloud lasted but a few seconds and caused no additional damage. Much of the sudden release of heat was intercepted and absorbed by smoke particles.

Pictures of this nature (of fires in which oil or other unusual contents affected the volume or height of flames and smoke) are not included among the 176 pictures forming the basis of this study. WIDE WORLD

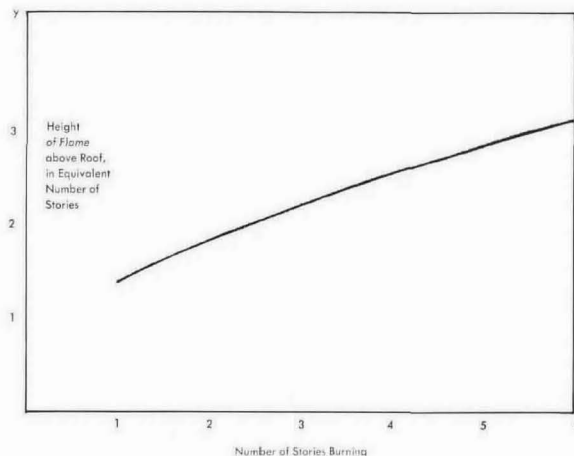


Figure 1

that exposure, and in determining what measures are necessary to offset the hazard. This article summarizes a study made by the NFPA Fire Record Department for the Committee on Exposure Fire Protection. The purpose of the study was to see if there was a useful relationship between the height of buildings and the height of flames above those buildings.

The NFPA picture files, which provided the basis for this study, consist of thousands of fire pictures, divided by occupancy. Of those thousands of pictures, 176 were selected as showing flames above the roof at what appears maximum or near-maximum height. Mushroom-cloud pictures of sudden flare-ups or explosions of flammable vapors or gases were excluded.

The maximum flame height, as measured by the pictures, depends on the number of consecutive stories that are on fire, counting from the top of the building downward. The more stories burning, the greater the flame height, but the relationship seems to be parabolic rather than linear (see Figure 1), with the relative increase in flame height falling off as more stories are involved in the fire. The pictures do not cover situations of more than six stories burning at one time, and, according to NFPA records, such situations must be rare. Although it is possible for a ventilation duct or elevator shaft fire to extend more than six stories, such fires have been limited in horizontal spread, and have not broken through the roof to any great height.

(Text continued on page 27; see the next two pages for photos)



On August 5, 1963, this one-story wooden elementary school in Bellevue, Washington, was heavily damaged by a fire that started at a light fixture in the combustible ceiling tile. The flames dropped to the wooden furnishings below and also broke through the wooden roof. The height of the building varied from 25 feet in the front to 16 feet in the rear. Burning studs of the building front are visible rising above the level of the roof of the low structure in the foreground (not involved in the fire). The height of the flames above the tops of the studs appears to be over 25 feet.

KING COUNTY, WASH.,
FIRE PROT. DIST. NO. 14

In New York City, on December 4, 1962, fire destroyed the idle 100-foot-by-25-foot-by-25-foot-high cooling tower atop a 23-story setback of a 42-story Broadway building. What appears to be a two-story burning structure, with flames rising over 25 feet above one end, is the cooling tower, a steel-frame structure with Transite® covering and redwood filling. The fire did not spread into the main body or setback of the fire-resistant office building.

WIDE WORLD



This fire on June 2, 1967, in San Diego, California, destroyed only one-quarter of the two-story (35-foot-high) furniture store. Flames above the roof reached a height of approximately 20 feet before the Fire Department established control. The fire started at a loading dock, entered the wooden building, and spread upward by way of an unprotected wooden staircase. It is estimated that the fire burned one hour before discovery. If much more time had elapsed, the flames would undoubtedly have reached higher above the roof.

JAMES GALLAGHER





Left: Electrical appliance assembly building fire of May 19, 1965, in Hannibal, Missouri. The fire started in the second story of the four-story building of ordinary construction and involved the upper three stories. The sudden burst of flame at the right of the picture was probably caused by the release of flammable liquids. For most of the roof area the flames do not extend much more than 20 feet high. The building is 45 feet high.

HANNIBAL, MO., FIRE DEPT.



Above: This two-story apartment house of wooden construction in Hampton, Virginia, had not quite been completed when a fire of undetermined cause destroyed it on August 25, 1965. High wind and lack of nearby hydrants were factors. The flames extended the equivalent of two or two and a half stories above the roof line.

WILLIAM E. BONSON

Right: Church fire of December 13, 1960, in Palo Alto, California. The church, of ordinary construction, was the equivalent of a three-story building in height. The chief combustibles present were the wooden pews, flooring, and roof, but the flames extended at least two stories above the roof.

PALO ALTO, CALIF., FIRE DEPT.





Above: Fairgrounds exhibition building fire of September 7, 1960, in Springfield, Missouri. The 12- to 20-foot-high wooden building with stone walls contained wooden bleachers and dry tanbark on the floor. The concentration of combustibles led to a huge fire in the isolated location, spreading to barns 30 to 60 feet away. This photo illustrates the difficulty in determining the exact height of flames when there is reflection from smoke rising from the fire. The flames, however, did extend much higher than in the average fire considered in this study.

PAUL MURRAY



Right: Woonsocket, Rhode Island, April 29, 1967. A four-story (50-foot-high) worsted mill ablaze on all four sides, with the flames from the roof equivalent in height to more than three stories. The plant was of mill construction and processed both wool and synthetic yarns. The fire, which started in the first floor from malicious use of gasoline, resulted in rapid spread of flames that overpowered the sprinkler system. Because the vertical cutoffs were incomplete, the fire soon spread to the upper stories. By the time the picture was taken, the first story had been practically burned out.

WOONSOCKET, R.I., Call

Bottom: Hotel fire of August 11, 1963, in Flint, Michigan. The fire started on the third story of the six-story (72-foot-high) hotel of ordinary construction and involved chiefly the four upper stories. After rescuing all but three of the occupants, the fire department used many large hose streams, but despite their efforts flames extended approximately three stories above the roof.

FLINT, MICH., FIRE DEPT.



The maximum flame heights above the roof, in terms of equivalent number of stories, are given below for different numbers of stories burning.

Number of Stories Burning	Flame Height above Roof
1	1.4 stories
2	1.8
3	2.2
4	2.6
5	2.9
6	3.1

Of the 176 pictures, 69 were of fires in manufacturing occupancies; 65, of fires in mercantile or storage occupancies; and 30, of fires in public assembly, educational, or office occupancies. The remaining 12 were of fires in various residential occupancies. There were some differences by occupancy in average flame height above the roof, but not enough to be particularly signi-

(Continued on page 32)

The NFPA Standards Story



HOW NFPA FIRE PROTECTION STANDARDS ARE DEVELOPED

How are NFPA fire protection standards developed?

By many different people of varied backgrounds, representing 311 organizations — professional, trade, governmental, and international. The list of organizations includes the American Association of Nurse Anesthetists, the American Institute of Architects, the American Oil Chemists' Society, the Institute of Electrical and Electronic Engineers, and the Society of Automotive Engineers. In a random skimming of the trade associations we find the Acoustical Materials Association, the American Association of Airport Executives, the Air-Conditioning and Refrigeration Contractors of America, the American Iron and Steel Institute, the American Boat and Yacht Council, the American Welding Society, the Association of Operative Millers, and the Automatic Fire Alarm Association — and all these are only part of the A category.

We have representatives from the United States Atomic Energy Commission, the Coast Guard, the Department of Agriculture, the Department of Commerce, the Department of the Interior, the Department of Labor, the Departments of the Air Force, the Army, and the Navy, the Federal Aviation Agency, the Federal Fire Council, the Federal Communications Commission, the Federal Housing Administration, the Forest Service, the General Services Administration, the Department of Transportation, the National Aeronautics and Space Administration, the National Bureau of Standards, the National Institutes of Health, the National Park Service, the Public Health Service, and the Veterans Administration.

From the states and the Provinces of Canada we have such typical groups as the New York State Division of Housing, the California Division of Building and Housing Standards, the Michigan State Police, the New Mexico Electrical Administrative Board, the Ontario Department of Lands and Forests, and the Oregon Bureau of Labor.

Editor's Note: This paper was prepared by Mr. Tryon as an address to the Second Annual Fire Protection Seminar, held in Chicago, March 16, 1968.

We have the leading fire departments of the United States, and some of the smaller ones — the fire departments of Los Angeles, Boston, Miami, and Chicago, for instance; and the fire departments of North Park, Illinois; Morgan City, Louisiana; and Rockville, Maryland.

The international organizations in our membership include the International Association of Fire Chiefs, the International Association of Fire Fighters, the International Brotherhood of Electrical Workers, the International Association of Electrical Inspectors, the International Air Transport Association, the International Conference of Building Officials, and the International Municipal Signal Association.

Organizational representation alone, however, would not suffice. There is a definite need to obtain representation from those who act as consultants and independent engineers, from those having detailed technical knowledge of fire protection equipment design, and from those who are directly affected by standards — the users.

At present, over 400 leading companies in this country and abroad gratuitously lend technical personnel to the National Fire Protection Association in the common interest of developing reasonable fire protection standards to protect the public. While a listing of those companies would constitute a directory of the largest industries in the United States, it would also include many representatives of small business, property insurers, fire equipment companies, and fire testing laboratories.¹

Originating Standards-Making Projects

Fire protection Standards originated almost with the NFPA. The Association was organized in 1896, and "from the outset the value of a meeting of minds on standards of fire protection was recognized." At each of the early NFPA Annual Meetings, the Association appointed additional Committees to develop further standards. The records show that in 1897 three Committees were appointed, one on automatic sprinklers, one on fire doors, shutters, and wired glass, and one on

¹ See the NFPA leaflet *Who Writes Them?* (1967), available without charge from the Association.

hose and hydrants. The next year four more Committees were appointed, on fire alarms, uniform inspection report blanks, cast iron water mains, and extinguishers. Through the years, as the needs developed, other Committees were appointed. In 1905, for instance, Committees on car barns and theater construction and equipment were appointed (the Committee on Theater Construction was undoubtedly a direct result of the Iroquois Theater fire in Chicago in 1903 in which 602 people died).

One interesting point is that any person or organization may request initiation of a National Fire Protection Association standards project. In recent years such requests have been honored by the appointment of such relatively new Committees as those dealing with boiler-furnace explosions, electrical equipment in chemical atmospheres, electronic computer systems, explosion protection systems, fire hazards in oxygen-enriched atmospheres, and halogenated fire-extinguishing agent systems. The criteria to determine the wisdom of establishing a standards project are 1) whether the scope of the proposed project is clearly defined, 2) whether the service requested is within the sphere of NFPA activity, 3) whether any existing standard adequately covers the subject, 4) whether the proposed project applies to a significant segment of society, and 5) whether the state of the art permits inaugurating the activity. Currently the National Fire Protection Association has about 190 Standards, covering virtually every phase of the fire problem; but modern technology brings new developments almost daily. One recent request calls for standards to protect rack storage of materials. At first, this may not seem difficult, but when we stop and analyze what type of protection is feasible in automated high-rack storage systems, the problem takes on serious dimensions. Already there are in existence rack storage installations 50 feet high, 500 feet long, and 100 feet wide. Thinking in terms of a multitude of diverse drug and chemical products in installations of this type with aisles only as wide as the automated stackers, a fire protection man could get gray hair overnight. It would not even have to be a bad fire — that is, bad in extent of damage — to cause complete disruption of the entire warehouse complex. A minor fire that might affect the stacking equipment could render the whole complex inoperable and cause complete business interruption for a period of weeks, if not months.

Selecting Committee Members

But let us return to the writing of Standards, which are prepared by men representing a wide range of interests and disciplines. What criteria do we use to select those

men? Basically, the criteria break down into four considerations: first, and most important, technical knowledge and competence; second, ability and willingness to participate actively in the Committee's work; third, obtaining balanced representation among all the interests substantially concerned; and, fourth, maintaining manageable working groups by limiting the size of the Committee. The technical knowledge and competence of the personnel selected are assured by the screening of each applicant before his appointment by the Association's Technical Advisory Committee and its Board of Directors. It is also necessary to obtain assurance of the willingness of each candidate to participate actively. Appointments are made on a yearly basis, so that those who may have good intentions but do not find time to devote to the activity can be dropped. Balanced representation is maintained, according to the needs of each project, to include the interests of producers and consumers, enforcement officials and property owners, architects and builders, and insurers and policyholders. Obviously, efficiency demands manageable working groups. It is truly an exciting experience to sit in on some Committee sessions and see and hear and appreciate how the members assemble knowledge from related disciplines and produce sound guidance in the mutual interest of all concerned. So many times, foreign visitors come into the NFPA Executive Offices and ask: "How are the Standards developed?" When we tell them, they can hardly believe us.

The members of our Technical Committees who serve as representatives of organizations are appointed by those organizations as spokesmen. One of the problems we encounter concerns the diversity of the cooperating groups. Some have excellent internal procedures of their own, permitting a representative to speak authoritatively for his organization. Others lack internal organization, and in those cases the organization and the NFPA must rely on the integrity of the individual selected. For instance, an organization like the National Electrical Manufacturers Association has its own codes and standards committees to pass judgment on the decisions reached by its representatives serving on NFPA Committees. On the other side of the coin, for the most extreme example, an organization such as the Federal Aviation Administration cannot delegate to any employee the authority of the Administrator. In the first instance we receive an industry position; in the second, the judgment of an individual.

People who serve as individuals representing a manufacturer, a hospital, a public school system, a fire department, an insurance company, or what have you are appointed only on the basis of their technical qualifications and eminence. It is sometimes amazing to see

technical people submerge their commercial interests in connection with their NFPA Committee work. Of course, the key is to obtain a technical man and not a salesman; to find men concerned with the end use of a product, not promotion of the product. In the few instances when a company representative has attempted to insert proprietary information into a Standard, he has been so chided by other members of the Committee that he has soon learned that that is just the wrong thing to do.

The need to coordinate our fire protection Standards is obvious, as anyone who looks at our list of Committees or our list of Standards will find. The Standards are an interesting mixture. Some deal with types of hazards — like flammable liquids, cutting and welding, and dust explosion hazards. Others are concerned with specific means of protection — such as automatic sprinklers, carbon dioxide extinguishing systems, dry chemical extinguishing systems, fire doors and windows, and portable fire extinguishers. Others are focused on specific types of occupancies — such as aircraft hangars, hospitals, mobile homes, garages, and piers and wharves. Others are broken down into a wide range of specialized problem areas, such as atomic energy, ovens and furnaces, electrical metalworking machine tools, finishing processes, storage of materials, and lightning protection. Still others deal with manual fire control problems, such as aircraft rescue and fire-fighting, protective equipment for fire fighters, and salvaging operations. The reader may imagine that with such a complex Committee structure we can run into some severe troubles; and, frankly, occasionally we do. The most successful solution is cross-representation to ensure coordination of related projects; and the NFPA Technical Advisory Committee, the group charged with supervision of all our technical work, is on constant guard to watchdog the overlapping interests and concerns of the various Committees.

Codes, Standards, Recommended Practices

In any Standards-making effort there always comes a time to decide on the format of each document under development. The NFPA has three formats: first, the *Code*, which contains only mandatory provisions, with the word *shall* used exclusively (explanatory material is included only in the appendix or the “notes”); second, the *Standard*, which contains both mandatory provisions (*shall* rules) and advisory provisions (*should* recommendations); and, third, the *Recommended Practice*, which contains only advisory provisions, with the word *should* used throughout. The Association defines the word *shall* as “indicating requirements”; the

word *should*, as indicating “recommendations, or that which is advised but not required.” Of course the NFPA itself has no police powers, so that our Codes and Standards must be adopted by a legal entity to become enforceable.

The NFPA encourages use of its Codes and Standards by the appropriate “authorities having jurisdiction,” in the interest of reducing fire loss of life and property. We do *not* encourage legal adoption of our Recommended Practices, although that material can frequently be used in the drafting of regulatory documents tailored to local needs. It is always interesting to see how NFPA technical material is used. Sometimes the Codes and Standards are adopted by the passage of enabling legislation indicating that compliance therewith is *prima facie* evidence of a reasonable degree of fire safety to persons and property. In other cases, ordinances are drafted to incorporate an NFPA Standard into law “by reference.” The Association has prepared model legislation to facilitate application of our material in both ways. With model legislation, a state, a county, or a city may use the material without the sometimes prohibitive cost of having to develop legislation and then publish it for public acceptance in accordance with local legal requirements. In those cases in which adoption “by reference” is not legally permissible, the local authorities must draft their own codes based on NFPA Standards. NFPA Codes and Standards are not, in the main, legalistic documents, but, rather, technical standards that may or may not satisfy the Attorney General or the courts in any particular jurisdiction. We urge enforcing officials who wish to use our Codes and Standards to establish for themselves the adequacy and appropriateness of the documents within the framework of their legislative prerogatives and political climate.

There are other uses of the Standards. Industrial firms, institutional administrators, and other property owners and managers frequently take NFPA material and reshape it to fit their needs. For example, a number of United States and foreign airlines have used the NFPA *Standard on Aircraft Fuel Servicing* as a basis for company regulations (and that Standard has even been used as a basis for the regulations applying throughout an entire country). Insurance rating bureaus and insurance underwriters also make wide use of NFPA material. In those cases, the Standards are used as a basis for determining the acceptability of a particular property to be insured at a standard rate or to determine if the protective equipment justifies a rate reduction. Every effort is made, whatever the Standard, to prepare it in terms of required performance, avoiding specification of materials or devices.

Steps on the Road to a Standard

There are ten basic steps in the NFPA Standards-making system. Let us assume that we are starting off with a proposed new Standard. First, an organizational meeting is held, Subcommittees are appointed, and work is commenced to draft the needed material. An NFPA Staff liaison representative works with the Committee, checking for possible need for inter-Committee coordination. During this period the scope of each Committee is evaluated for completeness.

The second step is to hold full session of the Committee, which meets maybe once, maybe several times to review the work of the Subcommittees, resolving the differences that may have developed, filling the gaps that have become evident, and voting informally on the results achieved. After the last such meeting the material is prepared in a form suitable to be presented for letter ballot by the Committee members, in an effort to obtain endorsement by at least a two-thirds majority of a proposal to submit the material for Tentative Adoption by the Association.

If the minimum two-thirds approval of the Sponsoring Committee is obtained, the third step involves publishing the draft material. Two months before the next NFPA Annual Meeting each Proposed Tentative Standard is published in a document entitled *NFPA Technical Committee Reports*. At this time, too, news releases are issued to the interested technical press and the *NFPA Technical Committee Reports* is distributed free of charge to all NFPA members concerned and made available at a modest cost to anyone else who might be affected.

The fourth step finds the Committee Chairman presenting the Proposed Tentative Standard to the open Annual Meeting of the Association, to which the public is invited. Opportunity is given to anyone to comment on the Proposed Tentative Standard and to recommend any changes. Whether or not the Standard secures Tentative status depends on its acceptance by the majority of those NFPA members present at the Meeting.

The fifth step is to circulate each Tentative Standard, in a special format indicating its nature, for comment and criticism by the public. Each Tentative Standard so circulated carries a deadline date for receipt of any critiques. In this format a Tentative Standard is *not* considered as containing "Official" NFPA recommendations; it is treated as a Committee working paper. In the normal course of events, comments are received on the Tentative Standard over a six-month period.

Then — the sixth step — the responsible Technical Committee meets again to consider any recommendations received, and reballoting is accomplished. A Tentative Standard may remain Tentative for several years,

depending on the nature of the comments received during the public review and the ability of the Committee to reconcile any objections received.

The seventh step is similar to the third, involving publication of the revised material in the *NFPA Technical Committee Reports* published two months before the next NFPA Annual Meeting. The Standard is now ready for Official Adoption, if it has once again won approval by at least two-thirds of the Sponsoring Committee. Again, news releases are issued to the interested technical press to assure that all parties outside the NFPA have knowledge of the proposals.

The eighth step finds the Committee Chairman presenting the Proposed Standard for Official Adoption to the open Annual Meeting of the Association. Again full opportunity is given for comment by anyone interested enough to appear. Comments received by letter are, of course, read into the record. At the Annual Meeting a vote is taken of all the NFPA members present. A majority vote brings acceptance of the Standard.

The ninth step is publication by the Association of each Officially Adopted Standard, in pamphlet form and as part of what the Association calls its *National Fire Codes* (10 volumes; 6,600 pages).

Where appropriate — the tenth step — the Standard is submitted to the USA Standards Institute for approval as a USA Standard in accordance with the By-laws of that organization.

The question most often asked about these procedures is: Why does the NFPA Annual Meeting have the authority to adopt in the name of the Association material developed by its Technical Committees? The answer is simply that the NFPA believes in the democratic process; and its record of achievements proves that the system works in Standards development. In many cases it might be possible for a technically competent committee of 20, 30, 40, or 60 people to develop a standard and publish it without further ado. We have found, however, that holding the open Annual Meeting is a very wise safeguard, and that it provides for an orderly process that has legal advantages. In most cases, of course, the reports of the Technical Committees are heartily and unanimously adopted by the Annual Meeting without any kind of rumble. Occasionally, however, objections are raised from the floor, by representatives of organizations or by individuals. By their very nature, safety standards frequently restrict free exercise of behavior; economic penalties are frequently involved. There are those who will oppose fire safety standards for these and other reasons — and their voices must be heard before the Association takes any formal action.

Sometimes a Committee unintentionally sets up impractical restrictions that could interfere unnecessarily

with an established practice, inhibit an efficient method, or be in restraint of trade. Through the open hearing of Annual Meetings, such oversights can be aired and evaluated. At the same time, the *NFPA Regulations Governing Technical Committees* prevents adoption of hasty, ill-conceived amendments at the open Annual Meeting by allowing the Technical Committee a 30-day period after the Annual Meeting to offer any objections to the actions taken (in that event the matter is referred to the NFPA Board of Directors for resolution). The whole matter of giving an open Annual Meeting its authority in NFPA procedures can be summed up by stating that there is no surer way of gain-

ing wide public acceptance than to give to the public the opportunity to review any Standard that may regulate its freedom before the Standard has been implemented.

NFPA Standards have *one objective*: to promote the science and improve the methods of fire protection. They have *one purpose*: to establish reasonable safeguards against loss of life and property by fire. They have *one result*: to advance fire protection engineering by assembling accumulated knowledge and bringing it to bear on what we all recognize as a major problem in our modern way of life — uncontrolled fire.

GEORGE H. TRYON

NFPA Director of Technical Services

Looking at Fire Hazards (continued from page 27)

ficant. The averages were as follows for one-, two-, and three-story buildings, excluding residential property, where the sample is too small.

Occupancy and No. of Stories	Flame Height above Roof
Manufacturing	
1	1.4
2	1.9
3	2.5
Mercantile and Storage	
1	1.3
2	1.5
3	2.2
Public Assembly, Educational, and Office	
1	1.7
2	1.8
3	2.2

While public assembly, educational, and office buildings presumably contain fewer combustibles than the other two categories, the construction may be, and often is, more combustible. The first two pictures on page 25 show, respectively, a school and an office build-

ing fire.

The bottom picture on page 25 illustrates, with a mercantile building, a situation of the department's arriving at the burning property barely in time to establish control. The flame height is less than maximum.

The top-right picture on page 27 illustrates, with a manufacturing building, a situation of aid's arriving too late to save the property. There the flames reach a considerable height.

It is not always easy to measure flame height from pictures, as the angle of picture-taking may introduce difficulties or the reflection of a flame from smoke may be confusing. In this study the attempt was made to exclude pictures of an ambiguous nature, but some may have intruded themselves. Therefore, the flame heights given in Figure 1 and in the tables must be taken as approximate only.

DANIEL PINGREE

Supervisor of Fire Records

NFPA Fire Record Department

Worldwide Trends



DENMARK

Because of the importance of ferry boat traffic to Denmark's national and international communications, the Danish Government has endeavored to find adequate fire protection for the car decks of ferries. Mock-up fire tests simulating gasoline spills showed that a water curtain cannot prevent flowing burning gasoline from spreading beyond the curtain and that water curtains spaced at intervals fail to provide protection in the fire area between two curtains. The tests indicated that complete coverage of ferry car decks with several manually operated deluge systems would provide the desired degree of protection.

HONG KONG

The Annual Report of the Hong Kong Fire Brigade for the fiscal year 1966-67 records an all-time high in the number of fires for the year — 4,970 — and a 78 per cent increase in the number of fire calls over the previous year; but the number of fatalities (20) decreased, and the property loss decreased by 26 per cent. The population of Hong Kong is four million. The Fire Brigade has 2,701 full-time employees and 911 auxiliaries.

The Brigade operates ambulance service for the Colony. That service made over 65,000 calls.

An interesting special hazard is reported: Careless handling of joss sticks, joss candles, firecrackers, and joss papers caused 250 fires and eight deaths.

SWITZERLAND

The Swiss firemen's organization, reported in this column in our January 1968 issue under the name *Schweizerischen Feuerwehr-Verein*, has changed its name to *Schweizerischer Feuerwehrverband* (or *Fédération suisse des sapeurs-pompiers* in French).

PERCY BUGBEE

UNITED KINGDOM

• Twelve fire liaison panels covering all the sections of the United Kingdom have been established under

the direction of a central fire liaison panel in London. The sponsors are the Fire Protection Association, the British Insurance Association, the Confederation of British Industry, and the Chief Fire Officers Association. Appropriate representatives from each of the four sponsors have been appointed to each of the 12 liaison panels. It is hoped that the panels will stimulate interest on the part of industry, commerce, and the public to control fire waste.

• A fire prevention education experiment, sponsored by the Home Office of the British Government and local authorities, has been carried on for four weeks in the city of Leicester. All sorts of fire prevention propaganda, such as posters and leaflets, contests for adults and children, exhibitions, and lectures, were employed. Every homeowner in the city received a fire check list and was asked to inspect his own home. The effects of the campaign on the fire record for the period will be measured in due course.

• At the request of the Confederation of British Industry, the British Government has established a new service to insure the availability of safe electrical equipment for use in locations where flammable and explosive atmospheres are likely to be present. The new service, to be known as the British Approvals Service for Electrical Equipment in Flammable Atmospheres (BASEEFA), will be administered by the Ministry of Technology. BASEEFA will take over from the Factory Inspectorate of the Ministry of Labour responsibility for certification of intrinsically safe electrical equipment and from the Ministry of Power responsibility for testing and certification of flameproof apparatus used in industries other than mining (*flameproof apparatus* corresponds to what is referred to in the United States as *explosionproof equipment*).

Regulation 27 of the Electricity Regulations requires electrical equipment to be constructed so as not to introduce a hazard. When BASEEFA has become fully operational, it will take much less time for British industry to obtain the certification of approval necessary for the manufacture of equipment to meet the requirements of Regulation 27.

PERCY BUGBEE

Safety for Football and Sports Grounds

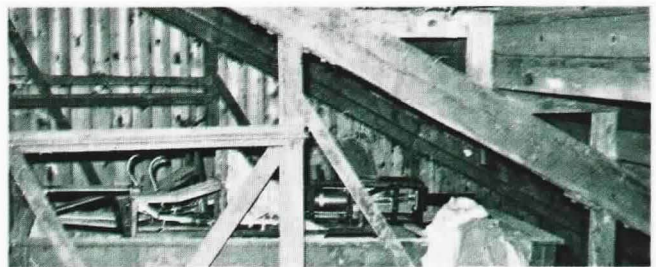
A. LEESE, *Chief Fire Officer*
City of Coventry Fire Brigade

FOOTBALL games and other sporting activities may today be considered large-scale public entertainment. A good number, if not the majority, of football grounds and stadiums were built, at the turn of the century, near or in the middle of our present centers of popula-

Editor's Note: Most of the conditions here described that affect spectator safety at British stadiums are strikingly similar to those that can be found in stadiums on the North American continent, and probably throughout the world. NFPA No. 102, *Standard for Tents, Grandstands and Air-Supported Structures Used for Places of Assembly*, contains recommendations for the protection of the occupants of grandstands from the hazards of fire, storm, collapse, and panic.

tion. While the reasons for the original siting of sports grounds may be obvious, can the same kind of construction and siting be justified for new stadiums?

Everyone who has attended a crowd-drawing meeting or event in or near the center of a city has witnessed conditions akin to chaos, with vast numbers of cars, buses, and other means of public transportation battling through almost blocked streets and roads, very often for considerable distances around the stadium. How long can we tolerate this almost complete clogging of the roads and thoroughfares of our large cities? To say nothing of the interference in the movement of ordinary traffic, the effects on the deployment and



Far left: top — old-type timber and corrugated iron stands; bottom — terraced sections — often tightly packed and lacking safety barriers.

Above and left: two examples of combustible rubbish below timber stands.

COVENTRY FIRE BRIGADE

travel of emergency appliances and vehicles around fire risks cluttered with parked cars has to be seen to be believed. Very little imagination is necessary to appreciate the possible consequences of all this obstruction. Today sports grounds could just as well be sited not in the middle of large centers of population, but at points appropriate to the over-all national transport-communications network.

Since England's winning of the World Cup in 1967, attendance at football grounds appears to be on the increase, and football management has begun to try to draw a balanced family audience — not only the traditional male fans, but men taking their wives and children to football matches and other large stadium-type entertainments and sporting events. Some of the more progressive football clubs are also replacing their old timber and corrugated iron stands with modern fire-resisting concrete structures and adding licensed bars and club rooms and other supporters' club facilities.

IN Great Britain the legal position regarding football and sports stadiums is not clear. It appears that Section 59 of the *Public Health Act* of 1936 applies to buildings within the curtilage of the football stadiums, and, therefore, safe ingress and egress can be secured for spectators in the stands. Where there are licensed bars or licensed clubs under the stands, the usual public entertainment safety provisions, such as secondary lighting, exit signs, adequate exits, fire-fighting equipment, and flameproofed furnishings and decorations, can be insisted upon under the *Licensing Act* of 1964.

The legal status of terraced sections and other open-air standing spaces where the spectators are tightly packed is obscure, because those places cannot be defined as structures. Safety measures in those situations are therefore left to the common sense of football management, which of course varies according to the quality of the management, and to other influences on standards — not the least being the prosperity and financial capability of the organization.

THE risks in large-crowd situations fall into two basic classifications — 1) a life and personal safety risk, and 2) an attendant fire and panic risk where the older,

Right, top: At this Midlands match on February 17, 1968, the barrier collapsed and children were injured. In the lower photo, taken at the same match, we see the tubular steel barrier broken by the swaying crowd.

BIRMINGHAM, ENGLAND, *Post & Mail*





A typical spectator crowd blocking gangways. As is obvious, the stands are uncompartmented. Crowds have been known to sway a distance of 40 feet.

MANCHESTER, ENGLAND, *Daily Express*

combustible-type stands and fixtures are still in use.

The principal fire risk in the average football ground is the traditional covered stand, built primarily of timber with the usual corrugated iron or asbestos roof. Once fire has gained a hold in this type of structure, it of course spreads rapidly and can destroy the stand — often before fire-fighting measures can be brought into effect. Moreover, fire-fighting operations can be complicated by the voids and spaces beneath the stands, where combustible rubbish and used and worn-out equipment are often stored. In such places fire can spread undetected.

Where the spaces under the stands are used for offices, dressing rooms, etc., the areas are often further subdivided by timber-studded partitions covered with combustible hard wood or soft board. In such structural conditions, without fire-resisting compartmentation, fire can spread rapidly.

IN Great Britain cinemas and theaters are strictly controlled by legislation, primarily because of the disasters that have occurred both in this country and in other parts of the world. There have of course been disasters in football grounds, but so far there is little evidence

of any improvements made after the tragedies.

For example, in England 33 people were killed and over 500 were injured at Bolton in 1946 when thousands of people forced their way into the football ground, crushing some spectators against barriers that collapsed, causing other spectators, including women, to be suffocated and trampled upon. And in 1964 over 80 people were injured in somewhat similar circumstances at Sunderland Football Ground.

In Lima, Peru, 300 people were killed and over 1,000 were injured while trying to escape from a football ground where a riot had broken out and the police were using tear gas. Recently, too, 34 people were killed and many were injured at a football match in Turkey.

All the ingredients for disaster are present among the emotional and often tightly packed spectators on the terraced sections of football grounds. When capacity crowds are attending cup ties and local derbies, access gangways are often solidly blocked with spectators, who, once they have gotten inside the ground, are jammed in until about 15 minutes before the game ends. As exciting incidents build up, throngs of spectators press forward, and this wave of movement runs through the whole crowd until arrested by crush barriers or by the ultimate compression of the spectators in the lower sections of the terraces into a dangerous solid mass of humanity.

If, as the signs of the times indicate, hooliganism and rowdiness are on the increase, who can predict the effects of panic or partisanship on tightly packed crowds of spectators? An atmosphere of excitement and rivalry sparked by a few pints of beer before the game can be the background for disaster. An element of rough play coupled with a few contentious decisions — and the pattern would be set.

A typical jammed-in crowd on terrace. Here the spectators forced into the field and the game was stopped.

COVENTRY, ENGLAND, *Evening Telegraph*





A carelessly discarded cigarette that ignited an upholstered chair was the probable cause of a fire that destroyed one-third of the 2,500-seat stands at the Coventry City Football Club, March 6, 1968. Most of the administrative offices, clubrooms, and dressing rooms occupying the two levels below the seats were also destroyed. The fire had made great headway before discovery by a passer-by at 7:00 am. The fire is believed to have originated in a small ground-floor clubroom occupied for a social gathering until 2:30 am.

COVENTRY Evening Telegraph

As is obvious to anyone who thinks at all about safety, the conditions in many football grounds demand further legislation. It would be refreshing to be able to hope for legislation to provide reasonable safety standards *before* another disaster can occur.

Fire prevention is another must. All spaces under stands should be cleared of combustible rubbish, and careful inspection made of all floors over voids for cracks and holes through which cigarette ends, lighted matches, or smoking materials could fall. While spectators are occupying the stands, there should be frequent inspections of the voids, followed by a final inspection at least 30 minutes after the spectators have left the stands.

All electrical equipment and wiring should be examined and tested by a competent electrical contractor at least once every three years.

Adequate first-aid fire-fighting equipment should be strategically positioned in the stands – and if there is any doubt about the adequacy or effectiveness of the apparatus, the chief fire officer for the area should be requested to advise on fire defense arrangements.

SAFETY for the spectators demands certain reforms. The following are a few suggestions.

1) Compartmentalize the standing crowds of spectators by subdividing the terrace spaces into areas that will comfortably hold perhaps 500 people, and enclose

those areas with the requisite robust railing or fencing.

2) Provide stewards (members of supporters' clubs), who after suitable training could prevent overfilling of the compartments and keep access gangways clear of spectators. Such an arrangement would serve both to assist the club to control crowds effectively and to help the police to locate and control troublemakers. The stewards could be trained in first aid to the injured, crowd control psychology, and elementary fire prevention.

3) Provide adequate primary and secondary lighting – particularly important during floodlit games.

4) Provide special enclosures for children and other special sections of the public who cannot participate in the usual spectator facilities.

FACULTIES or schools of architecture might carry out a research study into football grounds and stadium design, to meet modern standards of safety and comfort.

In Great Britain at least, there is also scope for a national review of the siting of large-crowd entertainment centers, perhaps by a committee set up under the auspices of the Ministry of Sport. No such study has ever been attempted or contemplated, but, were this to be tackled, the findings, together with the architectural study on ground design, would form the basis of a comprehensive documentary report. $\triangle$



INFRARED

Wildfire

Mapping

ROBERT L. BJORNSEN

Forester, Division of Fire Control

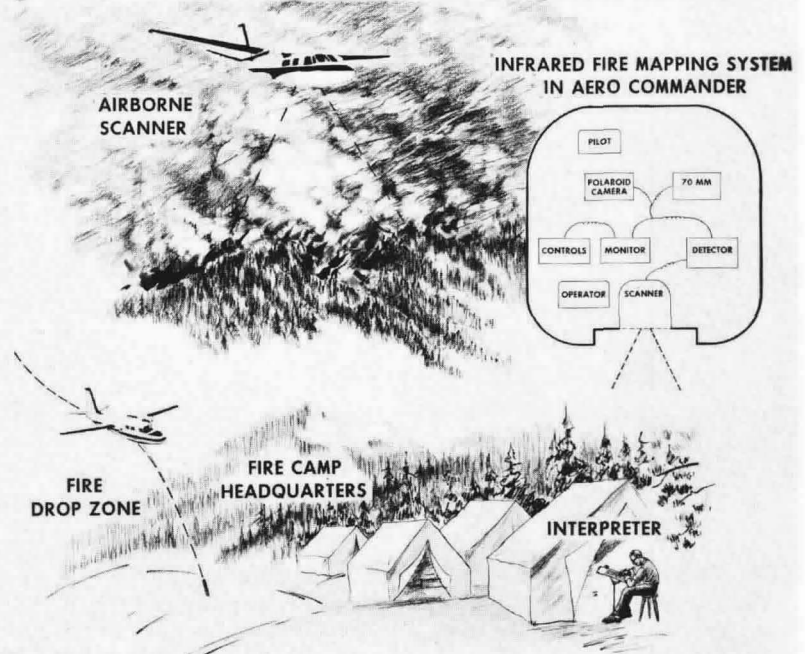
Forest Service, United States Department of Agriculture

A large forest fire rages out of control. For two days heavy smoke has blanketed the fire area. Reconnaissance aircraft are grounded, and the steep, inaccessible terrain causes long delays in receiving ground scout maps. Will lack of information mean losing another 10,000 acres of valuable forest resources? Just a few years ago the answer might well have been yes.

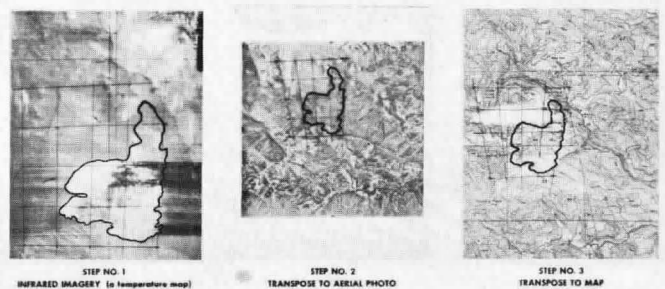
Below: Conventional oblique aerial photograph, Concow Road Fire, Oroville, California. Note the difference between this picture and the infrared thermal imagery, top of page; both show the same fire.

Right: Scanner schematic, operating, and interpretation procedures.

INFRARED FIRE MAPPING SYSTEM



INFRARED FIRE IMAGERY INTERPRETATION



Now a new tool, the airborne infrared fire mapper, gives fire bosses a proved capability for obtaining vital fire intelligence, day or night, even through dense smoke. The mapper is the result of five years' joint research and development by the United States Department of Agriculture, the Forest Service, and the Office of Civil Defense. For the first time, fire bosses can count on receiving graphic data round the clock.

DURING the uncontrolled stages of wildfire, fire bosses must consider such variables as fuels, topography, and weather, to calculate their manpower and equipment needs and the best way to deploy their forces. But before any decisions can be made, they need accurate information on the perimeter of the fire, the rate of fire spread, the intensity of the fire, and its location, together with the location of any spot fires.

Before the advent of infrared mapping, there were two sources of fire intelligence — air reconnaissance and ground reconnaissance. Confined to the daylight hours, air reconnaissance was often thwarted by dense smoke overlying the fire area for long periods. Ground reconnaissance usually meant slow foot travel over rough terrain and sometimes involved smoke and other fire hazards to the scouts. By contrast, the infrared mapper provides a unique means to deliver intelligence to command headquarters at the moment it is needed.

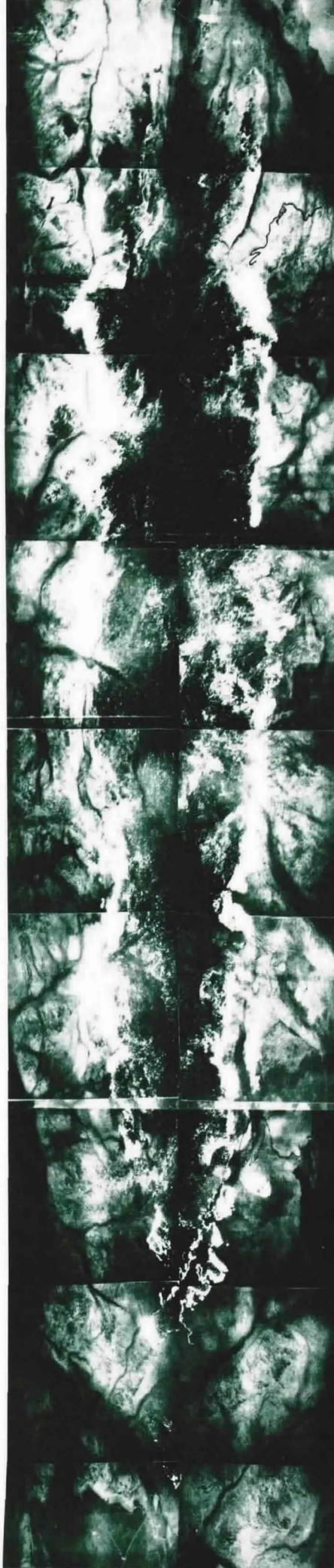
THE infrared scanner, which includes a detector and a printer, is mounted in a light, twin-engine aircraft. Imagery is produced as the aircraft flies over the fire area and the scanner picks up infrared energy emanating from hot burning fuels and surrounding terrain. Polaroid® photographs are made when the energy is converted to a visible light signal displayed on a cathode ray tube. The photographs (imagery) constitute a thermal map that shows in clear detail the fire perimeter, hot spots, small fires outside the main perimeter, and features of the terrain.

After the mapping sortie, the imagery is placed in a capsule and dropped at command headquarters, where an interpreter transfers the information to maps used in planning the control effort. Although the imagery is similar to aerial photographs, special skill is required

(Continued on page 42)

Right: Nighttime infrared imagery of the 56,000-acre Sundance Fire near Priest Lake, Idaho, September 1967 (taken between 2:18 and 2:30 am).

All the photographs in this article are by courtesy of the United States Forest Service.



The NEC and You



WIRING IN CLASS II HAZARDOUS LOCATIONS

In the March 1968 FIRE JOURNAL we described the types of wiring for Class I hazardous locations, as defined in NEC Article 500. The following is a similar discussion of the types of wiring required by the NEC for Class II locations. We shall cover Class III requirements in the July FIRE JOURNAL.

Class II Locations — Types of Wiring

No type of wiring other than those listed below is permitted.

Division 1

1. Threaded rigid metal conduit
2. Type MI cable with terminal fittings approved for Class II locations
3. Where flexibility is needed:¹
 - (a) Dust-tight flexible connectors
 - (b) Flexible metal conduit with approved fittings²
 - (c) Extra-hard-usage flexible cord with grounding conductor and bushed fittings³

Division 2

1. Rigid metal conduit
2. Electrical metallic tubing
3. Type MI cable with approved terminal fittings
4. Type MC cable with terminal fittings approved for Class II locations
5. Type ALS cable with terminal fittings approved for Class II locations
6. Where flexibility is needed: same requirements as for Division 1 locations

¹ Note to 3 (a), (b), (c): Where subject to oil or corrosive conditions, all flexible wiring shall have conductor insulation approved for the purpose or protected by suitable sheathing.

² Exception: Not permitted where dust is electrically conductive.

³ Exception: Required to have dust-tight seals at both ends where dust is electrically conductive.

Explanation of Types of Wiring

Whereas threaded connections are required for rigid metal conduit in Division 1 locations, both threaded and threadless connections are permitted for this wiring in Division 2. Electrical metallic tubing, also permitted in Division 2 but not in Division 1, is always of the threadless type. It is not permitted to be threaded because of its thin-wall construction.

Type MI cable terminal fittings are required to be of a type approved for Class II locations in Division 1 only. In Division 2, they are required to be approved

only for general use. Type MI cable fittings are available and UL-listed for all Class II Groups — E, F, and G.

Types MC and ALS cables are permitted only in Division 2 locations, and then only where terminal fittings approved for Class II locations are used. Fittings are available for general use for both types of cable. As of this writing, however, no terminal fittings for Type MC or Type ALS cable are listed in either the May 1967 UL *Hazardous Location Equipment List* or any of the Bi-Monthly Supplements through December 1967 for Class II or any other hazardous locations. I do not know the reason for this. Perhaps none have been submitted for testing. The NEC requirement for these specially approved fittings in Division 2 locations is probably based to a large extent on the need for substantial assurance of adequate grounding continuity and ampacity of the grounding path for fault currents.

Where flexibility is needed, dust-tight flexible connectors are available and UL-listed for all Class II Groups — E, F, and G. These are similar in construction to the flexible connectors described and shown in the March FIRE JOURNAL for Class I locations, although in Class II locations, for both Divisions 1 and 2, ordinary flexible metal conduit is also approved. Only the type found by test to have sufficient grounding continuity and ampacity should be used, however, unless a separate grounding conductor is used for grounding purposes. For flexibility at motor terminals and portable equipment, liquid-tight flexible metal conduit may also be used. The same precaution should be exercised to assure an adequate grounding path for liquid-tight conduit as is exercised to assure this for "regular" flexible metal conduit. Some manufacturers produce and sell both UL-listed and unlisted materials.

The bushings and, for electrically conductive dusts, dust-tight seals for cords are parts of the terminal fittings and do not have to be approved for Class II locations. Neither do the cords themselves. The cords do have to be of the extra-hard-usage types, such as Type S, SO, etc.

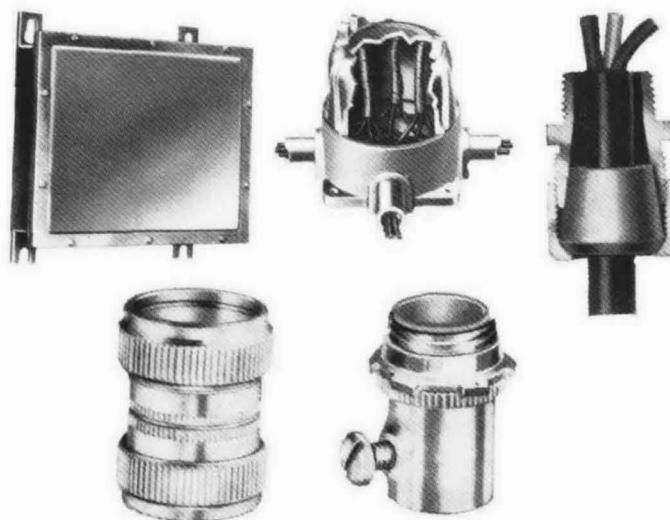
The sheath on liquid-tight flexible metal conduit is suitable protection against oil and most corrosive conditions mentioned in the Note to 3 (a), (b), (c). Since

liquid-tight flexible metal conduit is approved only at motor terminals and for portable appliances, however, a similar sheathing or coating on flexible metal conduit could be used; or, where suitable, a Type SO flexible cord could be used. The *O* indicates an oil-resistant quality.

Fittings and Boxes

As was noted in the discussion of Class I wiring in the March FIRE JOURNAL, boxes and some types of fittings are enclosures, but they are not referred to as such. The term *enclosures* is usually reserved for panel-board enclosures, switch enclosures, etc. (which will be discussed in later issues). Boxes and fittings, on the other hand, constitute a part of the wiring system.

Basically, there are two kinds of boxes: pull boxes and junction boxes. Junction boxes contain spliced conductors. Pull boxes contain unspliced conductors. A pull box may later become a junction box where a part of the wiring is replaced. Both may be used for a change in direction of a run of cable or conduit.



Top left: junction box, Class II; top center: junction box, Class I or II; top right: cord connection with seal; above left: threaded coupling; above right: threadless connection.

Fittings are sometimes used as pull boxes and for changing directions, such as tee- and ell-shaped fittings. Where of sufficient size for the purpose, they may also be used as junction boxes. Other types of fittings are couplings and connectors to join two pieces of conduit or tubing and to join conduit, tubing, cable, cords, etc., to boxes, other fittings, and other enclosures.

Class II Locations — Types of Fittings and Boxes

No type of boxes and fittings other than those listed below is permitted.

Division 1

1. Dust-ignitionproof - type boxes and fittings approved for Class II locations⁴
2. Threaded-type couplings and connectors

Division 2

1. Boxes and fittings containing splices, joints, or terminations shall be designed to minimize the entrance of dust, have telescoping or close-fitting covers, and have no mounting or other holes or openings
2. Couplings and connectors may be of the threadless type

⁴Exception: Where (a) dust is not electrically conductive, and (b) there are no splices, joints, or terminations, boxes and fittings need not be dust-ignitionproof, but shall be of the threaded type with tight-fitting covers and without mounting or other holes or openings.

Explanation of Boxes and Fittings

Dust-ignitionproof equipment has threaded hubs and gasketed covers and is designed to operate at safe temperatures in the presence of dust. Equipment intended for use in Class II locations, whether dust-ignitionproof or just with tight-fitting covers, has mounting holes in external appurtenances or brackets. The

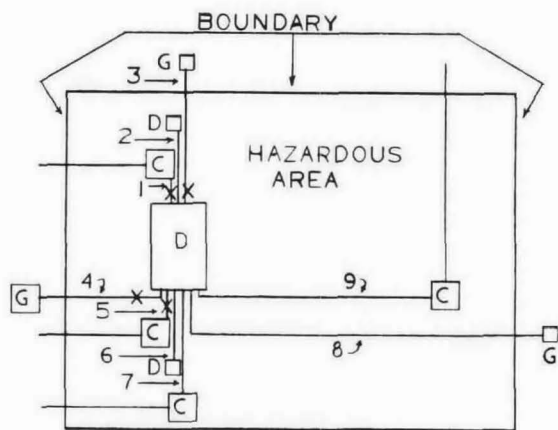


Figure 1. Conduit seals, Class II locations.

Boxes, fittings, and enclosures:

D — Dust-ignitionproof.

C — Close-fitting covers — not dust-ignitionproof.

G — General Use.

Seals required in Conduits 1, 3, 4, 5, 7, 8, and 9 connecting dust-ignitionproof enclosures with non-dust-ignitionproof enclosures.

Conduits 1, 3, 4, and 5 sealed with fitting (x).

Conduit 7 sealed with 5-foot downward vertical distance.

Conduits 8 and 9 sealed with 10-foot horizontal distance.

Conduits 2 and 6 interconnect dust-ignitionproof enclosures and do not require seals.

equipment must prevent or minimize the entrance of dust and prevent the escape of arcs, sparks, or hot particles, regardless of type. But only the dust-ignitionproof type need be so designed that it will operate at safe temperatures in the presence of dust. All types, of course, should be kept reasonably free from accumulations of dust.

Class II Locations — Sealing Requirements

<i>Division 1</i>	<i>Division 2</i>
1. Sealing fitting	Same requirements as for Division 1
2. A 10-foot-minimum horizontal length of conduit	
3. A five-foot minimum vertical length of conduit	

Location of Seals

A seal is required in a Class II location only where a raceway interconnects an enclosure that is required to be of the dust-ignitionproof type with one that is not required to be of this type. This could be a conduit interconnecting a pull box and a junction (splice) box, or a pull box and a switch box. Unlike Class I locations, Class II locations are not required to have seals in con-

duits where they enter or leave the hazardous area unless in doing so it connects an enclosure that is required to be of the dust-ignitionproof type with one that is not.

Explanation of Seals

Unlike seals in Class I locations that may be subjected to explosive pressures, seals in Class II locations are used only to prevent the passage of dust from an enclosure that is not dust-ignitionproof to one that is. This can be effectively accomplished by a sealing fitting in the conduit that is sealed with a suitable compound, which may be pliable material; by a 10-foot horizontal distance in the conduit; or by a five-foot vertical distance in the conduit extending *downward from* the dust-ignitionproof enclosure. If the conduit extends upward from the dust-ignition proof enclosure and does not also include at least a five-foot downward distance or a 10-foot horizontal distance before reaching another type of enclosure, then a sealing fitting must be used.

WALTER R. STONE
Editorial Coordinator
National Electrical Code

Infrared Wildfire Mapping (continued from page 39)

for interpretation, since the amount of infrared energy given off by the land mass and the vegetation varies with their inherent emissivity and the hour of the day (temperature factor). By contrast with the gray shades of topographic features, the fire perimeter and spot fires will show as white, varying in brightness with the intensity of heat. Interpretation corrects inherent distortions in the imagery, so that details of the fire perimeter can be transferred to aerial photographs and maps.

Later sorties provide sequential imagery for plotting changes in the fire perimeter. Comparison with earlier imagery permits calculations of the rate of spread, and thus a basis for calculating control line-manpower requirements.

To date, the infrared unit has mapped over 90 forest fires in the western states, including Alaska. More than

half of the mapping missions were performed in 1967, mostly in Oregon, Washington, Idaho, and Montana. There were several days during the height of the 1967 season when the unit mapped nearly 100,000 acres of wildfire per day. It is conservatively estimated that use of the mapper has reduced suppression costs by more than one million dollars — and saved more than 10 million dollars in resources that did *not* burn.

Besides its function in providing intelligence on wildfires, the infrared mapper can be used in urban-suburban missions, as was demonstrated, with the cooperation of the Los Angeles County Fire Department, in sorties flown during the Watts Riots in 1965, and again in a Civil Defense exercise in 1967. The airborne infrared mapper is a potential source of intelligence to the urban fire service faced with a need to pinpoint fires in riot-torn areas or to map a conflagration resulting from any kind of catastrophe. Δ

Computer Command-Control

How a Computerized Command and Control System was Developed for the Los Angeles City Fire Department

D. J. NIELSEN, *Chief Communications Officer, Los Angeles City Fire Department*

H. G. RYLAND, *ARINC Research Corporation*

IN the course of a year the Los Angeles City Fire Department handles more than 60,000 fire alarms and more than half a million radio messages, together with about the same number of telephone messages. In a large-scale emergency the handling of Fire Department communications and command becomes extremely complex. As this paper will show, the Fire Department is taking advantage of the speed and flexibility of computer processes to establish more effective control over alarms, dispatching, and communications in general.

BACKGROUND

THE present dispatching and alarm system of the Los Angeles City Fire Department (LAFD) was designed in the mid-1920's. Since that time the system has undergone various changes to accommodate the increasing number and complexity of the demands placed upon it. During the past 20 years the City has experienced a population growth of more than 50 per cent, and the alarm rate in the Los Angeles area has quadrupled.

The inadequacies of the present system were manifested during the Bel Air Fire in late 1961, the Watts Riots of 1965, and other disasters of recent years. Efforts to increase system efficiency with existing equipment had long since reached the point of diminishing returns. It became apparent that a new approach was needed in the area of Fire Department command and control. Since the Fire Department does not generally retain system design engineers for development assignments and sufficient funds are not available for that purpose, LAFD Chief Engineer Raymond M. Hill requested the

City to authorize funds for an outside agency to make an in-depth engineering evaluation of the Department's dispatching capabilities and to determine the changes needed in system design, operation, planning, and maintenance.

Seven aerospace system developers studied the problem and expressed interest in conducting an evaluation. In May 1967 the City of Los Angeles, through its Department of Public Utilities and Transportation, entered into contract with ARINC Research Corporation.

OBJECTIVES

THE specific objectives were to design a system having acceptable "reaction time" and sufficient capacity for both current and anticipated demands; to determine the availability of "off-the-shelf" equipment to implement the system; to develop the necessary design specifications for integrating the equipment to constitute a terminal system; and to prepare a technical procurement package sufficient to acquire, install, test, and implement the system.

The present system requires numerous steps to deploy the fire-fighting force — each step manually executed, each consuming precious time, but each vital to the success of a mission. Consequently, the over-all objective was to simplify and automate the predetermined command and control procedures.

Other important objectives were design simplicity, ease of maintenance, reliability, low cost, and flexibility. Fundamentally, the system must respond rapidly and effectively to the demands imposed upon it, and be able

to interface effectively with corresponding systems of adjacent municipalities and other Departments of the City of Los Angeles.

Since it was not financially possible for the City to acquire the entire command and control system at one time, the required and desired functions were to be ranked in priority order, to allow the City to acquire first the most urgently needed functions.

OPERATIONAL REQUIREMENTS OF THE SYSTEM

THE first step in the development of the advanced command and control (C&C) system was to establish the operational requirements of the LAFD, and the corresponding functions to be provided by the C&C system, through analysis of the dispatching and field operations of the LAFD and a survey of several other advanced city fire department dispatch systems, such as that of Phoenix, Arizona.

General and specific system functional requirements were established. The general requirement was that any dispatcher be able to handle incidents of any type or magnitude — from receipt of alarm to final disposition — at any console position, to eliminate the time-consuming movement of personnel inherent in the present dispatch procedures of most fire departments. Each console must have fire alarm box readout; incoming public telephone trunk lines; direct telephone links to other agencies (police, hospitals, public utilities, and other fire departments); communication links to all fire stations; radio links for all fire department frequencies; rapid access to the street index, detailed maps and emergency procedures, the location and status information for all LAFD units, and information concerning incidents being handled at other console positions; and communication links to other console positions (see Figure 1).

The system should be designed to keep track of the status of the various LAFD units. Dispatch personnel should be able to determine rapidly the location and status of all Fire Department companies and chiefs, especially during periods of high activity — which means that the dispatcher must have immediate means of finding the availability and location of each unit and of contacting it. As much as possible, therefore, the system should maintain unit status information without attention from dispatch personnel. Therefore, change in status should be entered into the system automatically or directly by the unit concerned.

Another function of the system should be to identify rapidly the appropriate available assignment for each incident handled by the LAFD. Dispatch personnel should no longer need to identify assignments manually from the street index and running cards and then deter-

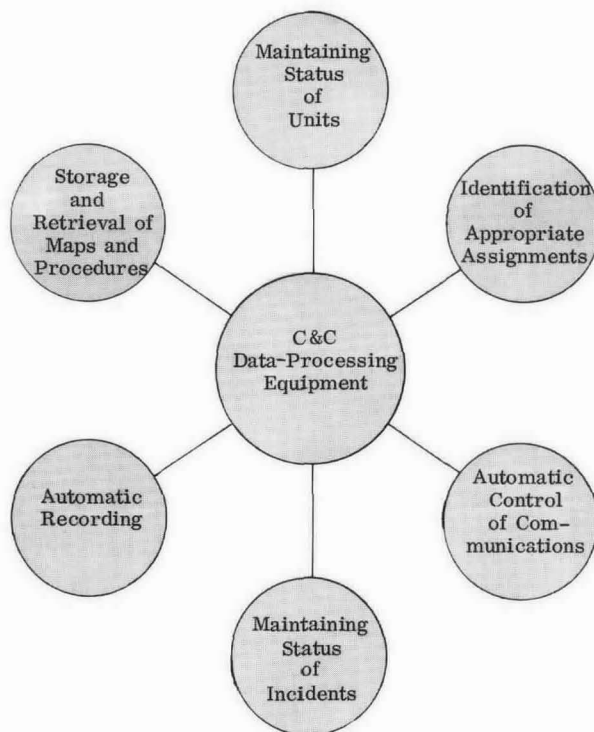


Figure 1. Functional diagram of the LAFD C&C system.

mine the availability of the needed LAFD units. The assignment identified by the system must be appropriate to the type, magnitude, and location of the incident. This function should also identify company move-ups and fill-in units.

The system should automatically establish communication links, including land-line voice, radio voice, and teletype, to dispatch the units.

The C&C system should automatically maintain the status of each active incident and display it to dispatch and command personnel as requested. This information will permit dispatchers to identify multiple calls for one incident and provide command personnel with information concerning the over-all status of the City with respect to LAFD responsibilities.

Many of the dispatching and related activities performed by the C&C system should be automatically recorded, thereby releasing LAFD personnel from having to complete a number of routine forms.

Another requirement of the system is to maintain, identify rapidly, and display, as needed, detailed street maps, utility distribution maps, and emergency procedures. The maps, displayed at the dispatcher consoles, will be extremely valuable in locating incidents not related to intersections or street numbers, and also in directing companies to the scene of an incident.

DESIGN AND OPERATION OF THE LAFD SYSTEM

Six important ground rules were established before the system design effort to ensure that the C&C system would satisfy all the requirements, standards, and applicable regulations:

1. Every system function must have at least one manual backup in case of equipment failure.
2. The major emergency operation of the C&C system must not differ significantly from normal operation, so that operating personnel will not become confused as to operational procedures in a major emergency.
3. The design of the system and of operating procedures must be such that individual equipment malfunctions only gradually reduce operating capability and do not change operating procedures.
4. The system must be operable by present dispatch personnel with a maximum of two weeks' additional training.
5. Present equipment possessed by the City must be used as much as possible where such use is consistent with operational requirements.
6. The system must be designed in terms of "building blocks" that can be obtained and implemented on an incremental basis.

Single-Point Operation

The LAFD Command and Control System will permit any individual dispatcher to receive emergency calls, dispatch appropriate assignments, and handle other command and control functions. Such single-point operation requires that all sources of information and all communication links be instantly available to each dispatcher. The system design for rapid and multiple access is therefore based on the use of a digital computer and other data-processing equipment with associ-

ated input-output consoles. A dispatch console will contain a cathode ray tube (CRT) display, a microfilm display, a color-coded unit status display, an input keyboard, and radio and telephone communications controls (see Figure 2).

Automatic or Semiautomatic Operation

The C&C system can be operated either automatically or semiautomatically, in that the dispatcher will exercise complete control over all functions and be able to alter or even eliminate any action proposed by the system. Instantaneous and comprehensive information and communication links will facilitate positive, rapid dispatch decisions and other appropriate action. Manual backup and checkout capabilities for each system function will ensure that C&C operations will continue in the event of failure of data-processing or other equipment.

Status of Fire Department Units

The unit status function of the C&C system will maintain status and location information for all LAFD companies, chiefs, and other personnel as required. The information will be maintained by the system computer according to the following basic status categories.

In-house and available. The unit is in its normally assigned quarters and can be dispatched over the normal communication channels.

Out-of-house but available by radio. The unit is within its normal response district and is available for assignment, but it must be dispatched by radio.

Assigned to an incident. The unit has responded to a dispatch and is not available for further assignment.

Out of service but available. The unit is temporarily

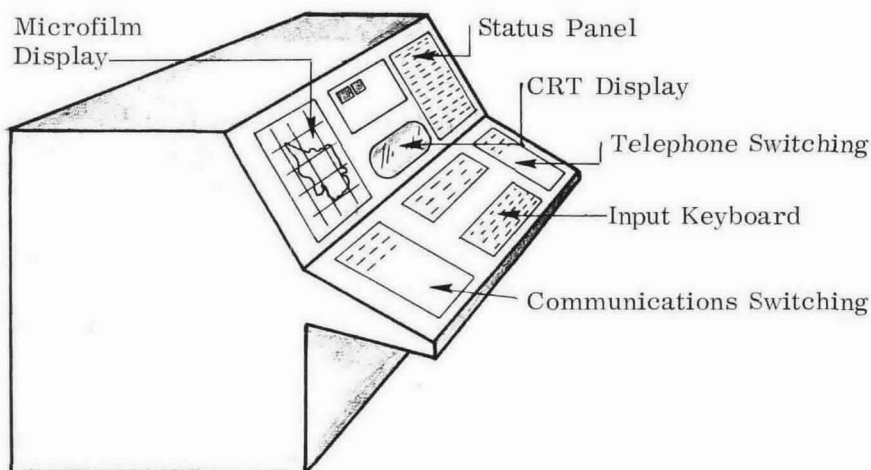


Figure 2. Dispatch console.

engaged in some activity (training, for example), but it could respond in an extreme emergency.

Out of service and not available. The unit is not available for assignment under any circumstances (for example, the equipment is inoperable or the unit is not manned).

Besides the basic status categories, three additional categories were established for units on special assignments:

Moved up: A unit temporarily operating out of another unit's quarters.

Split: A two-piece company temporarily split into two individually manned and responsible units.

Task force: Two or more companies and a battalion chief temporarily assigned to respond as a group.

As much as possible, unit status changes will be automatically entered, with provision for manual entry from each dispatch and an administrative console. This will provide 1) a means to receive status changes verbally, and 2) a backup for the automatic methods. The system computer will receive status information from several different sources, but certain details will be available only from computer memory and will not be shown on every status display, and certain status changes can be made only through the consoles.

Unit status changes will be made by field, dispatch, and other personnel using the following methods and devices.

1. For companies dispatched while in quarters, automatic confirmation that they have responded will be effected by the fire apparatus rolling over a specially armed switch as it leaves the station. The dispatcher will receive an alarm if an assigned unit does not respond within a given interval. This answer-back signal changes the company status from "in-house and available" to "assigned to an incident."

2. Certain status changes that are implicit in the dispatching process will be entered as a by-product of unit assignment- and incident status-monitoring. The computer will automatically change the status of units assigned to an incident or moved up by the system from "in-house and available" or "available by radio" to "assigned to an incident" or "moved up."

3. Status change keyboards, one of which will be located in each fire station, will include switches for unit identification and each of the basic status categories. Thus a unit will be able to identify itself and change its status without action by the dispatcher. Changes in status by units in the field will be reported by radio and entered manually at a console. Nonemergency status changes will use an administrative frequency and C&C console to conserve air time and dispatch capability.

4. A manually operated switch at each console can be used to change the status of each unit within the basic categories. This capability will be used only in event of failure of the other capabilities or if the dispatcher wishes to change an assignment or he receives verbal status information. The manual capability can also be used as an interim operational mode if the automatic mode is not initially installed.

Unit status information will be displayed primarily on the console CRT displays. Status information for the basic categories will be instantaneously and continually displayed on a large status board using color codes.

Additional status information (other than the basic categories) will be maintained for certain categories that will be available only by console CRT display. For example, the status of those units available only by radio will be accompanied by the frequency they are monitoring and the response district in which they are located; for units available by commercial telephone, the phone number will be given. This additional information will be manually entered into the system.

Figure 3, which shows a typical CRT status display, has most of the different status categories that would be included in actual operation. To conserve computer storage, the status displays will use mnemonic codes, which can easily be read after minimum explanation.

Figure 3. Sample CRT display — status of Battalion 16.

```

BC16-AVAIL/RAD F4 B3
E38-AVAIL
T38-AVAIL/RAD F3
E40-IN19 LOC 5271673 RES
T40-TSKF 40 AVAIL Q40
E49-OUT/AVAIL DRTR21 PH 6245211
B1-OUT/NOT
B2-MOV UP B1 AVAIL
B3-SPLT B3-AVAIL B203 - IN19 LOC 5271673 RES
  
```

NOTE

These status codes would be read as follows:

1. Battalion Chief 16 is available by radio on frequency 4 in Boat 3's district
2. Engine 38 is in-house and available
3. Truck 38 is available by radio and is monitoring frequency 3
4. Engine 40 is assigned to incident 19 (a rescue) at map coordinate location 5271673
5. Truck 40 is assigned to Task Force 40 which is in-house and available
6. Engine 49 is out of service but available by landline at Drill Tower 21 - phone 6245211
7. Boat 1 is out of service and not available
8. Boat 2 has moved up to Boat 1's quarters and is available
9. Boat 3 has split into (a) Boat 3, which is available in quarters; and (b) Boat 203, which is assigned to incident 19 (a rescue) at location 5271673 (Boat Company Number 3 would have to consist of two fire boats to be split.)

Dispatching Units

Automatically or on dispatcher demand, the system will identify and display the appropriate assignment for a specific incident, basing the assignment on the type of incident, its severity, and its location. For example, in identifying the appropriate assignment the system will take into account the source of the alarm, such as a call box, or the type of incident, such as a structure fire, a brush fire, an automobile fire, or a heart attack. The dispatcher enters the type of incident into the system through the console keyboard.

When an incident code has been entered into the system, generally through the depressing of a single key, a description of the incident will appear in written-out form on the CRT display (example: Structure Fire - 1), along with the time of alarm, for verification by the dispatcher (see Figure 4). If a particular incident requires special information, such as a phone number, an appropriate reminder will appear on the screen.

Next, the location of the incident will be entered through the console keyboard from any of the following information: exact address; freeway intersection; approximate address; map location code; street intersection; or alarm box identification number (entered automatically).

If the dispatcher does not want to type the address

into the computer, he can request the appropriate street index file from computer memory to appear on his CRT display and then select a location with his movable display pointer (cursor). The assignment will be for that approximate location, with the dispatcher verbally adding more specific dispatch information for the assigned units.

All location information by the dispatcher will be presented on the CRT display for verification. It will not be committed to the computer until the *Enter* key has been pressed.

After the incident type and location have been entered, the computer will verify that the street number and cross street, if provided, are valid and compatible (if the cross street has not been entered, it will be automatically displayed by the computer); verify that the incident is within the LAFD's geographical area of responsibility (if it is not, the responsible fire department is designated); determine if there is another similar incident in the vicinity (to ensure that this is not a multiple call from a reported incident).

Available units (normally in quarters or within a first-in district) will be selected for assignment and displayed on the CRT. If a unit in the standard assignment is not available, the computer will automatically select an alternative fill-in company. Companies operating out of other than their permanent station (move-ups) will be identified by an asterisk on the assignment display (see Figure 4). If with this dispatch move-ups become appropriate, they will also be identified by the computer, as is shown in Figure 4.

In some instances the dispatcher may not want to dispatch the assignment designated by the computer. He will be able to eliminate one unit by depressing its status switch on the console and to substitute another unit by pressing its status switch. Working from dispatcher inputs, the computer will remove and add units for the assignment.

Incident Status

The status of all active incidents will be maintained automatically and displayed either selectively or simultaneously at the consoles on request. The selective information will permit dispatchers to identify immediately multiple calls for a single incident, and the simultaneous display will apprise command personnel of the over-all status of Fire Department emergency activities.

Communication Links

The C&C system will automatically establish communication links to appropriate locations necessary to dispatch specific assignments. The communication links

Figure 4. Sample CRT display - a typical assignment.

```

INC-5                                1745
STRUCTURE FIRE-1
221 S NEWTON ST X MAIN ST
LOC 4681752
ASSIGNMENT-1
E20 E32*T20 BC11(F2)
MOVE-UP
E64 Q32 T39 Q20
  
```

NOTE

This display would be read as follows:

1. This is incident number 5 and it was initiated at 1745 hours.
2. The incident is a first-alarm structure fire.
3. The address of the incident is 221 So. Newton St., and the nearest cross street is Main St.
4. The map coordinate code for this location is 4681752.
5. The appropriate first-alarm assignment is - Engine 20, Engine 32 (the asterisk indicates a move-up company), Truck 20, and Battalion Chief 11 who is available only by radio and is monitoring frequency 2.
6. Move-up units suggested are Engine 64 move to 32's quarters and Truck 39 move to 20's quarters.

will consist of teletype links, which will print out an assignment at all stations and at other selected locations; links necessary to provide an alarm signal at those stations containing units included in the assignment; and audio links, to accomplish voice dispatching over the public address system in those stations containing units included in the assignment or by means of radio calls to assigned units in the field.

When the computer has dispatched the assignment, coded signals will initiate appropriate switching to establish teletype and telephone audio circuits to the fire houses and radio circuits to field units. The assignments will be printed at every fire house; but only those houses that contain assigned units will receive an appropriate alarm signal.

Telephone and radio links can also be established manually from each console position for manual dispatching and other communication requirements.

Automatic Recording

All information relating to incidents handled by the system will be automatically stored during the normal operating process and, except for disposition information such as damage or injuries, will require no attention from C&C personnel. Each storage record will contain a complete history of all the incidents during a shift, including the console positions and the dispatch personnel involved.

Maps and Emergency Procedures

Maps and emergency operating procedures will be photographed on microfilm, to be displayed at any console when they are needed. The primary functions of the console map display will be to provide City and County map sections necessary to identify the location of an incident that has been reported in a general area and to assist field personnel in various ways.

SYSTEM RELIABILITY

BECAUSE a fire department dispatch system must be available for use at all times, the design of the system could not permit random equipment failures to delay the dispatching process.

The first step in the reliability program was to use equipment with a high inherent reliability — for example, integrated circuit computers. Then the major ele-

ments of the system (such as the data-processing equipment) were duplicated to provide active redundancy. Thus, with two computers operating back to back, either computer can assume operation of the system if the other one fails.

Continuous testing, both manual and automatic, also increases system reliability. When not involved in a dispatch the computer will continuously check itself and the other system elements. For example, the computer will supervise the audio and teletype lines to the fire stations; the teletype and other equipment in the stations; and the equipment in the dispatch office.

Finally, there is at least one manual backup for each system function, and most of the functions have more than one backup. The manual backups still satisfy the single-point-operation philosophy, since they will not require dispatch personnel to leave their consoles.

THE MAN AT THE CONSOLE

IN complex systems such as this one, the over-all effectiveness reflects the extent to which the equipment has been designed to accommodate the human operator. The design must take into account all the factors that affect human performance. Throughout the development of this system, such factors as operator/machine interfaces, operator environments, personnel procedures, and fire service traditions were investigated.

Operational procedures present a very important consideration in the human factors. To simplify and facilitate the transition to the new C&C system, the initial operating procedures were made as much like present procedures as possible. The initial operating procedures will be refined and expanded as operators gain experience with the system.

Although this Fire Department C&C system will be more advanced than any existing system, nothing is new or "way out." In fact, identical equipment performing similar functions has been in operation for a number of years. The application of this technology to the fire service is the part of the project that is new.

The success of this project is due largely to coordinated team effort involving the Los Angeles City Fire Department, the Department of Public Utilities and Transportation, and ARINC Research Corporation. Each element of the team provided unique knowledge and experience.

This C&C system is extensive, since it was designed for one of the largest cities in the world, but a similar system with most of the capabilities that have been described could be provided to meet the needs and budgets of fire departments of any size. △

NFPA Staff in the Field



TRAVELS: MAY 1967—FEBRUARY 1968

During the nine-month period May 1, 1967, to February 1, 1968, members of the NFPA Staff traveled more than halfway around the world to spread the message of fire loss prevention and to keep abreast of new developments. The high spots of their travels are summarized below.

The Managerial Staff

- In his capacity as Honorary President of the Conference of Fire Protection Associations, NFPA General Manager Percy Bugbee attended the 1968 Meeting of the Conference in Paris, France, May 23–25. September 6–7 and January 8–10 Mr. Bugbee met in Washington with other members of the special commission that was appointed by the International Association of Fire Fighters to evaluate the no-strike provisions of the IAFF Charter. December 13–14 Mr. Bugbee attended the First Annual Meeting of the Information Council on Fabric Flammability, held in New York, and February 1–2 he attended meetings of the Urban Affairs Committee of the United States Chamber of Commerce in Washington.

- Assistant General Manager Charles Morgan attended a meeting of the Board of Directors of the New England Association of Fire Marshals in Providence, Rhode Island, on May 5 and the Annual Meeting of the Association in Chicopee, Massachusetts, September 22.

Mr. Morgan also serves on the Board of Directors of the American Boat and Yacht Council, and in that capacity he attended four meetings in New York. The Council is an association directed toward the advancement of safety in pleasure boating through development of advisory standards for boat construction and design. Its membership is broadly based, with representation from boat and equipment manufacturers, the boating public, yacht underwriters, and the United States Coast Guard. In February Mr. Morgan completed a three-year term as a Director, during which he served on the Executive Committee for a year and on a special committee appointed to study reorganization of the Council.

On January 15 Mr. Morgan and NFPA Marine Spe-

cialist Kent Savage went to Washington at the request of the United States Navy Department to discuss a possible joint seminar on naval fire protection. That discussion led to the arrangement whereby one entire session of the 1968 NFPA Annual Meeting in Atlanta will be devoted to naval fire problems and related developments.

The Technical Staff

- On June 8, 1967, George H. Tryon, NFPA Director of Technical Services, represented the NFPA at the opening ceremonies of the Factory Mutual Research Center in West Glocester, Rhode Island, largest single facility dedicated solely to fire research.¹

Mr. Tryon, who serves in a personal capacity on the National Academy of Sciences-National Research Council Fire Research Committee, attended two meetings of that Committee, on October 26 in Washington, D.C., and on January 18 at Harvard University. At the October meeting plans were made for a Workshop on Mass Burns, which was held March 13–14 at the National Academy in Washington; preliminary arrangements were made for the Committee to meet with the Metropolitan Committee of the International Association of Fire Chiefs in April; and the Committee received reports from the International Fire Service Administration and the United States Forest Service on various educational programs for the fire service. At the January meeting the Fire Research Committee discussed a draft of a new national fire research program and heard addresses by three leaders in the field of Operations Research — Dr. Martin L. Ernst, of Arthur D. Little Company; Dr. Joseph H. Engel, of the Communications Satellite Corporation; and Harold E. Price, of Serendipity Associates — on the application of OR techniques to fire service problems. The program was arranged by Eric Wolman, Head, Traffic System Analyst Department, of the Bell Telephone Laboratories, in cooperation with the Operations Research Society of America.

¹ See Bruce P. Mattoon, "New Factory Mutual Research Center," *FIRE JOURNAL*, Vol. 61, No. 6 (November 1967), p. 30.

The Fire Research Committee is currently chaired by Dr. Howard W. Emmons, who recently completed his report on a world tour, sponsored by the National Science Foundation, to investigate fire research internationally. Besides his visits to many laboratories in the United States engaged in fire research, Dr. Emmons toured Australia, Canada, Denmark, England, France, Germany, India, Italy, Japan, Spain, Sweden, and Switzerland.

As a member of the Executive Standards Board of the United States of America Standards Institute, Mr. Tryon attended a series of monthly meetings of the Board held at USASI headquarters in New York. The USA Standards Institute acts as the national coordinating institution for voluntary standardization in the United States. Organized in 1918 as the American Engineering Standards Committee, it was expanded ten years later to become the American Standards Association. In August 1966 it was reorganized under its present title. In essence, the USA Standards Institute is a federation of technical, professional, and trade organizations concerned with the development of standards for their many obvious benefits. It also acts as a clearinghouse for contact with the International Standards Organization (ISO). Through the USASI the United States gains representation on ISO projects of considerable interest to American industry.

The Executive Standards Board acts as the Executive Committee of the Member Body Council of the USASI (membership in the Council is open to each Member Body of the Institute.). The Executive Standards Board coordinates the over-all standardization activities of the Institute, acts on requests for new projects, and initiates new projects when they are needed.

On January 10 Mr. Tryon attended the Meeting of the NFPA Ad Hoc Committee on Electrical Equipment Maintenance. The Meeting, authorized by the NFPA Board of Directors, had as its purpose discussion of the possible need for development of a suitable NFPA manual on electrical equipment maintenance. As a result of the Meeting, which was attended by 31 individuals representing the major parties of interest, a motion was adopted to authorize the formation of a Subcommittee to draft a suitable scope statement to deal with the problem, to explore the matter further, and to formulate recommendations for the development of a guide to good practice on electrical equipment maintenance.

• NFPA Technical Secretary Richard E. Stevens attended the Meeting of the Model Codes Standardization Council (formerly the JCBC) May 19-20; par-

ticipated in a Symposium on Air Conditioning in Richmond, Virginia, June 8; and participated in a seminar on safety to life July 26 in Monroe, Louisiana, for building officials and those engaged in the design, construction, and administration of buildings. Mr. Stevens spoke on exits and life safety at a seminar for fire marshals and inspectors in Syracuse, New York, October 26, and at the Building Officials Institute, Champaign, Illinois, January 30. He also addressed architecture students in Boston on January 4 on the design of exits.

• Chief Engineer Horatio Bond attended several New York meetings of the Industrial Management Committee and the meeting of a Subcommittee that has been established to deal with the problem of large-loss potential in industry.

On January 19 Mr. Bond and Carl Peterson of the NFPA Fire Record Department attended a meeting of Post Office officials in New York to discuss the Morgan Postal Annex fire and its lessons (see this issue, page 20).

• Walter R. Stone, Editorial Coordinator of the *National Electrical Code*, attended meetings of Code-Making Panels 1, 4, 5, and 11. Mr. Stone was a member of a Technical Subcommittee appointed by CMP No. 5 to define and clarify various grounding terms. That Subcommittee met for two days. Its recommendations were accepted by CMP No. 5 and by the Correlating Committee.

Mr. Stone also met with Richard Lloyd, Vice-Chairman of the National Electrical Code Committee, to discuss features of planned editorial revisions of the *NEC*. Later he met with the Editorial Subcommittee of the Correlating Committee to discuss the first draft of the Style Manual, which he had prepared for review and comments.

Mr. Stone attended the meeting of the Correlating Committee in its review of the 17 Code-Making Panel reports.

• On June 8 Charles A. Tuck represented NFPA *Fire Technology* and the SFPE at a New York City Meeting of the Committee of Engineering Society Editors. That Committee of the Engineers Joint Council is keenly aware of the problems of the author, of the editor, and, more recently, of the reader in keeping up with the technical literature. Thus far, the Committee has made two significant contributions to the technical literature. First, it acted as a review board for a "Guide for

Source Indexing and Abstracting," containing techniques to help the reader to determine articles that will be of interest to him without reading an entire text. Second, the Committee prepared a *Recommended Practice for Style of References in Engineering Publications*, which was published by the Engineers Joint Council early in 1967.

- As a member of the Executive Committee of the Information Council on Fabric Flammability and as Chairman of its Committee on Education and Legislation, the writer attended six meetings in New York. The Council has as its purpose "the reduction of morbidity and mortality from burns caused by flammable fabrics and related materials by encouraging the exchange and dissemination of information concerning injury statistics, research findings, testing methods, and public information programs, to and from the varied disciplines desiring to participate; and to encourage experts in these various areas to participate in the Council's activities and meetings, and to appraise the developments in their fields."

As NFPA Technical Secretary, the writer represented the NFPA at a meeting in Washington of the Standing Committee of the United States Department of Commerce on CS191-53, *Flammability of Clothing and Textiles*.

The Field Service Specialists

- Fire Extinguishing Systems Specialist Charles W. Bahme spoke on automatic and portable fire equipment at 13 meetings during the nine-month period covered in this report — addressing across the country groups ranging from fire chiefs to students at a private school for girls. In addition to the above-mentioned speaking engagements, Mr. Bahme participated in three fire schools, witnessed two series of fire tests at Underwriters' Laboratories, Inc., and visited the factories of seven manufacturers of fire protection equipment.

- Gabriel O. Bedard, NFPA Fire Communications Specialist, visited 10 municipal communications centers and met with several officials on municipal communications problems, including consultation with officials on a new communications center now under construction in Fairfax County, Maryland. Mr. Bedard participated in a week-long fire alarm school held in Fresno, California, under the sponsorship of the Far Western Section, International Municipal Signal Association, and the State Board of Education. He also addressed the National Conference of the IMSA in Baltimore on

NFPA No. 73, *Standard for the Installation, Maintenance and Use of Municipal Fire Alarm Systems*.

- Kent Savage, Marine Specialist, attended meetings in Cincinnati, Ohio, Portsmouth, Ohio, Honolulu, Hawaii, and Port Arthur, Texas, that had been called by the United States Department of Labor to obtain closer orientation of marine gas hazards control activities as they are conducted by industry and government regulatory groups. During the summer and fall of 1967 Mr. Savage attended several meetings of the Shipbuilders Council Safety Committee and numerous meetings of Government agencies. The meetings of Government agencies were aimed at finding a method of legally transferring title to scrap vessels so that the vessels could be used for fire tests at the Marine Environmental Fire Testing Facility. Mr. Savage participated in two marine fire protection seminars, sponsored jointly by government and industry, held in New Orleans.

- The filming and editing of *Handling LP-Gas Emergencies* took Gases Field Service Engineer Wilbur L. Walls to Tulsa, Oklahoma, June 5-16, to Kansas City, Missouri, July 27, and to Topeka, Kansas, August 14-18. Mr. Walls attended the Annual Meeting of the National LP-Gas Association in Chicago on May 1 and, as NFPA Representative on USA Standards Committee Z21, meetings in Cleveland, Ohio, on May 24-26 and December 12-14. He participated in a seminar on liquefied natural gas in Palo Alto, California, August 22, and lectured on LP-Gas at the Maine Fire School on September 28. Mr. Walls attended a meeting of the National Fuel Gas Code Task Force in New York on January 10.

- Flammable Liquids Specialist Miles E. Woodworth was in Tulsa, Oklahoma, June 5-16 assisting in the filming of the new NFPA film *Handling LP-Gas Emergencies* and spent August 14-18 in Topeka, Kansas, editing the film. Mr. Woodworth conducted a course on flammable liquids fires at the New Mexico Firemen's Training School, instructed at an oil fire control school in Champaign, Illinois, and gave eight lectures at the North Carolina Fire Inspectors School. At the request of the State Fire Marshal, Mr. Woodworth inspected a service station in Newton, Kansas, January 29-30.

- His skill with a camera took Fire Service Specialist Robert W. Grant to Tulsa, Oklahoma, to take still pictures (from which a slide presentation for class instruction is being prepared) during the filming of *Handling LP-Gas Emergencies*. Mr. Grant also took his camera

to New Haven, Connecticut, Washington, D.C., Fort Worth, Texas, Miami, Florida, College Park, Maryland, and St. John, New Brunswick, to obtain photos of hose and ladder evolutions for a manual now in preparation by the NFPA Fire Service Training Committee. Mr. Grant visited the Ontario Fire Marshal's Office to obtain the information for the report on that Office published in the September 1967 *FIRE JOURNAL*. Mr. Grant's speaking engagements included the Western New York Firemen's Meeting, at Tonawanda, July 25; the Annual Meeting of the New England Fire Marshals Association, Chicopee, Massachusetts, September 22; the State-wide Fire Prevention Kickoff Luncheon, St. Paul, Minnesota, September 24; and the Kansas Fire School, Topeka, Kansas, October 16. In January he made field trips to North Carolina and Virginia to assist local officials in fire apparatus recommendations and organizational improvements.

The Fire Record Department

Speaking engagements and fire investigations accounted for several trips by members of the NFPA Fire Record Department.

- Ernest E. Juillerat, Manager of the Department, addressed the Southeastern Chapter, American Institute of Planners, in Greensboro, North Carolina, on mobile home fires; addressed the participants at the University of Maryland Industrial Short Course at College Park, Maryland, on industrial fires; and addressed the Massachusetts Safety Council in Boston, Massachusetts, on the Cornell Dormitory Fire.¹ At the request of the New Mexico State Fire Marshal, Mr. Juillerat went to Santa Fe to investigate the New Mexico State Hospital Fire.² Mr. Juillerat also represented the NFPA in successful efforts to prevent passage of a bill that would have permitted the sale of sparklers in Massachusetts.

- Carl E. Peterson and Albert Sears, Jr., did on-the-spot investigation of the Springfield, Vermont, High School Fire³ and the Amesbury, Massachusetts, Middle

School Fire,⁴ and Mr. Peterson investigated the December fire at the Morgan Postal Annex, New York City,⁵ and a tenement-house fire in Brooklyn in which 13 perished.

The Fire Service Department

- Warren Y. Kimball, Manager of the Fire Service Department, made numerous trips to attend meetings of fire officers and to consult with fire officials who had requested his advice on fire department problems. The meetings at which Mr. Kimball was a featured speaker were the Wisconsin Aerial Ladder Short Course (June 29–30, West Allis), the Convention of the Firemen's Association, State of New York (August 20, Albany), and the New York State Officers' Institute (October 14, Hinsdale). In May Mr. Kimball met with a special commission of the International Association of Fire Fighters to consider the no-strike policy of the IAFF Charter; in September he conferred with officials of Las Vegas, Nevada, on fire fighters' working conditions; in October, at the request of the Chief, he inspected the Newton, Massachusetts, Fire Department; and in January he conferred with a Town Committee studying the Walpole, Massachusetts, Fire Department.

- The Assistant Manager of the Fire Service Department, Paul R. Lyons, filled speaking engagements at meetings of the New York Fire Chiefs Association (June 11–14, Kiamesha Lake, New York), the Pennsylvania State Fire School (August 2–3, Lewiston, Pennsylvania), the Plymouth County Association of Fire Chiefs (October 23, Plymouth, Massachusetts), the Halifax Fire Department (October 30, Halifax, Massachusetts), and the AEC Contractors (January 29, Boston, Massachusetts). He also served on the Planning Committee of the Massachusetts Community College to establish degree courses for fire service personnel and in planning sessions for the annual Fire Department Instructors Conference in Memphis, Tennessee.

CHESTER I. BABCOCK

NFPA Technical Secretary

¹ Robert E. Gaudet, "Dormitory Fire Kills Nine," *FIRE JOURNAL*, Vol. 61, No. 4, (July 1967), p. 5.

² Ernest E. Juillerat, "New Mexico State Hospital Fire," *FIRE JOURNAL*, Vol. 62, No. 1 (January 1968), p. 5.

³ Carl E. Peterson, "Fire Delays the Opening of Two New Schools," *FIRE JOURNAL*, Vol. 62, No. 2 (March 1968), p. 19.

⁴ *Ibid.*

⁵ See this issue, page 20.

Editorial (continued from page 3)

ment of the efficiency, operation, or organization of the fire services;

7) Support by contracts and grants of the development, for use by educational and other nonprofit institutions, of fire safety and fire protection engineering or science curriculums and fire safety courses, seminars, or other instructional materials and aids for appropriate curriculums or courses of instruction.

The National Commission to be appointed under the Act is to be composed of 20 members, including the Secretary of Commerce and the Secretary of Housing and Urban Development. The other 18 members are to be appointed by the President. Not more than six members of the Commission are to be from the Federal Government. The Commission will also have four advisory members, two from the House of Representatives and two from the Senate. Obviously, the Commission can

FEDERAL ACTION ON OTHER FIRE SAFETY MATTERS

Besides the *Fire Research and Safety Act* discussed in the preceding Editorial and the amendments to the *Federal Flammable Fabrics Act* discussed in the January 1968 FIRE JOURNAL Editorial, several other recent Federal Acts, bills, and administrative decisions have a bearing on fire protection. A few of them are summarized below.

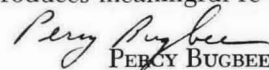
Federal Building Code Proposed. Title 8 of the proposed Low- and Moderate-Income Housing Act of 1968 (H.R. 12142; S. 3029) directs the Secretary of Housing and Urban Development, within one year of the date of enactment of the Act, to "develop and publish in the Federal Register a model building code which will permit the use of modern architectural and engineering techniques and practices to facilitate the construction of housing of reasonable costs. . . . No program of subsidy, aid, or assistance by any agency of the Department of Housing and Urban Development . . . may be carried on within any jurisdiction within which the model building code . . . is not in effect within three years after its publication."

Federal Standards on Safe Working Conditions. The proposed Occupational Safety and Health Act of 1968 (H.R. 14816; S. 2864) authorizes the Secretary of Labor to establish occupational safety and health standards that would be mandatory for all businesses engaged in interstate or foreign commerce. Violators may be fined or imprisoned or both. The Act also provides for training programs for personnel in the field of occupational safety and health; research; grants to states; and accident- and health-reporting procedures.

Fires in Rural Areas. Two identical bills (H.R. 13209 and S. 2263) would provide funds ranging from \$3,500,000 in fiscal 1968 to \$6,000,000 in 1970 "and thereafter such amounts as may be necessary" to "facilitate the establishment of adequate systems for the protection, control, and suppression of fires of woodlands, . . . crops, farmsteads, and other structures in rural areas." The bills would authorize the Secretary of Agriculture to defray up to 75 per cent of the expenditures for fire protection in rural areas, including those of a population of 5,500 or less not included in a metropolitan area.

make a significant contribution if it studies in depth the basic problem areas and pinpoints research needs.

If we assume that the dollars will actually be made available as authorized, it is clear that the passage of this broadly structured Act presents many opportunities in areas commanding the interest of readers of this publication. As the NFPA sees it, this Federal program should be directed to complement, as appropriate, and to supplement existing programs in the most effective manner. In our view, members of the NFPA in the United States and members of NFPA-affiliated Sections, such as the Fire Marshals Association of North America and the Society of Fire Protection Engineers, should do whatever they can to see that passage of the *Fire Research and Safety Act of 1968* produces meaningful results.


PERCY BUGBEE

Fireworks, Toys, Other Dangerous Articles. The *Child Protection Act of 1966* amended the *Hazardous Substances Labeling Act of 1960*. Among its provisions, the 1966 Act authorizes the Secretary of Health, Education and Welfare to ban from interstate commerce household substances so hazardous that warning labels are not adequate safeguards. It also bans toys and other children's articles containing hazardous substances, regardless of packaging. The Secretary has banned Class B fireworks but has exempted most Class C fireworks, including fountains, sparklers, torches, some skyrockets, and small firecrackers—all prohibited in the NFPA *Model Fireworks Law*, which has been adopted in many states.

Gas Pipelines. The Natural Gas Pipeline Safety Act of 1967 calls for establishment of minimum Federal safety standards for the transportation of natural gas, flammable gas, or nonflammable hazardous gas and for pipeline facilities within two years of its enactment. The Senate version, S. 1166, passed on November 9, 1967, would authorize the Secretary of Transportation to prescribe safety standards applying to the design, installation, inspection, testing, construction, extension, operation, replacement, and maintenance of pipeline facilities. Hearings on the House version, H.R. 14208, are currently in progress.

Product Safety. Last fall Congress authorized the President to appoint a National Commission on Product Safety to investigate the adequacy of existing measures to protect consumers against unusual risk of injury that may be caused by hazardous household products. The final report of the seven-man Commission, which is to be submitted to the President and to the Congress not later than January 1, 1969, is to contain a detailed statement of the findings and conclusions of the Commission, together with its recommendations for such legislation as it deems appropriate.

Recreational Boating Safety. The Recreational Boat Safety Act of 1968, now under consideration by the Congress (H.R. 15223; S. 3015), has as its purpose the reduction of boating accidents and boating accident-caused deaths and injuries. The Coast Guard is authorized to "issue regulations establishing safety standards for the design, construction, materials, and performance of boats and associated equipment . . ." Any state safety standard applicable to the same aspect of performance of the boat must be identical to the Federal standard (under exceptional circumstances, a higher state safety standard may be permitted).



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BIMONTHLY FIRE RECORD

These are a selected group of typical important fires reported to the NFPA. In some instances the accounts are based on preliminary reports, which are subject to verification. Please send any additional information to the NFPA Fire Record Department.

Reprints of the Bimonthly Fire Record can be obtained for 50 cents for single copies or \$15.00 per 100 copies. Orders should be filed in advance to assure delivery.

MISCELLANEOUS

VACANT BUILDING

Vulnerable Property Dec. 24, 1967, Monterey, Calif.

A person or persons unknown had burned two canneries and attempted to burn a third in the area. The fourth target was a windowless 300-foot-by-175-foot two-story wooden cannery that had been idle for some time. Because of the windowless walls, the fire was well advanced before discovery by a passer-by, who pulled a street fire alarm box at 2:16 pm. Nine fire companies confined the blaze to the building of origin, except for minor damage to an adjacent cannery and a warehouse across the street (see Photo 1).

The former cannery, whose timbers were laden with fish meal dust and impregnated with fish oil, lacked watchman service or any automatic protection to warn against fire or intruders. Like other unprotected vacant buildings, it posed a threat to the neighborhood and to the lives of firemen.¹

TRANSPORTATION

AIRCRAFT

Engine Malfunction Nov. 21, 1967, Honolulu, Hawaii.

A commercial four-engine jet aircraft was making its run for take-off when the No. 4 engine malfunctioned and disintegrated at about the 3,000-foot marker on the runway. Flying turbine components pierced the No. 3 engine, the fuselage, and the right

¹ See Ernest E. Juillerat, "The Menace of Abandoned Buildings," FIRE JOURNAL, Vol. 59, No. 1 (January 1965), p. 5.

wing tank, causing jet fuel to escape and ignite around the No. 4 engine and on the runway. The pilot was able to abort the take-off successfully, blowing three tires by the necessarily excessive braking. The 52 people aboard escaped unaided — most of them by means of a chute from the left rear doorway, a few through an escape hatch over the left wing.

The lookout at each of the two fire stations (about a mile apart) at the airport saw the fire immediately and sounded the alarm. The aircraft had come to a stop about 3,000 feet from each of the stations. Thirty-three men responded, with 12 pieces of apparatus; they arrived at the fire within one minute. A 4,000-pound-capacity carbon dioxide crash truck arrived first and began to discharge carbon dioxide from both the boom and ground sweep nozzles. Within a second or two, two foam trucks were applying foam over the fuel spill and the fuselage. The fire had been contained within 30 seconds after the arrival of the crash crews. Another truck extinguished the fire on the runway and in the grass beside the runway. The damage to the \$7,000,000 aircraft amounted to \$500,000. Officials believe that the aircraft was only a few seconds from total loss by fire, and that the prompt and skillful action of the crash crews limited the damage.

TRUCK AND CAMPER

Exhausted Driver

Oct. 25, 1967, Tower City, N.D.

The accident occurred at 3:00 pm on a four-lane divided highway. The road surface was straight, level, dry, and in good repair. The speed limit was 60 mph.

Three couples were riding in a 1944 school bus that had been converted into a camper. The camper was traveling between 30 and 40 mph in the right-hand, east-bound lane. A new truck

Photo 1, Monterey, Calif., Fire Dept.



Photo 2, Wade Hampton F.D., Taylors, S.C.



Photo 3, Broadview, Ill., F.D.



Photo 4, Wide World



tractor towing two new truck tractors in a double saddlemount arrangement was overtaking the camper from the rear at 50 to 60 mph. As he approached the camper, the truck driver apparently made no effort to pass or to apply the brakes.

The truck crashed into the rear of the camper with severe impact, swerved into the median strip, and rolled over. The camper continued about 1,500 feet down the road before coming to a stop. The impact ruptured a 55-gallon drum containing spare gasoline inside the camper and also broke the service line to an LP-Gas cylinder. Fire immediately engulfed the interior of the camper. The driver and one other occupant were fatally burned. The other four occupants received severe burns and impact injuries. The truck driver received impact injuries.

Investigation by the Bureau of Motor Carrier Safety of the U.S. Department of Transportation revealed that the truck driver had driven 1,085 miles over a period of 31½ hours, having made 11 stops of short duration. The total actual driving time during that period was 21 hours, during which time the truck averaged 51½ mph. The driver had been taking dexamy, which had been prescribed by a physician because of the driver's difficulty in staying awake. The driver had taken the medicine three times a day for several months. The official report concluded that the driver was fatigued from a long tour of duty and high-speed driving without proper rest and had exceeded all reasonable standards of endurance. He had also grossly exceeded the hours of service limitations in the Motor Carrier Safety Regulations of the Federal Highway Administration.

RESIDENTIAL

APARTMENTS

Water Heaters on Wooden Floor Dec. 3, 1967, Greenville, S.C.

Three gas-fired water heaters were installed on the wooden floor in a second-story storage room of the two-story brick, wood-joisted apartment building. The apartment units, which were stepped up a sloping plot (see Photo 2), were separated by gypsumboard-on-wood-stud partitions. The gas burners, which were about four inches above the floor, had no insulation from the floor other than a sheet metal plate covering part of the bottom of the burner chambers. One burner that had been giving trouble had been repaired a few days before the fire. At the time, the plumber had noticed heavy deposits of soot on the inside of the burner housing and some blackening of the gypsumboard partition beside the heater.

Apparently the heater malfunctioned and overheated at about 6:00 pm and ignited the floor beneath the burner. The fire soon spread to nearby cardboard boxes and magazines in the storage room, penetrated to gypsumboard partition, traveled upward between the wooden studs to the attic, and then spread by way of partitions and attics to two apartment units.

DWELLING

Clogged Furnace Filter Dec. 30, 1967, Lansing, Mich.

The glass fiber air filter in the gas-fired forced-air basement furnace was enclosed in a cardboard casing with brass reinforcing strips. The filter had become so clogged with lint and dirt that the fan created a partial vacuum and pulled the filter inward against the motor and fan wheels and pulley. The brass reinforcing strips were entangled in the wheels and pulley, causing heat of friction to ignite the cardboard filter casing and the fan belt. When the fan belt burned in two, the fan stopped, enabling the fire to spread over heavy accumulations of lint from the return air plenum to the return air duct directly above the furnace.

The return air duct had been formed by using the space between two floor joists enclosed at the bottom by sheet metal.

The sheet metal apparently had been cut slightly narrow, and ¾-inch stock was used inside the joists for nailers. The heavy concentrations of lint and dirt and the nailers inside the duct aided the spread of the fire and the ignition of the joists. The fire spread all the way along the 12-foot-long return air duct to the old wooden return air grill in the floor above. A tinder-dry Christmas tree was standing beside the grill, its lower branches extending over the grill. Flames ignited the tree and then spread throughout the living room. Meanwhile, heat and toxic fire gases were spreading throughout the two-story house.

Two children died of carbon monoxide poisoning in their upstairs bedroom. A third child was hospitalized for smoke inhalation; the father received minor burns. The mother had left the house about an hour before the fire was discovered at 7:57 am.

HOTEL

Partially Sprinklered Dec. 13, 1967, San Francisco, Calif.

The 55-room five-story-and-basement hotel was occupied mostly by elderly people as permanent residents. The basement and the corridors of the first story were sprinklered. There was also a single sprinkler just inside each bedroom doorway in the first story. No sprinklers were installed above the first story. The fire started in a bedroom in the second story when the occupant fell asleep while smoking in bed. She died in the fire. The fire extended from the room of origin to the room above by way of outside windows.

The fire was discovered by the hotel manager when she saw a glow in the light well. She and two policemen passing by who also saw the fire ran through the building alerting the occupants. The two stairways were open from the basement to the top story, and many guests had to be rescued over fire department ladders. Some reached safety by means of an outside fire escape. A few managed to get down one of the stairways.

DORMITORY

Wires, Holes, Stones Nov. 25, 1967, Niagara Falls, Ont.

Apparently an overloaded electrical circuit overheated and ignited the paper covering on insulation batts in the attic of the four-story masonry, wood-joisted dormitory. Inspection of the dormitory after the fire revealed general misuse of electricity. The fire spread throughout the undivided attic in one wing of the dormitory and through holes in an unparapeted masonry wall to the attic of an adjoining chapel.

Firemen could not reach the fire, which was concealed between the fourth-story ceiling and the tile roof of the dormitory and between the steeply pitched ceiling and the tile roof of the chapel. They were further hampered by stones in a new water main. The stones clogged hose nozzles and impaired pump operation. The eye of one pump was reported entirely filled with stones. The blaze eventually broke through and destroyed the roof, severely damaged the fourth story of the dormitory, and destroyed about half of the chapel roof. The damage to the \$2,500,000 building was estimated at \$600,000.

SORORITY HOUSE

Wire to Portable Heater Nov. 10, 1967, Corvallis, Oreg.

The fire started in the corner of a basement room occupied by three girls. On the morning of the fire the last girl in the room left at about 8:35 am. The fire was discovered shortly before 9:00 am by a girl in a nearby room who first noticed a light haze near the ceiling. She went to the room in which the fire was burning, opened the door, and saw the fire still confined to furnishings in one corner of the room. Leaving the door to the room open, she started down the corridor calling out to the other girls in the basement rooms. They all went to the first story of the two-story building, passing a local alarm pull station in the stair-

way and going to the opposite end of the building to operate the alarm. They attempted to call the fire department, but all the telephone lines from the building were in use, thus delaying the alarm to the fire department for several minutes.

Many of the girls did not respond to the alarm in the building, and a call was made over the building's public address system urging them to leave. Some girls still did not heed the warning and stayed in their rooms until others made a room-to-room inspection and ordered them out. At about that time, someone thought of using a portable extinguisher and got one from the second story. By that time, the stairway was too full of smoke for anyone to reach the basement. The stair doors, which did not have self-closing devices, were left open as the girls left the building. No one had thought to use the portable extinguisher near the room of fire origin when the fire was first discovered. In view of the apparent lack of concern and the resulting delay in evacuating the building, it is fortunate that the fire did not occur during the night, while the occupants were asleep. No one was injured.

Investigation revealed that the fire started when the wires to a 110-volt, 1,320-watt portable electric heater became overheated, melting the molded plastic plug in the outlet and igniting a blanket draped from a bed that was in contact with the plug and wire. A local appliance repairman verified that the wires to the heater were of insufficient capacity, and that other heaters of the same make and model had come to his attention because of melted plugs and short-circuited wires. The heaters were not thermostatically controlled. The heater causing the fire had been turned on at about 7:30 am. At about the time the fire started, a girl in an adjoining room had been using a hair dryer plugged into an outlet that was supplied by the same circuit as the heater. She said that for about five minutes before discovery of the fire, the dryer kept going on and off for no apparent reason.

Quick action by the fire department confined the fire to the room of origin, but there was heavy smoke damage throughout the sorority house because of the many doors left open when the girls left the building.

MOBILE HOMES

No Subdivision of Complex Nov. 7, 1967, Rainbow Lake, Alta.

A large portion of a "company town" on the site of a newly discovered oil field in a remote wooded area about 400 miles northwest of Edmonton consisted of about 45 mobile homes set close together and interconnected by enclosed corridors and walkways. The complex included bunking facilities, a laundry, washrooms, a commissary, a post office, a bank, and a pool room.

The fire of undetermined cause started in one of the bunking trailers at about 1:45 pm. Since there was no separation of the units and no fire-fighting apparatus, the fire swept through the complex. One hundred homeless employees were airlifted from the site. The loss was estimated at \$386,000.

RESIDENTIAL AND MERCANTILE

DWELLING, DEPARTMENT STORE

Combination of Events Dec. 20, 1967, Longview, Washington

A 62-year-old man died of smoke inhalation when a wood-burning stove in his home overheated, igniting combustible fiberboard wall paneling near the stovepipe. The man had been employed as custodian at a local department store, and one of his duties was to tend the store's heating plant. When the victim did not show up for work, other custodial employees were uncertain how to maintain proper operation of the boiler in the three-story brick, wood-joisted department store. As a result, they inadvertently let the boiler go dry, and the steam pipes overheated and ignited the wooden flooring through which they passed. Two sprinklers opened and transmitted an alarm to the fire depart-

ment. Firemen had to open the roof and walls to reach the concealed fire to complete extinguishment. The damage amounted to about \$9,000.

STORAGE

DRUG STORAGE

Improper Storage

Nov. 25, 1967, Kingston, N.C.

A passing policeman discovered fire in the second story of a two-story brick, wood-joisted commercial building and telephoned the alarm at 1:33 am. The fire, of undetermined cause, had started in one corner of the second story, which was used for storage of merchandise for a local chain of drugstores. Firemen forced open the door to the stairway that led from the sidewalk to the second story and advanced a hose line to the top of the stairway, where smoke and heat stopped them. High-piled stock and partitions enclosing several small rooms, which were full of stock, prevented effective use of the hose stream. Meanwhile, other firemen laddered the building and attempted to gain access by means of windows. They found all six windows in the second story completely blocked with high-piled stock. The delays in reaching the seat of the fire resulted in almost total burnout of the second story.

BUILDING SUPPLY WAREHOUSE

Wood in Sprinklers

Nov. 11, 1967, Broadview, Ill.

Using gasoline as an accelerant, an intruder started a fire in a sprinklered noncombustible warehouse containing aluminum siding. Ten sprinklers opened and transmitted a waterflow alarm to the fire department. The sprinklers controlled the fire until it was extinguished by fire department hose streams.

Inspection after the fire revealed that pieces of charred wood were lodged in the openings of three sprinklers directly above the area of fire origin (see Photo 3). The fire chief ordered the system flushed, and a considerable amount of foreign matter was found, mostly pieces of charred wood. Shortly after the owners had moved into the building, they had found it necessary to remove and clean all the toilets, valves, and other plumbing fixtures because of their being plugged with pieces of charred wood. Investigators theorize that during construction a fire was built in or near the open end of an eight-inch water main, and the ashes and pieces of charred wood got into the main. The problem did not show up when the sprinkler system received its original standard pressure test.

GRAIN ELEVATOR

Overloaded Bins

Aug. 14, 1967, Ortonville, Minn.

Overloading of bins caused the old, all-wooden grain elevator to collapse. When the building collapsed, it broke overhead power lines, causing sparks that in turn ignited grain dust explosively. The ensuing fire spread to an adjoining new elevator and caused serious damage to that structure. The fire also burned through another overhead electric wire, causing failure of the town water pump. The loss of power to the pump resulted in inadequate water for fire-fighting. The loss was estimated at \$450,000.

WHARF

Cutting Torch, Chain Saw Dec. 28, 1967, San Pedro, Calif.

Workmen were using a gasoline-powered chain saw and a cutting torch to repair pilings on a 3,700-foot-long wharf. The creosoted pilings along the wharf were also covered with oil, which had risen to the surface of the water from several leaks that had occurred over the years in pipelines running beneath the water. Some of the workmen were refueling the chain saw from a two-

gallon gasoline can while another man was using a cutting torch near by. The flame from the torch ignited gasoline vapors, causing a flashback to the chain saw. A workman tried to snuff out the fire on the saw by throwing a coat over it, but the can was ablaze at the spout. He kicked the can into the water, and burning gasoline floating on the water ignited the pilings. Flames spread 370 feet along the underside of the wharf before firemen could control the fire. Although the wharf had otherwise been well maintained, the fire stops beneath the creosoted timber deck had not been kept in repair. Two ships at the wharf and a gantry crane had to be moved to safety as 45 fire companies fought the fire.

EDUCATION

HIGH SCHOOL

Mixing Explosives Dec. 1, 1967, Miami, Fla.

A chemistry teacher was making an obviously hazardous mixture of red phosphorus, potassium nitrate, and thermite in a glass vial. The mixture exploded, severely injuring the teacher's hand and inflicting minor injuries to another teacher and two students in the classroom. About 20 students were in the classroom at the time of the incident.

PUBLIC ASSEMBLY

THEATER

Extension Cord Oct. 31, 1967, Kansas City, Mo.

An electrical extension cord was strung through a doorway into a temporary dressing room beneath the stage. From the top of the doorway, the extension cord was draped over a toggle bolt; then it ran down the wall for about 18 inches and was looped around an uninsulated clothesline wire that ran across the dressing room and through a hole in the combustible fiberboard-on-wood-stud partition.

Sometime around midnight, after the theater had closed, short circuits occurred at the toggle bolt and at the loop around the clothesline wire, melting the insulation on the extension cord and igniting the wallboard. A passer-by discovered the fire and telephoned the fire department at 12:42 am. By that time the fire had spread upward, igniting the wooden floor above the dressing room, and into a wood-enclosed ventilation shaft, by which the fire spread to the roof and to the attic above the auditorium.

MERCANTILE

DRUGSTORE

Electrical Outlet in Floor Oct. 22, 1967, Las Cruces, N. Mex.

Water on the floor leaked into an electrical outlet that had been installed flush with the floor beneath the counter of the soda fountain. The water accumulated in the junction box, causing a short circuit that overheated the outlet and the wires of a fan plugged into the outlet and ignited adjacent stocks of paper cups and other fountain supplies. The fountain area of the store received severe fire damage; the remainder of the store, heavy smoke, heat, and water damage. Water in the same outlet had caused a short circuit before, but apparently nothing had been done to correct the hazard.

INDUSTRIAL

OIL WELL

Drilling into Mine Dec. 28, 1967, Beckemeyer, Ill.

When the bit of a drilling rig reached a long-abandoned coal mine 300 to 400 feet beneath the surface, methane gas that had

accumulated in the mine escaped up the well hole and burst into flame, slightly injuring two workmen. Firemen called to the scene played water on a tank containing 1,800 gallons of diesel fuel alongside the rig until a bulldozer salvaged a large pump by pulling it away from the rig. The 80-foot-high steel derrick collapsed from the effects of the intense heat.

All extinguishing efforts failed, and the firemen withdrew to let the fire burn itself out. It was still burning 10 days later as the drillers waited to resume drilling for oil.

REFINERY

Lightning Dec. 19, 1967, El Segundo, Calif.

The 1,000,000-barrel oval-shaped reservoir was 464 feet wide, 782 feet long, and 19 to 22 feet deep, with the rim slightly above ground level. A roof of built-up covering on wood plank-ing on 2-inch-by-8-inch rafters covered the reservoir, which contained 846,000 barrels of residual fuel oil.

Although the roof was said to be rodged, lightning apparently struck an exposed valve on the roof near one end of the reservoir, tearing a hole in the roof and igniting the roof and the oil. The plant fire brigade attacked the roof fire with a 1½-inch hose stream, and they seemed to be gaining control of the fire when their supervisor called them away, fearing that the roof might collapse and drop the men into the reservoir. The fire then gained headway and could not be controlled (see Photo 4). The wooden roof was consumed within an hour.

At one point the firemen tried to smother the fire with high-expansion foam, but they could propel the foam only far enough to cover about half of the 7.25 acres of blazing oil. The plant workmen were able to pump about 15 per cent of the oil out of the reservoir, but the remainder burned for 13 days, after which the glowing residues were covered over with earth. The fire caused widespread fallout of heavy soot and residues. The loss was estimated at \$2,300,000.

LUMBER MILL

Cutting Torch, Sprinklers Off Dec. 7, 1967, Portland, Oreg.

Workmen had shut down one of several sprinkler systems in the plant to remove branch lines to facilitate removal of a conveyer. Instead of plugging the fittings where the lines had been removed, they left the system shut off. The workmen were cutting bolts from the conveyer with an acetylene cutting torch. They had not taken precautions to prevent fire starting from stray sparks, and some of the sparks went through cracks in the floor to land in sawdust accumulations.

After the workmen had quit work for lunch, they noticed smoke and discovered fire in the underfloor area. The sprinkler system that had been shut off had also served the underfloor area. The workmen strung out three standpipe hoses, but almost as soon as they had the lines out, smoke drove them from the building. The fire quickly spread to other areas, where the sprinkler systems operated and helped to control the fire. The damage amounted to \$195,000.

FIREWORKS

HOMEMADE FIRECRACKER

Mail Order Maiming Oct. 25, 1967, Monrovia, Calif.

A 15-year-old boy ordered instructions and materials to make fireworks from one of the many companies that promote the sale of such merchandise through magazine advertising. While the boy was putting the finishing touches on a large firecracker, it exploded in his hands. The boy's hands were badly mangled. The mail order kit included sulfur, potassium chlorate, and aluminum bronzing powder with instructions for making cherry bombs.



**If you put off seeing your "Automatic" Sprinkler man,
you could wind up in the hot seat.**

Some of our best prospects go up in flames because they waited too long.

And it is a terrible waste, because many are already paying for "Automatic" Sprinkler protection, even though they don't have it.

As an example of this already-paid-for-protection, take this factual—and not unusual—case history: a metal fabrication plant had an annual insurance premium—before sprinklers—of \$6,752. After sprinklers, their insurance premiums dropped to \$2,611. Their annual lease payment was \$1,148. That

means their extra dollars to profit during the lease period was \$2,993.

And, today, after the lease period, their extra dollars to profit is a big \$4,141 annually.

That's profitable fire protection.

The key to this kind of protection is your "Automatic" Sprinkler man. After all, who could know more about fire protection than the man

representing the largest totally integrated fire protection company in the world?

Get a more comprehensive picture of what "Automatic" Sprinkler protection can do for you. Send for a copy of our booklet, "The High Cost of Burning." Mail your request to Mr. E. A. Stroupe, Director of Marketing, Dept. F.J.-58, Box 180, Cleveland, Ohio 44141.

In the meantime, don't put off seeing your "Automatic" Sprinkler man. We don't want to lose another good prospect.



"Automatic" Sprinkler
CORPORATION OF AMERICA
CLEVELAND, OHIO 44141

For Architects and Builders



APARTMENT BUILDINGS WITH ONE EXIT

NFPA No. 101, the *Life Safety Code*, and most building codes permit the construction of apartment houses with one exit if the building design meets certain criteria — e.g., a specific degree of fire resistance of the building, a limited number of apartments per floor, a specific type of exit, a specific maximum travel distance to the exit, and separation of hazardous areas.

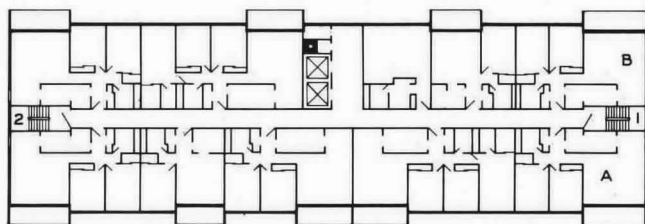
Rising construction costs and the demand for low-cost housing bring continual pressure on code authorities to liberalize the conditions that must be filled if only one exit is provided. Therefore, toward analysis of the advantages and disadvantages of one exit in apartment houses, we offer the following brief review of the minimum safety-to-life requirements for apartments and of their relationship to the over-all objectives of the safety-to-life requirements in codes.

The Need for Two Exits

There are two reasons for providing two exits in any building. First, if one of the exits should become unusable in a fire, occupants could use the other exit. (For example, if on a floor of fire origin the door to one of the exits has been blocked open, heat and smoke can enter the exit. If the exit is a stair and fire occurs on a lower floor of a multistoried building, the occupants above the floor of fire origin cannot use that stair as an exit.) Second, if there is a fire between the occupants and one exit, they can travel in a direction away from the fire to the other exit.

Figure 1 shows an acceptable type of two-exit layout for an apartment house. If fire occurs in Apartment A and the occupants evacuate that apartment leaving the

Figure 1. Double-loaded corridor plan, generally accepted by codes.



door open, the occupants of other apartments can leave the building by Stairway 2, since it is doubtful whether anyone, except possibly the occupants of Apartment B, can reach Stairway 1 because of the fire in Apartment A.

This theory assumes that the occupants of Apartment A are not trapped in their own apartment. It further assumes that an alarm will be sounded to alert the occupants of the other apartments, to enable them to escape to the exits before the fire and smoke from the open door of Apartment A make the public corridor (access to exits) untenable.

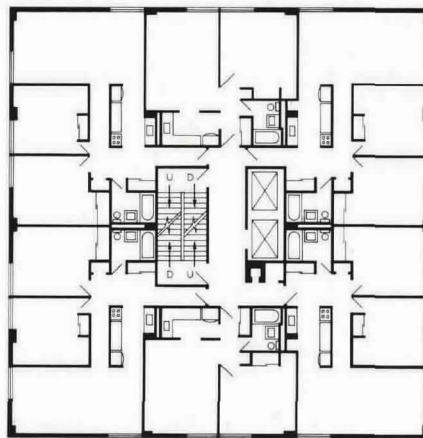


Figure 2. Two exits from tower-type building.

Figure 2 shows an acceptable exit layout for a tower-type apartment building. Two exits are provided by means of scissor stairs, and the travel distance to the exits is much less than in Figure 1. Furthermore, there are fewer apartments per floor, and, therefore, fewer occupants per floor to be exposed to a fire anywhere in the building. However, like the plan in Figure 1, this plan assumes that the occupants of the apartment of fire origin will not be trapped, and that the occupants of all the apartments will be alerted to the fire and will reach one of the exits before the access to the exits becomes untenable.

In neither Figure 1 nor Figure 2 do we find provision of two separate means of egress from each apartment; and, in general, codes do not require two separate means of egress unless the travel distance within the apartment exceeds a certain distance (50 feet in NFPA

No. 101). If the travel distance is exceeded, it is common practice to provide two doors to the apartment, both opening to the same corridor. Rarely do the two doors from the apartment open into separate routes to separate exits.

Equivalent Life Safety with One Exit

The designer may solve the problem of one exit from an apartment house by providing a means of egress that is no more hazardous to the occupants than the arrangements of two exits that are accepted by codes.

The possibility that the exit may become unusable, which was discussed above, may be overcome by using a smokeproof tower¹ or an outside stair as the exit. The code requirements for smokeproof towers and outside stairs attempt to assure that heat or smoke from a door opening into the exit will not make the exit unusable.

If there is more than one apartment per floor, it is impossible to overcome the possibility that on the floor of fire origin the access to the exit may be blocked by fire; but the danger can be reduced by limiting the travel distance between the doors to apartments and the exit to a relatively small figure, such as 20 feet. Usually this reduces the number of apartments, and the number of occupants, per floor.

Figure 3 shows another arrangement that may be acceptable — one that has considerable advantages over the preceding arrangements. In this plan the exit is separated from each floor by fire-rated construction, and the opening to the stairway is protected with a fire door that, to be approved, must have a closer and latch. Separation will prevent the exit from becoming un-

¹ "For Architects and Builders (Smokeproof Towers)," FIRE JOURNAL, Vol. 60, No. 1 (January 1966), p. 54.



Figure 4. Flames billowing from apartment of fire origin. Note that there is no area of refuge on these balconies for occupants awaiting rescue.

DONALD T. YOUNG

usable to occupants of upper floors if fire occurs in an apartment on a lower floor.

In addition, each apartment has a balcony on which occupants can await fire department rescue. Obviously, in such an arrangement provision must be made on the site for fire department ladder trucks to have access to the balconies at all times, and the height of the building will be limited to the reach of the available ladders. As is shown in Figure 4, fire emanating from the apartment of fire origin can endanger the occupants of the apartment if they have had to seek refuge on the balcony. The designer must provide a large enough section of blank exterior wall on the balcony behind which the occupants can take refuge, and the wall should be fire-resistive. This arrangement has an advantage over all the preceding ones in that it provides a second means of escape from each apartment.

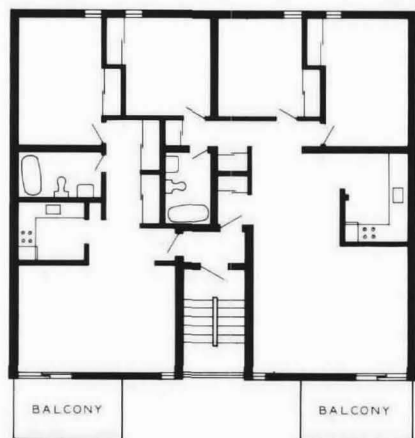
A building design that provides a separate exit for each apartment, either by a door at grade or by a stair for each apartment, is acceptable to most codes.

Summary

This paper deals only with means of egress from apartment houses, and not with the construction and protection of apartment houses, which can have an influence on safety to life from fire in such an occupancy. It is possible to provide acceptable means of egress from apartment houses with one exit. In fact, with one exit it is possible to provide for occupants of an apartment house a degree of life safety from fire at least equivalent to that attained with two exits under the generally accepted plans of means of egress. Through careful design and construction, architects and builders can improve the means of egress in apartment houses and at the same time reduce construction costs.

RICHARD E. STEVENS
NFPA Technical Secretary

Figure 3. Acceptable type of layout with only one exit: Each apartment has a balcony.



For the Fire Service



DRY STANDPIPES: TRY TESTING THEM!

Many buildings in downtown sections of California cities have dry standpipes, which are frequently used by the local fire departments when fire occurs. However, some of the systems are old and require diligent inspection and testing. Information supplied by Pasadena, California, Fire Marshal Don McClanahan was the basis for the following account.

As the result of failures of dry standpipes during fires in high-rise apartment and commercial buildings in a neighboring city, Pasadena Fire Marshal Don McClanahan took positive steps to minimize the possibility of standpipe failure in his city.

Under Section 3808 of the *Uniform Building Code* the fire chief is authorized to require periodic tests, as necessary, to insure adequate maintenance of dry standpipes. That legal ground was used to launch the program, and an interval of fire years was set between the tests. A pressure test was decided upon, rather than a flow test. Flow testing would have required Fire Department pumpers, and there is no local legislation to permit such use of Fire Department equipment. The pressure test, as outlined below, allows a reasonable opportunity to observe the standpipe and pinpoint its deficiencies.

The testing requirements were: 1) a pressure test of 150 pounds per square inch, plus five pounds' pressure for every story above ground; 2) a 20-minute period during which the test pressure was to be held; and 3), at the time of testing, the certification in writing by the testing agency to the Fire Department that the entire dry standpipe system had been serviced, maintained, and repaired, and that the standpipe was completely operable in all respects.

The City Attorney of Pasadena advised the Fire Department that qualified public businesses do the testing, to prevent any damage suits against the City on account of standpipe failure during testing (later there were several incidents of damaged and broken pipe during the tests). It was decided the tests would be performed by companies with a State C-16 Fire Protection Engineering License (the only exception: other companies that, after showing proof of their ability, received approval by the Fire Marshal). Inquiries were sent to 40 qualifying firms in the area to determine their interest in doing the particular job, and nine firms responded.



An inspector examines a new standpipe where the old standpipe had failed completely. The old standpipe, encased in the brick veneer of the building, ruptured in the pressure test. The building management decided that it would be less expensive to install a new standpipe than to remove the brick façade and repair the old pipe.

Notices and certificates were prepared and mailed to the owners of all buildings four or more stories in height. The notice allowed 60 days for the testing to be completed and the certificate, signed by the testing company, to be returned to the Fire Department. Each standpipe was required to be marked at the base with a metal tag showing the name of the company performing the test, the words *hydrostatic test*, and the date of the test. With 30 notices mailed, covering 73 standpipes, it became a real experience to see just exactly what conditions existed and how they were to be repaired. The tests were conducted on standpipes installed before the turn of the century and on those at the just-completed nine-story Millikan Library on the Cal-Tech campus.

It was not long before the testing companies began to report complete failures of standpipes. For example, the basement of a bank building was flooded, stand-



Above left: This Fire Department connection blew out of the wall under test pressure. During the original construction workmen had engaged only the first thread holding the connecting pipe nipple in place.

Above: The replacement nipple and connection for the standpipe shown above left.

Left: Inspectors now check these tags, showing the date of the latest hydrostatic test, to be sure that the standpipe has been tested within the last five years.

pipes broke loose from walls and supports, siamese connections cracked and blew off, valves leaked badly, and piping came apart inside walls. As the testing continued it became obvious what would have happened had the standpipes not been tested and a major fire necessitated using them. Standpipe failures in high-rise structures can be disastrous.

The largest number of failures involved the Fire Department siamese connections with the standpipe enclosed in the walls of the building. Exposed standpipes fared much better and required less repair than those that were enclosed. On one older building (four stories, constructed in 1908), the standpipe in the wall came completely apart, forcing water to flow out the face of the building through the brickwork. Under fire conditions that would have presented a dangerous situation. After careful examination and appraisal of the costs involved, a complete new standpipe was installed running exposed up the front of the building.

Valve and joint failures ranked second in the causes of failure and repairs. Valves installed in the early 1900's could not, and in most cases did not, hold up under the test pressure. One older hotel building containing 290 rooms had to have 30 new valves and seven sections of pipe installed. The building owner stated that the valves alone were fifty dollars each, installed.

The results proved how important a testing program could be: Thirty buildings, equipped with a total of 73 standpipes, had experienced 12 complete failures. *Complete failure* means major difficulty, standpipe inoperable.

Fire Marshal McClanahan feels that this is a needed and vital program. He invites all interested in details to write him at Pasadena Fire Department Headquarters, 145 East Holly Street, Pasadena, California 91101.

PAUL R. LYONS
Assistant Manager
NFPA Fire Service Department

Fire Marshals on Duty



SHORT COURSES IN FIRE PREVENTION AND INVESTIGATION

The Fire Marshals Association Executive Office receives many requests from public fire prevention officers regarding the availability of short courses in the techniques of fire prevention education, inspection, and investigation. To be a more effective clearinghouse of information, the FMA conducted a survey of all state and Provincial fire marshals and state training officers. The results of the survey were gratifying. Thirty states and five Provinces offer courses in fire prevention education and inspection techniques. Thirty-one states and five Provinces offer courses in arson detection and investigation. Only six states and four Provinces reported that they are not offering any specialized courses in arson detection or fire prevention techniques during 1968. One state did not report.

The information gained from the survey yielded a calendar of fire prevention and arson investigation schools that appeared in the April 1968 issue of NFPA *Firemen Magazine*. Each course was listed by its starting date. It is hoped that the calendar, which included other pertinent information, such as summaries of course content and sources of additional information, will aid the local fire prevention official in planning an educational program for his staff and increase his own awareness of the available specialized courses.

These courses are extremely valuable because they acquaint the individual with knowledge of specialized subjects and also allow him to associate with others in his field. Most fire prevention bureau personnel come from the fire fighter ranks, having been selected for personality, initiative, ability to learn, and interest in fire prevention. During their training as fire fighters they learned the basics of fire prevention. During in-service company inspections they receive experience in fire inspection techniques. In the majority of fire departments, when they are assigned to fire prevention bureaus they are given on-the-job training. New men are assigned to work with experienced men in the field. The formal training consists mainly of "learning the code."¹

¹ A few fire departments provide a formal course in fire prevention for new inspectors. These courses will be covered in future reports in this Department.

Thus, short courses in fire prevention and arson investigation form a very important part of the training of the public fire prevention official. Such courses not only present fundamental information but give background in the latest advances in the field. They also serve to broaden the education of the individual and to stimulate his thinking.

In length the courses vary from eight hours to 320 hours. The average length of the courses falls in the range of 40 hours. The courses are sponsored by many agencies, including state fire marshals; Provincial fire marshals or commissioners; state universities or colleges; state departments of community colleges; fire service extension departments; state insurance rating bureaus; state fire department associations; and local fire departments.

Although the courses vary extensively in content, they are all centered on the following subject areas:

Fire Prevention Courses (engineering principles, educational programs, and enforcement techniques)

Fire Prevention Code	Records-Keeping
Fundamentals	Public Speaking
Building Exits	Special Hazards
Code Problems	Institutional Fire
Blueprint-Reading	Prevention
Principles of Inspections	Construction Hazards

Arson Investigation Courses

Theory of Investigation	Interviewing Witnesses
Determining the Point	Arson Laws
of Origin	Interrogation
Collecting and	Records-Keeping
Preserving Evidence	Fire Causes
Court Procedures	

Perhaps the most unusual fire prevention course on the North American Continent is sponsored by the Fire Marshal of British Columbia. Called "Fire Safety for Commercial Fishermen," it has proved highly successful in teaching the fundamentals of fire prevention to the men of the fishing fleet.

For a closer look at the types of courses that are available, let us consider in more detail the programs of several states and Provinces.

Texas

The State of Texas is very active in fire prevention training, and fire prevention plays a prominent part in the annual Texas Fire School, headed by Chief Henry Smith of Texas A&M. The fire prevention section consists of Fire Marshal I, II, III, and IV, each of which is a 30-hour course. An examination is given on completion of each course. Other courses are taught in the field during the year.

Fire Marshal I offers training in the basic fire marshal duties and responsibilities; routine fire investigations; records and reports; fundamentals of inspection; reasons for inspections; fire hazards defined; types of hazards; the responsibility of the individual fireman and fire marshal in public relations; and variations in the use of visual aids. The classes are taught by guest instructors from the larger and more experienced departments and personnel from allied insurance agencies.

For the experienced fire marshal, Fire Marshal II offers more advanced methods and techniques: the municipal fire problem; fire defense and insurance rates; legal aspects of fire prevention; fire investigation and incendiaryism; records and measurements of results; local fire prevention committees; and fire hazards in industry. These classes are taught by experienced guest instructors.

Fire Marshal III offers still more advanced methods and techniques: the fire marshal's use of the *National Electrical Code*; electrical ignition — what to look for; fuels as accelerators; petroleum gases and associated chemicals; management fire indoctrination; fire investigation and sprinkler systems — operational data. Technical experts conduct these classes, and a high degree of success is obtained through group discussion and exchange of experiences, ideas, and techniques.

Fire Marshal IV, a new course, will offer new developments and new techniques and closer coordination with other intra-city agencies. This course will be taught by guest instructors such as the heads of city inspection departments; city planners; researchers; and representatives of many other allied agencies.

The Chairman of the annual fire marshal school is W. L. Heaton, Fire Marshal for the City of Austin, Texas, and former President of the Fire Marshals Association of North America.

Extension training for fire prevention personnel is conducted by a member of the Texas A&M staff who specializes in this area. Special training is given local fire marshals, fire inspectors, public school officials, and other people who are interested in fire prevention work. The course teacher also assists state agencies and colleges and universities in setting up fire prevention and inspection programs.

Area conferences and workshops are conducted as

part of the extensive training program. The conferences, for fire officials seeking technical information and new methods in fire prevention and control, are held in Abilene, Austin, Lower Rio Grande Valley, Lubbock, and Corpus Christi.

Florida

Florida established a Fire College, permanently located in Ocala since 1949, to provide instruction and training in fire-fighting and fire prevention for all the firemen in the State.

The College conducts both resident courses and extension courses in fire prevention and investigation. In order for students to be certified, they must pass a written examination.

The course content is as follows.

Fire Inspection (30 hours). This unit is concerned with making effective inspections, recognizing hazards, and assembling comprehensive reports and records, and provides information on new hazards, new types of hazardous materials, and new problems in the field of hazards. The class engages in round-table discussion of inspection problems, and makes actual building inspections.

Arson Detection (30 hours). This unit is focused on the principles of recognizing fires of suspicious origin through knowledge of fire causes and the ways to determine what is evidence, to preserve reliable evidence for the professional investigator, and to make preliminary investigations from the viewpoint of a fireman and of an investigator. There is discussion of case histories applying to the topic, and there are demonstrations of flammable liquids and chemicals.

Fire Prevention and Protection (30 hours). This unit gives the essential information for fire protection in the average municipality and outlines a program of fire prevention that will bring good results in protecting both life and property. To aid in reducing hazards and thereby to reduce fire losses, information is given on fire incidence in occupancies; protection of mercantile and industrial hazards; storage; public relations; and preparation of fire prevention programs.

Fire Investigation (30 hours). This course is designed to teach firemen the fundamentals of investigation, with special emphasis on investigation of the origin and cause of fire; the arson laws of Florida; preservation of evidence; records and reports; and the arson investigation process and other related subjects.

Fire Service Chemistry (30 hours). Through this unit the student becomes acquainted with the essentials of chemistry, including physical and chemical properties as well as the states of matter. Some of the fundamentals offered are elements, compounds, mixtures, atomic structure, symbols, and atomic weights

and numbers and their meaning, as taken from the periodic table. Measurements, temperatures, valence formulas, and the science of fire are explained. The class is limited to 15 persons.

North Carolina

The State of North Carolina annually conducts a one-week course in fire prevention that is well attended by State Fire Prevention Bureau personnel. The course is coordinated by R. Kenneth Scott, of the North Carolina Fire Insurance Rating Bureau. The school is divided into a three-year curriculum — basic, intermediate, and advanced. The NFPA *Fire Protection Handbook* is a required textbook for the course.

The objective of the course is to present in practical fashion the reasons behind fire prevention code requirements, so that inspectors will have a firm basis for making fire prevention recommendations. Another goal is to promote interest in fire prevention. Night sessions involve public speaking and fire prevention education techniques.

Students must complete the basic course and pass a test before they are eligible to take the intermediate course; and the same holds true for the advanced course.

During 1968 a new course was held for fire chiefs (32 fire chiefs attended the course).

The courses are as follows:

Basic Course: Auto Tire-Rebuilding Plants; Bowling Establishments; Combustible Fibers; Lumberyards and Woodworking Plants; Dry Cleaning Plants; Dust Explosions; Places of Public Assembly and Exitways; Explosives, Ammunition and Blasting Agents; Private Protection; Flammable Finishes; Flammable Liquids (a. General Provisions, Piping, Valves, and Fittings; b. Bulk Plants; c. Service Stations; d. Commercial and Industrial Establishments); Electric Wiring for Hazardous Locations; Garages; Hazardous Chemicals; LP-Gas; Welding and Cutting; The Use of the Camera in Fire Prevention; Recommendations to the Property Owner; Keeping Records.

Intermediate Course: Classes of Construction and Occupancy; Home Inspection Programs; Radioactive Materials; Private Alarm Systems; Fire Load Measurements; Standard Plan Notations and Drawing; Hazardous Chemicals; LP-Gas; Definitions; Using the Flammable Vapor Indicator; Fumigation and Thermal Insecticidal Fogging; Flammable Liquids; Heating Hazards; Permits; Courtroom Procedures; Keeping Records; Home Fire Escape Plans; Programs for Schools.

Advanced Course: Construction; Hazardous Chemicals; Explosives — Transportation, Storage; Ovens — Industrial Baking, Drying, and Cryogenics; Combustible Metals; Plastics (Hazards of Manufacturing, Machining, Storage); Review — Standard Plan Symbols; Study Habits; Toxicity of Materials; Vacant Buildings and Their Hazards; Question Period; Flammable Liquids — Tank Storage, Cleaning, Repairing; Field Inspection [practice inspections are made]; Preparation of Reports and Drawing Plans to Scale, Using Standard Plan Symbols; Institutions; Recognition of DOT Labels and NFPA Identification System; General Inspection Pointers.

Ontario

The Ontario Fire Marshal's Office has an extensive fire prevention education program. Of particular significance are the two courses taught at Gravenhurst Fire College, the Fire Prevention Unit and the Volunteer Officers' Fire Prevention Course.

Fire Prevention Unit. This Unit, consisting of 320 hours of academic study over a period of eight consecutive weeks, forms part of the Fire Protection Technology Course, which includes units on fire-fighting operations and fire department administration.

The Unit includes English, mathematics, science, and report-writing; principles of fire prevention and fire protection; features of building design; the preparation and interpretation of building plans; design of fire detection and fire protection equipment; functions of testing laboratories; preparation of fire prevention by-laws; and development of fire prevention programs.

The textbooks are the *Electrical Inspection Manual for Fire Departments*, *Office Consolidation of Statutes and Regulations respecting Fire Safety and Fire Prevention*, and *Building Fire Safety Design Standard* (all published by the Office of the Ontario Fire Marshal), the *National Building Code of Canada* and the *National Fire Code of Canada* (both published by the National Research Council of Canada), and the NFPA *Fire Protection Handbook*.

Volunteer Officers' Fire Prevention Course. This 5-day course of 40 hours of academic study includes procedures in conducting fire prevention inspections and report-writing; characteristics of heating and electrical equipment in places of public assembly, homes for the aged, nursing homes, schools, farms, and industry; special hazards associated with welding, flammable liquids and gases, chimneys, flues, explosive dusts, and spontaneous heating; limiting fire spread; design of means of egress; portable fire extinguishers; preparation and use of line drawings; and the issuance of fire marshal's orders.

The textbooks are *Fire Safety for Your Building*, *Electrical Inspection Manual for Fire Departments*, and *Office Consolidation of Statutes and Regulations respecting Fire Safety* (all published by the Office of the Ontario Fire Marshal) and the NFPA *Inspection Manual*.

Connecticut

Through its State Technical College and the State Fire Marshal's Office, Connecticut offers a program called the Fire Marshals Institute. The courses are taught once a week for 12 weeks.

The content of the Fire Marshals Institute program includes the following:

Supreme Court Decisions Affecting Fire Investigations; Arrest, Search, and Seizure; Court Presentation; Confessions, Interrogations; Preservation of Evidence (Photos); Fire Case Histories; Subrogation; Connecticut Fire Safety Code; LP-Gas — Laws and Regulations; Flammable Liquid Laws; Explosive Laws and Regulations; Fireworks Law; Outdoor Assembly; Dry Cleaning Laws; Oil Burner Laws.

Besides the Institute, a college-level course is offered as part of the Fire Technology and Administration Program of the State College.

Canadian Fire Investigation School

Conducted jointly by the Association of Canadian Fire Marshals and the Fire Underwriters Investigation Bureau of Canada, Inc., in cooperation with the Canadian Association of Fire Chiefs, this course covers the crime of arson, arson investigation, and suppression in the many phases of arson in Canada. The plan of the School is to provide, first, broad general information, then to advance to review of scientific investigative techniques and of the latest laboratory aids, and, finally, to examine detailed subjects that produce more effective detection, apprehension, prosecution, and conviction of the arsonist.

The Commissioner of the Royal Canadian Mounted Police offers the facilities of the RCMP Barracks at Rockcliffe, Ontario, and Regina, Saskatchewan, for the courses when they are held in Eastern and Western Canada, and, in addition, has made available specially trained RCMP personnel to lecture on a number of subjects covered in the courses.

Enrollment is limited to public officials who have statutory responsibilities to investigate fires, plus members of the Fire Underwriters Investigation Bureau of Canada, Inc. Attendance is limited to 30 candidates per course.

The course outline for 1967 was as follows:

Present-Day Arson: the elements of the crime — types — legal aspects — special applications — present and future trends.

Basic Principles in Making an Investigation: techniques and methods — reconstruction of the fire scene — modus operandi — search of the fire scene.

Determining the Fire Cause: the nature and causes of fire — electrical fires — spontaneous ignition — liquids — building materials — explosives.

Criminalistics for Arson Investigators: making use of the laboratory — basic equipment for investigators.

Interrogation of Suspects: methods of effective questioning — legal aspects of interrogation — ethics of interrogation.

Handling Juvenile Fire Setters: discussion of the investigator and the juvenile — trends in treatment — how critical the problem is — differences between the adult offender and the juvenile.

Handling the Pyromaniac: interrogation — special problems in handling the mentally afflicted arsonist.

Knowing Scientific Aids: how the scientific laboratory can assist the arson investigator.

Fraud Fire Investigations: checking business records — credit reports — insurance policies — real estate transactions — bank records.

Legal and Admissible Evidence: what evidence is admissible — confessions — hearsay — arrest procedure — court procedure — chain of evidence.

Getting the Conviction: cooperation with legal authorities — court demeanor — effective testimony — the investigator's professional responsibility.

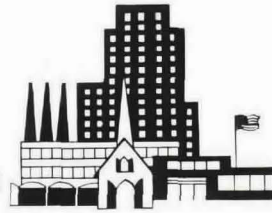
The programs here outlined will give the reader some idea of the extent of the short courses available to public fire prevention personnel. The survey made by the FMA Executive Office certainly indicates the scope and the availability of programs. Every state and Province should provide opportunity for training in fire prevention and investigation techniques.

ROBERT W. GRANT

Executive Secretary

Fire Marshals Association of North America

The Occupancy Fire Picture



CONTINUING FIRE PROTECTION EDUCATION FOR HOSPITAL PERSONNEL

The Detroit-Macomb Hospitals Association¹ maintains for its employees a continuing fire protection course that goes a long way to safeguard the lives of patients. The program, which consists of two parts — 1) a fire safety education film and fire extinguisher-operating classes, and 2) patient-carry classes — is presented in conjunction with the Detroit Fire Department at Detroit Memorial and with the Warren Fire Department at South Macomb.

The fire safety film and the fire extinguisher class take approximately an hour. The first part of the period is devoted to a brief introduction and the showing of a film on fire safety in hospitals. The film shows just what to do in case of fire.

After the film, firemen who are specially trained to make public presentations review the types of fire extinguishers located in the institution. They also discuss the kinds of fires on which various extinguishers should be used. The personnel are then escorted to an adjacent outdoor area, where each person is taught the proper way to handle extinguishers. The participants next take turns putting out demonstration fires started by the firemen in a metal trough. This procedure enables each individual to handle an extinguisher and to learn by doing. After a brief review, personnel are released to return to duty.

The fire extinguisher classes are held only from April through October because of the cold weather in Detroit during the remainder of the year. They are usually held several times a month, and each group is limited to 30 employees.

The other part of the program, patient-carry classes, is held primarily, although not exclusively, for nursing personnel, because it is they who most often come in contact with patients. It is important to hold the classes in a room containing a hospital bed, for the personnel to practice the carries under realistic conditions.



After an introduction, the firemen demonstrate the various carry techniques. Each of the 15 participants then performs the carries under close supervision by the firemen instructors. Employee participation is a necessary part of all the classes.

Patient-carry classes are held monthly during the entire year, each class lasting about 45 minutes.

Attendance sheets are maintained, to become part of the personnel record. The training sessions are held at different times of the day, so that no employee working on any shift will miss an opportunity to participate. It is best to schedule classes for a time when personnel are on the job, to eliminate payment of overtime, which is necessary when employees are called to work during off-duty hours. An effort is made to have employees participate yearly in this training.

Besides these activities, the Hospitals hold fire drills quarterly, as is recommended by the Joint Commission on Accreditation of Hospitals. The fire plan is also reviewed yearly with personnel.

Of course, it is hoped that a fire never occurs. However, should the unfortunate happen, the patients of Detroit Memorial and South Macomb Hospitals will be cared for by employees who have had the advantage of continuing fire protection training.

ROBERT A. BOISSONEAU
Assistant Administrator
The Ohio State University Hospitals

¹ The DMHA is a nonprofit corporation that operates two hospitals, Detroit Memorial and South Macomb. Detroit Memorial Hospital is a 345-bed unit located in downtown Detroit, Michigan, and South Macomb Hospital is a new, 200-bed structure in Warren, Michigan, 12 miles from Detroit Memorial.

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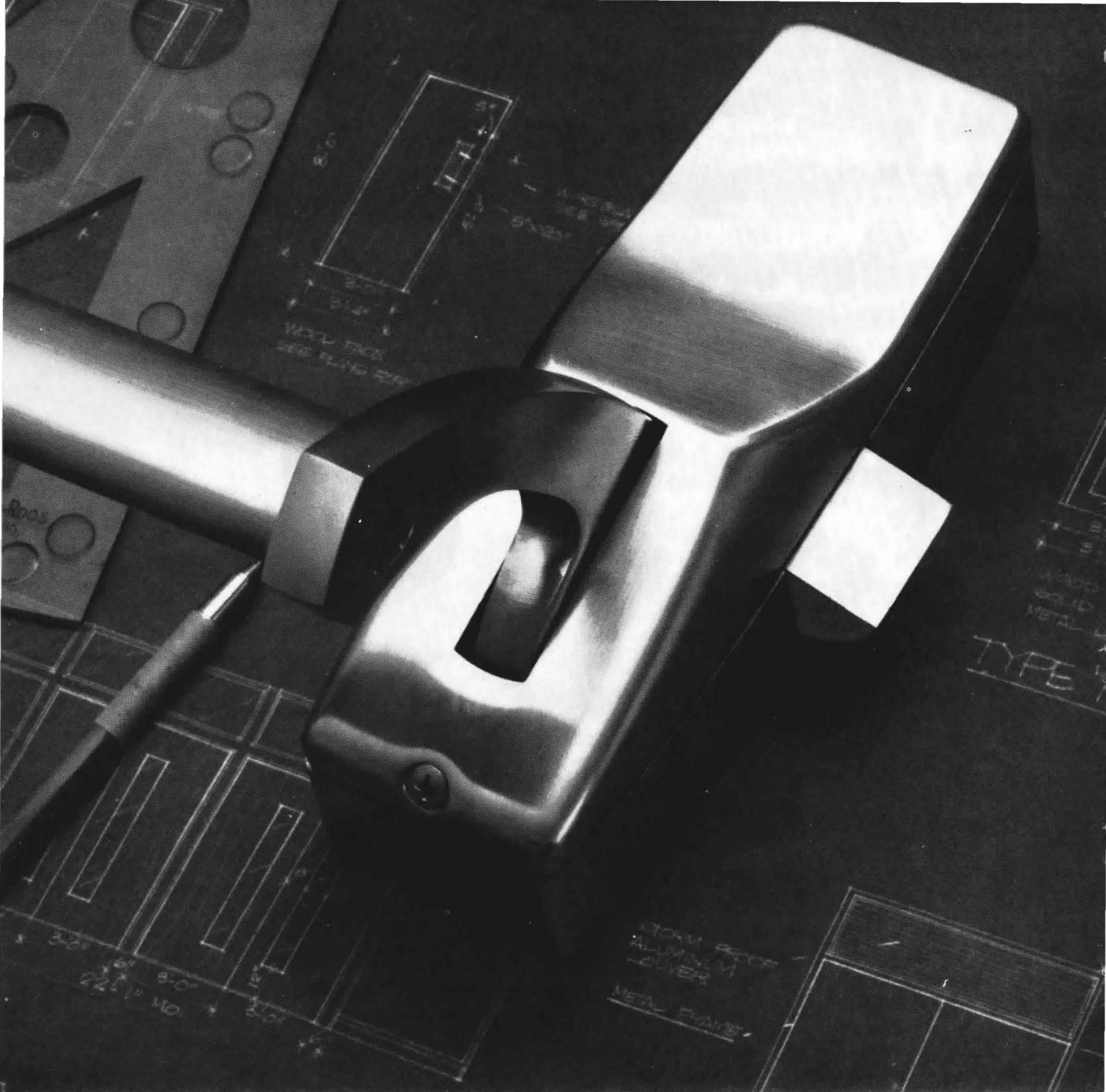
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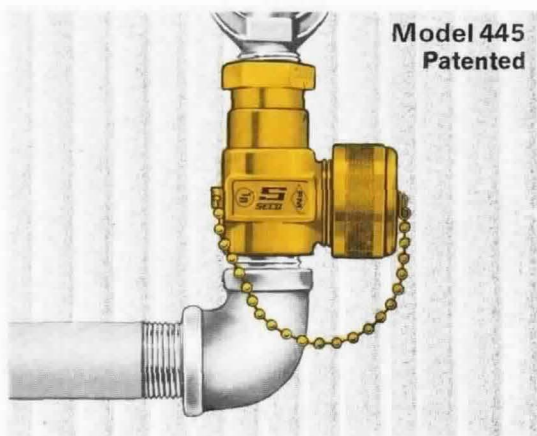
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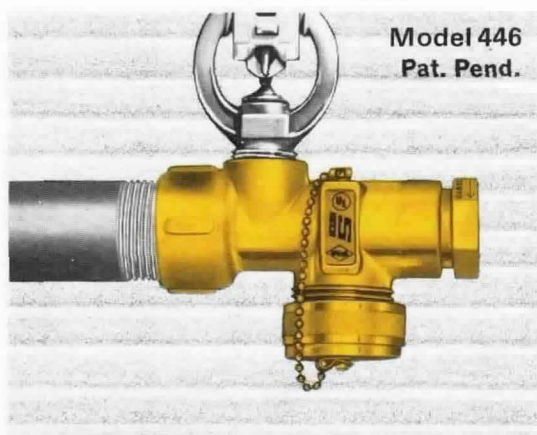
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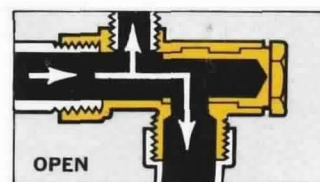
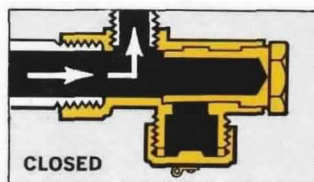
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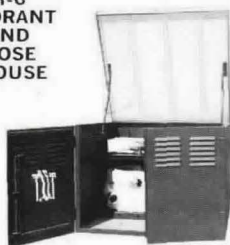
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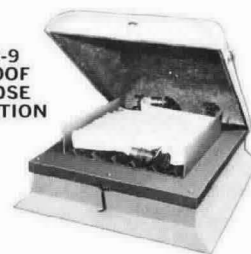
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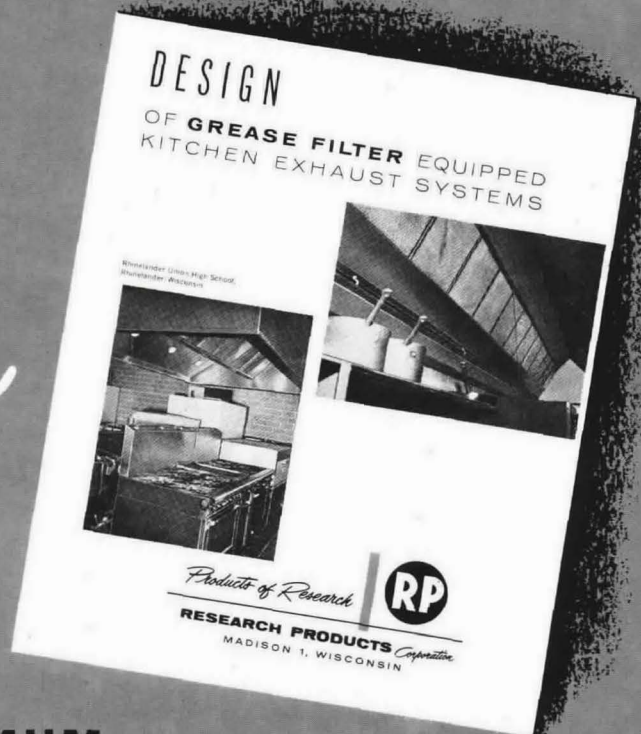
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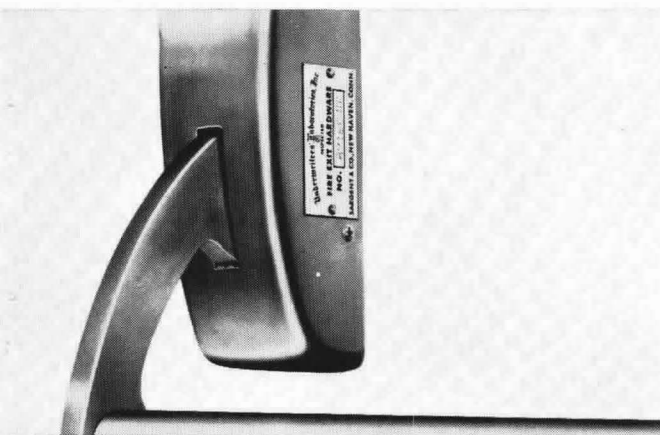
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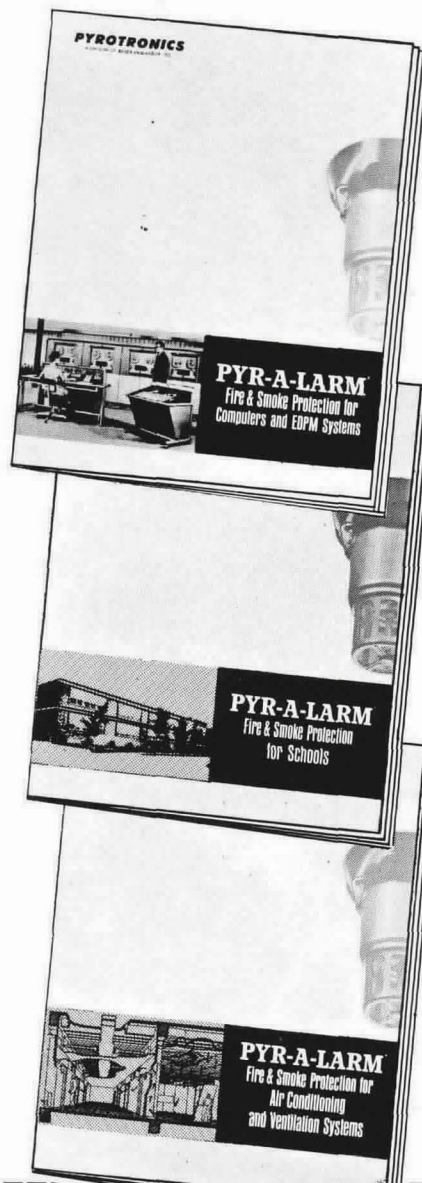
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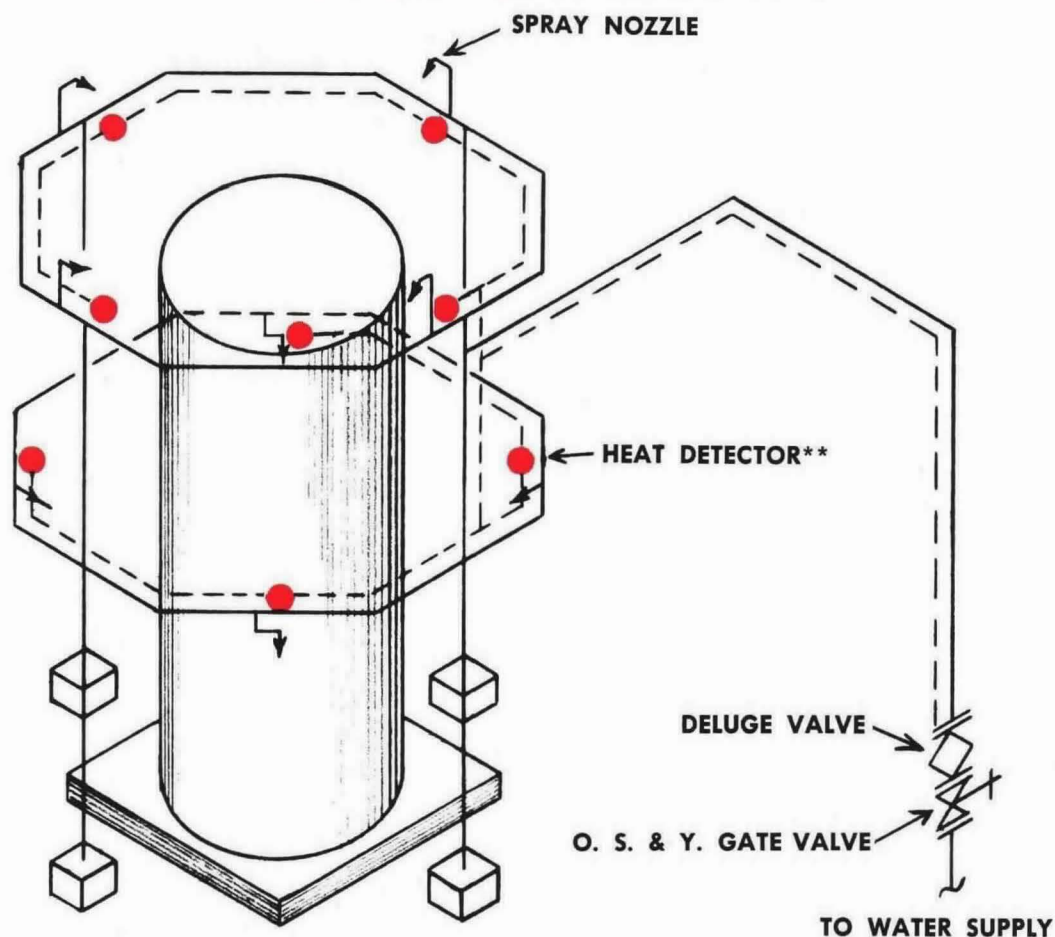


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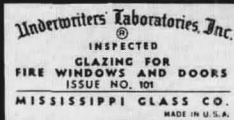
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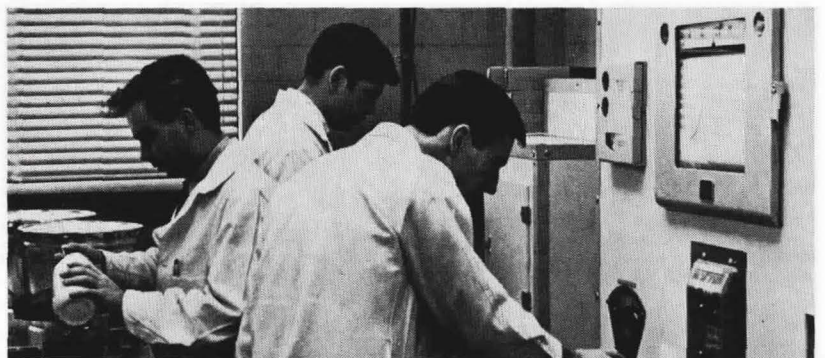
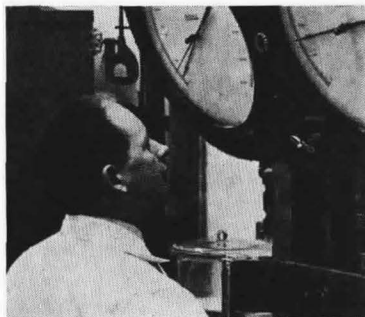
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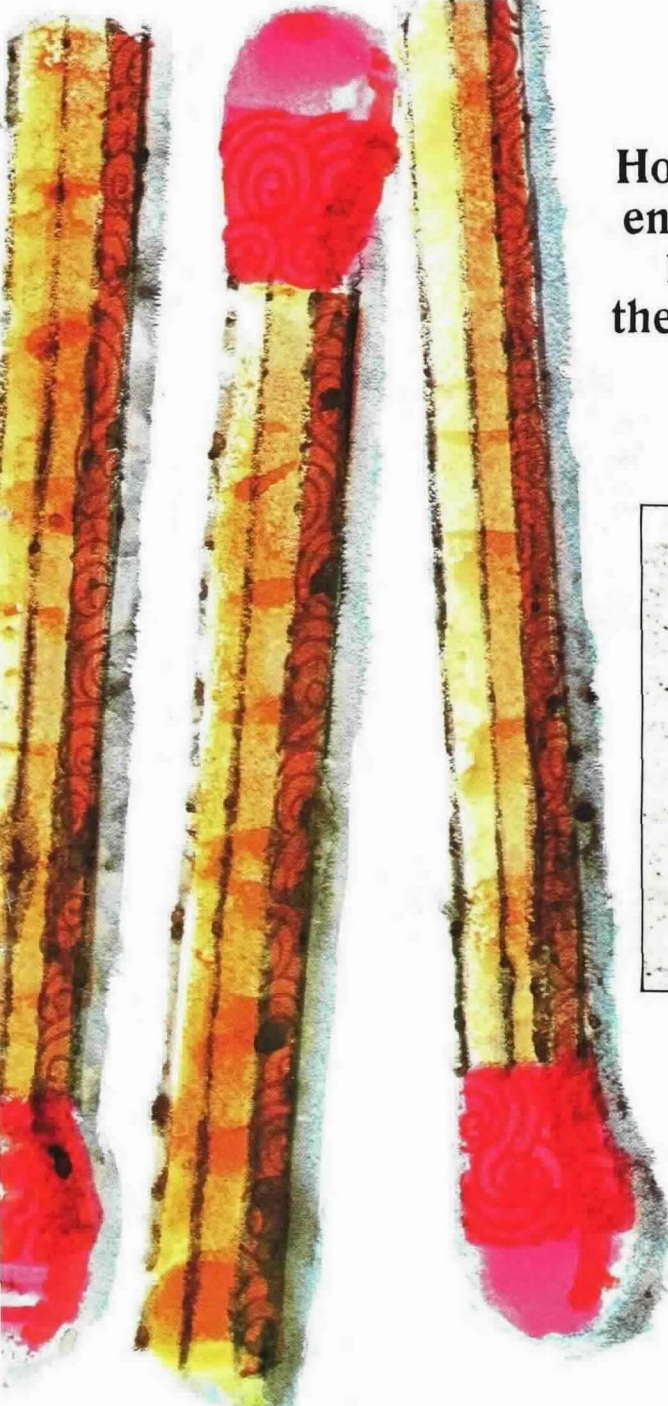
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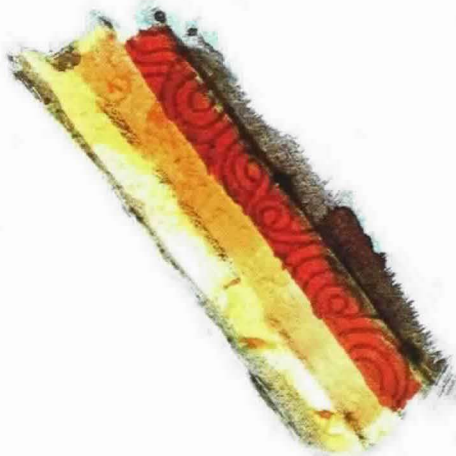
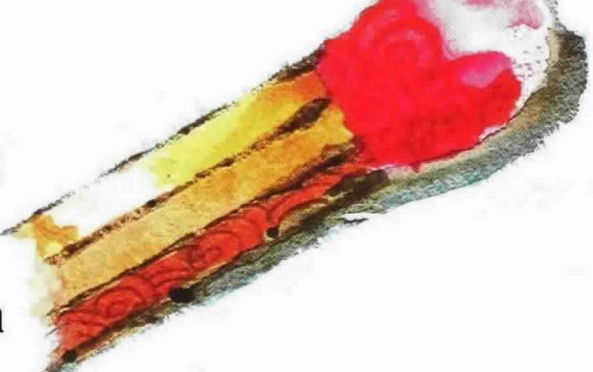
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Firestop XXX is the kind of product we strive for through GP/Bestwall's extensive research facilities. It cuts construction cost and makes buildings safer, too. And our stringent quality control program insures that Bestwall products conform to the high standards of the various building codes.

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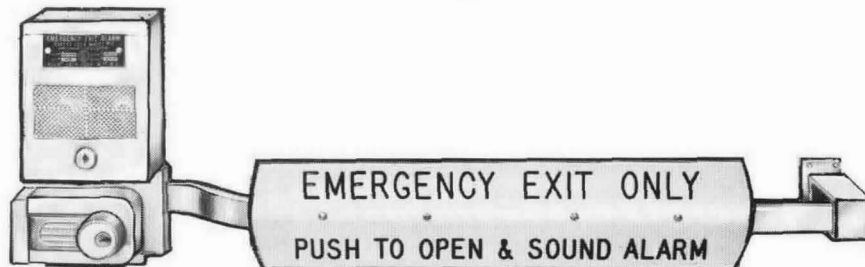
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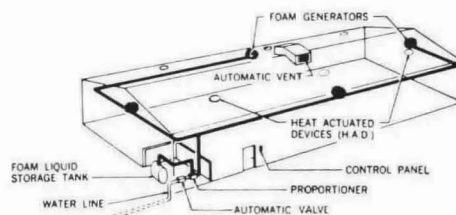
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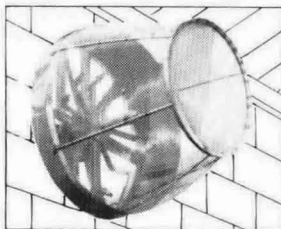
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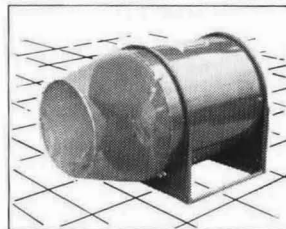


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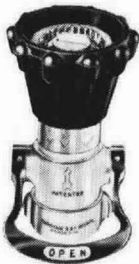


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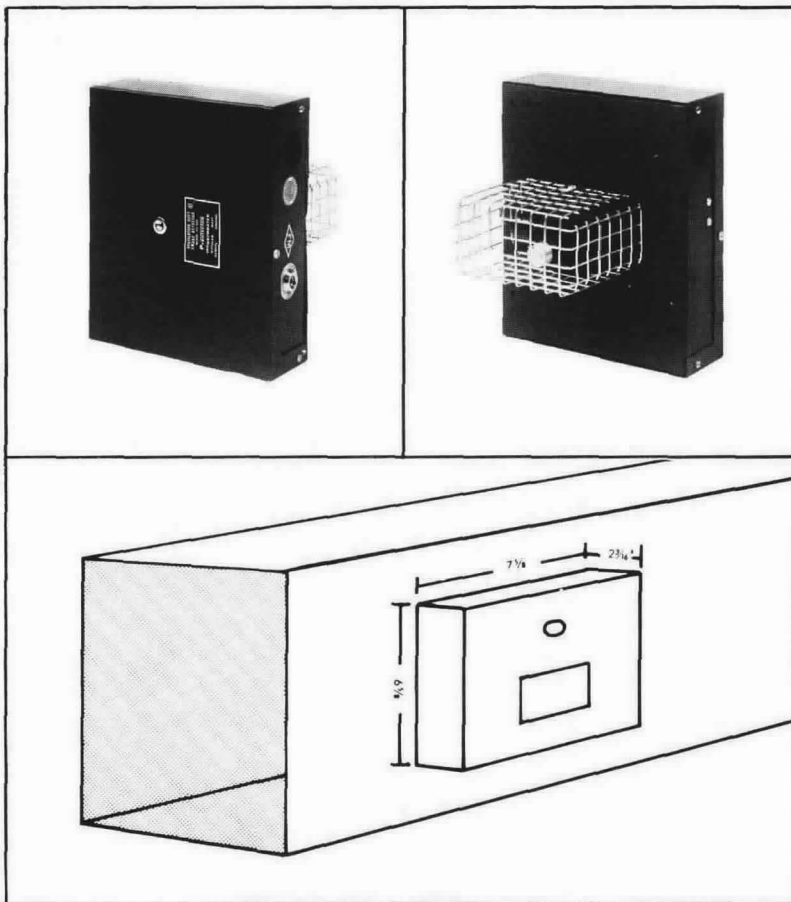
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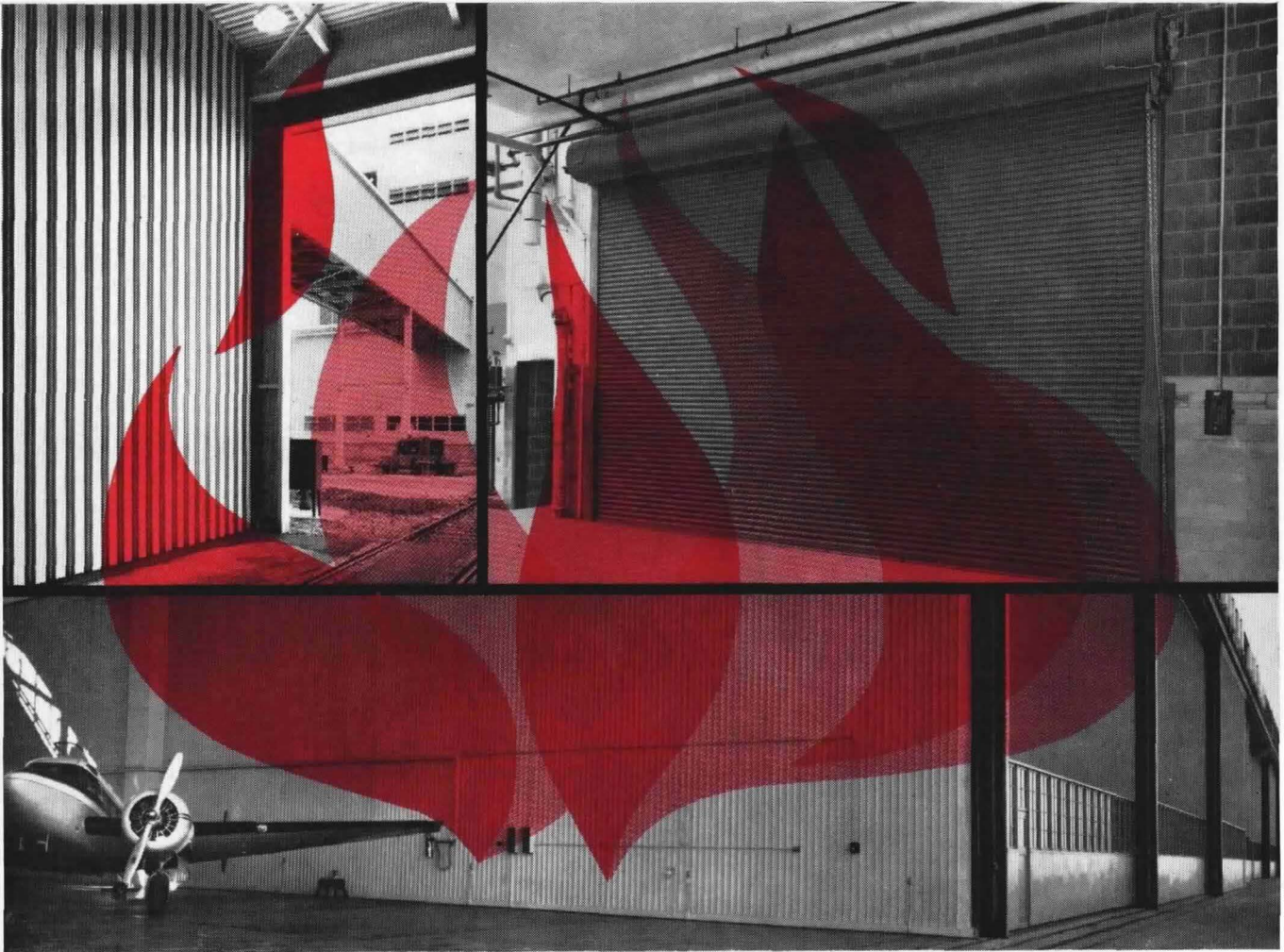
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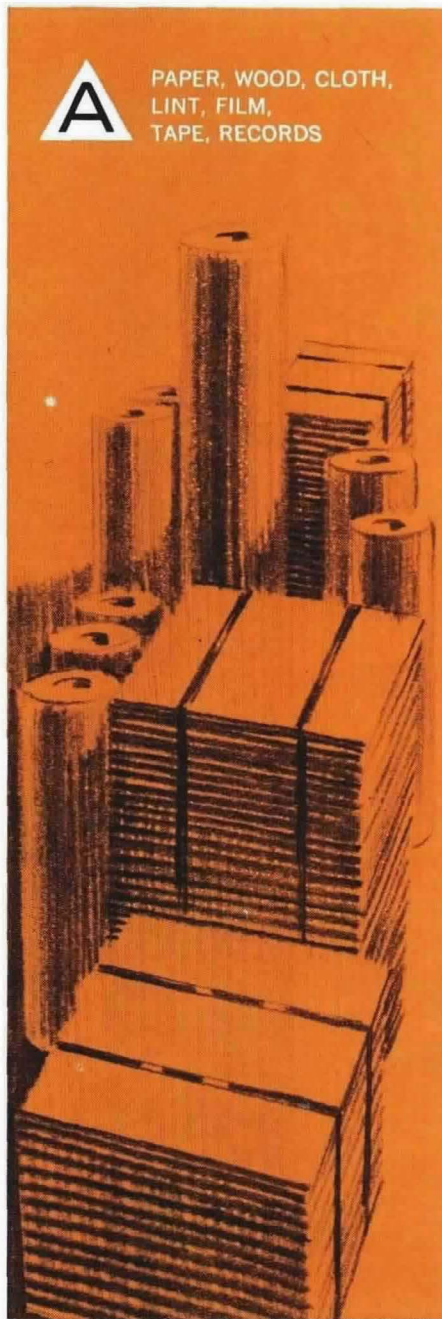
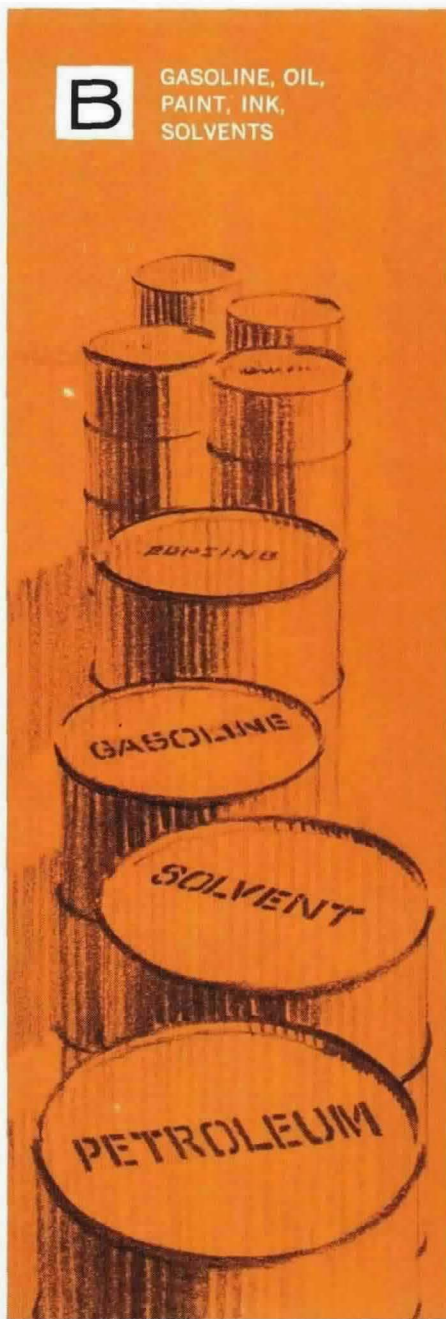
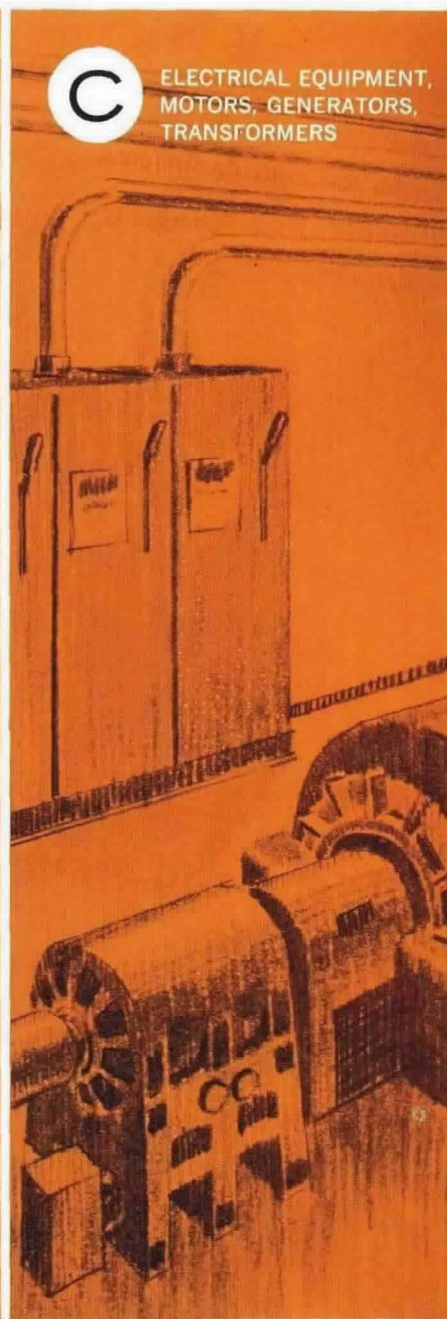
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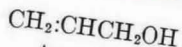
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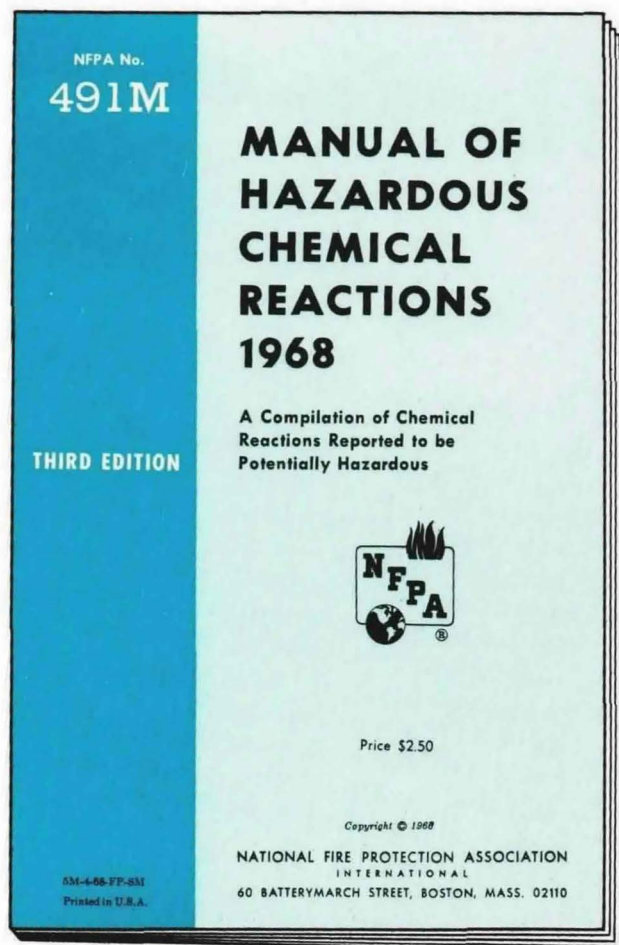


As a benzene extract of allyl benzenesulfonate was prepared from allyl alcohol and benzene sulfonyl chloride in the presence of aqueous sodium hydroxide, under vacuum distillation two fractions came off, then the temperature rose to 135°C., when the residue darkened and exploded.

W. T. Dye, and G. E. Ham, *Chem. Eng. News* 28: 3452 (1950).

This reaction was almost certainly a caustic-catalyzed polymerization of allyl alcohol.

Doyle (1960).



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Carbon Monoxide Deaths in Motor Hotel

Toxic fumes from an improperly installed, operated, and maintained swimming pool heater caused the death of three people and sent 70 to hospitals.

ON Sunday morning, November 19, 1967, three guests were killed and many were made ill by carbon monoxide escaping from an improperly installed, operated, and maintained swimming pool heater at the 240-room Yankee Clipper Motor Inn in Boston Heights, Ohio. Although the incident is not classified in the NFPA Fire Records as a fire, NFPA No. 54, *Installation of Gas Appliances and Gas Piping in Buildings*, includes requirements designed to prevent the hazardous release of carbon monoxide; and the toxic gas traveled throughout one building of the motor hotel by the same route that smoke and heat would have followed had a fire originated in the heater room or the adjoining laundry. Other conditions also pointed out fire protection inadequacies.

AT about 6:30 pm on Saturday, one of many couples attending a social function at the motor hotel began to feel nauseated. Their condition worsened, and at about 11:30 pm the woman fainted in their third-story room. The husband called the manager, who summoned a physician. After examining the couple, the physician decided that they were suffering from either food poisoning or inhalation of some kind of fumes. He asked the manager to send the couple to the hospital. A local police cruiser officer monitored the ambulance call on his radio and followed the ambulance to the hospital, arriving at 12:25 am Sunday.

The emergency-room doctor noted the couple's symptoms — nausea, headache, dizziness, and flushed cheeks — all common to many illnesses, including flu and food poisoning. Another couple, also from a third-story guest room, arrived at the hospital at 12:55 am exhibiting the same symptoms. Since those stricken had not all eaten at the same place, the doctor ruled out food poisoning

and began to suspect carbon monoxide poisoning. He ordered blood tests of all four patients and notified the police officer, who in turn notified the county sheriff's dispatcher's office to send help to the motor hotel.

Police and deputy sheriffs arriving at the motor hotel found many people ill and a fifth person on the way to the hospital. They asked the manager to call the remaining guests in the third story and tell them to leave their rooms as a precautionary measure. Meanwhile, a call to the hospital failed to confirm the cause of the illness, because the laboratory tests were incomplete at that time.

Several more guests from the third story who had become ill were sent to the hospital by ambulance. Guests from other parts of the building became ill one after another, as authorities continued to try to determine the cause of the illness and to urge guests to leave their rooms and reach fresh air.

By 1:30 am the hospital laboratory tests had definitely established the cause of illness as carbon monoxide poisoning. At about that time a bellman reported smoke coming from the swimming pool heater in the basement. Policemen ran to the heater room to see flames from the burners extending outside the heater casing and discharging soot and fumes. They shut off the heater and left, nauseated from the fumes in the room.

On the advice of the doctor at the hospital, the policemen, firemen, and other rescuers continued to administer oxygen to the victims and to send them to hospitals. About 70 people were treated at hospitals. The effects of the toxic gas varied from slight headache and nausea for some to death for two guests in the second story and one in the fifth story. Some guests were warned three and four times to leave their rooms, but they disregarded the warnings because, they said, they could not smell anything. Deputy sheriffs finally went from room to room, entering with a pass key, opening the windows, propping the doors open with chairs, and ordering the guests out.

This report is based on information furnished by officials of Summit County, Ohio, and by others who investigated the incident. All the photographs are by courtesy of Summit County Sheriff Robert D. Campbell.



Top of page: A view of the south end of the heater room. The pool heater and the chlorinator are at left. The filters are to the right. The vertical section of the vent pipe, including the draft hood, has been disconnected and moved to one side. The rectangular screened opening just below the vent wall penetration is the outside-air intake louver. The manifold and valves on the wall control the flow of the swimming pool water either through the heater or past it.

Above: The vent cap, directly outside the heater room window and directly above the small fresh-air intake louver. The distance from ground to overhang is about five feet.

THE source of the carbon monoxide was an improperly installed, operated, and maintained natural gas-fired swimming pool heater located in a partially cut-off room in the basement of the seven-story building.

The pool heater was a modified hot water boiler rated at 560,000-Btu-per-hour input. Pool water was pump-circulated through a bank of finned copper tubes at the top of the heater that were heated by contact with flue products. Gas was burned in eight atmospheric inspirating burners manifolded along one side of the heater near the bottom.

Air for combustion, ventilation, and draft hood dilution came in part from outside the building, through a 16-inch-by-12-inch louvered opening (net free area: about 100 square inches) in the heater room wall about six feet above the floor, and in part from inside the building, from the approximately 20-foot-by-10-foot-by-10-foot-high heater room and from the adjoining laundry room through the communicating doorway.

The heater was vented to the outdoors through about

12 feet of 12-inch-diameter single-wall metal pipe. The vent height above the draft hood was about two feet and the horizontal run was about 10 feet; the vent contained three 90° elbows (see the top photo on this page). The vent terminated outdoors in a horizontally mounted cap located immediately above and within six inches of the louvered air intake and under a nine-foot-wide overhang (see the lower left-side photograph on this page).

A pipe shaft that originated in the center of the laundry-room ceiling rose vertically through all seven stories. Tests indicated that the shaft produced a strong stack effect and a degree of negative pressure in the heater room.

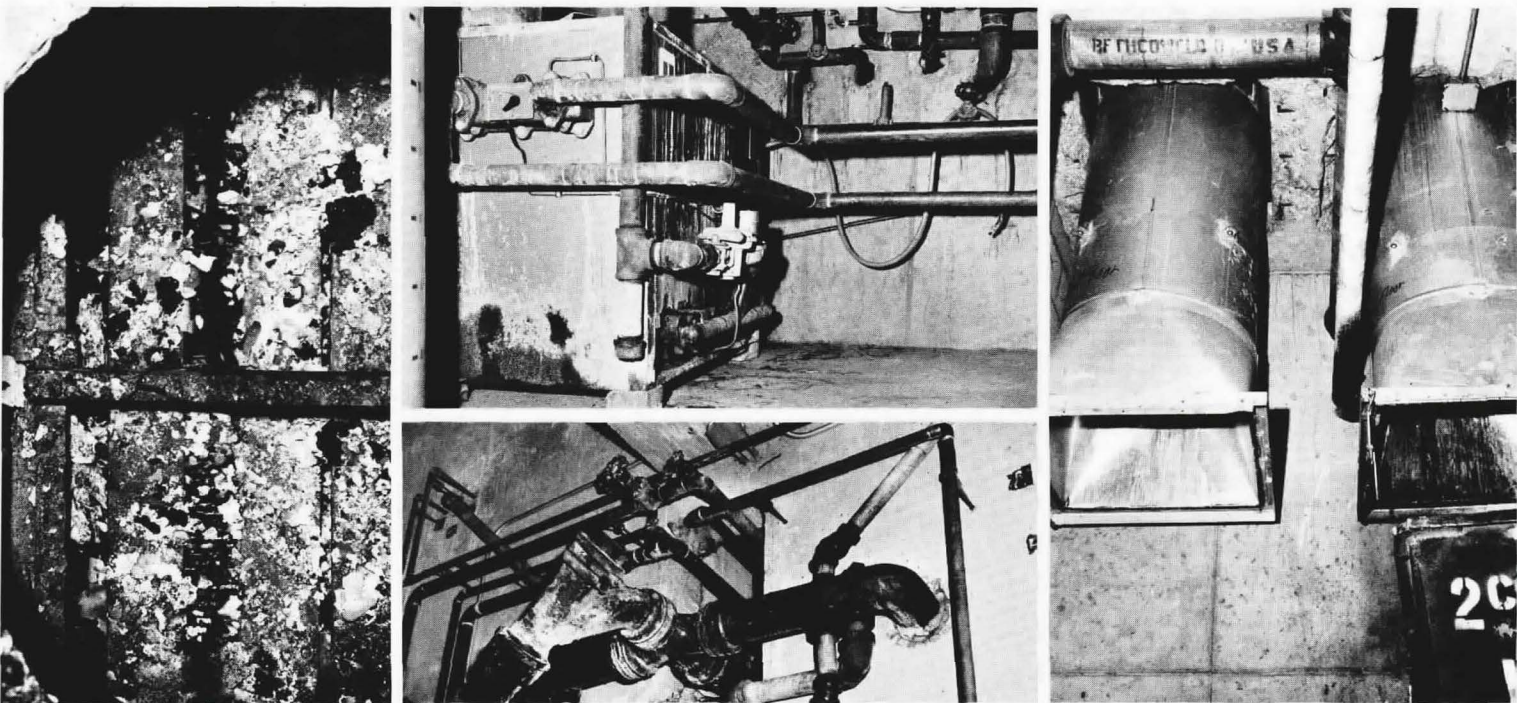
Besides the pool heater, the heater room contained the pool filtration and chlorination systems. The chlorinator, of the calcium hypochlorite solution type, was located adjacent to the heater.

The heater, installed in June 1965, was operated only during the winters of 1965-66 and 1966-67, and then just to maintain a water temperature adequate to prevent freezing. An attempt to put it into operation early in November 1967 revealed a clogged circulation pump. That defect was corrected on November 16, at which time (two days before the incident) heating began.

The provisions for air supply and venting were inadequate and not in accordance with NFPA No. 54, *Installation of Gas Appliances and Gas Piping in Buildings*, the manufacturer's instructions, or state regulations. Under those conditions, it is probable that the carbon dioxide produced by the at first normally functioning heater was largely spilling into the heater room through the relief opening in the draft hood; and, probably, substantial quantities of carbon dioxide were drawn out of the heater room and up the pipe shaft. While not a satisfactory situation, this would not have been likely to contribute in a major way to production of carbon monoxide by the heater.

Besides the seven-story guest-room building shown here, the motor hotel had a three-story guest-room building. The pool, in the left foreground, was located between the two guest-room buildings, which were joined at one end by a one-story building containing the offices, the lobby, and function rooms. Only the seven-story building was involved in the incident. The pool heater vent terminated beneath the ornamental overhang at the window (indicated by the arrow).





Left: This photo was taken looking directly into the vent opening in the top of the heater after the vent pipe had been removed. The accumulation of residues was caused by excessive condensation of water containing carbon dioxide and particulate matter and subsequent evaporation of the water. The top and sides of the heater gave evidence of the same condition.

Top center: The heavy sooting caused by incomplete combustion can be seen extending from the air intakes of the burners at the bottom of the heater to the top of the heater casing. Excessive condensation produced the white deposits.

Bottom center: A photo taken looking toward the ceiling of the laundry room, just outside the heater room. The pipe shaft was non-firestopped from its lower end here to its termination in the attic of the seven-story building. Carbon monoxide went up the shaft and into adjoining guest rooms in all seven stories. The fatalities occurred in guest rooms adjoining this pipe shaft in the second and fifth stories

Right: The laundry chute (at left) and the rubbish chute (at right) terminated in a small alcove in one corner of the laundry room in the basement. The chutes had originally been fitted with doors at the bottom, but the doors had been removed for convenience. The means of access to the chutes in the linen rooms in the various stories were stainless steel flush doors having rubber gaskets. Although smoke from test grenades went up the chutes, no smoke escaped around the access doors. The chutes were sprinklered at the fourth and seventh stories, they vented at the roof. The chute sprinklers, which were connected to the domestic water supply, were the only sprinklers in the motor hotel.

In addition to carbon dioxide, a normally functioning heater produces water in substantial quantity. The water is in the form of vapor at flue gas temperatures. However, if cooled sufficiently the vapor will condense. The pool heater had the potential to produce about six gallons of water an hour.

The first cool surface with which the combustion product water vapor came into contact in the heater was that of the finned tubes containing pool water. According to the manufacturer's instructions, the water inside the tubes should have been maintained at a minimum of 65° F to prevent condensation. The minimum comfort temperature is usually 75° F. However, the pool was not heated for comfort but only to prevent freezing, so the actual temperature of the water in the tubes was undoubtedly much lower than 65° F during the two "heating" seasons while the heater was in use.

Under those conditions, excessive condensation must

have occurred on the finned tubes and in the draft hood and ductwork; and probably the situation was aggravated by the inadequate venting system.

The condensed water absorbed carbon dioxide from the combustion products and possibly other gases present in the general atmosphere. It also picked up dust and other particulate matter entrained in the burner secondary air supply and around the burners. During shutdown periods and periods when the tube temperature rose high enough, the water evaporated, leaving a solid deposit. As time went on, the deposits built up to block the passage of combustion products through the finned tubes (see the left-hand photo above).

Thus the finned tubes were blocked when the heater went into operation on November 16, 1967. With normal passage out of the heater restricted, the combustion products accumulated in the heater until they escaped from the combustion chamber around the burner open-

ings. Factors contributing to off-ratio firing resulted in oxygen starvation and formation of carbon monoxide (see the top center photo on the preceding page).

DRAWN by the stack effect, the carbon monoxide spread into the laundry room and up the pipe shaft (see the bottom center photo on the preceding page). The pipe shaft contained hot water-circulating piping and other piping that branched off at each floor, penetrating the shaft wall through holes that were not sealed around the piping. The three fatalities occurred in

rooms adjacent to the pipe shaft.

The stack effect was verified by the travel of smoke from a test grenade operated in the heater room. Within a few minutes the smoke passed up the shaft and into guest rooms from the first to the seventh story.

Besides the pipe shaft, there were laundry and rubbish chutes running from the laundry room to the roof (see the right-hand photo on the preceding page). Smoke traveled up the chutes, too, but escaped out the vents at the top of the chutes, not around the rubber-gasketed access doors in the linen rooms in each story.

△

The Major Fires of 1967 (continued from page 12)

STATISTICAL DATA

1967 Fires Killing Three or More Persons

In the United States

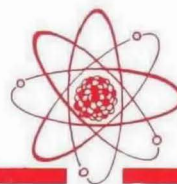
	No. Fires	No. Killed	Children Killed	Total No. Fires	Total No. Killed	Total Children Killed
Residential				163	656	379
Apartment houses	31	122	85			
Apartments with mercantile	4	17	7			
Dwellings	110	433	283			
Hotels	12	60	0			
Mobile homes, trailers	3	9	4			
Rooming houses	1	3	0			
Other residential occupancies	2	12	0			
Public assembly				2	30	0
Bowling center	1	5	0			
Restaurant	1	25	0			
Institutional				5	56	0
Homes for the aged	3	12	0			
Mental institution	1	6	0			
Penal institution	1	38	0			
Industrial plants				9	58	0
Miscellaneous				6	30	1
Construction equipment	1	4	0			
Mercantile	2	12	1			
Mining, Coal	1	4	0			
Gas and oil well	1	5	0			
Forest Fire	1	5	0			
Transportation				20	88	13
Aircraft	7	32	0			
Automobiles	8	37	13			
Railroad	1	6	0			
Ships	3	10	0			
Truck (general cargo)	1	3	0			
TOTAL				205	918	393

1967 Fires Killing Three or More Persons

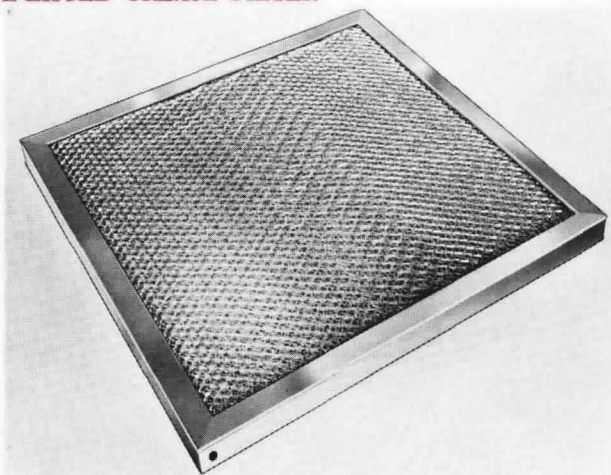
In Canada

Residential				46	184	87
Apartment house	1	13	11			
Apartments with mercantile	1	4	0			
Dwellings	42	160	76			
Rooming house	1	4	0			
Other residential occupancy	1	3	0			
Institutional				1	3	0
Home for the aged	1	3	0			
Miscellaneous				1	15	0
Mining, coal	1	15	0			
TOTAL				48	202	87
UNITED STATES AND CANADA TOTAL				253	1,120	480

What's New in Fire Protection



UL-LISTED GREASE FILTER



Research Products Corp., 1015 E. Washington Ave., Madison, Wis. 53701, offers its new Series 600 line of UL-listed 1 $\frac{3}{8}$ -inch-thick grease filters designed to trap up to 98 per cent of flammable grease and foreign particles at 350-fpm air flow.

diesel electric generating plant, 300 KW, designed to provide emergency service to hospitals, nursing homes, high-rise apartments, and commercial establishments where interruption of commercial electric power cannot be tolerated.

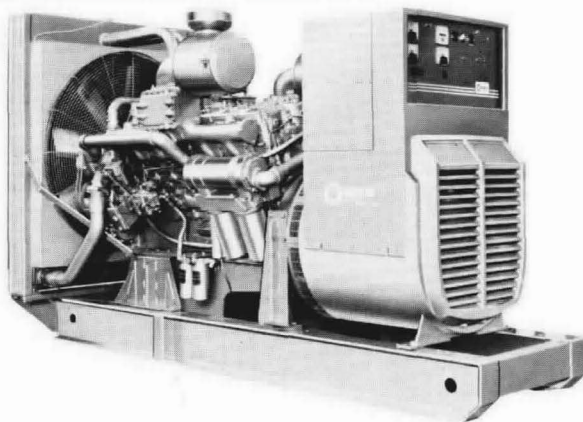
CO₂ PROTECTION FOR COMPUTERS

Protection for computers and their cableways with preheated carbon dioxide is the subject of an informative bulletin, *Hot Spots — Issue No. 2*, by Cardox, Div. of Chemetron Corporation, 840 N. Michigan Ave., Chicago, Ill. 60611.

MUNICIPAL ALARM CONSOLES

The bulletin *Program Modernization* describes fire department communications center alarm consoles for both large and small cities. Write to Bliss-Gamewell, 208 W. Central St., Natick, Mass. 01760.

INSTITUTIONAL STAND-BY POWER

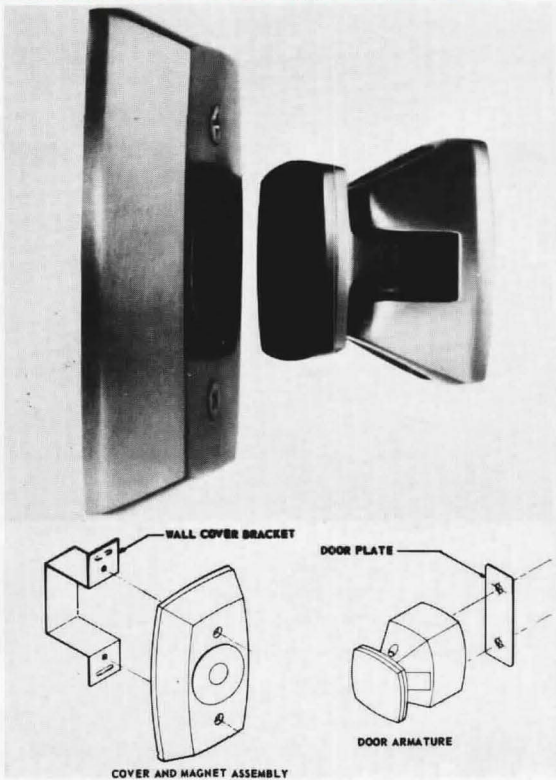


Onan, Division of Studebaker Corp., 2515 University Ave. SE, Minneapolis, Minn. 55414, announces a new

PLUG-IN THERMAL DETECTORS

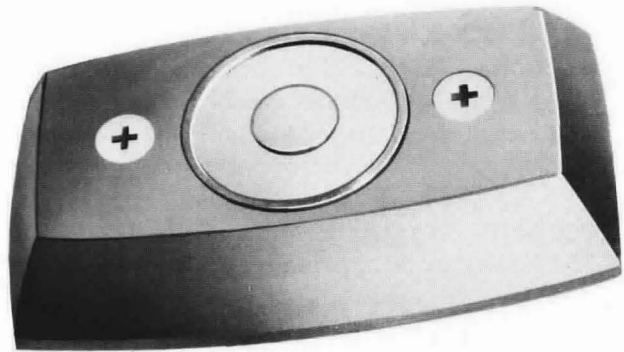


Pyrotronics, Inc., a subsidiary of Baker Industries, 2343 Morris Ave., Union, N.J. 07083, has added thermal detectors to its line of fire and smoke detection devices. The detectors are available with self-restoring (see right) or nonrestoring (left) fixed-temperature elements. The manufacturer now provides plug-in detectors to sense heat, infrared detectors to sense flame, photo-electric detectors to sense visible smoke, and ionization detectors to sense incipient combustion.

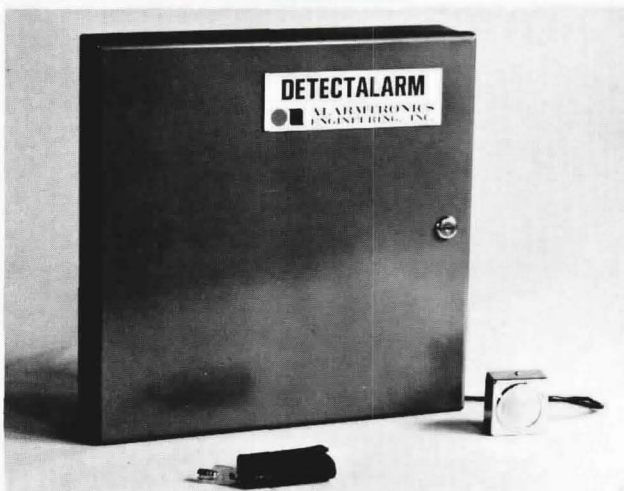
ELECTROMAGNETIC DOOR HOLDER/RELEASE

A new UL-listed electromagnetic door holder/release for fire and smoke barriers is described in the four-page catalog E-150.52 by Notifier Corporation, 3700 N. 56th St., Lincoln, Neb. 68504.

in commercial or residential buildings. Vibration, smoke, fire, flooding, and freezer monitoring sensors can be added to the Detectalarm.

DOOR HOLDER-RELEASE BUTTON

Firemark, Div. of Rixson, Inc., 9100 W. Belmont Ave., Franklin Park, Ill. 60131, announces that a positive release button, an innovation in door holder releases, will be standard on all door portions of the company's electromagnetic door holder-releases. The spring-loaded button, smaller than the head of a kitchen match, will set the door in closing motion whenever power to the electromagnet is turned off.

UL-LISTED INTRUDER DETECTOR

Alarmtronics Engineering, Inc., 154 California St., Needham, Mass. 02195, is now marketing its UL-listed ultrasensitive intruder detection system. The slightest sound of forced entry can alert police or set off alarms

NEW REMOTE ALARM LAMPS

Pyrotronics, Inc., 2343 Morris Ave., Union, N.J. 07083, is marketing two new remote alarm lamps, Models RAL-1 (above left) and RAL-2 (above right). These lamps can be used to indicate the alarming of fire detection devices located above hung ceilings, below raised floors, or in closets, vaults, or remote storage areas.

NFPA Library Accessions



Listed below are selected publications recently received by the National Fire Protection Association Technical Reference Library. A Code Number is assigned to each article for filing and information retrieval purposes, in accordance with the published NFPA Library Classification System for Fire Protection (available in pamphlet form, \$1.75 each copy). Readers interested in securing copies of any of these titles are urged to note the supplied source data.

LOSS OF LIFE AND PROPERTY BY FIRE

"Aluminium and the Gas Ignition Risk." From *The Engineer* (London), H. S. Eisner, February 17, 1967, Vol. 223, No. 5795, pp. 259-60.

1.4B.5a

Proceedings: Tripartite Technical Cooperation Program Panel N-3 (Thermal Radiation), Mass Fire Research Symposium (DASA 1949) (DASIAC Special Report 59). Washington, D.C. 20305: Defense Atomic Support Agency, DASA Information and Analysis Center, October 1967, 443 pages.

1.5A

World War II German Fire Document Translations (NRDL-TRC-67-41). C. F. Miller. Menlo Park, Calif.: Stanford Research Institute, for Office of Civil Defense, Washington, D.C., July 1967, 105 pages.

1.5B

Field Notes on World War II German Fire Experience (SRI Project No. MU-5070). C. F. Miller and J. W. Kerr. Menlo Park, Calif. Stanford Research Institute, for Office of Civil Defense, Washington, D.C. October 1965, 73 pages.

1.5B

FIRE PROTECTION AND ALLIED ORGANIZATIONS

Research and Technologic Work on Explosives, Explosions and Flames: Fiscal Year 1966 (IC 8349). Washington, D.C.: Bureau of Mines, U.S. Department of the Interior, September 1967, 21 pages, no charge.¹

2.4

Fire Research 1966, Report of the Fire Research Steering Committee with the Report of the Director of Fire Research. London, England: Ministry of Technology and Fire Offices' Committee, Joint Fire Research Organiza-

tion, Her Majesty's Stationery Office, 1967, 107 pages, \$1.80. Write: British Information Services, 845 Third Ave., New York, N.Y. 10022.

2.8

FIRE PROT. STANDARDS, LAWS & ENGINEERING Building Fire Safety Design Standard. Toronto, Ontario, Canada: Department of the Attorney-General, 204 Richmond St. W., September 1967, 95 pages.

3.1E

Statutes and Regulations Respecting Fire Safety and Fire Prevention. Attorney-General and Fire Marshal. Toronto, Ontario, Canada: Department of the Attorney-General, 204 Richmond St. W., August 1967, 296 pages.

3.1E

FIRE HAZARD PROPERTIES OF MATERIALS

Flammability of Materials in Hyperbaric Atmospheres (Final Report No. 4016). J. M. Kuchta, E. L. Litchfield, and A. L. Furno. Pittsburgh, Pa.: Explosives Research Center, Bureau of Mines, U.S. Department of the Interior, 30 August 1967, 57 pages, no charge.²

6.1C.11

"An Improved Fire Resistance Test for Thermoplastic Fabrics." From *American Dyestuff Reporter*, A. S. Endler and M. L. Hurwitz, September 11, 1967, pp. 23-6.

6.7A

Aluminium and the Gas Ignition Risk. See Item 1.4B.5a above for complete reference.

6.6B1

The Influence of a Fire-Retardant Undercoat on the Burning Characteristics of a Combustible Topcoat (NRL Report 6548) (AD 653 062). T. R. Walton. Washington, D.C.: Naval Research Laboratory, 22 May 1967, 17 pages, \$3.00.

6.8B.4

Ignition Hardening of Cellulosic Materials (USNRDL-TR-67-125). N. J. Alvares and T. H. Anderson. San Francisco, Calif. 94135: U.S. Naval Radiological Defense Laboratory, 10 August 1967, 27 pages.

6.8I.3

Screening of Flame-Resistant Materials and Comparison of Helium with Nitrogen for Use in Diving Atmospheres: First Annual Report on Combustion Safety in Diving Atmospheres (AD 651 583). G. A. Cook, B. M. Shields, and R. E. Meierer. Tonawanda, N.Y.; Linde Division of Union Carbide Corporation, for Office of Naval Research, U.S. Navy, Washington, D.C., 31 March 1967, 192 pages, \$3.00.³

6.8I.7

"Combustibility Tests on Several Flame-Resistant Fabrics in Compressed Air, Oxygen-Enriched Air, and Pure Oxygen." From *Textile Research Journal*, G. A. Cook, B. M. Shields, and R. E. Meierer, Vol. 7, July 1967, pp. 591-9 (summary of Report AD 651 583 listed above).

6.87.7

¹ See Footnote 1.

² Write: Publications Distribution Branch, Bureau of Mines, U.S. Department of the Interior, 4800 Forbes Avenue, Pittsburgh, Pennsylvania 15213.

³ Write: Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151.

Isothermal Degradation of Untreated and Fire Retardant Treated Cellulose at 350° C. (USNRDL-TR-67-89) (AD 658 717). A. E. Lipska. San Francisco, Calif. 94135: U.S. Naval Radiological Defense Laboratory, 23 February 1967, 22 pages, \$3.00.⁴ 6.8E

BUILDINGS AND OTHER STRUCTURES

Fire Hazard of Conveyor Belts (RI 7053). D. W. Mitchell, E. M. Murphy, A. F. Smith, and S. P. Polack. Washington, D.C.: Bureau of Mines, U.S. Department of the Interior, December 1967, 14 pages, no charge.⁵ 8.1C.3f

Noncombustible Building Construction Material (Special Interest Bulletin No. 294) (revised). New York, N.Y. 10038: Engineering & Safety Department, American Insurance Association, 85 John St., August 1967, one page. 8.1E.1

"Fire: A New Look at Old Problems." From *Architectural and Engineering News*, R. S. Moulton, April 1967, pp. 68-72, 75. 8.1J.2

National Building Code, 1967 Edition, Abbreviated. New York, N.Y. 10038: American Insurance Association, 85 John St., 1967, 114 pages. 8.1J.2a

Fire Resistance of Steel Deck Floor Assemblies (Building Science Series 11). H. Shoub and S. H. Ingberg. Washington, D.C.: Building Research Division, Institute for Applied Technology, National Bureau of Standards, December 1967, 24 pages, 25¢. Write: Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. 8.4B

Field Burnout Tests of Apartment Dwelling Units (Building Science Series No. 10). D. Gross, Washington, D.C.: National Bureau of Standards, U.S. Department of Commerce, September 29, 1967, 23 pages, 25¢. 8.8G

Diagrams for the Approximate Assessment of Radiation Exposure Hazards from Fires in Buildings (UP No. 153). J. J. Keough. Commonwealth of Australia: Department of Works, Commonwealth Experimental Building Station, July 1963, 27 pages. Write: Box 30, Chatswood, N.S.W., Australia. 8.13C

BUILDING EQUIPMENT AND FACILITIES

Application of the National Electrical Code and Underwriters' Laboratories, Inc., Requirements to Electrical Equipment for Hazardous Locations. R. Lloyd. Presented at the General Program of the Petroleum Industry Conference in Philadelphia, Pa., October 2-4, 1967. Write to the author at Underwriters' Laboratories, Inc., 1285 Walt Whitman Rd., Melville, L.I., N.Y. 11746. 9.3K.1

PUBLIC FIRE SERVICES

The Grading of Municipal Fire Protection Facilities, Its Relationship to Fire Insurance and to the Municipality's Fire Protection Policy. Washington, D.C. 20006: National League of Cities, 1612 K St., N.W., July 1967, 145 pages, \$5.00. 10.1C.4

"Documentation of Lightning Discharges and Resultant Forest Fires" (Research Note INT-68). D. M. Fuquay, R. G. Baughman, A. R. Taylor, and R. G. Hawe. Ogden, Utah: Intermountain Forest and Range Experiment Station, for Forest Service, U.S. Department of Agriculture, Washington, D.C., 1967, 7 pages. 10.5B.3c

"Aerial Forest Fire Control." D. G. Gould, Reprint from *DME/NAE Quarterly Bulletin*, No. 1967 (1), National Research Council of Canada, pp. 55-71. 10.5B.3f

EXTINGUISHING AGENTS

Full-Scale Fire Modeling Test Studies of "Light Water" and Protein Type Foams (NRL Report 6573) (AD 658 318). H. B. Peterson, E. J. Jablonski, R. R. Neill, R. L. Gipe, and R. L. Tuve. Washington, D.C.: Naval Research Laboratory, 15 August 1967, 58 pages, \$3.00.⁸ 15.4B

PROTECTION SYSTEMS FOR SPECIAL HAZARDS

"The Venting of Pentane Vapour - Air Explosions in a Large Vessel." From *Combustion and Flame*, Journal of the Combustion Institute, G. F. P. Harris and P. C. Briscoe, Vol. 11, No. 4 (August 1967), pp. 329-38. 17.7B

Control of Static Electricity (Special Hazards Bulletin Z-79). New York, N.Y. 10038: Engineering & Safety Department, American Insurance Association, 85 John St., September 1967, 10 pages. 17.8

ATOMIC ENERGY

Compilation of National and International Nuclear Standards (Excluding U.S. Activities), Third Edition. W. B. Cotrell, Chairman, NBS Special Subcommittee, United States of America Standards Institute, Oak Ridge, Tenn.: Oak Ridge National Laboratory, October 1967, 59 pages, \$3.00. Write: Clearinghouse, Springfield, Va. 22151. 19.2B

Major Aircraft Fires: Symposium No. 1. Fire Research Station, London, England: Ministry of Technology & Fire Offices' Committee Joint Fire Research Organization, Her Majesty's Stationery Office, December 9, 1966, 107 pages, \$5.50. Write: Sales Section, British Information Service, 845 Third Ave., New York, N.Y. 10022. 20.1A.1

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Crash Survival Design Guide (AD 656 621). J. W. Turnbow, D. F. Carroll, J. L. Haley, Jr., W. H. Read, S. H. Robertson, and L. W. T. Weinburg. Phoenix, Ariz.: Aviation Safety Engineering and Research, Flight Safety Foundation, Inc., July 1967, 267 pages, \$3.00. 20.1M

GENERAL REFERENCE WORKS

Fire Protection Directory 1968, Incorporating Fire Brigades of the World, 28th Edition. London, E.C. 4, England: Benn Brothers, Ltd., Bouverie House, Fleet St., 1967, 452 pages, 40s. 24.1B

Handbook of Industrial Loss Prevention, Recommended Practices for the Protection of Property and Processes Against Damage by Fire, Explosion, Lightning, Wind, Earthquake, Second Edition. Prepared by the Staff of the Factory Mutual Engineering Corporation. New York, N.Y. 10038: McGraw-Hill Book Company, 330 West 42nd St., 1967, 885 pages, \$27.00. 24.1D

⁴ See Footnote 3.

⁵ See Footnote 1.

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Letters to the Association



Necessarily, letters written to the Association are usually answered by various members of the Executive Office Staff. Where answers concern interpretations of Standards, advice is sought from the appropriate Technical Committee, or a copy of the reply is sent to the Chairman of the Committee, to assure maximum accuracy.

Readers are invited to comment, for publication, on any of the questions and answers below and on any article in *FIRE JOURNAL*. The editors reserve the right to digest comments.

BLANKETS AND OTHER NONCLOTHING FABRICS

To Louis Segal, Chairman, NFPA Committee on Wearing Apparel (from a Member of Congress):

I should appreciate information on the types of highly flammable fiber products on the market, such as certain types of blankets.

Answer:

[In the opening paragraph of his reply Mr. Segal discussed the clothing-fire problem. The following are Mr. Segal's views on the fire hazards of nonclothing fabrics.]

Your mention of the fire hazard properties of blankets leads me into another very important aspect of the over-all problem of flammable fabrics. You will note that in all the discussion above, we have been dealing exclusively with the problem of flammable clothing. Please forgive my entering an objection to the all too common practice of discussing flammable drapery fabrics, bedding fabrics, and clothing fabrics, together with furniture, carpeting, and even fuzzy children's toys, as if the hazards were the same. The hazards, the problems, and the solutions are most emphatically not the same, nor are they even similar in most respects, and I should like to explain why.

Many products commonly used by consumers are flammable to one degree or another. The degree of flammability is inherent in the material itself, and depends on its chemical and physical properties. But to give a proper evaluation of the actual fire risk of a product to its user, it is essential to include the manner and the environment of the use.

In simplified terminology, the phenomenon we call fire or burning requires three elements: fuel, air, and a source of ignition. Assuming air always to be readily available, we can narrow the requisites to two. The situation now can be likened in a sense to the potential for disaster inherent in a large body of water stored behind a dam. The potential is always there, but the hazard is nonexistent as long as the dam holds. By the same token, no matter how flammable a fabric or any other material may be, it does not manifest its hazard until it becomes ignited. This all-important factor of a required source of ignition is overlooked or not even recognized by many people in their evaluations of fire risks.

To illustrate this point, let us consider the relative hazards of a highly flammable fabric used for a blanket and the same fabric used for an article of clothing. In my opinion, there is no comparison between the two. The fire risk of the blanket is virtually negligible; of the clothing, very high. The difference lies in the use and the environment—more specifically, the potential for exposure to possible sources of ignition. An article of clothing could be ignited from contact with the kitchen range, a room heater, a candle on a birthday cake, the backyard incinerator, a bonfire or barbecue, a piece of a burning match head, or a dropped cigarette lighter. Compare all this with the possible exposures to a blanket on a bed. For nonsmokers there would be none; and even those foolish enough to smoke in bed rarely use matches and lighters so carelessly as to serve as sources of ignition of blankets.

I am very much aware of the propaganda long circulated from various sources about the supposed hazard of highly flammable blankets. Yet, to the best of my knowledge, the record speaks for itself. Every year there are thousands of incidents of ignition of clothing, but there is virtually no record of blanket fires. In this regard it is vitally important to recognize that all of this has nothing to do with the mechanism of the typical, deadly smoking-in-bed fire. There the villain is smoldering combustion over a long period of time initiated by a burning cigarette, and the relative flammability of blankets is immaterial.

Finally, there is another important difference between the hazard of a flammable blanket and that of an equally flammable article of clothing. Should one be lying in bed and accidentally ignite the top blanket, in all likelihood he would be able to escape from the fire without any particular difficulty. This is certainly not true in the case of clothing, where escape is virtually impossible. The normal reaction, to run from the fire, is the worst thing a person can do if his clothes are burning.

My opinion is the same on flammability standards for decorative materials, such as drapery fabrics for home use. One can justify flammability limits for draperies in public places. The terror of panic, which has caused the death of great numbers of people in many tragic fires, justifies the imposition of rigid fire safety measures in occupancies in which large numbers of people may gather. The life hazard to occupants of a private residence cannot be compared with the hazard in a public place such as a theater, a night club, or a restaurant. The same life hazard situation simply does not exist in the home. I certainly agree that it would be very desirable if all home furnishings were more fire-safe, but unfortunately a panacea is not yet attainable for many reasons, not the least of which are the economic implications for both the consumer and the textile industry.

Taking all these factors into consideration, I hope I have presented a convincing argument to support my conviction that one should not and actually cannot evaluate the fire risks of products without proper consideration of all the elements involved, including the conditions of use.

ELECTRICAL GROUNDING FOR AIRCRAFT

To NFPA:

We are in the process of reviewing USAF requirements and practices for electrical grounding of aircraft and support equipment during servicing and maintenance and while the aircraft

are parked outside hangars. Please give comments and recommendations on the following questions.

1. What is an adequate resistance criterion for earth ground rods? These ground rods are used for static drains, lightning protection, fault current and shock hazard protection, etc.

2. Are there recommendations or standards for inspection and maintenance of ground rods? Of particular interest are such factors as frequency of inspection, measurement techniques, and permanent written records.

3. Are there recommendations or standards for grounding of maintenance and servicing equipment used in aircraft-servicing (liquid oxygen, electric tools, hydraulics, generators, maintenance stands, etc.)? Should this equipment be connected to a ground rod, the aircraft, or both?

4. How can the workmen best be protected if there is a lightning storm near by? It is not practical to suspend operations until the last moment because of the high rate of false alarms.

Answer:

There are a number of NFPA Standards covering various aspects of aircraft-servicing and maintenance, including grounding. I am enclosing a list of our publications. The following comments are an attempt to answer your specific questions.

1. There are differences in allowable resistances for grounding to 1) control the accumulation of electrostatic charges; 2) to dissipate lightning-induced charges; and 3) to minimize the shock and fire hazards in case fault conditions have developed in electrical wiring or equipment. The needs must be separately analyzed and evaluated and the grounding method tailored to the hazard conditions.

Grounding facilities for clearing fault currents that present both fire and shock hazards should provide a very low impedance path for the fault current to facilitate rapid operation of the overcurrent device and remove the source of the fault current.

A much higher resistance than this will provide an adequate degree of protection against both lightning surges and static. Static electricity has an extremely low current value at a high voltage. Lightning surges have a high current value, but those values are proportionately small in relation to the voltage.

Shocks from static electricity are normally not dangerous unless they cause a person to react in a way to hurt himself or cause other hazards while reacting to the shock. Hence, in the case of static discharge the major objective is protection against fire. In the case of lightning, however, the available currents passing through a high-resistance ground path have a high difference of potential between two fairly close points, such as between the feet of a person walking or stepping in the area of earth dissipation of the lightning charge. This makes widespread dissipation paths desirable as well as reasonably low resistance to the earth.

The ohmic resistance of ground rods varies widely, depending upon the resistivity of the earth at the point where they are driven or buried. In moist clay soil, an eight- or ten-foot copper rod ½-inch in diameter would probably have a resistance to ground of between 10 and 50 ohms; but in an average soil of this type, it probably would average 15 ohms.

2. I do not personally know of any standards for inspection requirements for ground rods. A note following Section 250-84 of the *National Electrical Code* recommends "... that single electrode grounds when installed, and periodically afterwards, be tested for resistance." This can best be done by ground resistance-testing instruments that read directly in ohms (which are different from an insulation resistance-testing instrument that also reads in ohms and in megohms). There are a number of manufacturers of such instruments who would be glad to provide you with recommendations and techniques.

3. For this, I can recommend NFPA Standards and Recommended Practices, as follows:

No. 407, 1967 (USAS Z119.1 — 1967), *Standard for Aircraft Fuel Servicing* (note particularly Section 220 and Appendix B, but check the entire Code);

No. 77, 1966, *Recommended Practice on Static Electricity* (in entirety, but particularly Section 310);

No. 78, 1965 (USAS C5-1 — 1965), *Lightning Protection Code* (in entirety, but particularly 2175, 2176, and all of Section 25);

No. 70, 1965 (USAS C1 — 1965), *National Electrical Code* (particularly Article 513).

4. NFPA No. 78 gives hints to provide protection of personnel from lightning exposure. Your office will have to judge whether any of this guidance would be practical for USAF personnel working on aircraft outdoors. The simplest area of refuge is a lightning-protected hangar, an automobile or truck with metal top and body, or even a metal aircraft not undergoing hazardous maintenance.

RIGID METAL CONDUIT VS. NONMETALLIC SHEATHED CABLE

To NFPA (from a building commissioner):

A recent issue of a national magazine contained an article entitled "Obsolete Building Codes" that was critical of communities that require rigid electrical conduit when nonmetallic sheathed cable can do the same job at less cost. Several years ago our city enacted an ordinance requiring the use of conduit in apartment construction. The apartment builders have always protested the requirement on the grounds that it contributes nothing to safety or value. If we are out of step, I would be happy to reconsider the matter, and I would greatly appreciate any information or recommendations that you might be able to give me.

Answer (from Walter R. Stone, Editorial Coordinator, NEC):

The *National Electrical Code* is formulated in accordance with the procedures of the USA Standards Institute and was adopted by the USASI as a USA Standard (USAS C1 — 1965). Before such a code can become a USA standard, it must have a consensus of all the representative groups concerned; and each representative group consists of nationally recognized experts in their respective fields. The NEC is revised and updated at three-year intervals. The NFPA feels, therefore, that the *National Electrical Code* is a reliable document suitable for local adoption without changes.

In my opinion, nonmetallic sheathed cable, Types NM and NMC, or any other wiring recognized by the *National Electrical Code*, is reasonably safe when installed in accordance with NEC rules. There are restrictions on the use of nonmetallic sheathed cable, as there are on other types of wiring. Yet there are a great many acceptable uses for nonmetallic sheathed cable, including use for most of the wiring in multiple-family dwellings and in most types of commercial buildings. There are a great many buildings, including apartment houses, that contain this type of wiring.

It may be of interest to you to know that local adoption practices have not been consistent in their "exclusion" clauses. By that, I mean one municipality or region may prohibit Type SE cable and permit electrical metallic tubing for services, as one example, and another area will prohibit electrical metallic tubing and permit Type SE cable. In each case, the "reason" given is that the excluded or prohibited type of wiring is not safe, even though both types (and others) are permitted by the NEC and have been in use for many years where locally permitted.

Nearly everybody seems to agree that nationwide standardization is desirable, but not everybody seems willing to practice it or bring it about. There are those who contend that it is not safe to wire apartment houses with nonmetallic sheathed cable. The National Electrical Code Committee feels that it is when properly installed. The NFPA agrees with the NEC Committee, which it sponsors.

Therefore I can in good conscience recommend that you adopt the *National Electrical Code* without any changes.

AUTOMATIC SPRINKLERS: HOW MUCH WATER?

To NFPA (from M. M. Brown, Assistant Vice-President and Chief Engineer, Commerce and Industry Insurance Company):

Although it is provocative, the article "Automatic Sprinklers: How Much Water?" in the January 1968 FIRE JOURNAL shows a faulty approach. Its tabulation of satisfactory sprinkler operations and its derived averages of numbers of sprinklers operated are intended to prove that general water supply requirements are excessive.

An engineering approach to any design problem demands consideration of adverse, not average conditions. If one were to extend the average idea further, he could study all fires and find that in the average fire no sprinklers operate; hence, sprinklers are not necessary. Or, in determining how much insurance protection to buy, one could decide to buy only enough to cover the average-sized loss.

Additional expenditure to provide a good margin of safety is not necessarily "overdesign," especially if the added protection is cheap in relation to the major expenditure and to that which is being protected. Fire protection involves economic problems that do not generally lend themselves to "average" bases for solution.

HIGH-EXPANSION FOAM

To NFPA (from a fire chief):

To my way of thinking, Will B. Jamison, the author of "High-Expansion Foam in the Fire Department," in the November 1967 FIRE JOURNAL, has left out some important points regarding high-expansion foam in its use as a fire-extinguishing agent.

Once the foam surrounds the fire, it performs a very important function in preventing easy and rapid movement of air into the point of combustion. True, one must not dismiss the smothering action of the steam formed from the water in the foam, the cooling effect of the water, and the transfer of heat in formation of steam, but it is also necessary to take into account interference in the free motion of air.

Another advantage not mentioned in the article is the protec-

tion given by the foam to any occupants who might be trapped in a building. While there may be some dangers yet to be investigated, surely it cannot be more hazardous for a person to be covered with foam than to be exposed to fumes, superheated air, or fire itself.

Regarding the filling of a closed building, the following statement is made: "Thus, the fan of the foam generator must be able to deliver the required quantity of air to move the foam against the pressures at the time of a fire. It is fundamental that a fan running at constant speed will deliver a lower volume of air as the pressure is increased." I hold no argument against this, but nowhere do I see that tests have been made using a Roots-type blower, which is a rotary, positive-pressure blower. Depending on the designed volume production of the blower and the ability of the power source to maintain the speed of the rotors, it will continue to deliver foam against any back pressure to be encountered in a building fire.

I take issue with any tests I have seen or read about in the extinguishment of Class B fires. In all instances the conditions have been simple and controlled. Flaming oil has been confined within a receptacle.

How often will a fire department meet such a condition in an emergency? More than likely, they will find that a tanker has overturned or run into an abutment. The tank has ruptured, and flaming oil or gasoline is running along the roadway into a gutter or ditch and it may well be soaking into the ground beside the roadway. Probably there are flames over an area of several thousand square feet and running away. Also, what may have soaked into the ground will make a perfect setup for a dangerous flashback.

This is not to detract one whit from the ability of high-expansion foam to cope with such a situation, but I do think it would be much more to the point to run tests under such conditions and to develop appropriate generators. Engine companies must meet and fight whatever they face, and generators will have to be set up while oil is burning and flowing.

High-expansion foam, I believe, is on the verge of a new breakthrough in fire-fighting. Let the fire service and their suppliers develop it to the utmost, taking into consideration the types of fires that will be met and learning how to deal with them.

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