School Fire Safety

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FOREWORD

SCHOOL FIRES ENDANGER the lives of the pupils who are required or permitted to attend school, cause property losses, and may disrupt the school program for weeks or months. The schools have an obligation to develop and maintain fire-safe conditions in the school plants. Local and State school and other officials, teachers, parents, and custodians must accept a share of this responsibility. Sustained school fire safety requires careful planning and continued vigilance.

School Fire Safety stresses the importance of safe conditions in school plants, lists various hazards, and outlines certain procedures for avoiding or eliminating some of these hazards. It is designed as a guide for those interested in and responsible for school safety. However, the various sections should be of value to teachers as source material for class instruction in fire safety.

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SCHOOL FIRE SAFETY

SCHOOL FIRES ENDANGER pupils' lives and take annually a heavy toll in school property losses. Fortunately many school fires occur when the buildings are not occupied, and to some extent the life hazard is reduced. Fire hazards are present in many buildings. If not controlled, these potentials may be changed quickly into serious losses.

School officials, teachers, parents, and the public have an interest in school fire safety. Because of other interests and a lack of assigned responsibility in this area fire safety is too often neglected. With effective and sustained school fire safety programs the fire hazards may be reduced to a minimum.

Some factors in successful school fire safety programs are, for those in charge:

1. An awareness of the importance of fire safety in schools.
2. A knowledge of the nature and effect of fire
3. The ability to recognize fire hazards.
4. Some knowledge of the procedures for eliminating fire hazards, and for fire detection and extinguishment.
5. Untiring vigilance by all having concern or responsibilities in these areas.
6. A school or school and community organization to maintain fire safety.

Maintaining school fire safety would be a simple matter if all hazards could be removed, never to return again, in one campaign. This possibility does not exist. School fire hazards may develop in unexpected areas and at unexpected times.

School fire protection should begin with the planning of the building and should be a principal factor in many essential remodeling programs. It should be an integral part of all school-plant management programs. School activities should be so planned that the creation of fire hazards will be reduced to a minimum.

In order to develop and maintain an adequate program of fire protection the school administrator should have some knowledge of the problems involved. He should be able to interest his coworkers and community citizens in fire safety and to obtain their continued cooperation in maintaining safe conditions. He should know where to go for added information and assistance.

The following information and suggestions on school fire protection are not intended to provide a complete list of all of the fire hazards found in schools or to indicate all possible corrections. It is hoped that these suggestions will assist in directing attention to existing and potential fire hazards, and will indicate the need for adequate protection. The information outlined here should serve as source material for those responsible for school-plant fire safety.

In a few instances where emphasis seems necessary, information on a certain hazard may be included in more than one section.

I. Responsibility and Need for Fire Safety Programs

School and Community Responsibility

In the United States we generally accept the principle of compulsory education for youth to some acceptable age or achievement level. This carries with it a public obligation to *provide a maximum degree of fire safety in the schools these pupils are forced or permitted to attend.*

1. Scope of responsibility.
   - (*a*) The first or most important part of this obligation is for the protection of the lives and bodies of all who use the school buildings.
     - (1) Students are required to attend school.
     - (2) Patrons, teachers, and others are encouraged or permitted to use the school buildings.
   - (*b*) The obligation also applies to the protection of large investments in school plants.
     - (1) The loss of school plants destroyed by fire is complete. There is no return. Replacement may create a heavy tax burden.
     - (2) If replacement is delayed, educational progress may be seriously impeded.
   - (*c*) It applies alike to schools at all levels from the one-room rural school, through the metropolitan secondary school, to the colleges or universities.
2. Placing responsibility for protection.
   - (*a*) The responsibility for protecting school students is definitely a moral and, in some cases it may be a legal obligation.
   - (*b*) The parents and the general public must accept a part of the obligation to provide fire safe conditions.
     - (1) The citizens should hold school officials responsible for developing and maintaining safe conditions.
     - (2) Parents would be justified in requiring that school buildings be made reasonably fire safe before permitting their children to be endangered in them.
   - (*c*) Principals, teachers, and custodians charged with the operation and care of the local school plant have responsibilities for fire safety within their spheres of action. In accepting a position in the

school, each school employee or official also accepts certain responsibilities. Negligence on the part of any school employee in the matter of fire safety may lead to disastrous results.

(*d*) The State, here represented by officials of the State department of education or by other designated officials, has a definite obligation to promote the development and maintenance of reasonable fire safety for all students attending school in the State.

(*e*) The principal obligation for fire safety in the local schools falls on the administrative officials and staff responsible for organizing, directing, and financing the local school program.

(1) These officials should plan the safety programs, direct employees in plant-care programs, and hold them accountable for results.

(2) Ignorance of existing conditions, of the need for improvements, or of procedures to be followed are not valid excuses for the failure of these officials to maintain reasonable degrees of fire safety. The official who does not know how to maintain fire safe conditions should seek the advice of those who do know.

School fires

In order to develop and maintain successful fire safety program the school administrator should know something of the nature of fires, the dangers of loss, the usual causes of fires, and the places where school fires may originate.

1. The nature of school fires.

(*a*) Most school fires start small and can be controlled if attacked early. Probably 80 percent of all school fires could be checked easily in the early stages.

(*b*) Fires do not start without combustible fuels and without enough heat to bring this fuel to the kindling point. Controls involve prevention, the elimination of adjacent combustible fuels, and extinguishment which is usually done by cooling to below the kindling point or smothering by cutting off the oxygen supply.

(*c*) Uncontrolled fire can be a merciless enemy, destroying life and property and leaving ruin, sorrow, and pain in its wake.

2. School fire dangers.

School officials should understand the potential dangers of school fires. *They should realize that pupils are perishable but not expendable.* Carelessness in pupil safety is inexcusable, and education would be of of little value to the pupil who fails to get out of a burning building.

(*a*) Fire dangers are present in many school buildings, and new ones may develop quickly.

(1) It often requires a catastrophe to awaken people to some of the school fire hazards. Even then, unless the loss is made vivid by its nearness, they may drop back quickly into a self-satisfied feeling of safety.

(2) The feeling that it can't happen in our school may be dangerous.

(*b*) Each school fire represents a potential loss of life and/or property.

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(1) The National Fire Protection Association [1] estimates that during the years 1930–45 there were on the average more than 2,100 school fires a year. The reported loss of lives in 31 school fires during the years 1930–45 was 395.[2] This is not necessarily a complete listing for these years.

(2) It is difficult to obtain accurate data on school property fire losses. The National Fire Protection Association estimates of average school and college property fire loss in the United States for the years 1941–45, inclusive, were about $7,500,000 [3] per year. Reliable data on school life and property losses for the years 1946–50 are not yet available. General property losses seem to be increasing.

(c) School fires occur in nearly all types of school buildings.

The following sample headlines on school fires were selected at random from a limited coverage of newspapers for a period of 3 months from January 11, 1947, to April 11, 1947.

"School Swept by Flames on Northside"
Pittsburgh, Pa., *Post-Gazette*, 1/11/47

"300 Escape School Fire"—at Basketball Game
Newark, N. J., *News*, 1/14/47

"275 Children Escape School Fire in 'Drill' "
Minneapolis, *Tribune*, 1/21/47

"230 Safe in St. Martin's School Fire, Policeman Going to Blaze Killed ——"
Louisville, Ky., *Courier-Journal*, 1/23/47

"High School Blast Kills 4 Burns 5" at Monroe City
New York, *World Telegram* (AP) 1/23/47

"Cranston School Damaged By Fire"
Providence, R. I., *Journal*, 1/24/47

"Students Suffer Flash Fire Burns"
Birmingham, Ala., *Age-Herald*, 1/28/47

"88 Flee Flames, School Destroyed"
Philadelphia, *Inquirer*, 2/6/47

"Dormitory Fire Routs 65 Students"
Philadelphia, *Inquirer*, 2/8/47

"800 Children Escape Uninjured at Fire Levels Hazelhurst School"
Atlanta, *Constitution*, 2/11/47

"Hundreds of Students Escape School Blaze" at Warren
Erie, Pa., *Disptach-Herald*, 2/22/47

"900 Walk to Safety in High School Fire"
New York, *World Telegram*, 2/24/47

"Maine Nuns Save Pupils in Blaze"
Boston, *Herald*, 2/25/47

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[1] "School Fires," National Fire Protection Association, Boston, 1946. p. 5.
[2] Crosby, Fiske Forster, *Handbook of Fire Protection*. Boston, National Fire Protection Association, 1948. p. 5.
[3] Op. cit., p. 12.

"Students Flee in Connecticut Dormitory Fire"
New York, *Herald Tribune*, 2/26/47

"1500 March Out of ------, N. J. School as Smoke Fills Halls"
New York Times, 3/14/47

"Girl 19, Woman 68 Die in College Fire"
New York Times, 3/14/47

"300 Small Pupils Left Classrooms Shortly Before Janitor Discovers Blaze ------"
Wheeling, W. Va., *Intelligencer*, 3/15/47

"Service Slated Today for Girl Missing in (Junior College) Fire"
Rochester, N. Y., *Democrat and Chronicle*, 3/16/47

"Fire Destroys High School"
New York, *Herald Tribune*, 3/19/47

"Fire at College"
Dallas, *News*, 3/20/47

"Girl 12 Seriously Burned in School Cooking Class"
Baltimore, *Evening Sun*, 3/24/47

"Speedy Action by Six Checks Spread of Fire on Auditorium Stage"
Atlantic City, N. J. *Press*, 4/2/47

"Hint Vandals to Blame in School Fire"
Minneapolis, *Star*, 4/4/47

"Blast, Fire Damage School at Bishopville"
Charleston, S. C., *News and Courier*, 4/9/47

"250 Pupils Routed by School Blasts"
Philadelphia, *Inquirer*, 4/11/47

3. Causes of School Fires.

School fires may originate from various causes. Some of these causes result from the types of activities carried on in the building, some from outside exposures, some from defective building or equipment parts, and some from carelessness.

The causes of 1,116 school fires as reported by the N. F. P. A.[4] were divided as follows:

	Percent		Percent
Heating defects	18.0	Careless handling of flammable liquids[1]	4.9
Faulty equipment	10.0	Special hazards associated with manual training	4.6
Defective or poorly installed chimneys or flues	6.4	Open-flame devices in laboratories and kitchens igniting combustible materials	4.4
Careless disposal of hot ashes or coals	1.6		

[1] Including use of flammable liquids in laboratories.
[4] Op. cit. p. 1270.

	Percent		Percent
Misuse of electricity	17.0	Explosions (gas heating, chemical, and flammable vapors)	3.0
Smoking and matches	12.1	Lightning	3.0
Spontaneous ignition of oily rags or materials	10.3	Exposure	2.7
Incendiary (arson)	8.8	Miscellaneous	6.2
Improper rubbish disposal methods	5.0	Total	100.0

4. School building hot spots.

It is desirable to know the hot spots, the places in school buildings where fires are most likely to originate. The N. F. P. A.[5] showed that for 613 school fires the places of origin were: for student-occupied areas about 36.5 percent of all fires; for service areas, 34.1 percent; from outside, 12.4 percent; and for miscellaneous known places of origin, about 17.0 percent. This record also showed the specific areas in which these fires originated. Some of the reported points of origin of these 613 school fires were:

	Percent		Percent
Classrooms	7.5	Kitchens	2.4
Workshops, laboratories	11.3	Roofs	7.8
Auditorium, gymnasiums	8.6	Yards	2.6
Furnace rooms	8.3	Outside building	1.8
Basements	14.2	Attics-roof space	3.6
Closets, storerooms	7.2		

As indicated, fires occur in all types of buildings. One record [6] of 764 school fires showed that nearly 70 percent of the fires reported occurred in buildings with masonry walls and wooden interiors. However, some of these fires occurred in fire-resistive buildings.

II. Furnace Rooms—Heating and Ventilating Systems

HEATING AND VENTILATING systems are the sources of many school fires. The nature and use of the heating plant create potential fire hazards. However, suitable construction and adequate care and control will reduce these hazards to a minimum.

Furnace rooms

The furnace room is one of the hot spots in the school building and numerous school fires originate there. It often has combustibles for fuel and heat which together may create serious fire hazards. It is usually somewhat segregated and is often unattended while the custodian is in another part of the building.

[5] "School Fires." National Fire Protection Association, Boston, Mass., 1946 p. 27.
[6] Op. cit., p. 30.

Location

1. Furnace rooms should not be located under traffic corridors or assembly areas.
2. An outside but adjacent location is preferable for most school buildings.

Construction

1. The walls, floors, and ceilings of the furnace room should be of fire-resistive construction.
2. There should be one door exit to the outside, and there may be one directly to the main part of the building.
3. The door opening to the main building should be protected with an approved automatic or self-closing fusible link fire door.
4. The coal fuel storage room should be of fire-resistive construction. It is preferable that the fuel room be outside the building, adjacent to but separated from the furnace room by a fire-resistive wall. Door openings from the fuel to the furnace room should be protected by a fire-resistive door.
5. Furnace-room arrangements and furnace locations should facilitate repair work, operation, and frequent inspections.

HEATING AND VENTILATING SYSTEMS

Furnaces

Some school furnaces are located in rooms with combustible walls and ceilings, sometimes with open joists covered with old oil-soaked floors. In some cases it is not possible to move these furnaces immediately or to make the furnace rooms entirely fireproof; however, it is usually possible to reduce furnace-room fire hazards. The following suggestions apply to furnaces in all locations and particularly to those in combustible areas.

1. Smoke breechings and steam headers should be at least 18 inches from the combustible ceilings. Metal and asbestos shields suspended between the ceiling and the furnace and extending back over the breeching provide added protection. Cement plaster on metal lath on combustible ceilings also provides some protection.
2. Smoke pipes should be whole, of heavy metal, and should fit snugly at each end. Pipes should have solid joints and should be properly supported.
3. Combustible partitions, benches, or cases near the furnace should be removed.
4. The furnace and heating plant should have capacities to provide the services needed without overloading.

Furnace-room storage and housekeeping

1. Avoid using the furnace room for the storage of broken equipment, lumber, or junk.
2. Do not permit the storage of paper supplies, waste paper, oils, paints, or waxes in the furnace room.

3. Keep the furnace room clean. Rubbish furnishes tinder for fire.
4. Keep motors clean. Do not permit oils from engine or motor bearings to drip on the floors.
5. Do not permit waste to accumulate in or around incinerators or coal-fired water heaters located in the furnace room.

Care and operation of the heating plant

Lack of proper care and poor operating practices may make even good heating plants into potential machines of destruction.

1. Furnace overheating may be hazardous. It should not be necessary to force the furnace for the morning warm-up period or during the day.
2. The use of kerosene or other flammable oils to start fires is dangerous.
3. Banking fires with fire-box doors open may be hazardous.
4. Ashes should never be piled on the furnace room floor or placed in combustible containers. If a fireproof storage bin is not available, ashes should be removed from the building as soon as feasible.
5. Explosion possibilities should be reduced to a minimum. Boiler water levels should be checked frequently. Blow out and pop valves should be in good working order and checked often.
6. Defective heating plants cause many fires. Cracked furnaces should be repaired. Broken parts should be replaced. Damper controls should be kept in good working order.
7. Heating-plant mechanical equipment, such as motors and engines, should be adequately maintained and protected.
8. The furnace is not an incinerator. Rubbish and waste paper should not be burned in it or stored in it during vacations.
9. Relief valves on hot water tanks should operate freely.
10. The whole heating system should be inspected periodically by a competent person for operating safety and fire hazards.

Fuels, fuel storage

1. Coal storage outside the classroom building is preferable. Coal bin fires may occur when not anticipated. Old slack coal should be moved to the front of the bin before filling for the season.
2. Kindling should not be stored in fuel bins.
3. Coal fuel chutes should not feed directly from the bin to the furnace. They may feed to stoker hoppers.
4. Stoker regulators and cut-offs should be positive and should be checked often.
5. Oil storage tanks should be outside the building. Oil feed lines should be trapped. (Watch oil burners for leaks or overflow. Never relight an extinguished oil burner when there is free oil in the fire pit.)
6. Gas line cut-offs should be outside the building. Watch for gas leaks. Use a pilot light in lighting fires.
7. All gas used should have a malodorant to facilitate detection and pressures should be within safe limits.

Chimneys

Chimneys are the sources of numerous fire hazards. They are subjected to intense heat and some of them extend through concealed spaces.

1. Chimneys should extend to the ground. They should be perpendicular with no drifting.
2. Chimney linings of heat-resisting materials, such as fire brick or fire tile, should extend to a point above the area of intense heat. It is generally desirable to have these linings extend to the top of the chimney. Chimney walls should be stable and have sufficient thickness or insulation to limit heat conduction through them.
3. Chimney openings into classrooms are generally undesirable. If necessary, when room heat generators are used, avoid having openings from more than one floor into each chimney. Flue holes not in use should be closed.
4. Joists should not extend into or rest upon any part of the chimney walls. The chimney should not be used as a support. Air space should be provided between the chimney and combustible materials near it.
5. Breeching connections to the chimney should be tight. Chimney leaks should be closed. Chimneys should be inspected frequently, particularly in attics, for leaks.
6. Frequent chimney cleaning may be necessary with certain types of fuel. Chimney base cleanouts are essential.
7. Chimneys should extend a sufficient distance above walls and roofs near them to provide draft and to reduce the danger of roof fires from flue sparks. Low chimneys may more easily permit dangerous back-drafts. Tall isolated chimneys may need approved lightning rod protection.
8. With low chimneys and with combustible roof construction, spark arresters are desirable when using certain fuels.

Heat lines and local heating units

1. Ample clearance between steam lines and combustible walls or woodwork is essential.
2. Room stoves should be shielded from floors or any other combustible materials near them.
3. Gas heaters should be vented. Portable gas, oil, or electric heaters are not desirable for schoolroom use. Gas steam radiators are difficult to vent and are not generally recommended for schoolroom use. Where used, they should be equipped with pressure releases.
4. Suspended gas convectors may be hazardous if not properly shielded and vented.
5. Fireplaces should have masonry hearths and should be screened.
6. Clothing, papers, or other combustible materials should not be left on steam pipes, radiators, or other heating units.

Heating and ventilating ducts and fans

1. Heating and ventilating ducts should be self-contained and of noncombustible materials. Unlined enclosed spaces, such as between wood joists or over combustible corridor ceilings, should not be used as heat ducts.
2. Ventilating ducts should not empty into open attics. This is particularly bad if the attic is of combustible construction. Self-closing shutters at duct intakes may retard fire spread.
3. Hot-air furnace duct outlets should not be too near the furnace.

4. Vent duct outlets from classrooms should not be connected in walls but should extend through the roof or to an enclosed plenum chamber.
5. Corridor ventilating systems may spread fire and create smoke blocks in traffic lanes.
6. Heat ducts serving several rooms should have cut-off dampers. Fan blower cut-offs should be available.
7. Air filters may be combustible and should not be exposed to fire.

III. Roof and Attic Hazards

MANY SCHOOL FIRES originate on roofs or in attic areas. The roof probably is more exposed than any other part of the building to fire hazards from other buildings. It is also exposed to sparks from the building furnace and from lightning. The attic which is often used to store combustible waste may have exposed wiring in contact with combustible joists. Each of these areas is somewhat isolated from view and may be very dry from the effects of uprising building heat. Fires originating in these areas may spread quickly before being detected.

Roofs

1. Roof surfacing should be of noncombustible or fire-retardant materials. Old curled shingles and broken or frayed sheet roofing are invitations to fire and should be replaced.
2. The use of combustible wood roof framing and sheeting may endanger a building that is fire-resistive in wall and floor construction.
3. Leaves and rubbish in gutters and valleys may be ignited by sparks and should be removed.
4. Loose flashings may collect combustible waste and should be repaired.
5. Small burned spots or pits on roofs from sparks are indications of fire hazards. Using spark arresters, increasing the chimney height, or changing fuels may be desirable.
6. Roof skylights, cupolas, and dormer windows often have some combustible materials in their construction. They may collect dirt and waste and create fire hazards.
7. Electric wires in contact with roofs may lose their insulation through abrasion and become a direct cause of fires. Such wires should be relocated.
8. There is no one best type of roofing for all schools. Built-up roofing over a noncombustible roof slab is considered fire-resistive. Tile, slate, and asbestos-cement shingles, or metal roofs, when on noncombustible framing, have a high degree of fire resistance. Heavy built-up asphalt or tar roofs or heavy composition shingles with protective slag or gravel surfaces help retard fire spread.
9. Roof ladders in the attic may facilitate frequent roof inspections.

Roof fires may gain much headway before being detected.

Attics

1. Attic storage should be limited or prohibited. Combustible materials, such as holiday decorations, old books and papers, old window blinds, and broken furniture stored in attics, may become fire breeders.
2. Some smoke chimneys pass through attics. Chimney mortar may deteriorate, and flue leaks into the attic area may result. Such leaks should be closed.
3. Ventilating ducts emptying into attics create fire hazards and should be extended through the roof.
4. Upper story wiring is often in the attic. Some of it is old knob and tube wiring. Old wires may sag and come into contact with combustible joists. In some cases the insulation deteriorates, exposing the bare wire. These are fire hazards that merit attention.
5. Light combustible scuttle-hole covers may fail to retard or block fires in lower areas from spreading through the attics. Heavy slab or noncombustible covers should be provided and should be kept in place.
6. Frequent attic inspections for fire hazards should be required.

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IV. School Shop Fire Hazards

THERE ARE MANY TYPES of shops in school buildings. Some of these are used for school repair and maintenance work. Others are used for various types of student instruction. Some of these shops are used only for regular daytime school classes, while others may be used for night classes of youth or adults or as workshops for local hobby groups.

The types of materials and equipment used, the presence of heat-producing devices, and the nature of the work done in the various shops may create numerous fire hazards. Obviously there may be more fire hazards in some shops than in others. These hazards may vary in number and in severity with the types of shop activities and shop uses, the types of construction, operating procedures, and management and housekeeping practices.

In this general discussion of fire hazards in school buildings it is not feasible to give attention to or even enumerate all of the hazards that are found in various types of school shops. Some of the following comments apply in part to nearly all types of shops, but do not describe conditions in particular types of shops. Others may apply only to certain types of shops. However, fire hazards exist in most shops, and there is need for a comprehensive study of the types and the severity of the fire hazards in all school shops. Administrators, supervisors, shop teachers, and maintenance personnel should be alert to the need for eliminating such hazards in their spheres of responsibility.

Shop location and construction

The location of the shop may be an important factor in fire safety.

1. Some shops should be isolated from other parts of the building by distance and/or construction.
   (*a*) The use of basement areas for shops should be discouraged.
   (*b*) The more hazardous shops should be outside the regular classroom wings; other less hazardous shops may be a part of the main school building if completely enclosed or set apart by fire-resistive construction. It is preferable to locate most shops at one end or in a wing of the main building in order to reduce the fire and panic hazards that might be caused by a fire originating in them.
   (*c*) Shops completely segregated from other buildings may be of combustible wall and roof construction if adequate exits are provided.
2. As indicated, general construction standards may depend in part on location. However, certain areas such as the floors around forges, foundry and welding shops should be of fire-resistive materials regardless of the type of exterior wall construction.
3. Heavy duty electric power and/or heating circuits should be separate

from the lighting circuits, and all plug-in power outlets on these circuits should have special approved high voltage receptacles.

4. A master switch for the power circuit should be mounted in a protected location available for instant use in case of fire.
5. There should be ample exits. Where it is feasible, some exits should lead directly to the outside. Those between shops and other parts of the building should be covered with approved fire doors.

Shop equipment

Various units of shop equipment may create fire hazards. Proper use and protection will reduce the hazards.

1. Power equipment, such as engines, motors, saws, and planers, may create numerous fire hazards.
   (*a*) Equipment, such as planers and wood saws, that operate on combustible materials and create much waste should have adequate dust collecting systems. For smaller units creating less dust, an approved program of dust removal should be enforced.
   (*b*) Equipment used in metalworking should be so located and protected that sparks and bits of hot metal will not fall on or otherwise come into contact with combustible materials.
   (*c*) Heavy-duty machines should have oil drip cups or pans for oil bearings so that oil will not drop on floors or combustible materials.
   (*d*) Heavy-duty shop motors should have rigid electrical connections. When used in areas where dust may collect, the motors should be of a closed or shielded type.
   (*e*) Noncombustible bench tops should be provided for bench work involving the use of high heat or open flames. Electrical bench tops should be of materials having low conductivity.
   (*f*) Tools such as grinders that produce many sparks should be shielded at the sides, top, and rear. A waste-catching tray or pan under these units helps prevent the spreading of hot sparks.
   (*g*) Motor switches or starters should be enclosed and of an approved type.
   (*h*) Portable power tools such as drills, vibrators, buffers, and sanders should be used only with extension cords approved for such use. Grounding for these units is desirable.
   (*i*) Gas and gasoline engines may create fire hazards. Their use in shops should be limited and carefully supervised. Exhausts should be vented to the outside of the building and should have adequate clearance.
2. Heat equipment such as ovens, kilns, torches, welders, and forges may create fire hazards to combustible materials near them.
   (*a*) Flame, heat, and/or spark-producing units should never be used in places where flames might be dangerous. This applies particularly to areas where gases, oils, or other flammable materials may be present.
   (*b*) Welders and gas or electric cutting equipment should not be used where the hot metal might fall on flammable materials. Welding should be done in shielded booths or with adequate portable shields.
   (*c*) Blowtorches and soldering irons should not be used for such tasks as furniture repair until all combustible upholstering has been removed.

(*d*) Shields should be provided between glue pots and the benches under them. Visible pilot-light indicators are desirable for electrically heated pots.

(*e*) Heat-treating furnaces, ceramic kilns, and dryers should be so located that there are no combustible materials near them. Ample insulation and clearance should be provided at the top, sides, and bottom. In some cases exhaust or circulating fans are desirable. Automatic controls are desirable.

(*f*) Forges should be so located that fire hazards from them are reduced to a minimum. Cooling vats should be available near each forge.

(*g*) Users of heat-producing units should be required to exercise extreme care in their use. Supervisors should instruct students in their use and should be responsible for having all such units turned off when not in use.

(*h*) Heavy-duty electric heating units should be thermostatically controlled.

Some shop activities create numerous fire hazards. The effect of these hazards may be reduced.

1. Paint shops and finishing rooms. The dangers of flash fires and spontaneous ignition are always present.

   (*a*) Spray painting should be done in a protected segregated booth. The booth should be well ventilated with fan motors outside the booth and equipped with nonspark fan blades.

   (*b*) It is difficult to remove all paint residues. Power paint removal should be done outside the booth. Scrapers should also be of the nonsparking type. Smoking should be prohibited around the booths.

   (*c*) Brush painting and the use of solvents in paint removal should be done at points remote from flame-producing sources.

   (*d*) Bleaches, paint thinners, lacquers, oils, and solvents having a low flash point should be used with caution and only under supervision.

   (*e*) Paints and other flammable finish materials should be stored in fire-resistive cabinets.

   (*f*) Paint drop cloths and wipe rags should be removed from areas where they may create fire hazards.

   (*g*) Paint storage rooms should be of fire-resistive construction, and well ventilated. They should be protected when feasible by an adequate sprinkler or other automatic fire-extinguishing system.

2. Automotive shop activities may involve some spray painting and the use of flammable liquids. They may also involve the use and repair of internal combustion engines.

   (*a*) Automotive shops should be isolated by distance and/or construction from other parts of the building.

   (*b*) Automobile painting should be done in protected areas as outlined above for spray painting.

   (*c*) Automotive engine work should be over fire-resistive floors and in protected areas.

   (*d*) Gasoline storage in the building should be limited to small quantities and should be in approved "safety" containers bearing the Underwriters' label.

(*e*) Facilities should be provided for protecting any essential temporary storage and for frequent removal of waste oils, waste rags, and rubbish.

(*f*) Floors should be cleaned often. Oil accumulations on floors should be prohibited.

(*g*) Battery-charging services, battery-service equipment, and acid storage should be in well-ventilated, protected areas. Stands should be rigidly constructed so that there will be no spilling of acids. Acids should be kept in bottle racks that are not easily upset or broken. Smoking should be prohibited in these areas. There may be explosion hazards.

Shop supplies

Many shop supplies are combustible. Some of them have low kindling points. Lack of proper care and storage increases the danger of fire disasters in shops.

1. Segregate volatile oils and other flammable materials from other supplies. Store in fire-resistive cabinets or closets.
2. Make special provisions for storing lumber, paper supplies for the print shop, and other combustible materials in an orderly manner permitting easy accessibility and inspection. The storage of paints, acids, and gasoline was discussed in previous paragraphs.

Miscellaneous operating and housekeeping hazards

Numerous fire hazards develop in school shops from operating procedures and from poor housekeeping practices. It is possible to discuss here only a few of these hazards.

1. Protective noncombustible shields should be provided between all heat units and combustible materials near them.
2. Shavings and sawdust should not be permitted to accumulate on the floors or around wood working machines. Quantities of such dust in the air may have explosive qualities.
3. Equipment should be well maintained. Hot bearings, electric short circuits, overloaded motors, or arcing switches may be hazardous and should be prevented or repaired.
4. Metal containers should be provided for rags and waste materials.
5. Shop cleanliness should be a *MUST*. All personnel should be trained to maintain a clean shop.
6. Suitable approved fire-extinguishing devices should be readily accessible and properly maintained in each shop.
7. Temporary and extension-cord wiring should be kept at a minimum.
8. Pilot lights should be installed in the circuits for electric heaters.
9. Gas controls valves should be designed to show quickly and clearly the "off" and "on" positions.
10. Volatile liquids such as gasoline should not be used in the shop in cleaning machine parts, shop floors, or the hands of the workers.
11. "Fireproof" lockers should be provided for the storage of shop clothing of the students or other workers. Clothing worn by painters should be stored in metal-covered containers or removed from the building.
12. High heat gas-fired units should be attended at all times when in use.

V. Cafeterias, Lunchrooms, Home Economics Laboratories

THE NATURE OF THE ACTIVITIES carried on and the equipment used in school cafeterias, lunchrooms, and homemaking departments create some fire hazards. Some of these hazards result from poor maintenance practices, and some are created by the type of work done. Better planning, changes in operating practices, and more attention to fire prevention will aid in eliminating or reducing the effect of these hazards.

Power equipment

Numerous power-equipped units are used in cafeteria or lunchroom kitchens, and some are used in homemaking laboratories. Most of these units have small motors, but even these small motors may create some fire hazards.

1. Motors should be of the closed type and should be kept clean.
2. Where it is feasible, rigid connections should be used. Motors and connections should be properly insulated.
3. Such units as deep freezers, cold cases, and refrigerators that must remain in use at night or over the week end when the room is unoccupied should be protected.

Stoves and other heat units

In many cafeterias most of the cooking is done on large central stoves or ranges. These are usually easily shielded and vented. In small lunchrooms and in home economic kitchens, cooking is often done on small stoves or hot plates lacking proper protection and distributed over the room.

1. Ranges and laundry stoves.
   (*a*) Stoves fired with coal or wood should have a clearance of at least 36 inches at the top and 48 inches at the front from combustible materials.
   (*b*) Side and rear clearance needs will depend on other protection such as baffles, but clearance should be equivalent to at least 36 inches of air-space distance.
   (*c*) Clearance for gas- or oil-fired or electric ranges may be slightly less.
   (*d*) These units should be on fire-resistive bases. If they are on combustible floors, metal protection should extend under the stoves, and for coal or wood-fired units to some distance in front of the stove.
2. Heavy-duty ovens should be protected at the sides, rear, and front as outlined above for ranges and stoves. Top protection may be partially cared for if the top of the oven is covered with heat-retarding materials.
3. Gas and electric hot plates should have ample protection.
   (*a*) When hot plates are located on combustible tables or desks, there should be metal protection and at least 4 inches of air space between the burner and the table top.
   (*b*) Gas hot plates should have rigid gas connections.

(c) Gas ovens should be lighted by the use of a pilot light.
(d) Electric hot plates should have red pilot-light indicators.

4. Kerosene stove burners should be located over drip pans. An air space between this pan and a combustible base provides added insulation.
5. Miscellaneous
   (a) Gas turn-off cocks should be clearly marked to show "on" and "off" positions. However, the turn handle should be so shaped that it is not likely to be turned on by catching on the clothing of the workers.
   (b) Accumulations of oil or greases around stoves are hazardous and should be removed.
   (c) Open fire-box doors may create fire hazards to floors or to the clothing of the workers and should be prohibited.
   (d) Cafeteria steam-table pressures and temperatures should be controlled to safe limits.
   (e) Percolators or pans over gas burners may boil over and extinguish the gas fire. Relighting the gas before the room has been aired may be dangerous.

Hot water heaters

High water temperatures are required for sterilization in dish washing. In many cases the hot water heater is in or near the kitchens or food laboratories. Some of these hot-water tanks are heated by open or partially enclosed flames.

1. Combustible materials should not be near the heating unit.
2. Open flame-gas or oil-fired heaters, other than those properly controlled and designed for continuous operation, should be turned off at the end of the work day.
3. Thermostatic and relief-valve controls should be provided for all such heaters.

Kitchen exhaust ventilation

Steam and oil-laden vapors are thrown into the air in the cooking process. If not removed from the room, the oils and dust from the air gather on walls and other surfaces where they may create serious fire hazards. Hence, exhaust ventilation is essential where much cooking is done.

1. A large canopy hood with a vent is desirable over stoves or ranges used extensively for cooking.
2. Since accumulated greases in the exhaust ventilation ducts may burn, the ducts should be well constructed.
   (a) They should be of 18-gage iron and have riveted joints.
   (b) Duct walls should be at least 9 inches from any combustible materials.
   (c) Ducts should lead directly to the outside and should be separate from any other ventilating system.
   (d) There should be no dampers in the ducts.
   (e) Hand holes for cleaning may be desirable.
3. Rapid exhaust ventilation and frequent cleaning will reduce the hazards.
   (a) Exhaust air speeds of from 1,200 to 1,500 feet per minute seem to remove most of the oils in the air before they settle.
   (b) Automatic stopping of the exhaust fan in case of fire is desirable.

(c) Frequent duct cleaning to remove grease accumulations will reduce the fire risk.

Dining room areas

The fire hazards in dining room areas arise principally from their location, use, equipment, and congestion.

1. It is preferable that cafeterias be at or near ground level.
2. Adequate travel exits should be available for all dining rooms. Steep, narrow basement stairs do not provide safe exists.
3. Exit doors should open out, should be fitted with exit panic hardware, and should operate freely.
4. Overcrowding of dining rooms should be prohibited. Dining room seats and tables, particularly those tables with bench seats attached, may impede rapid exit. Aisle passageways should be kept open.
5. The kitchen and storage-room areas should be segregated by a partition from the dining room.

Electric heating units

Many of the fire hazards listed eslewhere under electric service apply here. Some of those often found in school homemaking departments are also discussed here for the sake of emphasis.

1. All electric heat units such as irons, percolators, stoves, toasters, and dryers should have an indicating red pilot light in the circuit.
2. Electric irons should have a temperature control. When heated, they should be placed on iron stands whem temporarily idle.
3. Electric dryers and heaters should be adequately protected. Portable heaters are not recommended.

Storage

Cafeteria and homemaking department supply and equipment storage may create some fire hazards.

1. Matches should be stored in fire- and rodent-proof containers.
2. Self-closing metal cans should be provided for paper and other easily ignited waste.
3. Cool room or semipermanent storage facilities should be arranged to permit easy inspection. It is often desirable for the administrative office to require periodic inspection reports and to maintain a record of them.
4. The storage of volatile liquids should be limited in quantity and to safe containers approved for such use.
5. Cleaning and polishing cloths should be stored in lidded metal containers.
6. A safe storage closet should be provided and used for the storage of dust mops, buffers, and wax applicators.
7. Well-managed storage, a part of good housekeeping practices, should be a *must* in these departments.
8. Floor sweepings should not be stored.

Cleaning

General house cleaning is discussed elsewhere, and this section is limited to the cleaning with volatile cleaning preparations.

1. Dry cleaning of clothing with flammable liquids should not be permitted in the home economics laboratories. Nonflammable cleaning liquids are available. Adequate ventilation is desirable.

2. The cleaning of floors or other room surfaces with flammable liquids should be prohibited.

VI. Science Laboratories

THERE MAY BE many fire hazards in science laboratories. Various heating units such as blowtorches, lamps, dryers, or ovens may have open flames and some of them produce intense heat. Many of the chemicals and some of the materials used are flammable. Some of the chemical compounds and compressed gasses are explosive. In addition many of the activities are carried on by pupils, and even with close supervision the use of certain equipment and chemicals by inexperienced youth may create fire hazards.

Laboratory equipment

1. Laboratory desks should have acid- and heat-resisting tops.
2. Laboratories in which there may be flammable vapor or gasses should be equipped with vapor-proof lamps and protected switches. Adequate ventilation reduces the hazard of dangerous gas concentrations in laboratories.
3. Fume hoods and ducts should be fire-resistive, with the exhaust fan motor outside the duct.
4. Laboratory floors should have a fire-resistive base or covering.

Heat units

1. Bunsen burners, torches, alcohol lamps, and other heat units having open flame burners may create fire hazards if not properly used.
2. Cut-offs for gas burners should be attached to rigid connections.
3. The fuel gas used should contain a malodorant.
4. Laboratory furnaces or other units of intense heat should be insulated. Fire-resistive baffles and air space will aid in protecting combustibles near them.
5. Sterilizers, evaporators, and dryers that may be continued in use when the students are out of the room should be properly installed and insulated. Where it is possible, they should be thermostatically controlled.

Chemical hazards

Various chemicals and chemical combinations may create fire and explosion hazards. It is not feasible to list here the various chemicals which might be hazardous.

1. Some acids fume and corrode metals near them and may create heat.
2. Some plastics and other substances are easily ignited.
3. Some chemicals become explosive when contaminated with dust.

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4. Some gasses may ignite with explosive suddenness.
5. Some chemicals generate heat on exposure to air and water.

Miscellaneous

1. Earthen jars should be provided for certain types of waste in chemical laboratories.
2. Acid carboys should be stored in tilting racks or be equipped with non-corrosive pumps to permit draining without spilling.
3. Safe segregated storage in steel cases fitted with locks should be provided for the more hazardous chemicals. The amount of such storage in laboratories should be limited.
4. Smothering blankets and/or flood showers should be provided in organic chemistry laboratories.
5. Ample gas and electric outlets should be provided to permit local application without long connections. Appropriate conductors and fuse protection for electrical appliances should be provided.
6. Teacher control and supervision
   (*a*) Should aid in reducing the physical hazards in the laboratory.
   (*b*) Should assist pupils in understanding the hazards involved and when necessary prevent acts that might create fire hazards.

VII. Classrooms

GENERAL CLASSROOMS usually have fewer places where fires might originate than do some of the laboratories. However, several recent trends in classroom management have increased the fire hazards to pupils. The movable seating may at times be so grouped that rapid exit might be impeded. With the activity-type programs pupils move equipment in the rooms, have more appliances, and use more supplies, some of which are combustible. With increased enrollments many rooms are overcrowded. In many secondary classrooms chair seating is so arranged that safe rapid room evacuation is impossible. School administrators and teachers should give specific attention to the elimination of conditions that might create fire hazards and to the improvement of exit facilities and procedures.

Classroom arrangement

1. Room exits.
   (*a*) Two doors are desirable and are a necessity for large rooms.
   (*b*) Classroom doors should swing with the line of traffic and should be equipped with hardware that cannot be locked against egress. Any locks attached should be operable by the usual exit device—knob or latch.
2. Room seating.
   (*a*) If loose seating is used, it should be so arranged that free and fairly direct traffic lanes to the door are maintained.

Classroom, books, and supplies suffer damage from both fire and water.

(*b*) Side and rear aisles should be open.
(*c*) Tablet armchairs or other loose seating should not be arranged in semicircles that leave open only a front outlet.
(*d*) Overcrowding is dangerous. Occupancy should be limited to the load the room is designed to handle.

3. Room heating.
   (*a*) Open-flame heaters are not desirable. If present, they should be protected. Pupils should not be expected to operate such units and should be cautioned against standing or playing near them.
   (*b*) Fireplaces should be screened.
   (*c*) Room-heating units should not be used as incinerators.

Room decorations

The desire of school officials and teachers to beautify school rooms is commendable. However, the decorative materials used should not increase the fire hazards in the rooms.

1. Curtains and blinds may add to the fire hazards.
   (a) Some old ragged window curtains may be easily ignited.
   (b) Window drapes or case curtains of paper or other flammable materials should be prohibited.
2. Paper decorations such as paper chains or other loose hanging paper ornaments might encourage flash fires when ignited, and should not be used in schoolrooms.
3. Decorations should usually be attached to flat surfaces and should not be left free hanging or free standing.
4. Decorations should not be suspended from sprinkler heads.
5. Miscellaneous hazards may be numerous.
   (a) Paper shades on lamp bulbs are hazardous.
   (b) Decorations should not be attached to lights or to electric wiring.
   (c) Combustible Christmas trees and trimming may create serious fire hazards. Their use should be prohibited or strictly supervised.

Room activities

1. The use of flammable constumes by pupils for special programs should be restricted and supervised.
2. The use of matches, candles, or makeshift extension wiring in the room should be controlled or prohibited.
3. The use of volatile flammable liquids, such as gasoline, in the rooms should be prohibited.
4. Any room activities that may create fire hazards should be controlled by the teachers in charge.
5. Room emergency exit procedures should be routinized.

Room housekeeping

General school housekeeping will be discussed elsewhere. However, some special classroom-housekeeping practices should be mentioned here.

1. Accumulations of loose paper and other waste in teachers' and pupils' desks may create fire hazards and should not be permitted.
2. Storage of highly combustible materials should be in fire-resistive closets or cans.
3. Rubbish accumulations should not be permitted.

VIII. Assembly and Gymnasium Areas

THE TYPES OF ACTIVITIES carried on in auditoriums, gymnasiums, and other school areas where groups of people assemble create some fire hazards. Several factors combine to help create these hazards and to increase the probability of personal injury in case a fire should occur. Where large numbers of people assemble, it is

often difficult to maintain open-exit lanes or to have them used efficiently. In many cases audiences are made up partly of non-school citizens who may be unfamiliar with school safety regulations, careless in protecting public property, and resentful of taking instructions from school officials. With increased community use of school buildings the school officials may find it difficult to direct or control the activities of some groups of people who may be using the building. However, local school officials have an obligation to protect school property and to provide safe conditions for those who are invited or permitted to use the school plant. These school officials should know the danger of fires in assembly areas, how to reduce the fire risks, and how to evacuate occupants from such areas safely.

Auditorium and gymnasium exits

1. These assembly units should be located at or near ground levels to facilitate safe handling of crowds.
2. There should be ample regular and emergency exits.
   (*a*) All exit doors should be equipped with panic bolt exit devices.
   (*b*) Exit lanes should be marked with approved signs and lights.
3. Exits should not be blocked. Group loitering at exits should be prohibited.

Control and use.

1. Loading.
   (*a*) Admittance should be limited to normal seating capacities.
   (*b*) The use of extra seats in aisles should be prohibited.
2. Control.
   (*a*) Copies of general control regulations should be available in duplicate.
   (*b*) School groups should be under normal school supervision when using these areas.
   (*c*) Non-school-group users should be required to abide by school safety regulations.
   (*d*) Designated school employees should be in charge of school property when the school auditorium or gymnasium is in use.
   (*e*) Out-of-school-hour visitors, spectators or program participants should be limited to designated areas or a sufficient staff of employees maintained to police all of the building.
   (*f*) Many buildings are not well protected during evening auditorium or gymnasium gatherings. Smoking should be prohibited or limited to designated protected areas.
3. Seating.
   (*a*) Auditorium or assembly room seat spacing and the number of seats in each row should meet the standards of the *Building Exits Code*.[1]
   (*b*) Aisles should be of ample width for rapid evacuation and should never be even partially blocked.
   (*c*) Loose seating in auditoriums, not always avoidable in combination

[1] *Building Exits Code*. National Fire Protection Association, Boston, Mass., Eleventh Edition, 1960.

auditorium—gymnasiums, may create serious hazards in cases of forced rapid evacuations. This difficulty can be in part overcome by fastening several seats together and by using bar clamps that tie each row of seats together while in place.

(*d*) Balcony seating should never be loose.

Auditorium stage hazards

Such factors as the quantity of lighting, the type of scenery, and the stage props, help create fire hazards on and around the stage. It is possible to eliminate some of these hazards and to reduce the effects of others.

1. Fire-resistive front stage curtains are desirable. Stage scenery should be treated to provide resistance to flames.
2. The use of flammable decorations or stage equipment should be prohibited or limited to times when ample fire protection can be provided.
3. Fly lofts, not generally recommended for school stages, may become draft chimneys for stage fires. Where such lofts exist, they should be ventilated and sprinkler protected.
4. Stage wiring should meet the standards of National Electric Code.
   (*a*) Dimmer bank controls should be inspected frequently.
   (*b*) Extension cord use should be limited to approved types of cords.
   (*c*) The use of colored paper over footlight bulbs or of papershades around other lamps should not be permitted.
5. Special exits should be provided from the stage and dressing-room areas to the outside or to a fire-resistive corridor.

Motion pictures in auditoriums

Some of the following comments are also applicable to other than auditorium areas.

1. The use of safety film reduces the fire hazard.
2. If picture booths are installed, they should meet the standards of the National Board of Fire Underwriters in such features as fire resistive construction, adequate ventilation, and automatic shutters on openings.

Miscellaneous

1. Dressing rooms.
   (*a*) Off-stage dressing rooms should not be used as junk and stage decoration depositories.
   (*b*) Gymnasium locker and dressing room conditions that may create fire hazards should be checked frequently.
2. Storage.
   (*a*) Highly combustible stage decorations should be destroyed or stored in "fireproof" vaults when not in use.
   (*b*) Stored stage scenery should be inspected frequently.
3. Window or other auditorium drapes should be treated to make them flame resistant.
4. All wire, bar, or other window guards near floor levels except light ones, ones easily opened, and ones used only to reduce glass breakage, should be prohibited.

IX. Incendiarism

N. F. P. A. TABULATIONS [1] of more than 1,100 school fires for the years 1941–45 indicate that about 8.8 percent were known to be of incendiary (arson) origin. This report indicated that about 12.1 percent of these school fires resulted from smoking and the careless use of matches. Thus a total of nearly 21 percent of all these school fires could be attributed directly to deliberate or careless personal activities of people. The total average annual school and college fire losses were reported [2] to be about $7,500,000. On this basis malicious and careless personal actions were responsible for an average school plant loss of over $1,500,000 per year. These are wholly preventable causes. This loss and also the attending danger to life could be reduced.

Malicious arson

1. Arson for profit does not seem to be a major cause of incendiarism in schools.
2. Intentional incendiarism does occur.
   (*a*) Various reasons, such as spite, craving for excitement, and general maliciousness, are given as causes for incendiarism.
   (*b*) Alertness to prevent such acts and automatic fire detection or sprinkler protection probably provide the best remedies. Punishment after the act may be necessary, but it does not restore the original loss.

B. School fires resulting from unapproved activities, even when the actual setting of the fire was not done to destroy a building, may result in substantial property losses. Such fires usually originate in parts of the building not then occupied by school classes.

1. Buildings are left open or are not securely locked.
   (*a*) Youths and others may enter buildings.
   (*b*) Entrances are likely to be repeated if watchman or custodial service men do not stop them.
   (*c*) As unapproved, free use of the buildings grows, the danger of either malicious or unintentional fires increases.
2. Students and others may prowl through the building when evening programs are in progress.
   (*a*) For practice periods, better teacher supervision would help control such activities.
   (*b*) Effective building (corridor) blocks to unoccupied areas plus good policing will restrain people from building prowling.
3. School fire losses resulting from unapproved building uses should be attributed partly to school official and community negligence. Such unapproved uses should not be permitted to continue.

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[1] Crosby, Fiske Forster. *Handbook of Fire Protection.* Boston National Fire Protection Association, Tenth Edition, p. 1270.

[2] Op. cit., p. 12.

X. Electric Service Fire Hazards

THE SCHOOL ELECTRIC SERVICE SYSTEMS create many fire hazards. Poor installations, overloading, misuse of appliances, and lack of care in use of electrical energy multiply these hazards. The three principal sources of electrical fire hazards are from arcing, sparking, and overloading. The number of electric fire hazards can be reduced. Wiring should be done by one qualified to do such work and should be in compliance with the provisions of the National Electric Code.[1] Electrical equipment and appliances should be of a type approved by the Underwriters' Laboratories, Inc.

The following lists of electrical fire hazards are provided as a sampling. The suggested preventive or corrective measures are general. The conditions mentioned are sometimes hazards to both person and property. In some instances the particular hazard is not described in detail but is implied in the suggested preventive or corrective measure. Other hazards may be found in most school buildings. The wiring in many of the older buildings is now loaded beyond its intended capacity, and fire hazards are common. However, hazards are also found in new buildings. In some cases the old service may be improved but in many cases the only logical solution is a complete job of rewiring. In any case overloading should be avoided.

General building wiring service

1. Wire entrances to the building should be so installed that water will not run down the wires into the building to rot the insulation. If wires do not enter the building through ground cables, they should be attached to the building through approved shielded heads.
2. If major transformers are in the building, they should be segregated in fire-resistive vaults.
3. Insofar as possible all building wiring should be fully enclosed.
4. Open or the ordinary knob and tube wiring may create hazards.
   (*a*) Insulation may deteriorate with age and exposure.
   (*b*) Insulation may rot away or be rubbed from the wire.
   (*c*) Wires may sag, letting exposed wires come into contact with rubbish or dry joists easily ignited.
5. Lighting service.
   (*a*) Wires for lighting circuits should be ample for normal loads. A minimum of No. 12 size is desirable for school lighting.
   (*b*) Avoid overloading lighting circuits. With the demands for better illumination there is a tendency to increase lamp sizes. It is desirable to limit most room lighting circuits to a 1000- to 1200-watt load.
   (*c*) Incandescent lamps generate much heat, particularly the large ones. Paper shades or other combustible materials near them create fire hazards.

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[1] National Fire Code, Volume 5, N. B. F. U., Pamphlet No. 70.

6. Miscellaneous wiring and lighting hazards.
   (a) Exposed wires are hazardous. Junction and outlet boxes should be covered. Joint splices should be soldered and taped.
   (b) Panel boxes should have dead face fronts and should be locked.
7. Auxiliary wiring.
   (a) Bell, public address, telephone, and other auxiliary wiring segregated from power and lighting circuits.
   (b) Fire alarm lines should be separate from lighting and power circuits.

Motors and equipment

Hazards from heavy shop motors were discussed under the heading of shops and will not be repeated here.

1. Electrical equipment should have the approval of the Underwriters' Laboratories.
2. Connections should be tight.
3. Heavy duty motors or heaters should not be on lighting circuits, and should have rigid connections.
4. Electric motors should be of a closed type, clean, and equipped with non-arcing starting switches. They should not be overloaded and should not be near flammable gasses or materials. Dirty motors may cause trouble.

Switches

The types of switches commonly found in schools are the knife, snap, and the automatic. The chief fire hazards arise from arcing.

1. Switches may heat from overloading or poor contact.
2. Pitted, burned, or corroded contact points may cause arcing.
3. Switches should be fully enclosed for use in areas where flammable fumes may be present.
4. For most light-service circuits, snap switches are preferable. Knife switches should be limited to safe areas and to uses where such switches are needed.

Fusing

Overloading electrical circuits is hazardous. Overburdened lines may get hot enough to start fires.

1. Fuses or breakers are placed in the circuits to serve as weak links or safety valves.
   (a) They are intended to blow out or break before the line gets too hot.
   (b) Frequent blowing or breaking may indicate overloading or other troubles and call for attention to the cause and its removal.
2. Overfusing is dangerous.
   (a) Fuses should be of the size (resistance) recommended for use in that location. Fifteen ampere fuses are generally recommended for room lighting circuits.
   (b) Each fuse socket should be marked to show the type (amps) of fuse to be used there.
   (c) Wiring around fuses, using pennies back of fuses, and tying or blocking of breakers removes the safety link in the circuit and may lead to serious trouble. Such expedients should be prohibited.

3. Fuses and breakers should be in good condition.
   (a) Fuses and breakers should have clean contact points.
   (b) The use of nails or additional resistance strips in fuses to give added strength invites line troubles and should not be permitted.
   (c) Burned spots or rough points, or corroded breaker points may stick and lead to line overheating.
   (d) Fuses should be located in enclosed boxes.

Portable electric units

Some portable light and power units are needed in various school programs. In general, the number of portable units should be limited to a minimum, and those used should meet recommended safety standards.

1. Extension cords and portable units.
   (a) Extension cords for hand lamps, drills, and other portable power units should be properly insulated.
   (b) Hand lamps should be wire caged. Socket shells should be insulated and protected against breakage.
   (c) Temporary wiring should not be used when fixed enclosed wiring can be made available.
2. Poor wiring.
   (a) Amateur wiring or repairs are often improperly done.
   (b) Wires should not be knotted, kinked, or pinched.
   (c) Wires should not be hung on nails or run under rugs.
   (d) Broken insulation and exposed splices may create hazards.
   (e) Extensions not rubber covered may short in damp places. It is bad practice to tack or staple temporary wires to the walls.
   (f) Plug-in connections should provide good contacts. Connections should be arranged for easy release in case of strain on the wires.

Miscellaneous

1. Radios and other special units.
   (a) Aerials and telephone lines should be protected from contact with power and lighting wires.
   (b) Wiring patterns should be designed according to approved codes.
2. Heat units.
   (a) Pilot lights should be provided in circuits.
   (b) Electric irons should have automatic controls.
   (c) Portable electric heaters are not generally desirable for school use When used, they should be of the non-tip variety and should not be used near combustible materials.
   (d) Ultra-violet lamps should be equipped with pilot lights.
3. Stage.
   (a) Dimmer banks should be protected.
   (b) The use of portable units should be limited.
4. Decorative and Christmas lighting is often hazardous. It should be used only under close supervision.
5. Electric furnaces and high voltage units.
   (a) These units may be subject to intense heat and should have adequate insulation.
   (b) High voltage units such as precipitants should have ample protection.

6. Lightning.
   (*a*) Where lightning rods are used, a good ground should be provided.
   (*b*) All connections should be tight. This is particularly important for such units as smokestacks where the current may jump from loose connections to the building reinforcing or supporting steel and cause much damage.
7. Static electricity hazards.

   Hazards from static electricity probably are less serious in schools than in some other establishments. However, such hazards do exist in schools.
   (*a*) They are less serious in moist atmosphere.
   (*b*) Grounds for various machines help drain off the charges.
   (*c*) Grounds should be used to drain charges in places where flammable liquids are poured or agitated.
8. Inspections.

   Periodic inspections by an experienced electrician are desirable.

XI. Reducing Storage Fire Hazards

Some schools find it desirable to store quantities of supplies. Many of these supplies are combustible, and some are highly flammable. In addition some schools have quantities of idle or discarded furniture and equipment. Out-of-use decorative materials and accumulations of waste add to the storage problems. Few schools have adequate safe storage facilities, and many materials are stored in places or areas where they create building fire hazards. Safe school storage helps protect the stored materials, the building, and the occupants.

Principles of safe school storage

1. Location and protection of storerooms.
   (*a*) Storage closets should not be located under stairways or in other places where a fire originating in them might endanger traffic lines.
   (*b*) Storage closets for highly combustable materials should be of fire-resistive construction and should have self-closing doors.
   (*c*) The use of combustible basement or attic rooms for junk storage is particularly hazardous.
2. Storeroom arrangement.
   (*a*) Supply storerooms should not be used for the storage of junk.
   (*b*) Supplies should be systematically stored to permit quick inspection.
   (*c*) Storeroom inspections should be made frequently.
3. Storeroom maintenance.
   (*a*) Packing waste such as excelsior, straw, or scrap paper should not be stored in the regular storeroom.

(b) Storerooms should be kept clean.
(c) Building supply storerooms should not be used as junk depositories.

Storage of current supplies and equipment

1. Supply storage.
   (a) Textbooks, bound flat paper stocks, and similar supplies do not create serious fire hazards if properly stored.
   (b) Toilet paper, light crepe or decorating papers, and other light materials should not be stored near heating units or other sources of ignition.
2. Equipment storage.
   (a) Storerooms for equipment should be away from traffic lanes and preferably separate from the storage of current supplies.
   (b) Storerooms should be well arranged to permit frequent inspection.

Storage of highly combustible materials

The storage of highly combustible or flammable materials should be limited in quantity and location. The storage of particularly hazardous materials should be restricted or prohibited in pupil-occupied buildings. Fire-resistive spaces should be provided for them.

1. Custodial supplies and tools.
   (a) Floor waxes, oils, cleaners, and other flammable supplies should be stored in fire-resistive vaults or closets.
   (b) Wax applicators and oily rags should be stored in metal cans or cases.
   (c) Dust and sweeping mops should not be stored near combustible materials.
2. Flammable liquids or chemicals.
   (a) Small amounts of gasoline may be stored in safety containers bearing the Underwriters' approval label, but larger quantities should not be stored in the building.
   (b) The use and storage of certain flammables such as naphtha, ether, sodium, turpentine, or phosphorus should be carefully regulated in school buildings.
3. Paint.
   (a) Paints, lacquers, and solvents, should be stored in safe areas and in metal cupboards to segregate them from other combustibles stored in the same area or storerooms.
   (b) Paint wiping rags, painters' uniforms, and protective canvases may undergo spontaneous ignition and should not be stored in the building any longer than necessary and then only in safe containers.
4. Hot-spot storage areas.

   Such areas should be sprinkler-protected.

Fuel storage

1. Fuel oils should be stored in outside underground tanks.
2. Kindling should not be stored in the coal rooms.
3. Coal-bin fires from spontaneous ignition may endanger school buildings.

In December 1944 fire started from spontaneous ignition of oily rags stored in combustible surroundings.

Much of the school coal is stored in quantities during the summer. Some of the coal pulverizes in handling and may heat. The hazards can be reduced.

(*a*) The depth of the coal pile should be limited.
(*b*) Accumulations of dust increase the possibilities of heating in the bin.
(*c*) There should be no steam lines or wood posts through the storage pile.
(*d*) Alternate wetting and drying seems to promote heating.
(*e*) Perforated air pipes extending down into the coal seem to reduce heating.
(*f*) It is desirable to check suspected piles frequently. If the temperature of the pile exceeds 140° F. it may be approaching the danger line.

Protecting school records from fire loss.[1]

School records have economic and historic values. Business records may be in part replaced. Personnel records may be needed for four or five decades. Numerous cases might be cited of the loss of school records through fire and of the resulting embarrassment to the persons effected. Absolute protection against any fire loss is essential. This involves safe storage facilities and proper use of these facilities.

[1] *Protection of Records.* National Fire Protection Association, Boston, Mass., 1947.

1. Records can be made up in duplicate and one copy safely stored. This may not be too difficult for current pupil-program records. For permanent records it might be more costly than it would be to provide safe storage.
2. Fireproof storage facilities should be provided.
   (a) Filing cases do not provide the desired protection against the heat of a major fire.
   (b) A fireproof vault, noncollapsible with double doors, ample wall insulation, and supports that prevent falling if the building is destroyed, is needed.
   (c) The vault should not be in a basement where its contents would be subject to water damage.
   (d) The vault should be a walk-in type with flushed threshold to facilitate easy transfer of records in wheeled filing cases.
3. Records should be kept in vaults.
   (a) Provisions should be made for quick return of records to the vault in case of fire.
   (b) The vaults will not protect records which are kept in some room or office. Record-return regulations should be enforced. There might be a fire.

Miscellaneous

1. Bicycle storage should not be so located as to impede traffic in or near the building.
2. Closets, attics, and basement areas cluttered with junk may add to the fire hazards.
3. Ashes should not be placed in combustible containers to be carried out nor stored in or next to combustible construction.
4. Matches (non-safety) should be stored in metal containers.
5. Waste bins should be of metal, should be metal-lined, and should have self-closing covers.
6. Storage closets should have self-closing doors.
7. The storage of quantities of loose paper in basement rooms may provide tinder for a major fire. Such storage should be controlled or prohibited.
8. Pupil use wrap and locker storage units may create some fire hazards. Frequent inspections will do much to reduce the hazards.
9. The removal of waste and sprinkler protection are excellent safety measures for storage areas.

XII. School Housekeeping, Minor Repairs, Building Control, and Fire Safety

THE WORK OF THE SCHOOL CUSTODIANS in building cleaning and upkeep, the work of the teachers and pupils in room care and protection, and the work of the administrative staff in building control, supervision, and protection are vital factors in school plant fire safety. Effective fire protection requires a coordination of the activities of these individuals and groups in plant care and continued vigilance on the part of all. It requires only one fire to destroy or endanger a school and a single negligent act or lapse in care may result in a fire.

Many of the housekeeping, repair, and control activities affecting fire safety have been discussed in other sections, hence the following is not a complete listing of such activities.

Housekeeping

1. Adequate housekeeping practices are important factors in fire safety.
   (*a*) The removal of rubbish and dirt eliminates many hazards.
   (*b*) Most fires start small. Rubbish or waste may serve as a feeder for fires originating near it. Removal of such rubbish may aid in preventing the start of a fire or in retarding its spread.
   (*c*) Cleaning activities may bring to light some hidden fire hazards, thus encouraging their elimination.
2. The daily and periodic cleaning activities should eliminate many existing and potential fire hazards.
   (*a*) The use of special and holiday decorations of flammable materials should be limited or prohibited. Even partially flammable decorations should be removed promptly.
   (*b*) Waste paper should not be permitted to accumulate. Waste baskets should be emptied daily. The waste paper baskets should be made of fire-resistive materials.
   (*c*) Waste paper should not be stored in combustible areas. If safe storage is not available, the waste paper should be burned daily.
   (*d*) The furnace should not be used as an incinerator.
   (*e*) Discarded materials, broken equipment parts, and some furniture or equipment temporarily out of use are often difficult to store. Some of it has only junk value and should be removed from the school building.
   (*f*) Packing waste should be destroyed or removed from the areas where it might create fire hazards.
   (*g*) Furnace rooms should be clean at all times. Combustibles should be segregated from the furnaces, steam lines, switch boards, or furnace breechings. Work benches should be orderly with tools in place. Combustible supplies should not be stored in the furnace room.
   (*h*) Ventilating and heating ducts should be cleaned as often as needed. Waste paper that may have been pushed through grills should be removed.

(i) Yard care may also be a factor in building protection. Dry grass, weeds, or rubbish near the building should be removed. Poorly maintained sheds and outbuildings may endanger the school building.

3. Teachers and pupils have housekeeping obligations.
   (a) Room supplies should be properly stored.
   (b) Waste such as sawdust or shavings in wood shops and grease on floors or work benches and around machines should be removed regularly.
4. Miscellaneous housekeeping and maintenance hazards.
   (a) Curtains, drapes, or decorations near hot plates or gas burners are hazardous and should be removed.
   (b) Thawing frozen pipes with a blow torch may be hazardous.
   (c) Gas or oil line leaks create fire hazards. Using an open lamp to hunt for such leaks is inviting disaster.
   (d) Flammable liquids should never be poured on old fire beds to revive them nor used directly to start fires. Sticks or starters soaked in kerosene may be used to start fires.
   (e) Flammable liquids should not be used in the school building for cleaning fabrics or washing hands.
   (f) Any essential fumigation in schools should be done with non-volatile gasses.
   (g) Grease around machine bearings, on stoves, or in vent ducts over stoves may be ignited and should be removed.
   (h) Cans or other fire safe containers should be provided and used for storing matches and other hazardous materials that must be maintained in small quantities.
   (i) School bonfires should be limited to approved areas and times. Advance provisions should be made for supervision and extinguishment. Unsupervised bonfires should be prohibited.

Current maintenance and minor repairs

Major repairs, remodeling, and rehabilitation affecting fire safety are discussed under building structures and other sections. There are some maintenance and repair tasks that are closely related to housekeeping and should be discussed here. It is not always easy or desirable to separate some of the custodian's housekeeping and maintenance duties. The samples listed here are usually considered current tasks by the custodian and may be worked into his daily routine.

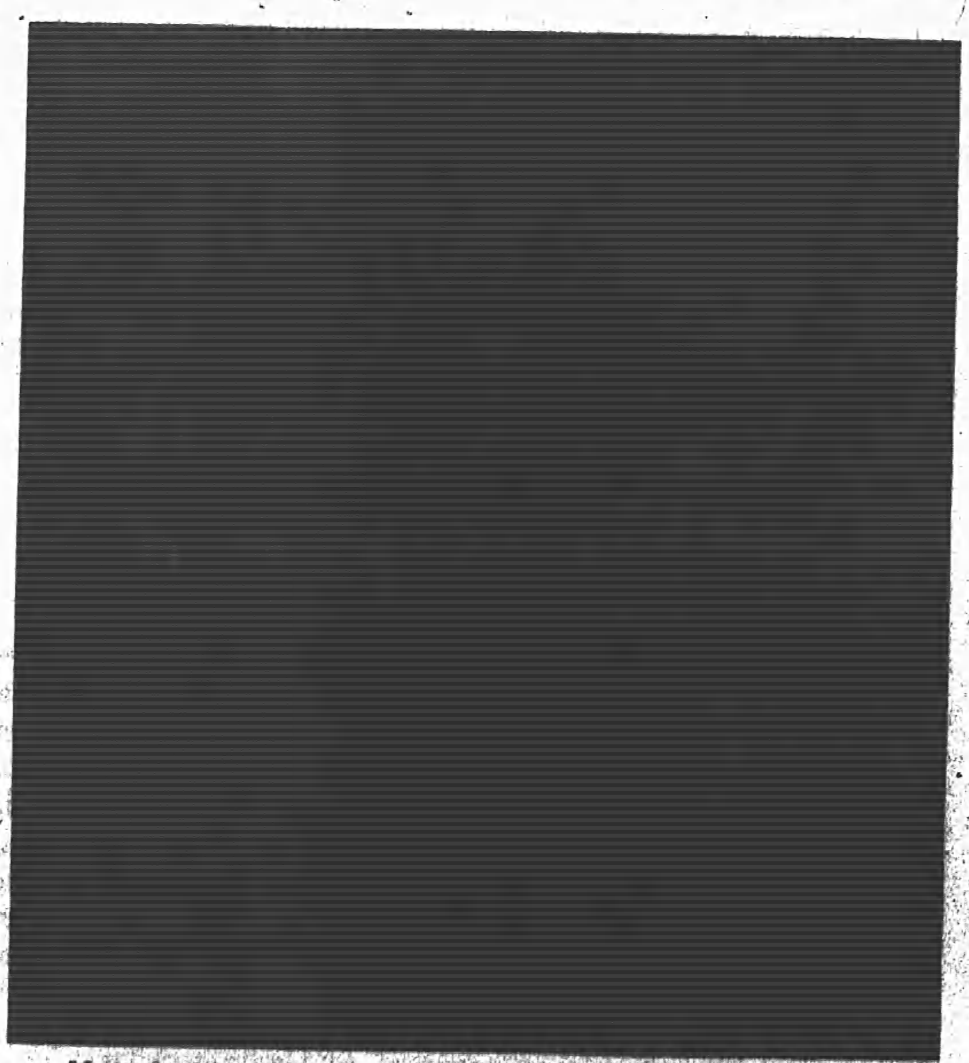
1. Floor care.
   (a) Old worn wood floors may have little resistance to fires, and oil-soaked floors may be an invitation to fire.
   (b) Oil-soaked sweeping compounds, oily mops, and some wax-soaked mops may be subject to spontaneous ignition. Safe storage is essential.
   (c) Accumulations of floor finish and wood dust removed in sanding may heat and start fires if left in the sanding bag or deposited in combustible containers.
   (d) Gasoline or other flammable liquids should never be used in cleaning floors.
2. Furniture care.
   (a) The use of some paint and varnish removers may be hazardous.

(*b*) Flammable liquids should not be used to clean furniture upholstery.

3. Some minor repairs
   (*a*) Broken plaster might permit fire entrance into concealed spaces where control would be difficult. Such breaks should be closed.
   (*b*) Broken window glass may increase exposure hazards.
   (*c*) Furnace, flue or chimney leaks create fire hazards. In many cases closing the leaks may be a minor task.
   (*d*) Loose wall or ceiling panels may expose hidden areas to fire entrance. Fire is difficult to control in such areas.

c. Building control

School plant management procedures including the control and supervision of use are important factors in maintaining school-plant fire safety. School plant uses for extended and out of school activities increase the difficulties of plant control. These uses may increase the hazards from fire in several ways. Uncontrolled activities of the occupants may increase the possibility of fire. Out of school hour occupants do not always respond readily to school safety



Most school fires occur from a lack of proper control and supervision.

regulations and school employee directions. Some of these extended and out-of-school activities are carried on at night when fewer custodians or teachers, who might provide some supervision, are in the buildings.

1. School responsibility.
   (*a*) School custodial employees should be on duty at all times when the building is open for use.
   (*b*) Teachers in charge of or sponsoring evening groups should be responsible for their supervision.
   (*c*) While the custodian usually does not supervise the activities of pupils or other building visitors, he should have definite authority to check any actions or activities which may materially decrease building safety.
2. Control devices.
   (*a*) The custodian should serve as the "keeper of the keys." Master keys should not be made available except to designated employees.
   (*b*) Use of some of the newer changeable lock barrels simplifies key control.
   (*c*) The use of corridor barriers, either doors or folding gates, may help restrict evening occupants to designated areas. If not properly located and controlled, they might delay rapid evacuation in case of need. They should never be used as corridor blocks during regular schools sessions.
3. Various school and extended school activities such as school parties, school plays, school athletic events, and practice periods for plays, carried on out of regular school hours may create some serious fire hazards.
   (*a*) The various activities may permit more freedom, and supervision is usually more lax.
   (*b*) Open but unused parts of the building may invite loitering.
4. Community adults often object to controls in their use of their school building. Smoking and lack of protection against misuse of electrical equipment or the use of flammable materials increase the hazards.

XIII. Building Structure and Fire Protection

TO OBTAIN GREATER FLEXIBILITY and to decrease obsolescence school administrators often ask for inexpensive buildings that can be abandoned and replaced after they have been used a few years. Temporary construction is not necessarily the answer to this request. Certain basic safety and protective features are essential in all school buildings. Lighter or cheaper construction may be feasible in some one-story buildings. In any except one-story buildings safety precautions require construction that is not temporary.

We are concerned here primarily with fire safety. Property protection is quite important, but first attention should be given to the protection of the bodies and lives of the building occupants. Plant design and types of construction are important factors in fire safety.

Types of construction that offer many opportunities for fires to originate and spread, or designs that fail to provide ample exit ways increase the fire hazards for the building occupants.

Fires do occur in fire-resistive buildings. However, the spread of fire in such buildings is usually less rapid, and the probabilities of safe evacuation and of reducing property losses are greater than in non-fire-resistive buildings. Some non-fire-resistive buildings, if not too high and if properly designed can be made to provide a fair degree of fire safety for the occupants. *Any building that is not and cannot be made fire safe should be abandoned.* Parents, teachers, and school officials should understand that masonry exterior walls and slate or tile roofs do not make a building fire-resistive. Such buildings might have combustible interior construction, poorly protected exit ways and many other hazards that endanger the pupils forced to attend school in such buildings.

Some principles of building construction and fire safety

Certain basic principles of fire safety should be considered in planning all school buildings.

1. Fires do not start without fuel. Construction that eliminates or reduces the quantity of combustible materials in areas where fires are most likely to originate may prevent the spread of many fires.
2. Small fires may grow and become more dangerous as they spread. Construction that reduces fire spread may prevent major property losses and reduce personal danger for the occupants.
3. Facilities for safe ecavuation in case of fire decrease the fire risk for the occupants. (See sec. XIV for information on exits.)

Structural and design types and fire safety

It is possible to discuss here only a few of the structural and design types that affect fire safety.

1. Building height and construction affecting personal safety; some suggested minimum standards.

   (a) *Buildings of one story may be of almost any type of construction provided ample exit facilities are maintained and the dangers of flash fires eliminated.*

   (b) *Buildings of two stories should have at least acceptable masonry walls and fire-resistive walkways from each classroom door to the outside. The term "fire-resistive walkways" means fire-resistive stairs and fire-resistive corridor floors, walls, and ceilings. Note that these are minimums and that other fire-resistive floors, roofs, walls, and partitions are desirable.*

   (c) *Buildings of more than two stories, not generally recommended but sometimes necessary for schools, should be of fire-resistive construction throughout.*

2. Types of construction and design.

   Fire-resistance is a matter of degree. In many instances fire-resistiveness that will withstand a severe fire heat for 30 minutes may give opportunity to protect the occupants through evacuation if they are alerted

to the danger, although it may not protect the building. In some cases a resistance of a 4-hour rating is desired. Resistance that retards a fire and delays its spread gives the fire-fighting forces a better chance to control the fire.

(*a*) The term "fire-resistive school buildings" as used here refers to buildings having fire-resistive exterior walls, floors, partitions, and roofs constructed of noncombustible materials. The term as used here does not mean total fireproofness. It is understood that some combustible floor surfacing, trim, and contents may be found in these buildings.

(*b*) Masonry walls extending through the roofs of combustible buildings help confine losses to the areas in which fires start.

(*c*) Special hot spots or spots where fires are more likely to originate should be segregated from pupil-occupied areas by fire-resistive construction or distance. Combustible furnace rooms should never be located under classrooms or corridors.

(*d*) Areas such as auditoriums or gymnasiums where groups of people assemble should be at ground floor levels and so located that egress is direct or nearly direct to the outside.

3. Some structural factors affecting fire control.

(*a*) Wood shingle roofs, wood gables, dormers, and other combustible roof projections increase the fire hazards.

(*b*) Combustible attic areas create hazards. The danger is materially increased if ventilating ducts empty into the attic. If this combustible area is not cut into segments by fire walls, fires originating in one place may travel through the attic or be carried by these ducts to other parts of the building.

(*c*) Cracked walls may fail to check fire spread. Some poor bearing walls and hollow or light block partitions may permit fire to spread from one area to another.

(*d*) Parapet walls help reduce the exposure hazards.

(*e*) Unprotected steel girders or posts may bend when subjected to much heat and their deflection may open new areas to fire damage.

(*f*) Plaster on metal lath protects girders from excessive heat exposure and delays entrance of fire into concealed spaces.

(*g*) Old lumber affected with dry rot or by termite tunneling may furnish easily ignited fuel for fire.

Floor and other openings that affect fire spread

Fires not confined to their places of origin may spread to endanger all of a building and its occupants. The rate of spread is materially affected by the fuel available, the resistance encountered, and the help given by air currents. School fires normally spread by burning through combustible partitions and walls, through vertical openings from one floor to another, through horizontal openings from room to room, through open attics, and through cornices. Drafts in vertical openings encourage the transfer of fire from lower to upper floors. Ducts that provide combustible fuels for fire spread increase the hazards.

1. Floor and ceiling openings.

There are numerous vertical openings extending from floor to floor or even from basement to attic.

(a) Stairways should be enclosed. Open stairs invite an upward flow of heat, smoke, and fire to increase the hazards on upper floors. This flow may make the stair ineffective as an exit.

(b) Chutes and dumb waiters should be of fire-resistive construction or metal lined and capped. Each opening into these ducts should have self-closing doors.

(c) Hot-air and ventilating ducts should be of fire-resistive materials and should not empty into attic spaces. These ducts should extend through the roof or be combined into one large vent in a fire-resistive plenum chamber.

(d) Scuttle holes to attics should be covered with heavy covers, preferably self-closing.

2. Other opening hazards.

(a) Use of spaces between wood joists or studs as hot-air or vent ducts is hazardous.

(b) Use of corridors as return ducts for hot air or as ventilation exhaust ducts may cause them to serve as funnels for fire gasses and smoke that might create serious panic hazards for pupils.

3. Concealed spaces.

Openings into concealed spaces may permit fire to enter. In some of these concealed spaces detection and extinguishment are often very difficult. In some concealed areas where drafts may be created fires spread rapidly.

(a) Furred and hollow walls with combustible construction in them offer opportunities for fire spread.

(b) Open spaces under floors may also provide places for fires to spread.

(c) Breaks in wall plaster offer opportunities for fire to enter concealed spaces in walls.

(d) Smoke and draft stops should be provided where feasible in such concealed areas.

Fire doors

1. Purpose, location.

(a) Fire doors prevent fire spreading from place of origin and to block off certain building areas as safety zones.

(b) Fire doors are desirable to segregate hot spots where fires might originate, in some cases with explosive effects, from the rest of the building. Furnace room segregation by fire doors illustrates one use.

(c) Use of heavy fire doors in school corridors to prevent fire spread from one part of a building to another might delay pupil evacuation and is not considered desirable. The use of properly designed light-weight fire-resistive doors at stair well openings as outlined in the section on exits is desirable.

2. Types of fire-doors.

(a) Door action may be: *automatic*—closes automatically when released because of the action of the heat (the door may stand open at other times); or *self-closing*—which is normally closed by some mechanical device each time it is opened. Illustration: the ordinary spring on a screen door is one type of a self-closing device.

(b) Fire doors may have either slide or hinge action closing. The slide type is usually automatic.

(c) Fire doors should bear the approval label of the Underwriters' Laboratories and should be adapted for the use to which they are put.

(d) Wired glass fire barriers may retard fires long enough for pupils to leave the building. They are not usually designed to hold major fires and should not be installed for that prupose.

3. Installation.

(a) The framing around fire doors should be of noncombustible materials.

(b) Release of the fire door should be by some fusible link or burn-out cord of a type that will provide positive action when needed.

(c) Doors to stair wells should be so arranged that they can be closed by a moderate pull when desired without waiting for the heat effect.

4. Maintenance.

(a) Doors should close easily and should not rub or bind.

(b) The release and the closing device should work properly.

(c) Fire doors should never be blocked open. Weight cords should not be tied back or looped over projections to prevent free action.

(d) Frequent testing of fire-door action is desirable.

Building finish

Even fire-resistive buildings can have fire hazards. Some of the inside finish in most buildings is of combustible materials. Certain insulating, acoustical, and drapery materials used in many schools are highly combustible. With proper selection, treatment, and use of these materials the fire hazards may be materially reduced.

1. Wood trim.

(a) Wood trim should not be used around fire door or wired glass window openings.

(b) Wood trim should not be close to steam lines or heat producing units.

(c) Fire-preventing impregnating and surface-coating treatments of wood and other combustible interior finishing materials seem to have some value in preventing a rapid spread of fire. Such treatments are not intended to provide continued resistance to intense heat.

2. Insulating and acoustical materials.

(a) Insulating materials vary in their fire-resistance. Some materials, such as spun glass, may have high resistance; while others, such as mineral wool bats with exposed ordinary vapor seals, have little resistance to fire spread.

(b) Untreated fiber-board acoustical materials may be combustible. The fiber-board or tile units should be securely attached, preferably to a solid background.

3. Miscellaneous.

(a) The use of protective or decorative strips of highly combustible materials that might form fire runners should be avoided.

(b) It is also desirable to avoid the use of finishing materials that give off toxic fumes when subjected to fire.

(c) Loose hanging drapes, untreated window shades, and cloth curtains may become serious fire hazards.

4. Flameproofing.
   (a) Flameproofing of fabrics is a protection against flash fires but does not protect against continued intense heat.
   (b) Stage scenery and curtains should be treated to make them flame-resistant.
   (c) The same or a similar treatment can be provided for drapes.
   (d) Some flameproofing materials are toxic, and others affect colors or fabrics.
   (e) Flameproofing of existing drapes and curtains can be done in the school. Most treatments lose their effectiveness with laundering and may need to be repeated.

Planning new buildings

1. Responsibility.
   (a) The administrator must accept the responsibility for planning safe buildings. His is the professional long-range responsibility.
   (b) Architects, engineers, and contractors can advise local officials on the effectiveness of certain features or materials in fire protection. However, decisions must be made by the school officials, and they cannot afford to be negligent of the future safety of pupils.
2. Safety and financial considerations.
   In most cases fund limitations prevent the inclusion of desired features in a new school building. Where funds seem to be ample the desires appear to increase accordingly.
   (a) Changing programs and teaching techniques demand increased activity spaces.
   (b) Community interests demand beauty in a building.
   (c) In many cases community use calls for increased space. This is particularly the case when the public insists that the school auditorium serve as a community auditorium.
   (d) The local school officials, while perhaps in sympathy with all of these demands, must keep the building program in balance.
      (1) It is usually not necessary to sacrifice beauty in order to obtain safety. Certainly costly towers or ornamental facades should not absorb funds that should be devoted to safety.
      (2) The same principle applies to space. If it becomes necessary to omit some special room or tournament seating space in a gymnasium in order to provide essential safety features, then such spaces should be omitted. In other words, do not sacrifice safety.
3. New building safety and the public
   (a) The need for safety features may not be as readily appreciated by the public as are more easily seen features such as space or ornamentation.
   (b) The administrator may find it necessary to sell to the staff and the public the idea that pupil safety provisions should be of paramount importance.

Inspection and rehabilitation

1. All buildings should be inspected periodically by competent authority for structural or other defects that might affect fire-safety. Inspection

reports should be in writing to serve as a basis for corrections and as a basis of protection for the local school officials.

2. Where needed, rehabilitation programs should be planned to correct existing defects.
   (a) If an existing building can be made safe the necessary improvements should be made.
   (b) If a building cannot be made safe, or if because improvement costs would be too high, then the building or the part in question should be taken out of use for pupil occupancy.

State responsibility for structural fire-safety

1. The State has a responsibility in the protection of all school students in the State against preventable fire hazards.
   (a) State laws require youth to attend school.
   (b) All public schools are State institutions and operate under State authority.
   (c) Students attending private schools are also citizens of the State and the State has an obligation to help protect its citizens.
2. State supervision of school fire-safety may be exercised through various State and/or local agencies.
3. State departments of education have a special obligation in this area.
   (a) Many State departments advise local officials on space requirements and arrangement.
   (b) Most of the State departments accept no or only a limited responsibility for fire-safety in planning new or remodeling old building structures.
   (c) Under modern administrative patterns it seems desirable for State departments of education to accept more of the responsibility for school fire safety. The department can:
      (1) Set up standard guides and regulations.
      (2) Provide a staff to carry these regulations into effect.
      (3) If it is impossible for the department officials to carry out all of these provisions, they can seek the advice and cooperation of State and/or National agencies with staff members able to provide the assistance needed.
   (d) If State departments do not provide service in the area of pupil protection, they may find the schools subject to nonflexible and sometimes ill-advised legislative regulations promoted by an aroused public after some particular fire loss.

XIV. Traffic and Exit Facilities

MANY SCHOOL BUILDINGS are constructed at least partly of combustible materials. Even buildings of fire-resistive or semi-fire-resistive construction usually have some combustible materials in the trim and decorations, and in the contents.

Because of these conditions no school buildings are completely fire safe. It is desirable to provide and maintain in all school buildings

adequate safe traffic lanes and exits so that the occupants can be transferred quickly from points endangered by fire to safe areas. School buildings house many pupils. Some of these pupils are too immature to know how to protect themselves in case of danger. School or community gatherings may create special problems in group evacuation.

Some principles of fire exit safety

1. Fire safety for persons involves the prevention of fires, warnings to and safe evacuation of the building occupants, and some provisions for delaying the spread of fire.
2. All occupants should be able to get out of the building without traffic or fire injuries.
3. Safe exits should be adequate under all conditions for all the people who might be in the building at one time.
4. The layout patterns for corridors, stairs, and exits, and the maintenance of these facilities are basic features in traffic and evacuation safety.
   (*a*) Building loading should be limited. Occupancy in excess of 25 people per 1,000 square feet of total floor area may increase exit difficulties.
   (*b*) There should be more than one way out. Large classrooms and other large areas should have at least two doors.

Corridors

1. Construction.
   (*a*) In buildings of more than one story the corridors should be of fire resistive construction, walls, floors, and ceiling.
   (*b*) In one-story buildings ordinary construction may be used if ample exits are provided.
2. Corridor widths should be ample to carry the maximum anticipated crowds.
3. Each corridor should terminate at or near an exit. Extensions of corridors beyond exits (or stairs) should not exceed 35 feet.
4. Corridor blocks, projections that might slow traffic, or sharp corners that might cause injury should be prohibited.
5. Corridor vestibule side pockets into which pupils might be pushed under panic conditions should be eliminated.

Stairs

1. Number.
   (*a*) There should be at least two stairways, remote from each other, from basement or upper story levels to the ground floor level.
   (*b*) The total number of stairways should be computed on the basis of standards set up in the Building Exits Code.[1] However, a rough estimate will be one stair exit lane of 22 inches for each 60 people or major fraction thereof.
   (*c*) There should be s stairway exit within 100 feet of the corridor door of each classroom on other than the ground level floors.
2. Location.
   (*a*) Stairs should not be located in the corridors where they may reduce the corridor clear passage width but at right angles to the corridors.

[1] *Building Exits Code.* National Fire Protection Association, Boston, Mass., 1950. p. 66–68.

(*b*) Stairs should be so located that the ground floor end empties at or near an exit.

3. Construction and design.
   (*a*) Stairs should be of fire-resistive construction.
   (*b*) School stairs from one floor to another should be in two runs with an intermediate landing having a clear width at least equal to the stair width.
   (*c*) A stair run from a landing to either floor should not have more than 16 risers.
   (*d*) Risers should not exceed 6½ inches. Treads, exclusive of nosing and overhang, should be not less than 10½ inches. R plus T should equal 17 or 17½ inches.
   (*e*) Each riser should be full width. There should be no winders in regular traffic lane stairs.
   (*f*) Stair widths of 44 to 60 inches are desired. These provide two traffic lanes (minimum width 22 inches each) on each stair.
   (*g*) There should be solid handrails 26 to 30 inches high on each side of the stair.
   (*h*) Short stairs of 3 to 4 risers in corridors may be hazardous.
   (*i*) Doors should not open directly on stairs or landings.
   (*j*) Storage closets under stairways or adjacent to landings are undesirable.
   (*k*) Stairs should be enclosed in fire-resistive stair wells.
   (*l*) Corridor entrances to stairs should be protected by smoke-retaining shields from the ceiling down to the stair door height. The doors should be fire-resistive and glazed with wired glass. Some school officials object to use of the free-swinging, double-action, or the self-closing (close each time they are opened—see Sec. XIII for definition) doors on stair wells and maintain that they impede daily traffic. This objection need not apply to the automatic, fusible-link, or cord-release door with weight or spring-closing. These doors can be held open for ordinary use by a catch or cord and released to close automatically by heat, or can be released by hand with a slight jerk or pull for special or emergency use. This makes them available as smoke blocks even when there is little heat.
   (*m*) Treads should have non-slip surfaces. Nosings, if any, should be flush with the treads.

4. Installing fire-resistive stairs in existing combustible interior buildings is not always feasible. In most cases it is possible to erect outside fireproof stair wells and stairs at or near the ends of corridors or stairs and to extend the corridors to them. In these cases it is important to protect the openings to delay the spread of fire that the stairs may be used safely.

D. Exits

1. Number.
   (*a*) Door exit capacities are also computed at 22 inches per unit or lane. The *Building Exits Code* exit [2] standards call for door exit lanes about as follows:

[2] Op. cit.

One unit of door width for each 2,400, or major fraction thereof, square feet of upper and basement floors emptying through the first or ground floor exits;

One additional unit of door width for each 4,000, or major fraction thereof, square feet of first or ground floor area other than auditorium or gymnasium area;

One additional unit of door width for each 600 square feet or major fraction thereof, of auditoriums and gymnasium areas on the first floor.

(*b*) Another rough measure of exit lane needs is:

Compute loading capacity of classroom wings at 40 square feet per person, auditorium and gymnasium areas at 6 square feet per person. Allow exit lanes: one for each 60 persons coming from floors above or below the ground floor level, add one exit lane for each 100 persons coming from ground floor classroom wings, add another for each 100 persons coming from auditorium and gymnasium areas. All of the preceding measurements are computed on the basis of capacity loadings.

2. Location.
   (*a*) Exits from auditoriums and gymnasium assembly areas should be, as nearly as possible, directly to the outside.
   (*b*) At least one exit from areas where fire hazards may be more pronounced as in furnace rooms, certain shops, and large kitchens should lead directly to the outside.
   (*c*) A stage exit should permit stage evacuation either into a fire-resistive corridor or to the outside without the occupants having to pass through the auditorium.
3. Door types.
   (*a*) Exit doors should be at least 36 inches wide. However, existing 40-inch doors may be counted as two exit units.
   (*b*) Revolving doors are not recommended for schools. If installed, they should be flanked with properly installed standard leaf doors.
4. Door action.
   (*a*) Exit doors should open out.
   (*b*) Each exit door, including each leaf of double exit doors, should be equipped with panic exit hardware that operates with a pressure of not over 15 pounds on the activating bar. Note, dead bolts of any type, top, bottom, or side, should not be used on exit doors.
   (*c*) Classroom doors swing with the line of travel and should be equipped with a type of hardware that cannot be locked against egress. If locks are installed, they should be of a type that is activated by the usual knob or latch used for egress.
5. Exit lanes should be well lighted and marked. Lighted exit signs should be provided for auditoriums.
6. Exit vestibules.
   (*a*) Vestibule or storm doors at any particular exit should have the same swing and a capacity at least equal to the regular exit door at that place. Such doors should be free acting, outward, or be equipped with panic exit hardware.
   (*b*) Vestibules should not reduce traffic capacity and should have no pockets into which pupils might be pushed in case of a hurried evacuation.

Some special building traffic and exit hazards

1. Gymnasium seating of the fixed type usually has stair aisles. Folding or demountable seating should also be equipped with stair aisles.
2. The use of loose seating on gymnasium or other floors for assembly purposes should be limited. When so used, the seating should be arranged in definite blocks with wide front to back aisles and cross aisles if needed. Some device should be used to maintain these formations or to maintain safe passageways.
3. Auditorium
   (*a*) Seating rows open at each end should be limited to 14, and those open only at one end should be limited to 7 seats. This regulation may be stated as follows:

   A person should not have to pass more than 6 seats to reach an aisle.

   (*b*) Main floor aisles may slope but should not have steps. Sloping aisles should have non-slip surfaces. Aisles should terminate at exits. The minimum aisle width should be 30 inches. This should be increased as the load increases.
   (*c*) For large auditoriums special emergency exits, not used as entrances, are desirable.
4. School auditorium and gymnasium exits should be at or near the ground level to facilitate safe exit.
5. Exit or classroom doors having glass panels should be glazed with wired or safety glass.
6. Ample exits direct to corridor or outside, should be provided for stage and gymnasium dressing room areas.

Fire escapes

The best "fire escape" is an enclosed fire-resistive stair well. In some existing buildings where enclosed stair wells are not feasible, outside escapes may be needed. If installed, they should meet certain safety requirements.

1. They should extend from the point of entrance to the ground. Weighted steps or ladders should not be used for schools.
2. They should be entered at floor level preferably through a door, panic bolt fitted. If fire escapes are entered through a classroom, the classroom should be treated as a corridor and free passage aisles through the room maintained. Also the door swing and hardware should facilitate such passage through the room.
3. The discharge end of the escape should be away from the building, open, and not blocked.
4. Any windows within 10 feet of the escape should have metal sash and framing and be glazed with wired glass.
5. Stair escapes should have handrails.

Emergency exit procedures

Since detailed information on the purposes of the organization, procedures, and direction of emergency evacuation is provided in a previous Office of Education publication *School Fire Drills* [3] and in the *Building Exits Code*, [4] only general principles will be outlined here.

[3] Viles, N. E., *School Fire Drills*. Washington, U. S. Government Printing Office, 1948, Federal Security Agency, Office of Education, Pamphlet 103, 19 p.

[4] *Building Exits Code*, 1950, National Fire Protection Association, Boston, Mass.

1. Alarm signals should be positive, different from any other building signals, and audible at all places in the building under all conditions.
2. Exit drills.

Exit drills should be set up on definite schedules as follows: Planned to fit the building and the age of the pupils; under complete control and observed by everybody in the building with no exceptions; practiced until routine is perfected; and repeated as often as needed to maintain routine.

Exit maintenance

Some exit maintenance procedures discussed under other sections will be repeated here for the sake of emphasis.

1. Exit doors.
   - (*a*) Exit doors should be maintained to operate freely at all times, and should never be blocked or locked when the building is occupied.
   - (*b*) Panic hardware should operate freely.
   - (*c*) Exit door closers should operate freely.
2. Stairs.
   - (*a*) Handrails should be solid.
   - (*b*) Treads should be non-slippery; nosings should be solid.
   - (*c*) There should be no storage of combustibles under or near the stairs.
3. Corridors, traffic lanes.
   - (*a*) Floors should not be slippery.
   - (*b*) Cases, tables, equipment, and tools should not block free passageway in corridors.
   - (*c*) Traffic lanes should be well-lighted and marked.
   - (*d*) Traffic lanes outside the building should not be blocked by parked cars, bicycles, or other obstructions.
   - (*e*) Outside exit steps, if any, should not be covered with ice that might impede evacuation.
4. Fire Escapes.

Fire escapes should be in good repair, unlocked and ready for use; and should be free of ice or blocks.

XV. Inspections

FIRES DO OCCUR in all types of school buildings, and each fire may create potential life and property hazards. Fire hazards may develop without the building occupants being aware of them. School officials and employees should recognize the need for fire safety in the building and be alert to any conditions that might create fire hazards. Planning alone is not enough. Fire hazards may develop progressively from deterioration, school activities, or other causes and may often be found in areas where not anticipated.

Frequent inspections should be made of all areas where fire hazards might develop. A well-planned inspection program might include

frequent self-inspections by the local staff, periodic inspections by the fire department and the rating bureau, and such special inspections as can be provided by boiler and electric wiring technicians.

Responsibility for inspections

1. Administrative.
   (*a*) The school administrative staff should organize and direct the inspection programs.
   (*b*) The governing school board should hold the administrative staff responsible for the inspections.
2. The teaching staff members should be responsible for safe conditions in their areas of operation and alert to hazards throughout the buildings.
3. The custodial and maintenance staffs should participate in and be responsible for making certain inspections. They should report in writing on conditions found.

Use of outside assistance

1. Insurance inspection bureaus usually make up rating sheets on each building showing various fire hazards for which rate penalities are added. In most instances the rating bureaus will advise on corrective methods and will provide copies of the rating sheets for local use.
2. Local representatives of fire and casualty insurance companies and other interested groups will advise on inspections and on the elimination of fire hazards.
3. Local fire departments have a definite interest in fire prevention and are usually available for assistance to
   (*a*) Advise on fire risks, and preventive measures.
   (*b*) Assist in inspections.
   (*c*) Suggest evacuation and other life safety measures.
   (*d*) Advise on primary extinguishing procedures.
   (*e*) Cooperate in setting up an alarm notification system.

Self-inspections

Self-inspection programs should be well organized. Instructions and procedure outlines should be specific.

1. Daily.
   (*a*) Require the custodian to make a last minute check of the building each evening before closing.
   (*b*) Require a brief check on opening the building in the morning.
   (*c*) Require frequent checks on certain hot spot areas.
2. Periodic inspections.
   (*a*) Inspect some areas weekly.
   (*b*) Make over-all building inspections at fixed datings each month.
3. Some inspection areas.
   (*a*) Check exit lanes for clear passage.
   (*b*) Try door checks, panic-exit hardware, etc.
   (*c*) Test fire alarm signals.
   (*d*) Examine fire escapes, if any.
   (*e*) Check storage, attic, basement, heating room areas.
   (*f*) Check fire hose, fire extinguishers.
   (*g*) Test fire door action.

(*h*) Check carefully on housekeeping practices, accumulations of trash, rubbish, etc.

4. Organizing self-inspections.
   (*a*) Designate persons to be responsible for over-all inspections.
   (*b*) Require teachers to inspect areas where they work.
   (*c*) Have designated times for inspections. Note that inspections in certain hazardous areas should be more frequent than the over-all building inspection.
   (*d*) Require written inspection reports. Also require written reports on fire hazards found in daily use of the building.
   (*e*) Hold staff responsible for reports and results. The principal, teacher, and custodian in accepting positions have accepted certain responsibilities. They should be responsible for and to the extent of their own negligence.
5. Use of inspection forms.
   (*a*) Special forms should be prepared for areas such as shops, furnance rooms, storage rooms, stage, that need frequent and perhaps special inspections.
   (*b*) More comprehensive forms should be prepared for over-all building inspections.
   (*c*) One copy of each report should be retained by the maker and others may be filed in the administrative offices as desired. Inspection reports should be made available to the governing board and to the public.
   (*d*) A copy of a comprehensive "Self-Inspection Blank for Schools" prepared by the National Board of Fire Underwriters follows. Other forms adapted to local conditions can be prepared as desired.

SELF-INSPECTION BLANK FOR SCHOOLS [1]

Prepared by

The National Board of Fire Underwriters

Chicago New York San Francisco

Approved and Adopted by

The National Association of Public School Business Officials

If precautions are taken to minimize the danger of fire and to provide for safety in case fire occurs, real progress will be made in safeguarding life and protecting property. Intelligent thought and care in practice can eliminate practically all fires within schools.

INSTRUCTIONS

Inspection to be made each month by the custodian and a member of the faculty at which inspection only Items 1 to 20 need to be reported. At the quarterly inspection, a member of the fire department should accompany the above inspectors, and the complete blank should be filled out. The report of each inspection (monthly and quarterly) is to be filed with the Board of Education or School Commissioners.

[1] Reproduced by permission.

Questions are so worded that a negative answer will indicate an unsatisfactory condition.

Date .....

Name of School ..... City .....

Class: Elementary ..... Junior High ..... Senior High .....

Capacity of School? ..... Number now enrolled .....

1. Are all exit doors equipped with panic locks? ..... Are these locks tested each week to insure ease of operation? ..... Do these lock securely so that additional locks, bolts or chains are not necessary? ..... Are such additional locks open whenever building is in use? .....
2. Are all outside fire escapes free from obstructions and in good working order? ..... Are they used for fire drills? .....
3. Is all heating equipment, including flues, pipes and steam lines:
   (a) in good serviceable condition and well maintained? .....
   (b) properly insulated and separated from all combustible material by a safe distance? .....
4. Is coal pile inspected periodically for evidences of heating? .....
5. Are ashes placed in *metal* containers used for that purpose *only*? .....
6. Is remote control provided whereby oil supply line may be shut off in an emergency? .....
7. Where is outside shut-off valve on gas supply line? .....
8. Check any of the following locations where there are accumulations of waste paper, rubbish, old furniture, stage scenery, etc., and explain under remarks: ..... basement, ... furnace room, ... stage, ... dressing room in connection with stage, ... attic, other locations .....
9. Is the space beneath stairs free from accumulations or storage of any materials? .....
10. What material or preparation is used for cleaning or polishing floors? ..... Quantity on hand? ..... Where stored? .....
11. Are approved metal cans, with self-closing covers or lids, used for the storage of *all* oily waste, polishing cloths, etc.? .....
12. Are approved metal containers with vapor-tight covers used for all kerosene, gasoline, etc., on the premises? ..... Why are such hazardous materials kept on the premises? .....
13. Are premises free from electrical wiring or equipment which is defective? ..... (If answer is *No*, explain under Remarks.)
14. Are only approved extension or portable cords used? .....
15. Are all fuses on lighting or small appliance circuits of 15 amperes or less capacity? .....
16. Are electric pressing irons equipped with automatic heat control or signal and provided with metal stand? .....
17. Are sufficient fire extinguishers provided on each floor so that not over 100 feet travel is required to reach the nearest unit? ..... In manual training shops and in stage; 50 feet? .....

18. Have chemical extinguishers been recharged within a year?_____
Is date of recharge shown on tag attached to extinguisher?_____

19. Is building equipped with standpipe and hose having nozzle attached?_____
Is hose in good serviceable condition?_____

20. Is a large woolen blanket readily available in the domestic science laboratory for use in case clothing is ignited?_____

Remarks (Note any changes since last inspection)

The following items to be included in each quarterly inspection—

21. Building construction: Walls_____ Floors_____
Roof_____ No. stories_____
No. classrooms_____

22. Which sections of the buildings are equipped with automatic sprinklers? _____

23. Are there at least two means of egress from each floor of the building? _____ Are these so located that the distance measured along the line of travel does not exceed
From the door of any classroom, 125 feet? _____ From any point in auditorium, assembly hall or gymnasium, 100 feet?_____

24. Are all windows free from heavy screens or bars?_____

25. Do all exit doors open outward?_____

26. Are all interior stairways enclosed?_____ Are doors to these enclosures of self-closing type?_____

27. Are windows within 10 feet of fire escapes glazed with wire glass? _____

28. Are manual training, domestic science, other laboratories and the cafeteria so located that a fire in one will not cut off any exit from the building?_____

29. Is a smoke-tight projection booth, built of noncombustible materials, and vented to the outside, provided for the motion picture machine?_____

30. Are heating plant and fuel supply rooms cut-off from the main corridors by fire-resistant walls, ceiling and doors?_____

31. Do all ventilating ducts terminate outside of building?_____

32. State type of construction of any temporary buildings in school yard_____
_____

33. Is nearest temporary building at least 50 feet from main building?_____

34. How often are fire drills held?_____ Average time of exit? _____

35. Are provisions made for sounding alarm of fire from any floor of building?_____ Is sounding device accessible?_____ Plainly marked?_____

36. Give location of nearest city fire alarm box_____
_____
How far distant from the premises?_____

Remarks

Inspector_____ Title_____

Inspector_____ Title_____

Inspector_____ Title_____

XVI. Extinguishment

THOSE IN CHARGE of school buildings should have some knowledge of the principles and procedures involved in fire extinguishment. The local school fire extinguishing program is not to be considered a substitute for fire department service. However, some school fires may be checked or extinguished in the early stages by using first aid extinguishers. If unchecked, the fires might in many cases gain headway and become major fires before the department fire fighting units arrive. It is anticipated that the school employees will give first attention to the protection of pupils. Property protection while secondary in importance, should not be neglected. In order to provide essential protection school officials and employees need to understand something of the nature of fire, the classes or types of fires, the principles of extinguishment, types and use of extinguishers, and the care of sprinkler or other extinguishing devices.

Principles of fire extinguishment

1. Nature of fire.
   (*a*) Fires do not start or continue until the materials to burn are heated to the kindling point. The temperature of this kindling or ignition point is very low for some of the volatile gasses or liquids and higher for the less flammable materials.
   (*b*) Fires will not persist if there is no fuel near them.
   (*c*) Fires cannot continue unless there is enough oxygen available to support the chemical action of burning.
2. Extinguishing principles.
   (*a*) The elimination of all combustible fuel is desirable but not always feasible in constructing and equipping school buildings. It is often difficult to remove fuel from the vicinity of a fire that has started. However, this measure is used in reducing the danger from heating coal piles.
   (*b*) Cooling or lowering the temperature so that it is below the kindling point is one way to stop fires. Water is the cooling agent most used.
   (*c*) A third method of checking fires is to cut off the oxygen supply. This is ordinarily called smothering or blanketing.
3. Effectiveness of local extinguishment.
   (*a*) Some school fires originate on roofs around chimneys, in attics or other secluded or enclosed areas not easily reached by school hand or hose extinguishing devices and where detection often comes too late for effective use of these devices.
   (*b*) Many school fires start as small fires and could be extinguished, or controlled until help arrives, if adequate extinguishing devices were available and are properly used.
4. Regulations and plans for using the school extinguishing devices.
   (*a*) Sprinklers should operate automatically when activated by heat.
   (*b*) Custodians and others should be taught how to use the first aid fire extinguishing devices.

(*c*) It is generally desirable to instruct those in charge to attempt extinguishment when:

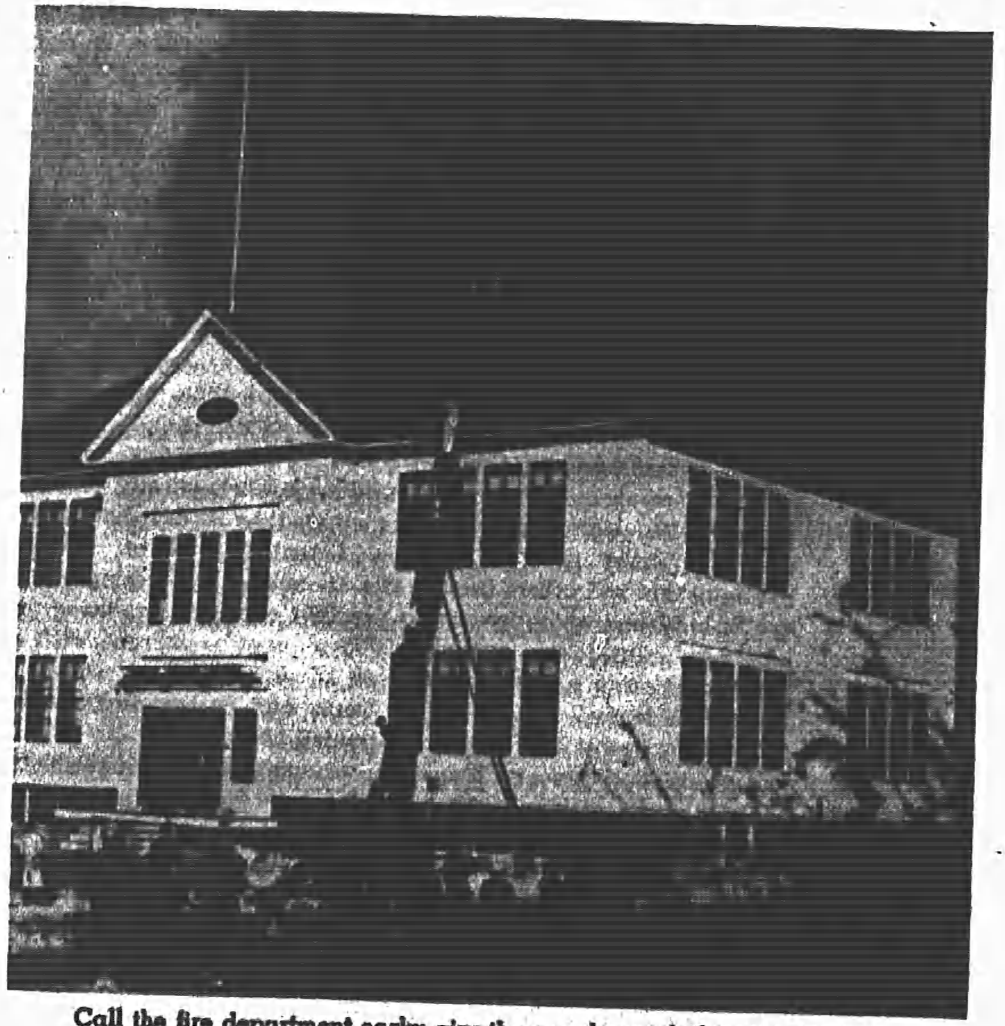
the fire is small and extinguishment seems possible; when extinguishment procedures will not delay or hamper safe pupil evacuation.

(*d*) Notifying the fire department should not be delayed. Plans for notifying the fire department should be developed and the responsibility for notifying them assigned to certain people

Types of fires

Extinguishing procedures are based partly on the classes of fires and extinguishing equipment should be located according to the type of risk.

1. Class "A" fires—of ordinary combustible materials such as paper, wood, straw, textiles, and solid fuel. The cooling process is generally used in extinguishing.
2. Class "B" fires—of such materials as flammable oils, greases, and volatile liquids. The usual extinguishing procedure is by smothering or cutting off the oxygen supply. Some cooling may be effected by the smothering



Call the fire department early; give them a chance before it is too late.

elements, but the use of streams of water on oil fires may help spread the fire.

3. Class "C" fires—around motors or electric wires. In some cases oil around the electric units may add to the fire hazard. The extinguishing medium must be a non-conductor of electricity or else the operator may be endangered. Fortunately some of the nonconducting extinguishing agents are also valuable for smothering fires.

School fire extinguishers

1. Sizes—Hand extinguishers are generally preferred for schools. These are mobile and can be carried easily by one man to the point of use.
2. The number of extinguishers needed will depend on building size, type of construction and finish, and the hazards involved. It is desirable to provide extinguishers for each floor. If the usual soda-acid (class A) or cooling type of extinguishers is used one of these for each 5000 square feet of floor area may be sufficient if the hazards are light. This number does not include the special smothering types of extinguishers that may be installed in shops and laboratories, or around motors.
3. Locations will be determined by the hazards present or anticipated.
   (*a*) General use cobling extinguishers should be located in corridors accessible to all. It is usually desirable to locate these so that one need not walk over 100 feet to get an extinguisher.
   (*b*) It is generally desirable to locate these in wall niches or to hang them about 5 feet above the floor where they are not easily upset or disturbed by pupils.
   (*c*) Other extinguishers, of a type adapted to the particular need, should be located in shops, in fan or furnace rooms, and other hot spots.
4. The type of extinguisher should be adapted to local needs.

   There is no one type of extinguisher best adapted to all uses. As indicated in this section, the cooling type fire extinguishers are usually preferred for ordinary or class "A" fires; blanketing types for oil fires; and nonconducting types for fires around electrical units.
   (*a*) Several extinguishers are designed primarily for cooling. Some of the most common are the soda-acid with a chemically created pressure; the water with pressure created by a CO_2 cartridge; and the water pumper with hand-created pressure. These extinguishers and others using water are subject to freezing. For use in locations where freezing is possible, extinguishers using an antifreeze solution are available. These may be charged with a calcium chloride solution or with an alkaline-metal salt solution (termed a loaded stream). The foam and carbon-dioxide extinguishing agents also have some cooling effect.
   (*b*) There are several types of blanketing or smothering extinguishers.
      (1) Foam type extinguishers have separate ingredients (sodium bicarbonate and aluminum-sulphate solutions). When these ingredients are combined by tipping the extinguisher, these expel carbon-dioxide bubbles that help to blanket or smother oil fires.
      (2) The vaporizing liquid extinguishers usually have a carbon tetrachloride base. In some cases a hand pump is used to develop pressure and in other cases pressure may be created

by stored air or carbon dioxide. The blanketing vapors choke off the oxygen supply. Consequently, these extinguishers are most effective in areas where the wind does not dissipate the blanketing fumes. The stream should be directed at the base of the fire.

(3) Carbon-dioxide extinguishers operate from a pressure tank. The range of throw is limited.

(4) Carbon-tetrachloride bombs or grenades are sometimes bought for attic installation. Timely applications from these attic units at the base of the fires cannot be guaranteed and their value for such use is questioned.

(5) Dust or powder spraying extinguishers are also used to give a blanketing effect, but these are not much used in schools.

(*c*) Nonconducting extinguishing agents are needed for fires around motors and electric wiring or applicances. The carbon tetrachloride vaporizing liquid and the carbon-dioxide extinguishers are usually recommended for such locations. The carbon-dioxide extinguishers for such use should have non conducting horns.

Building standpipe and hose installations

Many of the older and some of the newer school buildings have partially effective standpipe and hose fire-extinguishing facilities. Such facilities can be made effective.

1. Ample pressure should be available for the standpipe. Feeder lines should be large enough to provide continued pressure in case of need.
2. Hose outlets on each floor should be close enough together to permit reaching any point with a stream from a 75-foot hose.
3. Unlined linen hose is recommended. The hose should be racked ready for instant use.

Sprinkler protection

Sprinklers should operate automatically when subjected to heat. Hazardous combustible buildings should be completely sprinklered.

1. Some sprinkler values.
   (*a*) They are ever-ready watchmen and operate whether or not the building is occupied.
   (*b*) They automatically apply the extinguishing agent, water, at the point of fire (heat) and reduce fire spread.
2. Installations.
   (*a*) More complete protection is obtained if a building is fully sprinklered.
   (*b*) Even where it is not feasible to provide a complete sprinkler job, it is often desirable to install sprinklers in certain hot spots such as storage rooms and basement areas.
   (*c*) Where there is danger that sprinkler lines and heads may freeze it is possible to install a dry pipe sprinkler system. These work in about the same manner as the wet line system except that the water head is held back of the freezing area by valves and air pressure.

Use and care of school fire extinguishing facilities

1. Sprinklers.
   (*a*) Valves in water feed lines should be sealed open.

(b) Should be free of corrosion
(c) Wet piping systems should not be permitted to freeze.
(d) Air pressures on dry lines should be checked often.
(e) Cases or other articles should not be stored near sprinkler heads.

2 Standpipe and hose.
(a) Where the use of the fire hose might impede free safe pupil evacuation such use should be delayed until the pupils are out of the area involved.
(b) Hose should be dried after use and then re-hung.
(c) Water leaking from the lines into the hose may cause the hose to rot.
(d) Hose should be attached, nozzle should be open—ready for use.

3. Fire extinguishers.
(a) Should be checked often to see if in place and ready for use.
(b) Foam and soda-acid extinguishers should be refilled annually. In many cases the local fire department members will pick up, fill, label, and return with no cost other than for the filling ingredients.
(c) Carbon dioxide impeller capsules should be weighed often. A loss in weight may mean a loss in power.
(d) Extinguisher exhaust tubes should be checked often to determine whether they are open.
(e) Foam or soda-acid extinguishers that have been upset should be refilled.
(f) Fire extinguishers should be cared for and used as per the manufacturer's instruction.

XVII. Programs for School Fire Safety

SCHOOL FIRE SAFETY PROGRAMS do not just happen. They must be planned, and the responsibility for operation must be fixed. Successful programs must have public support. Obviously the primary purposes of such programs are to eliminate school fire hazards and to reduce school fire life and property losses.

Such programs should be cooperative

1. All school personnel should participate.
(a) Area of participation should be outlined for all school employees.
(b) Student groups should have a part in the program.
2. The local community should have a part in the program. Parent-teacher and other groups can help sustain interest, and can cooperate in reducing congestion and activity hazards arising from community use of the building.
3. The local fire department should be given an opportunity to assist in the program. They can point out certain fire hazards, check extinguishers and alarm systems, and advise on evacuation procedures.
4. The local school officials should be responsible for program organization, supervision, and success.

Extent of program

1 The program should have continuity.
   (*a*) Sporadic or special drives have some value in exciting interest.
   (*b*) It is the day to day continuing programs that are most effective in preventing the growth of fire hazards.
2 The program should cover all of the school plant and all of the activities in it.
   (*a*) It should include inspections.
   (*b*) It should cover operating practices that might create hazards.
   (*c*) It should include specific organized instruction in safety at all grade levels.
   (*d*) It should cover evacuation procedures.
3. Fire safety should begin with the planning of the building and carry through to its abandonment as school property

Organization of the program

1 Goals should be defined. One of the goals should be to develop an awareness of the importance of fire safety and a continued alertness to fire hazards.
2 Leadership should be developed or assigned.
   (*a*) In each school or building there should be some one person charged with the responsibility of promoting and directing the program.
   (*b*) Other group, squad, or area leaders may direct sections of the program.
3. Reports should be required.
   (*a*) Leaders should report periodically in writing to the administrative officer in charge of inspections made, conditions found, and recommendations.
   (*b*) All school employees, even if having no special safety assignment, should report on hazards found.
   (*c*) Arrangements should be made for periodic reports to the staff, the school and to the public on the fire risk involved in the building and its use.

The State also has a responsibility in fire safety

1. State code regulations should be limited to general safety provisions
2 State departments of education have an obligation. They
   (*a*) Should provide advisory service on fire safety in planning new buildings.
   (*b*) Should provide assistance in remodeling old buildings.
   (*c*) Should provide course of study materials, and arrange to provide preservice and inservice training in safety for teachers and custodians.
   (*d*) Should advise on safe operational practices.
3. A qualified State agency should have the authority to prevent the use of buildings which are hazardous for school purposes.

School officials should endeavor to maintain fire-safe conditions in their buildings. Buildings should be so planned that they do not provide many fire hazards. All school employees should be required to become familiar with some common school-fire hazards. These employees should be responsible for assisting in maintaining safe conditions. The total responsibility for fire safety in school buildingsmust be shared by all people who have any part in authorizing, planning, or directing the school system.

Bibliography

BOSWELL, B. HODGKIN. Fires and How To Prevent Them. Fire Prevention Manual. State Department of Education, Frankfort, Ky., 1949.

——The Dallas Civilian Club in cooperation with the Dallas Fire Department and Fire Prevention Council. Dallas, Tex., 1940.

CROSBY, FISKE FORSTER. N. F. P. A. *Handbook of Fire Protection.* National Fire Protection Association, Boston, Mass., Tenth Edition, 1948. 1544 p.

HOLMAN, A. T. *Fire Fighting on Farms.* Washington, U. S. Government Printing Office, 1946. U. S. Dept. of Agriculture, Misc. Pub. No. 612. 54 p.

NATIONAL BOARD OF FIRE UNDERWRITERS. Are School Drills a Farce in Your School? New York, The Board.

——Self-Inspection Blanks. New York, The Board.

——— Fire Protection as Applied to the Public and Parochial Schools. New York, The Board, 1935.

——— Construction of School Buildings and Improvement of Existing Structures. New York, The Board, 1937.

——— Protection of Openings in Walls and Partitions. New York. The Board, 1939.

——— First-Aid Fire Appliances. New York, The Board, 1948.

NATIONAL COMMISSION ON SAFETY EDUCATION. Fire Safety for Teachers of Primary Grades. Washington, D. C., National Education Association, 1950. 24 p. (Fire Safety Series No. 1.)

——— Fire Safety for Teachers of Intermediate Grades. Washington, D. C., National Education Association, 1950. 32 p. (Fire Safety Series No. 2.)

NATIONAL FIRE PROTECTION ASSOCIATION. National Electric Code. Boston, Mass., The Association. 416 p.

——— Building Exits Code. Boston, Mass., The Association. 1950. (11th Edition.)

——— Protection of Records. Boston, Mass., The Association, 1947. 63 p.

——— School Fires. Boston, Mass., The Association. 1946. 48 p.

OFFICE OF EDUCATION. A Curriculum Guide to Fire Safety. Washington, U. S. Government Printing Office, 1946. (Federal Security Agency. Office of Education, Bulletin No. 8.) 31 p.

PUBLIC BUILDINGS ADMINISTRATION. Manual of Fire Loss Prevention of the Federal Fire Council. Public Buildings Administration, U. S. General Services Administration. (Second Edition) Washington, U. S. Government Printing Office, 1945. 162 p.

REPORT OF THE COMMITTEE ON FIRE-PREVENTION EDUCATION. The President's Conference on Fire Prevention, May 1947. 29 p.

VILES, N. E. The Custodian at Work. New York, University Publishing Co., 1941. 391 p.

——— School Fire Drills. Washington, U. S. Government Printing Office, 1948. Federal Security Agency, Office of Education, Pamphlet No. 103) 19 p.

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