BLACKOUTS

UNITED STATES
OFFICE OF CIVILIAN DEFENSE
Washington, D. C.

Errata Memorandum of the Technical Section

CIVILIAN PROTECTION DIVISION

OFFICE OF CIVILIAN DEFENSE

"Blackouts" will subsequently be entirely revised and reprinted. The revisions to be incorporated will be the result of recent investigation and research.

In the present reissue of "Blackouts" the following revisions are included:

1. **Page 11, paragraph 16, line 8:**
   Delete "10" and insert, "3."

2. **Page 11, paragraph 17, line 10:**
   Delete "Lights in rooms not obscured must not be used." and insert, "Lights in rooms not obscured must be extinguished, properly shielded, or replaced."

3. **Page 26, paragraph 34, line 17:**
   Delete last sentence.

4. **Page 26, paragraph 36, line 14:**
   Delete "Any material which allows a glow to be seen outside will not do." and insert, "A satisfactory alternative to this can be secured by the use of special fixtures or interior blackout lamps which will eliminate the necessity of obscuration of openings."

5. **Page 27, paragraph 37, line 3:**
   Delete ". . . , and if possible the gas at the meter, . . ."

6. **Page 27, paragraph 39, line 13:**
   Delete "Outside lights should be covered with blue shades, . . ." and insert, "Outside lights should be extinguished or replaced by special fixtures or blackout lamps giving an illumination on the ground ranging from 0.0003 to 0.0006 foot-candle, . . ."

7. **Page 48, paragraph 78, line 8:**
   Delete ". . . , and remain visible for only a brief period after activation, their usefulness is limited." and insert, ". . . their usefulness is limited to specific applications. Recent developments indicate that certain phosphorescent paints will retain their visibility for approximately 8 hours."

8. **Page 54, paragraph 86, top of page:**
   Delete the two paragraphs headed respectively by "BLACKOUT CIVILIAN VEHICLE LIGHTS" and "Military or special lights" and insert, "Vehicles operating under blackout conditions must be equipped either with devices acceptable to the Office of Civilian Defense or with the devices used on military vehicles."

Specifications which are now being prepared by the Office of Civilian Defense will be issued in the very near future by the State or local civilian defense councils.

The specifications now in the course of preparation will cover the following subjects:

a. Fixtures and interior blackout lamps.
b. Vehicular lighting.
c. Paints.
d. Signs.
e. Hand lamps and flashlights.
f. Blackout equipment for highway, rail, water, and air transportation.

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BLACKOUTS

Prepared by the

WAR DEPARTMENT

With the Assistance and Advice of Other Federal Agencies

August 1941

UNITED STATES

OFFICE OF CIVILIAN DEFENSE

Washington, D. C.

Prepared under the direction of the
Chief of Engineers, U. S. Army
with suggestions of the
National Technological Civil Protection Committee

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Foreword

THE effectiveness of a blackout system depends upon the knowledge and the cooperative spirit of the people at large. Civilian Defense agencies are responsible for the proper education of the people as to the reason for and the methods of producing blackouts. Based on this knowledge the enthusiastic cooperation of the people must then be evoked by continuing publicity of a progressive nature. The proper authorities must present the vital seriousness of everything connected with blackouts. All concerned must realize fully that planning and advance preparation contribute most to the effectiveness of a blackout. This advance planning and preparation requires long, painstaking, and many times unnoticed, prior effort. Too often these efforts may appear to some to be expended on relatively unimportant details. But an effective blackout is not achieved by spectacular efforts at the beginning of or during an air raid. Except for meeting contingencies, little or nothing can be done to increase the effectiveness of a blackout while a raid is in progress.

It is inherent strength of character which enables a people to survive air raids. The knowledge that everything that can be done has been done, will enable a people to stand by each other and care for themselves.

This pamphlet, "Blackouts", is published to provide information as to how certain typical installations may be effectively blacked out. The data and information contained herein are based upon the latest and most authoritative information available upon the date of publication, and are intended as helpful suggestions to be modified and adapted to each local situation and to specific installations.

In no sense should issuance of this pamphlet be construed as a signal to start work immediately on any of the blackout procedures described. Using the material in this pamphlet as a guide, studies of existing installations and plans for effective blackout can be initiated by responsible agencies. The Office of Civilian Defense will announce when the active installation of blackout construction should take place.

The text pertaining to Protective Concealment should be consulted in the preparation and application of the blackout methods described since both blackouts and camouflage are phases of the general problem of concealment.

For information on the functions of the warning and communications systems, the text describing Air Raid Warning System should be consulted.

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BLACKOUTS

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Planning the Blackout

SECTION I: GENERAL CONSIDERATIONS

1 *PURPOSE*

The purpose of this pamphlet is to provide a common basis for instruction, by local civilian defense organizations, in the proper procedures necessary to achieve effective blackouts. A representative selection, covering the entire field of means and methods which have worked in practice, has been made and is presented in this pamphlet. The information furnished and methods outlined are by no means applicable to every type of dwelling, factory, or place of business. In urban and industrial communities the more elaborate blackout procedures will be required, while in farming areas and isolated communities only the relatively simple precautions will be necessary. The choice of means and methods will rest with the responsible individual, subject to the direction of the local civilian defense authority.

2 *SCOPE*

The subject matter included covers the information which the civilian population, both as individuals and organizations, need to know about blackouts.

Separate chapters provide information for those concerned with blackouts of the following types of facilities: Private homes and similar buildings; plants and factories; municipal utilities and large private lighting systems; and the various forms of transportation and traffic control. An appendix contains type specifications for blackout materials and devices.

3 *DEFINITIONS*

The meaning of some special terms and abbreviations which will be used in this and related pamphlets are given here. Some of those used (especially terms which involve an understanding of proposed civilian and military organizations and their operations) should be learned inasmuch as future instructions, issued from time to time, may make use of these terms without such explanation.

ARP—Air Raid Precautions—the term used in England to cover all procedures having to do with protection of the civilian population against air attacks.

Air Raid Warden—An air raid warden is a responsible and reliable member of the public who will advise and assist his fellow citizens in the sector to which he is allotted, in all the possible means of protection from an aerial attack; he will form a link between them and the authorities for reporting air raid damage and calling for assistance when required.

Alert or *alert condition*—See Par. 13, Chap. I.

Auxiliary Police System—A system of emergency police organizations operating under and supplementing the regular local police in their normal police functions.

Blackout—n. Condition under which all or certain lights are extinguished or effectively screened. v. To extinguish, or screen lights for this purpose.

Blackout Discipline—The willing, prompt, and efficient execution of all prescribed blackout measures by those responsible; orderly compliance with corrective instructions; and exercise of all necessary supervision by authorities without allowing panic or antagonism to interfere in any way. Briefly, complete cooperation on all matters concerning blackouts.

HE—High Explosive—term applied to powerful charges in bombs or shells.

Light Lock—A double door, curtain, or any passage arrangement which permits movement in and out of lighted buildings without light being visible outside.

Matt—rough, non-reflecting surface (to appear dark or light absorbing) as opposed to a smooth shiny reflecting surface; also refers to paints having such a surface.

Obscuration—Prevention of the escape of light from inside of a building by any means, such as painting glass, placing screens, etc.

4 *BLACKOUT TRAINING AND PROCEDURE*

The duty of the different Civilian Defense services is the protection of the civilian population at all times and under all conditions. The critical time in the operations of all such services is during blackouts. Special skill is required for work at night (sometimes in total darkness), because new and additional difficulties are encountered which do not have to be overcome during hours of daylight or when normal lighting is permissible. The training of members of Civilian Defense services should not be considered complete until all are experienced in working effectively under blackout conditions. (See Section III of this chapter.)

All-night every-night blackouts over the whole vast area of the United States will probably never be required. Areas within 300 to 600 miles of enemy front lines or the seacoast probably will be required to black out every night. Distant interior areas should be prepared to initiate blackout procedure when advised by Civilian Defense authorities. Several types of warning will be used. (See Section IV this chapter.) Figure 1, showing a typical street intersection by day and night, indicates why the blackout of street lights and sign boards is necessary.

A blackout comes under the heading of passive defense. It is passive only in the sense that it provides no direct means of fighting back against the bombers. On the ground there is intense activity. The first element to come into use is the Military Aircraft Warning Service. This service spots the enemy bombers before they reach their objectives, notifies all areas in time so that warning alarms may be given. A most important factor in the civilian warning system is the decision as to when and where to give the alarm. It must be realized what effect blackouts will exert on military and commercial ship, railway, air and motor traffic; what vital war production will be affected and how; which factories can afford to shut down and which can or must risk carrying on production.

A city in an alerted area ordinarily is kept dark, except for faint lights at traffic lights, safety signs and specially selected places such as railway stations. Motor and other traffic ordinarily use dimmed lights, all windows are obscured, and all outside or exposed lights are extinguished. Rigorous measures are taken against any who fail to comply with the provisions of blackout regulations.

At the end of the raid an "all clear" signal will mean that the immediate danger is past and that the area may resume such restricted lighting as may be authorized under the alert condition for that area. The old peacetime blaze of lights cannot be restored because another air attack may be launched, taking advantage of the opportunity which complete lighting affords.

Once the air raid warnings are sounded the actions taken will be as planned. Predetermined procedure which has been rehearsed and is known to all should be followed rather than attempt to improvise any new procedure.

ACTION AFTER BLACKOUTS

Immediately after the "all clear" signal, thorough inspection should be made of all blackout devices and facilities with the object of putting them immediately in condition for further use. Where a device is an essential one and no substitute will serve, repairs should be progressive so that all devices are placed in the best possible operating condition for use every night until final repairs have been completed. Replacements of personnel, equipment, and transportation should be secured from the proper sources to maintain defense services at full strength at all times.

Accurate reports should be submitted with recommendations for changes and improvements in procedures. Independent reports should be coordinated with those submitted by the organizations concerned. Reports should be analyzed to determine areas where failures to observe blackout instructions resulted in an increase in casualties, damage, or interruption in rates of production. Plans should be revised to take advantage of any better or simpler procedures evolved. Conclusions drawn from these reports should be used as a basis for instructions to decrease or increase the severity of blackout restrictions in future raids.

Judicious praise and publicity should be given in the press and on the radio by name with cita-

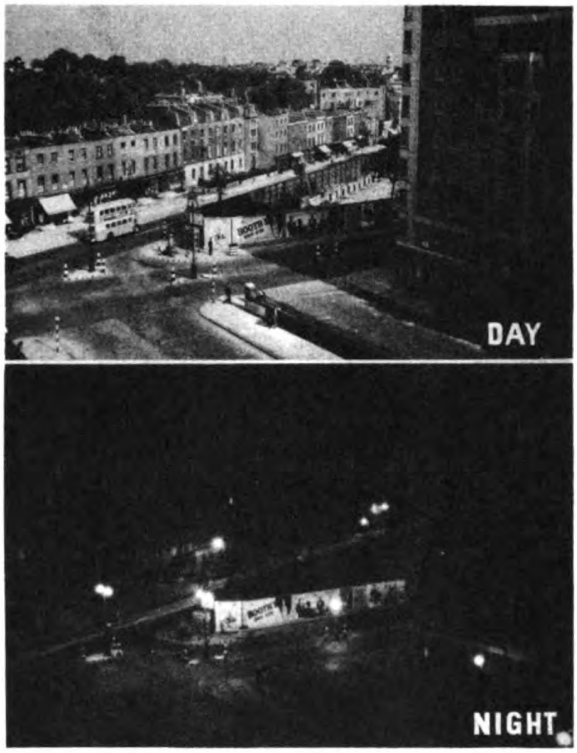

Figure 1—Typical city street intersection before blackout.

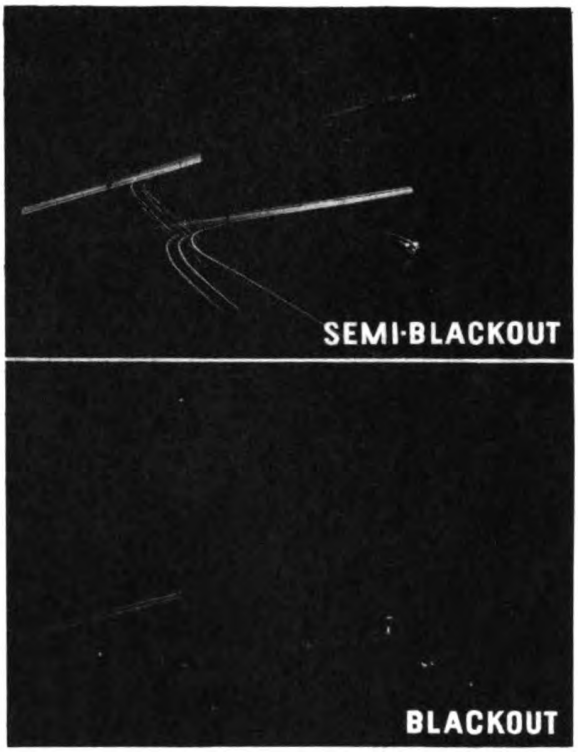

Figure 2—Same intersection as Figure 1 with semi-blackout and total blackout. {Note: For safety reasons vehicular lights were not obscured at time of the photo.}

tions for all outstanding achievements accomplished during blackout operations. Without placing blame on any particular persons or organizations, matters of negligence or violations of instructions should be pointed out and errors of judgment and execution should be corrected by indicating what better procedures must be followed. The maintenance of a high morale is most important if the blackout system, a naturally unpleasant and difficult one to put into effect, is to continue to operate efficiently.

6 *BASIC CONSIDERATIONS IN PLANNING BLACKOUTS*

Blackouts are effective only when they deprive enemy airmen of all possible reference points which might aid them in making attacks. Blackouts hinder the operations of air attacks against such vital objectives as:

Military positions, airfields, and bases.
Industries essential for wartime production.
Municipal utilities and transport facilities.
Stores of civil food supplies and material.
Civilian population in general.

EXTENT OF CONCEALMENT

A blackout, of itself, does not conceal the presence of cities. For example, on cloudless, clear nights when there is moonlight, or even starlight alone, there is sufficient light for aerial activity. In areas subject to air attack the alert must always be in effect regardless of weather, although blackout procedure may be modified if overcast conditions prevail for considerable periods of time or when proper precautions are taken. Flares and incendiary bombs may be dropped by enemy planes to disclose specific and area targets, but these cannot be dropped everywhere at the same time. A blackout conceals the pattern of streets and centers of activity (Fig. 3) and will:

(1) Prevent identification of the locality as a guide to other points more distant.

(2) Prevent use of lighted streets or areas as reference points for attacks on specific objectives within the immediate area.

(3) Prevent haphazard bombardment. Airplanes, once loaded and started on a bombing mission, will seldom land with their loads of bombs. If the bomber is unable to locate its assigned target due to a blackout, it will drop its bombs before returning to its base, probably on some enemy city or town which can be located by its lights. Hence, every city or town within reach of enemy bombing planes must be able to enforce blackout measures for its own protection, if for no other reason.

Areas in which blackouts are enforced may be important in themselves or indicative of other important areas. Blackouts often may be more difficult to enforce in the latter areas than in the former because the people do not consider that they are likely targets.

BLACKOUT AREAS

In the blackout of vital localities, area limits should be designated according to strategic and industrial boundaries rather than by State, county, or city boundaries. For example, the areas in which manufacturing is centered, such as those around Hartford, Boston, and Providence; or the Trenton, Philadelphia, Wilmington area; or the Pittsburgh, Wheeling, Akron, and Youngstown, area—all of which lie in several States—should each be considered as a single entity rather than as independent parts of the separate State or other political areas. To take full advantage of existing governmental agencies, such areas may be subdivided according to political boundaries, but the closest coordination must be effected between adjacent

Figure 3—Perfect targets for air bombing—an important industrial area with obvious important centers ablaze with lights.

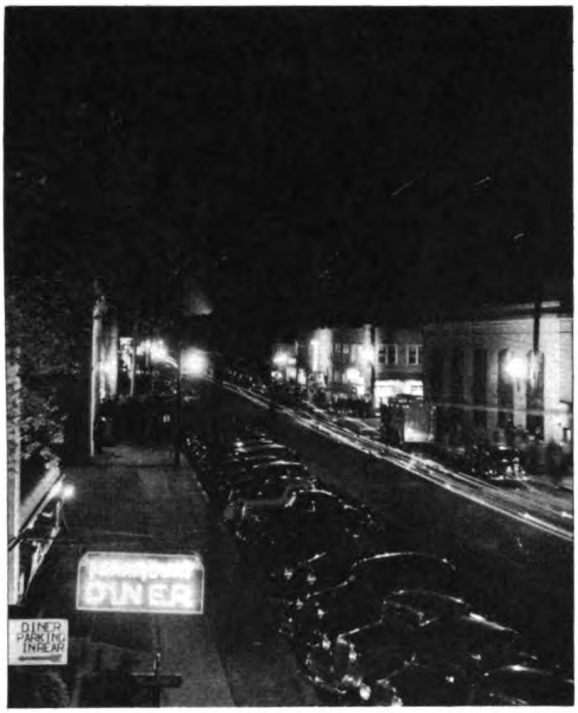

Figure 4—Lighted city street—note brightness of light sources and reflections from car tops.

agencies responsible for blackout control of all the various parts of the larger vital area. Slowness or negligence in any one sub-area will nullify blackout efforts of all the others with fatal results.

SOURCES OF LIGHT

Primary sources of light, where the light source is directly visible, such as: light from industrial activity, street lights, store fronts, factory roofs, side lights, house windows, electric signs, and vehicle lights (Fig. 4) must be blacked out, as well as reflections of light from windows, roofs, rivers, lakes, and paved areas (Fig. 5).

BLACKOUT METHODS

Primary sources of artificial lights usually can be controlled by being turned off entirely, by dimming by use of rheostats, by painting or some form of shades, and by screening so that no glow is visible from the air. Details of these methods as applied in specific cases are given later.

Light-reflecting surfaces may be more difficult to conceal than primary light sources. Reflections are minimized by shields limiting light dispersion, by blackening or by covering smooth reflecting surfaces. A factory may be well blacked out but its glass windows and its roof, wall and yard surfaces may reflect light of

Figure 5—Same city street as Figure 4 blacked-out. Note flares and searchlight beams in sky and light reflection from shiny auto tops and roof of diner.

the moon, stars, fires or flares (Fig. 5) very noticeably. The prevention of reflection of light from very large smooth areas, such as wide roads, large rivers, and lakes, is most difficult if not impossible in most cases.

ANTI-AIRCRAFT SEARCHLIGHT

Where some or all of the anti-aircraft searchlights placed about an area turn on their lights fully (Figs. 5 and 6) as soon as hostile planes approach any city or large installation, the effectiveness of the blackout as a whole will be decreased, but protection of specific point targets will still be effective.

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Figure 6—Airplane flares and anti-aircraft searchlight beams.

LIGHT PATTERNS

In cities and commercial areas the distribution of lighting is not uniform but forms certain distinctive lines and patterns (Fig. 3) which are easily identifiable from the air. If these patterns are varied by shutting off certain lights and adding others not normally visible, a form of deception which may have some value can be evolved. However, if all lights in a vital city or area are blacked out but the city or area remains surrounded by lights in houses and on roads in the adjacent countryside, the blacked-out area obviously will be a center of population or industrial area of importance. Hence, unless all country lights are also put out, the city or area must plan to have similar lights scattered through it with the same normal density as those in the surrounding country. The matter of variation of light patterns is covered further in Chapter V.

TWO FUNDAMENTALS

All these and similar matters must be considered by both Military and Civilian Defense authorities in preparing coordinated plans for air defense. Two cardinal points should be noted:

(1) If a total blackout would be of no value and is not required, only such blackout as *is effective and needed* should be enforced; and

(2) Whatever blackout regulations are prescribed should, in all cases, be enforced without laxity or exception of any kind.

SECTION II: RESPONSIBILITY FOR EXECUTION OF BLACKOUTS

7 *LEGALIZING BLACKOUT ENFORCEMENT*

In places where blackouts are needed, statutory regulations must be enacted by each of the various States, counties, municipalities, incorporated towns, and villages. These will set forth the responsibilities of the various agencies and require compliance under pain of various penalties for non-compliance by local authorities, employers, businesses and individuals.

ENFORCEMENT ORGANIZATION 8

Air Raid Wardens and Auxiliary Police working with the normal police force will put into execution and enforce the provisions of all blackout regulations and instructions. In cities and metropolitan areas the Chief of Police is usually designated the head of this system. The regular police will carry on their normal and added civil functions, but members of the auxiliary organization may be deputized for special police purposes as required.

SECTION III: ADVANCE PLANNING AND PREPARATIONS

9 *PHASES*

Preparation for blackouts may well be divided into three distinct phases:

(1) The first or initial phase, which should be initiated locally, should begin in time to permit deliberate and well considered planning integrated with the plans of local Civilian Defense authorities. During this phase all concerned should formulate plans for blacking out the installations for which they are directly responsible, including the preparation of lists of materials required, and a study of the sources from which materials may be obtained readily.

(2) During the second or preparatory phase, but only upon advice of the Civilian Defense authorities, active preparatory measures should be initiated. The necessary materials should be secured by the plant owner, home owner, or governmental agency concerned, and prepared for installation, and in some cases installed.

(3) The third, or final phase, will be undertaken only when the Office of Civilian Defense advises that such action is necessary. All necessary permanent installations will be completed, restrictions in exterior lighting will be imposed, and all industries and individuals will be prepared for the alert condition upon short notice.

Although planning should be thorough and detailed, the actual securing and installing of material should be discouraged until it appears necessary. The Civilian Defense authorities, with the advice of the Military, are best able to judge what phase of preparation is necessary in any particular area. The purchase of materials for use in areas not likely to be first affected may cause unnecessary expense for individuals, industries, and municipalities, and may divert these materials from areas where they are more necessary.

OBJECTIVE 10

The general objective of each of the various phases of blackout training and preparation should be drawn up and announced so the efforts of all agencies are integrated and effective. The objective of the whole organization is to perfect a system of blackout and light control in the local area and adjacent territory.

The actual practice of blackouts should be deferred until phase three has progressed sufficiently to make it desirable to check effectively upon blackout measures.

EDUCATION OF THE PUBLIC 11

A series of light control and blackout tests should be announced as soon as the organization therefor is completed. Tests should be held periodically thereafter, each test being progressive in scope, until a satisfactory standard of efficiency is attained. This standard should henceforth be maintained by well publicized check-up tests given as required. Test periods should be short initially (¼ hour) but test periods of 1 hour may be the maximum later. Plans should provide for total blackout at *any* time; if necessary, for the entire period of darkness, should actual attacks occur. Posters (Fig. 7) and all other available means of public-

ity should be employed to keep these tests in the public mind.

Prior to the initial tests, all responsible agencies will impart to all persons by every available means an understanding of the importance and purpose of the blackout, emphasizing the duties of the individual and the necessity for wholehearted cooperation. Newspapers, radio, movies, billboards, speeches and demonstrations in stores, schools, clubs, and similar places should be used. Details of the techniques used, addresses and names of key personnel in the organization that might be of value to or assist activities of enemy agents should be imparted only to those who are required to have such knowledge.

12 *TRAINING*

Actual tests of whole areas should be preceded by local tests of separate installations, individuals, and organizations, to assure that the requisite information and education has been disseminated and absorbed. All blackout operations cannot be checked carefully if tests cover too much ground.

CORRECTION OF ERRORS

At meetings of responsible, informed representatives, all errors noted should be brought to the attention of the agencies concerned and corrected in later tests. Especial attention should be given to errors of omission and defects in blackout discipline which would provide orientation toward or identification of the area as a whole or vital installations therein. Photographs both from the air and ground before and during the blackout from the same positions are of value to show errors and assist in studies thereof.

OBSERVATION

In later area tests aerial observers should fly over the areas blacked out to observe and report on favorable and unfavorable features noted, take pictures before, during, and after the alarms at stated intervals, using both vertical and oblique observation and photographs from the lowest to highest altitudes. Blimps, autogyros and other types of slow-

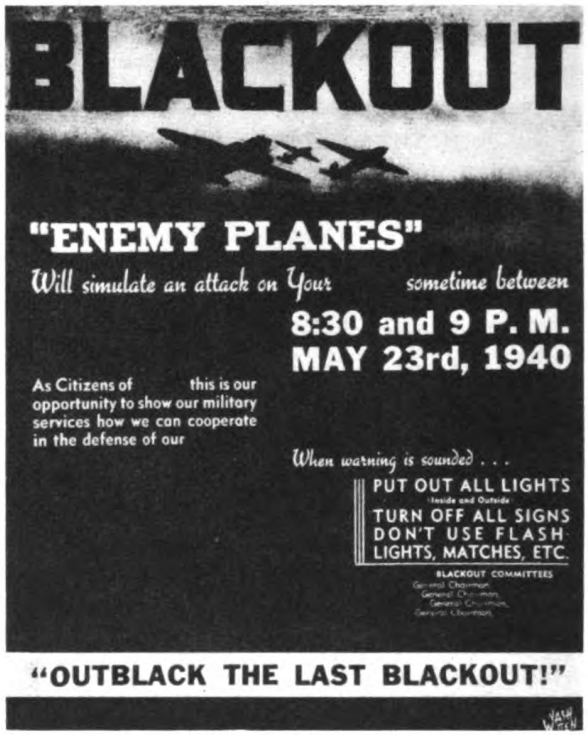

Figure 7—Typical poster publicity to advertise blackout tests.

flying aircraft are of value for corrective inspections. The necessity for the blackout of areas adjacent to the one being tested, and various combinations of these areas, should be noted. In the absence of aerial observation, check should be made of blackouts from high hills, towers, and buildings near and within the areas tested.

CHECKS AND RECORDS

General publicity of the results should be encouraged but data on specific defects found and remedies applied should be restricted to the personnel intimately concerned.

SUMMARY OF STEPS FOR ORGANIZING BLACKOUTS 13

a. Designation of boundaries of local Civilian Defense areas with special instructions, if necessary, regarding vital points.

b. Prompt passage of necessary State enabling legislation.

c. Designation of local Civilian Defense authorities by State or city authority for the area.

d. Prompt passage of the necessary city or county enabling legislation.

e. Organization of a system to coordinate and control the operation of blackouts.

f. Radio and press publicity campaign to inform the public of purposes and to secure volunteer recruits for the various blackout organizations.

g. Use of blackout organizations to conduct surveys and collect data on vital installations requiring special blackout measures; means of controlling all light, power, fuel, water, gas and similar facilities. Such surveys must be made promptly and thoroughly in cooperation with the operating organizations. Local technical societies, commercial clubs, business bureaus, chambers of commerce, etc., will be of help.

h. Instruction of the civilian population as to their duties in blackouts through newspaper articles, radio talks, demonstrations, in schools, stores, and other local organizations, using means and methods similar to those employed in local traffic safety, community chest, or city clean-up drives.

i. Practice blackout checkups at individual homes, factories, stores, etc., with corrections made in each case by competent observers.

j. Progressive series of local sub-area tests using all agencies for checkup and to practice their own particular functions.

k. Partial and total blackout tests for the entire area and checkup tests by air observers.

l. Correction of errors and improvement of installations.

m. Continued varied training for all possible contingencies by all Civilian Defense agencies with changes made in the plans whenever necessary to keep up to date on latest developments.

n. Although basic plans may be retained, detailed procedures should always be undergoing a continuous process of study, trial, improvement and simplification.

o. Sabotage is facilitated by conditions existing during blackouts and all agencies should include in their plans of operations full provision for additional guards. Guards are needed also to protect persons, buildings, and property in general from criminal activities and vandalism.

SECTION IV: COMMUNICATIONS AND AIR RAID WARNING MESSAGES

14 *AIR RAID WARNING MESSAGES*

Since the notice that lighting restrictions are necessary in an area is conveyed by the various air raid messages sent over the Civilian Air Raid Warning System, it is necessary to describe that system.

The United States has been divided into military air defense areas and each such area has been divided into warning districts.

Air raid warning messages will be dispatched from the headquarters of an air defense area over the civilian air raid warning system to the Civilian Defense headquarters or control rooms. From these points messages are disseminated by various means of signal communication to the inhabitants of the respective communities.

It is not probable that all parts of the United States will be subject to aerial bombardment at one time. Whether or not an area is vulnerable can be decided by considering the following factors:

1. Distance of the area from the nearest enemy air base.

2. Range of enemy bombers.

When the appropriate Military Commander decides that an air defense area is vulnerable to bombardment, he will alert that area, even though there appears to be no immediate threat of enemy action. A district is alerted when it is considered that the enemy is capable of delivering an effective attack upon it.

(NOTE.—Since the "Alert" requires preliminary measures of readiness on the part of all Air Raid Protection agencies, such as first aid stations and fire and police departments, it is applicable to the situation by day as well as by night, and may be intermittent, or continuous over long periods.)

Prior to the time when an area is alerted, no lighting restriction need be imposed. However, that area should have made preparations to put into effect the lighting restrictions required by the various warnings.

An area which has been alerted will be blacked out at night except for the following:

1. Essential industry and transportation will be allowed sufficient lights for efficient operation.
2. Street lights will be kept on but will be properly screened and of such lower power that they cannot be seen from the air.

When the appropriate Military Commander finds that the area is not likely to be subject to aerial bombardment, he will so inform the civilian air defense authorities in the area.

The types of air raid warning messages are as follows:

AIR RAID MESSAGE—YELLOW—PRELIMINARY CAUTION

This warning for confidential information is issued to essential industry and transportation allowed special lights. The YELLOW serves to notify them that they must get ready to obscure their special lights upon a BLUE or RED warning. This warning may also be issued to places where action in connection with air raid precautions requires a long time to put into effect.

AIR RAID MESSAGE—BLUE—LIGHTS WARNING

This warning is issued to essential industry and transportation. It serves to notify them that they must obscure their special lights at once. If, as may happen, a RED warning is given without a prior BLUE warning the special lights must be obscured at once.

AIR RAID MESSAGE—RED—ACTION WARNING

This warning is a public warning issued by all planned means of communication. RED means that an air raid may occur in five minutes and that immediate action in regard to air raid precautions is to be taken.

AIR RAID MESSAGE—WHITE—RAIDERS PASSED

This warning, upon which a public signal is given if action warning RED is in force, means that the hostile planes have left the area or the threat of a raid is no longer imminent. The WHITE notifies essential industry and transportation that they may resume the use of the special lights allowed them under provisions for the "alert". If, as may occur, the recipient has received no previous warning, no action is required.

SECTION V: EXTENT AND NATURE OF LIGHTING RESTRICTIONS

15 *GENERAL*

In any future war, restrictions on lighting in some parts of the United States may be as drastic as those enforced in regularly bombed parts of warring Europe.

Whole sections of the country may have to be darkened for the purpose of depriving enemy airmen of means of locating targets or checking their own positions. With normal lighting any city or town is conspicuous at night from the air as a general glow and a closer view shows streets and general centers of activity. The layout of inhabited areas is clearly revealed by unscreened sources of illumination and even the glow from gas plants or factory fires contributes to the general level of illumination. To cut off all power at one central switch might seem a simple solution. But the plunging of the locality into darkness by switching off electric power at the generating stations would also interfere with running of trains, trolley buses, elevators, drainage pumps, and electrically driven machinery of all kinds and this, therefore, can seldom be contemplated for long periods. Apart from this, the vital necessity of maintaining illumination in essential control stations, operating hospitals, etc., will require installation of emergency lighting systems.

REDUCTION IN OUTSIDE ILLUMINATION 16

In a situation in which an alert is declared illumination will be reduced to a minimum. Since it has been determined by clear weather observation that illuminations of large areas or surfaces to values on the order of full moonlight

(.02 incident foot-candles) result in fair visibility to aircraft observers, it is suggested that artificial lighting of large surfaces during blackout conditions be kept below moonlight values. Where the illuminated areas, as in the case of prominent streets, may be important map points, then incident intensities not generally exceeding 10 percent of full moonlight are recommended.

It must be noted that the visibility of lighted surfaces is chiefly a function of their brightness and their area. Upon a dark surface the incident illumination could be much higher than upon a light colored one, without resulting in any greater visibility. Consequently, the proper measure of permissible illumination must take into account the co-efficient of reflection of the surface. The incident illumination measured in foot-candles, when multiplied by the co-efficient of reflection expressed as a decimal fraction, gives the apparent brightness in foot-lamberts. For example, 8 foot-candles falling upon a concrete road having a reflection co-efficient of 0.40, would have a foot-lambert value of 3.2. The foot-lamberts from the same illumination of white blotting paper with a reflection co-efficient of 80 percent, would be 6.4 foot-lamberts. Consequently, the permissible illumination should be expressed in foot-lamberts.

Foot-lamberts may be measured directly by aiming a visual photometer at the illuminated surface. However, when dealing with brightnesses at or below the intensities of moonlight, such measurements become difficult for the average person and may have to be left to the photometric specialist, or estimated by brightness comparisons with some known standard. In this work the average foot-candle meter is not usable because of its limited range.

Measures toward the reduction of illumination will suppress particularly all luminous signs. Show window and street lighting will be reduced to the degree authorized by local instructions. All forms of out-door gas lighting will be done away with unless means are available for controlling such lighting easily and shutting it off promptly on an alarm. Street lights which are kept in use will be entirely masked above by means of a deep, opaque shade designed to cut off all light rays above the horizontal. Street lights will be modified so as to let pass only the essential amount of light. The ground at the foot of lamp posts will be darkened with rough non-reflecting dark materials such as asphalts and cinders, or soot mixed into concrete surfaces.

Where complete extinction of street lights might have serious consequences, special lighting systems will be established, limited to street designations and warning lights on curbs and similar obstructions. These lights will be so arranged that there will be no reflections on the ground or on walls that could be seen by an aerial observer.

Experiments should be made to determine the exact manner of handling this special lighting. Civilian Defense agencies in each town and city must study this matter on their own initiative and decide upon a method of effective modification and shielding of such exterior lights as must be kept in service during alarms.

OBSCURATION 17

In time of war, all windows, skylights and glazed doors in the areas designated by Civilian Defense authorities must be rendered opaque or light-proof at night; this masking of existing interior lighting is called "obscuration." This can best be achieved by the fitting of dark blinds or use of other means to make any inside lights completely invisible from outside. All rooms in a building likely to be occupied after dark should be so fitted. Lights in rooms not obscured must not be used. Blackout, as one of the first measures of passive defense to be adopted, to be effective, must be successfully executed. A thorough blackout can extinguish or shield all lights from aerial observation, especially in cities and industrial areas, and may even contemplate "alteration of the map" by changing the lighting pattern. Strong blinds behind windows and under skylights also serve to minimize danger from glass shattered by explosion of bombs. Windows, glazed walls, etc., of workshops, garages, stores and shops, whether they open on streets or upon interior yards, must be so masked and special attention must be given to openings in roofs such as skylights. Where such means cannot be used, inside lighting must be reduced and shielded as for outside lighting.

18 *STUDIES TO BE MADE*

Studies will be undertaken to provide a system for rapid extinction of lights on alarm signals and control of such lights as must be kept on during the alarm, based upon lists of essential lighting fixtures. All fixtures must be equipped with means for permitting lights to be cut down to the absolute minimum.

Plans for eliminating delays in extinction of lights must be devised. Such a plan must provide for distant control from central points, using means already established, to permit simultaneous extinction or dimming of a number of lights and grouping street lights on separate circuits controlled from transformers. In case neither of the foregoing is immediately possible, detailed plans for prompt control by other means must be developed.

19 *TYPICAL RESTRICTIONS*

Some lighting restrictions which, in the event of war, would be strictly enforced in *alerted areas* are:

PRIVATE HOUSES, SHOPS, BUSINESS PREMISES AND PLACES OF ENTERTAINMENT

All occupants of premises used after dark are required, for duration of war, to mask all windows, skylights and doors at night with dark blinds, curtains or other means, so that no light inside such premises is visible from outside. Outside lights of any kind are forbidden.

BILLBOARD LIGHTING AND ILLUMINATED SIGNS

All illuminated advertisements and signs (other than signs installed specifically for air raid protection purposes) are prohibited.

FACTORIES AND INDUSTRIAL PREMISES

Emission of direct or reflected light from existing factory buildings must be prevented, normally by screening all windows and skylights with dark blinds or paint. Outside lighting in general is prohibited.

STREET LIGHTING

Normal street lighting is not permitted. Street lamps and traffic control signals, fitted with approved bulbs and masking devices, are allowed to remain in operation in darkened streets where necessary.

ROAD VEHICLES

Similarly, restrictions are imposed on lights carried by road vehicles. Motor car headlamps can be used only when heavily screened and provided with hoods or masks. Interior lighting in public vehicles if it cannot be properly obscured, is prohibited.

RAILWAYS

Lighting in trains and on railway premises is also subject to restriction. Details must be arranged with the railway companies concerned in each defense area of the country.

SHIPPING, NAVIGATION AND AIRCRAFT LIGHTS

Shipping, navigation and aircraft lights will be controlled by arrangements made in conjunction with the local, State, or Federal agencies concerned.

CHAPTER II

Obscuration Methods and Materials

SECTION I: GENERAL

20 *IMPORTANCE*

A most important phase of an efficient blackout is the complete, and where necessary, rapid obscuration of inside forms of lighting which must of necessity remain burning. This is usually done by blocking normal wall openings so that no light can be seen outside. Some of the means of procuring the desired results involve application of paints and other materials directly on the glass, placing shutters outside, and the installation of blinds, screens, and other devices inside the glass, or blocking off the escape of light by interior canopies enclosing both the light source and the area to be lighted.

21 *COSTS*

Where prices of materials and installation are quoted, it should be understood that these are approximations intended only to illustrate estimated *relative* costs of various types of installations. These prices should in no case be considered as actual costs since cost will vary considerably depending on whether direct purchase, contract, hired labor or other means are used to achieve the desired results. Prices will also vary with the current market quotations, the locality and many other conditions which must be taken into account by the builders.

MATERIALS 22

Where trade names are given, they are used only to define the type and kind of object or material suggested or recommended for use. A similar material or appliance made by other manufacturers may be used equally well or better but all such could not be known or mentioned as examples. Any available product that will serve the purpose intended is considered satisfactory.

SECTION II: TREATMENT OF GLAZED SURFACES

23 *GENERAL*

In order that the normal activities of life may be carried on inside buildings, glazed areas are installed. The amount of the surface area of any building that is glazed depends, in a large measure, upon climate and the character of the activity to be carried on within. In preparation for blackouts, some glazed openings may be obscured permanently, but others must be left undisturbed so that daylight may enter the building. At night, however, these latter areas must be capable of being rapidly obscured. These considerations must be kept in mind in preparing for blackouts. In addition, glass when suddenly broken, as by an explosion, creates a highly dangerous splinter-hazard.

Most of the protective measures outlined below will darken interiors; often some transparent or translucent material to replace broken glass will be desirable. For this, plain or reinforced transparent cellulose or cellulose acetate sheets are useful, and oiled or waxed paper, oiled cloth or sacking painted with boiled linseed oil, admit a reasonable amount of light and stand up under moderate wind pressures. These can be nailed or stuck with adhesive to the window frames. Installations of this type must also be obscured during the hours of darkness.

A most important consideration is the danger from, and resistance of glass to, bomb blast and anti-aircraft shell fragments. Glass roofs of the more modern types of peacetime construction (as in aircraft and automobile factories) have proved particularly vulnerable to bombing, and heavy casualties have been caused by broken glass in numerous instances.

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24 *STRENGTH OF GLASS*

All glasses of normal commercial thicknesses, whether sheet, plate, or wired, are liable to be broken by intense blast effects within about 200 ft. from any HE bomb. At greater distances chances of breakage depend, apart from the size of the bomb, upon a number of factors, such as strength of the glass, size of panes, methods of placing, rigidity of the window frame, whether the window is open or closed, and degrees of protection afforded by adjacent walls. It is, therefore, possible only to approximate the extent of area in which glass may be broken as about 150 times larger than the area of intense blast effect. The devices described below, although intended primarily to deal with damage by distant effects, are nevertheless effective in many cases under more intense blast pressures, even within a radius of 200 ft. from a bomb. Within this inner area many windows are likely to be subjected to blast alone, bomb fragments being stopped by obstructions; outside that area damage by fragments will be comparatively rare. Therefore, the devices take no account of bomb fragments even at long range and are suggested for use in rooms such as offices, stores, etc., where the contents are not of special value, and where the entry of one or two chance fragments is not important.

25 *GLASS INSTALLATIONS*

To determine whether one type of window glass is more resistant than another is almost impossible, except in very general terms, as there is considerable variation in the strength of glass, even of panes cut from the same sheet. However, the following should be considered.

If a window is wide open, the panes are less likely to be broken than if the window is shut because there is a better chance of the blast acting on both sides simultaneously. Risk of damage is probably less in casement windows which can be opened completely than in double hung sash which can leave open only 50 per cent of the window area.

A semi-rigid fastening is better than a rigid one, because the window as a whole can more readily vibrate with the blast wave. For instance, an unfastened sash window that is a loose fit in its runners, or a casement window held by a loose-fitting peg stay, or by a sliding stay, usually has some freedom of movement. However, violent vibration of the window as a whole may result in breaking of the glass. Glazing in a door that is open, or glass held in rubber or felt strips, has a somewhat better chance of survival than more rigidly held panes. When leaded lights or panes of flexible glass substitutes fail, they usually do so bodily, falling out as complete units, sometimes with little damage to the glass itself.

Where glass is strong in relation to the frame, the latter may be forced out, the glass sometimes remaining unbroken. This may occur in windows divided by numerous glazing bars into small units, or where thick glass is held in slender steel or bronze frames.

Wired glass is about as easily broken by blast as unwired glass in equivalent sheets but it does not, however, fly so readily into small dangerous splinters.

Areas of glass bricks held in a light framework of reinforced concrete offer very considerable resistance to blast. Where they can be protected against bomb fragments, they may be expected to withstand blast even as near as 50 ft. from a bomb, unless they are used in exceptionally large areas.

Glazed partitions and door transoms inside buildings may be broken where external windows remain undamaged because left open, or where external windows, left closed, suffer no more damage than frame buckling.

USE OF PAINT 26

The simplest and quickest obscuration is obtained by painting the outside of the glass with various weather-proof compounds such as heavy outside or asphalt paints. This painting gives quick results in emergencies but is, of course, effective only so long as the glass remains unbroken.

For emergency use, black and green obscuring paints are available, with relative prices and covering capacities of one type of black water paint as follows:

7 lb. can, 225 sq. ft. minimum on glass	$1.20

25 lb. can, 900 sq. ft. minimum on glass..... $4.00

The more permanent alternative measures required should be provided at the earliest possible moment, since the glass may be broken in the first raid and require a long time to replace.

27 *ADHESIVE TREATMENTS ON GLASS*

Various means of covering glass, with the aim of minimizing the effects of blast, take the form either of materials affixed to glass with an adhesive as all-over coatings or strips, or of materials, supplied in liquid form, applied to glass by brush or spray. The purpose of these treatments is only to prevent glass from flying into small, dangerous splinters and not to prevent breakage. Nevertheless, certain materials, properly applied, may slightly decrease breakage of glass by distant blast effect.

In selecting a window treatment to reduce the risk of glass splintering, important requirements are:—

Material should possess considerable tensile strength or extensibility.

Material should adhere strongly to the glass.

Both material and adhesive should retain their properties for a reasonable time under exposure on the window.

If these qualities are obtained, it does not matter much whether the material is applied as an all-over coating or in strips, provided the latter are in a close pattern. All-over coatings in some cases render the glass non-reflecting, which is an important advantage on sky lights or other glazed installations located on the roof.

Exhaustive tests of the numerous materials available for treatment of windows are required. The following general methods and materials are the best known at present:

Paper.—Papers that are thick and tough are preferable to thin papers, since the latter provide little protection against splintering. Papers reinforced with meshes of cotton, linen, hemp, sisal, or other fibers are better than the same thickness of other types without reinforcement. It is important that the adhesive should remain slightly "tacky" (sticky) and not dry out. Suitable adhesives are an ordinary flour paste with 5 per cent of glycerine or molasses added, or gum arabic with 5 per cent of glycerine added.

Cardboard.—Where permanent obscuration is permissible, an all-over covering of cardboard may be used. Adhesives stronger than those used for paper are required, such as: flexible glues for either cold or hot application, paperhangers' paste or "cold water paste". The last two should be stronger than those used normally and it may be necessary to wet the cardboard before applying adhesives to it.

Textile materials.—Used as all-over coatings, these are of two types: (1) those which give permanent obscuration, and (2) those which admit a certain amount of light. Of the former, sacking pressed into a bituminous emulsion painted all over the glass, is opaque and gives good resistance to splintering; this is a suitable method for use on factory sky lights where obscuration is required. Of the latter, cotton, linen, sisal, or other light-colored fabrics, pressed into one of the adhesives mentioned above is reasonably translucent and gives good resistance to splintering.

Where windows should provide some light, textile materials may be used in strips. The pattern should leave open rectangular spaces not greater than about 6 in. each way. Surgical adhesive tape (which need not be medicated) and insulation or tire tape are typical materials in this class. Adhesion of these is improved if pressed on with a warm iron.

Transparent wrapping films.—Although these have the merit of admitting a large proportion of light, they are generally not so resistant to splintering as the textile materials (with suitable adhesives) discussed above. Some transparent films, however, are reinforced with a fabric mesh which improves their strength. The material may be used in strips or as all-over coatings.

There are three types of material readily distinguishable by burning tests as described below. They are widely sold under many trade names, suitable adhesives being sometimes sold with the material.

(1) *Cellulose nitrate film* (commonly called "Celluloid")—This is highly inflammable, and is not recommended for use on windows. Test: flames violently when set on fire.

(2) *Cellulose film* (two types).—The "coated" or moisture-proofed variety should not be used. The "uncoated" can be detected by moistening with the tongue, when it will curl and soften slightly, whereas the "coated" will not. Test: burns like newspaper when set on fire. Suitable adhesives are: a good clear gum with 15 per cent glycerine added; or gelatine or gum arabic dissolved in hot water with 15 per cent glycerine or molasses added. Adhesives should never be applied to the film itself, but should be smeared on the glass and the dry film then applied, preferably with a roller or ruler. If panes are large it may be easier to apply several smaller strips, side by side. Cellulose film will adhere by wetting with water only, but this should not be done since coatings so applied have little protective value. Some cellulose film comes coated with sticky adhesive and needs only to be pressed onto the glass.

(3) *Cellulose acetate film.*—Test: does not readily take fire; when ignited it melts and drops. Gum is not a suitable adhesive; in the absence of special adhesives supplied by the makers, use a mixture of 9 parts of molasses with one of warm water. In applying transparent films it is desirable to use grades much thicker than are generally sold commercially for wrapping papers, or alternatively, two or three layers. The use of a roller or ruler, starting at the top of the pane, helps to insure even contact between film and the glass without leaving wrinkles or blisters.

Adhesives in General.—An important requirement in adhesives is that they should not dry out and become brittle, hence the need for adding glycerine or molasses. Glass should always be cleaned thoroughly before application of protective substances, special care being taken to remove all grease.

Of the flexible glues mentioned under cardboard, a suitable type for hot application is "bookbinder's glue". Of the pastes, those obtainable ready to mix for paperhanging are most suitable. Sodium silicate ("water glass") should not be used as an adhesive as it is liable to damage glass surfaces. Some additional resistance to splintering may be obtained by coating the outside as well as the inside of glass. It is usually better to provide adequate strength with internal treatment only, avoiding deterioration by action of wind, rain and smoke gases. To prevent reflection, outside water-proof or asphalt paints may be used.

Liquid Coatings.—A wide variety of compositions, some of which are patented, are sold as window coatings. Some are transparent, others have a black pigment added to give obscuration. Flexible glues for hot application (mentioned above as an adhesive) may be used as an all-over coating. This material, obtainable as a tough jelly, should be heated until fluid enough to permit application with a brush. Two or three coats will give good resistance to splintering. Glue films can be removed easily with hot water and therefore are not suitable for steamy atmospheres. Many compositions include rubber latex as an ingredient and may be brushed or sprayed on the glass; these should be applied quickly. Only those that contain prevulcanizing latex or vulcanizing ingredients are likely to have more than a short life.

It is not possible to state how long various all-over coatings remain effective. Some, such as the glues mentioned, may give protection over long periods (1–2 years); others lose strength or adhesion to the glass in 1–3 months without visible signs of failure such as peeling or cracking. Any coating becoming defective should be renewed immediately.

SPLINTER PROTECTION 28

Assuming that glass will be broken, protection should be devised to prevent damage from flying pieces of glass, to exclude wind and rain and to act as obscuration.

Flying pieces of glass are stopped by wire netting of mesh not greater than ½ in., placed as near the glass as possible. Where windows are only partly blocked with sand bags or other devices against bomb fragments, wire netting usually may be fixed inside the window. If wire netting is fixed to window frames, windows cannot be cleaned or opened and closed and hence netting is best fixed to separate removable frames. If suitable fabric is also fixed behind the netting, on the side away from the window, a serviceable screen is provided that will have some degree of weather resistance should the glass be broken (see Figs.

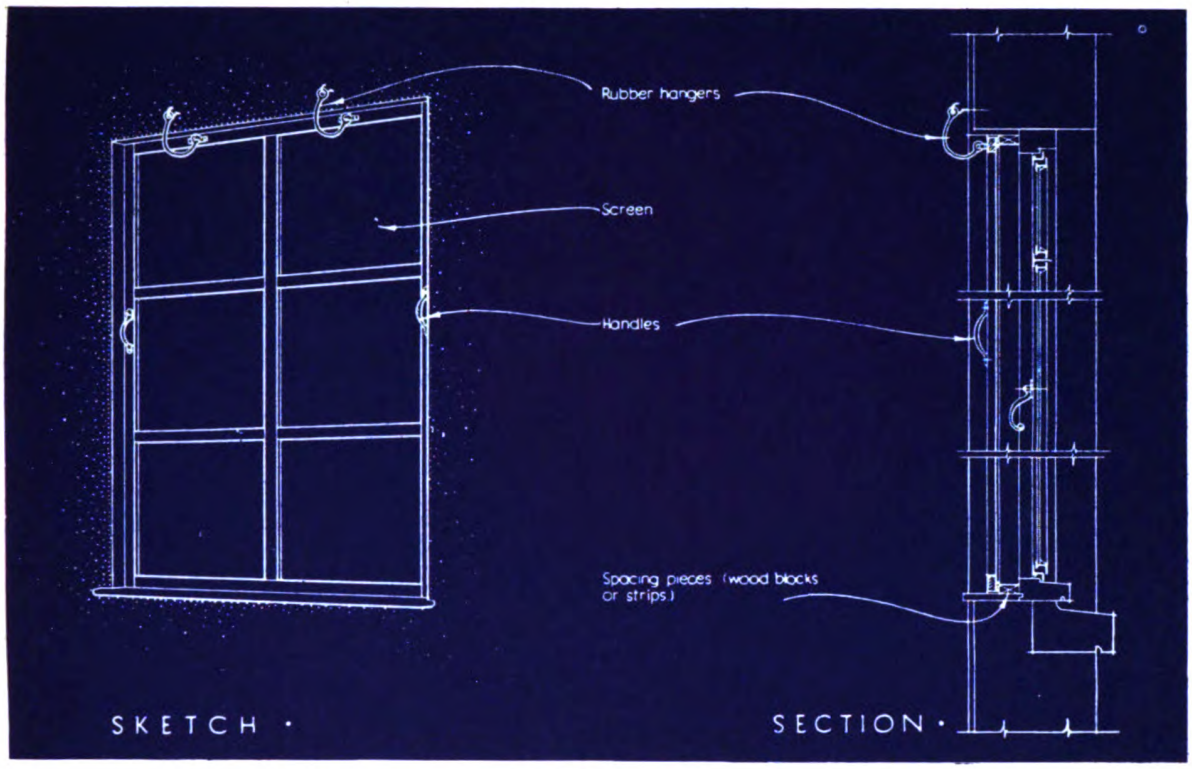


Figure 8—Typical internal lightweight opaque screen.

8 and 11). Fabrics can be translucent or opaque; the latter would also serve as blackout screens.

Curtains or blinds also stop pieces of glass that are not thrown with great violence; the thicker and heavier the material, the greater will be the stopping power. New curtains for this purpose may be made of low-cost materials such as burlap or other sacking. It is desirable to weight curtains with wooden battens or metal rods or pipes fastened at the bottom. A temporary roller blind or curtain, illustrated in Figure 10, tends to resist flying glass and acts as obscuration (if sufficiently opaque), but does not prevent penetration of wind and rain if the glass is broken. It is therefore not suitable for areas liable to be repeatedly bombed.

29 *LIGHTWEIGHT SCREENS*

In areas where more than one raid may take place, it is hardly worth while to replace broken glass with new. If glass is broken, window openings are closed with some form of screen that will continue in use under more than one blast effect. Such screens of various materials are described below. They may be used with an opened window to preserve the glass in the latter as long as possible.

Weather-resisting screens, easily made and put into place, completely filling window openings, should yield to blast and fall out harmlessly so they can easily be put back again. Such a screen arrests flying glass before the screen is displaced. It thus serves as obscuration and, if desired, may be made gas-excluding. Screens as described are placed on the room side of windows. They may be made of or covered with any inexpensive, flexible, lightweight sheet material that is not likely to warp and can be made to resist rain. The sheet material should be mounted on a light wooden frame unless rigid and strong enough to stand by itself. (See Figs. 8 and 11.)

SHEET MATERIALS

The following materials, not themselves waterproof, can be made reasonably rainproof

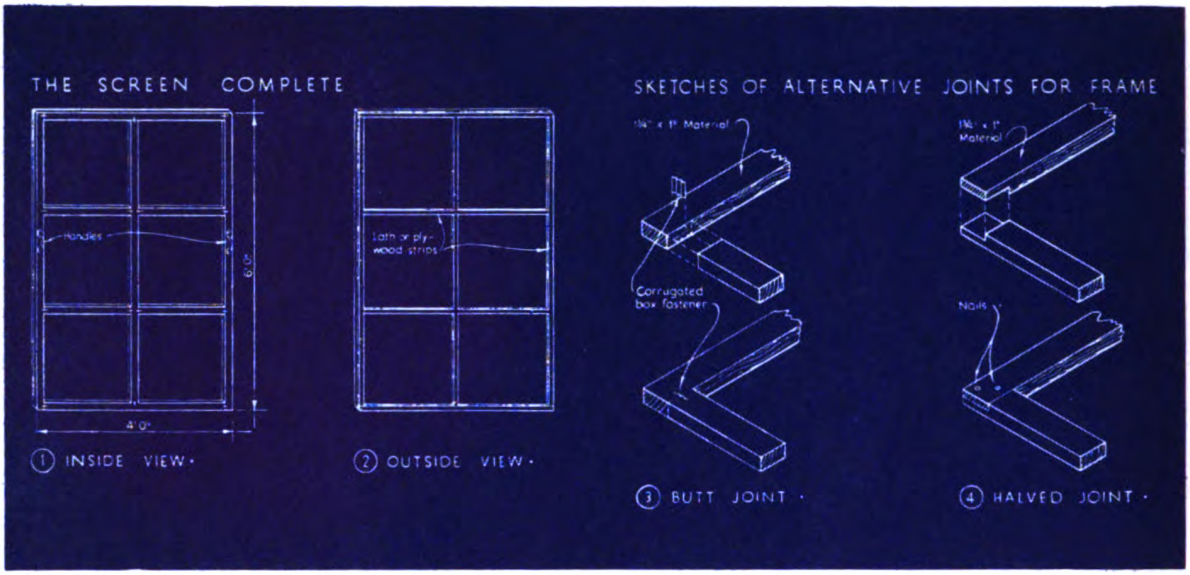


Figure 9—Making lightweight

with a single coat of oil paint. Varnish in a single coat is less effective. Edges of wood fiber sheet materials are specially liable to soak in moisture and should be thickly painted.

(1) *Strong Liner Paper.*—Minimum thickness should be .016 in. Suitable for windows well protected against blast and driving rain.

(2) *Corrugated Fiberboard (or double faced corrugated board).*—Can be used without a frame on small windows, say 4 ft. by 2 ft. or less. Edges should be protected with paper stuck on before painting.

(3) *Thick Solid Cardboards.*—Either a strong container board or chip board.

(4) *Wallboard or Building Board.*—Insulating board about ½ in. thick or dense pressed board about ⅛ in. thick; the latter is preferable. These can be used without frames on small windows.

(5) *Plywood.*—Any grade is suitable, 3-ply usually adequate but liable to warp.

(6) *Wire Netting and Fabric.*—(described in par. 27).

(7) *Very Thin Box Crate Boards.*—Since these are available in small sizes only, cross battens or frames with cross members are necessary.

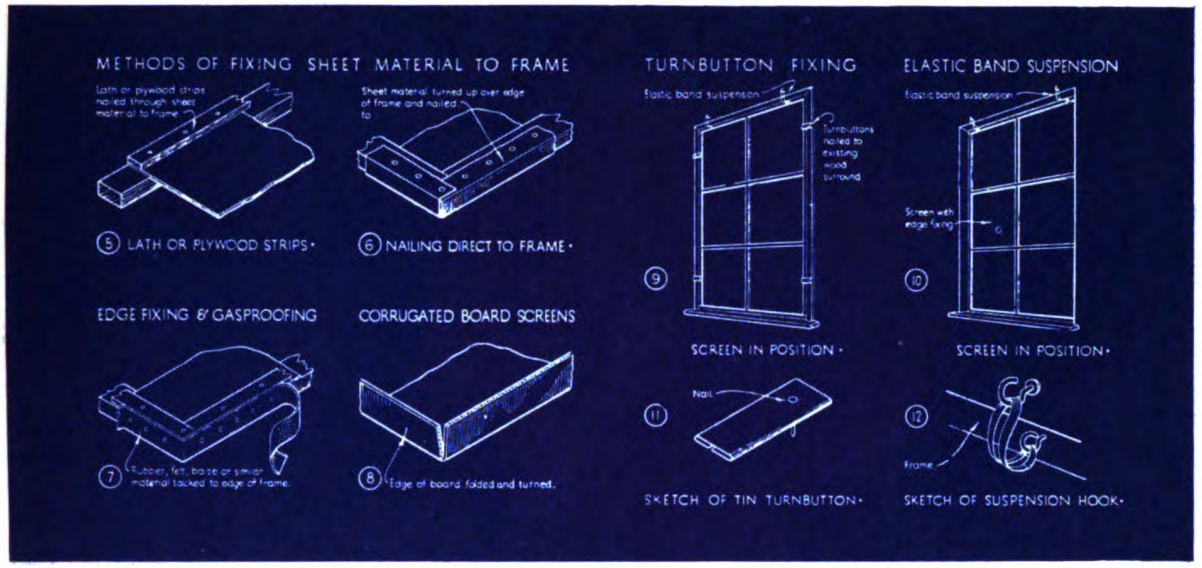
(8) *Thin Metal Sheets.*—Suitable where weight is not excessive. Perforated thin sheets of metal may be used but require fabric backing for weather resistance and obscuration of light.

(9) *Bituminous Sheeting.*—Any good roofing felt that offers good resistance to tearing. Should be well supported in frames by cross members. Linoleum may be similarly used.

(10) *Plaster Board.*—Liable to fracture and should, therefore, be well supported in frames by cross members. Especially suitable where non-inflammability is important. An asbestos board containing at least 50 per cent of asbestos is an alternative. Wooden frames should be coated with fire retarding paint, the whole having a fire-resistance of at least half an hour.

(11) *Asbestos-cement Panels.*—Are both strong (especially if corrugated) and fireproof, but shatter when hit and thus have a fragmentation hazard.

Screen Construction.—Screen materials should be framed according to kind, strength and size of individual screen. Extra weight and strength are undesirable, a simple test being "if the frame can be carried in the hands without flapping or distortion, it is strong enough." A typical screen for a window 6 ft. high by 4 ft. wide can be framed with 1″ x 2″ wood (see Fig. 9). If covered with wallboard, no cross members are needed, but if with liner board, bituminous sheeting, plaster board, or other like material, one or two cross members each way should be



screens. {1} to {12}

provided, partly to give strength and partly to provide extra framework for nailing the sheets. Corners usually require bracing.

Strong sheet materials can be simply nailed to the frame and nails clinched in back; liner board or corrugated fiber board should be held between plywood strips or plaster laths and the frame, the whole securely nailed together. Alternatively, the sheet material should be bent around the edges of the frame and tacked at the back. Joints of frame members are most easily made with corrugated box fasteners simply hammered in. Alternatively, joints may be mortised and nailed and wood or metal angle braces or blocks may be used (see Fig. 9).

A strip of rubber, felt, flannel, or other thick fabric, tacked on the outside edge and over the face of the frame to make a close fit with the window frame, is necessary where the screen is to keep out gas (see Fig. 9 (7)). It also allows a fairly tight jamming fit to hold the screen in place against moderate wind pressures and in some cases no additional fixtures are necessary. (see Fig. 9 (10)). Where some extra fastening is needed it must not be so strong that the screen itself is broken when struck by blast, but will readily fall away from the window harmlessly as a unit. Extra fastenings may be ball catches or turnbuttons (Fig. 9 (9) and (11) and Fig. 11) either standard or improvised, or zinc or bronze spring weatherstripping nailed to the frame edges.

PLACING SCREENS

Fitting screens to windows often presents minor difficulties. Almost all windows have three alternative positions for screens, which are:—

(1) Close against the frame of the window.
(2) In the space ("reveal") between the window frame and the inside wall face. This is the most usual.
(3) On the inside wall face.

Each screen can, if necessary, be given a pair of handles for lifting it into place. Wooden blocks or fillets can be nailed in the space between the screen and the window, against which the screen can be pressed into place. Difficulties will often be presented by projecting window mouldings, casement window handles and rods, or blind and curtain fixtures. These may either be removed altogether or a hole cut in the screen to receive them, the hole being covered by loose cloth bags, the edges of which are stuck by an adhesive to the screen material. Alternatively, the screen may be placed on the inside wall face in order to clear such objects.

Very large windows may require multiple screens; for example, a wide horizontal window

may have two or more screen units side by side covering the window. Edges between screen units need an overlapping strip of wood and adjacent screens may be held together by light wooden bars in slotted wood or metal brackets. The units of multiple screens should not be much larger than 6 ft. by 4 ft. for which frame sizes are given in *b* above.

SUSPENSION OF SCREENS

All but the lightest unframed screens should be suspended so that they do not fall to the floor when thrown out by blast. This is best done by fastening the screen frame to the window head or lintel with lengths of rubber shock absorber, wide elastic, or rings cut from old automobile inner tubes. The elastic material should be long enough to allow free backward movement of the screen, but not enough to allow it to strike the floor. The use of rubber shock absorbers or elastic loops allows the screen to be taken down. (Fig. 9 (10) and (12)). Rope, cord, leather straps or webbing may be used, but are not so suitable as elastic materials.

SKY LIGHTS

These are a more serious problem than regular windows. Obscuration is more difficult, particularly where it is desired to admit light during daytime. Weather protection must be far more thorough, especially when located above any object or goods liable to damage by moisture. Broken glass may do more damage falling from an overhead skylight than from a window. The best treatment of sky lights is to remove the glass altogether and cover the openings with galvanized corrugated sheet steel, protected metal sheeting, or bituminous sheeting on boarding, placed to discharge rainwater safely. This plan involves the continuous use of

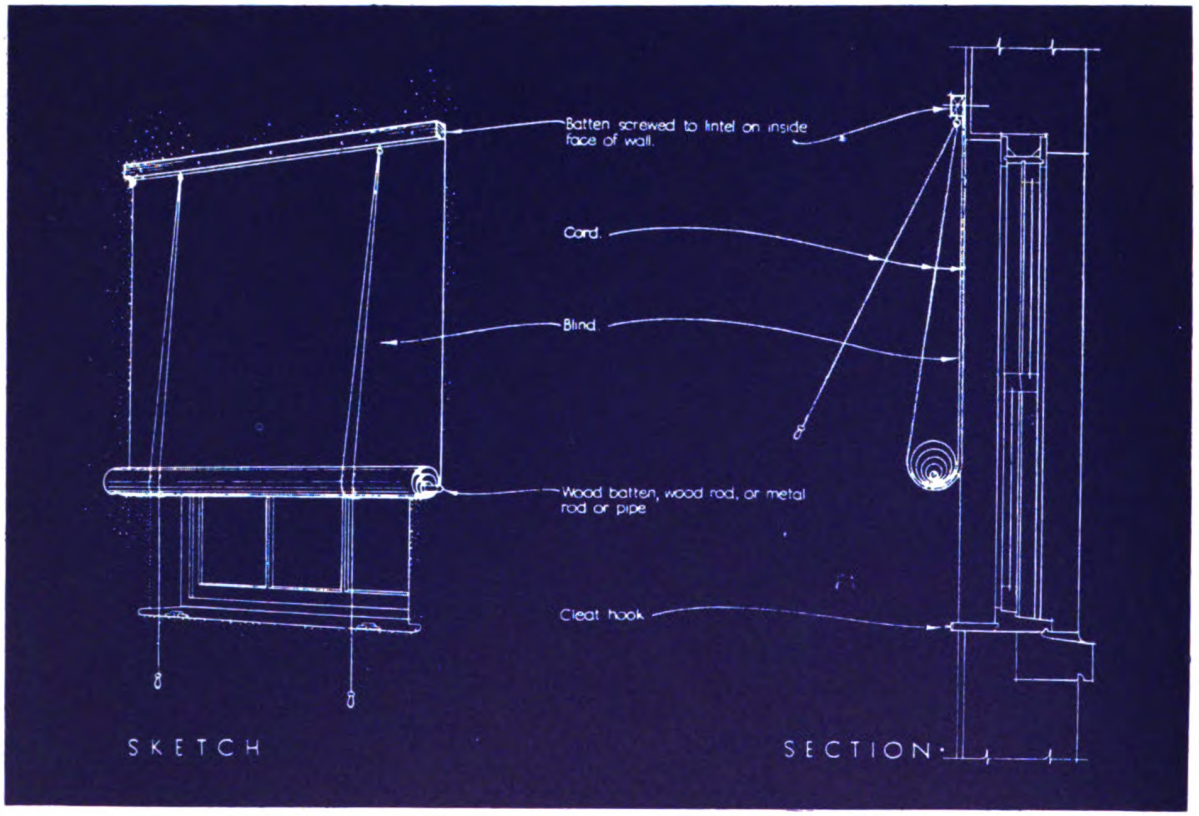


Figure 10—Temporary improvised screen blind {window shade}.

artificial light, but fulfills the three objectives mentioned in paragraph 33. Removal of large areas of glass and substitution of weathertight alternative construction is often too costly or difficult, if not wholly impracticable. In such case, as an alternative, external obscuration systems that resist weather may be provided, together with measures to reduce damage from falling glass. Several patented obscuration systems, applicable to long lengths of sky light, as in sawtooth roofs, have been devised; some of these allow units to be folded back during daylight, either mechanically or by hand. They should be designed to exclude wind and rain, whether or not the glass remains unbroken. Wire netting of ½ in. or smaller mesh, which may also be covered with fabric, firmly fixed below the glass and as near to it as possible, should arrest all but the smallest fragments of glass; an adhesive coating on the glass, in addition, reduces risk of small fragments penetrating the netting.

Obscuration systems placed internally arrest falling glass but do not prevent rainwater dripping from the lower edges of the sheet materials. Covering glass with an all-over treatment, such as textile and adhesive (paragraph 26) together with wire netting below, should effectively prevent all broken glass from falling, and when the glass is broken, give some resistance to weather.

Sky lights also may be broken by falling fragments of anti-aircraft shell. None of the methods of treating glass described above will prevent damage from this cause, although some of them will save panes from falling wholly out when broken. Roofs to resist penetration by falling anti-aircraft fragments (and also small incendiary bombs) should be in accordance with types of constructions required for overhead protection. Several general schemes for obscuration are shown in Figures 12 and 13. An improved type of sawtooth roof construction, using wire glass (or glass backed by a wire screen) leaning outward at the top 10–15° from the vertical in a 6″ reinforced concrete slab roof, would answer most of these requirements in the case of new construction (Fig. 14).

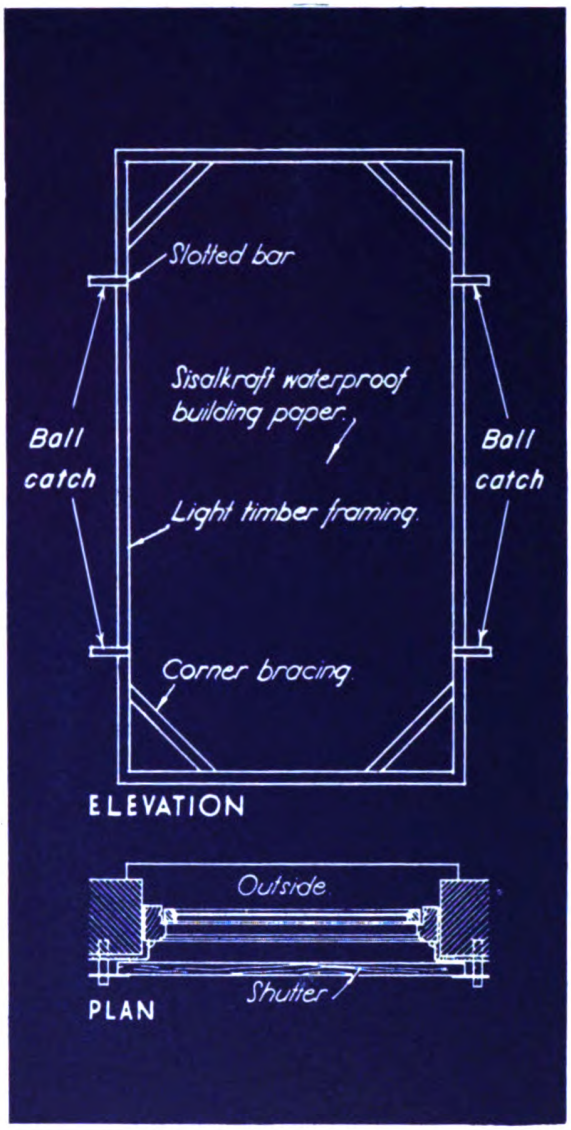


Figure 11—Inexpensive form of lightweight screen.

VENTILATION

In the use of any method of obscuration, careful thought must be given the matter of ventilation. Adequate ventilation can be achieved by a number of methods depending upon the location and type of windows and skylights. For suggested methods see Figures 15 and 16.

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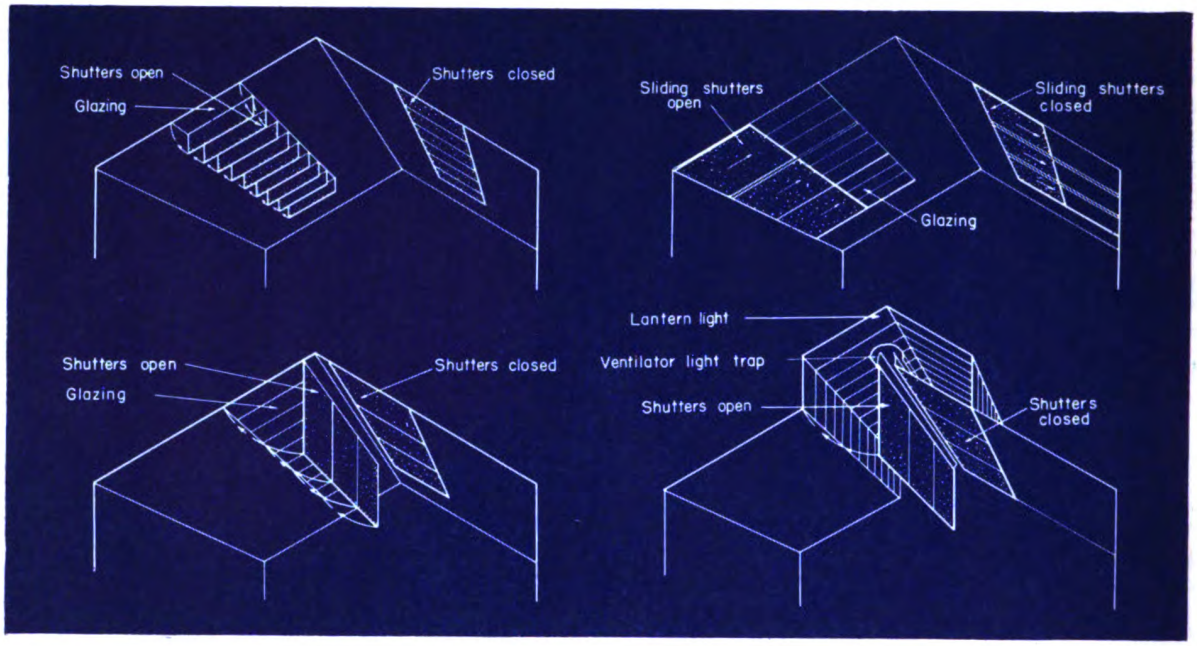

Figure 12—Obscuration of skylights.

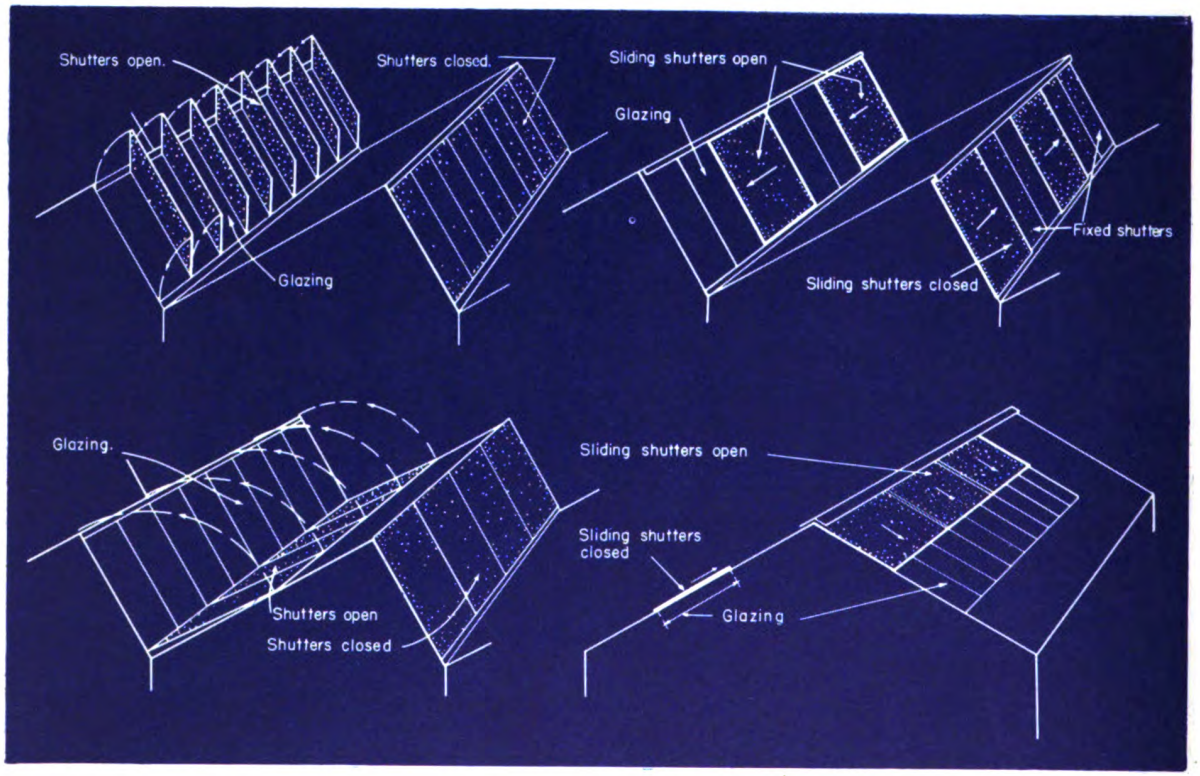

Figure 13—Obscuration of skylights.

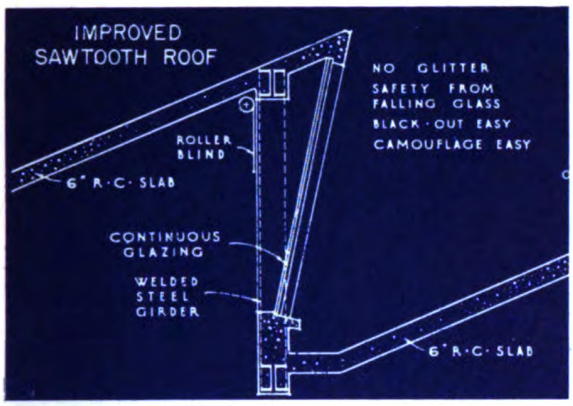

Figure 14—Improved type of sawtooth roof construction.

Figure 15—Types of ventilators.

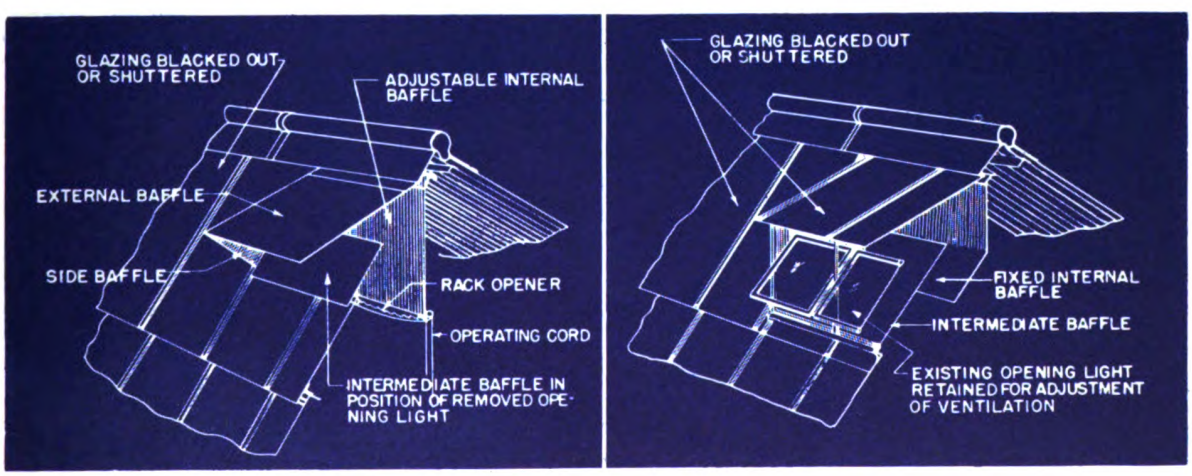

Figure 16—Types of ventilators.

CHAPTER III

Individual Persons and Dwellings

SECTION I: THE INDIVIDUAL

32 *GENERAL*

The individual is the basic element of the nation's strength particularly in the nation's resistance to aerial attack. The part played by the civilian population is fully as active, in many respects, as that of the soldier. For the protection of all, everyone must know and obey the Civilian Defense regulations. The subsequent instructions apply principally to those who live in the large centers of population and areas of industrial activity; however, in less settled and more rural districts, the need for some precaution will still exist. Those who come from the less to the more settled areas must be aware of the conditions they may expect and how to meet them.

33 *ADVICE TO THE INDIVIDUAL*

When you go out just before or after dark when blackouts are likely, always wear blackout equipment and other protective apparel which may be required. When air raid warnings sound after dark during blackouts, don't get panicky but proceed about your business calmly and quietly without undue haste. To run or shout will do no one any good and may set a bad example to those easily frightened. (Fig. 17.) Know the meanings of the various kinds of warning signals. Know where you want to go, think over in your own mind how far it is, your route, how many streets you cross and what turns must be made to avoid being lost. Use your flashlight, if permissible at all, as little as possible and then only for a few seconds at a time to check your location; never point it upward nor on any object such as a glass window or wet street which might reflect it upward, or cause a glow noticeable from the air. (Fig. 18.) One person's error might not be noticeable but many making the same error might well be so. "No smoking" in the open should be the invariable rule. Always pass and keep to the right (Fig. 19), using the same courtesy and rules you should use in operating your automobile. The man approaching from your right has right of way. Be careful not to push persons walking next to the curb as they may be struck by cars running close to the curb using it as a guide line. Look down and not upward so that you can see the white stripes on posts at barricades and obstacles on the ground. If planes are overhead, keep your head down as many upturned faces make the streets where crowds are congregated very conspicuous from the air, especially if streets are lighted by flares or burning buildings.

If you take pets out with you after dark, be sure they are on a leash (Fig. 20) so they will not become separated from you during a warning and run away, causing injury to others by getting in the way. Crossings should always be made at street intersections or places marked as pedestrian crossings (see par. 83). Watch the traffic lights and observe them scrupulously because any jay-walker who gets knocked down during a blackout is almost certain to get run over fatally by the next vehicle behind. In going up or down curbs or steps, hold to railings and always have one arm free so that you can catch yourself if you slip or fall. If you are hurt in any way, move to the nearest wall and stop the first persons to come along. (Fig. 21.) Ask that they report your injury and location to the nearest first aid station. Wherever possible, assist those infirm, frightened or lost and if you are familiar with the locality report any matter you cannot handle to the nearest Civilian Defense agency. If you are not familiar with the neighborhood, ask someone who is or report to the first policeman or air raid warden. (Fig. 22.) In matters requiring such cooperation the golden rule is a good one to remember; don't just walk off minding your own business.

Figure 17—DO NOT run when air raid warnings sound after dark during blackouts.

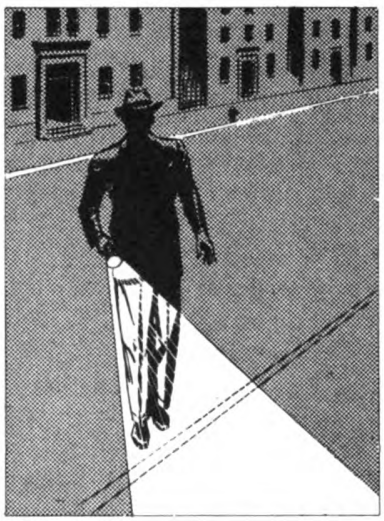

Figure 18—Use your flashlight as little as possible, if at all. Never point it upward nor at any object that might reflect upward.

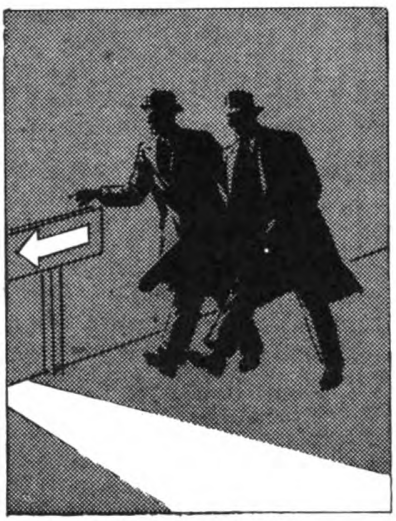

Figure 19—Know where you want to go and how to get there. Keep to the right.

Figure 20—Keep pets on leash if you take them out after dark.

Figure 21—If you are hurt, move to the nearest wall and ask the first persons who come along to report your injury to the nearest first aid station.

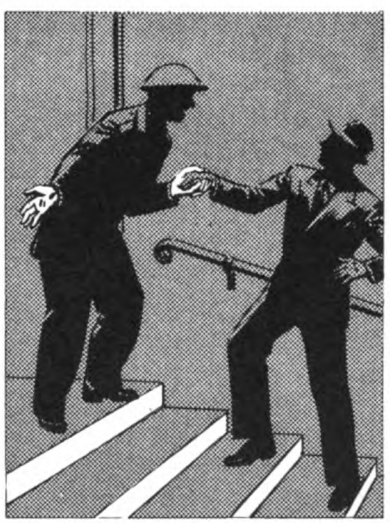

Figure 22—If you are not familiar with the neighborhood, ask someone who is or report to the first policeman or air raid warden.

34 *INDIVIDUAL BLACKOUT EQUIPMENT FOR STREET USE*

Since a bump from a bus or auto can be just as fatal as a piece of shrapnel or whiff of gas dropped by an enemy bomber, some European cities take blackout fashions in clothing seriously. Numerous ingenious devices have been adopted. A light reflecting dickey is worn over the shoulders so that a white square hangs on the chest and back like a sandwichman's sign. For this, white oilcloth, silk and patent leathers are used; gas mask containers and straps may be covered with these materials. Luminous and reflecting disks are similarly used as belt buckle, lapel and hat ornaments, and as buttons (see Fig. 23). As added precaution on foggy blackout nights, canes, umbrellas, anklets or bracelets carrying small tinkling bells have been proposed. Pocket flashlights with an approved filter or bulb are procurable with a gravity or mercury cut-off which will cause them to go out automatically if they are pointed upward at any angle above the horizontal.

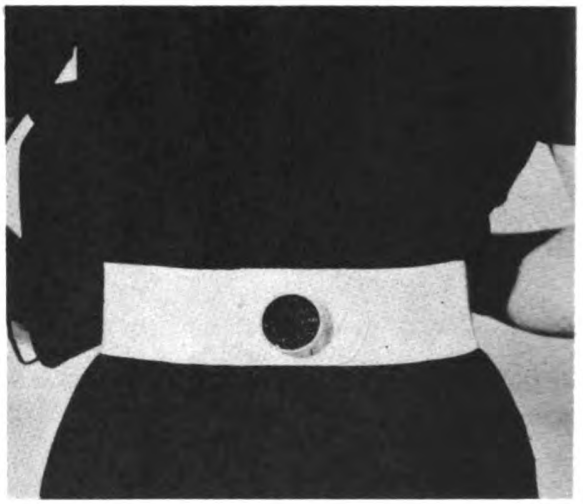

Figure 23—Blackout wearing apparel using white materials.

SECTION II: THE INDIVIDUAL DWELLING

35 *GENERAL*

On board ship the crew and passengers are instructed and required to practice well beforehand what they must do and where they must go when danger threatens. The head of every household should act similarly with regard to those for whom he is responsible during air raids. Every assistance will be given by those agencies which can do so but usefulness of the measures taken in individual homes will depend largely on the individual efforts of those who live there.

Every home should have a shelter or room in the house which the members of the household may occupy with maximum degree of safety during air raids. The characteristics of air raid shelters or refuge rooms in the home itself are given in other pamphlets ("Protective Construction" and "Protection Against Gas"). See that each one with ability to comprehend the importance of the planned arrangements understands just what he or she must do for the good of all.

PREPARATION FOR OBSCURATION 36

All occupied rooms in the house will have to be darkened and lights permanently turned out in others (electric bulbs removed) so that they cannot be turned on through carelessness where windows are not covered. All lights near an outside door must be screened so that no light is visible when the door is opened. Outside garden or porch light bulbs must be removed so lights cannot be turned on by mistake. Provision must be made to darken every window, skylight, glass door, and exterior opening wherever lights are used after dark, using dark blinds, window shades, thick curtains, special screens or other heavy material. Any material which allows a glow to be seen outside will not do. This must be kept in mind when new curtains and shades are bought. Other glazed openings can be covered with paint on the outside and paper or other materials pasted on the inside. For details of materials to be used and methods of installation, see Chapter II.

37 *CONDUCT DURING AN AIR RAID*

Go around the house to see that no lights, visible from outside, are left burning. All gas lamps, and if possible the gas at the meter, should be turned off to reduce later danger of explosion. Do not use more open flame lights in the refuge room than necessary but any amount of properly shielded electric light is permissible. Do whatever else your own common sense indicates is necessary and then after making certain that everyone and everything needed is at hand, close the door and seal it if there is any possibility that gas might be used (see pamphlet, "Protection Against Gas").

CHAPTER IV

Stores, Factories, and Industrial Buildings

SECTION I: GENERAL

38 *IMPORTANCE*

The personnel and equipment at all vital plants and factories should be given special protection against air raids in order to create in all workers a feeling of security and confidence and to enable defense production to be maintained at the highest possible rate. In factories and like installations blackouts should insure that, without taking avoidable risks, the least possible check to the production rates will occur. This applies especially to factories engaged on production of essential war supplies or similar important work vital to the national effort.

The lighting restrictions imposed on installations connected with the defense effort require a special study in each case in which the necessity for the maintenance of production must be balanced against the safety of the installation and the operating personnel.

39 *BLACKOUT METHODS*

For blackout of existing plants and factories no elaborate or excessively expensive protective measures are recommended initially. Possibility of severe, long sustained bombings can usually be foretold long enough in advance to make counter preparations. Recommendations for immediate action usually cover provision for blackout of existing plants, and intelligent planning and location of new plants. Blackout can be achieved most simply with windowless air-conditioned plants, but this construction will seldom be mandatory. In other types of construction opaque shutters must be built over all windows, light-locks provided at entrances, and provision made for thorough ventilation and prevention of condensation. Outside lights should be covered with blue shades, and white guide lines should be painted on walks and drives, where necessary. Any large building or object that reflects light may defeat the purpose of a blackout. Aluminum painted water towers or bridges, marble or other light stone structures, and other light reflecting surfaces, such as tin roofs or light concrete walls and aprons, should be painted or otherwise treated to produce a dark roughmatt surface. Blackout concealment of the factory under construction in Figure 24 would present many difficulties.

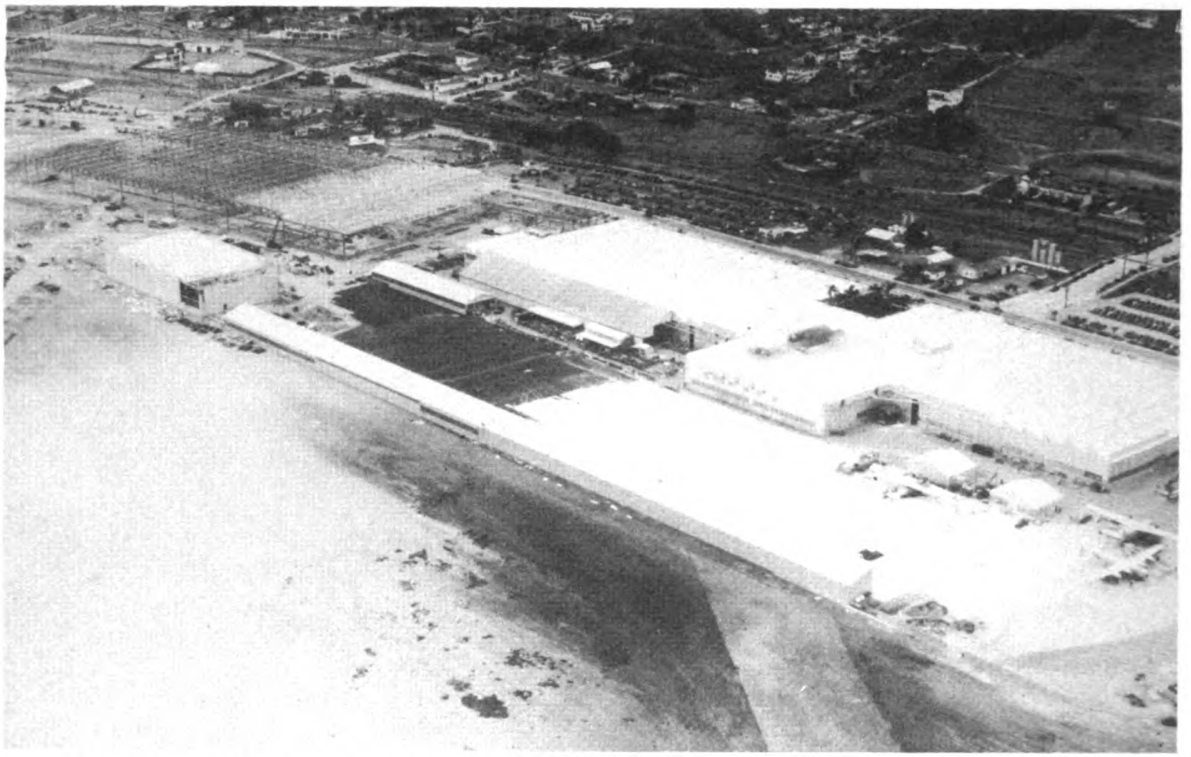

Figure 24—A type of factory construction most difficult to black-out. {Note glare from sawtooth glass roofs.}

SECTION II: PRELIMINARY PREPARATIONS

40 *GENERAL*

A survey should be made of the vital parts of the plant to see what can be done to afford local protection against damage by blast and splinters, to provide blinds, screens and shades over light sources as well as shields for machinery essential to the continued working of the factory. Storage of highly inflammable materials, such as petroleum products in tanks, should receive special consideration on account of grave risks of fire. This should be considered here since fire will nullify blackout measures. Where not already done, tanks containing inflammables should be mounded (surrounded by banks or levees) to prevent burning liquids spreading over large areas. Where large tanks are on upper floors, drain pipes to sumps outside may prevent burning liquids flowing from floor to floor. Telephone switchboards and other places essential to communication and control will require protection, also any place earmarked for use as a first aid post or for some other similar air raid service. Large areas of glass should be protected, by wire netting or otherwise, to prevent scattering of glass if shattered by shell fragments or explosions.

SUPPLIES OF ESSENTIAL SERVICES 41

Although it is beyond the scope of this pamphlet, the question of how work could be carried on if supplies of water, electricity and gas from public or private sources were interrupted by damage to producing stations or service mains should be carefully considered. Since a private generating plant offers an immediate solution to this problem, private generating plants, where replaced by supply from public utility mains, should, if possible, be retained in working condition. In view of

the fire risk, reserves of water or alternate sources of supply should be arranged wherever practicable.

42 *EMERGENCY COMMUNICATIONS*

In time of war, no assurance can be given that bells or telephones will remain in operation. They may be damaged or lines may become overloaded. Arrangements should accordingly be made for emergency methods of communication, such as runners and cyclists, between different parts of the plant and with vital places outside. A plan must be prepared for warning key personnel and workmen generally and for emergency methods of communication.

43 *LIGHTING RESTRICTIONS*

Restrictions on factory lighting imposed in time of war are not merely to prevent conspicuous buildings being picked out by night from the air as targets for attack, but (if enemy airmen have no means of checking their positions) they may also afford protection for the whole nearby neighborhood or area.

The occupant of a factory or business premises should be prepared to comply with restrictions which would prohibit use of any lights visible from outside. There would have to be exceptions to this in the case of factories engaged in essential work dependent on unscreened lighting; but no exemption should be granted until the authorities are satisfied that all lighting has been extinguished or obscured in so far as practicable. It should be a condition of any exemption that visible lights must be extinguished on receipt of air raid warnings. The more dependent a factory is on visible lights, the greater would be the dislocation of work under threats of air raids.

All illuminated billboards or signs should be absolutely prohibited and all external lights, except as expressly authorized by proper authority, should be extinguished. Roads and pathways should be marked by guide stakes, white posts or stones, or by whitewash for the convenience of those who have to use them after dark.

All windows, skylights and glazed doors should be rendered opaque at night, either by the use of paint covering the whole window, by the fitting of screens, or by a combination of both methods. If these are not placed now, measurements required should be taken and recorded as part of the factory's air raid precautions scheme. If new construction is required, the type should be considered with respect to blackout requirements.

Practicability of carrying on work with lamps of low power or so shaded as to throw light as desired only on the bench or machine should also be given consideration.

All these measures need be taken only where it might be necessary for the factory to be at work during the hours of darkness.

For special industrial processes which cannot be effectively screened, such as blast furnaces, coke by-product plants, potteries and steel mills with open furnaces, air raid officials should ascertain how quickly such operations can be stopped or suspended and report to those responsible for the safety of the whole district. Whether night work can be permitted may then depend on whether sufficient warning of impending air raids may be expected. All steps to make less easy identification of objectives by day, as well as by night, should be taken by removal or screening any signs on or near buildings which might reveal the identity of the premises.

SECTION III: INDUSTRIAL LIGHT CONTROL

44 *GENERAL*

The amount of lighting considered normal in peace time is likely to be much reduced in war time. Need for stringent economy in all things in a war emergency will automatically require reduction in expenditure of gas and electricity on artificial lighting.

Apart from this general reduction in illumination, it will be necessary to screen light to confine it to the activity illuminated, and reduce any upward dissipation or reflection to a minimum. To avoid direct observation from the air a lamp can be shielded either by means of a shade or by a painted glass, obscured so as to

prevent escape of light above a plane inclined downwards 10° from the horizontal. To reduce reflection of light from illuminated surfaces the power of lamps should be reduced to the minimum necessary for safety and illuminated surfaces should be made as non-reflecting as possible.

Where necessary, a separate system of low intensity pilot lights should be installed to enable key men to tend vital plant machinery in a blackout and to enable personnel to reach their shelters in safety when the ordinary lighting is extinguished. Dimmer switches on the lighting system will be found of use in turning off all external or exposed lighting on receipt of a warning. Signs painted in luminous paint are a useful expedient. Large industrial concerns have carried out successful tests on use of low intensity illumination for night workers and have found that the operatives soon get accustomed to the comparative darkness and can move about freely. Lighted in this way large saw tooth roof factories should not be clearly discernible from the air. Various types of low wattage sprayed lamps are available.

45 *OBSCURATION CONSIDERATIONS*

With half the window and roof glazing permanently obscured, factories often are able to carry on in the daytime, and if this can be done the problem is reduced considerably in magnitude.

In the obscuration of windows and sky lights the main factors requiring consideration are:

(1) Opacity.

(2) Weatherproof qualities—in case the glass should break.

(3) Protection from flying glass.

(4) Non-inflammability of obscuring materials—desirable but not essential.

(5) Insect-proof qualities—especially in the case of food factories.

(6) Internal or external application.

(7) Desirability of admitting day light when practicable.

(8) Gasproofing—less emphasis initially placed on this aspect but it may become locally critical.

DETAILS OF FACTORY INSTALLATIONS 46

The problem of obscuration is closely related to the effect of blast and splinters on glass and industrialists should deal with both together (Chapter II). The effects of blast from high explosive bombs cannot adequately be predicted. It would be safe to assume that *all* windows and roof glass in a factory would soon be blown out under protracted aerial bombardment. Falling glass is an ever present danger which must be dealt with if work anywhere in a factory is to continue during a raid. Windows in key positions can be maintained much longer if glazed with reinforced glass or various plastic materials such as Xylonite.

One such glass substitute is a clear plastic .08 inch thick, reinforced with half an inch wire mesh welded at every crossing. It is a non-inflammable cellulose acetate thermoplastic material which costs about $8.00 per 61 x 27 in. sheet or $.80 per square foot. Another is .022 inch thick reinforced with wire gauze, and costs about $2.50 per 55 x 24 inch sheet or $.30 per square foot.

Some plastics .003 inch thick can be stuck on glass with special solutions at a cost of $.30 per 35 x 24 inch (3 oz.) sheet. All these and equal materials are obtainable from various commercial sources.

SUBSTITUTES FOR GLASS 47

Broken roof glazing in frequently bombed areas should not be replaced during continuance of hostilities but high strength steel plates should be substituted. In places where falling glass would be specially dangerous or injurious light steel sheeting should be installed under the glass, thus at the same time adding to resistance against incendiary bombs.

Where great splinter protection is required in a window, such as in offices or control rooms occupied during a raid, the installation of special steel shutters is preferable.

BLAST MATTRESSES 48

Provision of complete blast and splinter protection in all window openings by any form of

solid shutter is normally prohibitive in cost, but curtain mattresses of metal wool about 4 inches thick hung over window openings generally, as shown in Figs. 25 and 26, afford good splinter protection. These safety curtains consist of high grade steel or brass wool woven to form resilient and resistant mattresses contained in a galvanized woven steel mesh envelope of equal flexibility. Such safety curtains should be appreciably larger than the door, window or machinery to be protected and should preferably be arranged to permit some give in a direction away from the source of explosion or blast and yet remain in place.

The prices given include a suspension channel section with hooks but not the installation of brackets for suspending this on the wall. Assume an approximate weight of the safety curtain to be 2 lbs. per sq. ft. of area and treble this figure for design of hanger brackets to allow

Figure 25—Typical metal wool mattress for covering window.

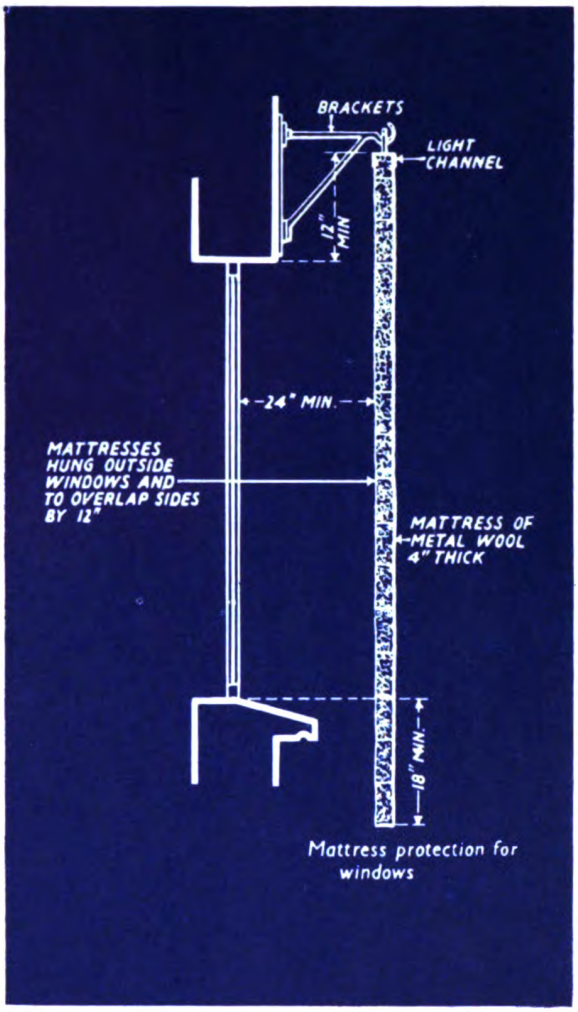

Figure 26—Detailed dimensions for blast mattresses.

for resultant drag when the curtain is struck by bomb splinters or is subject to blast. Approximate prices should be: for steel, $.85–.95 per sq. ft., 4 in. thick; or with galvanized chicken wire envelope replacing woven steel mesh envelopes, $.75 per sq. ft., 4 in. thick; in brass, $1.50 per sq. ft., 4 in. thick, or $1.35 with galvanized chicken wire envelope. These prices apply only for mattresses of 20 sq. ft. and over and smaller sizes would be somewhat higher.

If splinter protection to windows is prohibitive in cost, some kind of glass catching and blacking-out screen may have to be adopted instead (Chapter II).

49 *COMPLEMENTARY COLORS*

Various schemes for using colored lamps (e. g. orange) in conjunction with colored filters of complementary color (e. g. blue) applied to the windows and skylights have been put forward as a solution to the problem of preventing the emission of light from buildings. It has been claimed that by such a method sufficient light for daytime work is allowed to enter, while at night insufficient light is shown outside to render the premises visible. The system is expensive and not recommended since if windows are broken, all light would of necessity have to be shut off and all work stopped. Certain of the schemes that have been suggested involve the use of very deeply colored artificial lighting within the buildings and very deeply colored filters on the windows with the result that only a relatively small proportion of daylight enters the building.

Any system of this type is acceptable only if it prevents the emission from the premises of all direct or reflected light of whatever color.

50 *PAINTS*

The simplest way of blacking out is to spray on paint internally or externally, and in a factory of moderate size this may take from two to three days with a reasonable number of small crews. Paint selected for this purpose should be waterproof and sufficiently opaque in one coat only. As the cost of removing ordinary paint may be three or more times the cost of applying it, any paint used should be removable by a convenient and inexpensive process when required. External application of paint by sprayers is usually cheapest and best, as it prevents glare from the glass and, if properly selected, will assist in camouflage.

A suitable paint can be made up of: 100 lbs. black ground in oil, 50 lbs. paste dryer, 2 gal. turpentine, ½ gal. boiled linseed oil, and 1 pint of terebene, giving 10 gals. of blackout paint.

A suitable stripper would consist of: 5 gal. benzene, 3.3 gal. acetone, 15 lbs. paraffin wax giving 10 gal. of paint remover. Glass can be painted with blackout plack paint at about $12.00 per 100 lb. can with a covering capacity of 400-500 sq. yd. applied with brush or by spray as desired.

Various forms of latex and mixtures of bitumen and rubber can be easily peeled off the glass and cost approximately $.25 per sq. yd.

A flat paint, for internal use on glass to give obscuration with one coat only, consists of:

Pigment: 57% (by weight) consisting of carbon black and a filler.

Medium: 43% (by weight) consisting of gum and oil, 40%, and volatile thinners, 60%.

The gum and oil vehicle consists of fossil resin, tung oil and linseed oil.

51 *SCREENS AND SPLINTER PROTECTION*

The use of paint on existing glass may prove a very expensive expedient since the damage bound to result to glass in a bombardment will necessitate the extinguishment of all the lights in the factory until the glass has been replaced. In any event, to prevent danger from flying glass splinters it is desirable to install close mesh galvanized wire netting and cloth on frames at a cost of about $0.15 per sq. ft.

It is usually desirable to obscure light by shutters of material such as ply board, composition board, or wood covered with a waterproof material, which will obscure light, hold glass and prevent it from flying into the room in the case of blast and be weatherproof if window panes are broken.

Frame shutters which can be taken down during the day and also be made gasproof and applied inside the window are an advantage. One such arrangement involves use of rubberized cotton fabric stretched on a light frame on the inside of the window with ball catches; so that under blast pressure the whole shutter is blown inwards and left hanging by special suspension pieces of india rubber. This is a safety factor and is a system which has been subjected to actual test. Shutters, if light and easily fixed, can be handled by youths or girls employed in the factory (see Figs. 8 and 9).

Textiles such as cotton and sacking impregnated with a cellulose solution can be made grease, water and germproof, noncracking, and remain undamaged by mustard gas or by subsequent boiling for decontamination. Plain

fabric suitable for strengthening of window glass costs at least 10–15 cents per sq. yd. It can be obtained for $.28 per sq. yd. in any color, preferably dark greens or black, and can be stuck to the glass with normal adhesives or stretched on the frames previously described. Portable shutters cost about $.28 per sq. ft. of window area.

A cheaper arrangement of gas and light obscuration screen for vertical windows costing about $.10 per sq. ft. consists of rubberized cotton fabric tacked at the ends of two wooden uprights, which are wedged in position between the horizontal members of the window frame. During the day the whole arrangement pulls out for convenient storage and when wedged into position forms a gas-tight, light-obscuring screen which is sufficiently loose to yield under blast pressure and is therefore calculated to survive very much longer than would a fixed screen. Use of light-proof paper screens on batten frames (Fig. 11) is another cheap arrangement. Suitable materials are:

a. Light proof paper.

48 in. wide	$6.50 per 100 yds.
60 in. wide	8.00 per 100 yds.

b. Brown kraft paper (6-ply). This reflects most of the light falling upon it but transmits none. It is also water, wind and tear proof, and is suitable for making up into roller blinds. Approximate prices:

36 in. wide	$0.13 per lin. yd.
42 in. wide	.15 per lin. yd.
48 in. wide	.18 per lin. yd.
54 in. wide	.21 per lin. yd.
60 in. wide	.25 per lin. yd.

Approximate costs of shades made up with brown kraft blackout shade material are:

Width	Length	Type A	Type B	Type C
3′6″	4′0″	$0.62	$1.06	$1.37
4′6″	6′0″	.87	1.37	1.87
6′0″	8′0″	1.13	1.87	3.00
9′0″	9′0″	1.25	2.75	3.75
12′6″	9′0″	3.00	6.00	8.00
15′0″	12′6″	4.00	7.50	12.00

Type A. Eyeletted at top with lath at bottom.
Type B. Flange roller.
Type C. Automatic spring roller.
Delivery and installation charges extra.

TYPICAL SCREEN INSTALLATIONS 52

Figure 27 shows a sliding tray which enables sky lights to be obscured in a few seconds and provides protection for the interior against flying splinters of glass broken by an explosion. The shutters slide on rods, and are pulled to one side by means of a wire, which serves to open or close a considerable number of shutters in a single row, so that all the glass in a large number of sky lights may be obscured very quickly.

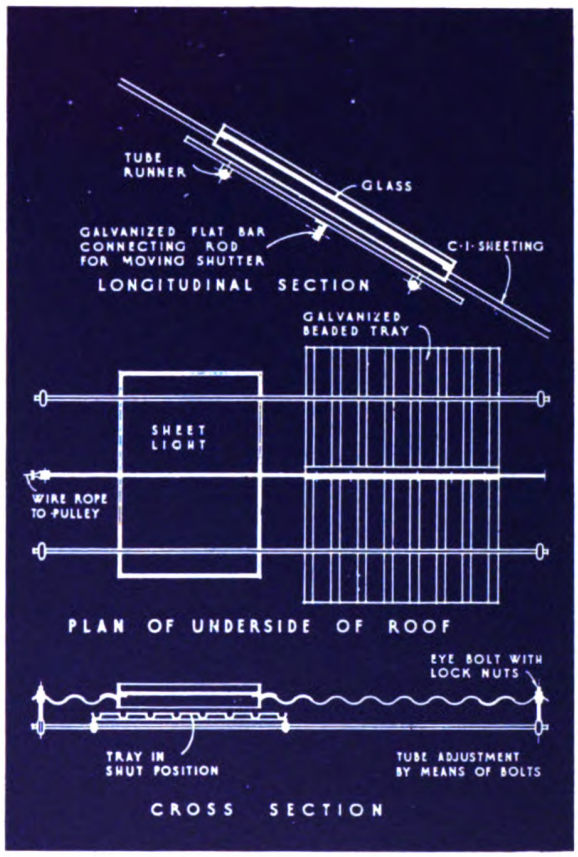

Figure 27—Sliding tray screen under roof lights.

Where it is possible to get access to the roof glazing conveniently from the outside, some such arrangement as shown on Figure 28 will be found the most convenient. Glass from every alternate bay in the roof glazing is removed and stored (but kept available for repairs during an emergency) and opaque painted

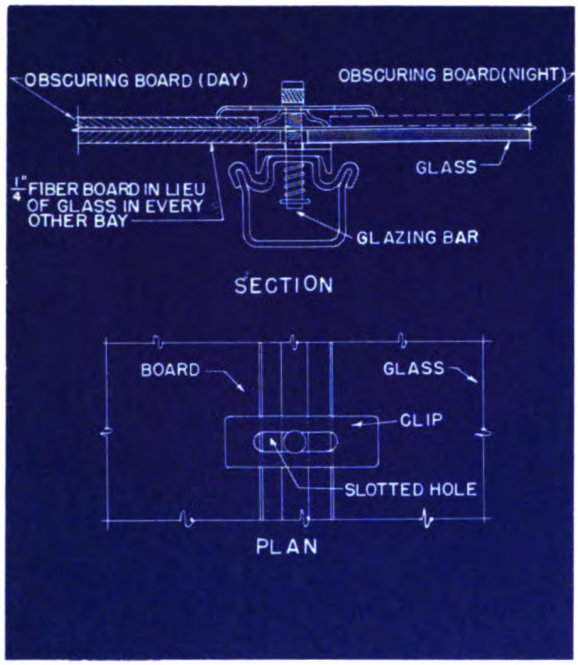

Figure 28—External obscuring boards.

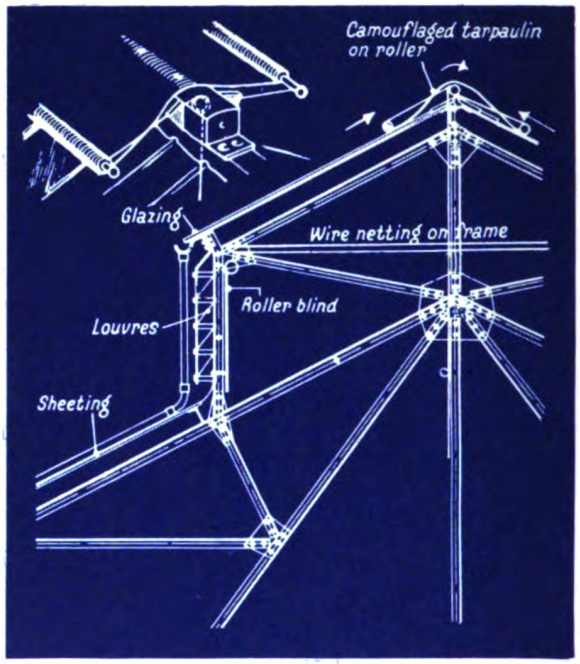

Figure 30—Outside tarpaulin and inside roller blind.

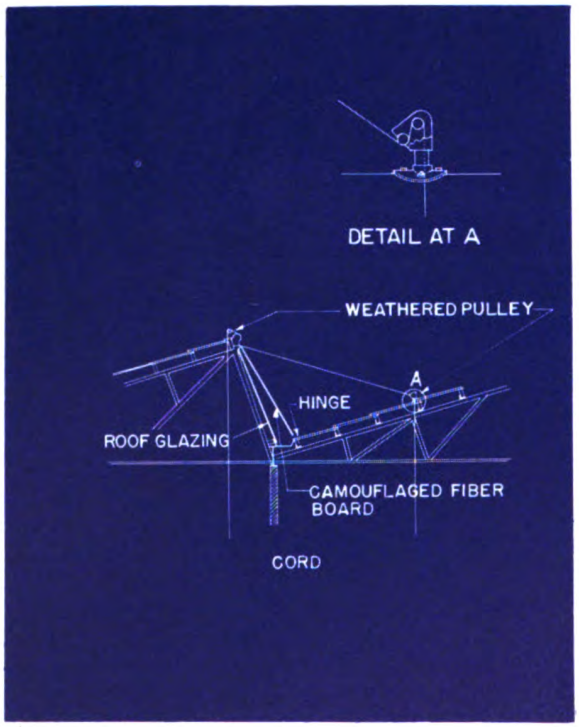

Figure 29—External hinged shutters.

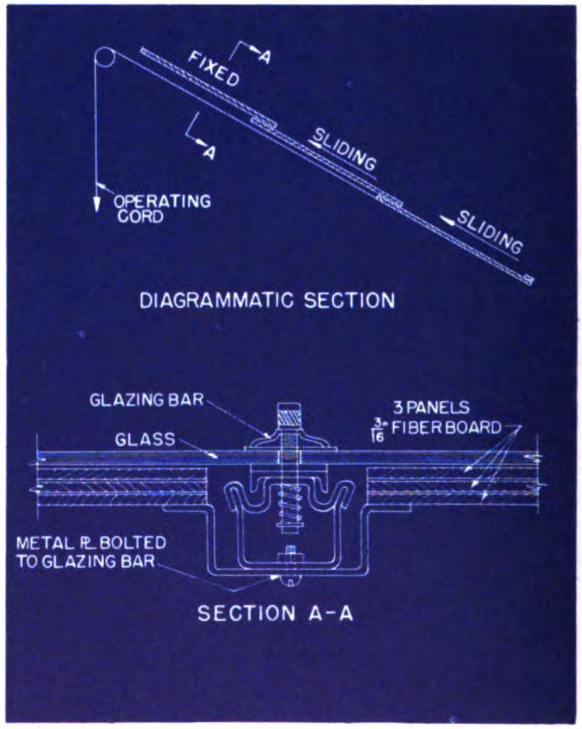

Figure 31—Internal sliding shutter.

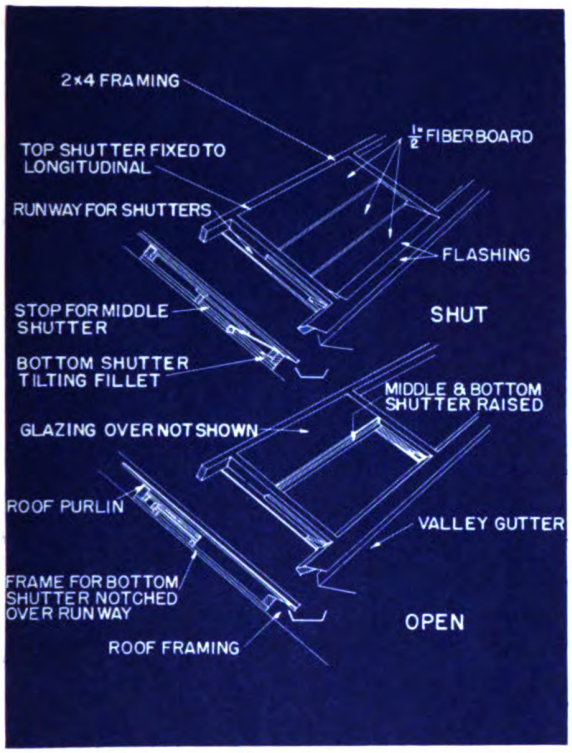

Figure 32—Internal sliding shutter providing temporary weather protection.

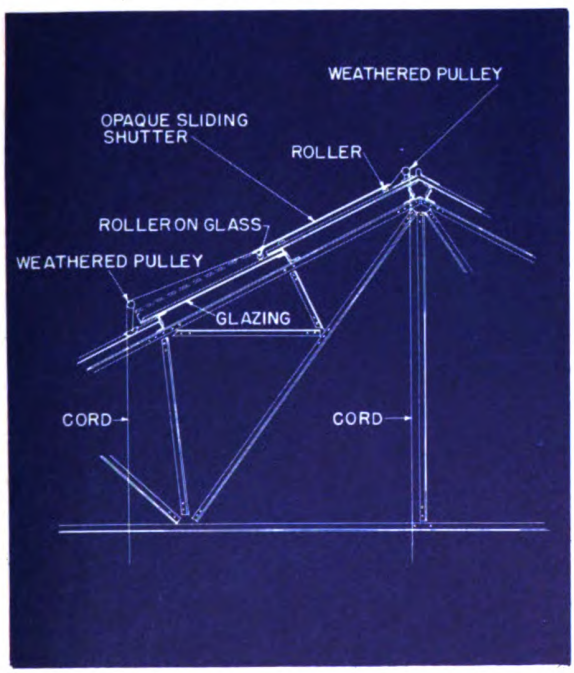

Figure 33—External sliding shutters operated from the inside.

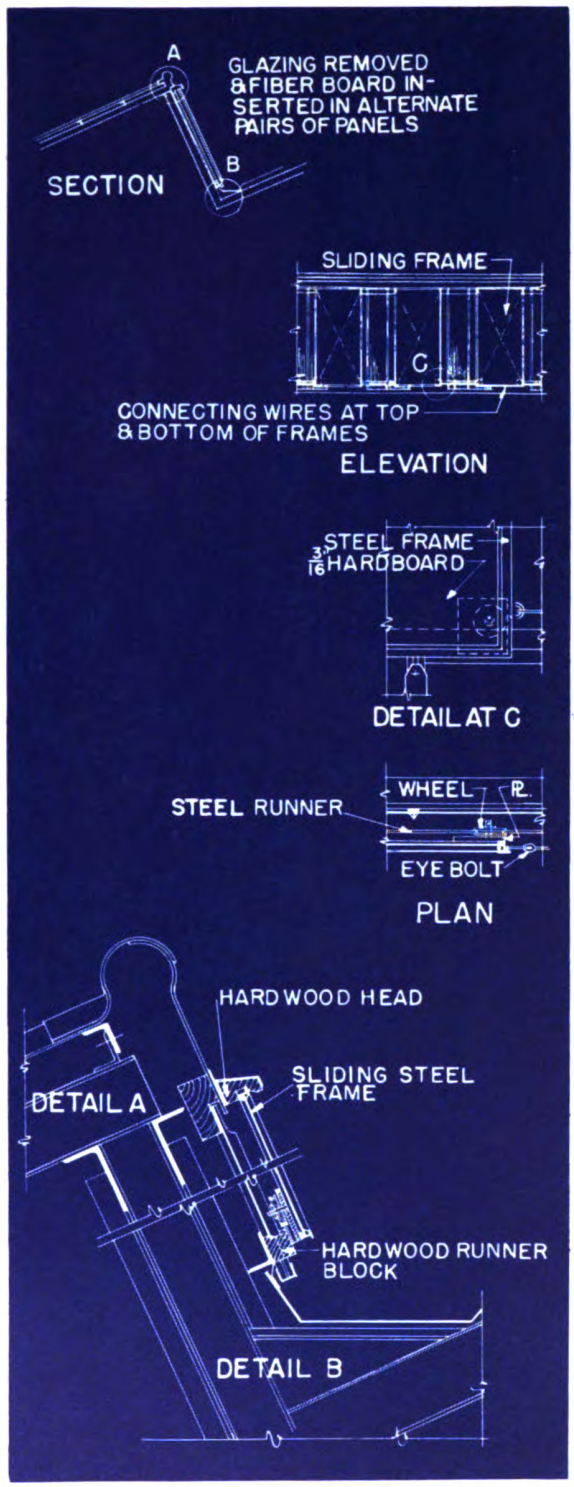

Figure 34—External sliding shutter, horizontal movement.

boards of ¼ in. fibre board are installed instead. By this means 50 percent of the light will be permanently blacked out. The obscured portions serve as storage space for the obscuring boards during daylight. To avoid the expense and difficulty of installing complicated hinge devices over the existing glazing bars, the arrangement shown (Fig. 28) can well be adopted, as obscuring boards need be only 3/16 in. thick; such a board easily clips under the standard copper glazing clips at the base of the bar. Position of the obscuring board by day and by night is shown on the sketch. Estimated cost of ¼ in. painted hard fibre board is $.10 per sq. ft. and 3/16 in. painted hard fibre board, $.08 per sq. ft.

Clipping an additional light steel tee section to glazing bars provides a similar method of wedge fixing of fibre board covering for roof glazing and windows. It can be used on many types of glazing bars and fixed by unskilled labor. The slotted tee sections are permanently placed in position by means of special clips and left until it is necessary to obscure the light. When required, opaque boards can be fixed in a short time by means of wedges which, being fixed without nails or screws, can be removed quickly and easily without damage. An adaptation of this method can be used externally or internally on vertical windows.

An arrangement for operating sawtooth roof obscuration from the inside of the building is indicated on Figure 29. Fibre board shutters (which can be camouflaged) fixed to a hinge on one side of the valley gutter so as to lie on the sloping portion of the roof during the day are pulled over the roof glazing during the night, as indicated on the sketch. The estimated cost of this installation is $.30 per sq. ft.

Figure 30 with obscuration for monitor type construction shows a vertical roller blind over the inside of the louvers at $.16 per sq. ft., and a camouflaged tarpaulin on rollers operated from the ridge, generally as indicated over the top of the lantern light at an estimated installed cost of $.25 per sq. ft.

Opaque sliding shutters (Fig. 31) have the advantage that there is little to go wrong and they can be operated easily even in high wind; estimated cost is $.50 per sq. ft. installed.

Another method (Fig. 32) of installing internal wood sliding shutters has the advantage of producing a reasonably weather-tight roof covering when in the blacked-out position. This is especially useful when the roof glass is broken as the interior of the building can then be protected from shattered glass, and also from the weather, until glazing is repaired.

Installations for internal sliding shutters are shown in Figs. 33 and 34.

VENTILATION

Factory officials in blacking out their premises should realize that the means adopted for this purpose must not interfere with essential ventilation, which, if too restricted, might have serious effects on the health of workers. Even where conditions do not immediately affect health, adequate ventilation and reasonable temperature are always necessary if productive capacity is to be maintained. On the average, air volume should be changed at least six times an hour, with more frequent changes in hot weather than in cold, and where combustion or manufacturing processes vitiate the atmosphere. Normal conditions of ventilation can be restored by simple means, such as shown in Figure 29, which will ensure enough air for ventilation without permitting escape of interior light. Natural ventilation will not usually be sufficient, however, unless suitably arranged additional openings of adequate size are provided. Where windows or ventilators are not sufficient to maintain the correct number of air changes, exhaust fans or blowers must be employed. In designing traps for intercepting light at these openings, therefore, care must be taken to avoid restricting the air flow more than is necessary. Some restriction of flow, possibly as much as 50 per cent, is unavoidable. Louvers and baffle plates, often necessary parts of the design, will inevitably give rise to eddy currents and friction losses, and so reduce effective areas of the openings, particularly if they are not kept clean. Where it is impracticable to provide sufficient inside ventilation by natural means, mechanical methods, such as the plenum

system, with intake and exhaust air pipes, must be installed. Necessary inlets and outlets for such an air system must not be made ineffective by blackout measures.

Mechanical ventilating appliances are often put out of action in cold weather if there is insufficient warning. Heating arrangements must therefore be such as to ensure that both a reasonable temperature and adequate ventilation can be maintained as provided by plenum systems. In other cases, pre-heating must be effected by radiators or other heaters, but overheating owing to closing up or obstruction of ventilating openings, must be avoided. Efficiency of equipment provided in many works for removing dust, fumes or steam may be adversely affected if the general ventilation is interfered with. To ensure proper use of ventilating and heating appliances, supervision should be allocated to some experienced responsible person, whose duty it should be to give daily attention to checking these matters.

SECTION IV: LIGHT-LOCKS

54 *ESSENTIAL FEATURES*

Light-locks are means whereby persons may enter or leave buildings during blackouts when no visible light may emerge from the interior. Certain other types of similar screening devices (light traps) are also included. A light-lock consists essentially of a passage or tunnel (usually 2 feet 3 inches wide) having dark walls and ceiling, so constructed that no direct light source, or light reflected therefrom, is visible at its exterior entrance.

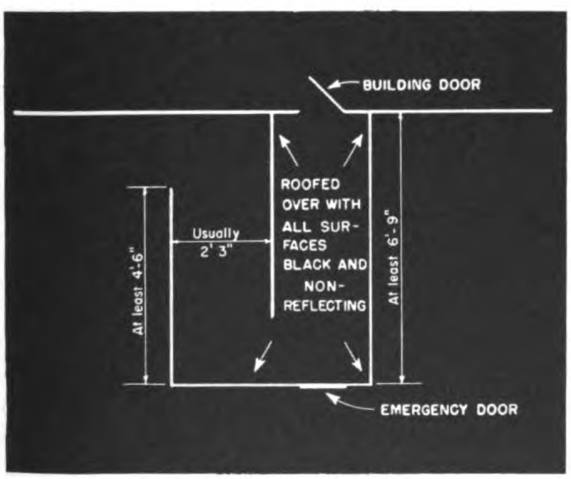

Figure 35—Essential features of inside and outside light locks.

Figure 35 illustrates an inside or outside light-lock possessing these essential features, constructed so that all direct light passing through the inner entrance undergoes double reflection from its walls. However, when this construction presents difficulties, double reflection may be dispensed with and simpler arrangements adopted, provided that any sources of light near the inner entrance are suitably screened. Two doors or lightproof curtains in a passage will serve the same purpose. An emergency door for hasty direct entrance or exit should be provided, as shown, when possible.

INTERIOR OF LOCK 55

Walls and ceiling of a light-lock usually are painted dull black. For pedestrian traffic usually a white line over 2 in. wide is drawn horizontally along the walls at a height of 3 ft. 6 in. The floor may be any dark material which does not polish. Solid walls extend to the ceiling of the lock. Where there are steps at entrances, their edges should be dull matt (rough) white, with warning (e. g., "6 steps down") painted on the floor just inside the entrance and another (e. g., "6 steps up") at the bottom.

Partitions may be prepared in collapsible hinged sections that can quickly be erected and removed. They may be made of materials such as plywood or fiberboard, subjected if possible to some fire-proofing process. If used, the dead black coating is applied *after* fire-proofing treatments have been done.

TYPICAL EXAMPLES 56

ENTRANCES FREQUENTLY USED BY PEDESTRIANS TO SMALL BUILDINGS AND SHOPS

Where no part of the light-lock can be permitted to encroach on the space outside, light-

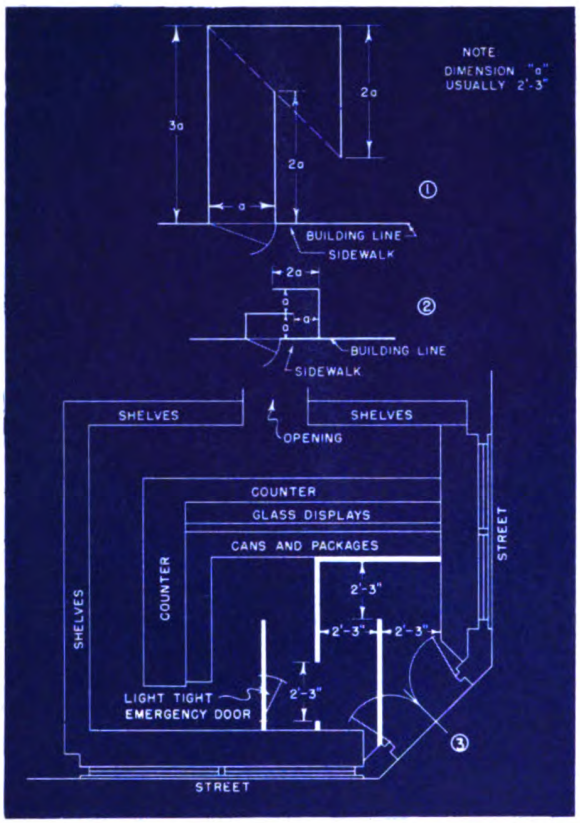

Figure 36—Examples of inside single light locks.

locks, single type (Fig. 36 (1) (2)), and light-locks, double type (Fig. 37 (1) (2)), are used.

The outerwall or walls should extend beyond the central baffle by a length at least equal to the width of the passage-way.

Where some encroachment on the space outside is permissible, similar locks are constructed outside instead of inside the building, or part of the lock may be inside and part outside the building (Fig. 31 (3)). If inside lights are screened so no direct light enters, baffle may be omitted.

NUMEROUS ENTRANCES, FREQUENTLY USED BY PEDESTRIANS (E. G., A ROW OF SHOPS), WITH EXTERNAL LIGHT-LOCKS

The light-locked space, common to several entrances, (Fig. 37 (4)), forms an arcade, preferably not less than eight feet wide, (A), to allow shoppers to pass; the sidewalk width outside (A′) should be adequate for pedestrian traffic. Where arcades can use one-way traffic, the width may be materially reduced. During daylight double doors (B) facing shop windows and end doors should be left open to provide free passage. After dark double doors should be used only as emergency exits and opposite each

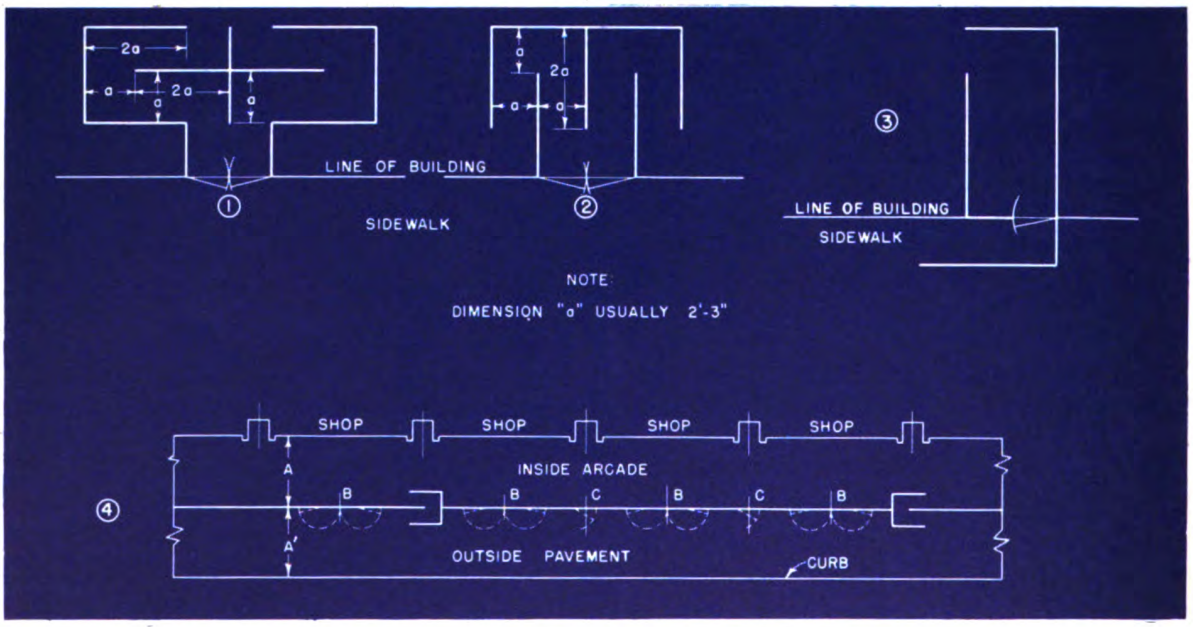

Figure 37—Examples of double and outside light locks.

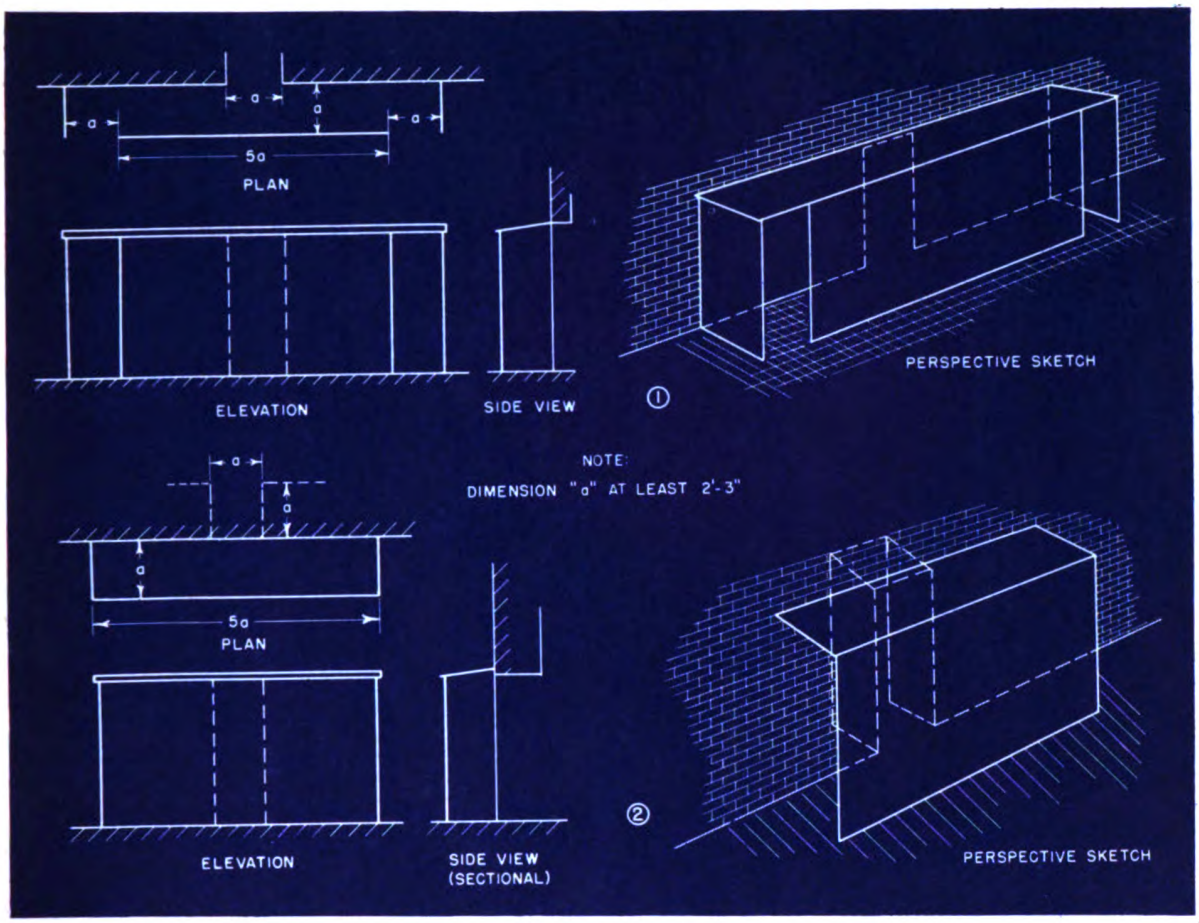

Figure 38—External removable light locks for factory use.

shop entrance an additional emergency exit (C) is provided. Normal lighting may be provided within the arcade, and illuminated windows are permissible, provided light-locks otherwise satisfy the requirements outlined above. Use of this method is subject to having pavements of adequate width and consent of local authority.

PEDESTRIAN ENTRANCES AT FACTORIES AND SIMILAR BUILDINGS

When light-locks can be arranged immediately inside exit doors, methods shown in Figure 36 are recommended. In other cases use of blackened corridors or simple baffle arrangements immediately opposite and within the doorway may answer. When arrangements cannot readily be made inside the factory, a form of external device (Fig. 38 (1)) with baffles at each end may be adopted. It should be portable and roofed in but open on the side facing the factory door, so as to be removed during the day and wheeled into position covering the factory door at night. Width of passage should be not less than width of the exit doorway (A) and it should extend out a distance of not less than twice the width of the exit door on both sides. Interiors should be painted dull black with arrows indicating direction of movement painted in white on the wall facing the exit. Effectiveness of the arrangement is considerably increased when a short darkened passage within the factory leading to the exit door can be provided. No direct light should emerge through the exit door (Fig. 38 (2)).

57 *TREATMENT OF EMERGENCY EXITS*

Any type of light-lock involving any obstruction to rapid passage of the public is undesirable as an emergency exit. The following will reduce to a minimum the amounts of light thrown outside the building if the exit is so used after dark.

a. All direct light from any source or reflector should be shielded from the exit.

b. Any passageway approaching an exit should be lighted as dimly as is consistent with safety and walls adjacent to the exit should be painted with a dark matt paint.

c. Where exits are not approached by passages, tunnels of a length not less than twice the width of the doorway should be constructed of matt black materials immediately inside or outside the exit doorway.

58 *PROVISION OF ILLUMINATED SIGNS WITHIN LIGHT-LOCKS*

Where illuminated signs are permissible, letters or symbols forming such signs may be

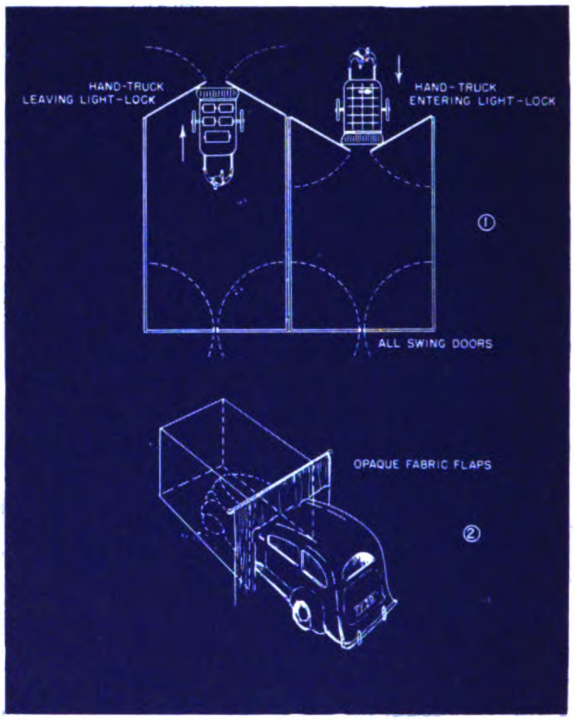

Figure 39—Hand truck light locks and portable enclosures.

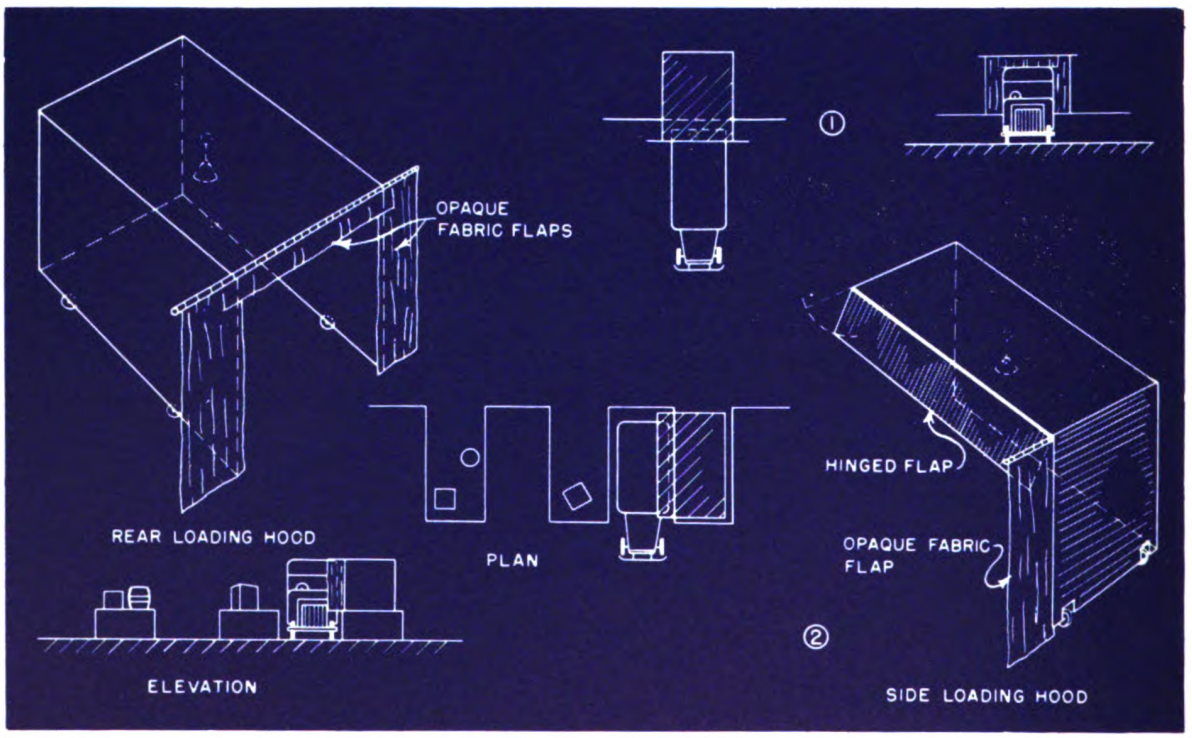

Figure 40—Portable enclosures for rear and side loading of trucks.

cut or otherwise made in the wall of the light-lock. These openings, made under expert supervision, should be covered with translucent diffusing material, and placed so they receive light from inside the building and are visible from within the light-lock.

59 *GRADUATION OF LIGHT IN THE VICINITY OF LIGHT-LOCKS*

To prevent entry of strong light into the locks, sources of light near entrances to interiors of buildings should be shielded. Diminution in intensity of light in this vicinity is also necessary to lessen the contrast between bright interior lighting and relative darkness within the lock, thus aiding adaptation of the eyes to these conditions.

60 *OTHER SCREENING DEVICES*

Where adoption of light-locks is not convenient, as at garages and warehouses where motors and other vehicles are constantly entering, special means of blocking out light at exits must be used. All vehicles can pass through special light-locks or long covered passages which have an equivalent effect. The following are typical examples:

HAND-TRUCK ENTRANCES AT FACTORIES

For this purpose an arrangement of two sets of double swing-doors may be effective (Fig. 39(1)).

MOVABLE SCREENS FOR USE OUT OF DOORS WHERE OTHER METHODS OF OBSCURATION ARE IMPRACTICABLE

These may be complete portable enclosures in a variety of designs capable of being quickly transferred from place to place. A small and compact form of screen enables engines of motor vehicles to be examined by artificial light under a canopy (Fig. 40(2)). More elaborate forms, to facilitate loading and unloading of trucks, are used in areas where complete obscuration presents difficulties (Fig. 41(1)(2)). The above devices may not be applicable where loading is done across sidewalks between building and roadway. A double or treble row of overlapping portable screens on rollers with auxiliary curtaining, if required, will prevent any light escaping through joints or cracks while the truck is being loaded, and allow for adjustment of the screens to block any escape of light when the truck is removed (see Fig. 41).

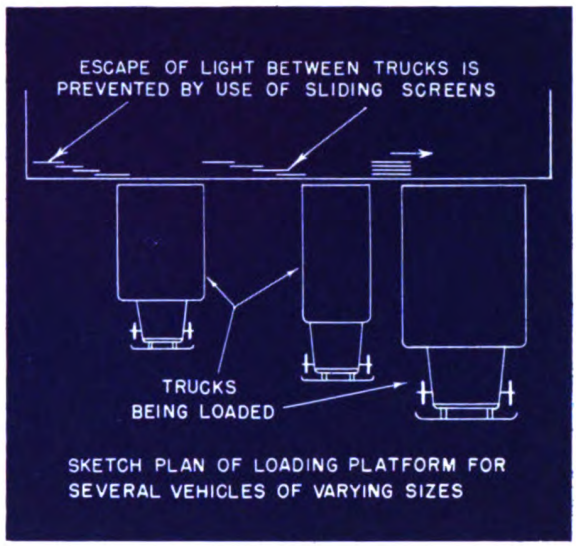

Figure 41—Use of portable screens for loading all kinds of trucks.

SECTION V: MISCELLANEOUS MEASURES

61 *WINDOWLESS FACTORIES*

The need for controlled conditions of light, air, humidity, and temperature as aids to production in some processes has caused a demand for a type of construction to provide these factors. The advent of air-conditioning and fluorescent lighting, with its low heat generation, has resulted in the windowless type of construction. Such construction is inherently and permanently blacked out. But use of such construction for the purpose of blackout alone can be considered only for plants of vital importance in national defense.

62 *SMOKE IN CONNECTION WITH BLACKOUTS*

Smoke may either defeat the purpose of a

blackout or increase its effectiveness. Just as the lighting pattern of a city or industrial activity is characteristic, so may the type, amount, and frequency of smoke emission indicate the character of the installations. Certainly, the emission of smoke may well indicate the location of an activity which a blackout is striving to hide. Consequently, in planning for and carrying out a blackout program smoke control should be considered.

The use of smoke to increase the effectiveness of a blackout will, in practically all cases, be intentional. The smokes used may be natural to the producing source, or enhanced by additions thereto, or may be special types emitted from specially designed sources similar to those used in the military service. Smoke may be placed from stationary positions such as fixed balloons, tall buildings or factory chimneys, or from mobile sources such as automobiles, railroad trains, airplanes, blimps, or boats. The purpose of such smoke will be either to conceal specific targets in vital areas or to simulate an activity of a type which can be easily identified by its smoke. To increase the effectiveness of such a plan there should be variable periodic duplication of concealing smokes at several points other than the important centers. Key Civilian Defense personnel should know when any type of smoke scheme is to be used so that it will not be confused with a possible gas attack by the enemy. In regions where industrial smoke might betray plant locations in spite of blackouts, smoke control boards and technical combustion experts should be consulted on, or wholly charged with, projects of abatement. These same groups and persons should be called on to assist in projects of concealment, or duplication by dummy target areas, by the use of specially created smokes.

Whether used intentionally or occurring as a by-product of industry, the effect of smokes on lighting facilities and natural or forced ventilation systems must be studied so that both will be capable of functioning during smoke periods without reduction in efficiency.

63 *GLOW FROM INDUSTRIAL PROCESSES*

In any important industrial area there are always a number of factories easily identifiable by the glow caused by the process. The various phases of the iron and steel industry are the classic examples of this factor. They are not, however, the only sources of glow. Sugar refineries, oil fields, oil refineries, brick and pottery works, power and utility plants may have more or less glow according to the type of process and efficiency of operations. The iron and steel industry, in its various phases, furnishes the best example of the problem. At full operation these mills and their slag dumps are visible from the air from a distance of 25 miles or more under favorable flying conditions. The following are typical operations carried on in a steel industry area: blast furnace, Bessemer converter, open hearth furnace, cupola furnace, soaking pit, annealing furnace, and rolling mill.

BLAST FURNACE

This operation gives off light during charging and when the furnace is tapped.

BESSEMER CONVERTER

This operation requires about 10–15 minutes and a great amount of light is given off during the entire period.

OPEN HEARTH FURNACE

This operation gives off light from its stacks and during pouring.

CUPOLA FURNACE

Similar to open hearth furnace.

SOAKING PIT

Such a pit gives off light when ingots are placed therein or removed.

ANNEALING FURNACE

Similar to open hearth furnace.

ROLLING MILL

This operation is carried on under cover with a minimum of glow and the usual light prevention methods used for factories will solve the problem.

Concealing glow from these ovens in operation is a major problem. They give off considerable light and are in long batteries. To erect covered obscuring sheds over this type of plant operation would be difficult and it would be extremely difficult to extinguish the ovens quickly. Several pilots of considerable experience have stated that the length of these batteries and the amounts of glow therefrom make it very easy to recognize them. As their exact location is usually known, the pilot can orient himself on other possible objectives therefrom.

Similar problems exist with regard to power and other public utility plants as discussed in Chapter V.

64 *METHODS OF PREVENTING GLOW*

There is no general method of glow or glare prevention suitable for universal application and each plant must be examined and dealt with on its own merits. In any plant where glow occurs in the process used, considerable thought should be given to planning the sequence of operations so that the phase or phases during which glow does occur take place during the daylight hours. The following are suggested methods which have been successfully employed in Europe:

Glare from the top of active blast furnaces can be screened by use of large fireproof louvered hoods carried over the charging platforms of furnaces.

Top flames from cupolas can be dealt with in a similar manner.

Glow from inspection holes, slag pipes and other external apertures in cupolas can be screened with large sheds over charging platforms and at ground level.

Reflection of light from kiln chimneys can be dealt with by use of asbestos sheet baffles.

Glow from open hearth furnaces, soaking pits, or foundries installed in open sided buildings can be minimized by the construction of louvered sides having a large overhang.

Ventilating gaps and louvers in lighted workshops can be screened by external hanging shutters arranged to pass ventilation through a form of light-lock.

Light-locks (see pars. 53–56) must be used on all doorways used after dark, when the interior is brightly lighted.

Wall fans can be screened permanently by use of large external louvers in reinforced concrete or similar material.

At sugar refineries, illumination and fires in boilers can be quickly extinguished. However, sugar under process (3 hours usually) will cake during any extended shut down and can be removed only with difficulty; also, afterglow will be visible above the smoke stacks for some time after the boilers are shut down. It would appear that special methods of drawing off sugar being processed and of hiding or quenching the glow should be developed by the refineries concerned.

In oil fields, lights and gas flares can be quickly eliminated, except that heavy gases released without flaring in still, damp weather do not rise rapidly and constitute a definite fire hazard. In this event, the operators should close in the wells or extend the flare line by a riser. For large gas volumes disposed of through a single line, such risers might have to be 40–50 feet in height. The solution used in each case should be adapted to the needs and conditions of that particular field and not applied without prior investigation and tests.

CHAPTER V

Utilities, Municipal Services and Installations

SECTION I: GENERAL

65 *IMPORTANCE*

The continued operation of the essential services of light and power supply, water supply and transportation, together with their distribution systems, is vital to the continuance of life and industrial activity in any area. The municipal services of waste collection and disposal are necessary to the maintenance of the health of the community. Hospitals, although not strictly a utility, nor in all cases a municipal service, are equally important to the life of any community or industrial area. Some, if not all, of these services must function and be maintained during air raids. Special methods for the protection of installations during air raids and special technique for the operation of services during blackouts will be necessary. In general, the methods to be used for light control, protection and ventilation are similar or identical with those described in Chapters IV and VI for analogous types of factory, plant, or transportation. This Chapter will be concerned principally with light control.

66 *UTILITIES*

The supply of essential utilities should be both certain and continuous. One of the chief Civilian Defense problems will be the repair and maintenance of utility systems during blackouts, whether bombing occurs or not. In some instances work can be carried on with normal lighting extinguished and replaced by a few well-shaded lamps so screened that obscuration of windows and roof lights is unnecessary. Typical cases are electric power stations or engine and boiler houses, where only a limited number of specific objects need be rendered visible for the conduct of operations. Here there need be only a few dim, well-shaded lamps illuminating dials or switch boards and it may be possible to apply a fluorescent paint to these objects, to be activated by shaded ultra-violet lamps. Such procedure will obviate the more elaborate methods required in plants where greater intensity of lighting is required for proper operation. Repair crews will be needed by light and power systems to make repairs, to bypass damaged areas, and to prevent fires and exposure of lights from indicating where bombs have fallen. Cutting off and re-routing around damaged lines will be most vital. Similar procedures will be required for gas systems, telephone and water systems. A workable setup for the organization, disposition and size of additional crews, adequate equipment and drills and tests must be provided during the planning stages as they cannot be improvised when air raids are imminent. The procedures of work must be coordinated with those of the air raid warden, police, gas defense and fire fighting Civilian Defense services, and these services, in turn, must know how best to help utility personnel.

67 *MUNICIPAL SERVICES*

The specific services carried on by a municipality vary from city to city. However, the water supply system, particularly in the larger cities, is a municipal function. The disposition of sewerage, also usually a municipal function, is analogous in operations to that of water supply and the methods applied to it will be similar. There may be other services which must be maintained under blackout conditions but the mention of the major activities will suffice for the purposes of this publication. None of these services are directly involved in blackouts, as such, but their installations must be handled in the same manner as any industrial activity.

68 *PREPARATIONS AND PLANNING*

Preliminary work for blackouts is of much the same type as that described in Chapter IV, involving a thorough study of the restrictions or requirements which will be imposed, what facilities are available, what needs to be done, and then deciding upon responsibility for the various phases. These decisions amplified in greater detail are the basic plans for blackout operations.

SECTION II: ELECTRIC LIGHT AND POWER

69 *GENERAL*

The three components of the usual system are generation, transmission and distribution. Blackout of generating plants (either fuel burning or hydroelectric) is accomplished by means already given (see Chapters II and IV) for light control and elimination of glares from stacks and furnaces. The size, location and surroundings characteristic of plants and overhead power lines make it almost impossible to conceal their identity.

The distribution system is the chief one on which any form of blackout regulation can be imposed and even here certain classes of load service must be maintained. Light load areas may be supplied by: (1) a radial system of feeder lines extending like spokes of a wheel from a distribution sub-station with few, if any, inter-connections to other feeder lines; (2) a loop system of feeder lines wherein two feeders, either from the same or separate sources, are operated in parallel; and (3) a network system with inter-connection of feeders, resulting in a form of grid.

The operating problems on these systems are too specialized for treatment herein. However, planning authorities should be aware of these fundamental considerations and, after stating their exact requirements and type of coordination requisite for blackout plans, should leave the solutions to experienced personnel of the companies involved.

70 *LIGHT PATTERN DIVERSITY*

Normally, during the hours of darkness, each city, community, or lighted area has a definite light pattern when observed from the air (see Fig. 3). This pattern results from the arrangement of street and highway lighting, and will naturally vary with different areas or cities. This natural or normal light pattern depends upon relative geographical location of streets and highways with their corresponding intersections, as well as the installed lighting arrangement and the type of lights, which may be mercury vapor, sodium vapor, or (most often) incandescent. In planning for pattern diversity, it is necessary to map out the locations of each street light, giving each a designated number, then designate which lights should be extinguished in order to place the remaining lights in a pattern other than the normal. The pattern could be rearranged at stated intervals. By so doing, it would be possible to change the apparent direction of highways and streets as observed from high altitudes at night. Modification of the pattern could also be carried out by the extension of new light circuits in directions away from military objectives, and energized in anticipation of an air raid. Depending on the system of power distribution and the means provided for controlling the street lighting system, this scheme will be simple or difficult. In general, in the larger cities and industrial areas, the difficulties and expense are likely to be very great, since a grid system of distribution with interconnecting ties is used for distribution, and street lights are often controlled by such means as astronomical clocks.

The military value of this procedure as compared to the procedure of complete blacking out is a matter of conjecture, as it is based on the assumption that hostile agents will have taken photographs of the normal light pattern in the vicinity of all military objectives and that these patterns will be used as guides in the conduct of air raids. Pattern diversity can have little value from the viewpoint of decoying night air raids in certain areas, for example, where wide rivers, bays or lakes provide unmistakable signposts. Since all individuals in air

raid precautions enforcement organizations cannot be expected to know the details of such a highly technical plan, enemy agents might well take advantage of the situation. For example, a series of lights which actually serve as "pointers" to a bombing objective, could be claimed to be a part of the light pattern diversity scheme.

However, the scheme of light pattern diversity merits some investigations and tests in areas where operating conditions make it feasible.

Blackout warning signals made by flashing lights should always require at least 5 or 6 blinks to distinguish alarms from normal (usually three) operation trips and reclosures. Water, power, hospital and other independent standby plants should be started and all individuals should extinguish all but shielded essential lights. This load reduction normally is compensated for by governors at the regulating plant and causes no generation problem. Certain industrial plants which cannot have even momentary interruptions of service should be given more special consideration than where lighting only is involved.

Handling of street and highway lighting usually constitutes an ordinary operating problem which can be solved by utilities personnel once any simple and practicable procedure is determined upon. In general, main street ornamental lighting (clusters) will be eliminated or simplified, and ordinary lighting levels reduced by reductions in voltage or changes in wattage or types of bulbs used and changes in mountings and shielding installed.

The general level of outdoor illumination should be of very low intensity (about 0.0002 foot-candle) on the ground; this low level should cover no larger an area than necessary. Illumination to be effective should be uniform, not spotty.

Light sources should not throw any light upward and should not be visible from above by reflection from the ground or adjacent windows or wall surfaces. Some light, however, should be thrown horizontally so that sources may serve as guide posts or beacons.

Electric signs hung inside of windows or store fronts should have outside switches to be operated by air raid wardens in case individual owners fail to cut them off.

SECTION III: MUNICIPAL SERVICES

71 *GENERAL*

Of all the services which a municipality may supply, the most important from a blackout standpoint is the water supply system. Uncontrolled fires of incendiary origin may well nullify careful blackout preparations and effort. Hence, protection of the water supply system is a corollary effort in any blackout system. The nerve center of the water supply is often a single initial source, such as a pumping station, deep well, dam, lake, or intake, which if damaged may result in a major disaster. Raw water, after being filtered, is usually pumped by several other plant units to various storage areas within the city proper so that these filter, pumping and storage plants are almost as vital to the water system as the source. If the primary source is shut down for several days, the amount of water remaining in storage, even if rationed, may soon be exhausted under normal conditions. Should fires of large proportions occur when the primary plant is out of operation, the reserve supply may be seriously diminished. As one severe city fire might consume several million gallons, several days of active incendiary bombing might leave the city or industrial area without any water for normal or fire use once the primary source was disabled as a logical primary objective of bombing or, still more likely, of sabotage.

WASTE DISPOSAL 7

Here again the activity is indirectly related to blackouts since the means of disposal may be by burning. Open fires, especially on city trash dumps, provide excellent orientation and must be quenched or blanketed at night so that no afterglow will be visible. Gas producers, refineries and incinerators, which also glow, will require special treatment.

SECTION IV: HOSPITALS

GENERAL

Lighting restrictions on hospitals are particularly difficult and are similar to those of other installations and factories which must keep operating, sometimes with an overload in excess of capacity during blackouts. They usually have large areas of windows but all these need not be curtained in emergency. Lights, however, are essential at night in wards, operating rooms, kitchens, possibly also in laundries. Preparations should be made in peace for providing curtains in these rooms on short notice. The material may be any black or dark material in as many folds as necessary, fastened by rings and hooks, to cut off the light. In other parts of the hospital where only a small amount of light is needed, brown paper pasted on the windows will screen the dimmed lights and lessen the risk of injury from splinters; or the windows can be darkened with dark or black paints. These, however, will serve only if light bulbs of low (15–25 watts) power or ordinary bulbs sprayed with paint are used where no curtains or blinds have been provided.

ALTERNATE LIGHTING METHODS

Where separate standby electric lighting services do not exist, storage battery lighting sets should be installed in every hospital for essential services. Every operating room, at least, should be fitted with some type of emergency lighting fully equal to that needed for normal operation purposes. Other parts may have to depend on electric torches, candles, and special lamps, but even these will have to be used so that their glow cannot be observed through an insufficiently screened window. Ordinary oil or alcohol lamps should not be used because of fire danger. Electric torches or other forms of dry battery lamps should be provided for the use of doctors and nurses. Alternate operating rooms should be designated and provided with alternate lighting.

CHAPTER VI

Transportation

SECTION I: GENERAL

TYPES

The various means of transportation which will have to be provided with blackout and light control arrangements are:

Motors, together with all means of traffic control on city streets and country highways.

Railroads (including street car and interurban lines), together with all means of traffic control on city streets and elevated lines, in railroad yards, and warehouse areas, and on main lines between cities.

Water transportation, together with means of control and warnings on canals, rivers, lakes and oceans, and in ports, harbors and locks.

Air transportation, together with means of control and warnings such as beacons, air port lighting, warning lights, or towers and chimneys.

76 *IMPORTANCE*

Inasmuch as types and routes of transportation may have very definite light patterns in each vital area, special attention must be paid to seeing that blackout provisions are fully coordinated with the general plans for the ar as a whole. Negligence or other errors cooperation by one transport agency might far worse than many mistakes by individu or even by many small areas.

SECTION II: MOTOR TRANSPORTATION

77 *AIDS TO MOVEMENT*

When street lighting is restricted or extinguished and vehicle lighting is likewise restricted, some of the necessary requirements for aiding the movement of motor traffic are:

Screened traffic control signals.
Screened direction signs.
Screened warning signs.
Screened obstruction lighting.
Distinguishing marks on the roadway, curbs, and associated features (trees, lamp posts, walls, or fences).
Motor vehicle blackout lighting devices.
Traffic police.
Highway traffic devices.

The direction signs, warning signs, and obstruction lighting may be indicated by use of self-luminous materials or by use of illuminated signs.

78 *SELF-LUMINOUS MATERIALS*

Self-luminous materials are confined to phosphorescent materials and radium compounds.

PHOSPHORESCENT MATERIALS

These are usually in the form of paint which glows after exposure to sunlight or artificial light (including ultra-violet, or "black", light). Since they can be seen for only short distances, are ineffective if dirty, and remain visible for only a brief period after activation, their usefulness is limited.

RADIUM COMPOUNDS

Radium compounds will last indefinitely without an appreciable loss of intensity. Buttons using these compounds may be used for road delineation, for marking the backs of troops or traffic personnel, and for attachment to rear and front of vehicles. Luminous batons for directing traffic may also be made fro radium compounds.

ILLUMINATED SIGNS

These may be classified into three groups:

Activated signs.—Signs or road edge marker may be painted with fluorescent paints o lacquers. Long wave ultra-violet or "blac light" excites these fluorescent paints to a lo brightness visibility without the light source itself being generally visible. The most common "black light" source consists of the 100 watt PAR 38 bulb high intensity mercury lamp. This light source may be installed as a part of the sign or directed toward the luminescent object from a specially equipped vehicle. For emergency purposes there may be employed a special tungsten filament lamp in a deep purple glass bulb. This bulb is much less efficient but can operate on either direct or alternating current, whereas mercury lamps must be burned on alternating current only and through special current limiting transformers.

Exterior illumination.—Signs, when shielded from air observation by hoods or louvers, may be illuminated from the exterior by a low intensity, directional light source.

Interior illumination.—The lower intensity light source for signs of this type is placed inside a suitable box and is allowed to shine through only the letters or symbols of the sign. Letters or symbols may be made by covering a translucent material (such as white cloth, frosted glass, or similar material) with paint or stencil so that only letters or symbols remain uncovered and allow passage of light.

SCREENING

In general, signs of this type should be screened by visors extending the full width of the sign giving a cut-off equivalent to that of a

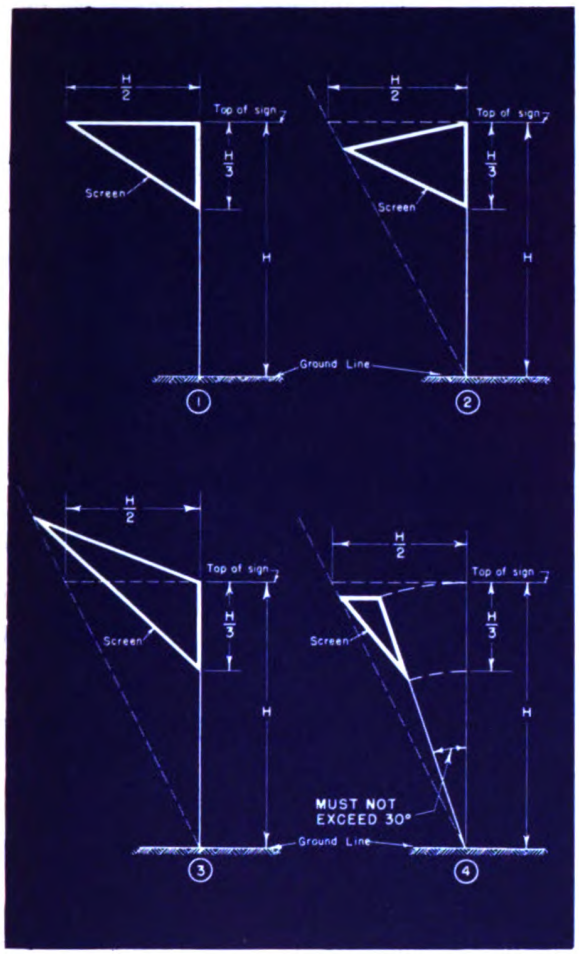

Figure 42—Proportions of screening for illuminated signs.

horizontal screen projecting at the top of a vertical sign at least a distance equal to half of the height of the sign (Fig. 42 (1) (2) (3)). Side screens are not mandatory, but if provided, should not extend down more than a third the height of the sign. Where signs are inclined forward to reduce projection of screens, the angle from the vertical should not exceed 30° (Fig. 42 (4))

80 *TRAFFIC LIGHT SIGNALS*

Traffic signals must be kept in operation. Probably the most practical means of reducing the visible brightness of traffic signals is by voltage control. Filters are not generally recommended for masking lights because such filters are expensive and difficult to procure. The most rapid means of reducing the visible brightness of the red, amber, and green traffic signals is the use of an opaque cover leaving an aperture for the emission of light in a form such as that shown in Figure 43. Green arrow signals may be treated with black paint to reduce the width of the line forming the arrow to ¼ or ⅛ inch, but the length of the arrow need not be materially altered. The pedestrian signs must be similarly altered. Red neon tube signs, "WALK—DON'T WALK," should be covered with a translucent plastic cover and shaded so as to be visible only from the opposite curb at the street level.

PREPARATORY WORK

The required number of masks made of thin, blackened sheet metal, plastic or rubber material so formed that they can be firmly secured in front and flush with the face of the signal lenses, should be obtained and stored. Masks must be so screwed, wired or otherwise fixed in place that they cannot be shaken loose and fall off as a result of bombing, leaving the lighted disc exposed. Where there are a very large number of signals to be treated, and fitting the masks will take a long time, the necessary equipment for spraying the lenses with suitable opaque paint

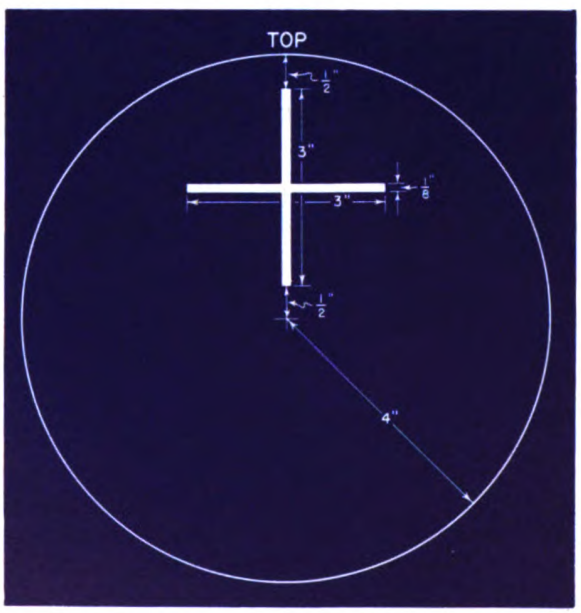

Figure 43—Mask or paint stencil for lenses of traffic lights.

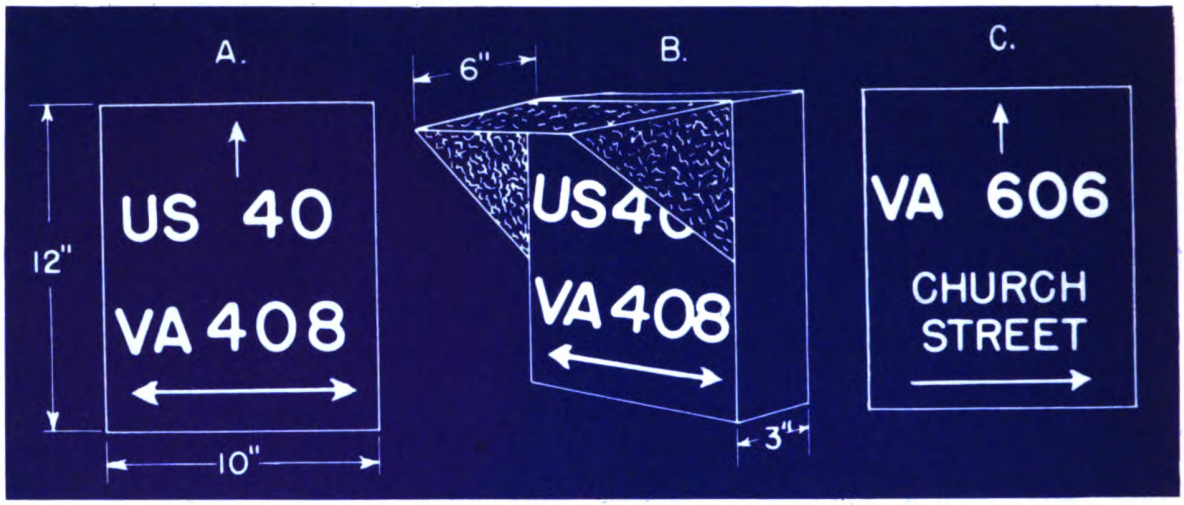

Figure 44—Route numbers and direction signs. {Letters should appear white on black background.}

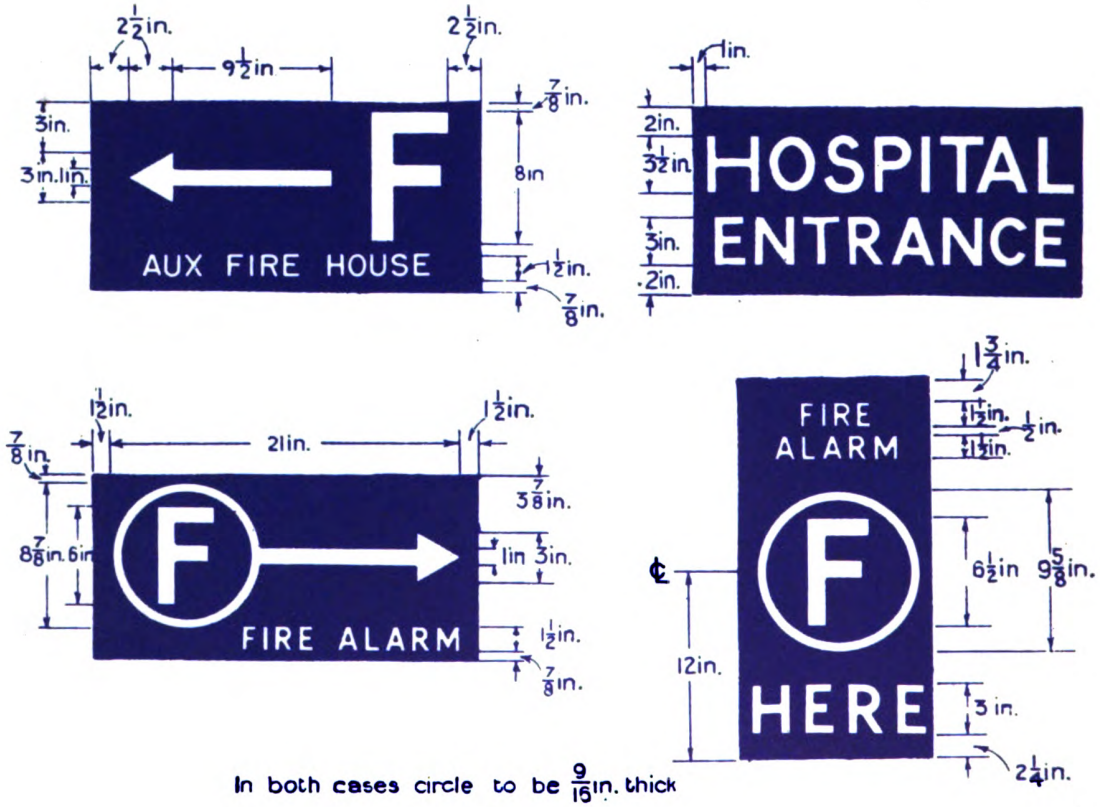

Figure 45—Direction and location signs for Civilian Defense agencies. {In general, direction signs are horizontal and location signs vertical.}

or latex, using a cross-shaped stencil or adhesive tape to produce the required aperture, should be obtained and stored. Spraying should be only a temporary measure until such time as appropriate masks can be fitted. Locked control boxes should be provided at each traffic signal for manual operation to control traffic and to permit turning off the lights should the masks be damaged and leave the full lights exposed.

81 *ROUTE NUMBERS AND DIRECTION SIGNS*

Through routes traversing towns and cities must be adequately indicated by illuminated route numbers and direction signs. Existing illuminated direction signs must be dimmed and screened in the same manner as other warning signs. Where unlighted direction signs already exist, lighting by means of screened lamps may be provided. Lamps should throw light in a downward direction onto the sign, care being taken that light is not cast on the road or other adjacent surfaces. Brightness requirements for white parts of the sign are as for other warning signs.

Screened self-luminous signs of the type shown in Figure 44 should be mounted on lamp posts or suitable columns at a height of about 7 feet above the ground. Letters and figures, at least 2 inches high, should appear white on a dark background, with special attention given to layout for maximum legibility. Letters and figures should have a brightness of about one candle per square foot so as to be legible under blackout conditions at 100 feet, but the sign should be inconspicuous at 250 feet. Consideration should also be given to illuminating the names of important streets, squares and localities where these names are required for guidance of traffic. Direction and location signs for Civilian Defense services are shown in Figure 45.

82 *WARNING SIGNS*

Illuminated signs of this type, such as "Turn Right—One Way Only", and "Do Not Enter—One-Way Street", should be retained in operation, but should be screened from above and so dimmed that under total blackout conditions, though legible to drivers at 100 feet, they are inconspicuous at a distance of 250 feet. Brightness of lettering should not exceed 0.1 candle per square foot.

Types of screening are shown in Figures 46 and 47. The side wings of screens should not obstruct vision of the sign from an essential direction.

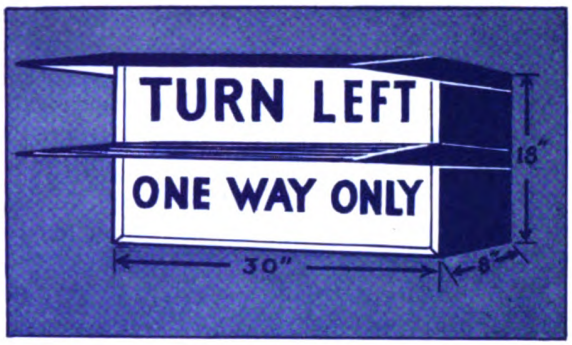

Figure 46—Type of screening.

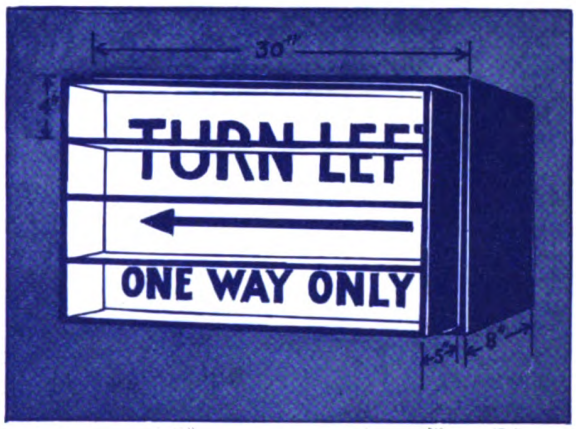

Figure 47—Type of screening.

Dimming may be effected by several means:

(1) Use of low wattage bulbs sprayed to give the required brightness to the panel.
(2) Application of a film of paint, etc., to the inner face of the glass panel.
(3) Affixing a sheet of translucent material, such as colored cellophane or translucent plastic of a suitable density, behind the panel.
(4) Frosting with acid or other means one or both sides of the glass.

Usually a combination of methods (1) and (2) or (1) and (3) will be found most satisfactory. The variety of types of signs in use makes it

impossible to specify in general precisely the type of bulb or the density of screening material; this should be adapted to satisfy particular conditions existing in each case.

PREPARATORY WORK

Necessary fittings, lamps and paints for screening and dimming existing illuminated road-marking signs should be obtained and stored. Screened lighting units should be obtained for illuminating signs which are at present unlighted, and connections from a lighting supply which will be in operation when ordinary street lighting is extinguished should be run to the positions intended for the lighting units. Additional self-luminous signs required should be obtained.

83 *SAFETY ZONES AND OBSTRUCTIONS*

SIGNS ON SAFETY ZONES

"Keep Right" and similar panels at the tops of illuminated signposts on pedestrian island safety zones or refuges should be screened and dimmed as required for other warning signs. Letters should appear white on a dark ground. Lighted supports of the sign should be completely screened. Unessential illuminated panels (as those facing towards the center of safety zones) should be completely obscured. Non-illuminated panels should be screened and illuminated if required for use. Light should be white, and colored panels should be replaced by white letter panels. Safety zones and refuges not normally equipped with illuminated signs posts should be treated as obstructions in the roadway (see below).

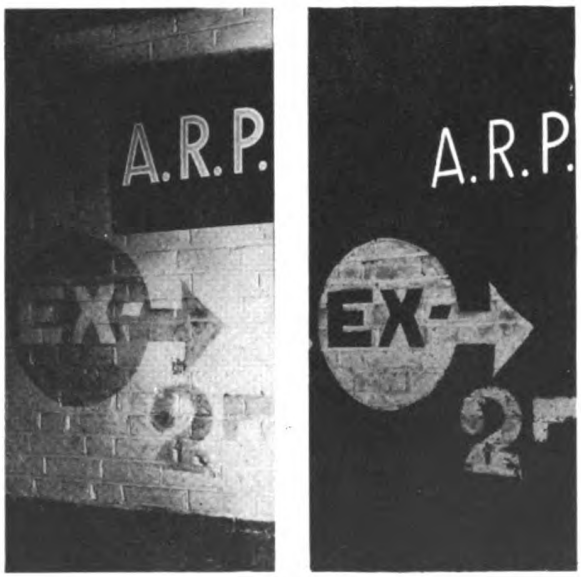

Figure 48—Signs painted on wall with luminescent paints: Appearance under ordinary light on left; under ultra-violet (black) light on right.

All existing illuminated signposts should be examined to decide exactly how they are to be screened and dimmed, and necessary fittings, lamps, and paints obtained and stored. Colored glass panels should be replaced by white glass panels. Portable pedestrian zones or refuges fitted with signposts should be built (or material procured) and held ready for installation at wide street junctions and intersections where no central islands exist at present, or where there is no intention of installing permanent islands. Connections from a lighting supply which will be available when ordinary street lighting is extinguished should be prepared at the appropriate positions.

Signs which normally depend on street lights for their visibility at night should be either replaced by an irradiated or self-luminescent sign (Figure 48) or rendered visible under blackout conditions by the attachment of a screened lighting unit to the top of the sign. This unit should throw light downward upon the sign only and not on roadways, sidewalks or other adjacent surfaces. Requirements of brightness and visibility of the white parts of the sign are the same as in the case of the illuminated signs referred to above. Color of lights used in or upon all such signs should be white.

All signs at present illuminated by street lights should be examined to decide exactly how they are to be screened and/or dimmed to comply with the requirements specified, and necessary fittings, lamps, and paint should be obtained. Screened lighting units for signs which are at present unlighted should be designed, obtained and stored, and connections to power circuits which will be available when ordinary street lighting is extinguished should be made at points nearest where they are to be used.

OBSTRUCTIONS

All obstructions in roads and streets (not merely those which are equipped fully with "aids to movement") should be indicated at night by lights to warn drivers. Dimmed and well-screened glass lanterns of about one candle power, which throw no light above the horizontal and cast no appreciable glow on the road surface, should be used for this purpose. Color of the glass should be red preferably, or white.

In the case of obstructions caused by bombing, lamps of this kind should be used with the routes available for traffic being marked out by large patches of white paint, lime, newspapers, cloth or other light colored material placed on each side. Light weight barricades painted with diagonal white or yellow stripes should be used to indicate where traffic must stop or turn.

The necessary screens for masking oil lanterns should be made up and stored. Reserves of suitably screened and dimmed obstruction marking lamps should be obtained and stored. Arrangements should be made for nails, lumber, stakes, buckets of white paint and brushes to be available at every depot where lanterns are kept.

DISTINCTIVE MARKINGS

White paint should be applied: (Figure 49)
(1) In lengths of one foot and with one foot gaps to vertical faces and, where considered necessary, to horizontal faces of curbs, at street corners and intersections, circles, corners, and places where road widths alter abruptly. Curbs of safety zones and islands should be similarly marked.
(2) In lengths of one foot with one foot gaps, on streets leading out from junctions for a distance of 25 feet on both sides where no parking should be allowed after dark.
(3) In horizontal bands 6 inches apart on all trees, lamp posts, etc., along roadways, from ground level to a height of 4 feet. Vertical supports of pedestrian guard rails should be painted in a similar manner. Bands of any white reflecting material more permanent or efficient than white paint may be used as an alternative.
(4) In the form of a continuous white line along centers of streets. Where lines defining three or more traffic lanes already exist, the central continuous white line may be laid down in a manner which will not cause confusion.
(5) In horizontal bands or stripes 6 inches to 12 inches wide and a similar distance apart on buildings, walls, fences, railings, etc., at bends and corners of streets and roads so edges of the road and turns are more easily visible.

Quick-drying glossy outside paint or enamel, similar to that ordinarily used for marking traffic lines on streets, is the most effective material easily obtainable. Usual yellow traffic stripe paints may be used in lieu of white.

A survey should be made to decide where white paint needs to be applied and necessary stocks of sprays, brushes and paints should be obtained and stored, together with reserves of paint for renewing markings from time to time. Owners of walls, poles, fences, etc., to be so marked should be informed in advance of reasons for, extent, and date of marking to be undertaken.

PEDESTRIAN CROSSING PLACES 85

At all places where there is considerable pedestrian traffic crossing streets, white lines 6 inches wide should be painted outside the line of existing metal studs, if any, within which pedestrians should cross. A letter "P", for example, may be painted in white on the sidewalk at a distance of about 30 feet on the approach side of such crossings. The upright stroke of the "P" should be parallel to the center line of the street and the top of the letter point toward the crossing. Letters should be 4 feet high and 2 feet wide, all strokes about 8 inches in width. Crossing places to be marked should be noted on a map or list and the necessary stocks of brushes and paints obtained and stored.

MOTOR VEHICLE BLACKOUT DEVICES 86

Blackout operations may be conducted either with vehicle lights screened with shields designed for that purpose or without lights of any kind; and with or without special blackout lights and lighting devices.

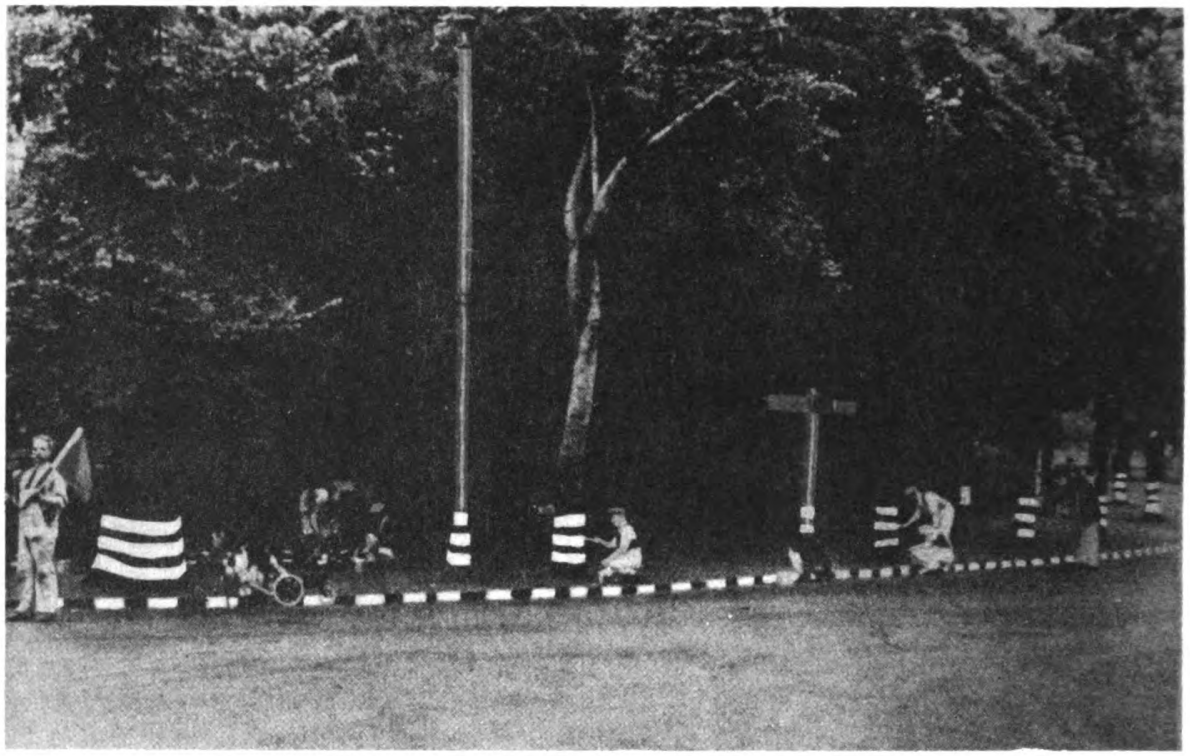

Figure 49—Trees, posts and curbs striped with white paint for guidance of motorists and pedestrians.

BLACKOUT CIVILIAN VEHICLE LIGHTS

Dark oilcloth or rubber masks or hoods may be securely attached to head and tail lights of vehicles with a horizontal slit in the lower portion about ½″ x 3″ covered inside with blue cellophane. Special types of lamps and mountings may be required.

Military or special lights.—These are highly directional lights of low intensity mounted on the vehicle. The reflected light produced by such equipment is ordinarily invisible to air observers flying at altitudes greater than 400 feet. The direct light cannot be seen at an angle greater than 12 degrees above the horizontal axis of the lamp and is invisible to the naked eye at any angle from a distance greater than 1,000 feet.

VEHICLE GROUND LIGHTS

In the event vehicles are not equipped with masks or special blackout lights, an improvised ground light may be made by attaching under the center of the vehicle body a small can with a shaded bulb installed at the closed end. The open end of the can should point vertically down, and wiring should be arranged so that no other vehicle lights burn when the ground light is turned on.

DUTIES OF TRAFFIC POLICE IN BLACKOUTS

Traffic police should be equipped with luminous, reflecting, or phosphorescent gloves, helmets, shoulder straps, coats or capes to assist and protect them in handling blackout traffic. Traffic police should see that only the most essential traffic lights are operated during blackouts. When traffic lights are exposed because of damage to the covering masks, lights will be cut off and the traffic handled by hand, flashlight and whistle signals until masks can be repaired. Autos which have masks damaged will have all lights cut off and will not be al-

lowed to proceed until masks are replaced or some dim form of lighting provided. During raids, all except essential vehicles should stop, leaving two lanes in center of streets clear. They should not park closer than 25 feet from intersections and should leave at least 25 feet of curb clear on both sides of any fire hydrant or other connection. All such points should be conspicuously marked with white paint. In the event bombing has seriously damaged or blocked streets, traffic lights should be set permanently red and temporary barricades and warning lights should be installed to detour traffic until streets in the bombed area can be cleared and damage to essential facilities repaired or fires extinguished. Special squads with special vehicles should be organized for this purpose as part of the regular police or emergency Civilian Defense organizations.

HIGHWAY TRAFFIC DEVICES

Many of the same methods as are used for city traffic, as described above, may be used in the country or on highways. However, because greater speeds are allowable, certain modifications are made to allow longer sight distances.

CONTRASTING COLORS

White paint, (either oil or water paint can be used), rolls of white tracing tape, cloth or paper, are useful for guidance under blackout conditions.

STOP AND GO SIGNALS

For blackout operation, long tubular hoods may be attached to each lens of a colored light signal so as to restrict the angle of light dispersion. Visibility may be decreased by using low powered bulbs, by masking lens with cloth or other suitable material, or by covering portion of lens with paint in such a manner that only a small amount of light is allowed to escape (Figure 44).

TRAFFIC SEMAPHORES

Semaphores may be used under blackout conditions. Signals to traffic are given by position of semaphore arm; e. g., vertical position means "Go", and horizontal position means "Stop". The arm should be outlined with luminous buttons or a controlled light similar to lights described in preceding subparagraphs.

RADIO AND PUBLIC ADDRESS EQUIPMENT

Low powered, portable radio transmitters with a range limited to a few score yards may be installed at critical locations along the road and used to send verbal signals or instructions to vehicles equipped with radio receivers tuned to the wave length of the transmitter. Public address equipment using high powered loud speakers will accomplish the same purposes for vehicles not equipped with radios.

SECTION III: RAILROADS AND ELECTRIC LINES

RAILROADS

Blackouts of railroad traffic lights are handled in general in a similar manner to those for motor traffic. However, because longer sight distances are required, more use will be made of shielded traffic operating lights, making them highly directional rather than dimming or screening them. Types of lights so retained at full power will be those on semaphores, traffic signal bridges, etc., whose lights should not be visible from above engine cab level or off the line of approaching tracks at minimum distances as dictated by such considerations as operating speeds, smoke, or weather conditions. Lights on switch stands may be both shielded and dimmed, with flags marked with luminous paints and activated by black light lamps mounted on switch engines where necessary. Head and tail lights on trains will be retained but the glare of normal headlights will have to be obviated; a substitute track obstacle detector may be devised by use of some form of photoelectric cell at track level. Glows from firing boilers, from fire boxes and from stacks will have to be minimized by screens and baffles. Floodlights in yards and similar characteristic

forms of railroad lighting not essential to operations will have to be well screened or eliminated. This will require highly trained and skilled train and yard personnel, familiar with yard layouts, formed into cooperative teams. Provisions regarding lights in stations, freight warehouses, shops, and roundhouses will be similar to those for similar types of buildings, stores, and industrial plants previously covered (Chapter IV). In trains all shades will be drawn to prevent the emission of any light and dimmed circuits (similar to those on sleeper coaches) will have to be provided in case windows and shades are damaged.

All railroad blackout regulations will have to be coordinated with the general plans of the areas they serve.

ELECTRIC STREET, ELEVATED, AND SIMILAR LINES 90

One of the most characteristic lights noticeable from the air over a blacked out city is the arcing from electric transportation which may be still running. This produces a vivid green-blue flash, which may be either a momentary or almost continuous arc between the trolley and wires overhead on car and bus lines or between the shoe and third rails of rapid transit elevated or surface lines. Means for shielding or damping these flashes should be devised and installed where such traffic will continue to operate. Flashes of plows running in slots on the usual streetcar line are not usually noticeable if shielded by hoods attached below the cars themselves.

SECTION IV: WATER TRANSPORTATION

91 *NAVIGATION LIGHTS*

For most river traffic these are divided into two general classes: channel lights, which give the pilot his direction, and obstruction lights, which warn him of bridges, piers, and floating plant moored in the river.

Channel lights are further subdivided as follows:

(1) A few oil lamps which are lit and extinguished by light-tenders may still be in use.

(2) Electric lights operated on regular commercial current which are turned off and on at the light by light-tenders.

(3) Electric lights operated from commercial electric current turned off and on by photo-electric cells, or astronomical clocks.

(4) Electric lights operated by current from storage batteries at the location. They are turned off and on by light-tenders.

Few, if any, of these lights can be controlled from central switch boards. One feasible solution for preventing observation of these lights may be to turn them off permanently during periods of danger from aerial bombing. In general, lights should be mounted on vertical white or striped posts. If pilots can use their dimmed head lights, they can probably navigate by picking up the white post with boat lights Another possibility is to have channel lights dimmed and shielded and use of boat lights restricted to emergencies only.

Warning lights on obstructions to navigation such as bridges, docks and general floating plant are further subdivided into:

(1) Lights operated from commercial electric current which are turned on by switches at power stations.

(2) Lights operated from commercial electric current which are turned on and off by electric clocks at the location.

These can be controlled, dimmed and shielded in a manner similar to street traffic and similar lights.

OIL LAMPS

One appropriate solution in this case is to replace oil lights at bridges and docks by forms of luminous striping. Lights on floating plant moored in the river can be extinguished by the plant operator or by watchmen.

INSTRUCTIONS 92

The Federal Government, through U. S. division and district engineers and other regulatory agencies, may issue special blackout instructions to govern traffic and uses of lights which will differ with the requirements of each waterway and harbor and types of traffic thereon. Such instructions should be closely coordinated with the general blackout schemes of the areas covered by the waterway.

SECTION V: AIR TRANSPORTATION

It is beyond the scope of this pamphlet to discuss the technicalities of blackouts in connection with air transportation. Specific rules and regulations will be promulgated by the proper Civilian Defense authorities in collaboration with the Civil Aeronautics Authority.

Airfields, beacons and radio ranges are ideal guides to enemy airmen. Indeed, they have been developed for the sole purpose of guiding our own pilots. Consequently, successful blackout of aids to air movement assumes great importance.

When the situation requires that certain areas be blacked out regularly, air travel in those areas must be severely curtailed if not suspended. Buildings, control towers, shops, air landing fields (including runway, boundary and other special lights) should be blacked out by methods already described. Wing tip, tail and landing lights should not be used by planes on the ground. Positive communications or actual remote control should be provided to assure prompt cut off for airway beacons and all other air navigation facilities including radio, whether federally or privately owned and operated. All loading and refueling should be done inside light proof buildings with light locks or under light proof canvas or metal boards. Concrete runways should be coated with asphalt or paint in order to eliminate surface reflection. Motor traffic to and from an airport should be more carefully supervised and restricted than elsewhere lest a well blacked out airport be outlined and emphasized.

Measures for deception such as devising what appear to be street patterns crossing the airport may be resorted to when there is any real need therefor. Installations for defense against hostile air landings should be coordinated with the blackout plan so that if such landings are attempted sufficient light can be provided to permit active defense measures.

In areas not regularly blacked out the requisite planning involved is considerable. Such areas should be prepared to restrict lighting on short notice. This may involve changes in the destination of airships on airlines coming into the area, immediate grounding of local ships, extinction of beacons and silencing of radio beams.

APPENDIX I

Bibliography

A. American Publications.

Andrews, W. Earle, and Richard M. Bennett, "Defense Plan for the City," *The Architectural Forum*, Vol. 73, No. 5 (November 1940), pp. 409–428.

Anonymous, "Bird's Eye Planning: A New Factor in Industrial Planning Design? Protection Against Air Raids," *Architectural Record*, Vol. 88, No. 3 (September 1940), pp. 74–79.

Goodman, Percival, "Defense-Time Planning for Peace-Time Use," *Architectural Record*, Vol. 88, No. 5 (November 1940), pp. 95–98.

Iverson, E. F., "Air Raid Protection; Data, Drawings, and Photographs," *The Architectural Forum*, Vol. 73, No. 5 (November 1940), pp. 429–436.

B. British Publications.

NOTE.—Material relating to blackcuts appears in a number of Air Raid Precaution publications and in the British Standard Specifications, ARP series. Selected references are given below. Information as to the availability of publications can be secured from the British Library of Information, 620 Fifth Avenue, New York, N. Y.

Ministry of Home Office and Home Security, Air Raid Precautions Department (London: His Majesty's Stationery Office):

Factory Ventilation in the Blackout. (Factory Forms 33–9999.)

Lighting During Blackout Hours in Shipbuilding and Ship Repairing Yards. (Misc. ARP 34–292.)

Memorandum cn Aids to the Movement of Traffic to be Installed in Roads and Streets in the Absence of Street Lighting, 1939, 11 pp.

Ventilation in the Blackout, 1940, 8 pp.

Wartime Lighting Restrictions, Lights Carried by Road Vehicles, 7 pp.

Wartime Lighting Restrictions for Industrial and Commercial Premises, 1939, 12 pp.

Wartime Lighting Restrictions, Shops—Window Displays and Illuminated Signs, 1939, 8 pp.

Your Home as an Air Raid Shelter, 1940, 24 pp. Statutory Rules and Orders (London: His Majesty's Stationery Office):

Restrictions on Lighting (1941 No. 625, Emergency Powers, Defence), 2 pp.

Glover, C. W., Civil Defence (London: Chapman and Hall, Ltd., 3d ed.), 1941, 822 pp. See especially Lighting for Refuges, pp.169–173; Obscuration of Light, pp. 586–608; Lighting Restrictions, pp. 684–686.

APPENDIX II

Type Specifications for Blackout Materials and Devices

In each Civilian Defense area, specifications for materials and equipment prescribed for the area should be prepared well in advance and kept up to date. An ample number of copies, sufficient for all possible users, should be prepared and distributed. In general, the specifications should be as short and simple as possible. Reference should be made to applicable parts of U. S. Government specifications and those of the American Society for Testing Materials, the Illuminating Engineering Society, and similar trade organization specifications. These trade bodies should be consulted in preparing a specification under which members of their associations will furnish supplies, to insure that requirements are possible of fulfillment without excessive cost or unnecessary difficulty. Wherever possible, typical arrangements, details, and other matters should be shown in the form of generalized illustrations rather than long wordy descriptions. Specifications should be given permanent designations taken from blocks of numbers assigned for groups of related subjects. Each should be dated and state what prior similar specification it supersedes.

The following is an outline summary of the contents of a typical British Standard Specification (classified as BS ARP 3 August 1939):

Title.—Electric Hand Lamps.

1. *General.* This Specification covers electric hand-lamps for general use out of doors or in buildings in which the windows, roof-lights, etc., are not screened. It does not apply to hand-lamps specifically designed for use in inflammable gases or vapours (e. g., coal gas, petroleum vapours).

(NOTE. The ordinary flashlight does not comply with this Specification.)

2. *Construction.*—(*a*) The lamp shall be strong, but of as light a construction as is compatible with adequate mechanical strength and suitability for continuous outdoor use under any weather conditions.

(*b*) The design of the lamp shall be such that the battery, bulb and switch are housed in one unit and shall permit rapid replacement of both the bulb and the battery. Provision for carrying a spare bulb is desirable.

(*c*) The lamp shall be capable of being fitted on the person at chest height by straps, hooks or other suitable means in such a manner as to leave both hands free.

(NOTE. It is not desired that the lamp be fitted to the head.)

3. *Switch.*—The switch shall be capable of being operated by a simple movement and shall have positive "on" and "off" positions; it shall, as far as possible, be designed to prevent inadvertent operation. Devices for varying the intensity of light, for altering the focusing during use, or for extinguishing the lamp if it is inverted shall not be incorporated.

4. *Battery.*—The battery may be either of (a) the dry-cell type, in which case the closed-circuit voltage shall not fall to less than two-thirds of the initial open-circuit voltage after the lamp has been in continuous operation for six hours; or (b) the "unspillable" storage battery type, in which case the light output shall be maintained without material diminution when the lamp is in operation continuously for a period of not less than six hours.

5. *Direction of Light.*—The design shall be such that the light emitted by the lamp is so directed and screened that when the lamp is placed in its normal operating position 4 feet above the ground no direct light from any part of the lamp (including any reflector, etc.) is visible at any point more than 3 feet above the

ground at a distance of 10 feet from the lamp. The lamp shall not be fitted with movable shutters or screens of any kind.

6. *Intensity of Light.*—The intensity of the light emitted by the lamp in any direction shall not exceed 1 candle-power. With the lamp in the position referred to in Clause 5 the intensity at all angles up to 60° from the vertical shall be not less than ½ candle-power in the forward direction, and not less than ¼ candle-power at all angles within 45°, measured horizontally, of the forward direction. For the purpose of this test the bulb and battery shall be new, and the lamp shall have been in continuous operation for one hour before the test is made. The light shall be white.