

CHAPTER 5

STORAGE OF SPECIAL COMMODITIES

Section 1. LUMBER

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5-101. General

The information and instructions in this section are designed to aid personnel performing lumber storage and handling operations.

Note. Further technical data with respect to lumber storage can be found in MI L-HDBK-7, *Lumber and Allied Products*. That portion of section 6 of the handbook, dealing with Handling and Storage of Lumber is superseded by this regulation.

a. *Storage and materials bundling.* The advances made in the mechanized handling of lumber have changed storage and handling methods. The development of handling equipment, such as forklift trucks and 'straddle carry trucks, that can be used to stack, unstack, and transport lumber, has brought about revolutionary changes; the most notable being the handling of lumber in packages. Regardless of whether lumber is handled by mechanized equipment or by manual labor, the objectives of storage and handling are unchanged.

b. *Objective of storage and materials handling.* The objective of lumber storage is to maintain the lumber at or bring it to a moisture content suitable for its end use with a minimum of deterioration. The objective of lumber handling is to load, transport, unload, stack, and unstack lumber economically and, without damage. Both of these objectives are obtained easily if good handling and storage

practices are followed. Adequate protection of lumber in storage will help prevent attack by fungi or insects and changes in moisture content, which encourage checking, warping, twisting, and stain in lumber and make it unsuitable for the intended use.

c. *Condition of lumber placed in storage.* The condition of lumber placed in storage, with respect to moisture content and possible fungus infestation, has an important bearing on the subsequent qualities of the lumber over long periods. Fungi (wood rot) and subterranean termites infecting wood are retarded in their growth when the moisture content of the wood is lower than 20 percent, however, dry wood termites, powder post beetles, and other wood borers can develop successfully in well dried wood. Lumber may be treated with a **preservative** in accordance with section 5 of MI L-H DBK-7 to prevent infestation for longer storage periods. If infestation occurs during drying, the fungus will continue to live in a dormant state for months or years after the wood dries and resume activity if moisture content again becomes high enough. A key to preventing deterioration during long storage is to eliminate infestation during drying and keep the wood dry in storage. All lumber must be checked thoroughly at time of receipt for moisture content and fungus infestation before storage. The preparation for storage and the type of storage will be

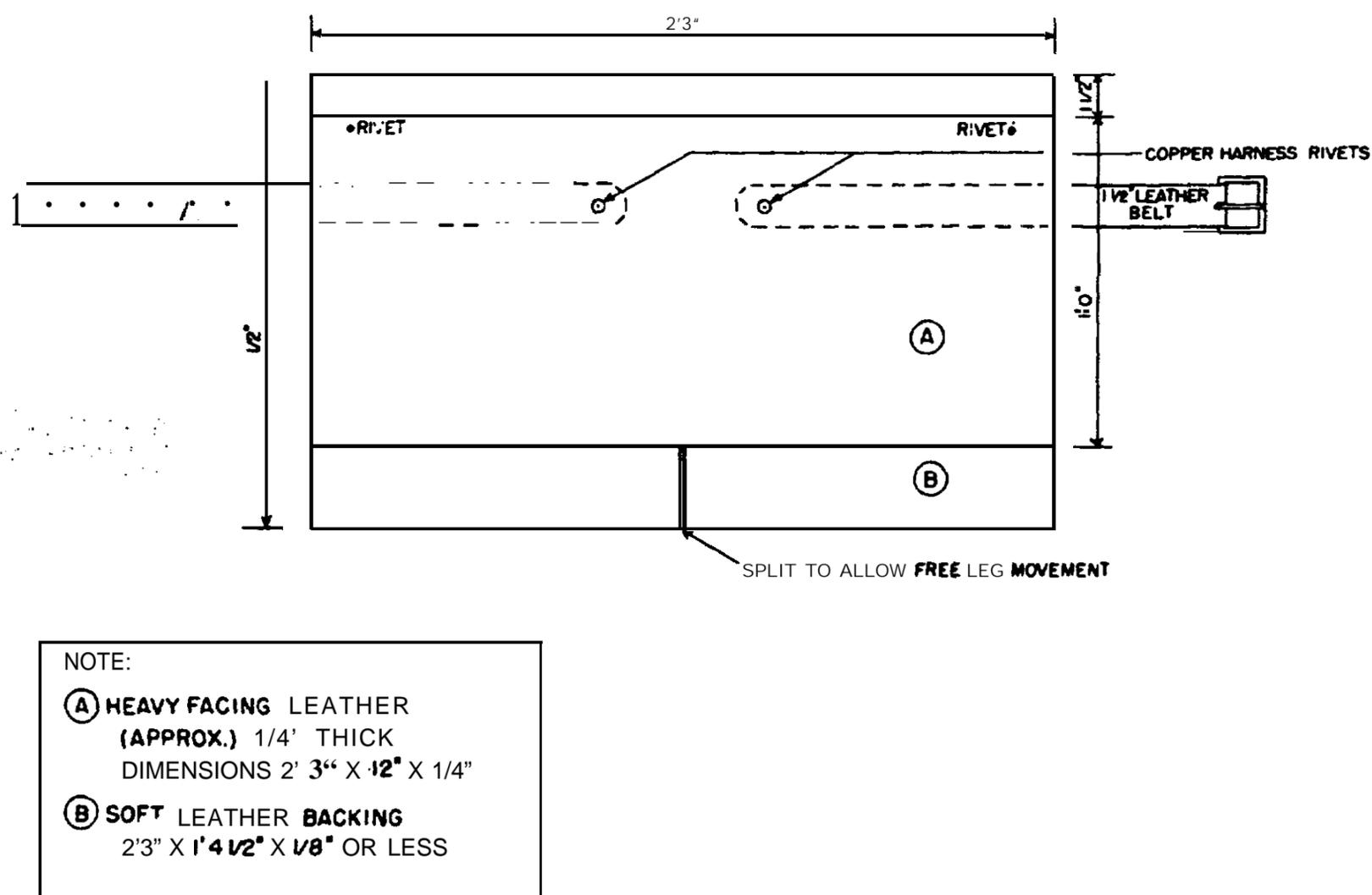


Figure 5-1. Diagram of leather apron for use in the handling of lumber.

based upon the results of these checks, It is important, especially when lumber is received in drafts, to choose drafts from different parts of each shipment and disassemble the drafts for examination; unless this procedure is followed the condition of the lumber inside the draft cannot be ascertained. Lumber presents unique problems in storage. Special piling methods are necessary to provide proper ventilation to prevent deterioration of the lumber. The method of stacking each shipment of lumber must be determined by competent personnel.

d. *Protective equipment.*

(1) **Lumber apron.** The lumber apron for use in lumber handling should be constructed in accordance with the specifications outlined in figure 5-1. The apron should consist of a soft leather backing faced with heavy leather three-sixteenths of an inch or more in thickness. The two pieces of leather should be riveted together and supported by a belt 1 1/2 inches in width or wider, to insure adequate distribution of the weight of the apron and lumber being handled to prevent cutting or chafing. This apron is to protect lumber handlers from injury from slivers or splinters.

(2) *Protective gloves.* Gloves that provide adequate protection from slivers or splinters must be worn by lumber handlers.

5-102. Handling Methods

a. *Receiving.* Lumber is normally received as strapped units on gondolas, flatcars or trucks. The use of automatic and hand applied strapping and

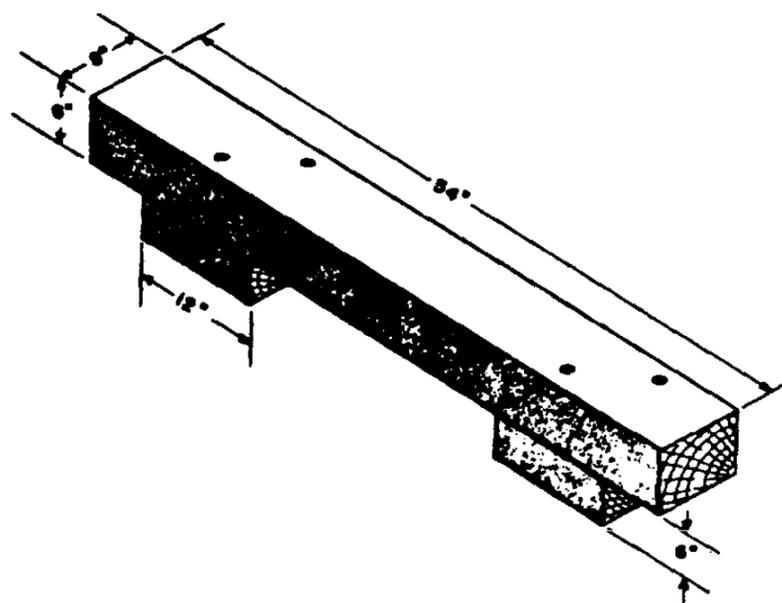


Figure 5-2. Diagram of bolster for use with 57-inch straddle carry truck.

improved handling equipment has nearly eliminated handling boards one at a time. When lumber is unitized and loaded as specified in MIL-L-14362, Unitizing and Loading of Lumber, the lumber may be moved by crane, forklift, straddle carry truck, or **sideloader**, eliminating manual handling. (chap. IV, sec 2 depicts MHE.) Lumber received in this manner should be placed on bolsters for transport. When drafts do not meet requirements for storage because of moisture content, improper snickering or other causes, the units should be reunited (in accordance with **para 5-103**) to correct the deficiencies prior to being placed in storage.

b. Bolsters.

(1) Bolsters should be constructed in accordance with specifications shown in figure 5-2, except that the width of the straddle carry truck if used, will determine bolster length. In selecting timber for bolsters, care should be exercised to select solid straight grained wood, as bolsters will be subject to excessive strain in the lifting and transporting of materials. Hardwoods are preferable for construction of bolsters; however, when hardwood is not available straight grained Douglas fir or larch may be used.

(2) As the lumber is placed in storage, the empty bolsters are removed and stacked for return to loading/unloading sites. These stacks are prepared by placing two or more bolsters in position for pick up and solid piling other bolsters across them. Each successive layer of bolsters is cross piled to bind the stack securely for stability while being transported.

5-103. Formation of Lumber Drafts

a. General. The handling and transporting of lumber in drafts and stacking lumber in drafts have become accepted practice throughout the lumber-producing and wood-using industries. These practices have brought about changes in yard layout and in stacking methods. Although the principles of good air-seasoning have not changed, a certain amount of adjustment is needed to conform to the more modern handling and stacking methods.

(1) When lumber is stacked for air drying in the form of drafts, the type of snickering will be determined by the seasoning required. Drafts for yard drying vary between $3\frac{1}{2}$ and 4 feet, with 4 feet the most common width, and 3 to 4 feet the average height. The width of the draft will be determined by the width of the lumber and the fork

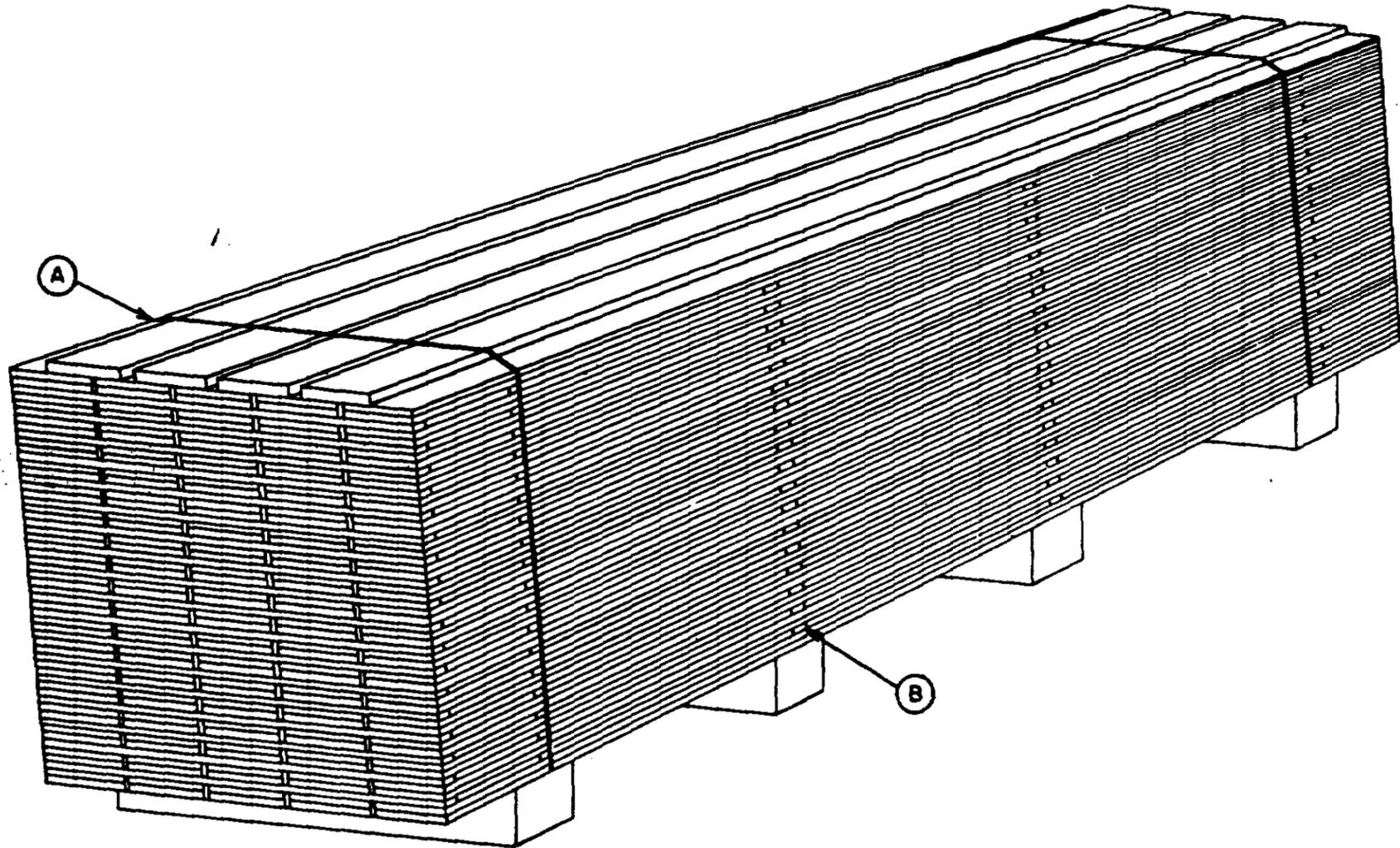
capacity of the lift equipment. The forks normally available will handle drafts approximately 4 feet in width. Stacks of unitized lumber generally are considerably narrower than handstacked piles. This tends to increase the drying rate of lumber stacked in drafts over lumber stacked by hand.

(2) Uniform size of boards in a draft is desired so that each draft of the same material will contain exactly the same number of board feet (fig. 5-3). This will eliminate many of the problems encountered in the issue and inventory of lumber products. This applies to every size of lumber handled. When it is absolutely necessary to make up a draft of random lengths, the lumber should be sorted by length and unitized with the longest lumber placed on the bottom of the draft, and the balance of the lengths grouped by length in the draft in length sequence.

b. Assembling a lumber draft.

(1) *Construction of butt boards.* The butt boards should be constructed according to specifications in figure 5-4. The 4- by 4-inch piece used for the flat base should be oak. The base should be nailed together with 16d spirally grooved, screw-type nails. Metal corners or angle irons will help reinforce the base and are essential if Douglas fir or other soft wood is substituted for oak. The angle on the butt boards is designed to give a forward pitch to each draft of $1\frac{5}{8}$ inches to each 12 inches in height. Since the slope of the stack foundations from front to rear is 1 inch for each 12 inches of length, this provides five-eighths of an inch pitch per foot in height in the completed stack. Should the slope of the lumber beds vary from 1 inch of slope in 12 inches of length, an adjustment to correct the pitch can be made easily by starting with a line perpendicular to the ground, then giving a forward pitch of five-eighths of an inch to each 12 inches of height plus the slope of the lumber bed. For example, suppose the slope of the foundation on which the lumber will be placed is $1\frac{1}{2}$ inches in each 12 inches of length. The slope forward on the butt board will then be $1\frac{1}{2}$ inches plus five-eighths of an inch in each 12 inches of height of the butt board. This equals $2\frac{1}{8}$ inches forward slope or pitch of the butt board in each 12 inches of height. For each 10 feet of height from the bottom of the first draft, the stack will project forward $6\frac{1}{4}$ inches at the top beyond the end of the bottom board.

(2) *Anchoring of butt boards.* Once the position of each butt board is established, it should be an-



DRAFT DATA

STRAPPINGS A

ITEM ① R WND, STEEL, GALV. 10 GA.

ITEM ② FLAT STEEL 1/4" WG. 035 GA.
(ITEM@ FIRST CHOICE)

SNICKERING B

ITEM ③ LATH SIZE 1 1/2" X 1/2" @ 4S'

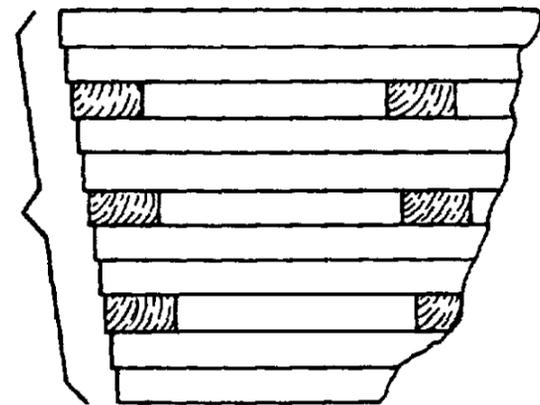
ITEM ④ STOCK SIZE 2" OR 3" X 3/4" X 48"

NOTE 1,
LUMBER WHICH HAS A MOISTURE CONTENT OF 19% OR LESS IS TO BE STICKERED AT EACH 8" OF HEIGHT

NOTE 2
LUMBER WHICH HAS A MOISTURE CONTENT OF 24% OR ABOVE IS TO BE STICKERED BETWEEN EACH LAYER. STOCK STICKERS ONLY (ITEM@) ACCEPTABLE FOR LUMBER IN THIS CATEGORY

NOTE 3
LUMBER WHICH HAS A MOISTURE CONTENT BETWEEN 19% & 24% IS TO BE STICKERED BETWEEN EACH TWO LAYERS OF MATERIAL 1/2" THICK OR LESS AND EACH LAYER 1/8" THICK & ABOVE

NOTE:
1 5/8" PITCH FOR EACH FOOT OF HEIGHT



| STANDARDS FOR LUMBER | | |
|-----------------------------|---------|---------|
| | MINIMUM | MAXIMUM |
| DRAFT WIDTH | 40" | 48" |
| DRAFT HEIGHT | 36" | 48" |

Figure 5-1. Diagram outlining draft requirements for outdoor storage.

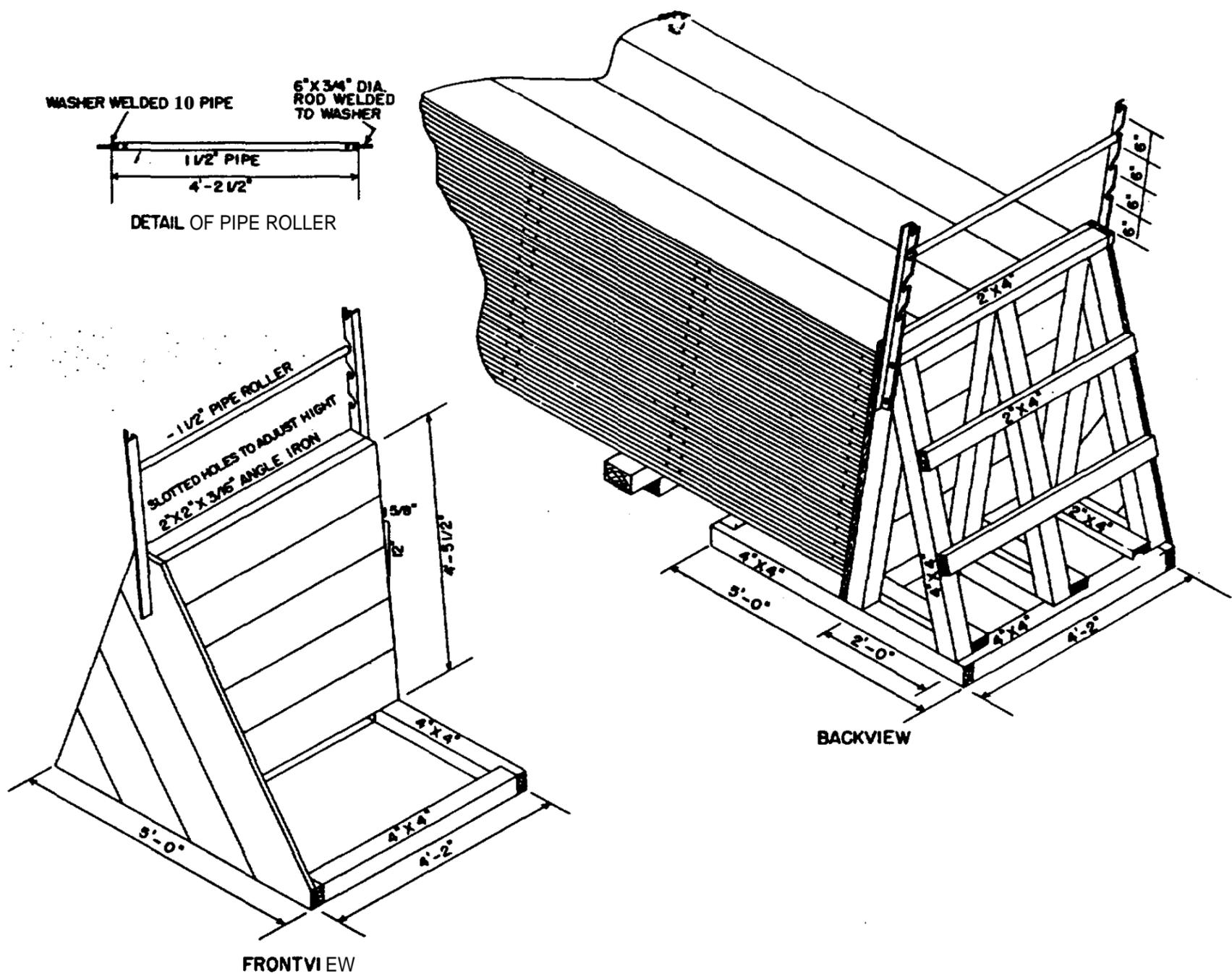


Figure 5-4. Diagram of butt boards used to control pitch on draft face.

chored **firmly**. This can be done by driving iron rods into the ground at points where pressure will be exerted or by nailing pieces of 2-inch stock to the butt board, extending these pieces to the platform, and nailing the pieces securely to the platform. To assist in stabilizing the butt board, a 2 by 4 is sometimes placed across the base flush against and, parallel to the face of the butt board. In this way the front end of the draft should just clear the forward straddle carry truck bolster so that a portion of the weight of the **front** end of the draft rests on the 2 by 4. It is essential that each butt board remain in exactly the same position once a draft of lumber is started to obtain the correct pitch and uniform face on each rick of lumber.

(3) *Placing and alignment of stickers.* The proper alignment of stickers in each draft of lumber

is necessary to prevent warping and bowing. Proper alignment is also necessary to assure vertical columns of stickers from top to bottom of the storage stack when the stack consists of several drafts (fig. 5-5). When placing stickers, the first stickers should be against the butt board. This will give an inverted stair step appearance to the face of the completed draft and will cause water to drip from the front of the pile instead of seeping in. The sticker will retard end drying and tend to prevent end checking of the lumber. The second sticker should be placed 12 inches from the front of the pile and the balance of the stickers positioned at 5-foot 4-inch intervals directly over pile foundations, as shown in figure 5-5. The only variation in the sticker spacing will be in the stacking of hardwoods or other lumber prone to warp. Sticker spacing for these lumbers will be on 2-foot 8-inch centers.

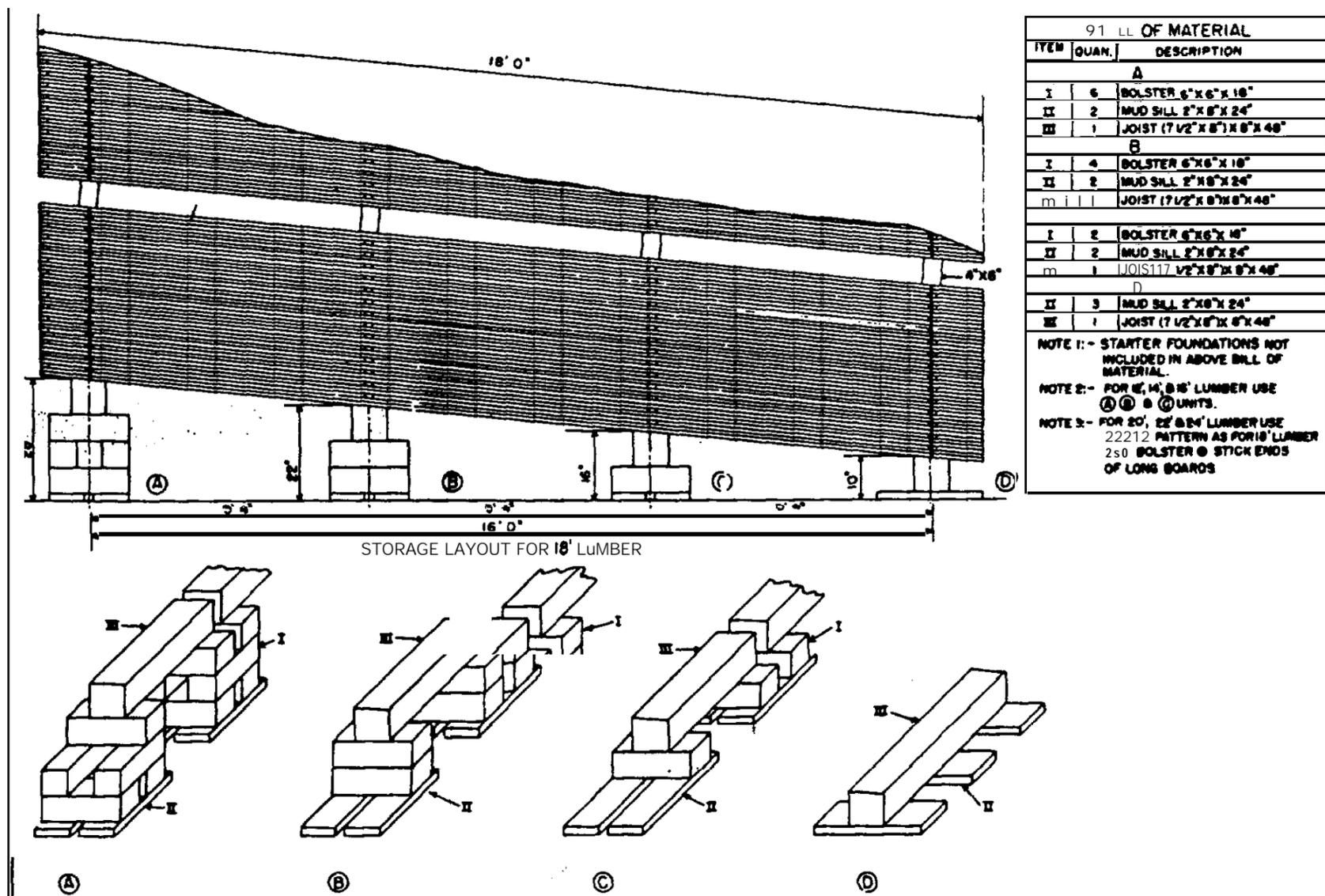


Figure 5-5. Diagram of properly stickered and formed drafts of lumber stored on wooden block foundation.

(4) *Sticker guide.* The sticker guide (fig. 5-6) is essential in the formation of drafts of lumber. Its basic function is to guide the placing of stickers so that the stickers will provide vertical columns of support for the lumber over each foundation support timber. Sticker guides must be constructed to function in conjunction with the butt board to give the column of stickers the same degree of pitch as is maintained on the face of the pile. Otherwise, the proper stacking of drafts of lumber is impossible as sticker alignment between drafts could not be maintained. Sticker guides should be constructed to provide the longitudinal sticker spacing shown in figure 5-5, except that, at activities where the standard storage plan has not been implemented, foundation spacing will determine sticker spacing. However, under no circumstances will sticker spacing exceed 6 feet.

(5) *Sticker construction and care.* Stickers may be made from any species but preferably from **heartwood**. Sapwood is undesirable, as it may harbor stain organisms. All stickers must be sound,

dry, free from stain and decay, of uniform thickness, and must be of sufficient width to support the weight of the pile without crushing the stickers or causing compression marks in the face of the lumber. Stickers, when not in use, should be protected from the weather to be kept dry and ready for future use.

(6) *Snickering requirements.*

(a) *General.* Lumber when received may be partially green, partially air dried, or thoroughly seasoned. To establish snickering requirements, the moisture content of the lumber must be determined.

(b) *Snickering of lumber when moisture content exceeds 24 percent.* Partially green lumber, or lumber with a moisture content of 24 percent or more, requires a greater amount of air circulation within the draft to remove this excess moisture as rapidly as **possible** to avoid possible stain and rot. Lumber with a moisture content of 24 percent and above will be stickered between each layer with stickers 2 or 3 inches wide by three fourths of an

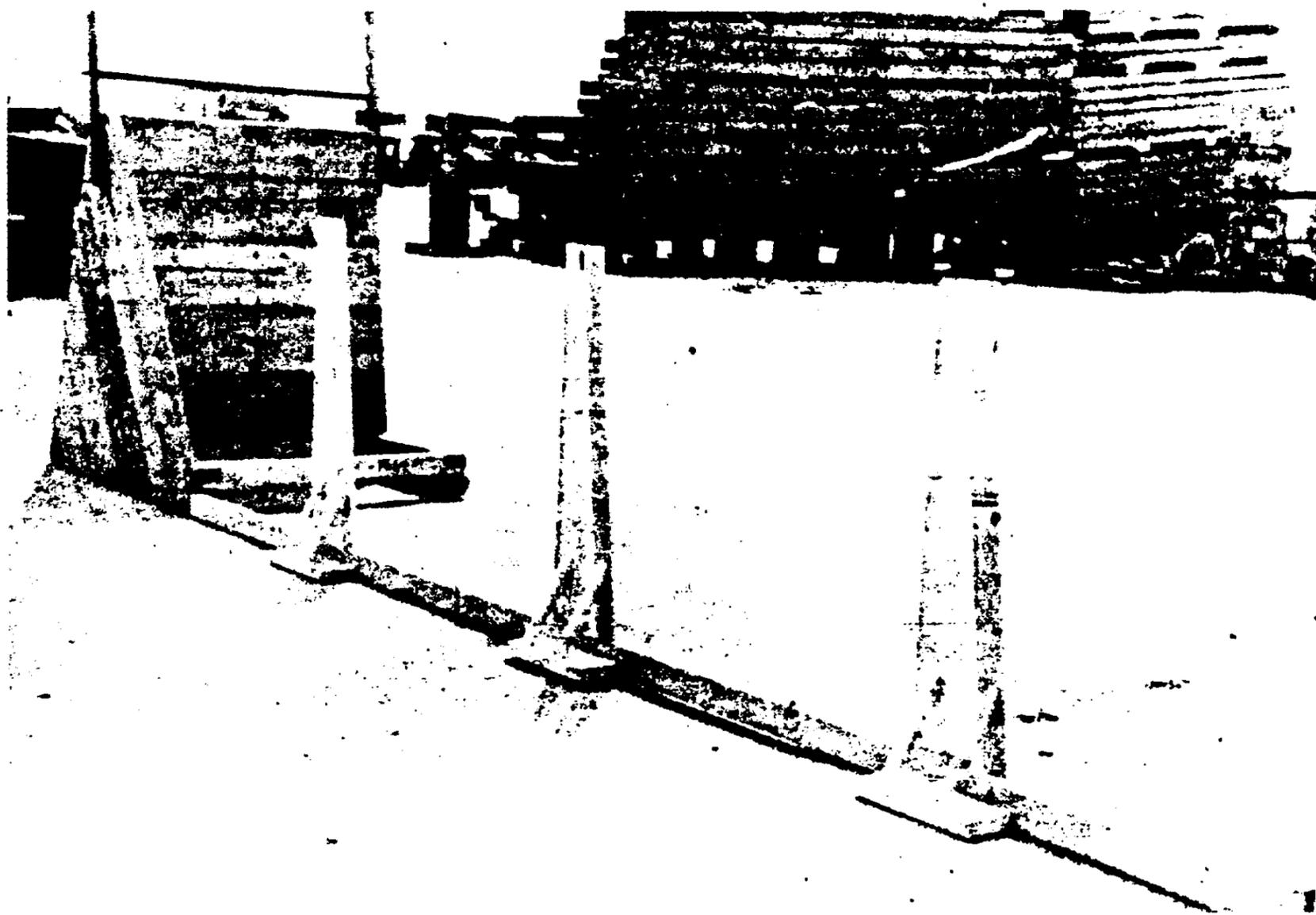


Figure 5-6. Sticker guide and butt board ready for use.

inch thick and of sufficient length to fully support each course of boards. Hardwoods $1\frac{1}{4}$ inches and over in thickness with a moisture content of 24 percent and above which are to be stacked in open storage for air drying will be stickered with 1-inch or thicker stickers. Hardwood is a slow-drying wood and should be well ventilated to speed drying and prevent stain and rot in these premium type woods.

(c) *Stickering of lumber having 20 to 23 percent moisture content.* Lumber with a moisture content between 20 and 23 percent does not require as much drying as green lumber and consequently requires less air circulation within the draft. This lumber will be stickered with lath ($1\frac{1}{2}$ by $\frac{1}{2}$ by 48 inches) between each two layers of material $1\frac{1}{2}$ inches thick or less and between each layer 1% inches **thick** and above. However, hardwoods having a moisture content between 20 and 23 percent, which are being placed in open storage for continued air seasoning, will be stickered with 1 or 1%- by

%-inch stickers of sufficient length to adequately support each board and prevent warp.

(d) *Stickering of seasoned lumber.* Drafts of seasoned lumber having a moisture content of 19 percent or less maybe placed directly into storage and stickered at sufficient intervals to stabilize the draft.

(7) *Air drying of lumber.* The air drying of lumber is dependent upon the temperature, the relative humidity of the outdoor air, and the extent air is caused to enter and circulate within the stack so that it reaches each individual board.

(a) *Air flow.* Air, at any condition below 100 percent relative humidity or moisture saturation, possesses the ability to take up moisture from green lumber. Air that enters a stack becomes cooled as it takes up moisture from the lumber and, as its temperature decreases and relative humidity increases, it loses its ability **to** dry the lumber. As a consequence, if drying is to continue, the air within the stack must be replenished by ejecting the sat-

urated air and admitting fresh drier air. This is accomplished by natural horizontal and vertical air movements. Horizontal movement within the stack is brought about by differences in pressure between the two sides of the stack caused by prevailing winds, while **vertical** movement is brought about by the increase **in** density of the air within the stack as the air is cooled. Since it has been established that the horizontal movement of air within a lumber stack is the principal means of accomplishing drying, it is highly important that channels for this **movement** be **provided**. Vertical movement in itself **accomplishes little drying** except in the case of squares or when stock is stacked on edge, but vertical movement through interior spaces induces horizontal air movement across the faces of the boards from which most of the evaporation of moisture occurs. Horizontal movement of air **within** the stack takes place through the spaces formed by the stickers. Spaces for the downward movement of air are obtained to a minor degree in the draft from the natural openings between the board edges; however, the major provision for the downward movement of air is the between-stack-spacing. The wider these spaces, with respect to the total width of the stack, and the smoother the vertical sides of the spaces, the greater will be the passage of air through them. Edge-to-edge stacked boards, in drafts **3½** to 4 feet wide, with good stack spacing in the rows are comparable to boards in a wide hand-stacked **pile** with **chimneys** at several foot intervals. In this manner, the spacing between the stacks acts as a chimney to carry the damp or saturated air down, thus stimulating horizontal movement of air within the draft.

(b) **Effect of stack height on air drying.** The effect of stack height on drying rate is similar to that of stack width. Increasing the stack height tends to retard drying, particularly in the lower parts of the stack. The air traveling downward in a stack becomes cooled and approaches saturation at a point higher up in a **tall** stack than in a short one, unless the air is replenished by horizontal movement as it moves downward. Tall stacks also tend to restrict general wind movement at the ground level of the yard. Lumber stacked in the form of drafts may range from about 4 to 20 feet in height. Movement of air through the 6-inch between-draft spacings will increase to some extent air circulation at the lower levels of the stacks.

5-104. Binding of Lumber Drafts

a. **Binding requirements.** Each draft of lumber, which is assembled for storage or shipment, should be bound with an appropriate binding. Binding of the draft is necessary to prevent movement of lumber during handling operations. Shifting of the lumber could alter the pitch on the draft face or cause the dislocation of stickers and the subsequent distortion of the lumber in the draft. Bindings must be placed directly over the stickers in order to secure a tight binding and to prevent distortion of the lumber. Also, binders placed other than over the sticker ends will tend to **force** the lumber in the draft together, thus closing any edge spacing between board edges which will restrict the vertical flow of air through the **draft** and retard drying. Bindings should be over the second and last sticker in each draft, as shown in figure 5-3. Lumber, which is to be transferred immediately from unloading point to point of use, will not require binding or snickering except as desirable to stabilize the draft for transportation purposes.

b. **Binding materials.** Binding should be either 10-gauge round steel galvanized **wire** of $\frac{3}{4}$ by 0.023-inch. type I or IV flat steel strapping in accordance with **QQ-S-781**. Corner protectors are not required in the binding of lumber, as the bite of the binding will tend to hold the binding in place over the stickers.

5-105. Marking of Lumber Drafts

Each draft of lumber should be properly marked prior to final storage. Marking should include stock number, board feet, and the date and year received. For example, lumber received on 11 July 1977 would be dated 192/77 (**192d** day of 1977). Marking lumber will facilitate issue and inventory and will make it possible to issue the oldest lumber first. Lumber received from other activities is issued according to the original receipt date noted on the marker tag which should be placed on the front or pitched end of each draft. Thus, lumber received **from** another activity would be issued prior to lumber in stock if the marker tag indicated it was the older lumber. Adoption of this standard method of marking and dating lumber will aid in preventing the retention of old lumber in storage. Tags for the marking of lumber must be weather-resistant and capable of withstanding long periods of outdoor storage without becoming unreadable. Typed or handwritten paper tags, sprayed with a clear liquid

plastic coating, may be used. Suitable diptype plastic coatings are also available. Tags made of embossed aluminum or other weather-resistant materials may also be used.

5-106. Open Storage

a. Yard location and surface. Preferably, the storage yard is located in an area where the lumber is received, shipped, or used. The best location is on high ground that is level, well drained, remote from water, bodies, or wind obstructing objects, such as tall trees or buildings. A low site is likely to be sheltered from the full sweep of the winds and can cause dampness which may retard drying and promote stain and decay. The ground surface should be kept free from debris and vegetation. Debris harbors stain and decay organisms and obstructs the movement of air over the ground surface and beneath the lumber piles. Vegetation can be controlled by applying crude oil, salt, or weed killers. Covering the ground with cinders, gravel, shells, or crushed stone will retard the growth of vegetation. Yard surfaces should be firm and smooth for the operation of lumber handling equipment. Rough terrain causes additional wear and tear on the machines and may cause injury to operating personnel. Also, such conditions may cause displacement of

stickers and boards in the draft being transported and may impede the accurate placement of the draft during stacking operations.

b. Yard layout. A yard for storage of lumber is laid out in blocks separated by aisles (fig. 5-7). A well-designed yard facilitates the movement of lumber and the taking of inventories. The yard layout is affected by the size and shape of the available area and by the equipment used for transporting and stacking. Aisles in yards where the lumber is machine-stacked are usually 24 to 30 feet wide, the optimum being 24 feet. The aisles provide routes for transporting lumber, permit the movement of air through the yard, and serve as a protection against the spread of fire. The rows of lumber in machine-stacked yards run at right angles to the aisles with the boards parallel to the aisle. Storage blocks should not exceed 10 stacks in depth, preferably stored in combinations of 5-5, 7-3, or 6-4 stacks in back to back storage. The direction of the main aisles, those from which the stacks are built or taken down, generally is established by the nature of the yard site. Whether main aisles run parallel with or at right angles to the direction of the prevailing winds probably will not affect ventilation and air movement through the yard due to cross aisles which run at right angles to the main aisles.



Figure 5-7. Yard layout.

To permit rapid drying of aisles after a rainstorm or the melting of snow, it is advantageous to run the main aisles north and south. To increase air circulation within the stacks an **aisle** 2 to 3 feet in width should be maintained between the rows of stacked lumber (fig. 5-8). This between-rows aisle will be of valuable assistance in issue and inventory functions. The stack and aisle layout plan (fig. 5-9) for shed and open storage has been prepared to assist storage personnel in planning yard layout. The storage area is laid out to utilize the truck and **railroad areas as main** or longitudinal aisles with **24-foot cross** aisles intersecting the storage area at approximately 50-foot intervals. This is sufficient storage depth to permit stacking five stacks deep in back to back storage. See chapter III, section 3, for stock numbering techniques.

c. Foundations, general. Flat piling is satisfactory for inside storage but it is recommended that **all out-of-doors** stacks be given a reasonable amount of slope. Slope facilitates runoff when water leaks through or blows in at the sides of the stacks. This aids in keeping the lumber dry, thus preventing development of conditions favorable to the growth of stain, decay, and attack by insects. When lumber is stacked in drafts by forklift truck, changes in stack foundations over those used for hand stacking are necessary. Also, efficient utilization of the fork truck in stacking operations requires that the drafts be stacked parallel to the aisles rather than at right angles. The top of the foundation must afford at least 1 inch of slope for each lineal foot of length. At most activities, the sloping of stacks of unitized lumber is common practice. The foundations of all stacks, except the last stack of a row, must be

spaced or arranged to permit the entrance of the fork truck. For this reason, long stringers cannot be used successfully as foundations for draft stacked lumber, especially for the center foundation,

d. Portable lumber foundations. The application of the portable lumber foundation for lumber storage is illustrated in figure 5-10. The stability of these foundations is obvious and they afford sufficient ventilation beneath the stack for drying purposes. The foundation is composed of creosote treated timber to prevent deterioration. The portable lumber foundation is spaced on 5-foot 4-inch centers (fig. 5-11). This spacing of the foundation, constructed as shown, produces the desired slope and is sufficient for the storage of most species of lumber. However, hardwoods and some other types of lumber require additional foundation support to prevent bow and warp during the drying process. This portable foundation can be increased easily from a 4- to a 7-point foundation to accommodate hardwood drafts stickered in accordance with paragraph 5-103. This increased support is achieved by placing an additional foundation unit midway between units A, B, C, and D shown in figure 5-5. The unit between is erected the same as the lower of the units which it separates and the required increase in height is obtained by placing a 3-inch thick spacer between the joist and the bolster.

e. Component parts of the portable foundation. The portable foundation consists of three component parts-6- by 6- by 18-inch blocking (7½ by 8 in) by 8- by 48-inch joists, and 2- by 8- by 24-inch mud sills (fig. 5-12). Utilization of these mud sills produces a bearing surface of approximately 11 square feet for each unit stack, which is sufficient

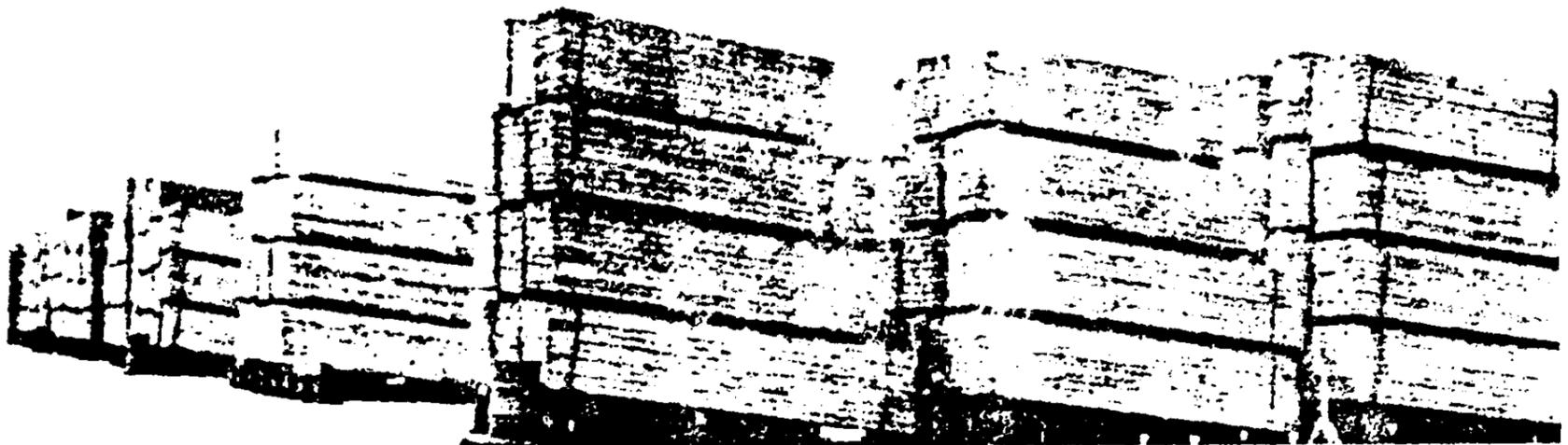
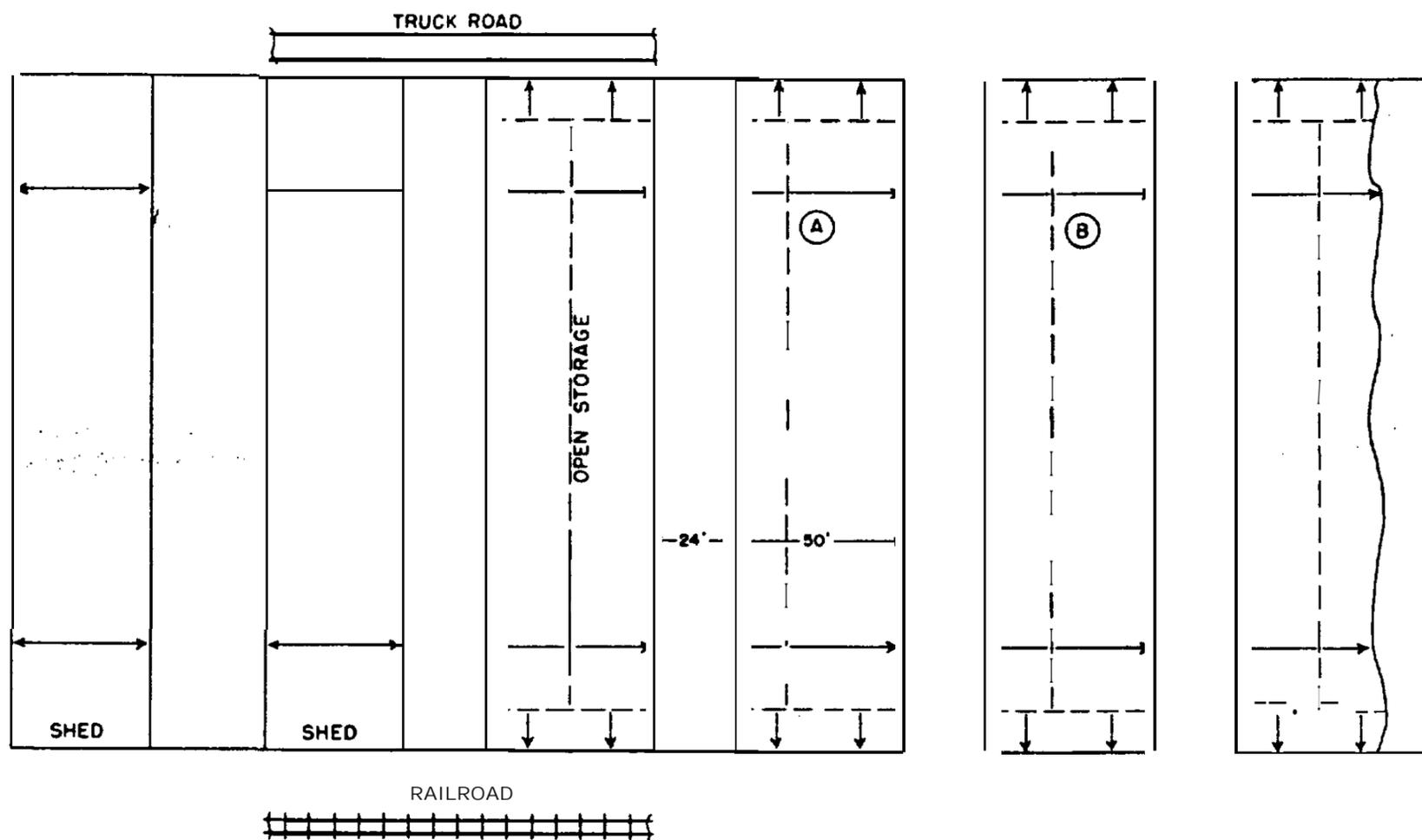


Figure 5-8. Two-foot aisles maintained between rows of stacked lumber to facilitate flow of air through the lumber yard.



THIS RELEASE IS INTENDED TO ILLUSTRATE SEVERAL DESIRABLE FEATURES WHICH SHOULD BE CONSIDERED IN PLANNING LUMBER YARD LAYOUT. IT SHOULD BE NOTED THAT THE TRUCK AND RAILROAD AREAS ARE UTILIZED AS LONGITUDINAL AISLES. ALSO THE STORAGE AREAS ADJACENT TO THESE AISLES ARE USED FOR SMALL LOT STORAGE. THE STORAGE AREAS BETWEEN CROSS AISLES ARE 50' WIDE, WHICH IS SUFFICIENT TO STORE TWO LOTS, FIVE STACKS DEEP, IN STACK TO ACCESS THESE AREAS MAY ALSO BE UTILIZED TO STORE VARIOUS QUANTITIES OF LUMBER BY STORING LOTS IN COMBINATIONS OF 6-4 OR 7-3 PILES PER LOT, AS ILLUSTRATED IN AREAS A AND B. SUFFICIENT AREA ADJACENT TO THE RAILROAD SHOULD BE UTILIZED FOR UNLOADING OPERATIONS TO PERMIT LUMBER TO BE SORTED AND PLACED IN DRAFTS, AT CAR SIDE, AS IT IS UNLOADED. TRUCK UNLOADING AND SORTING AREAS SHOULD BE ASSIGNED ACCORDING TO ACTIVITY REQUIREMENTS.

Figure 5-9. Diagram of yard and shed layout.

to support maximum unit load stacks on yard surfaces that will withstand the normal operations of heavily loaded fork trucks. These foundations are removed easily and unitized as lumber storage decreases thus permitting easy readjustment or layout of the lumber storage area. To facilitate storage operations, foundation components should be unitized in the quantity required to store an average car load of lumber and placed at strategic locations throughout the lumber storage area. Foundations not required for immediate use, except those strategically located about the yard, should be stored in one central location by component type.

5-107. Stack Spacing and Roofing Protection

a. Horizontal spacing.

(1) *General.* Although stack spacing will vary with different situations, stacks of stickered or solid piled drafts of lumber should not be placed too close

together. Circulation around the stack is necessary if drying is to take place in lumber which is above an air-dry condition and to prevent dry lumber from picking up moisture from stagnant, humid air pockets.

(2) *Spacing between stacks of unitized lumber.* Lateral spacing between stacks should be 6 to 12 inches. Vertical passages or flues are somewhat more difficult to build into drafts of lumber than in the relatively wider hand-stacked piles. The need, however, for building flues into drafts 4 feet or less in width has not been demonstrated. The sum of the width of flues in hand-stacked piles equals about 20 percent of the width of the stack. Flues within the drafts should not be required if 6 to 12 inches are allowed between the sides of the stacks of unitized lumber in the yard. With this arrangement, movement of air in the spaces adjacent to the stacks will induce horizontal movement of air through the draft and accomplish drying. When drafts are

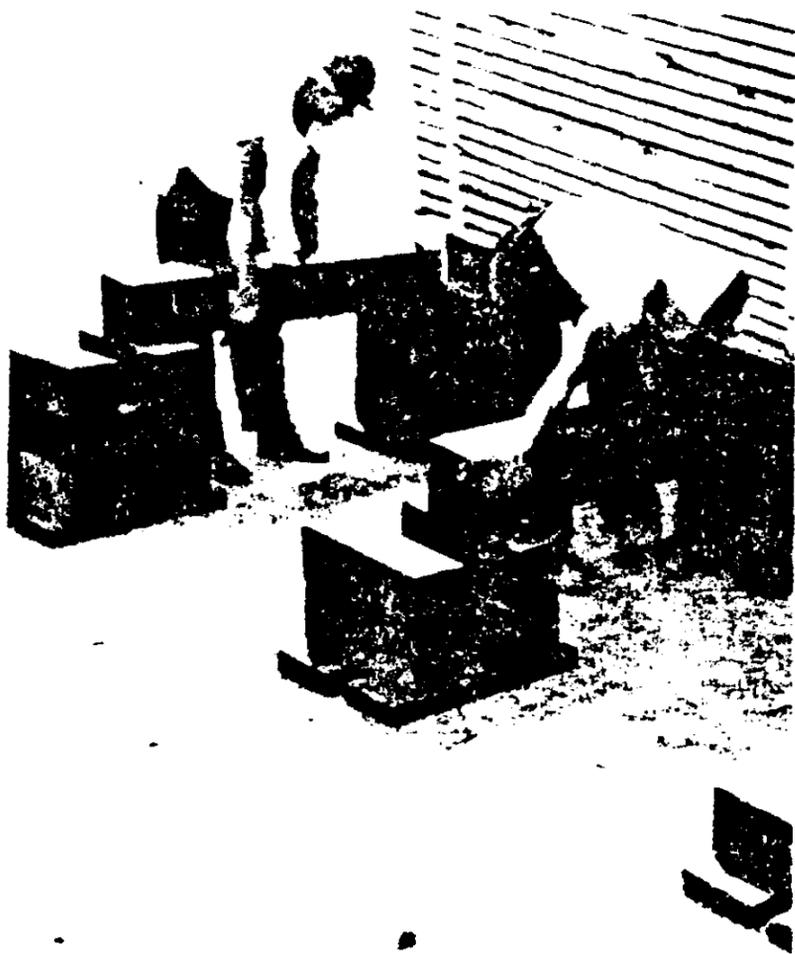


Figure 5-10. Application of the portable lumber foundation.

stacked in this manner, the spacing between the stacks takes the place of flues built into hand-stacked piles; this space, therefore, should equal **approximately** 20 percent of the unit stack width.

(3) *Spacing of storage rows.* Generally, at machine-stacked lumber yards there are no rear aisles, and spaces between the ends of the stacks are provided by spacing the rows. Spaces between rows of unitized lumber stacks vary from 2 to 3 feet in air-drying yards. Here **also**, it is not feasible to recommend an optimum spacing, but a spacing of 2 to 3 feet should be sufficient at stack ends to induce sufficient air currents between, through, and under the stacks to carry off moisture saturated air.

b. Vertical spacing.

(1) *Space required for use of forklift trucks.* Spacers (dunnage) used in connection with the stacking of lumber in drafts may be considered to be a part of the stack foundation. When a draft of lumber is picked up or set down, space for the insertion or removal of the forks must be provided. Usually, this space is about 6 inches wide in slope stacked lumber, but may be narrower when the new

model of forklift truck is used. These newer trucks have an arrangement for tilting the forks through an angle of 5° for picking drafts from sloped stacks of lumber; however, tilting mechanism is not required if 6-inch spacing is maintained between drafts.

(2) *Placing of spacers.* When building a stack of prepared drafts of lumber, the spacers are placed (directly over the stickers) on top of each draft or on top of the upper one when handling two at a time, before stacking. Of course, this need not be done with the lower draft of the stack where the top is reached readily from the Wound. When the stack is completed, the channels caused by the placement of these spacers provide additional area for air passage through the stack. Thus, these passages conceivably may counteract the disadvantages of the relatively high stacks usually found in mechanized lumber yards.

c. Roofing protection for stacks. Lumber which cannot be stored under cover should be protected from the weather by adequate roofing. Roofing should be placed on the top draft and lashed down prior to placing the draft on the stack. A good roof always has been considered an essential feature of good air-drying practice. A roof shields the stack from direct sunshine and precipitation, particularly the upper lumber courses, and to a lesser extent, the lower part of the stack. Without a roof, the upper courses of lumber become warped and checked, and rain is permitted to penetrate the stack from the top or to drive in from the ends and sides. A leaky roof will afford protection against direct sunshine but will permit water to wet the upper lumber courses and to penetrate the stack. To afford maximum protection, a roof should project 12 to 18 inches at the ends of the stack and approximately 6 inches over the sides.

(1) *Staggered board protection method.* A good low-cost roof, adequate for lower grades of lumber, dimension stock, or lumber which will not remain in storage for a long period of time, can be built into each draft as it is formed. To form this roof, one piece of lumber is left out of the top layer and the remaining lumber is staggered or placed so that each board covers an opening between the tiers of lumber (fig. 5-13). Thus, moisture is prevented **from** entering the draft and the two layers of each unit load becomes the roof. Since drafts are built with a 1%-inch pitch per foot of height and stored on foundations which provide 1 inch of slope per



Figure 5-II. Portable lumber foundation spaced on 5-foot 4-inch centers.

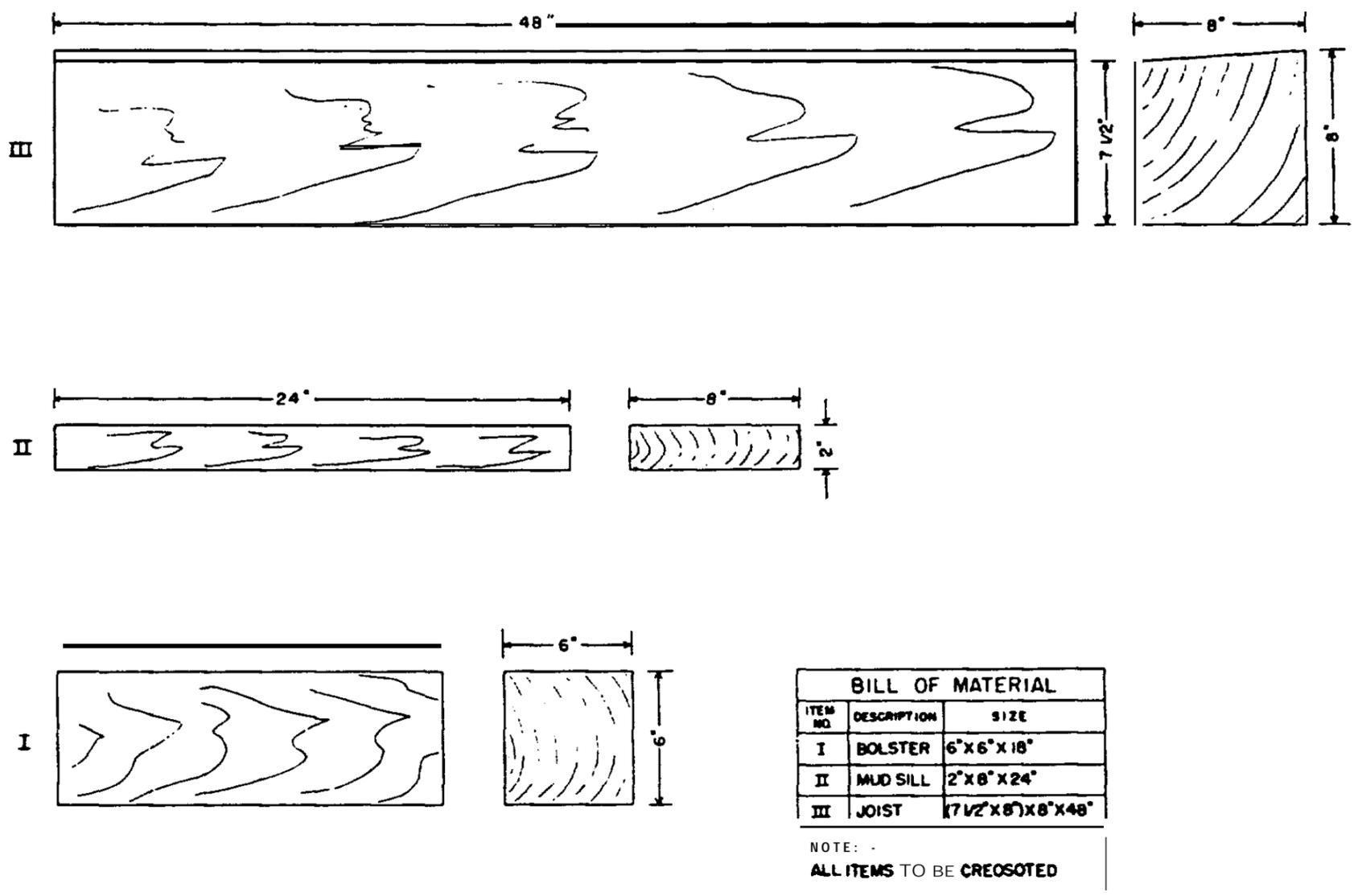


Figure 5-12. Diagram of lumber foundation components.

lineal foot, this roof will afford good protection for normal storage requirements. This roof does not afford quite as much protection from the weather as roofs with extended ends and sides, however, this is compensated for in several ways; for example, lumber is always roofed and cannot be accidentally left **uncovered**; permanent roofs are not maintained or stored when not in use; man-hours are not expended in subsequent roofing operations; and, as unit loads are bound, additional lashings are not **required** to keep roofs in place.

(2) *Paper or roll roofing protection method.*

Building paper or roll roofing may be combined with boards to form a roof. The paper or roofing provides watertightness, while the boards support the paper or roofing in a flat sheet and permit the roof to be anchored to the stack. The boards in this type of roof should be laid in a single layer and, roughly, edge to edge. The boards forming the front and rear portions need not be overlapped but can be butted over a central **crosspiece**. Since this type of roof is tight, the pitch can be flatter than one composed of a double layer of overlapping boards. The use of a combination of building paper or roll roofing and boards probably is more applicable to stacks of unitized lumber than to **handstacked** piles. The paper or roll roofing can be laid in strips, running either crosswise or lengthwise of the stack. When laid crosswise, the strips should be **lapped** like shingles and held down by three or more tie pieces running lengthwise of the stack. When the strips are laid lengthwise, a tie board should be placed over each lap. This type of roof consists of a double layer of boards with paper or roofing between. The boards of each layer are laid with several inches between

the edges. With a roof of this type, there would not be a need for the boards to overlap. There is a wide variety of papers and roofing on the market, and the choice of a suitable material should be based on the life of the material with reference to the length of time the stack is to stand in the yard. It is probable that the most economical way would be to discard the paper or roofing when the stack is taken down.

(3) *Other protection methods.* Boards, roofing, plywood, panels, corrugated aluminum, metal sheeting, and other roofing materials also may be combined to form roof panels. The panels may be used singly or doubly in the length of the stack. In all cases the roof should be raised several inches above the top course of lumber to permit movement of air between the roof and the top of the stack. Special roofing should be used only when lumber such as oak and other high grade lumber is to be stored for long periods of time for air drying or when, because of unusual conditions, thoroughly seasoned lumber must be placed in open storage.

5-108. Covered Storage

a. Sheds-open. An open shed may be likened to a storage yard with a roof. In covered storage, however, lumber may be stored on level foundations, 12 inches in height, as these stacks will not be exposed to rain or snow and will not require slope to accelerate moisture runoff. The open shed is advantageous for the storage of surfaced lumber or the better grades of lumber which are to be held in storage for a long period of time. Lumber having a moisture content in excess of 20 percent, which eventually will require covered storage, may be

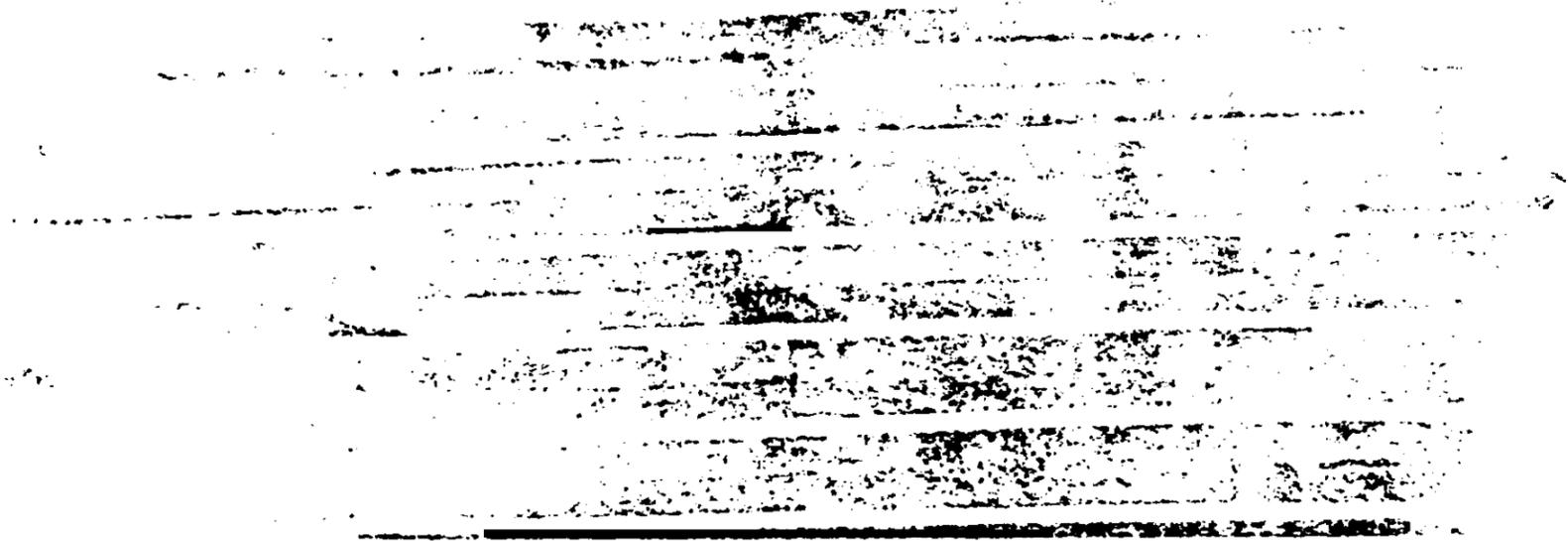


Figure 5-13. Method of building a roof into a draft of lumber.

sticker piled and placed in open shed storage for air drying, as open shed storage has approximately the same drying qualities as an open lumberyard. Lumber is placed into and removed from open sheds from the open sides thus, the areas adjacent to the shed are **utilized** as working aisles. Stocks may be stacked from the center of the shed out, in back to back storage or, completely through the shed, depending on quantity and similarity of stocks stored. Surfacing requirements for open sheds are similar or equal to those required for open lumber storage areas.

b " **Sheds—closed.**

(1) *Uses for closed sheds.* Closed sheds are used primarily for the storage of well-seasoned or kiln-dried lumber, plywood, molding, frame stock, and other show-type lumber intended for special use where end use moisture content requirements will be 12 percent and less. The objective during storage is to prevent the lumber from absorbing atmospheric moisture. For this reason, it is advantageous to stack lumber and other items solidly with only sufficient stickers to stabilize the stack or to designate quantities, grades, or items of stock.

(2) *Floor surfacing.* Closed sheds should be provided with floors, preferably concrete, asphalt, wood block, or planking. Loose surfacing is not too satisfactory and, earthen floors, particularly if the shed is located on a low damp site, may increase the moisture within the shed. For this reason, closed sheds should be located on dry well-drained sites. Ventilation of the shed should be provided by adequate and adjustable openings in the walls. Stack foundations in closed sheds should be high enough to permit air to circulate beneath the stacks. Stagnant air underneath the stacks probably would accumulate excessive dampness and thus, increase the moisture content of the lumber in the lower part of the stack. If the floor is earth or surfaced with some loose-surfacing materials, the stack foundations should be about 12 inches in height. When the shed floor is surfaced with concrete or other hard surfacing, a clearance of 4 inches beneath the stack is sufficient.

(3) *Heating of closed sheds.* The efficiency of a closed shed in maintaining a low moisture content in lumber and other items for **high-grade end** uses is increased greatly if heat is available when weather conditions require it. When a source of heat is available, a low relative humidity within the shed and consequently, a low equilibrium moisture

content for the lumber can be maintained by increasing the shed temperature 10° to 20° F. above the outdoor temperature. The heating system should be arranged so that the temperature throughout the shed is uniform.

5-109. Storage of Special Items

a. Storage of shooks. Shooks should be stored under cover, preferably near the main packaging areas. Many activities find it beneficial to procure shooks instead of box lumber for the majority of standard box requirements. Shooks can be procured in open-end contracts and delivered in the quantities required for normal operations. Thus, storage space is required for only a 30- to 60-day supply of each type shook. This reduces lumber storage yard requirements and, proportionately, the need for stack foundations, stickers, **bolsters**, pile spacers, butt boards, box manufacturing machinery, and the intradepot hauling of lumber.

b. Storage of lignum vitae. Lignum vitae is a greenish brown, hard, and heavy wood. Usually, it is stocked as blocks or logs. There is only one correct method of storage for **lignum vitae**, which is to store submerged in fresh water. There are various satisfactory methods of underwater storage. One method is to drive the U-or I-bolt into the end of the logs or blocks, attach the bolt to a cable and place in any pond or other body of fresh water. In the absence of natural water storage facilities, ponds or tanks must be prepared for the submerged storage of this wood. When **lignum vitae** is stored in tanks or ponds, it is not necessary that the water be changed as stagnant water will protect this wood as well as water that is constantly being changed. Lignum vitae quickly becomes unsuitable for use if stored exposed to the air, therefore, another method will not be substituted for the submerged storage of this material.

c. Storage of plywood. Plywood will normally be in a dry condition when received and should be stored in a closed shed, particularly when the plywood has interior **gluelines**. For prolonged storage, a heated storage **building** is recommended. Plywood is commonly solid piled. Under humid conditions, there is some tendency for edges to swell because of exposed end grain, and this swelling causes **dishing**, especially in the upper panels of high piles. Dishing can be minimized by placing stickers in the pile at intervals. Enough stickers should be used so that plywood will not **bend** between them. Dry

1-inch strips are suitable for snickering plywood.

d. Storage of timbers. Moisture content itself is not of major concern for timbers. The objectives in timber storage are to prevent serious deterioration and at the same time accomplish slight drying. Timbers held in open air storage are subject to checking, splitting and **warping**. They are also subject to decay. Checking, splitting and warping are associated with shrinkage, stresses generated by the drying of the outer portions. Decay can result where infection takes place in those portions of **timbers** that are exposed to moisture and air. In **large timbers**, end checks may occur that are likely to develop into splits that may extend a considerable distance along the length of the timber. Surface checks are generally of minor importance except where they develop into the relatively large cracks that are likely to occur in boxed-heart timbers. Timbers may decay in storage because of fungi that were in the living tree, or infection may start during the storage period. Decay may start on the surfaces of timber in **solid** piles because surface drying is retarded; or in surface checks or splits into which rain or snow water penetrates.

(1) *Outdoor storage of timber.* Timbers stored in piles outdoors are usually exposed to sunshine and wetting because it is impractical to provide roofs. Timbers stored outdoors should be **end-coated** for protection from end-checking. If the coating is applied before end-checking has started, it will greatly retard the drying of the **end-grain** that causes checking and splitting. The various types of **antisplitting irons** that are used commonly on railroad ties may be used on timbers to prevent the opening up of splits that may develop from end checks. Timbers stored outdoors should be piled so that the air has access to all faces. The timbers in each layer, of course, should be placed several inches apart, and the courses should be separated by 2 by 4's. The stickers should be spaced 6 to 10 feet apart. Pile foundations should slope, and the pile of timbers should be built with a forward pitch much like hand-stacked piles of boards or dimension lumber.

(2) *Open shed storage of timbers.* Timbers stored in an open shed are subjected to practically the same atmospheric conditions as timbers stored outdoors, but they are protected from sunshine and wetting by the roof of the shed. Piles are level, rather than sloped and pitched.

e. Storage of poles and piling.

(1) Storage methods are identical for poles and piling. Items treated with preservatives should be close piled. Checks may expose untreated wood to infection by decay, fungi and attack by insects. Partially treated material, such as butt-treated poles, needs the same type of storage as untreated material. The foundations of piles for untreated poles should be of the pier-and-beam type and should support the first layer of poles at least 18 inches above the ground. The foundations, if wood, should be constructed of the **heartwood** of decay-resistant species, such as cypress, cedar and redwood, or of pressure-treated timbers of any species. Concrete piers also are satisfactory.

(2) In **figure 5-14**, the poles are piled parallel to one another, and for the most part, in contact with one another. Cross pieces 4 to 6 inches in diameter are placed as stickers to separate the pile by groups of six layers each. This method of piling is the so-called **crib type**, and is used in localities where the decay hazard is not high.

(3) In a method of piling, known as the **cross-hatch type**, the poles in adjacent layers are placed at right angles as shown in **figure 5-15**, in which the number of poles in each layer is about the same.

(4) In another method, alternate layers of poles are separated by two tiers of poles as stickers. Under some conditions, it maybe advisable to have several additional tiers of poles as stickers. The more open piling, as compared with the close piling in **figures 5-14** and **5-15**, permits a more rapid drying rate with less chance that stain and decay will develop.

On the other hand, if it is **desired** primarily to reduce checking rather than stain and **decay**, the crib or crosshatch may be preferable.

5-110. Measuring Moisture Content

a. General. **Ordinarily**, the amount of moisture in wood is expressed as a percentage of the weight of the wood when oven dry. The three distinct methods of determining moisture content are the **oven-drying method**, the **distillation method**, and the **electrical moisture meter method**. The latter of the three methods is the most **rapid**, and **does not** require cutting the material. The only accurate and rapid test is by the use of a **lumber moisture meter** (**fig. 5-16**), used in accordance with MIL-STD-1363, Measurement of Wood Moisture Content.

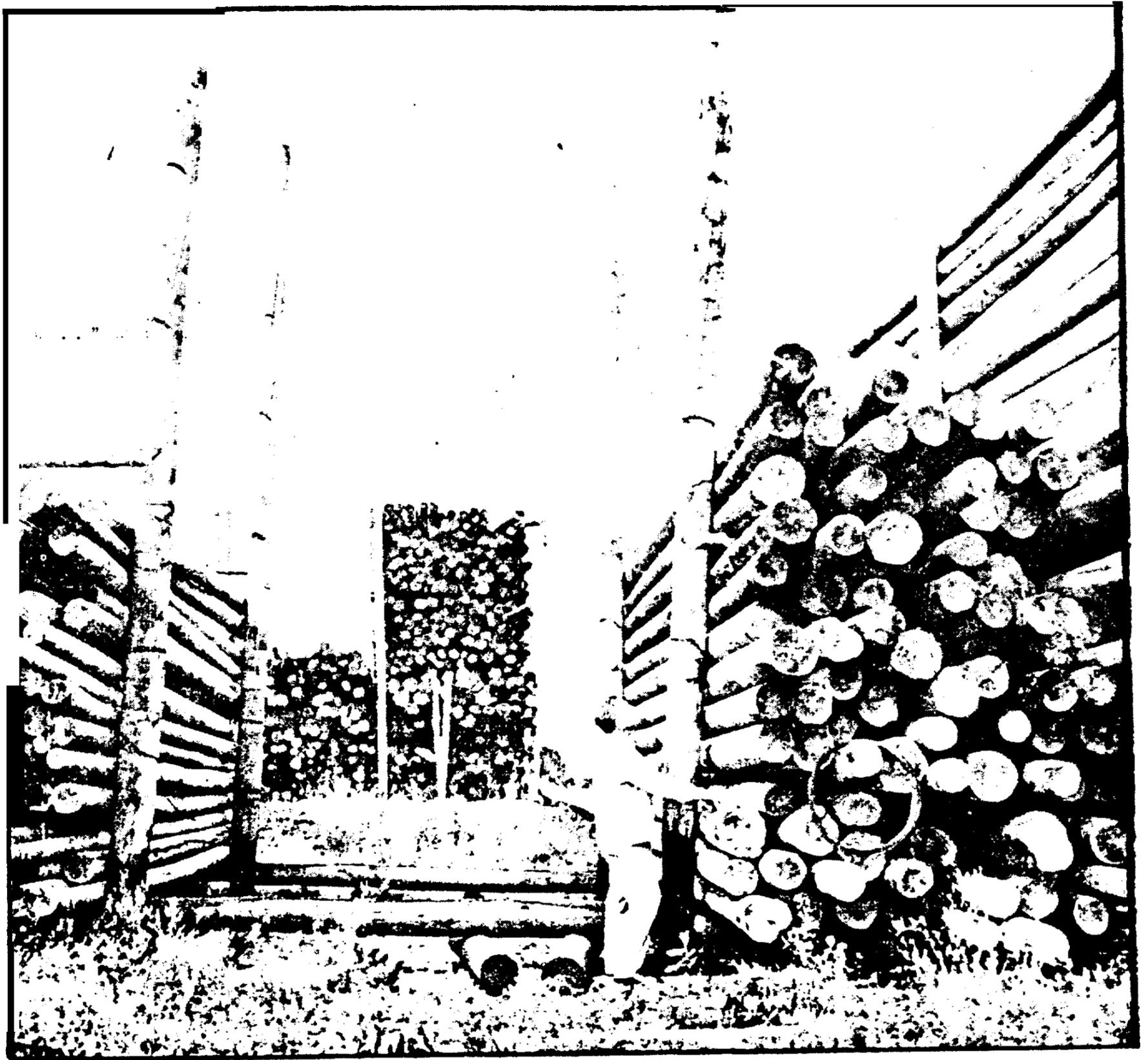


Figure 5-14. Crib method of piling poles.

b. Use of the electrical-resistance method. When the rapid indication of the moisture content of wood is desired for inspection purposes, the **electrical-resistance** method is the most suitable. This method is based upon the well-known fact that the electrical resistance of wood changes with moisture content. Several types of portable electric moisture meters are now on the market. The features common to the meters are two pairs of sharp metallic terminals that can be embedded quickly in the wood, batteries for supplying an electric current through the wood

intervening between the two terminals, and a means for reading the resistance in the electric circuit directly in terms of the moisture content of the wood holding the terminals. Different species of wood vary in their electrical resistance for a given moisture content, and this fact must be taken into consideration in making moisture determinations. Usually, manufacturers supply proper correction factors. The range of the present meters is about 7 to 24 percent moisture content. Moisture meters are now available with **needles** that are insulated

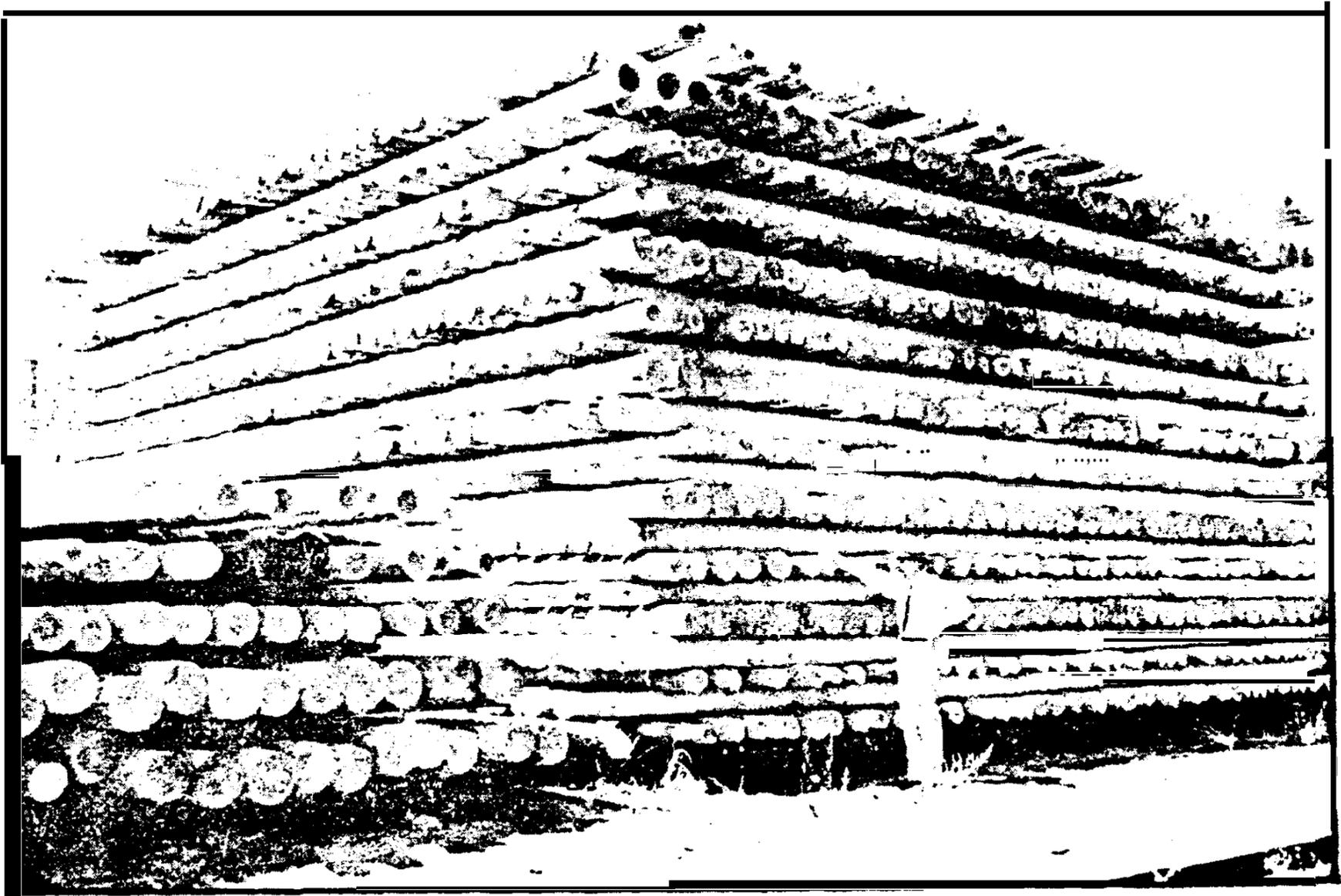


Figure 5-15. Crosshatch method of piling poles with same number of poles in each layer.

with a nonconductive coating except for the extreme tip. The insulated needles are preferred since they can measure the moisture content at various depths within a piece of lumber. The electrical-resistance method has an advantage *over* the oven-drying and distillation methods, principally, because of its speed and convenience as only a few seconds are required to determine the amount of moisture in any piece of wood. It is, therefore, adaptable for sorting lumber on the basis of its moisture content. The moisture content is determined by inserting the prongs of the meter in the back of the piece somewhere near the center. This avoids marring the face of the board when the metallic terminal points are inserted. The electrical methods are the only practical means thus far developed by which the moisture content of finished woodwork in place can be determined without serious injury to the wood.

c. Methods of determining moisture content in

timbers. Since wood acts as a resistance element in the electrical circuit of a moisture meter, the current flowing between electrode needles will follow the path of least resistance which is the path with the greatest amount of moisture. Thus, a meter with uninsulated electrodes **will** show the moisture content of the wettest wood contacted by the electrode needles. Therefore, electrical meters should not be used on lumber that has been recently wet by rainfall since the meter may indicate too high of a moisture content. Meters equipped with insulated needles are preferred. The insulated needles respond only to the moisture content of the wood in contact with the uninsulated tips, hence, it is possible to take readings at different depths to obtain a more complete indication of the moisture distribution. If moisture meters with uninsulated needles are not available, the moisture content at a depth of one-fifth of the thickness of a board will be nearly equal to the average for the entire cross section.

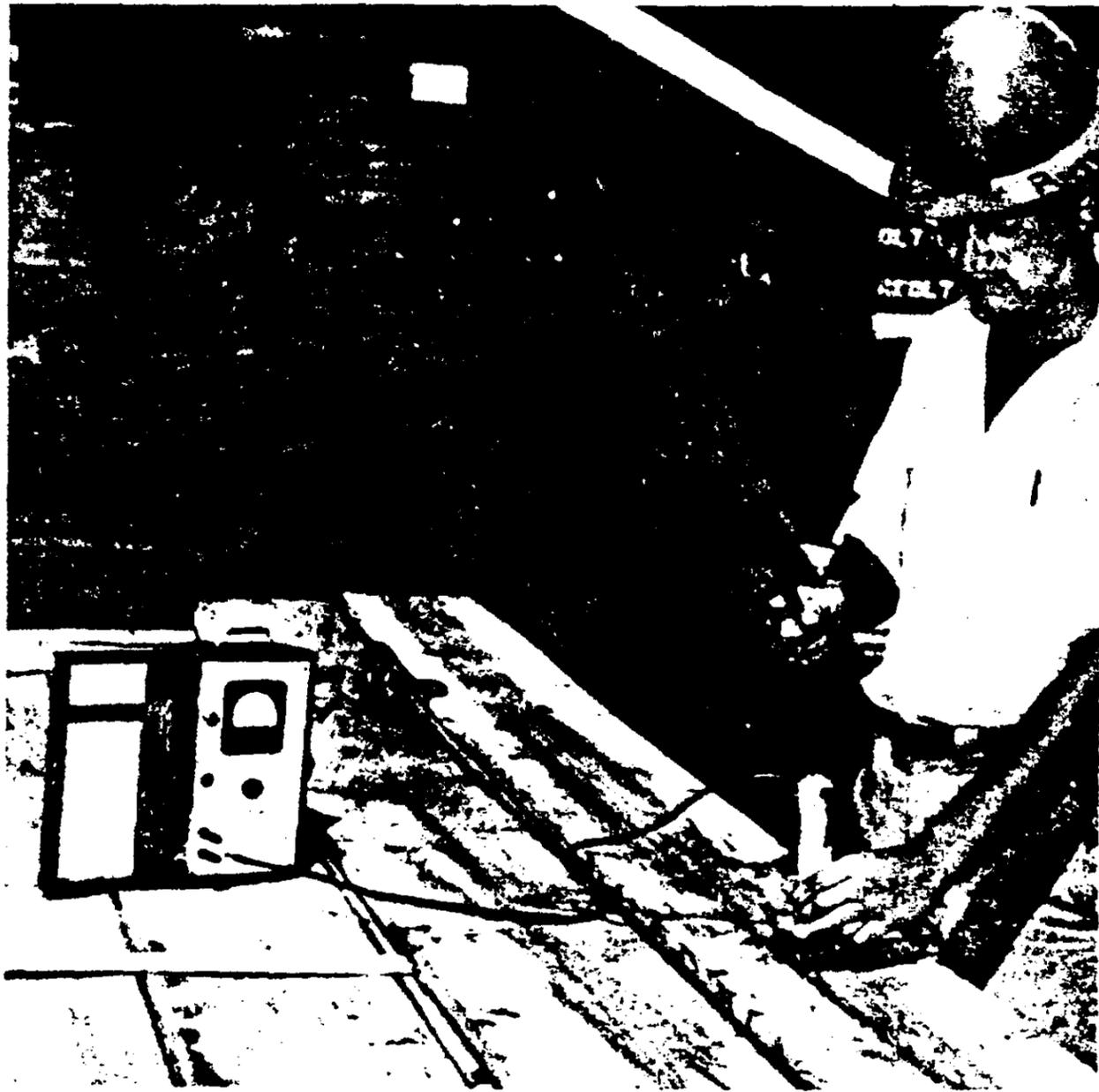


Figure 5-16. Moisture meter being used to determine the moisture content of lumber during unloading operations.

5-111. Kiln Drying

a. **Semidry lumber.** Semidry lumber showing some visible evidence of decay either should be kiln dried to prevent further ravages of decay and then stored in the same way as uninfested dry lumber or, preferably, it should be used up as soon as possible after receipt at the installation. The choice on bundling this type of lumber will depend on the

extent of visible decay.

b. **Wet lumber.** Lumber that is wet and showing visible evidence of decay should be immediately kiln dried to prevent further deterioration. If a kiln is not available the lumber should be used as quickly as possible. If the lumber can be kiln dried, then its subsequent handling will be similar to the handling of semidry infested lumber.

Section 2. AMMUNITION AND EXPLOSIVES

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5-201. Purpose and Scope

The purpose of this section is to establish standard policies and principles governing the receipt, storage and issue, and care and preservation of ammunition and explosives at Department of Defense establishments.

5-202. General

a. These policies and principles are general in nature. Contingencies not covered will require the exercise of discretion and judgement in complying with the requirements of this section. Detailed operational procedures are not included but will be found in the publications of the Military Services. The Department of Defense Explosives Safety Board also publishes information concerning ammunition and explosives. Military ammunition and explosives are products of war and as such are manufactured primarily to kill and destroy. Such products have inherent hazards that affect all handling operations from time of manufacture until expended in service. With a knowledge of the hazards involved, the first and foremost principle that should be considered in any discussion of ammunition storage is that ammunition and explosives must be handled, stored and shipped in a manner that will afford optimum protection against deterioration, accidental ignition and detonation.

b. A comprehensive safety training program should be established and administered at **all** military establishments where ammunition and explosives are stored. Safety organizations should be established for the purpose of supervising a single coordinated Safety Program including Safety Committee activities, accident prevention inspection and **correction** of day-to-day unsafe conditions and practices; employee training programs, publicity, accident cause investigation and first aid training. Diligent and vigorous efforts should be made to prevent and eliminate hazards and unsafe practices. The planning of the handling of ammunition for any reason must be performed carefully and by competent experienced personnel to insure that all hazards have been recognized and that adequate safeguards are provided.

5-203. Facilities

a. Magazine. Any building or structure, except an operating building, used for the storage of explosives, ammunition, or loaded ammunition components (chap. II, sec 1).

b. *Igloo magazine or arch-type magazine.* An arch-type earth-covered magazine which may be constructed of concrete, or metal.

c. *Earth covered magazines-barricaded.* Earth covered magazines which are so located that the earth-covered sides or backs are toward each other, or the front of one magazine with a door barricade is toward an earth-covered side, back, or barricaded front of another magazine.

d. *Earth covered magazines—unbarricaded.* Earth covered magazines which are so located that the front of one magazine without a door barricade is toward an earth-covered side or back of another magazine.

e. *Standard igloo magazine.* An earth-covered, reinforced concrete, arch-type magazine, with or without a separate door barricade, constructed according to approved standard service drawings.

f. *Special type magazines.* Include but are not limited to.

(1) Magazines with steel (instead of concrete) arches and steel, wood or concrete end walls.

(2) Earth-covered, reinforced concrete magazines (such as **Corbetta**, dome or box type).

g. *Above-ground magazines.* Any type of approved magazine which is not earth covered. They may be either barricaded or unbarricaded.

h. *Open storage.* This type of storage is undesirable and should be only an emergency expedient when authorized by the controlling authority

5-204. Storage Plan

A storage plan will be prepared **and** maintained on a current basis by each establishment storing ammunition. The storage plan should include as a minimum

a. The quantity and kinds of buildings in which ammunition and explosives are stored.

b. The quantity distance restrictions on each storage building **and** storage site, **loading** dock, holding

yards and areas, installation rail classification yards, and ammunition work shops and operating sites.

5-205. Warehousing

a. General. Preparation for receipt of ammunition and explosives should commence as soon as it is known that ammunition will be received. Storage comparability charts or tables, explosive weight content of the item and other characteristics of the item being received should be checked prior to determining the storage location for the item. Within the restrictions mentioned above, a storage building should be selected to effect maximum utilization of space. When dunnage is required, a type of dunnage should be selected that will assure stack stability, proper ventilation, and ease in handling and subsequent rehandling of the item.

b. Quantity-distance tables. Quantity-distance tables established by the appropriate Military Service will govern quantities of ammunition or explosives that may be stored in a single location based on the distance the storage site is located from other storage sites, public highways and railroads, inhabited buildings, air fields, runways and boundary lines, utilities and utility lines.

c. Storage computability charts or tables. The factors which determine grouping are; effects of explosion of the item, rate of deterioration, sensitivity to initiation, type of packing, effects of fire involving the item and quantity of explosive per unit. Storage comparability groupings should not be confused with hazard classifications established for quantity-distance requirements. The appropriate Military Service will issue detailed storage computability groupings.

d. Aisles.

(1) Inspection aisles should not be maintained except when specific instructions to the contrary are issued by the controlling authority.

(2) Operating aisles widths in magazines should be adjusted to conform to widths required for specific types of available forklift equipment or other operational needs.

(3) Aisles should be provided for use of handling equipment, inventory, surveillance, or as necessary to distribute the load within the floor capacity, ventilation, etc., as prescribed by the appropriate Military Service. Aisles should not be maintained solely for inventory purposes, however, if storage density will not be adversely affected, storage is to

be arranged to facilitate material inventory whenever possible.

e. Space layout and utilization.

(1) The military services are responsible for publishing instructions in the form of drawings, sketches, narratives or combinations of these media on the approved methods of storage of all types of ammunition.

(2) Having given due consideration to safety and preferred magazine usage, the controlling authorities should establish controls which will assure storage in such a manner that most effective usage of existing storage space will result.

f. Preferred storage for certain ammunition and explosive items. This list is not complete. More details may be obtained from publications of the appropriate military service.

(1) *General.* Ammunition will be stored in accordance with published storage comparability charts or tables.

(2) *Storage of small arms ammunition.* Small arms ammunition may be stored in above ground magazines, providing service security requirements are satisfied. Where there is more than one type available, the type which offers the most protection against fire and pilferage should be selected.

(3) *Storage of bombs with HE components.* Bombs should be stored in approved earth-covered magazines where possible.

(4) *Storage of separate-loading shell or projectile.* Separate loading shell or projectile should be stored in earth-covered magazines where possible.

(5) *Storage of pyrotechnic items.* Pyrotechnic items will be given preferential storage in magazines which are well ventilated, dry and in good repair.

g. Storage aids.

(1) *General.* Ammunition should be stored and shipped palletized to effect a reduction in handling time. For proper grounding of ammunition and explosives while in storage, reference should be made to applicable publications of the appropriate military service. The following methods of palletization are permitted when authorized by the appropriate military service in the handling, storage and shipping of ammunition:

(a) *Unstrapped pallets.* Conventional double-faced pallets.

(b) *Short dunnage.* Short dunnage of varying lengths used as horizontal dunnage in lieu of pallets

and where authorized by the appropriate military service drawings.

(c) *Palletized unit loads.* Applies to an assemblage of a particular commodity, packaged or unpackaged, strapped or tied together in a bundle. When a unit load is strapped or fastened to a pallet, it becomes a "palletized unit load." This method is commonly employed for the storage and shipment of separate loading shell or projectile and should be used to the maximum extent possible for storage and shipment of other items.

(2) *Box pallets.*

(a) *Small quantities* of ammunition may be retained in box pallet storage to meet current issue demands.

(b) Box pallets may be used for storage of irregular shaped, hard to stack and crushable items such as container packed items, fiber containers, bagged goods, loose **small** items, etc.

(3) *Dunnage.*

(a) Dunnage should be placed beneath the **first** layer of ammunition or explosives to keep the ammunition or explosives **from** coming in contact with the floor or ground. The type dunnage is specified on agency storage drawings, sketches **and/or** narratives.

(b) Steel racks which are grounded may be used for storage of separate loading shells, bombs and other cylindrical objects of ammunition.

h. Storage of pilferable ammunition. Appropriate security procedures as set forth in military **department/agency** regulations will be applied for all small arms ammunition, demolitions, and explosives such as blasting caps, igniters, detonators, fuses and related items. The use of special locks and keys is required as directed by the controlling authority. Key and lock control procedures as set forth in appropriate military department/agency regulations will be applied.

i. Storage of ammunition beam-rig security classification of Confidential or higher. The **responsibility** for taking the proper security measures involving the receipt, storage and issue of classified material will rest with the commander of the installation involved. Structural standards, key and lock control and applicable security procedures should conform to standards set forth in DOD 5200. 1-R and appropriate military department/agency regulations.

j. Storing and stacking of dunnage. The storage of dunnage in a permanent open storage site should

conform with the provisions of section 1 of this chapter so far as conditions permit. The location of **dunnage** yards will be governed by regulations published by the appropriate military service.

k. Fusible links on magazines. Fusible links will be listed on the current approved list published by Underwriters Laboratories, Inc., **or** other recognized testing laboratories. The melting point will be between 155° and 165° F. with a minimum rated breaking strength of 20 pounds for the door ventilator link and 8 pounds for the rear-stack ventilator link. Fusible links will not be painted.

1. *Rewarehousing.* **Rewarehousing** of ammunition will be kept to the minimum consistent with safety and operational needs.

m. Termite control.

(1) One method of controlling subterranean termites in ammunition magazines is to provide a layer of poison soil under the slabs or around footings during construction. This principle may also be applied to structures already in place.

(2) Earth-covered magazines will be treated only when vacant. If necessary, one section at a time may be treated.

n. Protection against moisture damage. Every effort should be made to protect wood boxes from excessive moisture, as moisture increases the possibility **of** attack by various types of fungi, **particularly** mildew. Wood boxes of ammunition exhibiting fungi should be stacked on a pallet in a manner that will provide for air circulation around the boxes. Use of dunnage between layers is a method of allowing for air circulation.

5-206. Receiving Rail Cars and Motor Vehicles

Rail cars and motor vehicles containing ammunition and explosives received at military establishments will be inspected for sabotage, mechanical defects and condition of the loading at an established inspection point. All shipments received in damaged or otherwise unsatisfactory condition because of deficiencies such as improper preservation, packing, or marking will be reported on **DD Form 6** (Packaging Improvement Report) in accordance with AR 700-58/NAVSUPINST 4030.29/AFR 71-3/MCO P4030.29A/DLAR 4145.8, or SF 361 in accordance with AR 55-38/NAVSUPINST 461 O.3WU AFR 75-18/MCO 4610.19B/DLAR 4500.15.

5-207. Care of Ammunition in Storage

a. It is the responsibility of the commander of an

installation to maintain stocks of ammunition in an issuable condition. When it becomes known that there is a need to perform a preservation operation, the commander should schedule the operation in accordance with the department policies and in such a manner that required preservation is accomplished with a minimum of delay.

b. Proper type storage for ammunition to afford adequate protection should be selected in accordance with policies and regulations of the appropriate **military** service.

c. **Incoming** ammunition should be inspected to **determine** condition and whether adequate preservative protection has been applied. Those packages of ammunition which have been opened and are being returned to the installation as excess should be cautiously checked to determine further serviceability and preservation requirements.

d. Inspections of ammunition in storage should be made to determine if the preservatives and protective measures are adequate. A definite inspection schedule should be established and pursued,

e. Proper preservation and cleaning methods and procedures will be established and published by each military service.

5-208. Shipping

a. General. Ammunition **shall** be packaged in the containers prescribed by the drawings and specifications for the specific stock number involved. In addition, the individual departments publish standard **carloading** and **truckloading** drawings, sketches and narratives in compliance with Department of Transportation (DOT) and US Coast Guard regulations. Other requirements are specified by AR 55-355/NAVSUP PUB 444 (REV.)/AFM 75-2/MCO P4600. 14A/DSAR 4500.3 (Transportation and Travel Military Traffic Management Regulation)).

b. Preparation for delivery.

(1) Shipping activities will comply with DOT and departmental regulations, whichever are more restrictive.

(2) **All** ammunition shall be loaded in accordance with the applicable outloading drawings and standards. Where such a drawing or standard does not exist, guidance contained in Bureau of Explosives Pamphlet Nos. 6,6A and 6C shall be followed. These pamphlets can be obtained from Bureau of Explosives, Association of American Railroads, 1920 L Street N. W., WASH, DC 20036.

(3) All shipments will be documented and marked in accordance with DOD Regulation 4500.32-R, Military Standard Transportation and Movement Procedures, and MI L-STD-129, Marking for Shipment and Storage.

(4) Certification for shipment by military air will be made on DD Form 1387-2, Special Handling Data/Certification, as set forth in AFM 71-4/TM 38-250/NAVAIR 15-03-500/MCO P4030. 19. For shipment by commercial aircraft, Restricted Articles Tariff No. 6 is applicable.

(5) Authorized deviations from DOT "regulations are issued in the form of special permits. These permits remain in effect for the period specified. Requests for new permits and renewal of existing permits are made through the cognizant Inventory Control Point (ICP).

(6) Ammunition lot integrity should be maintained in storage and shipment from the time of manufacture and assembly through the supply action to troops. Lots should not be mixed in storage and shipment.

(7) Placards should be placed on the outside of both rail car doors, indicating on which side of the rail car the documents are to be found.

(8) Components of DOD will give technical aid and assistance to rail and motor carriers in the event of an incident involving explosives and ammunition. All such incidents will be reported to the agency administering the installation rendering the aid in conformance with regulations of the appropriate military department.

(9) Lumber and nails used for blocking and bracing of shipments will be of the size, variety grade and **specifications** approved by DOT, Bureau of Explosives and the individual department drawings, sketches or narratives.

(10) Adequate safeguards will be taken to insure that ammunition being shipped agrees with the item and condition **specified** on the shipping directives.

(11) Preparation for intransit security should conform to standards as set forth in appropriate military **department/agency** regulations for shipment of **classified** and/or sensitive material.

5-209. Locator System

Locator records will be established at all military establishments where ammunition and explosives are stored. There should be two records established which can be crossreferenced-one should be a **rec-**

ord of each lot of ammunition and the locations in which it is stored (the ammunition lot record cards may be used as this part of the locator system), the second record should be a **planograph** for each storage building or a loose leaf book by magazine number on which **is** indicated its contents.

5-210. Inventory

Detailed inventory procedures are prescribed by the individual DOD Components.

5-211. Safety

a. General. An integral part of all ammunition handling operations is consideration for the safety of personnel, property, ammunition, and explosives. It is the policy of the Department of Defense that its agencies establish adequate controls consistent with a safe and efficient operation. **The** controlling authority is responsible for insuring that safe practices are being observed in **all** operations in which ammunition and explosives are handled. That line of responsibility remains unbroken until it reaches that person who handles the item.

b. Safety rules. Each military service is responsible for the publication of safety rules, regulations and procedures to be followed in the handling of ammunition.

c. Posting instructions. General instructions governing the storage and care of explosives should be posted in each magazine and building where ammunition and explosives are stored. These general instructions will include as a minimum the following

(1) Always handle explosives and ammunition carefully.

(2) Remove dirt, grit, and foreign materials from containers and ammunition before placing in storage.

(3) Do not store explosives and ammunition in damaged containers.

(4) Keep all containers in magazine effectively closed.

(5) Store each lot separately. Make the piles stable. Provide for a free circulation of air to all parts of the pile. Where dunnage is required to keep containers and ammunition off the floor, metal **dunnage** is preferred.

(6) Do not open, repair, pack, or repack containers in or within 100 feet of magazine, except as specifically authorized.

(7) Do not keep empty containers, tools, or other materials in magazine containing ammunition or explosives except as specifically authorized **by** controlling authority.

(8) Cleanliness and order must be maintained.

(9) Use only electric lights approved for use in magazines.

(10) Do not smoke, or bring matches or other flame or spark producing devices into magazine.

(11) Do not allow unauthorized persons in or near magazine.

(12) Keep magazine sparktight, with ventilators well screened, and no openings around doors or foundations.

(13) Keep doors locked when magazine is unattended. Close doors when vehicle is approaching platform unless vehicle is equipped with spark arrestor on exhaust.

(14) Keep the 50-foot cleared space around above ground magazines free **from** combustible materials and keep adequate cleared space around igloo magazine ventilators.

(15) Two or more doors, when available, must be open when personnel are working in a magazine containing explosives or ammunition.

d. Standard bundling methods. Standard handling methods, consistent with the safety rules and regulations of each military service, should be established for handling **all** serviceable ammunition packed in accordance **with** agency approved drawings and specifications. For all items not packed in accordance with agency drawings and specifications or an item considered to be extremely hazardous, a standard operating procedure should be developed and then approved by the commander of the installation prior to starting the operation. As a minimum, standard operating procedures should be prepared for all preservation, renovation, and modification operations.

e. Educational program. An educational program should be instituted in each installation to develop and maintain employees' interest in the safety program and to train employees in safe practices and safe procedures. Some of the mediums available for employee education are posters, bulletin boards, score boards, special exhibits, safety contests, articles in establishment publications, safety rules, hand-out cards, pamphlets, warning signs for specific hazards, suggestion system, essay contests, sound slide films or motion pictures for groups. Appropriate "off the job" accident pres-

entation features should be included in the **program**, and the safety organization should stimulate the interest of and cooperate with outside agencies concerned with this phase of the accident **prevention program**.

f. Indoctrination of personnel. Before any new employee is placed on the job, he/she should be made cognizant of specific safety rules and **regulations** of the installation and the military service

and in consonance with the duties to be performed, insofar as is practicable. The instructions concerning the performance of new duties **should** be planned in advance so that the instructor can **present** them in an orderly fashion. Instructions to each worker should be clear and definite. A continuous program of follow-up, reinstruction and **enforcement** of regulations and procedures with each **employee** should be maintained.

Section 3. VEHICLES (TRACKED AND WHEELED) AND ARTILLERY

| | |
|---|-----------|
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| Storage patterns | 5-303 |
| Fire protection | 5-304 |
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5-301. Scope

This section prescribes policy for the storage of wheeled and tracked vehicles and artillery at Department of Defense installations. Detailed operational procedures will be prescribed, as deemed necessary, by the individual military **service/agency**.

(4) Once items have been placed in storage, control should be maintained through use of a locator system employing a grid layout as defined in chapter III, section 3.

b. Covered storage areas.

(1) There are three general types of covered storage space which may be used for the storage of vehicles and artillery: controlled humidity (CH) warehouses; general purpose warehouses; and other covered space such as sheds and transitory shelters. Though large items such as vehicles and artillery are expensive in terms of the space they occupy, there remain significant advantages in using covered space for the storage of such items. Some of the advantages to be gained, to varying degrees dependent upon the type of covered storage space used, are as follows:

5-302. Storage Areas

a. *Geneml.*

(1) Storage areas for vehicles and artillery may be located either under cover (as in a warehouse) or in the open. The type of storage area in which any specific type of vehicle or artillery piece should be stored will be determined by such factors as the degree and length of environmental exposure the item will satisfactorily withstand, the size and weight of the item, the ease with which the item may be handled, the availability and type of vacant storage space, and the requirements imposed by the owning military service/agency.

(a) Ability to store material in assembled condition, requiring only minimal effort to ready it for issue.

(b) Reduced requirement for item preservation.

(c) Extended storage with reduced requirement for inspection and subsequent represervation.

(2) Vehicles and artillery, being relatively heavy and bulky, are difficult to handle. Therefore, storage areas selected for such items should be in proximity to rail sidings and truck loading facilities; this reduces the handling time and travel distance incident to the receipt, storage, and shipment of these items.

(2) When planning for the storage of vehicles and artillery in covered storage areas, factors to be considered include the floor load rating of the applicable storage area and the size, quantity, and location of the doors in the structure(s) involved.

(3) Sufficient space should be provided either within or adjacent to the storage area to serve as a preparation area for shipments of multiple item quantities which may require such actions as the marshaling of items for marking, addition of on-vehicle equipment items, inclusion of log books, and preshipment inspection.

(3) **CH** storage space provides a high degree of protection to prevent item deterioration. To the extent this space is available and considering its necessary use for other critical material, this type of storage is also suggested for artillery, wheeled **trucks** and truck-tractors, and tracked combat, as-

sault, and tactical vehicles. It is recommended that items equipped with fire control (critical optics) components and other costly to preserve components be furnished CH storage. When determining what type of storage space to use for a specific application, it **must** be remembered that CH space is one of the most costly types of storage space to construct and maintain.

(4) General purpose storage space, though obviously less advantageous than CH, still offers **substantial** protection from the elements.

(5) Transitory shelters may be used for the storage of vehicles and artillery.

(6) Of **all** the types of covered storage space, sheds offer the least amount of protection from the elements since one side is normally open. When constructing sheds, care should be taken to assure that a closed side of the shed faces the direction of the prevailing wind to minimize the effects of rain and snow.

c. *Open storage areas.* Use of open storage areas results in the exposure of material to the elements; hence, the material may deteriorate from exposure to sun, rain, snow, dust, and sand. Exposure to dust or sand (especially if windblown) may result in difficulties such as clogged fuel lines and filters, stripping of paint or other protective materials from exposed surfaces, pitted glass, and malfunction of mechanical parts. For these reasons, plus the advantages noted earlier for covered storage areas, the use of open storage areas is not recommended for wheeled and tracked vehicles. However, since this material must oftentimes be stored in the open for a variety of reasons, the following actions should be taken to **assure** achievement of the best possible results:

(1) Increase the degree of protection over what is required for items placed in covered storage areas.

(2) Increase the frequency of inspection over what is required for items placed in covered storage areas. Also, consider increasing the thoroughness of the inspection.

(3) For some parts of certain vehicles (e.g., cargo trailer beds, dump truck bodies, etc.), take precautionary action to reduce the accumulation of snow or rainwater. Such accumulation may result in the corrosion of both painted and unprotected surfaces on these parts of this type of vehicle. The probability of this occurring may be reduced by elevating one end of the vehicle or applicable

vehicular component. Cargo trailers with tailgate assemblies which allow moisture to run off should be elevated at one end (fig. 5-17). Dump truck bodies should be maintained in a slightly elevated position by inserting a 4-by 4-inch block between the dump body and the vehicle's frame. The tailgate may also require blocking to open slightly. Exposed unpainted and machined surfaces of the hydraulic ram should be preserved, then wrapped in accordance with the requirements of the applicable military **service/agency**.

(4) Wheeled and tracked vehicles in open (or covered) storage need not be blocked off the ground. However, vehicles which must be stored in open areas, should be placed on the most favorable terrain available to prevent this equipment from resting in mud or water. Where changing terrain or draining patterns cause this condition to exist, the equipment should be moved to a more desirable area, or some type of fill (gravel, stone, etc.) spread, or landing mat positioned to provide a more proper ground condition.

5-303. Storage Patterns

a. *General.* Whenever material is placed within a storage area, the manner in which items are located in relation to one another forms a pattern. This is referred to as a "storage pattern." The back-to-back and the block storage patterns are two efficient patterns for use in the storage of vehicles and artillery.

(1) The back-to-back storage pattern consists of two rows of material placed in proximity to one another as shown in figure 5-18 and 5-43. Note that an aisle separates each double row so that any item is accessible without the need to move any other item.

(2) The block storage pattern is made up of more than two rows of material placed in proximity to one another as shown in figure 3. With the block pattern, depending upon the depth of the block, access to a **specific** item may require that other items must be moved.

b. *Selection of the proper pattern.* Many factors must be considered when determining the best storage pattern to use in a **specific** situation. Factors which must always be considered include, but are not limited to, the following

(1) *Efficient space utilization.* A block storage pattern will make more efficient use of space than will a back-to-back pattern since the block pattern ,

requires a minimal quantity of aisles. Although block patterns do result in more efficient use of space, consideration of other factors discussed below may dictate the use of a back-to-back pattern. However, a specific single type of pattern need not be used throughout an entire storage area; it is permissible to use a combination of both.

(2) *Type of storage area.* Normally, there is nothing which will physically inhibit the use of either type storage pattern in an open storage area. However, since open space is at less premium, the **back-to-back** pattern is usually used so as to minimize materials handling. In a covered storage area, the need for specific aisle placement and the location of firewalls and building supports may not allow the use of a block pattern.

(3) *Item mix.* When a large quantity of a single item is to be stored, the use of a block pattern is usually the logical choice, if facility design will permit. Where small quantities of different items are involved, a back-to-back pattern generally proves to be more efficient.

(4) *Item issue requirements.* If the issue of each piece (vehicle or artillery piece) is controlled by serial number or a similar control factor, the use of a block storage pattern is not the logical choice unless the precise sequence in which pieces will be issued can be accurately predetermined. The requirement for a single piece in the center of a block pattern could necessitate the movement of many pieces so that the desired piece may be obtained.

(5) *Care of supplies in storage.* The care of supplies in storage program (chap. 111, sec 6) for vehicles and artillery specifies that, under certain conditions, vehicle drive trains or artillery recoil mechanisms be exercised periodically. In some instances, this can be accomplished through use of a mechanical device and, when such a device is used, sufficient space must be made available between items to allow the device to approach the item to be serviced. This may also be true when inspection defines the need to represerve material.

c. *Planograph.* Planographs should be used when planning and controlling space utilization in the storage of vehicles and artillery (see chap. 111, sec 3).

5-304. Fire Protection

Fire protection policy is not prescribed in this section and will be that stipulated by the individual services and chapter VI of this regulation.

5-305. Methods for Storage, Receipt, and Issue

a. Storage.

(1) *Stacking.* Since vehicles and artillery are relatively bulky items, they occupy considerable floor space within covered storage facilities. Economical and efficient use of such facilities may be appreciably enhanced if these items are stacked to utilize available cubic space. Stacking methods vary with the weight, dimensions, and type of item to be stacked.

(u) Except for a few items which may be stacked without need for racks or a substantial quantity of supporting dunnage, vehicles should only be stacked in covered storage areas possessing a level, surfaced floor. The use of bare earth, which is normally uneven and highly compressible, can result in an unbalanced stack. When stacking vehicles or trailers for storage or when storing vehicles or trailers loaded with other material it may be necessary to place blocks between the axle and frame to relieve pressure on the springs.

(b) Some items, such as certain types of trailers, may be stacked inverting one item and placing it over another as shown in figure 5-20. Normally, under these conditions a relatively stable stack is produced which will allow storage on slightly uneven surfaces such as dirt floors or open storage areas. When this method of stacking is used in open storage areas, the undercarriage of the uppermost item is exposed to the elements and the degree of preservation should be increased accordingly.

(c) Vehicles and artillery should not be stacked in open storage areas, except as noted in (b) above. The costs for materials handling, racks, and dunnage far outweigh any potential benefit since open storage space is the least costly of all storage space.

(d) When stacking vehicles and artillery in covered storage areas, the floor load rating of the area must be known. The combined weight of all items in the **stack**, plus the nominal additional weight of stacking aids (racks, stands, or dunnage), must not exceed this rating otherwise, damaged floors, structural damage, and damage to the stored material may result.

(e) A variety of MHE types maybe used to stack vehicles and artillery. The type required must be determined prior to making the decision to stack. Some of the heavier MHE with sizeable lifting capacities may be too large to move through warehouse doors, or may result in a need for oversize

aisles. This would reduce the savings to be derived through stacking. The various types of MHE which may be used for stacking are covered elsewhere in this section.

(f) To facilitate the actual stacking of vehicles and artillery, **racks**, stands, or dunnage may be used. The cost of these aids rises in direct relation to their weight capacity. Racks and metal stands may be obtained from commercial sources while wood stands and precut dunnage may be fabricated **locally**. Items which **experience** a relatively rapid fit and **turnover** should not be considered as prime candidates for stacking since the increased handling costs for such items will tend to negate the short term space saving.

(g) Racks may initially be the most **costly** of the three types of stacking aids, but their cost may also be more rapidly offset by their minimal incidence of repair and the limited requirement to handle and rehandle them during stacking operations. Most racks are designed to accommodate one general type or size vehicle. They are constructed in one of three basic configurations: roll-through, cantilever, and suspension. Roll-through racks are **well** suited to the stacking of lightweight vehicles (fig. 5-21); these are basically commercial pallet racks modified by adding channels upon which equipment may roll forward when inserted in the input end of the rack. Since roll-through racks may make up long rows and are both loaded and unloaded from the ends, they may be placed close together in a block pattern with minimal aisle **requirements**. This configuration will enhance the ease with which the first in/first out principle may be practiced. The second type of rack is of cantilever design (fig. 5-22). This type of rack consists of a pair of stanchions fitted with cantilever type "arms" which support the stored item **from** underneath. The cantilever type of rack may be used to stack items considerably heavier than those which may be stacked on **roll-through** racks. The suspension type rack (fig. 5-23) consists of a pair of stanchions fitted with brackets from which lightweight or mediumweight vehicles may be suspended by their bumpers, lifting eyes or **pintles**.

(h) Stands may be constructed from wood or metal. Many are built in a "sawhorse" configuration and, depending upon both their design and the materials from which they are constructed, they can support items of nearly any weight (figs. 5-24 and 5-25). Unlike racks which **support** each item inde-

pendently (no requirement for the lowermost item to support the superimposed weight of any items stored above it), stands support the weight of **all** items above them. The stacking procedure involves placement of the stands directly upon the lowermost item in the stack, then placing the next item on top of those stands. Whenever stacking vehicles or artillery pieces on stands, the stands used must be sufficiently strong and so placed so as to avoid instability of the stack and damage to the **suspension** of each stacked item.

(i) In some instances, dunnage may be used for the same purpose of racks and stands. When properly used, dunnage permits the stacking of extremely heavy items (fig. 5-26). Dunnage material must be carefully chosen to assure that it possesses sufficient strength to support the weight to be superimposed upon it. Improperly chosen dunnage may be too soft, resulting in compression and the inability to remove the stacked items, or it may be brittle and break, resulting in an unstable stack. Properly chosen dunnage can be an easily fabricated, safe, and economical stacking aid.

(2) *Fork extensions and adapters*. By adding fork extensions to the common forklift truck (chap. IV, sec 2), it becomes possible for the truck to **handle larger** and bulkier items which it might otherwise not be capable of handling. Considering the extended load centers involved, care must be taken to assure that the forklift truck is not overloaded. Fork adapters may **also** be used for handling some vehicles and artillery pieces. Fork adapters are **similar to** fork extensions except that they are designed to accommodate specific types of styles of undercarriage configuration. Figures 5-27 and 5-28 show two different types of forklift adapters while figure 5-29 shows an adapter in use. As with extensions, when **using** adapters and extended **load** centers are involved, caution must be exercised to assure that the forklift truck is not overloaded.

(3) *Towing in storage*. Towing offers a distinct advantage over handling by MHE since, in many instances, towing may be accomplished by means of nonspecialized equipment already on hand. **However, towing is** a preferred method of movement only when item preservation will not be adversely affected by moving the item on its own wheels or tracks. Care must be exercised in the selection of a towing vehicle with adequate capacity (drawbar **pull**). A **towing** vehicle may be capable of moving an item on **level** ground while being incapable of

moving the same item up even a slight grade. Such conditions will cause damage to the towing vehicle. The same logic applies when towing items over rough, uneven terrain. Considerably more effort must be exerted when towing an item over rough terrain **than** when towing the same item on a smooth, level surface since the towed item's drag (inertia) is more on rough terrain. (See chap. IV, sec 3.)

(4) *Towing equipment.*

(a) *Prime movers.* There are two basic types of **prime movers**, either of which, when properly outfitted, may be used to tow or push even the heaviest vehicles and artillery. One is a pneumatic tired, diesel powered industrial tractor with **four-wheel** drive which can operate on rough terrain as well as on improved surfaces (fig. 5-30). The other common type of prime mover is the tracked tractor (fig. 5-31) which can also operate on rough **terrain** as well as on improved surfaces. However, tracked tractors can damage improved surfaces unless their tracks are filled with rubber track blocks (fig. 5-32).

(b) *Towing medium and lightweight material.* Medium and lightweight vehicles and artillery may easily be towed over improved surfaces with a variety of equipment such as warehouse tractors (chap. IV, sec 2), $\frac{1}{2}$ -ton trucks, 5-ton trucks, etc. Care must be taken **to** assure that the drawbar pull of the equipment used is not exceeded ((3) above). As the weight of the item to be towed increases and the quality of the terrain over which the item must be towed diminishes, consideration should be given to the use of a prime mover.

(c) *Towing aids.* Cables and chains of various lengths and strengths may be equipped with fittings which will allow them **to** be used in towing vehicles and artillery. However, since both chains and cables are flexible, an extra man maybe required to steer or apply the brakes of the towed item. This need may be circumvented by use of a tow bar (fig. 5-33). Tow bars which are strong enough to **allow** both towing and pushing **permit** positive control of the towed item by the operator of the towing vehicle.

(6) *Item disassembly.* Unless specifically approved and designated by the owning agency, the disassembly of vehicles and artillery for the express purpose of gaining storage space is prohibited, except as noted in *b(3) below*. If disassembly to some extent is deemed necessary, **full** justification will

be furnished to the **owning** agency as a prerequisite to gaining approval for such action. As a minimum, the justification for desired disassembly action will include all pertinent costs, the time required for item reassembly, and the method(s) of maintaining item integrity.

(6) *Exercising.* The drive trains of some vehicles and the recoil mechanisms of some artillery pieces must be exercised on a periodic basis (**stipulated** by the owning agency) to prevent deterioration in storage. In the case of vehicles, exercising may be accomplished by either running the vehicle or by the application of an exercising device consisting of a set of batteries mounted on a trailer. The batteries are attached to the vehicle's starter motor which can then move the drive train without need of starting the vehicle's engine. Running the vehicle destroys preservation; the use of an exercising machine does not. Consequently, exercising machines are recommended for this action. **Artillery** recoil mechanisms should also be exercised with an exercising machine (fig. 5-34) since manual exercising is for the most part ineffective.

(7) *Inflation of tires.* When vehicles and artillery are placed in storage, all tires (mounted and unmounted alike) will be **inflated** and kept at their normal operating pressure. **Tire** preservation should be as specified in paragraph 5-617.

b. Receipt and issue.

(1) In some cases, special equipment such as heavy duty cranes may be required to facilitate the **loading/unloading** process. However, all receiving activities may not be equipped with such special handling devices. Consequently, the shipping activity (point of shipment origin) must determine and allow for any undue handling difficulties that may be created at the destination. Such difficulties may sometimes be avoided by merely changing the placement of items on the conveyance or by changing the type of conveyance to be used.

(2) Vehicles and artillery may be shipped on any commonly used conveyance (e. g., **railcar**, tractor-trailer, etc.) in accordance with loading drawings, AAR rules or other applicable carrier requirements. One additional method of shipping vehicles is via the **driveaway** method where the vehicles are actually driven to their destination. Driving a vehicle to its destination will prevent the application of preservation by the shipper or will destroy any preservation previously applied to its engine and drive train. This can mean that a port

of embarkation or other consignee may be required to represerve the item before it is transshipped or stored. For shipments of some types of powered vehicles, these disadvantages may be overcome to some extent by using the piggyback method of shipment depicted in figure 5-35.

(3) Many vehicles and artillery pieces possess parts that are prone to damage or pilferage (e.g., exterior mirrors, easily removed controls, soft-top cabs, on-vehicle equipment items, etc.). Such parts **must** be protected **during** both shipment and storage. Small parts **may** be removed and placed in a **protected area** such as a vehicle map compartment. Larger parts may be removed, preserved, packed, then securely affixed to the end item by any appropriate means (e.g., strapped with steel banding). Removed bolts, nuts, washers, etc., must be placed in one of their mating parts and secured to prevent their loss. Figure 5-36 shows boxed parts affixed to the exterior of an item awaiting issue. Note that the box has been marked so that it may be readily identified by the ultimate user.

(4) The freight planning operation will take into consideration such factors as proper segregation or consolidation of the items being shipped to assure assessment of the lowest possible freight charges and the effective utilization of available cube on the conveyance. The load pattern in or on the conveyance should be established by taking into account the possibility of partial unloading of material at stopoff points enroute; improper item placement in or on the conveyance may result in a need for much unnecessary handling at such stopoff points. The Official Railway Equipment Register contains information regarding the dimensions and cubic capacity of the **railcars** owned and operated by individual **railroads**; this document will prove useful when determining the best load configuration to use when shipping on American **railcars**. Additionally, some military technical publications provide information as to the quantity of items which may be loaded in or on a specific type of conveyance. Such information, though useful for guidance, will not abridge the requirement for the most practical load configuration within the rated capacity of the conveyance.

(5) When making oversea shipments of vehicles and artillery, the transportation charges are in large part determined by the amount of cubic space occupied by the items being shipped. Therefore, item cube will be reduced to the maximum practi-

cable extent for all oversea shipments. A word of caution: Item cube must not be lowered to the point where it becomes overly difficult for the receiving activity to ready the item for storage or use. The reduction of item cube may be accomplished by, among other things: Lowering gun tubes or artillery pieces to a horizontal position; removing **soft-top cabs** from vehicles and both lowering and boxing the windshield to protect it from damage (fig. 5-37); and, in general, removing or lowering all cube consuming parts on the item being shipped. Another method of reducing cube is to invert one lightweight item, place it over another, **and** strap the two together with steel banding (fig. 5-20). All parts removed or exposed by such action will be preserved and packed to the extent necessary to protect them from the hazards inherent to shipping and from exposure to the elements.

(6) Cranes are not generally well suited to handling operations within confined spaces in a warehouse, Cranes are particularly useful in handling vehicles and artillery in loading **and** unloading operations. While a large variety of crane types is available, this does not imply that a large variety is required at any installation. Normally, one *or* two types in quantities commensurate with workload will suffice, especially if these are made more versatile with a carefully chosen selection of slings and spreader bars (fig. 5-38). The use of slings and spreader bars will also protect the surfaces of the lifted item **from marring** or crushing. Some of the general types of cranes are discussed briefly below: All of the types discussed are available in a wide range of lifting capacities.

(a) *Truck mounted crane.* This **type** of crane (fig. 5-39) consists of a selfpowered crane unit which is equipped with a boom and mounted on a powered truck or truck chassis suitable for highway travel. The truck mounted crane is highly mobile, best suited to operation on a relatively smooth and level surface, and has a lifting capacity which is generally somewhat less than that of the other types of cranes discussed below.

(b) *Wheel mounted crane.* This type of crane (fig. 5-40) is self-powered and equipped **with** a boom. The chassis on which it is mounted may or may not be **selfpropelled**; if it is not selfpropelled, then the entire crane must be towed **from** one work site to another. A wheel mounted crane that is **selfpropelled** is nearly as mobile as the truck

mounted crane, yet its lifting capacity is normally greater.

(c) *Crawler mounted crane.* This type of crane (fig. 5-41), equipped with boom, is mounted on a selfpropelled, track laying (crawler) chassis. Its lifting **capacity** approximates that of the wheel mounted crane, and it is well suited to operation in unimproved open storage areas. The crawler mounted crane is less mobile than either the truck or wheel mounted type.

(d) *Gantry crane.* The gantry crane is not equipped with a boom but consists of a hoisting apparatus suspended above the ground by a **gantry**-type framework. It is a powerful crane of great lifting capacity (some with more than 100,000 pounds capacity). The gantry crane may be immobile, but more commonly it is mounted on rails (fig. 5-42). It is very well suited to loading and unloading operations involving volume handling of very heavy, bulky items.

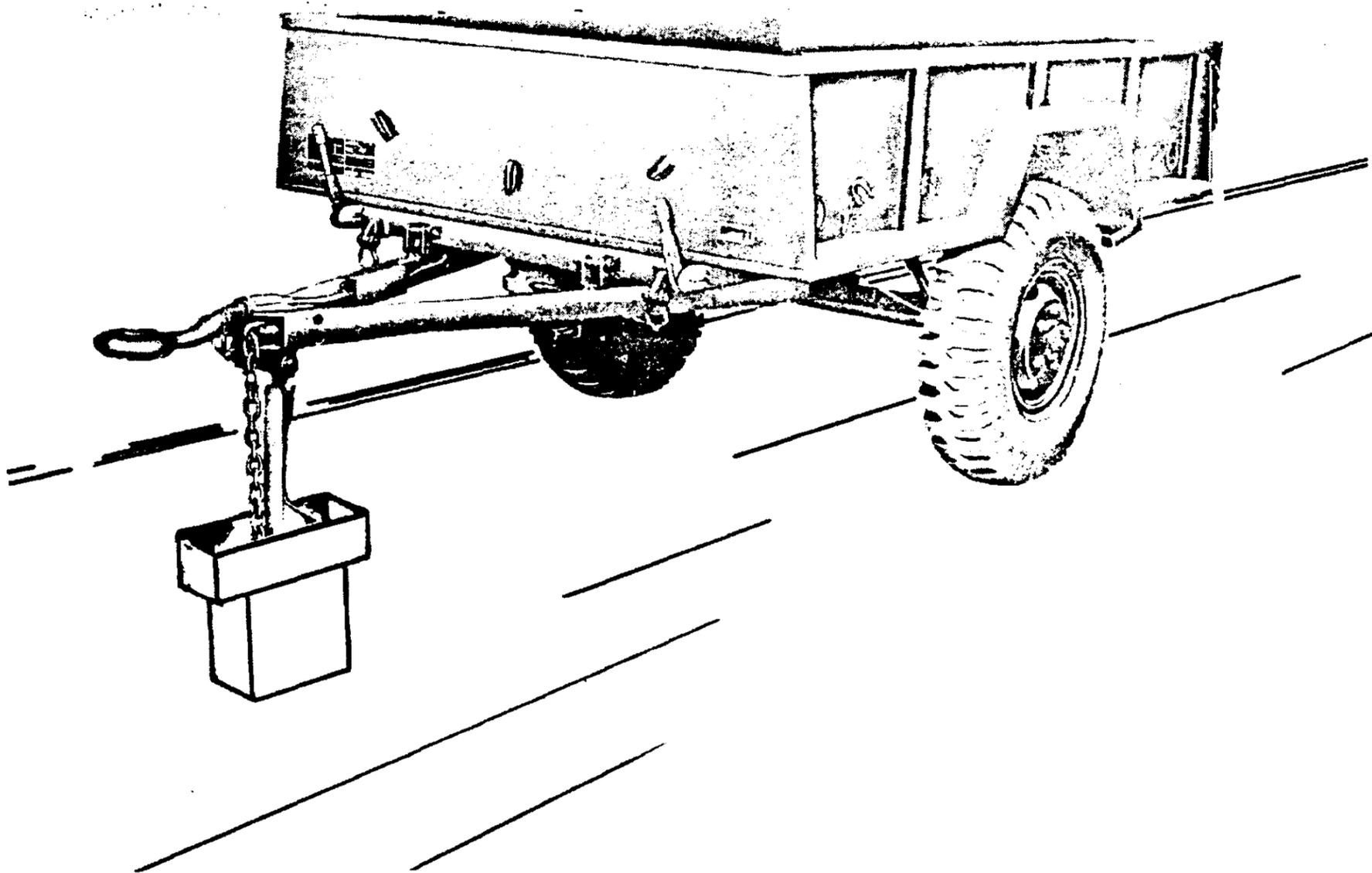


Figure 5-1 ?. End of trailer elevated to promote *drainage*.

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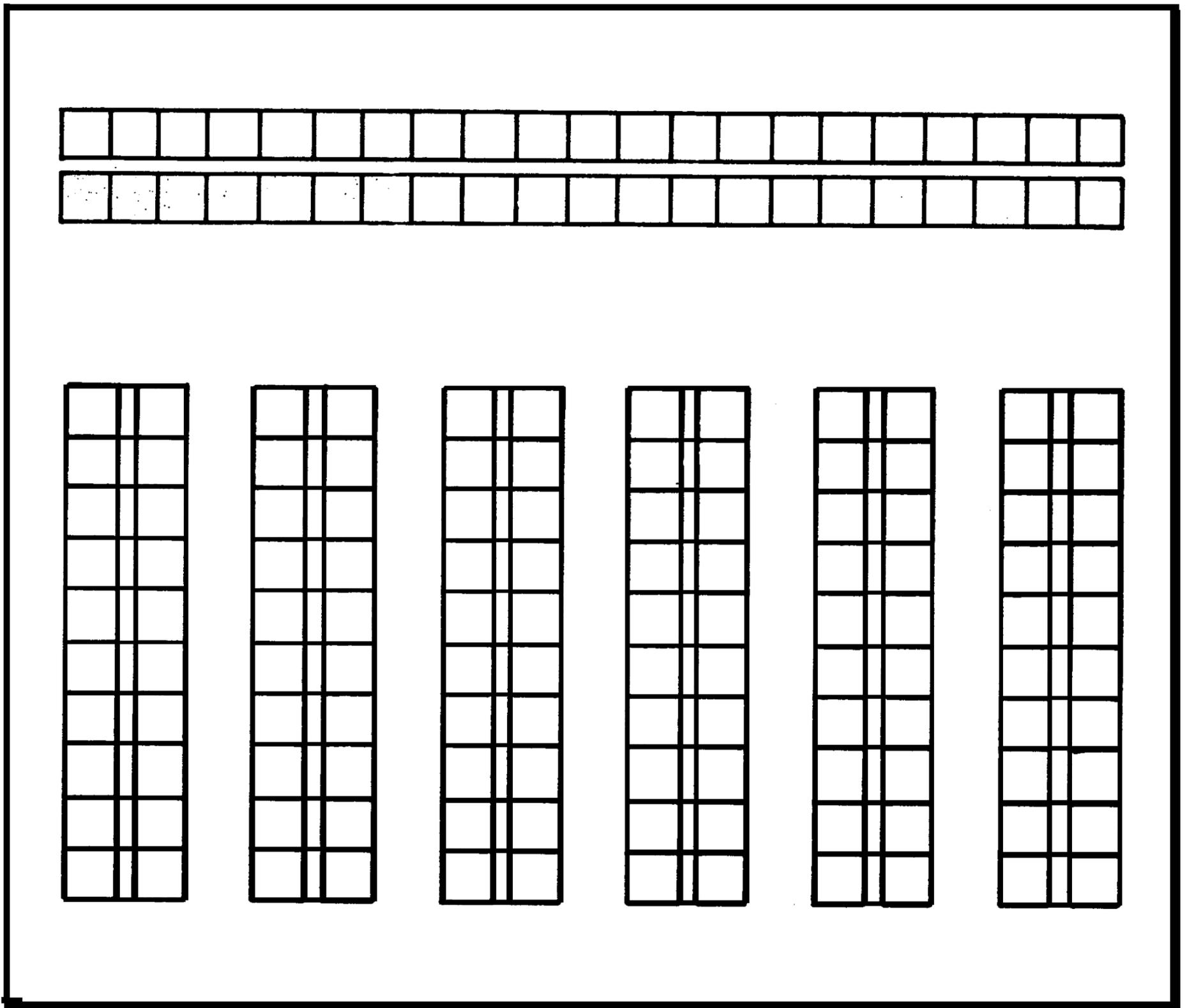


Figure 5-18. The back-to-back storage pattern.

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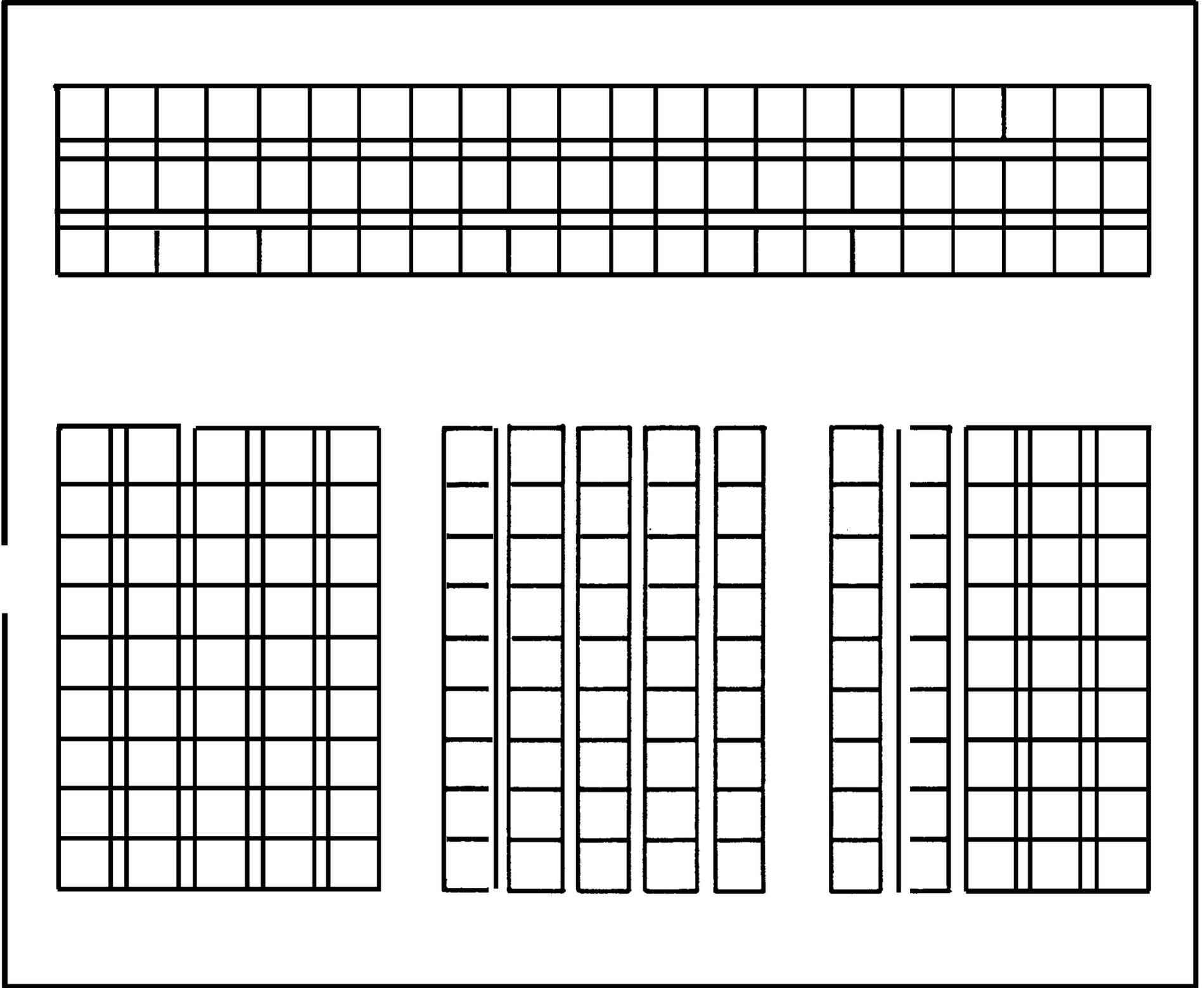


Figure 5-19. The block storage pattern.

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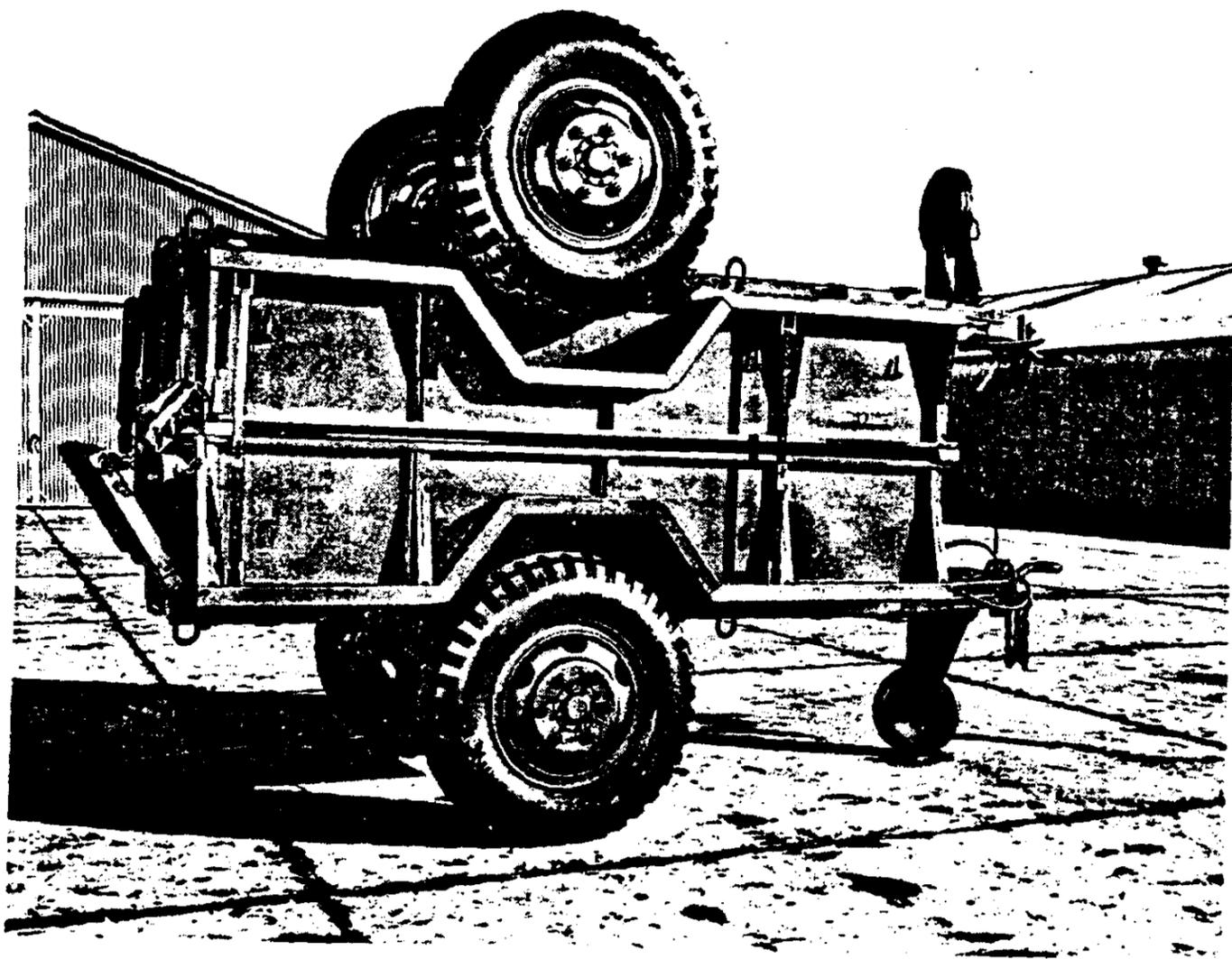


Figure 5-20. Inverted trailers ready for storage.



Figure 541. Roll-through racks for stacking vehicles in storage.

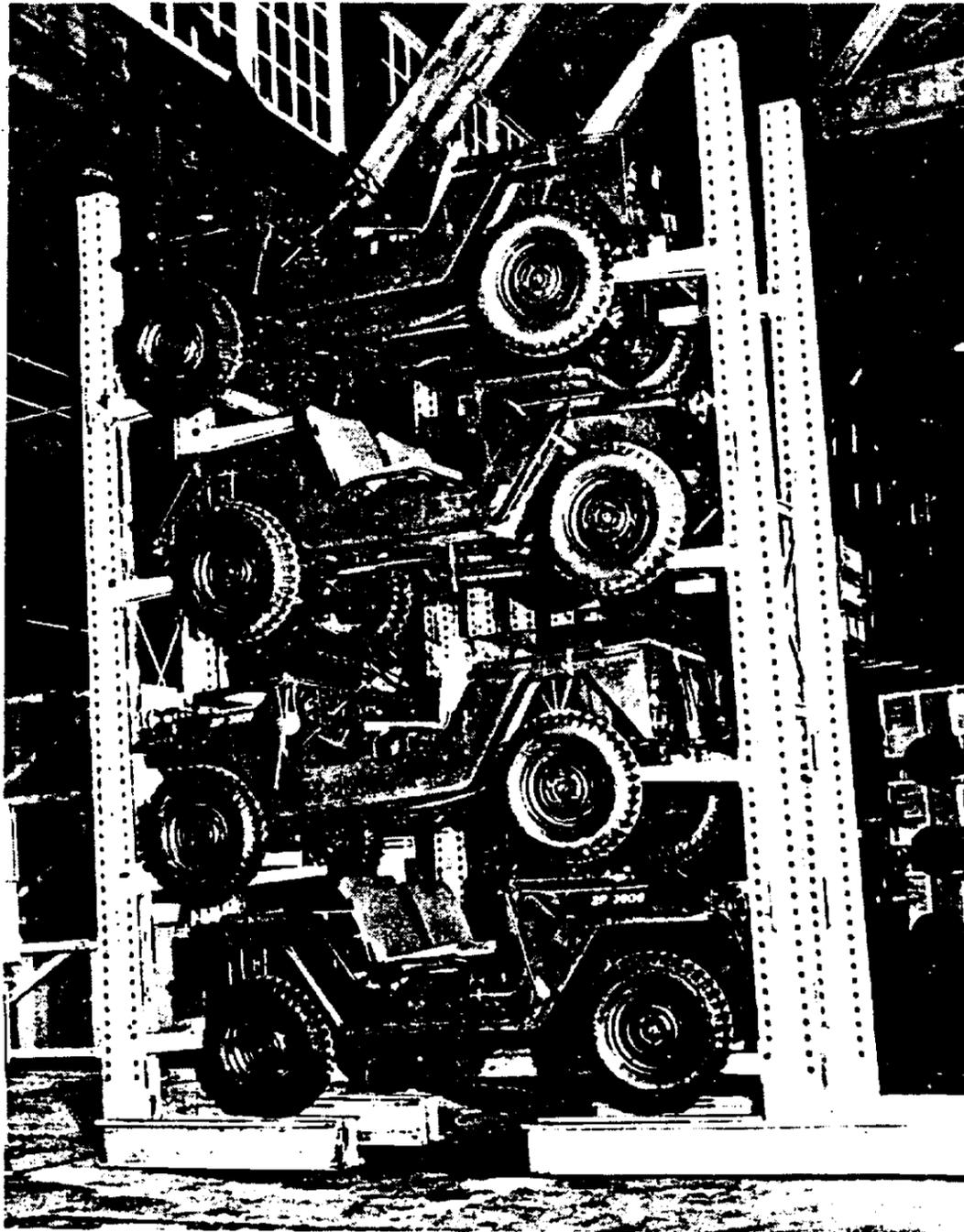


Figure 5-22. Cantilever racks for stacking vehicles in storage.

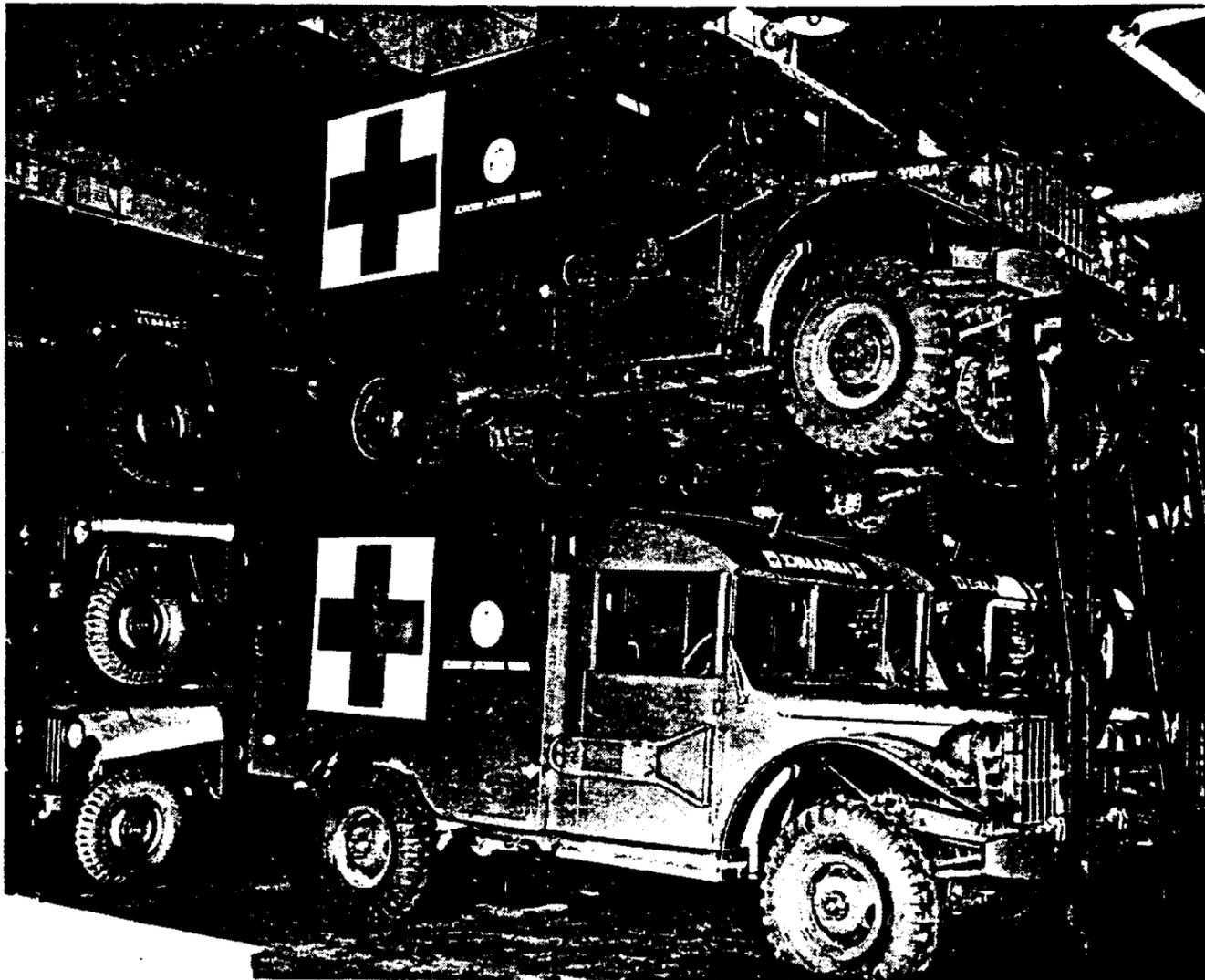


Figure 5-23. Suspension-type racks for stacking vehicles in storage.

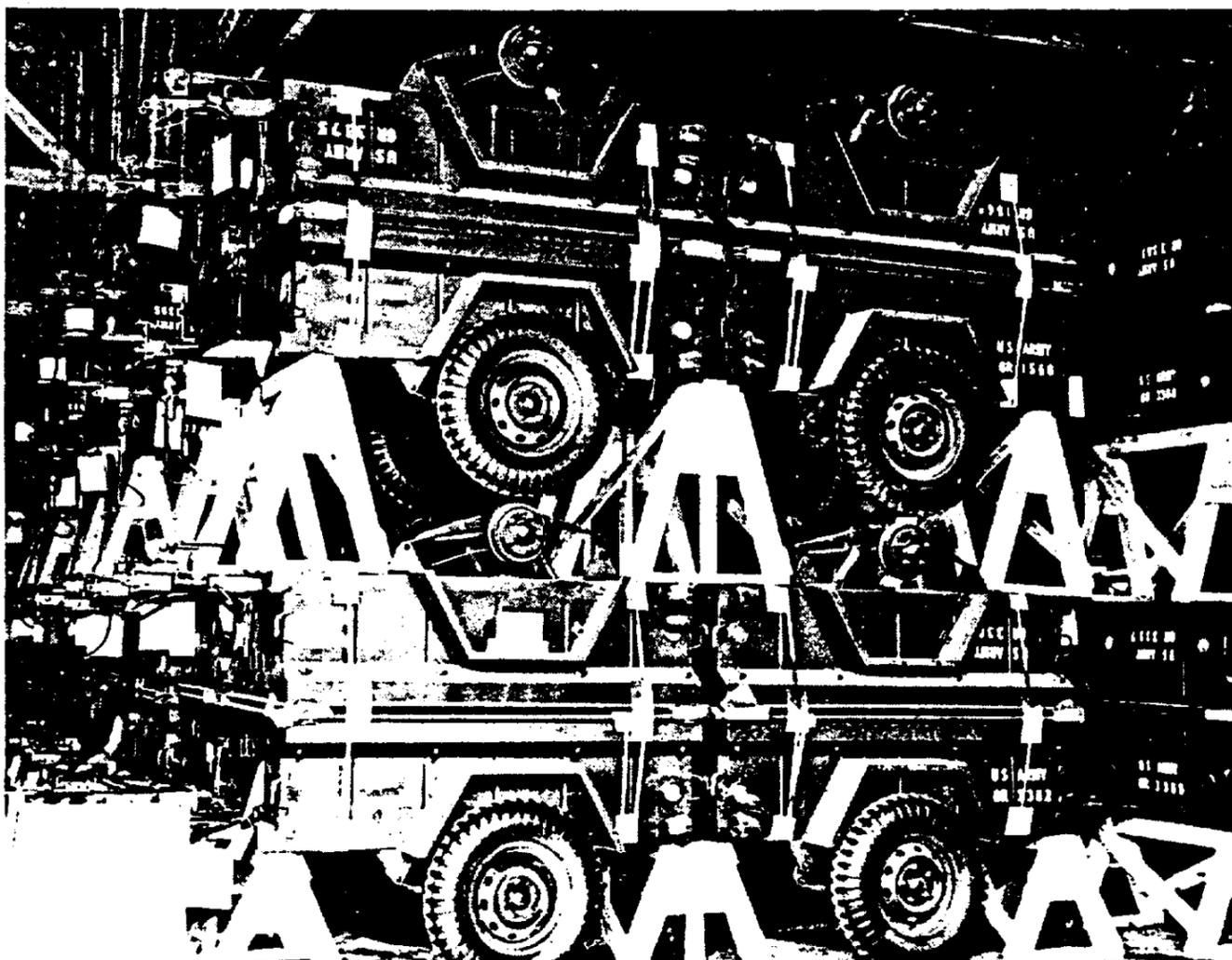


Figure 5-24. Wood stands for stacking vehicles in storage.

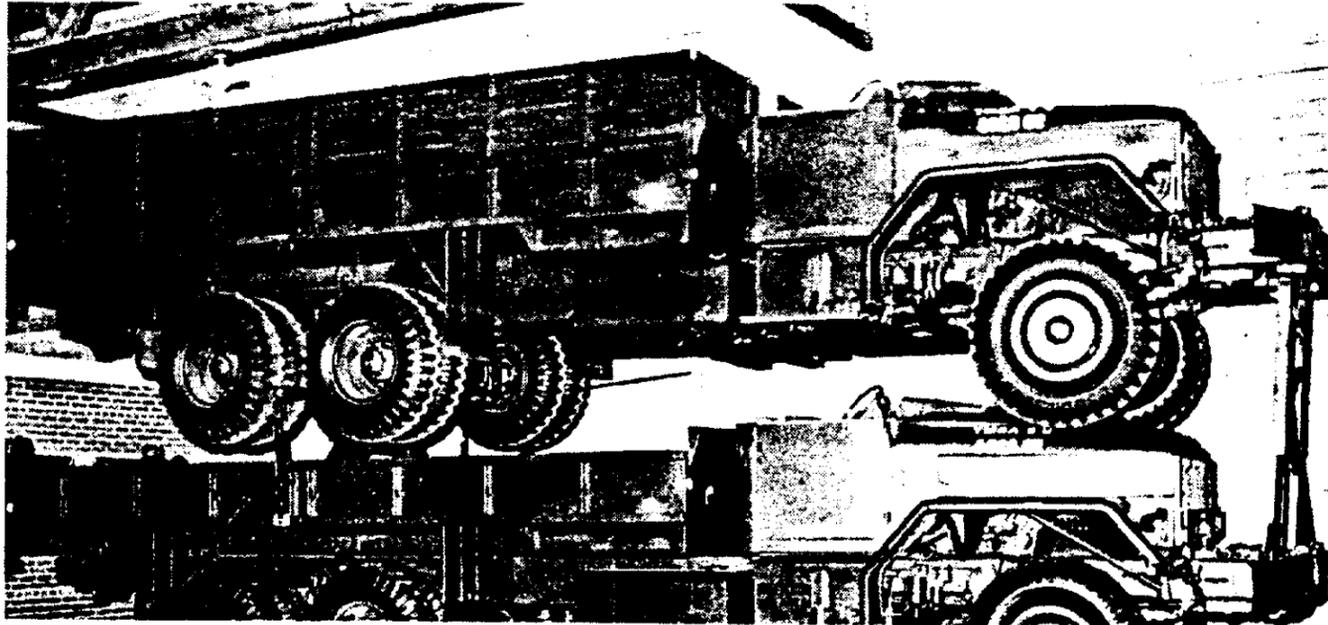


Figure 5-25. Metal stands for stacking vehicles in storage.

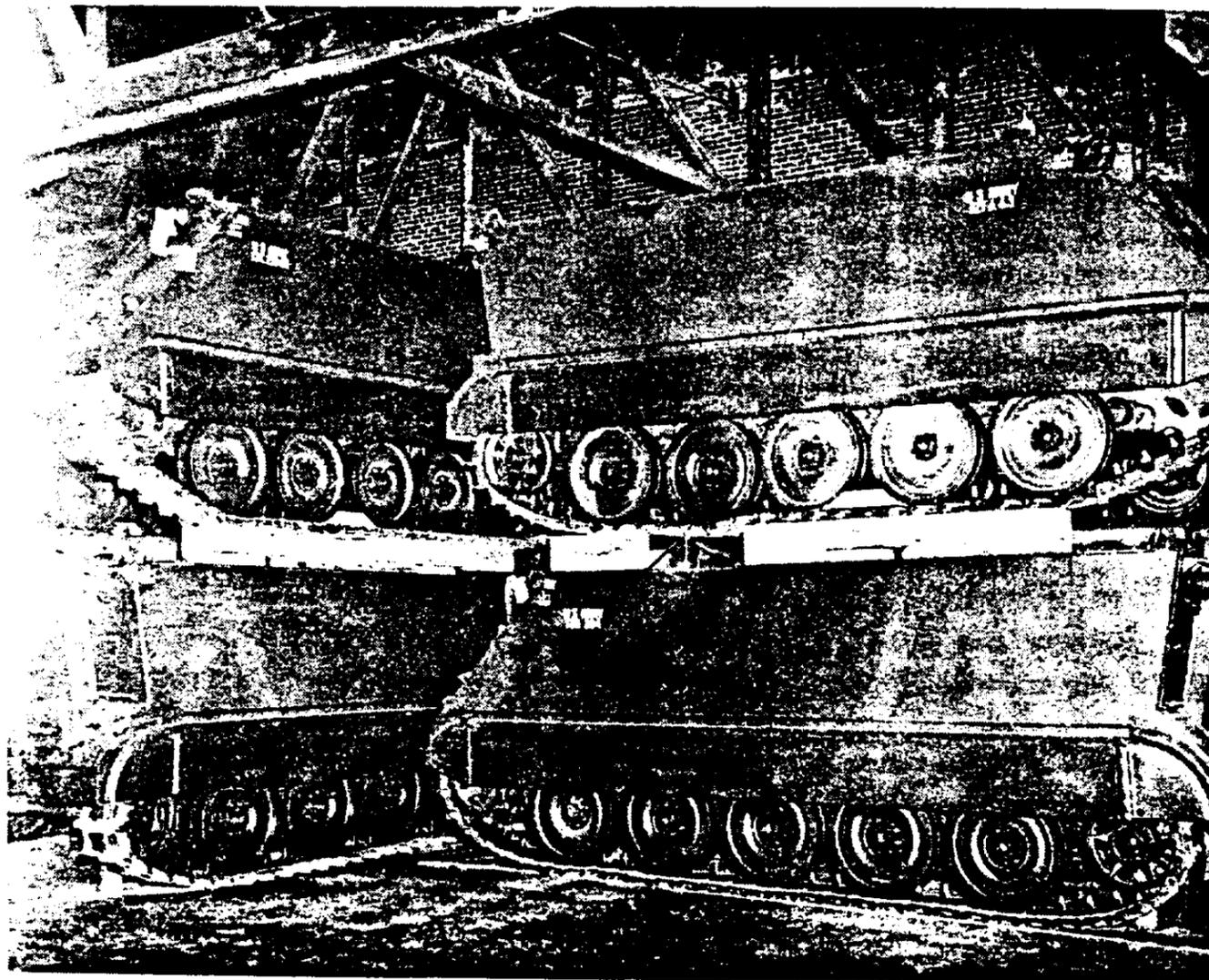


Figure 5-26. Wood dunnage for stacking vehicles in storage.

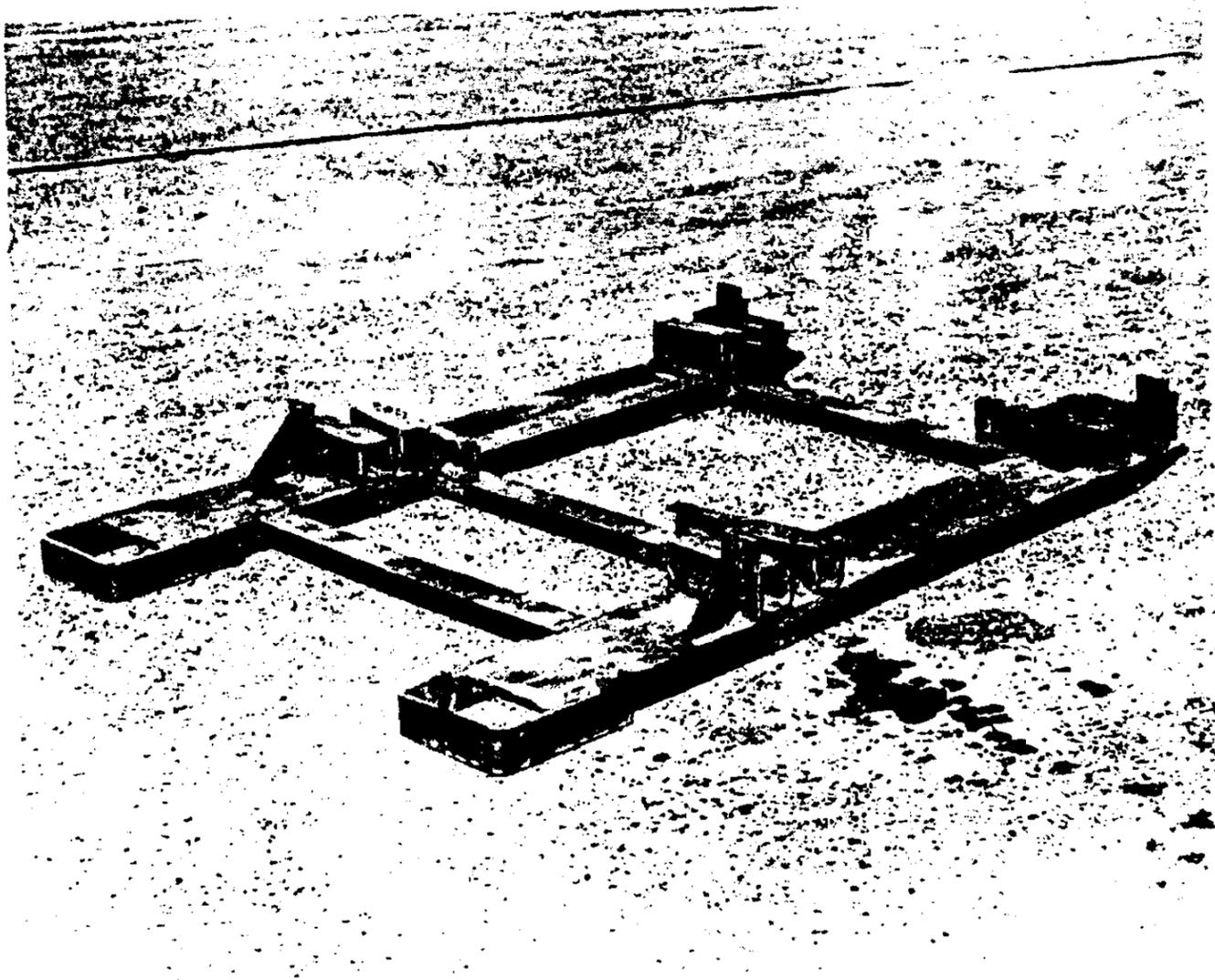


Figure 5-27. Forklift adapter used for stacking M37B1 cargo trucks.

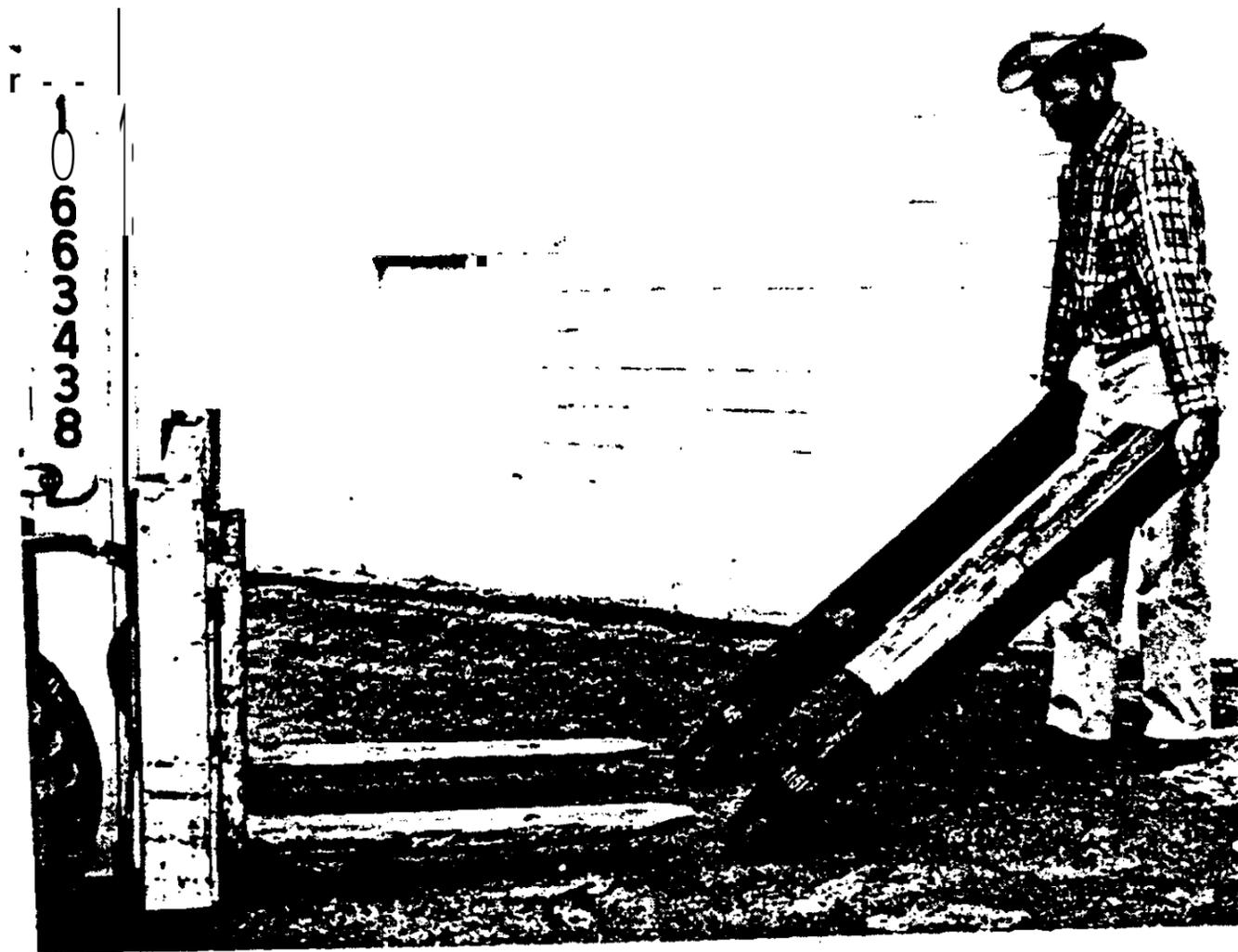


Figure 5-28. Forklift adapter used for stacking M 151 trucks.

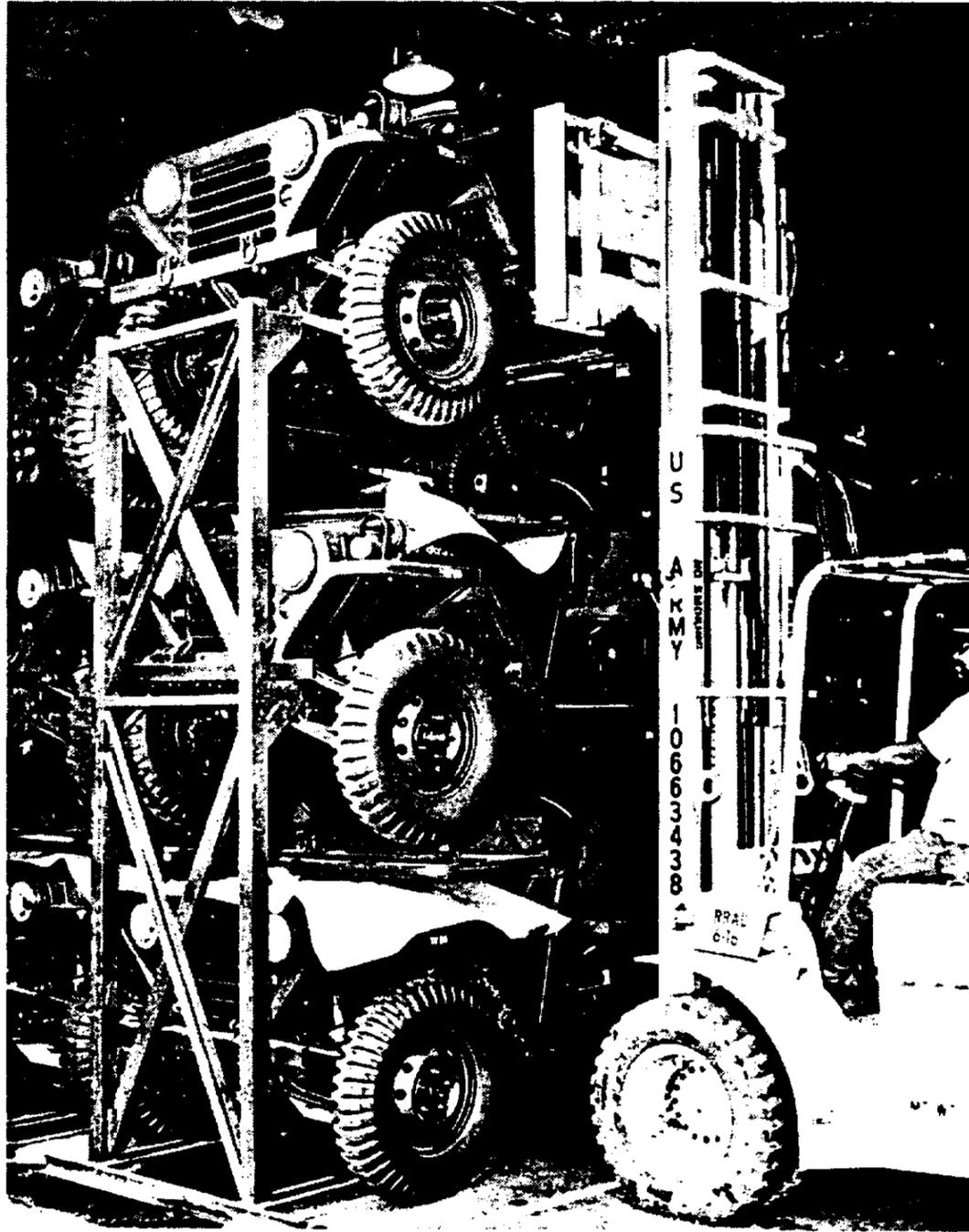


Figure 5-29. Forklift adapter used to stack an M151A1 truck.

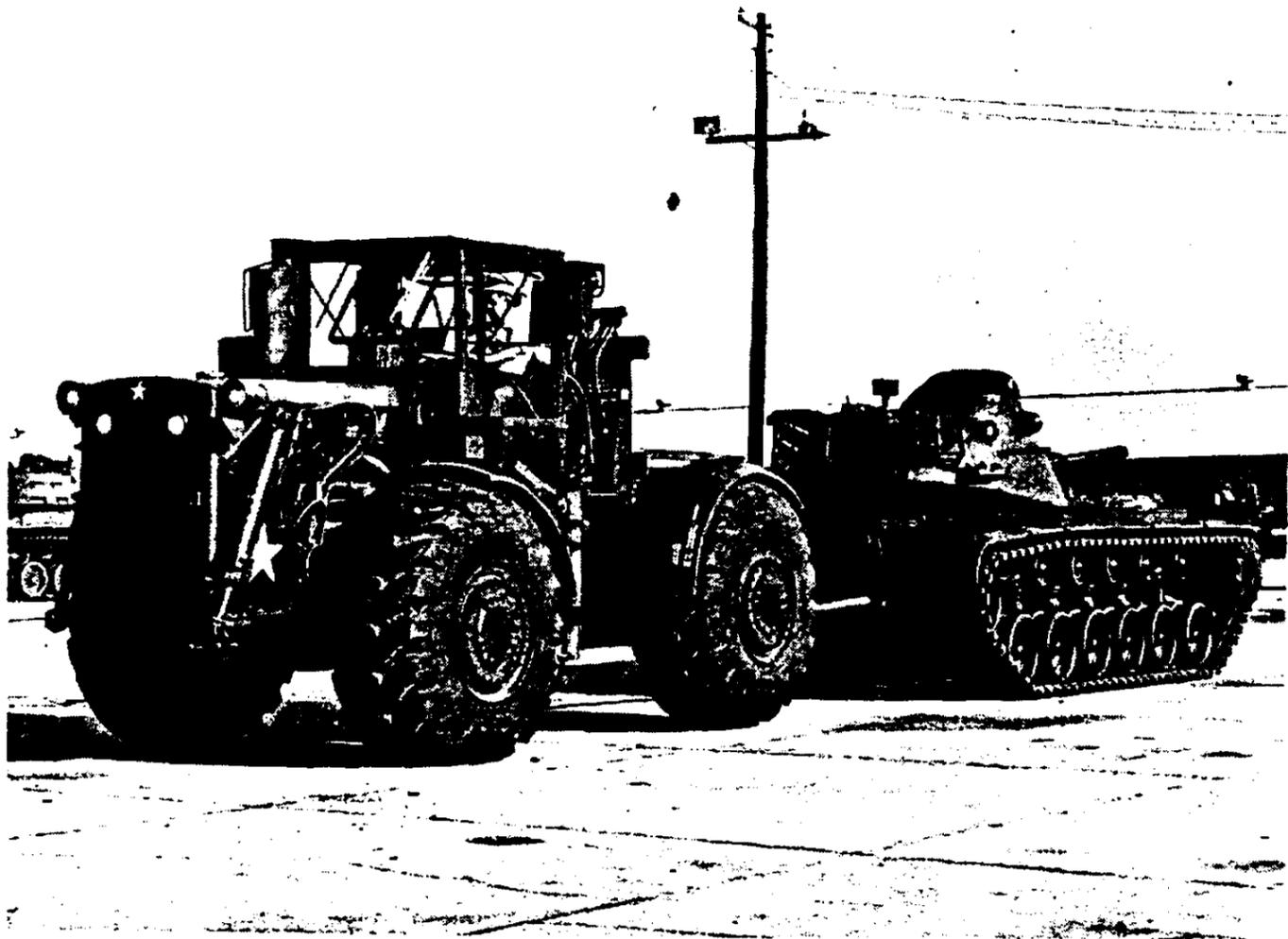


Figure 5-S0. Example of a wheeled prime mover.

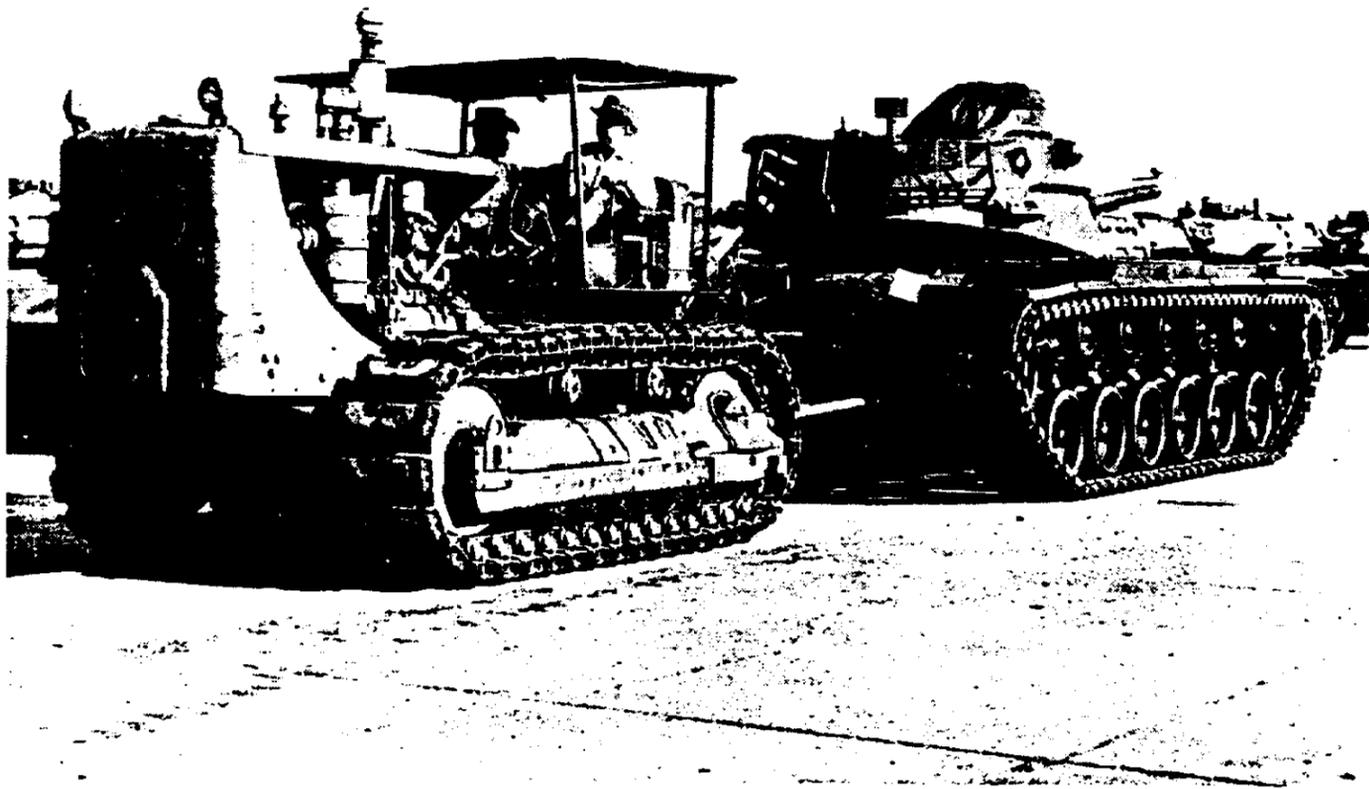


Figure 5-31. Example of a tracked prime mover.

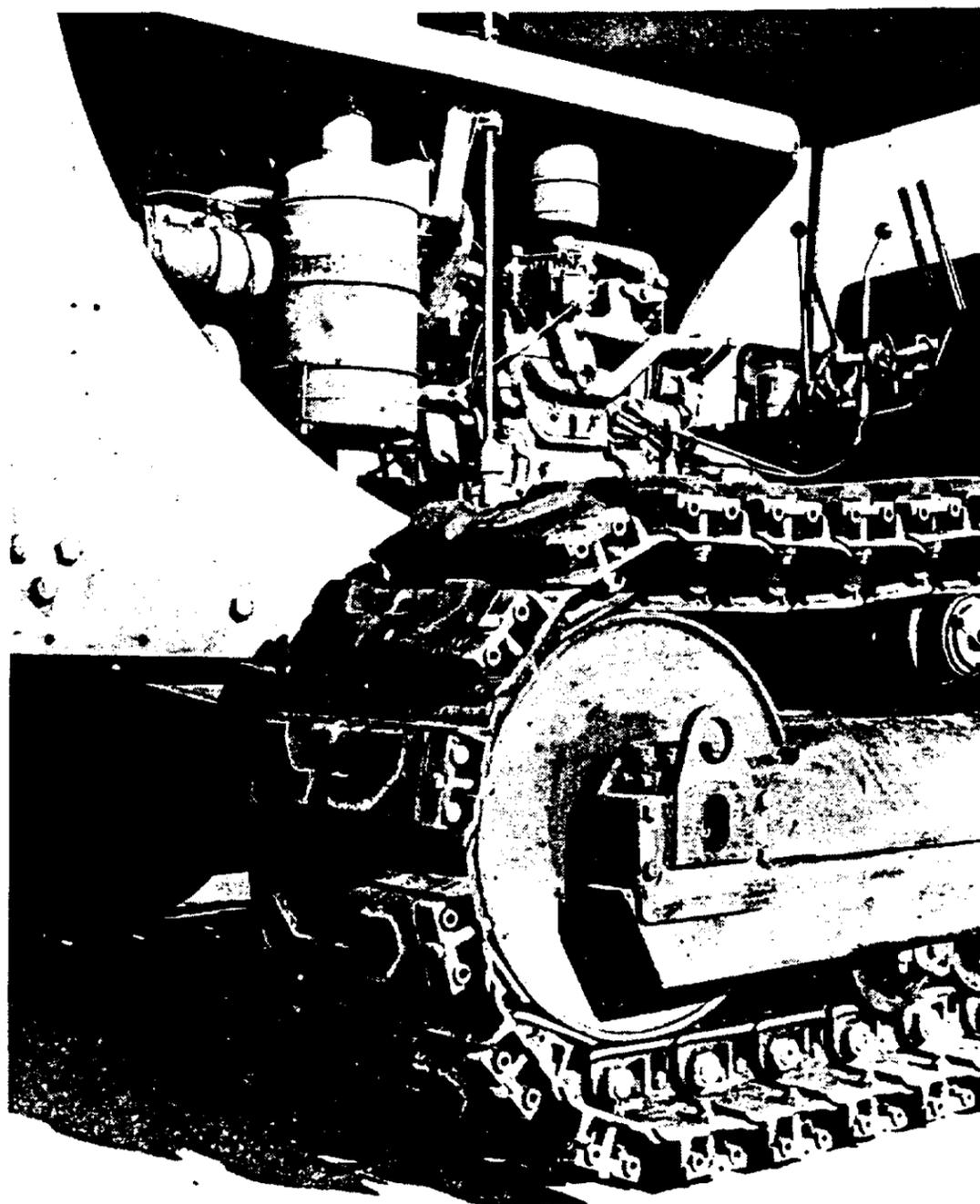


Figure 5-32. Rubber track blocks used to protect improved surfaces.

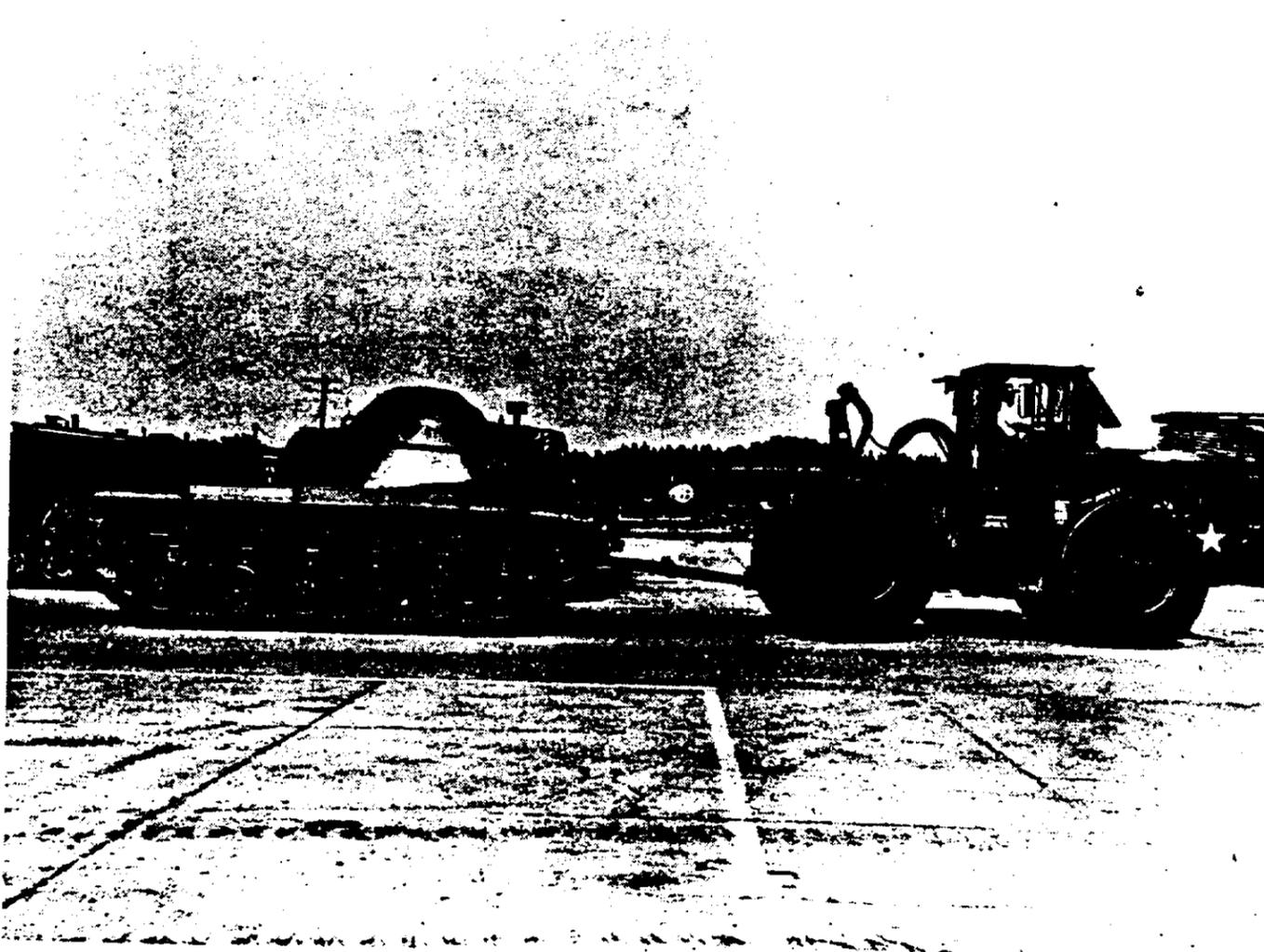


Figure 5-33. A tow bar for use when pushing a vehicle.



Figure 5-34. An exerciser for use on recoil mechanisms.

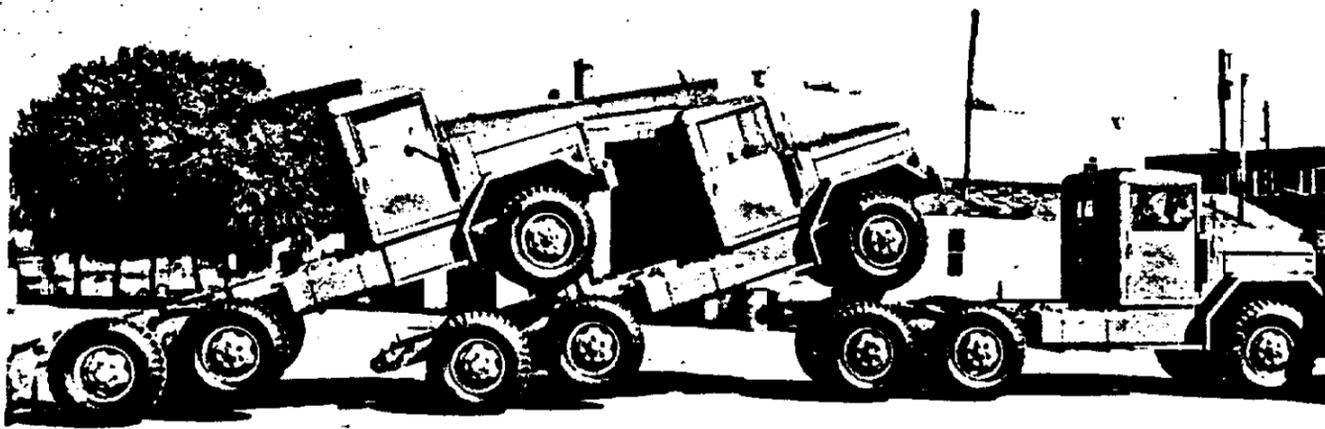


Figure 5-35. Truck tractors piggybacked for driveaway shipment.



Figure 5-36. Parts, boxed and attached to end item for shipment.

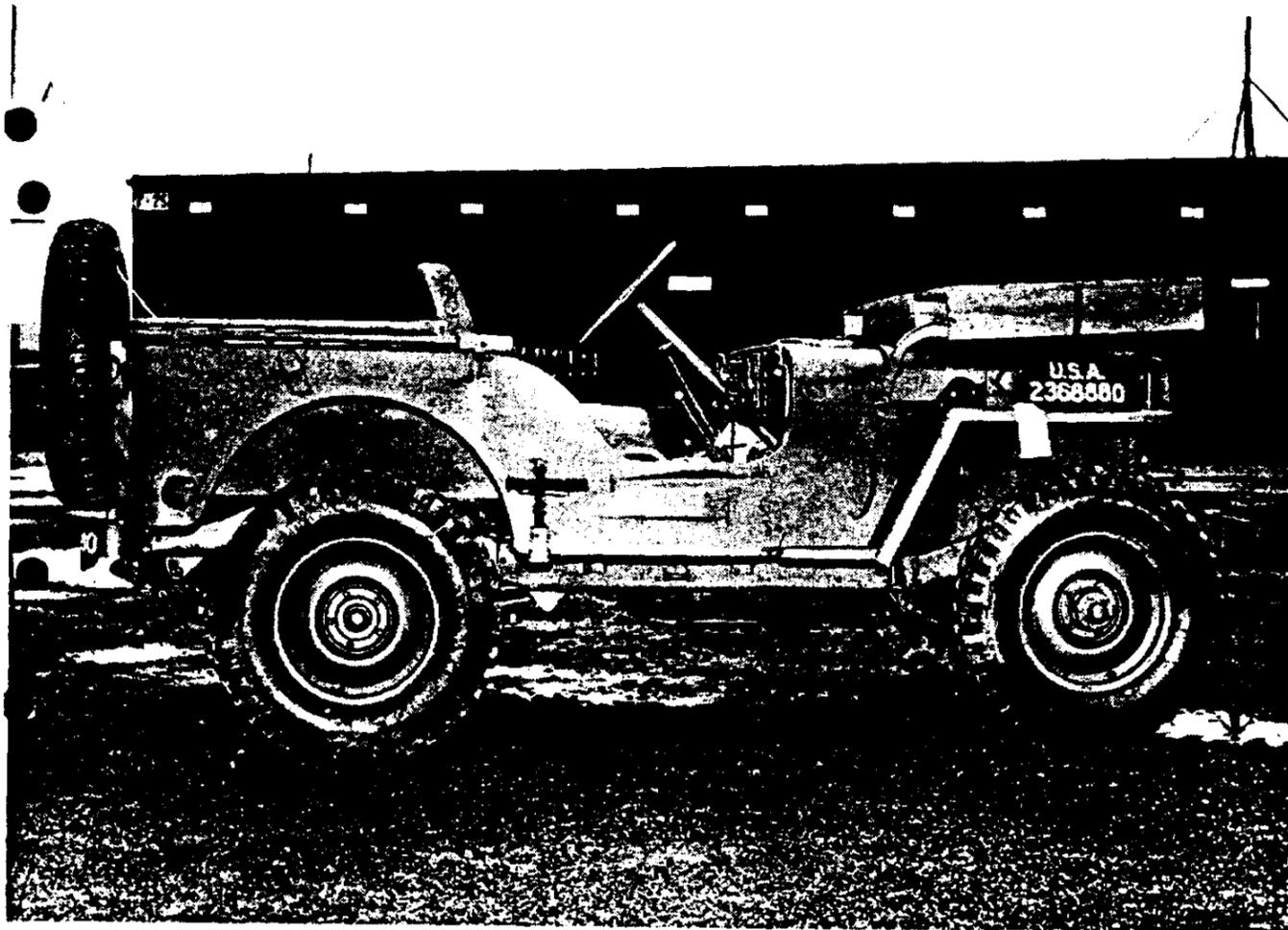


Figure 5-37. Windshield, boxed for protection during shipment.

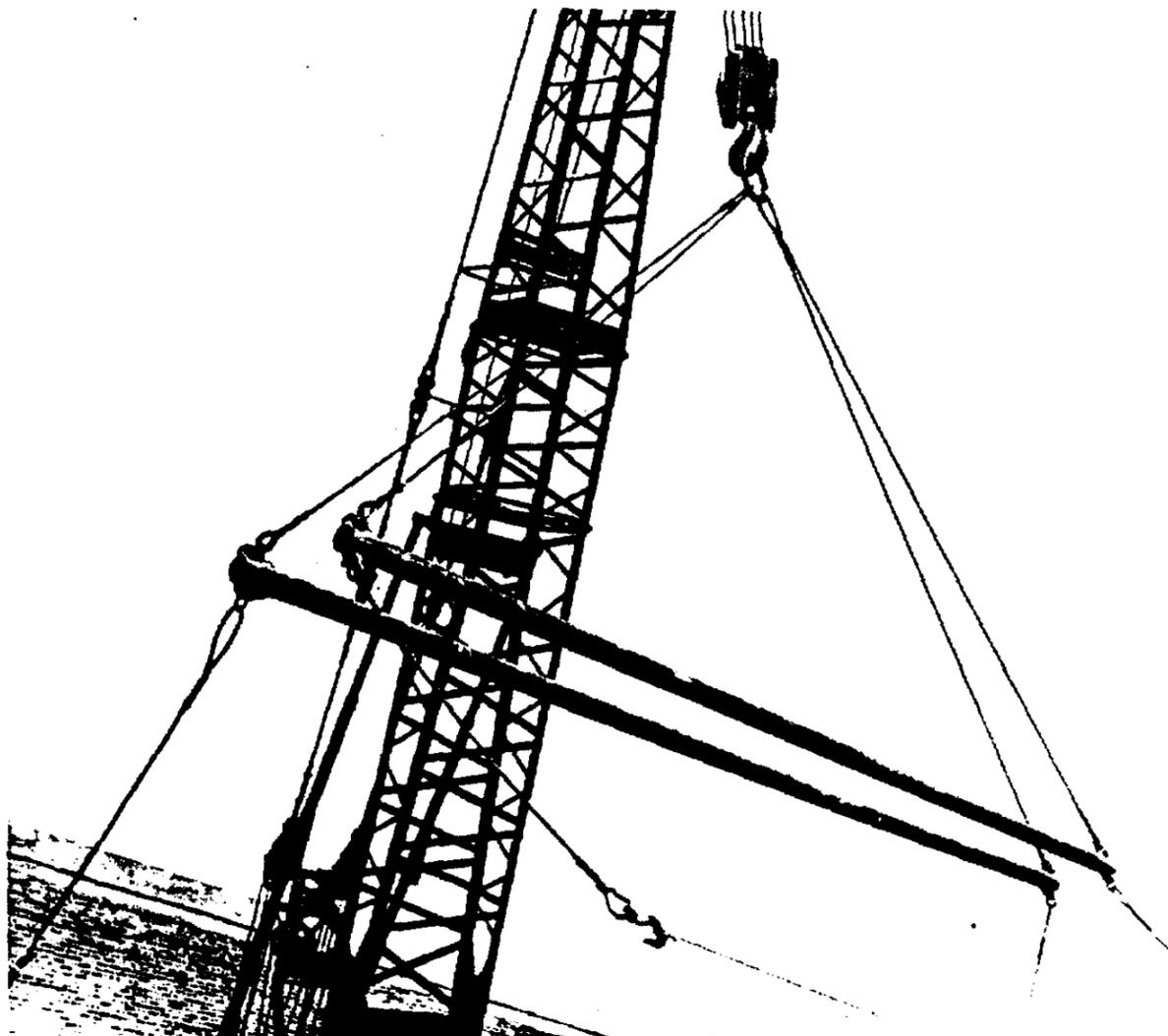


Figure S..?8. Slings and spreader bars fin- use with cranes.

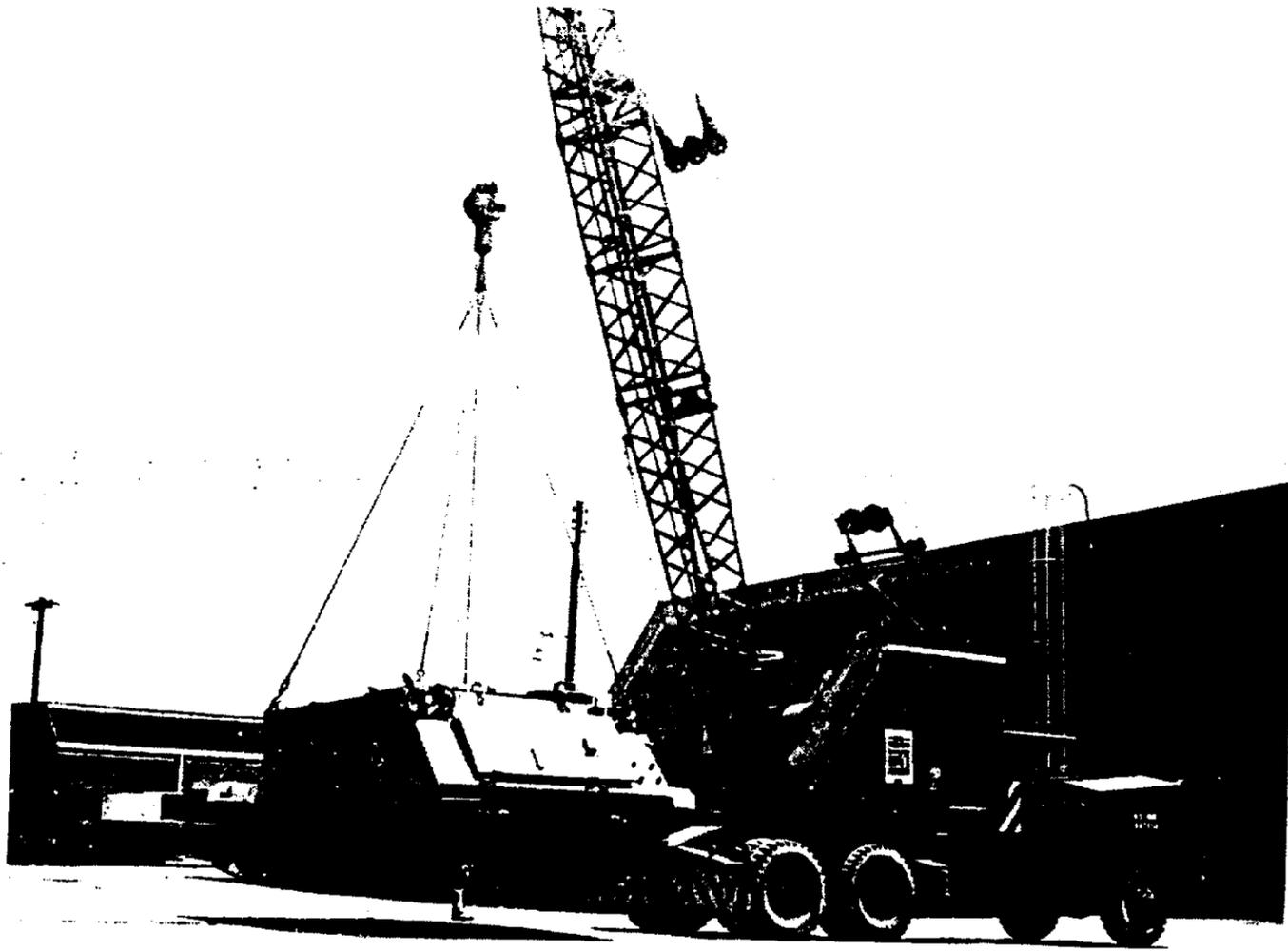


Figure 5-39. Truck-mounted crane.

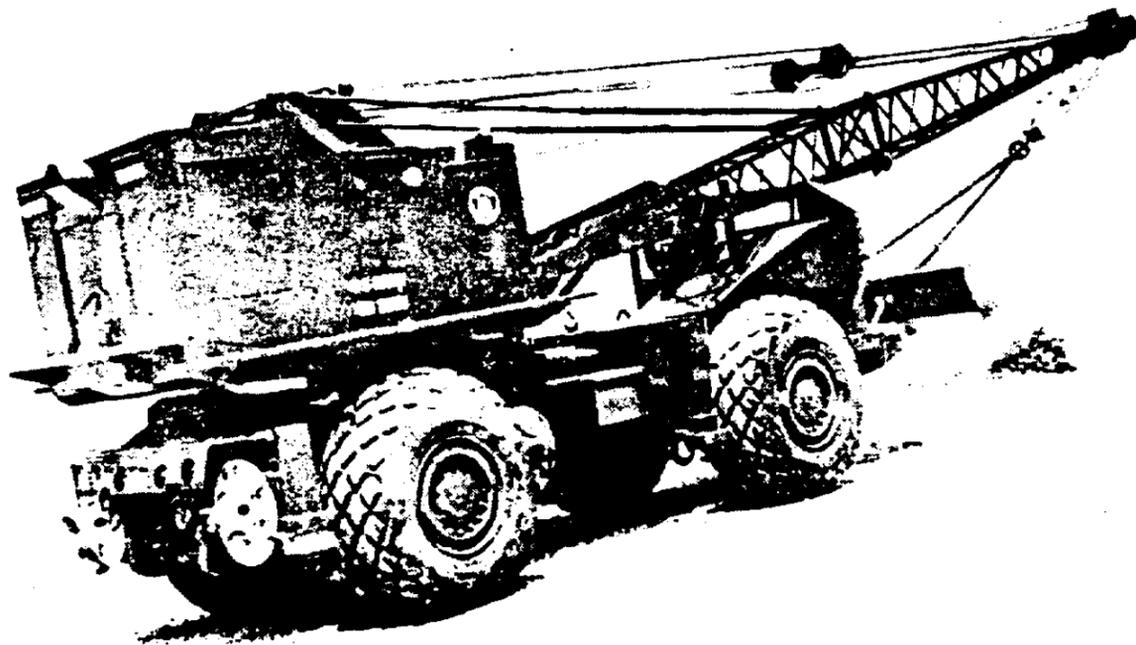


Figure 5-40. Wheel-mounted crane.

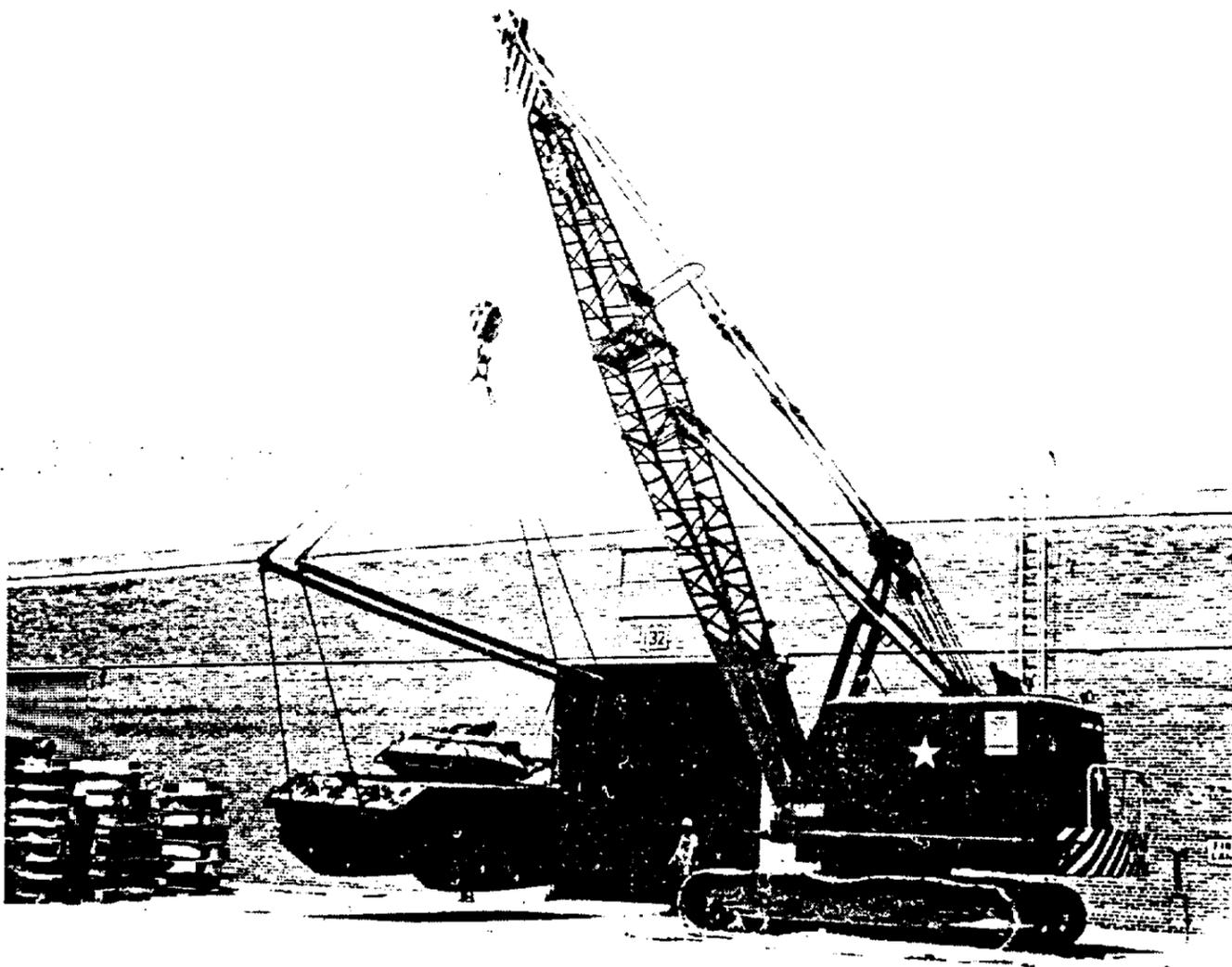


Figure 5-41. Crawler-mounted crane.

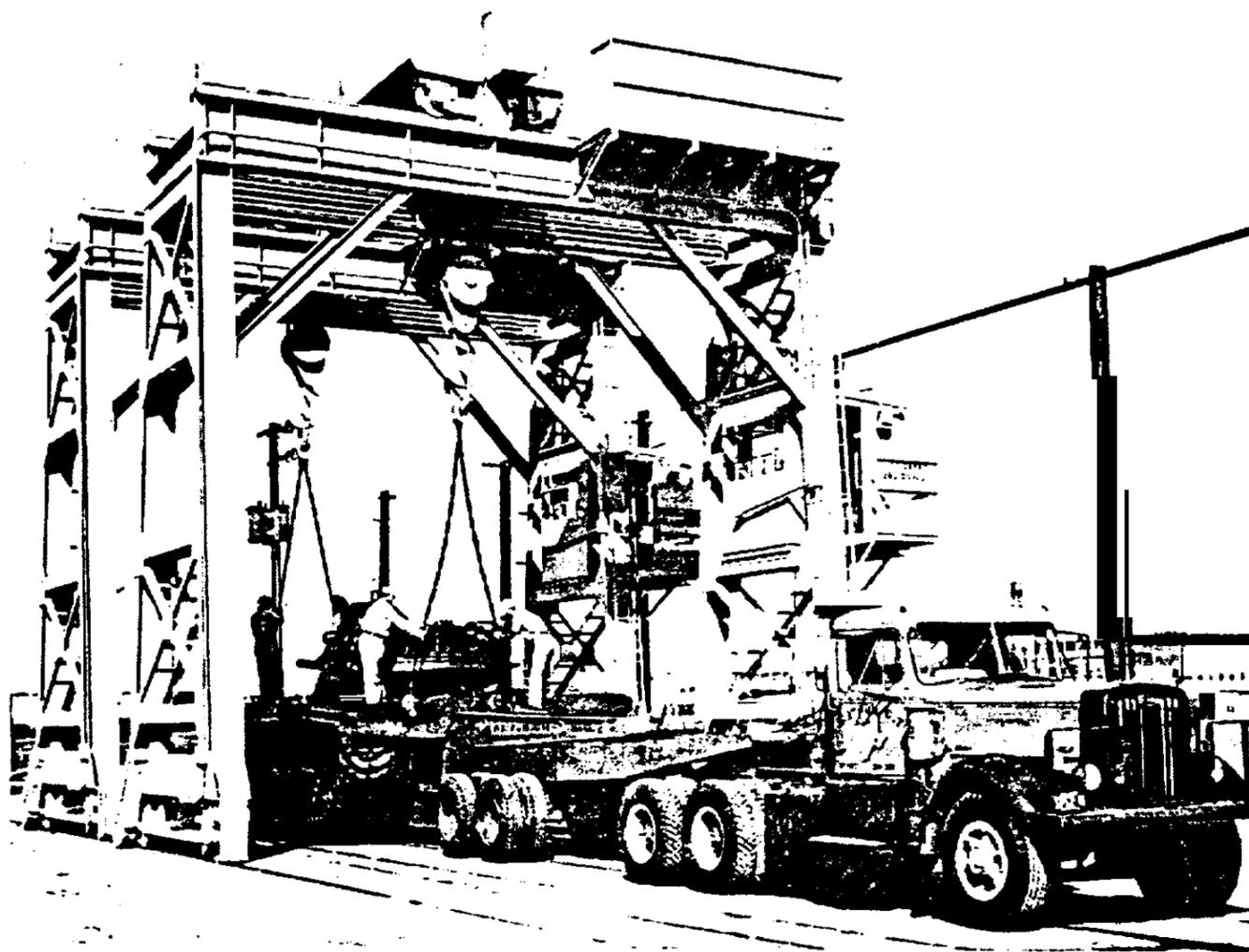


Figure 5-42. Rail-mounted gantry crane.



Figure 5-43. Modified back-to-back (herringbone) storage pattern. (Note: This pattern allows items to be driven or maneuvered directly into their locations with minimal handling.)

Section 4. HAZARDOUS COMMODITIES

| | Paragraph |
|--|-----------|
| General | 5-401 |
| Radioactive material | 5-402 |
| Materials with explosive characteristics | 5-403 |
| Flammable and combustible liquids | 5-404 |
| Compressed gases | 5405 |
| Acids | 5-406 |
| Table of hazardous materials | 5-407 |

5-401. General

a. It is neither possible nor practical to provide a complete detailed item-by-item listing of hazardous materials and their storage compatibility characteristics. This section provides overall guidance for storage and handling of various types of hazardous commodities. (Chap. VI delineates safety requirements.) Methods of storing and handling of hazardous commodities are to be oriented towards facilities acceptable to provide the necessary **fire** and accident **prevention/protection** programs. Facilities utilized to store hazardous commodities will meet the criteria established by **this** section. Items

not covered herein or by cm-rent service/agency directives should be researched for hazard characteristics in the following references

(1) Dangerous Properties of Industrial Materials, by N. Irving Sax (Reinhold Publishing Corporation, 450 W. 33rd St., New York, NY.

(2) NFPA Fire Protection Guide on Hazardous Materials (Pamphlets 325A, **325M**, 49, 491F and **704M**), National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.

(3) Handbook of Industrial Loss Prevention by Factory Mutual (McGraw-Hill Handbook, 330 West 42nd Street, New York, NY 10036).

(4) OSHA Safety and Health Standards (29 CFR 1910).

b. Local procedures should be developed and coordinated with the installation Safety Officer or other appropriate personnel of the respective service for dealing with these items as they are brought into the inventory and made available for storage.

c. When there is a doubt as to the hazard, identity, and storage location of any item in stock, or any item to be stored, the installation fire department, Safety Officer, Industrial Hygienist, or other appropriate personnel of the respective service should be consulted for guidance.

d. If leakage or spillage of one of these items occurs and it has not been covered by local procedure, evacuate the immediate area and seek advice of the Safety Officer or other appropriate personnel of the respective service prior to clean up or disposal operation.

5402. Radioactive Material

The handling of radioactive material involves serious health hazards. Receipt, storage, packaging, handling, shipment and disposal are covered in the joint services regulation, DLAM 4145.8/AR 700-64/NAVSUPINST 4000.34/AFM 67-8/MCO P 4400.105, Radioactive Commodities in DOD Supply System. MIL STD-129, Marking for Shipment and Storage; MIL STD-1458, Radioactive Materials, Marking and Labeling of Items, Packages and Shipping Containers for Identification in Use, Storage and Transportation; and AFR 71-4/TM 38-250/NAVSUP PUB 505(Rev)/MCO P4030.19D/DLAM 4145.3, Preparation of Hazardous Materials for Military Air Shipment; code of Federal regulations (CFR) 49, and OSHA 1910.96 should be consulted when shipping radioactive materials. Matters not covered by current service/agency directives or above reference should be referred to the local Radiological Protection Officer or Safety Officer for specific instructions.

5-403. Materials With Explosive Characteristics

a. Many items have unsuspected inherent properties that are potentially dangerous and, although not listed as explosive or flammable when stored alone, may become hazardous when stored in proximity to other items. For example, oils combined with liquid oxygen can cause an explosion.

b. Care must be exercised when handling these potentially dangerous items to assure storage is not

in proximity to other items. If there is a doubt, the installation Safety Officer or fire department should be consulted for specific instructions.

c. For information in these matters not contained in current service/agency directives or in this regulation refer to the National Fire Protection Guide on Hazardous Materials (NFPA 325A, 325M, 49, 491M and 704M) published by the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02110.

5-404. Flammable and Combustible Liquids

a. General. Storage of flammable and combustible liquids must consider stacking heights and distances between stacks. To provide these data, this paragraph defines classes of flammable and combustible liquids together with tables depicting the storage requirements.

b. *Flammable and combustible liquids (29 CFR 1910.106).*

(1) *Combustible liquids.* Any liquid having a flashpoint at or above 100° F. (37.8° C.). Combustible liquids are divided into two classes as follows: (29 CFR 1910.106(a)(18))

(a) *Class II liquids.* Liquids with flashpoints at or above 100° F. (37.8° C.) and below 140° F. (60° C.) except any mixture having components with flashpoints of 200° F. (93.3° C.) or higher, the volume of which makeup 99 percent or more of the mixture.

(b) *Class III liquids.* Those liquids with flashpoints at or above 140° F. (60° C.). Class III liquids are subdivided into two subclasses:

1 *Class IIIA liquids.* Those liquids with flashpoints at or above 140° F. (60° C.) and below 200° F. (93.3° C.) except any mixture having components with flashpoints of 200° F. (93.3° C.) or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

2 *Class IIIB liquids.* Those liquids with flashpoints at or above 200° F. (93.3° C.).

(2) *Flammable liquids.* Any liquid having a flashpoint below 100° F. (37.8° C.), except any mixture having components with flashpoints of 100° F. (37.8° C.) or higher, the total Of which make up 99 percent or more of the total volume. Flammable liquids are categorized as class I liquids. Class I liquids are divided into three classes as follows:

(a) **Class IA liquids.** Those liquids having flashpoints below 73° F. (22.8° C.) and having a boiling point below 100° F. (37.8° C.).

(b) **Class IB liquids.** Those liquids having flashpoints below 73° F. (22.8° C.) and having a boiling point at or above 100° F. (37.8° C.).

(c) **Class IC liquids.** Those liquids having flashpoints at or above 73° F. (22.8° C.) and below 100° F. (37.8° C.).

c. Tables (indoor storage) (29 CFR 1910.106 Table H-14).

d. **Warehouses or storage buildings for flammable and combustible liquids (29 CFR 1910.106)**

(1) If the storage building is located 50 feet or less from a building or line of adjoining property that may be built upon, the exposing wall will be a blank wall having a fire-resistance rating of at least 2 hours.

(2) The total quantity of liquids within a build-

ing will not be restricted but the arrangement of storage will comply with table 5-1 or 5-2.

(3) Containers in piles will be separated by pallets or dunnage where necessary to provide stability and to prevent excessive stress on container walls.

(4) Portable tanks stored over one tier high will be designed to nest securely, without dunnage, and adequate MHE will be available to handle tanks safely at the upper tier level.

(5) No pile will be closer than 3 feet to the nearest beam, chord, girder, or other obstruction and will be 3 feet below sprinkler deflectors or discharge orifices of water spray, or other overhead fire protection systems.

(6) Aisles of at least 3 feet wide will be provided where necessary for reasons of access to doors, windows or standpipe connections.

e. Tables (outdoor storage) (29 CFR 1910.106 Table H-16).

Table 5-1. Indoor container storage.

| class | liquid Storage level | *Protected storage maximum per pile | | Unprotected storage maximum per pile | |
|-------|-------------------------|-------------------------------------|--------------|--------------------------------------|--------------|
| | | Gallons | Height | Gallons | Height |
| IA | Ground and upper floors | 2,750 (50) | 3 ft (1) | 600 (12) | 3 ft (1) |
| | Basement | Not permitted | | Not permitted | |
| IB | Ground and upper floors | 5,500 (100) | 6 ft (2) | 1,375 (25) | 3 ft (1) |
| | Basement | Not permitted | | Not permitted | |
| IC | Ground and upper floors | 16,500 (300) | 6 ft (2) | 4,125 (25) | 3 ft (1) |
| | Basement | Not permitted | | Not permitted | |
| II | Ground and upper floors | 16,500 (300) | 9 ft (3) | 4,125 (75) | 9 ft (3) |
| | Basement | 5,500 (100) | 9 ft (3) | Not permitted | |
| III | Ground and upper floors | 55,000 (1,000) | 15 ft (5) | 13,750 (250) | 12 ft (4) |
| | Basement | 8,250 (450) | 9 ft (3) | Not permitted | |

Note 1. When 2 or more classes of materials are stored in a single pile, the maximum gallonage permitted in that pile will be the smallest of the 2 or more separate maximum gallonages.

Note 2. Aides will be provided so that no container is more than 12 feet from an aisle. Main aisles will be at least 8 feet wide and side aisles at least 4 feet wide. (Numbers in parentheses indicate corresponding number of 55-gallon drums.)

Note 3. Each pile shall be separated from each other by at least 4 feet.

*A sprinkler or equivalent fire protection system installed in accordance with NFPA standard 30.

Table 5-2. Indoor portable tank storage.
(29 CFR 1910.106 Table H-15).

| Class | liquid Storage level | Protected storage maximum per pile | | Unprotected storage maximum per pile | |
|-------|-------------------------|---------------------------------------|--------|---|--------|
| | | Gallons | Height | Gallons | Height |
| IA | Ground and upper floors | Not permitted | | Not permitted | |
| | Basement | Not permitted | | Not permitted | |
| IB | Ground and upper floors | 20,000 | 7 ft | 2,000 | 7 ft |
| | Basement | Not permitted | | Not permitted | |
| I | Ground and upper floors | 40,000 | 14 ft | 5,500 | 7 ft |
| | Basement | Not permitted | | Not permitted | |
| H | Ground and upper floors | 40,000 | 14 ft | 5,500 | 7 ft |
| | Basement | 20,000 | 7 ft | Not permitted | |
| III | Ground and upper floors | 60,000 | 14 ft | 22,000 | 7 ft |
| | Basement | 20,000 | 7 ft | Not permitted | |

Note 1. When 2 or more classes of materials are stored in a single pile, the maximum gallonage permitted in that pile will be the smallest of the 2 or more separate maximum gallonages.

Note 2. Aisles will be provided so that no portable tank is more than 12 feet from an aisle. Main aisles will be at least 8 feet wide and side aisles at least 4 feet wide.

Note 3. Each pile will be separated from each other by at least 4 feet.

Table 5-3. Outdoor container storage.

| Class | 2 | 3 | 4 | 5 |
|-------|---|--|--|--|
| | Maximum per pile (see note 1) Gal | Distance between piles (see note 2) Ft | Distance to property line that can be built upon (see notes S and 4) Ft | Distance to street, alley, public way (see note 4) Ft |
| IA | 1,100 | 5 | 20 | 10 |
| IB | 2,200 | 5 | 20 | 10 |
| IC | 4,400 | 5 | 20 | 10 |
| II | 8,800 | 5 | 10 | 5 |
| III | 22,000 | 5 | 10 | 5 |

Note 1. When 2 or more classes of materials are stored in a single pile, the maximum gallonage in that pile will be the smallest of the 2 or more separate gallonage.

Note 2. Within 200 feet of each container, there will be a 12-foot wide access way to permit approach of tire control apparatus.

Note 3. The distances listed apply to properties that have protection for exposures as defined. If there are exposures, and such protection for exposures does not exist, the distances in column 4 will be doubled.

Note 4. When total quantity stored does not exceed 50 percent of maximum per pile, the distances in columns 4 and 5 may be reduced 50 percent, but not less than 3 feet.

Table 5-4. Outdoor portable tank storage.
(29 CFR 1910.106 Table H-17)

| 1 | 2 | 3 | 4 | 5 |
|-------|-------------------------|------------------------------|--|---|
| class | Maximum per pile Gal | Distance between piles Ft | Distance to property line that can be built upon Ft | Distance to street, alley, public way Ft |
| IA | 2,200 | 5 | 20 | 10 |
| IB | 4,400 | 5 | 20 | 10 |
| IC | 8,800 | 5 | 20 | 10 |
| II | 17,600 | 5 | 10 | 5 |
| 111 | 44,000 | 5 | 10 | 5 |

Note 1. When 2 or more classes of materials are stored in a single pile, the maximum gallonage in that pile will be the smallest of the 2 or more separate gallonage.

Note 2. Within 200 feet of each portable tank, there will be a 12-foot wide access way to permit approach of fire control apparatus.

Note 3. The distances listed apply to properties that have protection for exposures defined. If there are exposures, and such protection for exposures does not exist, the distances in columns 4 will be doubled.

Note 4. When total quantity stored does not exceed 50 percent of maximum per pile, the distances in columns 4 and 5 maybe reduced 50 percent, but not less than 3 feet.

f. Spill containment. The outdoor storage area will be graded in a manner to divert possible spills away from buildings or other exposures or will be surrounded by a curb at least 6 inches high. When curbs are used, provisions will be made for draining of accumulations of ground or rain water or spills of flammable or combustible liquids. Drains will terminate at a safe location and will be accessible to operation under fire conditions.

g. Fire control. Suitable fire control devices, such as small hose or portable fire extinguishers, will be available at locations where flammable or combustible liquids are stored.

(1) At least one portable fire extinguisher having a rating of not less than 12-B units will be located outside of, but not more than 10 feet from, the door opening into any room used for storage.

(2) At least one portable fire extinguisher having a rating of not less than 12-B units must be located not less than 10 feet, nor more than 25 feet, from any Class I or Class 11 liquid storage area located outside of a storage room but inside a building (29 CFR 1910.106(d)(7)(i)).

h. Warehouse design for storage of flammable/combustible material.

(1) The building will be a single purpose structure, of noncombustible or fire-resistant construc-

tion, one story in height without basement or crawl space, detached, and separated from other buildings by at least 50 feet, or as specified by the respective service. The building will be divided into individual compartments or stock rooms not to exceed 20,000 square feet in areas by means of standard fire walls (fig. 5-45). In addition, a method of exhaust ventilation should be installed as recommended by the respective service. Ventilation will be located in the building in accordance with ventilation engineering standards.

(2) Electrical installations will be in accordance with Class I, Division 2, as defined in Article 500 of the National Electric Code.

(3) Automatic sprinkler protection will provide a discharge floor density of 0.5 gallons per minute/square feet of floor space.

(4) Low level ventilation will be installed to provide .25 cubic feet per minute/square feet of floor area. This ventilation is designed to preclude the accumulation of toxic or explosive mixtures.

(5) Building will be provided with suitable floor drains or wall scuppers to expedite the removal of water discharged from sprinklers and hose streams. If floor drains are used, they will be connected to an appropriate dry well or holding tank and not to a sanitary sewer system or storm sewer.

FLOOR AND ROOF CONSTRUCTION OF NONCOMBUSTIBLE OR FIRE RESISTANT MATERIALS

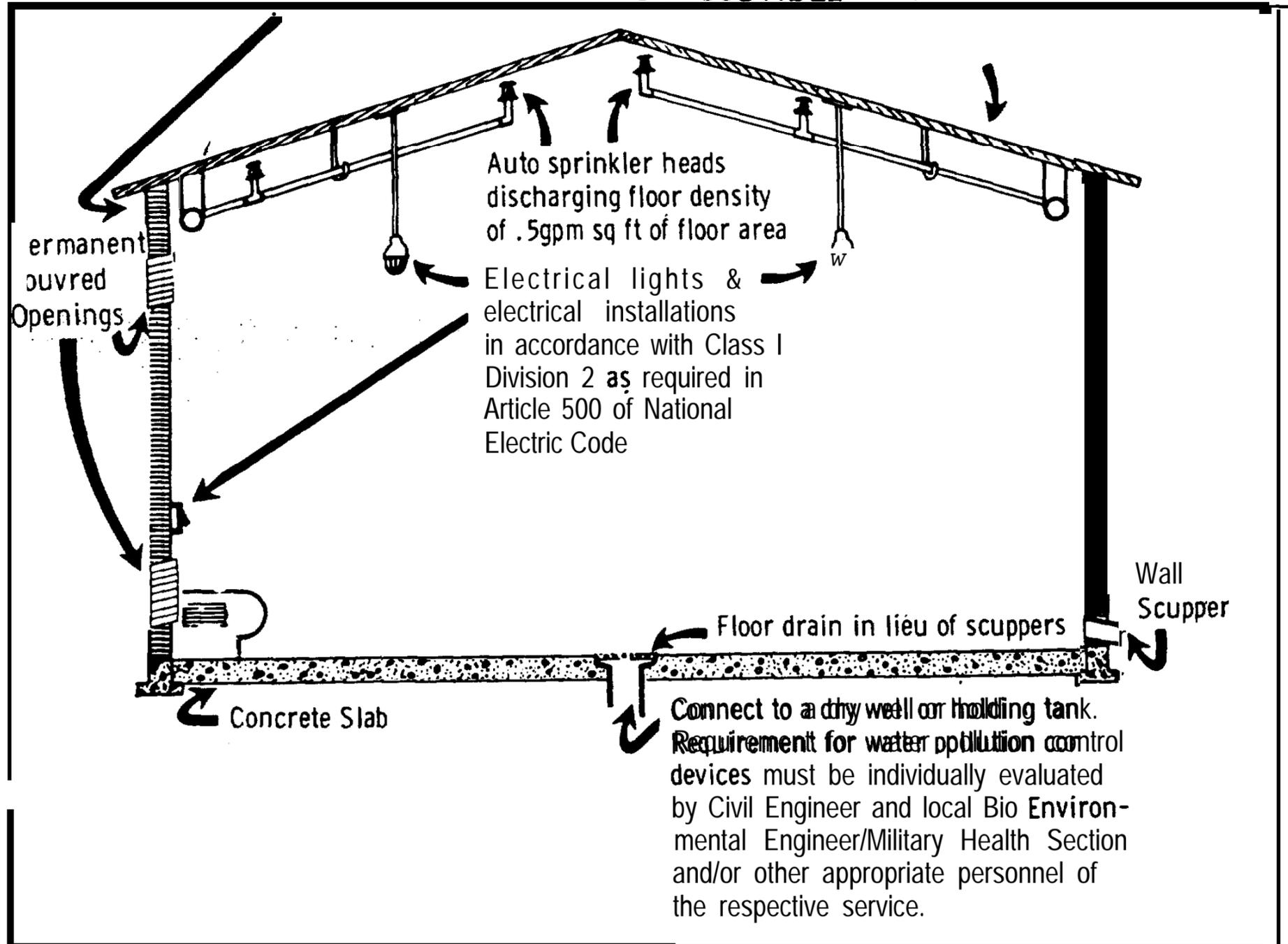


Figure 5-45. Flammable storage warehouse.

i. Flammable/combustible storage procedural guidelines.

(1) *General guidelines.*

(a) Open flame devices will not be used in the flammable storage facility. Avoid storing items against pipes or coils producing heat.

(b) Combustible materials, other than the wood pallets used in the storage of flammable commodities, will not be stored in the facility.

(c) The NO SMOKING rule will be rigidly enforced.

(d) Paint drums stored horizontally should be rolled half a turn periodically, preferably every 90 days. (It is not necessary to roll drums containing thinners.)

(e) Handling of **all** stock should be conducted so as to avoid damage to **labelling**.

Caution. Relabeling of materials whose original **labels** have been obliterated must be done with utmost caution to avoid mislabeling with consequent danger of misuse or waste of materials.

(f) When materials are received for storage, they **will** be checked for date of manufacture and, in the case of mandatory shelf life material, for shelf life expiration date. Materials received without date of manufacture **labelling** will be marked with shipping document date. This date will then serve as the manufacture date for purposes of age control.

(2) *Gasoline motorized industrial vehicles* will be prohibited **from** use in the flammable storage facility. Industrial trucks approved for use in hazardous locations will be used.

(3) *Container bundling guidelines.*

(a) Containers will be handled with extreme care to prevent rupture or breakage.

(b) Containers will be inspected for leaks before being placed in storage and will be inspected periodically while in storage.

(c) **Leaking** containers will be removed from the storage area immediately upon discovery and isolated from other stocks in a well ventilated area in preparation for disposal or repackaging as applicable.

(d) Containers will be stored in a manner **which will** enable issue or use in the order of dates **of manufacture, with** material bearing the oldest date issued first.

(e) Hazardous materials in any quantity will not be stored in open containers.

(f) Containers of paint should be **palletized** before storing.

(g) **Extra** precautions should be taken to protect stored aerosol containers from heat. It is advisable to store aerosols in a well ventilated location **in** case of pressure releases of vapors due to container damage, valve leakage, etc. Since many materials packed in aerosols have short shelf life, ready accessibility for age inspection, etc., should be a condition of storage.

(h) Containers also include ISO/ANSI containers of lengths from 20 feet to 40 feet and a width of 8 feet.

Warning. Aerosols are packed at pressures up to 70 psi. Heat can increase internal pressures to the bursting point. Do not store aerosols in temperatures exceeding 120° F. Keep out of direct sunlight and away from other heat sources which may generate such temperatures.

5-405. Compressed Gases

a. *Types of gas.* For the purpose of a better understanding of this section the following gases are described.

(1) *Compressed gas.* Any material or mixture having in the container an absolute pressure exceeding 40 psi (pounds per square inch) at 70° F. or regardless of the pressure at 70° F. having an absolute pressure exceeding 104 psi at 130° F.; or any liquid flammable material having a vapor pressure exceeding 40 psi at 100° F. as determined by ASTM Test D-323.

(2) *Liquified gas.* A gas which, under the charged pressure, is partially liquid at a temperature of 70° F.

(3) *Flammable gas.* Classified as "flammable compressed gas" if any of the following occurs:

(a) Either a mixture of 13 percent or less (by volume) with air forms a flammable mixture or the flammable range with air is wider than 12 percent regardless of the lower limit. These limits will be determined at atmospheric temperature and pressure. The method of sampling and test procedures will be acceptable to the Bureau of Explosives.

(b) Using the Bureau of Explosive's flame projection apparatus, the flame projects more than 18 inches **beyond** the ignition source with the valve fully opened *or* the flame flashes back and burns at the valve with any degree of valve opening.

(c) Using Bureau of Explosive's open drum apparatus, there is any significant propagation of flame away from the source.

(d) **Using** the Bureau of Explosive's closed drum apparatus, there is any explosion of the vapor-air mixture in the drum.

(4) *Toxic gas.* All gases that are **hazardous** to life or health under normal conditions.

b. Hazards.

(1) *Care in handling.* Because compressed gases are under pressure, such gases **must** be handled with extreme care, particularly the flammable and explosive gases. Compressed gas cylinders must never come in contact with **fire**, sparks, or electrical circuits. An exploded steel container would have the same destructive effect as a bomb explosion.

(2) *Anesthetic gases.* Some gases are anesthetic when inhaled, and, when absorbed in the blood, exert a drug-like action. The inhalation of considerable quantities can cause death.

(3) *Irritant gases.* Irritant gases are not absorbed into the blood, but when inhaled, injure the surface tissue of the breathing passages. Death may result from continuous exposure because of the contraction of the respiratory tract. Examples of irritant gases are chlorine, **sulphur** dioxide, and ammonia.

(4) *Asphyxiating gases.* Some gases are considered harmless in small quantities, but inhaling large quantities of gases that prevent oxygen from reaching the lungs can cause suffocation. Examples of such gases are nitrogen, hydrogen, and helium.

c. *General precautions.* General precautions for handling and storing compressed gases are as follows (29 CFR 1910.101; 1910.1W, 1910.1W, 1910.104; 1910.105; 1910.111).

(1) **Identification** of cylinders will bear color code of noun in accordance with MIL STD-101. Filled cylinders will be **tagged/labelled** with two stock numbers—one for the gas and one for the cylinder. The empty cylinder tag will be **over-stamped "MT"** to designate "empty."

(2) Gases should be referred to by proper name, rather than just "gas."

(3) Safety devices in valves of cylinders (fig. 5-46) will not be tampered with.

(4) Normally, **cylinders will** not be handled, shipped or stored **without** valve protection caps. However, **small** cylinders of less than 40-pound capacity, "ram-bottom" type cylinders, and cylinders with less than 625 cubic inches of volumetric capacity, such as, carbon dioxide and medical gases, do not require valve protection covers.

(5) The valve outlet connectors of both full and empty cylinders must have an authorized dust cap.

(6) Oxygen cylinders must be free from grease or oil.

(7) Numbers of markings that are stamped on cylinders will not be altered or defaced nor will additional markings be applied to cylinders without proper approval.

(8) For storage and handling purposes, all cylinders will be considered **full** and corresponding care must be exercised.

(9) Empty cylinders will be stored separately but in the same manner as **full** cylinders. Therefore, empty cylinders will not be stored with full cylinders on the same pallet or in the same stack. Cylinders will not be lifted by the valve protection cap.

(10) Cylinders **will** not be lifted by cranes or mechanical lifts unless fastened in proper containers, racks, and cradles. Rope and chain slings and electromagnets will not be used to lift cylinders.

(11) Cylinders will not be used as rollers, supports, or for any purpose other than for containing compressed gases.

(12) Compressed gas will not be used to dust Off clothing.

(13) Flames will not be used to test for leaks in compressed gas cylinders.

(14) Valves on empty cylinders will be kept closed.

(15) Cylinder valves will be closed before moving cylinder.

(16) Suitable materials handling equipment will be used for lifting and transporting cylinders.

(17) Suitable hand trucks should be provided

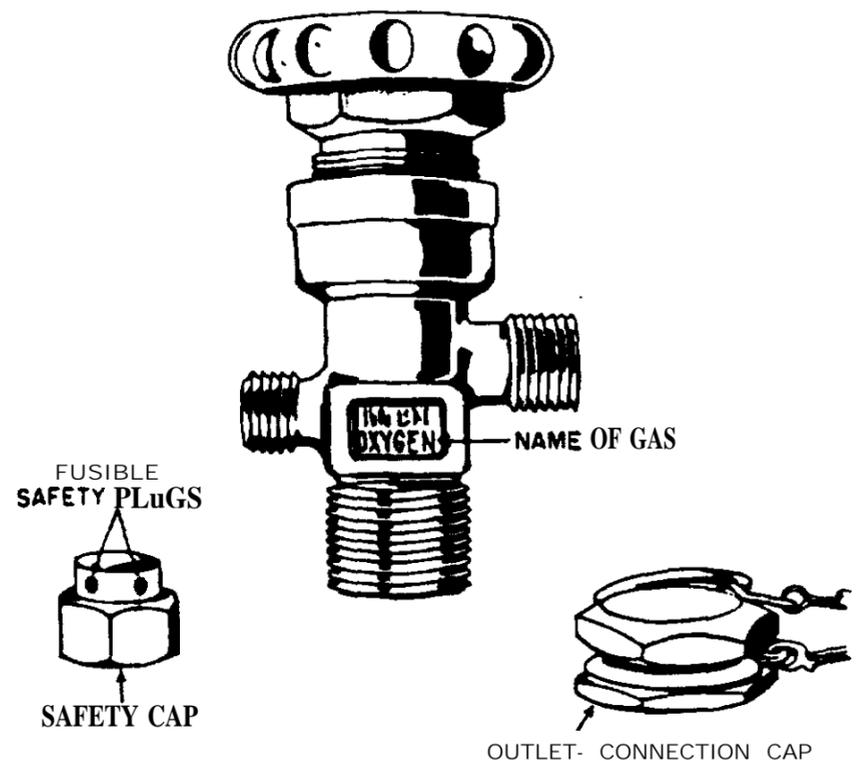


Figure 5-46. View 1. Oxygen cylinder valve.

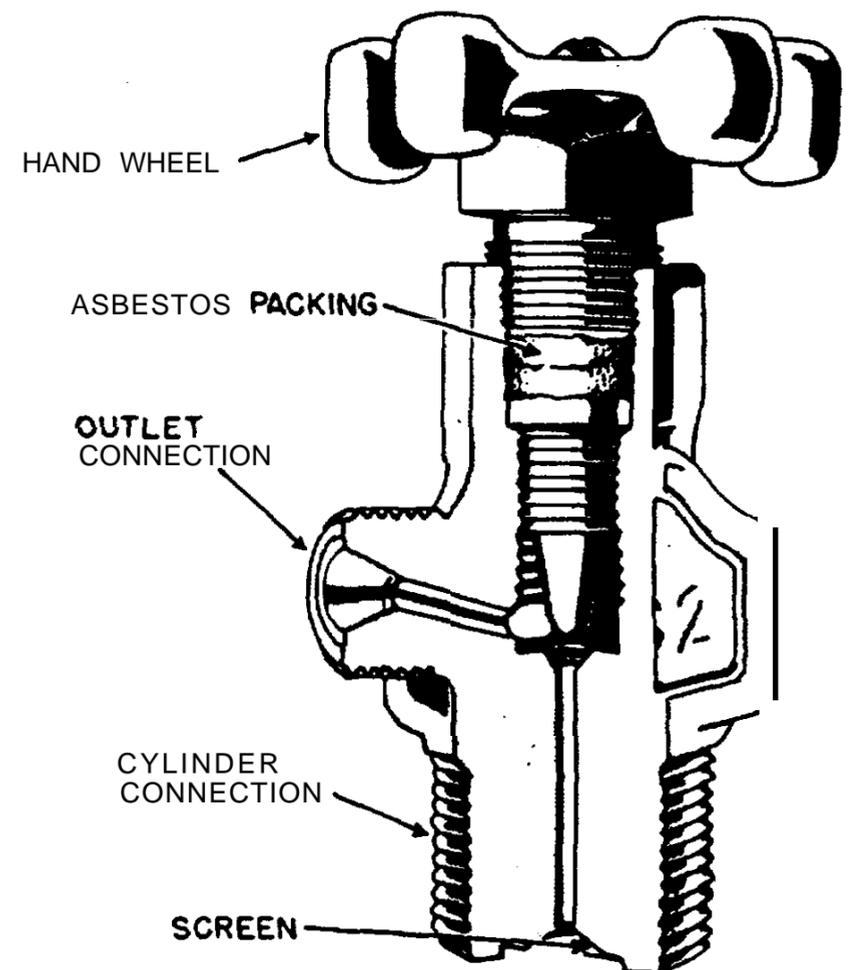


Figure 5-46. View 2. Cutaway view of acetylene cylinder valve.

for conveying cylinders; cylinders moved on hand truck must be held securely in position.

(18) When suitable hand trucks are not available, cylinders will be moved by tilting and rolling

on the bottom edge. Do not drag or slide the cylinders.

(19) Cylinders to be transported in trucks, rail cars, or ships will be braced securely to avoid overturning or moving.

(20) **Cylinders** will not be dropped or permitted to strike against each other violently.

(21) Any cylinder of compressed gas which is not **definitely** identifiable as to contents will not be issued until the content is identified.

(22) **"NO SMOKING"** signs will be posted, and **smoking prohibited in or around** compressed gas storage sheds,

d. Storage criteria for gas cylinders.

(1) Storage *facility design*. The following criteria will apply to all cylinder storage of compressed gases. Future construction of structures for storage of these gas cylinders must meet these criteria and should be examined by safety personnel to verify conformity with safety standards prior to acceptance by supply.

(a) Roofed, open-sided shed storage on a **concrete** slab, above grade, is the preferred type of storage facility if climatic conditions are favorable and security precautions are adequate,

(b) All storage facilities for compressed gases will be separated from other buildings by at least 50 feet.

(c) Flammable gases and gases which support combustion must be stored in separate sheds with a distance of at least 50 feet between sheds.

(d) Preferably, sheds **should** be constructed of light, noncombustible materials.

(e) If one or more sides are installed, provisions must be made to insure a complete change of air at least six times each hour.

(f) All electrical installation will be in accordance with Class I, Division 2 locations as defined in Article 500 of the National Electrical Code. The use of skylights is recommended to decrease the need for electrical connections.

(g) Sheds will not be heated. The use of stationary or rotating roof vents may be necessary to lower the temperature near the ceiling to ambient conditions during warm weather.

(2) Enclosed storage facilities will meet the following criteria

(a) A single story building, above grade, must be utilized.

(b) Separate storage rooms or compartments must be constructed for flammable gases and for

gases which support combustion. Additional compartments for specific types of gases may also be constructed,

(c) The walls, partitions, floors, and ceilings " will be of noncombustible, nonporous material. All walls and partitions will be continuous from floor to ceiling, and will be securely anchored and sealed with mineral wool, rubberized grouting, or other nonporous sealant. At least one wall of each storage room or compartment, for combustible gases, must be on an exterior wall.

(d) It is recommended all doors to storage rooms or compartments be directly through exterior walls. All doors to storage areas will have a fire resistance rating of at least **1½ hours**. All doors to storage areas **from interior parts of the building (when necessary) will be protected by a swinging type, self-closing fire door for Class B openings.**

(e) Windows will be wired glass with approved metal frames and fixed sash. Installation will be in accordance with Standards for the Installation of Fire Doors and Windows, NFPA 80.

(f) Every inside storage room or compartment will be provided with either a gravity or a mechanical exhaust ventilation system or a combination of each type. Such systems will be designed to provide for a complete change of air within each room or compartment at least six times per hour. Where gravity ventilation is provided, the fresh air intake as well as the exhaust outlet from the room or compartment will be on the exterior roof or exterior wall of the building in which the room is located. Provisions will be made for exhaust outlets to accommodate gases heavier than air and lighter than air. Exhaust outlets for heavier than air gases will be within 6 inches of the floor. If a mechanical exhaust system is used, it will be controlled by a switch (manual or automatic) located outside the door of the storage room.

(g) All electrical installations will be in accordance with Class 1, Division 2, locations as defined in Article 500 of the National Electrical Code (NFPA 70).

(3) A fire suppression system for shed and enclosed storage should be installed if the cost of the facility and stored material indicates a need. If temperatures reach the freezing point of water, a **dry-pipe** sprinkler system should be used. If temperatures do not reach freezing, an automatic wet-pipe sprinkler system should be installed in accordance with NFPA Standard 13. Either system should **de-**

liver an application density of 0.50 gallons per minute per square foot for a minimum area of 2,000 square feet. The sprinkler heads installed should meet Factory Mutual Laboratory requirements for large water-drop equipment. A water flow discharge ~~from~~ the sprinkler system must transmit an alarm to central fire department receiving equipment. Scuppers or floor drains should be provided to remove discharged water in enclosed storage facilities.

e. Protective equipment. Where irritant gases, such as ammonia and sulfur dioxide are present in nuisance or light concentrations, gas tight goggles and respiratory protective devices, or full face mask respiratory protective devices should be worn. When entering areas known to be highly contaminated or when rescuing personnel from gassed areas, rescuers will be properly equipped with self-contained breathing apparatus or other appropriate respiratory equipment. Mechanical filter respirators offer no protection against high percentages of gas concentrations and should not be used. When entering areas containing hazardous concentrations of atmospheric contaminants, necessary protective equipment will be worn as prescribed by the installation Safety Officer. Personnel shall be trained in the use and care of respiratory protective equipment and in inspection for operational capability. This training will be the responsibility of the installation fire department or appropriate personnel of the respective service. A good reference is the American National Standards Institute (ANSI) Z88.2-1969, Practices for Respiratory Protection. Additional guidance on the storage and handling of compressed gases and gas cylinders is provided in DLAR 4145.25 /AR-700-68 /NAVSUPINST 4440.128B/MCO 10330 .2B/AFR 67-12, Storage and Handling of Compressed Gases and Gas Cylinders.

5-406. Acids

a. The following fire protection and safety criteria will apply to bulk storage of acids (fig. 5-47).

(1) Building should be one story in height of noncombustible *or* fire-resistant construction and should be equipped with automatic sprinkler protection. If the building has sprinklers, it will be equipped with either floor drains or wall scuppers.

(2) Buildings will be heated to prevent freezing of certain acids. Ventilation will be provided by means of permanent louvered openings at floor and ceiling levels or other accepted gravity ventilation methods.

(3) Electrical installation may be for general purpose requirements.

(4) Protective clothing, eye wash, deluge shower, and self-contained breathing apparatus will be readily available for operating personnel. Personnel shall be trained in the use and care of respiratory protective equipment and in inspection for operational capability. This training will be the responsibility of the installation fire department or appropriate personnel of the respective service.

b. Typical acids that can be stored in the acid facility include:

Hydrochloric (Muriatic) Acid.

Nitric Acid.

Sulphuric Acid.

Phosphoric Acid.

c. Different acids will be stored separately in designated areas. In lieu of aisle space, noncombustible barriers up to a minimum of 3 feet high and sealed at the floor level may be used to obtain maximum storage space.

d. "NO SMOKING" signs will be posted and smoking prohibited in or near acid storage buildings.

e. Acids are among a group of materials that are injurious to personnel because of their corrosive qualities. Care must be taken to prevent any spillage or container breakage which could permit contact to skin, eyes, or inhalation into lungs of personnel working with such material.

5-407. Table of Hazardous Materials (Table 5-5)

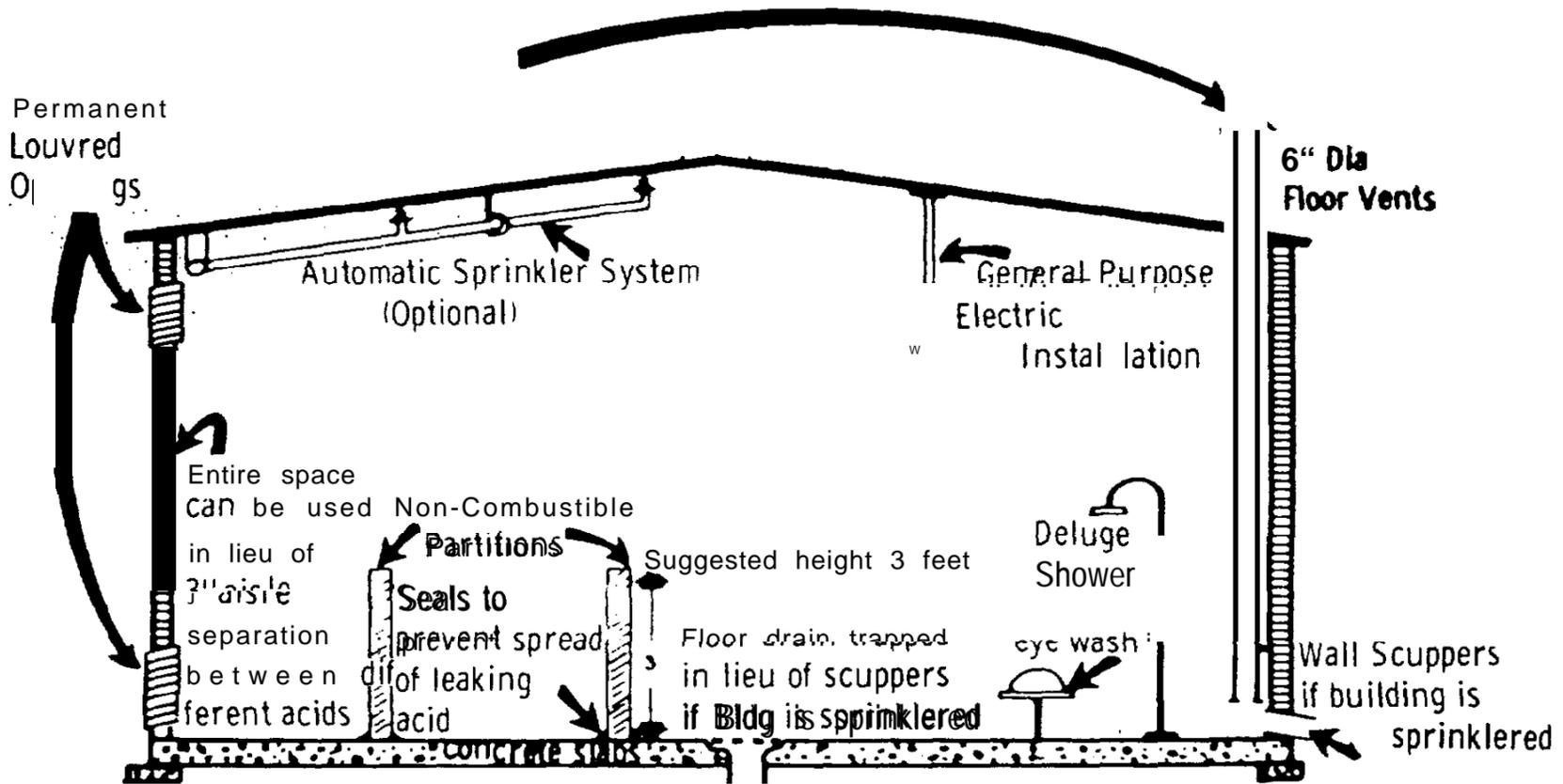
a. The table lists many of the items contained in current DOD Stock Lists and stored at DOD installations. The hazard identity column provides planning guidance to fire departments for safe tactical procedures in emergency situations by providing on-the-spot information to safeguard the lives of fire fighting personnel.

b. Under conditions of leakage or spillage, items with a health or reactivity rating of 2, 3, or 4 are dangerous to personnel not wearing proper protective equipment.

c. Items marked with double asterisks in the table indicate radioactive materials. Consult with the Radiological Protection Officer *or* the Safety Officer for specific instructions.

d. Items not covered in the table should be researched for hazard characteristics in the applicable service *or* agency publications.

BUILDING CONSTRUCTION PREFERABLY NONCOMBUSTIBLE



Ventilation will be located in accordance with ventilation engineering standards

Requirement for water pollution control devices must be individually evaluated by civil engineering and local bio environmental engineer/military health section and/or other appropriate personnel of the respective services.

Note: Strong oxidizing acids such as perchloric and nitric acids should be separated from organic acids such as acetic acid.

Figure 5-47. Acid storage warehouse.

Table 5-5. Hazardous Materials Storage and Handling Criteria

(See notes at end of table for explanation of codes.)

| Noun | Hazard Identity | | | Storage and Handling | Storage Comp Group | Separation Requirement | Type of Storage | | | Portable Fire-extinguisher Type | Class Liquid |
|---|-----------------|--------------|------------|----------------------|--------------------|--|-----------------|------------------|-----------------|---------------------------------|--------------|
| | Health | Flammability | Reactivity | | | | Specific Hazard | Flamm Stage Bldg | Acid Stage Bldg | | |
| Acetaldehyde | 2 | 4 | 2 | 0 | A | 4' aisle space | X | | | 2a-3 | IA |
| Acetic Acid | 2 | 2 | 1 | | B | Minimum of 4' aisle space | | X | | 1-2a-3 | II |
| Acetic Acid Anhydride (See Acetic Anhydride) | 2 | 2 | 2 | E | A | 4' aisle space | X | | | 2a-3 | II |
| Acetone | 1 | 3 | 0 | O | A | 4' aisle space from class I flammables. | X | | | 2a-3 | III |
| Acetone Cyanohydrin | 4 | 1 | 2 | O | A | 4' aisle space | X | | | 2a-3 | IB |
| Acetonitrile | 2 | 3 | 1 | O | A | 4' aisle space | X | | | 2a-3 | IB |
| Acetyl Chloride | 3 | 3 | 2 | H | A | None | | | | 2a-3 | IB |
| Acetyl Oxide (See Acetic Anhydride) | | | | | | | | | | | |
| ACETYL PEROXIDE (25%) | 1 | 2 | 4 | D | E | 4' aisle space | | | | | II |
| Acetylene | 1 | 4 | 3 | O | C | Solid wall compartment or separate building. | | | X | 1-3 | IA |
| Acetylene (in Acetone) | 1 | 4 | 2 | O | A | None | X | | | 2-3 | IB |
| Acetylene Dichloride | 2 | 3 | 2 | O | D | 3' aisle space | | | | 1 | |
| Tetrabromide | 3 | 0 | 1 | 0 | A | 4' aisle space | X | | | 1-2a-3 | IB |
| | 3 | 3 | 2 | O | A | 4' aisle space | X | | | | |
| Acrolein Dimer | 1 | 2 | 1 | O | A | 4' aisle space from class II flammable. | X | | | 3-4 | II |

Table 5-5. Hazardous Materials Storage and Handling Criteria—Continued

(See notes at end of table for explanation of codes.)

| Noun | Hazard Identity | | | | Storage and Handling | Storage Comp Group | Separation Requirement | Type of Storage Facilities | | | | Portable Fire Extinguisher Type | Class Liquid |
|--|-----------------|------------------|-------------|-------------------|--|--------------------|---|----------------------------|----------------|-------|-------------------|---------------------------------|--------------|
| | Health | Flare ma-ability | Reac-tivity | Spe-cific Haz-ard | | | | Flamm Stge Bldg | Acid Stge Bldg | C S F | Gen Pur-pose Whse | | |
| Acrylic Acid | 3 | 2 | 2 | 0 | Protect against physical damage. | B | 4' aisle space | ---- | X | - | ---- | 3 | 11 |
| Acrylic Aldehyde (See Acrolein) | | | | | | | | | | | | | |
| Acrylonitrile | 4 | 3 | 2 | 0 | Store in end of building to aid fire fighting. | A | 4' aisle space from class 11 flammables. | x | ---- | - | ---- | 3-4 | IB |
| Aerosols (Paint) | See label | | | | More in end of building. | D | 3' aisle space | ---- | ---- | - | x | 2,3,4 | |
| Alcohol (Denatured) .. | — | 4 | 0 | 0 | More in end of building to aid fire fighting. | A | 4' aisle space | x | ---- | - | ---- | 3-4 | IB |
| Aldehyde (See Acetaldehyde) | | | | | | | | | | | | | |
| Allyl Alcohol | 3 | 3 | 1 | 0 | Store in end of building. | A | 4' aisle space from class II flammables. | x | ---- | - | ---- | 3-4 | IB |
| See Organic Coating Materials. | | | | | | | | | | | | | |
| Allyl Aldehyde (See Acrolein) | | | | | | | | | | | | | |
| Allyl Chlorocarbonate (See Allyl Chloroformate) | | | | | | | | | | | | | |
| Allyl Chloroformate . . | 3 | 3 | 1 | 0 | Store in end of building. | A | 4' aisle space from class 11 flammables. | x | ---- | - | ---- | 3-4 | IC |
| Allylamine | 3 | 3 | 1 | 0 | Store in end of building. | A | 4' aisle space from class I I flammables. | x | ---- | - | ---- | 3-4 | IB |
| Alum (See Aluminum Potassium Sulphate) | | | | | | | | | | | | | |
| Aluminum (Dust or Powder). | 0 | 1 | 1 | E | Separate from combustible items. | D | 3' aisle space | ---- | ---- | - | x | 5 | |
| Aluminum Acetate ---- | 1 | 0 | 0 | 0 | No special handling --- | D | None | ---- | ---- | - | x | 1-3 | |
| Aluminum Ammonium Sulphate. | 1 | 0 | 0 | 0 | No special handling ... | D | None | ---- | ---- | - | x | 1-3 | |
| Aluminum Chloride ---- | 3 | 0 | 2 | E | No special handling | D | None | ---- | ---- | - | x | 1-3 | |
| Aluminum Potassium Sulphate. | 1 | 0 | 0 | 0 | No special handling ... | D | None | ---- | ---- | - | x | 1-3 | |
| Aluminum Sulphate ... | 1 | 0 | 0 | 0 | No special handling --- | D | None | ---- | ---- | - | x | 1-3 | |

| | | | | | | | | | | | | | | | | | | | |
|--|---|----|---|---|---|---|--|-------|-------|-------|-------|--|--|--|--|--|--|--|------|
| Amino Cyclohexane (see Cyclohexylamine) | | | | | | | | | | | | | | | | | | | |
| Aminopropane (See Propylamine) | | | | | | | | | | | | | | | | | | | |
| Aminotoluene (See Toluidine) (Ortho, Pars) | | | | | | | | | | | | | | | | | | | |
| Ammonia (Anhydrous) | 3 | 1 | 0 | 0 | Separate from gases such as chlorine, bromide, etc. | C | Separate building or solid compartment. | ----- | ----- | X | ----- | | | | | | | | |
| Ammonium Acetate ... | 0 | 0 | 0 | 0 | No special handling -- | D | gone ----- | ----- | ----- | ----- | X | | | | | | | | -3 |
| Ammonium Bifluoride . | 2 | 0 | 0 | 0 | No special handling -- | D | None ----- | ----- | ----- | ----- | X | | | | | | | | -3 |
| Ammonium Chloride . | 1 | 0 | 0 | 0 | No special handling -- | D | None ----- | ----- | ----- | ----- | X | | | | | | | | -3 |
| Ammonium Citrate ---- | 0 | 0 | 0 | 0 | No special handling -- | D | None ----- | ----- | ----- | ----- | X | | | | | | | | -3 |
| Ammonium Dichromate | 3 | 2 | 1 | D | Separate from combustible items. | D | 3' aisle space ----- | ----- | ----- | ----- | X | | | | | | | | -3 |
| Ammonium Hydroxide | 2 | 1. | 1 | o | Separate from combustible "items. | D | 3' aisle space ----- | ----- | ----- | ----- | X | | | | | | | | -3 |
| Ammonium Nitrate ---- | 2 | 1 | 3 | D | Separate from Organic materials, immediately remove and dispose of any spilled nitrate. 'Bulk quantities should be stored in accordance with TO 428-1-3.' | D | 3' aisle space ----- | ----- | ----- | ----- | X | | | | | | | | |
| Ammonium PerChlorate | z | 1 | 4 | D | Separate from combustible items. | D | 3' aisle space ----- | ----- | ----- | ----- | X | | | | | | | | |
| Amyl Acetate | 1 | 3 | 0 | o | Store with class I flammables. | A | 4' aisle space with class 1 I flammables. | X | ----- | ----- | ----- | | | | | | | | -4 |
| Amyl Alcohol | 1 | 2 | 0 | 0 | Store with class II flammables. | A | Separate from class I flammable by 4' space. | X | ----- | ----- | ----- | | | | | | | | ,3,4 |
| Amyl Hydrosulfide (See Amyl Mercaptan) | | | | | | | | | | | | | | | | | | | |
| Amyl Mercaptan | 2 | 3 | 0 | 0 | Store with class 11 flammables. | A | Separate from class I flammable by 4' space. | X | ----- | ----- | ----- | | | | | | | | ,4,5 |
| Amyl Sulphydrate (See Amyl Mercaptan) | | | | | | | | | | | | | | | | | | | |
| Aniline | 3 | 2 | 0 | 0 | Store with class 11 flammables. | A | 4' aisle space ----- | X | ----- | ----- | ----- | | | | | | | | ,4,5 |
| Anthion (See Potassium Persulfate) | | | | | | | | | | | | | | | | | | | |

Table 5-5. Hazardous Materials Storage and Handling Criteria—Continued
(See notes at end of table for explanation of codes.)

| Noun | Hazard Identity | | | | Storage and Handling | Storage Comp Group | Separation Requirement | Type Facilities | | | Portable Fire Extinguisher Type | Claw Liquid |
|--|-----------------|--------------|------------|-----------------|---|--------------------|---|-----------------|------------------|--------------------|---------------------------------|-------------|
| | Health | Flammability | Reactivity | Specific Hazard | | | | Flamm Stge Bldg | Com Gas Stg Bldg | Gen Pur. pose Whse | | |
| Anti-Freeze (75% Ethylene Glycol). | — | 1 | 1 | 0 | None ----- | D | 6' aisle space | ----- | --- | x | 3-4 | IIIB |
| Antimonic Sulfide (See Antimony Pentasulfide) | | | | | | | | | | | | |
| Antimony Pentasulfide | 3 | 1 | 1 | 0 | Separate from other items. | D | 6' aisle space | ----- | --- | x | 1 | |
| Antimony Red (See Antimony Pentasulfide) | | | | | | | | | | | | |
| Argon Gas ----- | 0 | 0 | 0 | 0 | None ----- | C | None ----- | ----- | x | ----- | N/A | |
| Aqua Fortis (See Nitric Acid) | | | | | | | | | | | | |
| Azotic Acid (See Nitric Acid) | | | | | | | | | | | | |
| Barium Binoxide (See Barium Peroxide) | | | | | | | | | | | | |
| Barium Chlorate ---- | 1 | 0 | 2 | D | Separate from other items. | D | 6' aisle space | ----- | --- | x | 1 | |
| Barium Dioxide (See Barium Peroxide) | | | | | | | | | | | | |
| Barium Nitrate | 1 | 0 | 1 | D | Do not store on wood pallets. Immediately remove and dispose of any spilled nit rate. | D | 6' aisle space | ----- | --- | x | 1 | |
| Barium Peroxide . . . | 1 | 0 | 1 | D | Separate from combustible organic materials. Remove spilled peroxide immediately. | D | 6' aisle space | ----- | --- | x | Dry powder. | |
| Barium Superoxide (See Barium Peroxide) | | | | | | | | | | | | |
| Benzene | — | 3 | 0 | 0 | Store in end of building to aid fire fighting. | A | Separate from class II flammable liquids by 4' space. | X | --- | ----- | 3,4,5 | IB |

| | | | | | | | | | | | | | | | | | | | |
|---|-------|---|---|---|--|---|---|----|-------|------|------|--|--|--|--|--|--|--|-----|
| Benzol (See Benzene) | | | | | | | | | | | | | | | | | | | |
| Benzoic Acid | 2 | 1 | 0 | 0 | Separate from oxidizing materials. | D | 3' aisle space | -- | ---- | ---- | x | | | | | | | | 3,4 |
| BENZOYL PEROXIDE. | 1 | 4 | 4 | D | Special facility handling. | E | | | | | | | | | | | | | |
| Beryllium (Dust or Powder). | 4 | 1 | 1 | E | Separate from oxidizing materials. | D | 3' aisle space | -- | ---- | ---- | x | | | | | | | | |
| Biethylene (See Butadiene) | | | | | | | | | | | | | | | | | | | |
| Bleaching Powder (See Calcium Hypochlorite) | | | | | | | | | | | | | | | | | | | |
| Boroethane (See Diborane) | | | | | | | | | | | | | | | | | | | |
| Bromine (Small Lots Only). | 4 | 0 | 0 | M | Separate from acids-Keep from freezing. (Freezing point is 20° F.) | B | Maintain 5' space from acids. | -- | x | ---- | ---- | | | | | | | | |
| Bromochloromethane .. | 1 | 0 | 0 | o | Protect from physical damage. | D | None | -- | ---- | ---- | x | | | | | | | | N/A |
| Bronze (Duet or Powder). | ----- | 0 | 1 | E | Protect from physical damage. | D | Keep separate from aluminum dust. | -- | ---- | ---- | x | | | | | | | | |
| Burnt Lime (See Calcium Oxide). | | | | | | | | | | | | | | | | | | | |
| Butadiene Gas | 2 | 4 | 2 | o | Do not store with oxygen cylinders. | c | Separate building or solid compartment. | -- | | x | ---- | | | | | | | | 4 |
| Butanal (See Butyraldehyde). | | | | | | | | | | | | | | | | | | | |
| Butane Lighter Fuel (2 3-oz containers). | 1 | 4 | 0 | 0 | Store in end of building. | A | 3' aisle space from class II flammables. | x | | ---- | ---- | | | | | | | | 4 |
| Butanoic Acid (See Butyric Acid). | | | | | | | | | | | | | | | | | | | |
| Butanol (See Butyl Alcohol). | | | | | | | | | | | | | | | | | | | |
| Butyl Alcohol | 1 | 3 | 0 | 0 | Store with class II flammables. | A | Separate from class I flammable liquid by 4' aisle space. | x | | ---- | ---- | | | | | | | | IC |
| Butyl Acetate | 1 | 3 | 0 | 0 | Store in end of building. | A | Separate from class II | x | ---- | ---- | ---- | | | | | | | | 4 |
| Butyl "Cellosolve" | 2 | 2 | 0 | 0 | Store with class II flammables. | A | 1' aisle space from class I flammables. | x | ---- | ---- | ---- | | | | | | | | 4 |
| Butyl Ether (See Dibutyl Ether). | | | | | | | | | | | | | | | | | | | |
| BETYL HYDROPEROXIDE. | 1 | 4 | 4 | D | Special storage and handling. | E | 1' aisle space | -- | ---- | ---- | ---- | | | | | | | | 3,4 |
| BUTYL PERACETATE. | 2 | 3 | 4 | D | Special storage and handling. | E | | | | | | | | | | | | | |

Table 5-5. Hazardous Materials Storage and Handling Criteria-Continual
(See notes at end of table for explanation of codes.)

| Noun | Hazard Identity | | | | Storage and Handling | Storage Comp Group | Separation Requirement | Special Facilities | | | | Portable Fire Extinguisher Type | Class Liquid |
|--|-----------------|--------------|------------|-----------------|--|--------------------|--|---------------------|----------------|-------------------|------------------|---------------------------------|--------------|
| | Health | Flammability | Reactivity | Specific Hazard | | | | Flammable Stge Bldg | Acid Stge Bldg | Corrosive St Bldg | Gen Purpose Whse | | |
| BUTYL PERBENZOATE. | 1 | 3 | 2 | D | Special storage and handling. | E | | | | | | | |
| BUTYL PEROXYPIVALATE | 2 | 3 | 4 | D | Special storage and handling. | E | ----- | ----- | ----- | ----- | 3,4 | | |
| Butyraldehyde (Normal and Iso). | 2 | 3 | 1 | 0 | Store in end of building, | A | 1' aisle space ----- | x | ----- | ----- | 3,4 | Foam | IB |
| Butyric Acid | 2 | 2 | 0 | 0 | Store in end of building. | B | 1' aisle space ----- | ----- | x | ----- | 3,4 | | 111A |
| Butyric Aldehyde (See Butyraldehyde). | | | | | | | | | | | | | |
| Cadmium Oxide ----- | 3 | 0 | 0 | 0 | No special treatment | D | None ----- | ----- | ----- | ----- | x | 1-3 | |
| CALCIUM ----- | 1 | 4 | 2 | E | Special storage and handling. | E | ----- | ----- | ----- | ----- | 5 | | |
| Calcium Carbide ----- | 1 | 4 | 2 | E | Store in unsprinklered, non-combustible shed for storage over 10 drums. | D E | End of warehouse with 3' space from other materials. | | | | | | |
| Calcium Cyanide ----- | 4 | 0 | 0 | 0 | No special treatment | D | Separate from oxidizing materials. | ----- | ----- | ----- | x | 3 | |
| Calcium Hydroxide (Slacked Lime). | 1 | 0 | 0 | 0 | No special treatment | D | None ----- | ----- | ----- | ----- | x | 1-3 | |
| Calcium Hypochlorite (Bleaching Powder). | 2 | 4 | 2 | E | Protect against physical damage. Keep dry, store in unsprinklered space. | D | Separate from combustible materials by 3' aisles. | | | | | | |
| Calcium Oxide (Quick Lime). | 1 | 0 | 1 | 0 | Store in dry place ----- | D | None ----- | ----- | ----- | ----- | x | 1-3 | |
| Calcium Sulfate ----- | 1 | 0 | 0 | 0 | No special treatment | D | None ----- | ----- | ----- | ----- | x | 1-4 | |
| Calibrating Fluid (F.P. 100° F.). | See label | -- | ----- | 0 | Store with class II flammables. | A | Separate from class I by 4' aisle. | x | ----- | ----- | ----- | 3-4 | II |
| Calyx (See Calcium Oxide) | | | | | | | | | | | | | |
| Carbamic Nitrile (See Cyanamide) | | | | | | | | | | | | | |
| Carbolic Acid (See Phenol) | | | | | | | | | | | | | |
| Carbon Dioxide (Gas) . | 1 | 0 | 0 | 0 | Extinguishing agent . | c | None ----- | ----- | ----- | ----- | x | N/A | |
| Carbon Dioxide (Solid) | 1 | 0 | 0 | 0 | No special treatment | D | None ----- | ----- | ----- | ----- | x | N/A | 11 |

| | | | | | | | | | | | | | | | |
|--|-----------------|---|---|---|---|---|--|---|--|-------|-------|-------|-----|-----|----|
| Carbon Disulfide ----- | 2 | 1 | 3 | 1 | — | 0 | Stored in end of building to aid fire fighting. | A | Separate from class 11 flammables by 4' aisle space. | x | ----- | ----- | --- | 1,4 | II |
| Carbon Removing Compound. | see label | | | | | 0 | No special handling .. | D | None | ----- | ----- | ----- | x | 1,4 | |
| Carbon Tetrachloride .. | — | 0 | 0 | 0 | 0 | 0 | Protect from physical damage. | A | None | ----- | ----- | ----- | x | N/A | |
| catalyst ----- | see label | | | | | 0 | Store with class II flammables. | A | Separate from class I flammables. | x | ----- | ----- | --- | 1/4 | |
| Caustic Potash (See Potassium Hydroxide). | | | | | | | | | | | | | | | |
| Caustic Soda (See Sodium Hydroxide). | | | | | | | | | | | | | | | |
| Celluloid (See Cellulose Nitrate). | | | | | | | | | | | | | | | |
| Cellulose Acetate (Dopes) | 2 | 2 | 3 | 0 | 0 | 0 | Protect against excess of heat or light. | A | Separate from class I flammables by 3' aisle space. | x | ----- | ----- | --- | 1 | |
| Cellulose Nitrate (Dopes) ----- | 2 | 3 | 3 | 0 | 0 | 0 | Store in end of building to aid fire fighting. | A | Separate from class II flammables by 3' aisle space. | x | ----- | ----- | --- | 1,3 | |
| Cement, Rubber | see label | | | | | 0 | Store in end of building to aid in fire fighting. | A | 1' aisle space from class 11 flammables. | ----- | ----- | ----- | x | 1,4 | |
| Charcoal | 0 | 2 | 0 | 0 | 0 | 0 | Store away from oxidizing materials (subject to spontaneous heating). | | | | | | | | |
| Charcoal (Activated) .. | 0 | 2 | 0 | 0 | 0 | 0 | Store away from oxidizing materials (subject to spontaneous heating). | D | 1' aisle space | ----- | ----- | ----- | x | 1 | |
| chloride of Lime (See Calcium Hypochlorate). | | | | | | | | | | | | | | | |
| Chlorinated Lime (See Calcium Hypochlorate). | | | | | | | | | | | | | | | |
| Chlorine ----- | 3 | 0 | 1 | D | D | D | Keep in separate building or separated from acetylene, ammonia hydrogen gases. | c | Solid wall compartments or separate building. | ----- | ----- | x | --- | 1 | |
| Chlorobenzene (See Monochlorobenzene). | | | | | | | | | | | | | | | |
| Chlorobenzole (See Monochlorobenzene). | | | | | | | | | | | | | | | |

Table 5-5. Hazardous Materials Storage and Handling Criteria—Continued

(See notes at end of table for explanation of codes.)

| | Hazard Identit: | | | | Storage and Handling | Storage Comp Group | Separation Requirement | Storage Facilities | | | | Portable Fire Extinguisher Type | Class Liquid |
|---|-----------------|----------------|-------------|-------------------|--|--------------------|--|-------------------------|-------------------------|-------------------------|------------------|---------------------------------|--------------|
| | Health | Flam-ma-bility | Reac-tivity | Spe-cific Haz-ard | | | | Flamm Stge Bldg | Acid Stge Bldg | Cor Ga Stg Bld | Gen Purpose Whse | | |
| Chloroethane (See Ethyl Chloride). Chloroethene (See Vinyl Chloride). Chloroethylene (See Vinyl Chloride), Chloroform ----- Chlorosulfonic Acid . . . | — 3 | 0 0 | 0 2 | 0 N | No special treatment Drums must be stored with plugs up. Drums must be vented once a week. | D B | None ----- 3' aisle space ----- | ----- ----- | ----- x | ----- ----- | x ----- | N/A N/A | |
| Chromic Acid (See Chromium Trioxide). Chromic Anhydride (See Chromium Trioxide). Chromium Trioxide . . . | 1 | 0 | 1 | D | Do not store on wood floors or pallets. | B | 3' aisle space ----- | ----- | x | ----- | ----- | 1 | |
| Cinnamene (See Styrene). Cleaning Compound Solvent (F.P. 190° F.). Cleaner and lubricant (See Methyl Chloroform). Cobaltus Nitrate ----- | See label ----- | | | | Separate from class I flammables. | A | 4' aisle space from class I flammables. | X | | ----- | ----- | 5 | IIIB |
| Collodion (See Cellulose Nitrate). Copper Carbonate ----- Copper Sulfide ----- Copper Sulphate. Copper Nitrate ----- | 1 1 1 | 0 0 0 | 0 0 1 | 0 E D | No special handling -- No special handling -- Do not store on wood floors or pallets. | D D D | None ----- None ----- Separate from combustible materials by 3' aisle space. | ----- ----- ----- | ----- ----- ----- | ----- ----- ----- | x x x | 3 1-3 1 | |

| | | | | | | | | | | | | | |
|--|-----------|---|---|---|--|-----|---|---|--|---|---|-------------|------|
| Corrosion Preventive (F.P. 350° F.). | See label | | | 0 | No special handling | A/D | 4' aisle space | x | | | x | I | IIIB |
| Corrosion Remover | See label | | | | No special handling | D | None | | | | x | II | II |
| Cresol, Ortho | 3 | 2 | 0 | C | No special handling | A | May be stored with class II flammables. | X | | | | II,5 | II |
| Meta | 3 | 1 | 0 | c | | | | | | | | | |
| Cresylic Acid (See Cresol). | | | | | | | | | | | | | |
| Cresylic Alcohol (See Cresol). | | | | | | | | | | | | | |
| CUMENE HYDROPEROXIDE. | 1 | 2 | 4 | D | Special facility requirement. Non-combustible, detached, ventilated, unheated building. Water deluge system required for large quantity storage. | E | Do not store with other material. | | | | | 1,4,5 | IIA |
| Cupric Carbonate (See Copper Carbonate). | | | | | | | | | | | | | |
| Cupric Fluoroborate | 1 | 0 | 0 | 0 | No special handling | D | None | | | | x | 3 | |
| Cupric Nitrate (See Copper Nitrate). | | | | | | | | | | | | | |
| Cupric Sulfate. | | | | | | | | | | | | | |
| Cyanamide | 4 | 1 | 3 | 0 | No special handling | D | 1' aisle space | | | | x | 3 | IIIB |
| Cyanogen (Gas) | 4 | 4 | 2 | E | Do not store with oxygen cylinders. | c | Separate building or solid wall compartment. | | | x | | | |
| Cyclohexane | 1 | 3 | 0 | 0 | | | | | | | | | |
| Cyclohexanone | 1 | 2 | 0 | 0 | | | | | | | | | |
| Cyclohexylamine | 2 | 3 | 0 | 0 | No special handling | A | May be stored with class I flammables. | x | | | | 1, 2a, 3, 4 | IC |
| Desk (See Diethyl Aluminum Chloride). | | | | | | | | | | | | | |
| Decaborane | 3 | 2 | 1 | 0 | Separate from oxidizing agents. | D | 1' aisle space | | | | x | I | |
| Decaboron Tetradehydride (See Decaborane). | | | | | | | | | | | | | |
| Decontaminating Agent | See label | | | 0 | No special handling | D | None | | | | x | II | |
| Deodorants (Dichlorobenzene Ingredients). | 2 | 2 | 0 | 0 | No special handling | D | None | | | | x | II | |
| DeOxidant | | | | | No special handling | D | None | | | | x | II | |
| Desiccants (Activated) | | | | | No special handling | D | None | | | | x | II | |
| Developer Inspection Penetrants (Fluorescent and Non-Fluorescent). | See label | | | | Store with class II flammables. | A | Separate from class I flammables by 3' aisle space. | x | | | | II | |
| Diacetyl Peroxide (See Acetyl Peroxide). | | | | | | | | | | | | | |

Table 5-5. Hazardous Materials Storage and Handling Criteria—Continued

(See notes at end of table for explanation of codes.)

| Noun | Hazard Identity | | | | Storage and Handling | Storage Group | Separation Requirement | Type of Storage Facilities | | | | Portable Fire Extinguisher Type | Class Liquid |
|--|-----------------|--------------|----------|-----------------|---|---------------|---|----------------------------|----------------|--------------------|------------------|---------------------------------|--------------|
| | Health | Flammability | Toxicity | Specific Hazard | | | | Flamm Stge Bldg | Acid Stge Bldg | Comp Gas Stge Bldg | Gen Purpose Whse | | |
| Diamine (See Hydrazine). Diborane (Gas) ----- | 3 | 4 | 3 | E | Separate from oxygen cylinders. (Gas will ignite spontaneously on contact with air.). | C | Separate building or solid compartment. | ----- | ----- | X | ----- | 1-4 | IA |
| Diboron Hexahydride (See Diborane). Dibutyl Ether ----- | 2 | 3 | 0 | 0 | Store in end of building to aid fire fighting. | A | 1' space from class II flammable liquids. | X | ----- | ----- | ----- | 1,4,5 | IC |
| Dibutylperoxide (Tertiary). | 2 | 3 | 4 | D | Store in end of building to aid fire fighting. | A | 1' space from class II flammable liquids. | X | ----- | ----- | ----- | 1,4,5 | IB |
| Dichlorobenzene (Ortho) | 2 | 2 | 0 | 0 | Store with class III flammables. | A | 1' aisle space from class I. | X | ----- | ----- | ----- | 1,3,4,5 | IIIA |
| Dichlorobutane ----- | 2 | 2 | 0 | 0 | May be stored with class II flammable liquids. | A | Separate from class I flammables, 4' aisle space. | X | ----- | ----- | ----- | 1,4,5 | II |
| Dichlorodifluoromethane (Freon—12 Gas). | 1 | 0 | 0 | 0 | No special handling... | C | Inert gas—may be stored with any other type gas. | ----- | ----- | X | ----- | | |
| Dichloro Ethane (See Ethylene Dichloride). Dichloroethylene (See Vinylidene Chloride). | | | | | | | | | | | | | |
| Diethyl Aluminum Chloride, | 3 | 3 | 3 | E | Protect containers against shock and damage. | A | May be stored with class II flammables. | X | ----- | ----- | ----- | 1-4 | |
| Diethylamine ----- Diethylene Dioxide (See Dioxane). Diethylene Ether (See Dioxane). Diethyl Ether (See Ether). Diethyl Oxide (See Ether). | 2 | 3 | 0 | 0 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | 1a,3,4 | |

| | | | | | | | | | | | | | |
|--|-----------|---|---|---|---|-----|--|------|--|--|---|--------|------|
| Diethylenetriamine | 3 | 1 | 0 | 0 | Protect against physical damage. | A | May be stored with class II flammables. | x | | | | 2a-3-4 | IIIB |
| Diethylene Glycol (F.P. 276* F.). | ----- | 2 | 0 | 0 | No special handling if in general purpose warehouse. | A,D | 4' aisle space if stored in flammable building. | x | | | x | 3-4 | IIIB |
| Diethyl zinc | — | 3 | 3 | E | Protect against physical damage. | A | 3' aisle space ..----- | x | | | | 3-4 | |
| Diisopropylamine | 3 | 3 | 0 | o | Protect against physical damage. | A | 4' aisle space | x | | | | 2a-3-4 | IB |
| DIISOPROPYL PEROXYDICARBONATE. | — | 4 | 4 | D | Special handling and facility. Max. 53° F. | E | | | | | | | |
| Dimethylamine (See Methyl Amines). | 3 | 4 | 0 | o | | | | | | | | | |
| Dimethyl Benzene (See Xylene). | | | | | | | | | | | | | |
| Dimethylene Oxide (See Ethylene Oxide). | | | | | | | | | | | | | |
| Dimethyl Sulfide | 4 | 4 | 0 | 0 | Store in end of building to aid fire fighting. | A | Separate from class I flammables by 3' aisle space. | x | | | | 3-4 | |
| DINITROBENZENE (ORTHO). | 3 | 1 | 4 | 0 | Special handling and facility. | E | 4' aisle space | ---- | | | | 1,3,4 | IIIB |
| DINITROTOLUENE | 3 | 1 | 3 | 0 | Special treatment and facility. Explosive hazard when involved in fire. | E | | ---- | | | | 1,3,4 | |
| Dioxane Pars | 2 | 3 | 0 | 0 | Store in end of building to aid in fire fighting. | A | Separate from class 11 flammables by 4' aisle space. | x | | | | 3-4 | IB |
| Diphacinpariffin (See Rodenticide). | | | | | | | | | | | | | |
| Dopes (See Cellulose Nitrates and Cellulose Acetates). | | | | | | | | | | | | | |
| Drying Agent (Aerosol) | 0 | 1 | 0 | 0 | No special treatment | D | None ----- | ---- | | | x | 3-4 | |
| Dust Mop Treatment Compound. | See label | | | | No special treatment | D | None ----- | ---- | | | x | 3-4 | |
| Dye Solutions (1 Qt. Bottles). | See label | | | | Store in end of building to aid in fire fighting. | A | Separate from class II flammables by 3' aisle space. | x | | | | 3-4 | |
| Dye, Xylene. Azo, Xylene. | 0 | 3 | 0 | 0 | Store in end of building to aid in fire fighting. | A | Separate from class II flammables by 3' aisle space. | x | | | | 3-4 | |
| Enamels (See Organic Coating Materials). | | | | | | | | | | | | | |
| Ether (Ethyl—Diethyl) | 2 | 4 | 1 | 0 | Store in end of building to aid in fire fighting. | A | Separate from class II flammables by 4' aisle space. | x | | | | 3-4 | IA |

Table 5-5. Hazardous Materials Storage and Handling Criteria—Continued

(See notes at end of table for explanation of codes.) , “”.

| | Hazard Identity | | | | Storage and Handling | Storage Comp Group | Separation Requirement | Type of Storage Facilities | | | | Portable Fire Extinguisher Type | Clam Liquid |
|--|-----------------|--------------|------------|-----------------|---|--------------------|--|----------------------------|----------------|--------------------|------------------|---------------------------------|-------------|
| | Health | Flammability | Reactivity | Specific Hazard | | | | Flamm Stge Bldg | Acid Stge Bldg | Comp Gas Stge Bldg | Gen Purpose Whse | | |
| Etherin (See Ethylene). Ethyl Acetate | 1 | 3 | 3 | 0 | Store with class I flammables, | A | Separate from class 11 flammables by 4' aisle space. | x | ---- | ----- | ---- | -4 | IB |
| Ethylacetic Acid (See Butyric Acid). Ethyl Acrylate ----- | 2 | 3 | 2 | 0 | Store with class I flammables. | A | Separate from class 11 flammables by 4' aisle space. | x | ---- | ----- | ---- | ,3,4 | IB |
| Ethyl Alcohol ----- | — | 4 | 0 | 0 | Store with class I flammables. | A | Separate from class II flammables by 4' aisle space. | x | ---- | ----- | ---- | 3 -4 | IB |
| Ethylamine Ethyl Benzene | 3 2 | 4 3 | 0 0 | 0 0 | Store with class I flammables. | A | Separate from class II flammables by 4' aisle space. | x | ---- | ----- | ---- | -1 | IB |
| Ethyl Benzol (See Ethyl Benzene). Ethyl Chloride ----- | 2 | 4 | 0 | 0 | Store with class I flammables. | A | Separate from class II flammables by 4' aisle space. | x | ---- | ----- | ---- | -4 | 1A |
| Ethyl Nitrate (Nitric Ether). Ethyl Ether (See Ether). Ethyl Nitrite (Nitrous Ether). | 2 2 | 3 4 | 4 4 | 0 0 | Store with class I flammables at end of building. | A | 4' aisle space from class II. | x | ---- | ----- | ---- | ,3,4 | 1A |
| Ethyl Oxide (See Ether), Ethylene | 1 | 4 | 2 | 0 | Separate from oxygen, chlorine gases. | c | Separate building or solid compartment. | ----- | ---- | x | x | -4 | |
| Ethylene Aldehyde (See Acrolein). Ethylene Chloride (See Ethylene Dichloride). Ethylene Dichloride ... | 2 | 3 | 0 | 0 | Store with class I flammables. | A | Separate from class II flammables. | x | ---- | ----- | ---- | -4 | IB |
| Ethylene Glycol Monobutyl (See "Butyl Cellosolve"). | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|--|-----------|---|---|---|---|---|--|-------|-------|-------|-------------|------|
| Ethylene Oxide (Gas) .. | 2 | 4 | 3 | 0 | Store in separate shed or in gas building separate from oxygen. | c | Solid compartment away from oxygen. | ----- | ----- | ----- | -4 | |
| Feric Chloride | 2 | 0 | 0 | H | No special handling .. | D | ----- | ----- | x | ----- | -4-5 | |
| Ferric Nitrate | 0 | 1 | 0 | D | No special handling .. | D | ----- | ----- | x | ----- | -4 | |
| Ferrous Sulphate | 0 | 0 | 0 | o | No special handling -- | D | ----- | ----- | x | ----- | -4 | |
| Fluorine ----- | 4 | 0 | 3 | J | Separate storage or separate from oxygen. | c | Separate building or solid compartment. | ----- | ----- | ----- | Vater spray | |
| Formaldehyde Solution | 2 | 2 | 0 | o | Separate from combustible and oxidizing materials. | | | | | | | |
| Gas ----- | 2 | 4 | 0 | 0 | | D | 4' aisle space ----- | ----- | ----- | x | -4 | 111A |
| | | | | | | c | | | | | | |
| Formalin (See Formaldehyde). | | | | | | | | | | | | |
| Formic Acid ----- | 3 | 2 | 0 | c | Separate from other acids. | B | ?' aisle space ----- | ----- | x | ----- | -3 | 111A |
| Formic Aldehyde (See Formaldehyde). | | | | | | | | | | | | |
| Freon (See Dichlorodifluoromethane). | | | | | | | | | | | | |
| Glycerol (See Glycerin). | | | | | | | | | | | | |
| Glycerin ----- | — | 1 | 0 | o | No special treatment | D | 4' aisle space .. - . . . | ----- | ----- | x | -3 | IIIB |
| Greases ----- | o | 1 | 0 | 0 | No special treatment | D | None ----- | ----- | ----- | x | -3-4 | |
| Gum Preventive (Gasoline). | — | 3 | 0 | 0 | Store in end of building. | A | 3' aisle from class II flammables. | x | ----- | ----- | -4 | |
| Guncotton (See Cellulose). | | | | | | | | | | | | |
| Helium ----- | o | 0 | 0 | 0 | Inert gas | c | None ----- | ----- | ----- | ----- | √/A | |
| Helium and Methane .. | 0 | 1 | 0 | 0 | No special handling .. | c | None ----- | ----- | ----- | ----- | √/A | |
| Helium and Nitrogen .. | 0 | 0 | 0 | 0 | Noncombustible gas | c | None ----- | ----- | ----- | ----- | √/A | |
| Herbicides ----- | See label | | | | No special treatment | D | None ----- | ----- | ----- | x | -3 | |
| Hexametaphosphate ... | 0 | 0 | 0 | o | No special treatment | D | None ----- | ----- | ----- | x | -3-4 | |
| Hexamethylene (See Cyclohexane). | | | | | | | | | | | | |
| Hexone (See Methyl Isobutyl Ketone). | | | | | | | | | | | | |
| Hydraulic Fluid | See label | | | | No special handling .. | D | None ----- | ----- | ----- | x | -3-4 | |
| Hydrazine (Anhydrous) | 3 | 3 | 2 | C | Store in end of building to aid in fir fighting. | A | Separate from class 11 flammables by 4' aisle space. | x | ----- | ----- | -3-4 | 11 |
| Hydrochloric Acid ---- | 3 | 0 | 0 | c | Protect against physical damage. | B | 3' aisle space ----- | ----- | x | ----- | -3-4 | |
| Hydrocyanic Acid (See Hydrogen Cyanide). | | | | | | | | | | | | |

Table 5-5. Hazardous Materials Storage and Handling Criteria—Continued

(See notes at end of table for explanation of codes.)

| | Hazard Identity | | | | Storage and Handling | Storage Comp Group | Separation Requirement | Type | Facilities | | | Portable Fire Extinguisher Type | Class Liquid |
|---|-----------------|--------------|------------|-----------------|---|--------------------|--|-------|-----------------|-------------------|------------------|---------------------------------|--------------|
| | Health | Flammability | Reactivity | Specific Hazard | | | | | Flamm Stge Bldg | Com Gas Stge Bldg | Gen Purpose Whse | | |
| Hydrofluoric Acid | 4 | 0 | 0 | c | Protect against physical damage. | B | 3' aisle space | ----- | | | | 1 | |
| Hydrogen (Gas) | 0 | 4 | 0 | 0 | Storage in separate building or gas storage shed. | c | Solid partition from oxygen cylinders. | ----- | | x | | 3-I | |
| Hydrogen Chloride (See Hydrochloric Acid). Hydrogen Cyanide ---- | 4 | 4 | 2 | 0 | Store in end of building to aid fire fighting. | A | 4' aisle space from class 11 flammables, | X | | | | 3-4 | IA |
| Hydrogen Dioxide (See Hydrogen Peroxide). Hydrogen Fluoride (See Hydrofluoric Acid). Hydrogen Peroxide ---- | 2 | 0 | 1 | M | Do not store on wood pallets or dunnage. | B | 10' space from other acids. | ----- | | | | 1 | |
| over 52% Hydrogen Sulfate (See Sulphuric Acid). Hydrogen Sulfide ----- | 2 | 0 | 3 | M | | | | | | | | | |
| | 3 | 4 | 2 | 0 | Separate building or air compressed gas shed, separate from oxygen. | c | Solid partition from oxygen cylinders. | ----- | | x | | 1-2-4 Spray | |
| Hydroxybenzene (See Phenol). Hydroxylamine ----- | 1 | 3 | 3 | 0 | Separate from class I flammables. | A | 4' aisle from class I flammables. | X | | | | 3 | IIIB |
| Inhibitors (See Trisodium Phosphate). | 0 | 2 | 0 | 0 | No special handling .. | D | None ----- | ----- | | | x | 1-3 | |
| Insecticide (Chlordane) | 3 | 2 | 0 | 0 | No special handling .. | D | None ----- | ----- | | | x | 1-3 | |
| Insecticide (DDT) ----- | 3 | 0 | 0 | 0 | No special handling .. | D | None ----- | ----- | | | x | 1-3 | |
| Insecticide (DDT-Aerosol). | 3 | 1 | 1 | 0 | No special handling .. | D | None ----- | ----- | | | x | 1-3 | |
| Insecticide (Diazinon) -- | 3 | 0 | 0 | 0 | No special handling -- | D | None ----- | ----- | | | x | 1-3 | |
| Insecticide (Dieldrin) .. | 3 | 0 | 0 | 0 | No special handling -- | D | None ----- | ----- | | | x | 1-3 | |
| Insecticide (Lindane) .. | 3 | 0 | 0 | 0 | No special handling -- | D | None ----- | ----- | | | x | 1-3 | |
| Insecticide (Malathion) | 2 | 0 | 0 | 0 | No special handling .. | D | None ----- | ----- | | | x | 1-3 | |
| Insecticide (Pyrethrin) | 2 | 1 | 0 | 0 | No special handling -- | D | None ----- | ----- | | | x | 1-3 | |

| | | | | | | | | | | | | | | | | | |
|---|-----------------|---|---|---|---|---|---|---|---|---|-----|-----|-----|-----|--------|-----|----|
| Insect Repellent ----- | 2 | 1 | 1 | 1 | 0 | 1 | 0 | No special handling | D | None ----- | --- | --- | --- | x | 1-3 | | |
| Inspection Penetrant Emulsifiers & Removers. | See label ----- | | | | | | | Store with class I I flammables, | A | 3' aisle space from class I flammables. | x | --- | --- | --- | --- | 3-4 | |
| Insulating Varnish ---- | See label ----- | | | | | | | More in end of building to aid in f fighting. | A | Separate from class I I flammables by 4' aisle space. | x | --- | --- | --- | --- | 3-4 | IC |
| Isopropyl Formate ---- | 2 | 3 | 0 | 0 | | | | More in end of building to aid in f fighting. | A | 3' aisle space from class II flammables. | x | --- | --- | --- | 3-4 | | |
| Isopropyl Methanoate (See Isopropyl Formate). | | | | | | | | | | | | | | | | | |
| Iodic Acid (Crystals) -- | 0 | z | 1 | D | | | | Separate from other acids. | B | 3' aisle space ----- | --- | x | --- | --- | 3-4 | | |
| Iodine ----- | 2 | 0 | 0 | D | | | | No special handling | D | None ----- | --- | --- | --- | x | 1,3,4 | | |
| Isoamyl Acetate (See Amyl Acetate). | | | | | | | | | | | | | | | | | |
| Isobutyl Methyl Ketone | 2 | 3 | 2 | 0 | | | | Store in end of building. | A | 1' aisle space from class I I flammables. | x | --- | --- | --- | 3-4 | IC | |
| Isopropyl Alcohol ---- | 1 | 3 | 0 | 0 | | | | Store in end of building. | A | 1' aisle space from class I I flammables. | x | --- | --- | --- | 3-4 | IB | |
| Kerosene (130° F. P.) -- | 0 | 2 | 0 | 0 | | | | Store with class 11 flammables. | A | 1' aisle space from class I flammables. | x | --- | --- | --- | 3-4 | II | |
| Lacquers ----- | See label ----- | | | | | | | Store in end of building. | A | Separate from class II flammables. | x | --- | --- | --- | 3-4 | IC | |
| Lanthanum Nitrate ---- | 0 | 0 | 3 | D | | | | No special handling | D | 3' aisle space ----- | --- | --- | --- | x | 1-3-4 | | |
| LAUROYL PEROXIDE. | --- | 2 | 3 | D | | | | Special facility required for quant storage. | E | | | | | | | | |
| Lead Nitrate ----- | --- | 1 | 2 | 0 | | | | Store in end of building. | D | Separate from class, I I flammables. | --- | --- | --- | x | 1-3-4 | | |
| Lead Sulfoyanate ---- | 1 | 1 | 1 | 0 | | | | Separate from other items. | D | 3' aisle space ----- | --- | --- | --- | x | 1 | | |
| Lead Thiocyanate (See Lead Sulfoyanate). | | | | | | | | | | | | | | | | | |
| Lime (Unslaked) (See Calcium Oxide). | | | | | | | | | | | | | | | | | |
| LITHIUM ----- | 1 | 1 | 2 | E | | | | Special handling and storage required. | E | | --- | --- | --- | --- | 5 | | |
| Lithium Aluminum Hydride. | 3 | 1 | 2 | E | | | | No special handling | D | | --- | --- | --- | x | 5 | | |
| LITHIUM HYDRIDE | 1 | 4 | 2 | E | | | | Special handling and facility required. | E | | --- | --- | --- | --- | 5 | | |
| Lye (See Potassium Hydroxide). | | | | | | | | | | | | | | | | | |
| MAGNESIUM | --- | 1 | 2 | E | | | | Special handling and storage. | E | | --- | --- | --- | --- | 5 Talc | | |
| Magnesium Chloride --- | --- | 1 | 0 | 0 | | | | No special handling | D | | --- | --- | --- | x | 1-3-4 | | |

Table 5-5. Hazardous Materials Storage and Handling Criteria
(See notes at end of table for explanation of codes.)

| | Hazard Identity | | | | Storage and Handling | Storage Comp Group | Separation Requirement | Type of Storage Facilities | | | | Portable Fire Extinguisher Type | class Liquid |
|--------------------------------|-----------------|--------------|------------|-----------------|---|--------------------|--|----------------------------|----------------|--------------------|--------------------|---------------------------------|--------------|
| | Health | Flammability | Reactivity | Specific Hazard | | | | Stge Bldg | Acid Stge Bldg | Comp Gas Stge Bldg | Gen Fur. pose Whse | | |
| Magnesium Nitrate | 1 | 0 | 1 | D | Protect from physical damage. | D | Separate from combustible items by 3' aisle space. | ----- | ----- | ----- | X | 3-4 | |
| Magnesium Perchlorate | 1 | 0 | 1 | D | Protect from physical damage. | D | Separate from combustible items by 3' aisle space. | ----- | ----- | ----- | x | 3-4 | |
| Maleic Anhydride (Crystals). | 3 | 1 | 1 | E | Store with class 11 flammables. | A | 3' aisle space ----- | x | ----- | ----- | | 3-4 | |
| Mandelic Acid (crystals). | 1 | 0 | 0 | 0 | No special handling ... | D | None ----- | ----- | ----- | ----- | x | 1-3-4 | |
| Mannitol (Crystals) | 1 | 1 | 0 | 0 | Protect from physical damage. | D | Separate from combustible items by 3' aisle space. | ----- | ----- | ----- | x | 3-4 | |
| Mercury | 3 | 0 | 0 | 0 | No special handling --- | D | ----- | ----- | ----- | ----- | x | 3-4 | |
| Mesityl Oxide | 3 | 3 | 0 | 0 | Store in end of building to aid in fire fighting. | A | Separate from class II flammables by 4' aisle. | ----- | x | ----- | | 3-4 | IC |
| Methacrylic Acid | 3 | 2 | 2 | 0 | Protect against physical damage. | B | 3' aisle space ----- | ----- | x | ----- | ----- | 3-4 | IIIA |
| Methanol (See Methyl Alcohol). | | | | | | | | | | | | | |
| Methane Gas | 1 | 4 | 0 | 0 | Separate from oxygen cylinders. | c | Solid compartment or separate building. | ----- | ----- | x | ----- | 4 | |
| Methyl Acrylate | 2 | 4 | 2 | 0 | Store in end of building. | A | Separate from class II flammables by 4' aisle. | x | ----- | ----- | ----- | 3 | IB |
| Methyl Alcohol | — | 3 | 0 | 0 | Store in end of building. | A | Separate from class 11 flammables by 4' aisle. | x | ----- | ----- | ----- | 3-4 | IB |
| Methylamines (Mono, di). | 3 | 4 | 0 | 0 | Store in end of building. | A | Separate from class II flammables by 4' aisle. | x | ----- | ----- | ----- | 3-4 | IA |
| (Tri). | 2 | 4 | 0 | 0 | | | | | | | | | |
| Methyl Benzene (See Toluene). | | | | | | | | | | | | | |
| Methyl Bromide | 3 | 0 | 2 | 0 | Non Flammable Gas .. | c | None ----- | ----- | ----- | x | ----- | N/A | |
| Methyl Chloride | — | 4 | 0 | 0 | Flammable Gas | ----- | Separate from Oxygen | ----- | ----- | x | ----- | Stop-flow of gas. | |
| Chloromethane. | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|--------------|------|---|---|---|---|--|-------|-------|-------|-------|-----|------|
| Methylene Chloride ---- | 2 | 0 | 0 | 0 | Non Flammable Gas .. | c | None | ----- | ----- | X | ----- | 1/A | |
| Methyl Chloroform ---- | 2 | 0 | 0 | 0 | No special handling --- | D | None | ----- | ----- | ----- | x | 4 | |
| Methyl Cyanide (See Acetonitrile). | | | | | | | | | | | | | |
| Methyl Ethyl Ether --- | 2 | 4 | — | 0 | Store in end of building to aid in fire fighting. | A | Separate from class II flammables by 4' aisle. | x | ----- | ----- | ----- | 4 | I A |
| Methyl Ethyl Ketone .. | 2 | 3 | o | 0 | Store in end of building. | A | Separate from class II flammables by 4' aisle space. | x | ----- | ----- | ----- | 4 | IB |
| METHYL ETHYL KETONE PEROXIDE. | 2 | 2 | 4 | D | Special handling and storage. | E | | | | | | | |
| Methyl Formate ----- | 2 | 4 | — | o | Store in end of building to aid fire fighting. | A | Separate from class II flammables by 4' aisle space. | x | ----- | ----- | ----- | 4 | IA |
| Methyl Isobutyl Ketone | 2 | 3 | — | 0 | Store in end of building to aid fire fighting. | A | Separate from class II flammables by 4' aisle space. | x | ----- | ----- | ----- | 4 | IC |
| Methyl Methacrylate .. | 2 | 3 | 2 | 0 | Store in end of building to aid fire fighting. | A | Separate from class II flammables by 4' aisle space. | x | ----- | ----- | ----- | 4 | IB |
| Methyl Phenol (See Cresol). | | | | | | | | | | | | | |
| Methylene Oxide (See Formaldehyde). | | | | | | | | | | | | | |
| Mineral Spirits (See Naphtha Aromatic). | | | | | | | | | | | | | |
| Molybdenum Disulfide (See Molybdenum Sulfide). | | | | | | | | | | | | | |
| Molybdenum Sulfide .. | 1 | 0 | 0 | 0 | No special handling -- | D | None | ----- | ----- | ----- | x | 3-4 | |
| Monochlorobenzene (Chlorobenzene). | 2 | 3 | — | 0 | Store in end of building to aid fire fighting. | A | Separate from class II flammables by 4' aisles. | x | ----- | ----- | ----- | 3-4 | IC |
| Monochlorodifluoromethane. | 2 | 0 | o | 0 | Separate from oxygen cylinders. | c | Separate building or solid compartment. | | ----- | x | ----- | 3-4 | |
| Monoethanolamine (Ethanolamine). | 2 | 4 | 0 | 0 | Store in end of building to aid fire fighting. | A | Separate from class I I flammables by 4' aisle. | x | ----- | ----- | ----- | 3-4 | IIIB |
| Muriatic Acid (See Hydrochloric Acid). | | | | | | | | | | | | | |
| Naphtha ----- | See label .. | | | 0 | Store in end of building to aid fire fighting. | A | Separate from class I I flammables. | x | ----- | ----- | ----- | 3-4 | |
| Naphtha Aliphatic ---- | 2 | 3 | 0 | 0 | Store in end of building to aid in fire fighting. | A | Separate from class I I flammables. | x | ----- | ----- | ----- | 3-4 | |

Table 5-5. Hazardous Materials Storage and Handling Criteria-Continued
(See notes at end of table for explanation of codes.)

| Noun | Hazard Identity | | | | Storage and Handling | Storage Comp Group | Separation Requirement | Type of Storage Facilities | | | | Portable Fire Extinguisher Type | Class Liquid |
|---|-----------------|--------------|------------|-----------------|--|--------------------|--|----------------------------|----------------|--------------------|-----------------|---------------------------------|--------------|
| | Health | Flammability | Reactivity | Specific Hazard | | | | Flamm Stge Bldg | Acid Stge Bldg | Comp Gas Stge Bldg | Gen Purpose Wks | | |
| Naphtha Aromatic . ---- | 2 | 3 | 0 | 0 | Separate from class II flammable. | A | 3' aisle space ----- | X | ----- | ----- | --- | 3-4 | |
| Naphthalene | 2 | 2 | — | 0 | Separate from class I flammables. | A | 4' aisle space ----- | x | ----- | ----- | --- | 3-4 | 111A |
| Neatsfoot Oil | 0 | 1 | 0 | 0 | No special handling --- | D | 4' aisle space | ----- | ----- | ----- | X | 3-4 | IIIB |
| Nickle Acetate | 1 | 0 | 0 | 0 | No special handling --- | D | None ----- | ----- | ----- | ----- | X | 3-4 | |
| Nickel Chloride . . ---- | 1 | 0 | 0 | 0 | No special handling --- | D | None ----- | ----- | ----- | ----- | X | 3-4 | |
| Nickel Nitrate | 1 | 0 | 1 | D | Separate from other items. | D | 3' aisle space ----- | ----- | ----- | ----- | X | 3-4 | |
| Nickel Sulfate | 1 | 0 | 0 | K | No special handling --- | D | None ----- | ----- | ----- | ----- | X | 3-4 | |
| Nitric Acid | 2 | 0 | 2 | K | Store with bungs up. Do not store on wood pallets or dunnage. | B | 3' aisle space ----- | ----- | x | ----- | --- | 1 | |
| Nitric Ether (See Ethyl Nitrate). | | | | | | | | | | | | | |
| Nitroaniline | 3 | 1 | 1 | 0 | Separate from other items. | D | 4' aisle space ----- | ----- | ----- | ----- | X | 1-3 | IIIB |
| Nitrobarite (See Barium Nitrate). | | | | | | | | | | | | | |
| Nitric Oxide (See Nitrogen Tetroxide). | | | | | | | | | | | | | |
| Nitrous Ether (See Ethyl Nitrite). | | | | | | | | | | | | | |
| Nitrobenzene | 3 | 2 | — | 0 | Store with class 11 flammables. | A | 4' aisle space from class I flammables. | x | ----- | ----- | --- | 1-3-4 | 111A |
| Nitrobenzol (See Nitrobenzene). | | | | | | | | | | | | | |
| Nitrocellulose (See Cellulose Nitrate). | | | | | | | | | | | | | |
| Nitrochlorobenzene ---- | 3 | 1 | 1 | 0 | Store with class 11 flammables. | A | 4' aisle space from class I flammables. | x | ----- | ----- | --- | 1-3-4 | IIIB |
| Nitroethane | 1 | 3 | 3 | 0 | Store with class I flammables. | A | 4' aisle space from class II and other class I flammables. | x | ----- | ----- | --- | 3-4 | IC |
| Nitrogen (Gas) | 0 | 0 | 0 | 0 | Nonflammable gas ---- | c | None ----- | ----- | ----- | X | --- | N/A | |
| Nitrogen Peroxide (Gas) (See Nitrogen Tetroxide). | | | | | | | | | | | | | |

| Chemical Name | 3 | 0 | 1 | D | Storage Instructions | Class | Separation/Storage | Flammability | Other | IC |
|--|-----------|---|---|---|--|-------|--|--------------|-------|-------|
| Nitrogen | | | | | Store away from oxygen cylinders. | C | Separate shed or solid compartment. | | | |
| Nitromethane | 1 | 3 | 4 | 0 | Store in end of building | A | 4' aisle from class II flammables. | | X | IC |
| Nitropropanes | — | 2 | 3 | 0 | Store in end of building | A | 4' aisle from class II flammables. | | | II |
| Nitrous Ether (See Ethyl Nitrite). | 2 | 4 | 4 | 0 | Do not store with flammable gases. | C | Separate building or solid compartment. | | X | |
| Nitrous Oxide | 2 | 0 | 1 | 0 | | | | | | N/A |
| Nitric Ether (See Ethyl Nitrate). | | | | | | | | | | |
| Organic Coating Materials (Oil Base Paints, Enamels & Aerosols). | See label | | | | Store in ends of bays or in areas offering quick access to fire department hose streams. | D | 3' aisle space | | X | 2,3,4 |
| Oil of Vitriol (See Sulphuric Acid). | | | | | | | | | | |
| Oils (Lubricating) | 0 | 1 | 0 | 0 | Store away from other items. | D | 3' aisle space | | X | 3-4 |
| Oxalic Acid | — | 0 | 0 | 0 | No special handling | B | 3' aisle space from other acids. | X | | 3-4 |
| Oxygen Gas | 0 | 0 | 1 | 0 | Do not store with flammable gases. | C | Separate building or solid compartments. | | X | N/A |
| Paints (Oil Base) (See Organic Coating Materials). | | | | | | | | | | |
| Paints (Water Base) | See label | 2 | 3 | 1 | No special handling | D | None | | | |
| Paraldehyde | 2 | 3 | 1 | 0 | Store with class I flammables. | A | Separate from class II flammables. | X | | 1-3-4 |
| Parathion | 4 | 1 | 0 | 0 | Separate from other items. | B | 3' aisle space | X | | 3-4 |
| Penetrating Fluid (See Inspection Penetrant). | | | | | | | | | | |
| Peracetic Acid | 3 | 2 | 4 | 0 | Separate from other items. | B | 4' aisle space | X | | 1 |
| Perchloric Acid | 3 | 0 | 3 | K | Separate from other items. Protect against freezing—4° F. Do not store on wood pallets. | B | 3' aisle space | X | | 3-4 |
| Petroleum Ether (See Ether, also Benzine). | — | 4 | — | 0 | | | | | | |
| Phenol (Carbolic Acid) | 3 | 2 | 0 | C | Separate from other items. | B | 4' aisle space | X | | 3-4 |
| Phenolphthalein | 1 | 0 | 0 | 0 | No special handling | D | None | | X | 3-4 |
| Phosphorus (Red) | — | 1 | 1 | 0 | Separate from other items. | D | 3' aisle space | | X | 1 |

T b 5-5. Hazardous Materials Storage and Handling Criteria—Continued

(See notes at end of table for explanation of codes.)

| Material | Hazard Identity | | | Storage and Handling | Storage Comp Group | Separation | Type of Storage Facilities | | | | Portable Fire Extinguisher Type | Class Liquid |
|-----------------------------|-----------------|--------------|------------|----------------------|--------------------|---|----------------------------|-----------------|----------------|--------------------|---------------------------------|--------------|
| | Health | Flammability | Reactivity | | | | Specific Hazard | Flamm Stge Bldg | Acid Stge Bldg | Comp Gas Stge Bldg | | |
| Potassium (Yellow) | 3 | 3 | 2 | 0 | D | 0 aisle space | ^ | --- | --- | --- | 1 | |
| Phosphorus Pentasulfide | 3 | 1 | 2 | E | D | 3' aisle space | --- | --- | --- | X | 3 Dry Sand | |
| Phosphorus Sesquisulfide | 2 | 1 | 1 | O | A | 3' aisle space | X | --- | --- | --- | 1 | |
| PHOSPHORUS TRICHLORIDE | 3 | 0 | 2 | H | E | Special facility | --- | --- | --- | --- | --- | |
| PICRIC ACID | 2 | W | 4 | D | E | Special facility | --- | --- | --- | --- | --- | |
| Pine Oil | 1 | Z | 0 | O | A | 4' aisle space 4' space from class I flammables. | X | --- | --- | --- | 3-4 | IIIB IIIA |
| POTASSIUM | 3 | . | 2 | E | E | Special facility and handling. | --- | --- | --- | --- | --- | |
| Potassium Bifluoride | 1 | 0 | 0 | O | D | None | --- | --- | --- | X | 3-4 | |
| Potassium Bromate | 1 | 0 | 0 | D | D | None | --- | --- | --- | X | 3-4 | |
| Potassium Carbonate | 1 | 0 | 0 | O | D | None | --- | --- | --- | X | 3-4 | |
| Potassium Chlorate | --- | 0 | 2 | D | D | 3' aisle space | --- | --- | --- | X | 1 | |
| Potassium Chromate | 1 | 0 | 0 | D | D | None | --- | --- | --- | X | 3-4 | |
| Potassium Cyanide | --- | 0 | 0 | O | S | 3' aisle space | --- | --- | --- | X | 3 | |
| Potassium Dichromate | 2 | 0 | 0 | D | D | 3' aisle space | --- | --- | --- | X | 3-4 | |
| Potassium Fluoride | 1 | 0 | 0 | O | D | None | --- | --- | --- | X | 3-4 | |
| Potassium Hydroxide (Lye) | 3 | 0 | 1 | B | D | 3' aisle space | --- | --- | --- | X | 1 | |
| Potassium Iodide | 1 | 0 | 0 | O | D | None | --- | --- | --- | X | 3-4 | |
| Potassium Nitrate | 1 | 0 | 2 | D | D | 3' aisle space | --- | --- | --- | X | 1 | |
| Potassium Perchlorate | 1 | 0 | 2 | D | D | 3' aisle space | --- | --- | --- | X | 3-4 | |
| Potassium Permanganate | 0 | 0 | 1 | D | D | 3' aisle space | --- | --- | --- | X | 3-4 | |
| Potassium Peroxide | 3 | 0 | 2 | D | D | 3' aisle space | --- | --- | --- | X | 4 | |
| Potassium Persulfate | 1 | 0 | 0 | D | D | 3' aisle space | --- | --- | --- | X | 1 | |
| Potassium Sodium Tartarate. | 1 | 0 | 0 | O | D | None | --- | --- | --- | X | 3-4 | |

| | | | | | | | | | | | | | |
|--|---------------------|---|---|------|--|---|--|------|------|------|---|------------------|----|
| Potassium Sulfide | 2 | 1 | 0 | 0 | Separate from other items. | D | 3' aisle space | ---- | ---- | ---- | x | | |
| Propionaldehyde (Propanal). | 2 | 4 | 1 | 0 | Store in end of building. | A | 1' aisle space from group II flammables. | x | ---- | ---- | | I-4 | IB |
| Propionic Acid ----- | 2 | 2 | 0 | 0 | Separate from class I flammables. | A | 4' aisle space from class I flammables. | x | ---- | ---- | | 1-3-4 | 11 |
| Propane Gas ----- | 1 | 4 | 0 | 0 | Stored separated from oxygen. | c | Separate building or solid compartment. | ---- | ---- | x | | 1-4 | |
| Propane Torch Fuel (14 oz. containers) (See Soldering Torch Kit). | | | | | | | | | | | | | |
| Propylamine | 3 | 3 | 0 | 0 | Store in end of building. | A | 3' aisle space from class I I flammables. | X | ---- | ---- | | 3-4 | |
| Propyl Nitrate ----- | 2 | 3 | 3 | 0 | Store in end of building. | A | 4' aisle space ----- | X | ---- | ---- | | 3-4 | IB |
| Propylene (Gas) | 1 | 4 | 1 | 0 | Separate from oxygen cylinders. | c | Separate building or solid compartment. | ---- | ---- | x | | 3-4 | |
| Propylene Oxide ----- | 2 | 4 | 2 | 0 | Store in end of building. | A | 4' aisle space ----- | X | ---- | ---- | | 3-I | 1A |
| Pyridine | 2 | 3 | 0 | 0 | Store in end of building. | A | 4' aisle space ----- | x | ---- | ---- | | 3-I | IB |
| Pyrogallol ----- | 1 | 0 | 0 | 0 | No special handling --- | D | None ----- | ---- | ---- | ---- | x | 3-4 | |
| Pyroxylin (See Cellulose Nitrate). | | | | | | | | | | | | | |
| Que Bracho ----- | 0 | 1 | 0 | 0 | No special handling --- | D | None | ---- | ---- | ---- | x | 1-3-4 | |
| Quick Lime (See Calcium Oxide). | | | | | | | | | | | | | |
| Quick Silver (See Mercury). | | | | | | | | | | | | | |
| Rodenticide (Diphacinparaffin). | see label | | | 0 | No special handling . . . | D | None ----- | ---- | ---- | ---- | x | 1-3 | |
| Rosin | see label ----- | | | 0 | No special handling --- | D | None ----- | ---- | ---- | ---- | x | 3-4 | |
| Saltpeter (See Potassium or Sodium Nitrate). | | | | | | | | | | | | | |
| Shellac (Liquid) ----- | 0 | 4 | 0 | 0 | | A | None ----- | ---- | ---- | ---- | x | 2,3,4 | |
| Silicone Compound . . . | see label ----- | | | ---- | No special handling . . . | D | None | ---- | ---- | ---- | x | 3-4 | |
| Silver Cyanide | 1 | 0 | 0 | 0 | No special handling . . | D | None ----- | ---- | ---- | ---- | x | 3-4 | |
| Silver Nitrate ----- | 1 | 0 | 1 | D | Separate from other items. | D | 3' aisle space ----- | ---- | ---- | ---- | x | 3-4 | |
| Skin Protective Compound. | 0 | 0 | 0 | 0 | No special handling --- | D | None ----- | ---- | ---- | ---- | x | 3-4 | |
| SODIUM ----- | 3 | 1 | 2 | E | Special handling and facility. | E | | | | | | | |
| Soldering Torch Kit (Portable Propane Torch, 14-02. fuel cylinders). | 1 | 4 | 1 | 0 | Store in end of building to assist in fire fighting. | A | Separate from class II flammables by 3' aisle space. | x | ---- | ---- | | 3-4 | |
| Sodium Acetate ----- | 0 | 0 | 0 | 0 | No special handling . . | D | None ----- | ---- | ---- | ---- | x | 3-4 | |

r',
E

Table 5-5. Hazardous Materials Storage and Handling Criteria--Continued

(See notes at end of table for explanation of codes.)

| | Hazard Identity | | | | Storage and Handling | Storage Comp Group | Separation Requirement | Type of Storage Facilities | | | | Portable Fire Extinguisher Type | Class Liquid |
|----------------------------------|-----------------|--------------|------------|-----------------|---------------------------------|--------------------|--|----------------------------|----------------|--------------------|-----------------------|---------------------------------|--------------|
| | Health | Flammability | Reactivity | Specific Hazard | | | | Flamm Stge Bldg | Acid Stge Bldg | Comp Gas Stge Bldg | Gen Purpose Warehouse | | |
| Sodium Bicarbonate . . . | 3 | 0 | 0 | 0 | None ----- | D | None ----- | ----- | ----- | ----- | X | N/A | |
| Sodium Bisulfate ----- | 3 | 0 | 0 | E | None ----- | D | None ----- | ----- | ----- | ----- | X | 3-4 | |
| Sodium Borate ----- | 0 | 0 | 0 | 0 | None ----- | D | None ----- | ----- | ----- | ----- | X | 3-4 | |
| Sodium Bromide ----- | 1 | 0 | 1 | E | No special handling ... | D | None ----- | ----- | ----- | ----- | X | 1-3-4 | |
| Sodium Carbonate ----- | 0 | 0 | 0 | 0 | None ----- | D | None ----- | ----- | ----- | ----- | X | 3-4 | |
| Sodium Chlorate ----- | — | 0 | 2 | D | Separate from other items. | D | 3' aisle space ----- | ----- | ----- | ----- | X | 1 | |
| Sodium Chloride ----- | — | 1 | 2 | D | Separate from other items. | D | 3' aisle space ----- | ----- | ----- | ----- | X | 1 | |
| Sodium Cyanide ----- | 3 | 0 | 0 | E | Separate from other items. | s | 3' aisle space ----- | ----- | ----- | ----- | X | 1 | |
| Sodium Hydrosulfite .. | 3 | 1 | 2 | E | Separate from other items. | D | 3' aisle space ----- | ----- | ----- | ----- | X | 1-3-4 | |
| Sodium Hydroxide (Lye). | 3 | 0 | 1 | B | Separate from other items. | D | 3' aisle space ----- | ----- | ----- | ----- | X | 1 | |
| Sodium Hyperchlorite . | 2 | 1 | 0 | D | Separate from other items. | D | 3' aisle space ----- | ----- | ----- | ----- | X | 1-3-4 | |
| Sodium Hypophosphite | 2 | 2 | 0 | 0 | Separate from other items. | D | 3' aisle space ----- | ----- | ----- | ----- | X | 1-3-4 | |
| Sodium Nitrate ----- | ----- | 0 | 2 | D | Separate from other items. | D | 3' aisle space ----- | ----- | ----- | ----- | X | 1 | |
| Sodium Perchlorate --- | 2 | 0 | 2 | D | Separate from other items. | D | 3' aisle space ----- | ----- | ----- | ----- | X | 1 | |
| Sodium Peroxide ----- | 3 | 0 | 2 | J | Separate from other items. | D | 3' aisle space ----- | ----- | ----- | ----- | X | 1-4 | |
| Sodium Phosphate ----- | 2 | 0 | 0 | 0 | No special handling --- | D | None ----- | ----- | ----- | ----- | X | 1-3-4 | |
| SODIUM POTASSIUM ALLOYS. | 3 | 3 | 2 | E | Special facility and handling. | E | | | | | | | |
| Sodium Silicate ----- | — | 0 | 0 | 0 | No special handling --- | D | None ----- | ----- | ----- | ----- | X | N/A | |
| Sodium Sulfide | 2 | 1 | — | 0 | Separate from other items. | D | 3' aisle space ----- | ----- | ----- | ----- | X | 1 | |
| Sodium Sulphate ----- | 0 | 0 | 0 | 0 | No special handling --- | D | None ----- | ----- | ----- | ----- | X | 3-4 | |
| Sodium Sulphite ----- | 1 | 0 | 1 | H | No special handling --- | D | None ----- | ----- | ----- | ----- | X | 3-4 | |
| Starter Fluid ----- | 2 | 4 | 1 | 0 | Store in end of building. | A | 3' aisle space from class II flammables. | x | ----- | ----- | ----- | 1-%4 | |
| Stoddard Solvent (Dry cleaning). | 2 | 3 | 0 | 0 | Store with class II flammables. | A | 4' space from class I flammables. | x | ----- | ----- | ----- | 3-4 | II |
| Strontium Nitrate ----- | 1 | 0 | 1 | D | Do not store on wood pallets. | D | 3' aisle space ----- | ----- | ----- | ----- | X | 1-3-4 | |

| | | | | | | | | | | | | | |
|---------------------------------|-----|----|---|---|-----------------------------------|---|--|---|---|---|---|--------|------|
| Strontium Peroxide ... | 1 | 0 | 1 | D | Do not store on wood pallets. | D | 3' aisle space ----- | | | | X | 1-4 | |
| Styrene (monomer) | 2 | 3 | 2 | 0 | Store in end of building. | A | 4' aisle space from class II flammables, | x | | | | 3-4 | IC |
| Sulfuric Ether (See Ether). | | | | | | | | | | | | | |
| Sulphur ----- | 2 | 1 | 0 | 0 | Separate from other items. | D | 3' aisle space ----- | | | | x | 1 | |
| Sulphur Dioxide ----- | 3 | 0 | 0 | 0 | No combustible gas ... | C | Store with oxygen cylinders. | | | X | | N/A | |
| Sulphuric Acid ----- | 3 | 0 | 1 | K | Separate from other acids. | B | 3' aisle space ----- | | X | | | 4 | |
| Talc ----- | see | el | | 0 | No special handling --- | D | None ----- | | | x | | 3-4 | |
| Tannic Acid | 0 | 1 | 0 | 0 | Separate from other items. | B | 3' aisle space ----- | | X | | | 3-4 | |
| Tar Camphor (See Naphthalene). | | | | | | | | | | | | | |
| Tetraethyl Lead (TEL Compound). | 3 | 2 | 3 | 0 | Store with class 11 flammables. | A | 3' aisle space from class I flammables. | X | | | | 1-3-4 | |
| Tetraethyl Lead (TML Compound). | 3 | 3 | 3 | 0 | Store in end of building. | A | 3' aisle space ----- | X | | | | 1-3-4 | |
| Tetra Hydrofuran ----- | 2 | 3 | 1 | 0 | Store in end of building. | A | 4' aisle space from class II flammables. | x | | | | 2a-2-4 | IB |
| Tartaric Acid | 0 | 1 | 0 | 0 | | | | | | | | | |
| ● Thorium Nitrate ----- | 1 | 0 | — | D | Separate from other items. | D | 3' aisle space ----- | | | | x | 1 | |
| Toluene ----- | 2 | 4 | 0 | 0 | Store in end of building. | A | 4' aisle space ----- | x | | | | 2,3,4 | IB |
| Toluene—Diisocyanate | 2 | 1 | 2 | E | Separate from class I flammables. | A | 4' aisle space ----- | x | | | | 3-4 | IIIB |
| Toluene—Methyl Isobutyl Ketone. | 2 | 3 | 0 | 0 | Store in end of building. | A | 3' aisle space ----- | X | | | | 3-4 | |
| Toluidines (Ortho, Para) | 3 | 2 | — | 0 | Separate from class I flammables. | A | 4' aisle space .. ----- | x | | | | 3-4 | 111A |
| Toluol (See Toluene). | | | | | | | | | | | | | |
| Triamylamine | 2 | 1 | 0 | 0 | Separate from class I flammables. | A | 4' aisle space ----- | X | | | | 3-4 | 111A |
| Tributylamine . . . ----- | 2 | 2 | 0 | 0 | Separate from class 1 flammables. | A | 4' aisle space ----- | x | | | | 3-4 | HIA |
| Trichloroethane ----- | 2 | 0 | 0 | 0 | No special handling --- | D | None ----- | | | | X | 3-4 | |
| Trichloroethylene ----- | --- | 1 | 0 | 0 | No special handling --- | D | None ----- | | | | X | 3-4 | |
| Trichlorofluoromethane | 2 | 0 | 0 | 0 | No special handling .. | D | None ----- | | | | x | 3-4 | |
| Trichlorotrifluoroethane | 2 | 0 | 0 | 0 | No special handling .. | D | None ----- | | | | x | 3-4 | |
| Triethanolamine . ----- | 1 | 1 | 1 | 0 | No special handling --- | D | None ----- | | | | x | 3-4 | |
| Triethylamine | 2 | 3 | 0 | 0 | No special handling ... | D | 4' aisle space ----- | | | | X | 3-4 | IB |
| Triethylborane (See Diborane). | | | | | | | | | | | | | |
| Tricresyl Phosphate ... | 2 | 1 | 0 | 0 | No special handling ... | D | None ----- | | | | x | 1,3,4 | |

Table 5-5. Hazardous Materials Storage and Handling Criteria—Continued

(See notes at end of table for explanation of codes.)

| | Hazard Identity | | | | Storage and, Handling | Storage Comp Group | Separation Requirement | Type of Storage Facilities | | | | Portable Fire Extinguisher Type | Class Liquid |
|------------------------------------|-----------------|--------------|------------|-----------------|-----------------------------------|--------------------|---|----------------------------|----------------|--------------------|------------------|---------------------------------|--------------|
| | Health | Flammability | Reactivity | Specific Hazard | | | | Flam Stg Bldg | Acid Stge Bldg | Comp Gas Stge Bldg | Gen Purpose Whse | | |
| TRINITROBENZENE | 2 | 4 | 4 | 0 | Special facility and handling. | E | | | | | | | |
| TRINITROTOLUENE (TNT). | 2 | 4 | 4 | 0 | Special facility and handling. | E | | | | | | | |
| Trisodium Phosphate | 2 | 0 | 0 | 0 | No special handling --- | D | None ----- | --- | ----- | ----- | x | 3-4 | |
| Turpentine | 1 | 3 | 0 | 0 | Separate from class I flammables. | A | 4' aisle space ----- | x | ----- | ----- | ----- | 3-4 | IC |
| Unslaked Lime (See Calcium Oxide). | | | | | | | | | | | | | |
| Unsymmetrical Dimethylhydrazine. | 3 | 4 | 1 | 0 | Store in end of building. | A | 4' aisle space from class I I flammables. | x | ----- | ----- | ----- | 3-4 | IB |
| ● Uranium Nitrate --- | — | 0 | 1 | D | Separate from other items. | D | 3' aisle space ----- | --- | ----- | ----- | x | 1 | |
| ● Uranyl Acetate ----- | 1 | 0 | 1 | 0 | No special handling --- | D | None ----- | --- | ----- | ----- | x | 3-4 | |
| Varnish ----- | See k | 1 | --- | 0 | No special handling --- | D | None ----- | --- | ----- | ----- | x | 3-4 | |
| Vinegar Acid (See Acetic Acid). | | | | | | | | | | | | | |
| Vinyl Acetate ----- | 2 | 4 | 2 | 0 | Store in end of building. | A | 4' aisle space from class 11 flammables. | x | ----- | ----- | ----- | 3-4 | IB |
| Vinyl Benzene (See Styrene). | | | | | | | | | | | | | |
| Vinyl Chloride (Gas) . | ----- | ---- | 1 | 0 | Separate from oxygen cylinders. | c | Separate building or solid compartment. | --- | ----- | x | ----- | 3-4 | |
| Vinyl Ether ----- | 2 | 3 | 2 | 0 | Store in end of building. | A | Separate from class J I flammables by 4' aisle space. | x | ----- | ----- | ----- | 3-4 | IB |
| Vinylidene Chloride . | 2 | 4 | 2 | 0 | Store in end of building. | A | 4' aisle space ----- | x | ----- | ----- | ----- | 3-4 | IA |
| Xylenes (Ortho, Para Meta). | 2 | 3 | 0 | 0 | Store in end of building. | A | 4' aisle space from class I 1 flammables. | x | ----- | ----- | ----- | 2-3-4 | IC |
| Xylol (See Xylene). | 2 | 4 | 0 | 0 | | | | | | | | | |
| Water Glass (See Sodium Silicate). | | | | | | | | | | | | | |
| Zinc (Powder) ----- | — | 1 | 1 | () | Separate from other items. | D | 3' aisle space | --- | ----- | ----- | x | 5 | |
| Zinc Chlorate ----- | 2 | 0 | 2 | D | Do not store on wood pallets. | D | 3' aisle space | | ----- | ----- | x | 1-5 | |
| Zinc Oxide ----- | 1 | 0 | 0 | () | No special handling . . | D | None | --- | ----- | ----- | x | 3-4 | |
| Zinc Sulfide ----- | 1 | 0 | 0 | () | No special handling .- | D | None | --- | ----- | ----- | x | 3-4 | |

| | | | | | | | | | | | | | | |
|---------------------------------|---|---|---|---|----------------------------|---|----------------|--|--|--|--|---|---|--|
| Zirconium (Powder) | 1 | 4 | 1 | 0 | Separate from other items. | D | 1' aisle space | | | | | X | 5 | |
| Zinc Diethyl (See Diethylzinc). | | | | | | | | | | | | | | |
| Zinc Ethyide (See Diethylzinc). | | | | | | | | | | | | | | |
| Zinc Ethyl (See Diethylzinc). | | | | | | | | | | | | | | |

Notes.

1. The following codes describe the health hazards. (A dash (—) means identity to be developed)

| Code | Explanation |
|------|---|
| 4 | A few whiffs of the vapor could cause death, or the vapor or liquid could be fatal on penetrating the fire fighter's normal full protective clothing which is designed for resistance to heat. The normal full protective clothing available to the average fire department will not provide adequate protection against skin contact with these materials. |
| 3 | Materials extremely hazardous to health, but areas maybe entered with extreme care. Full protective clothing, including selfcontained breathing apparatus, rubber gloves, boots and bands around legs, arms and waist should be provided. No skin surface should be exposed. |
| 2 | Materials hazardous to health, but areas may be entered freely with selfcontained breathing apparatus. |
| 1 | Materials only slightly hazardous to health. It may be desirable to wear selfcontained breathing apparatus. |
| 0 | Materials which on exposure under fire conditions would offer no health hazard beyond that of ordinary combustible material. |

2. The following codes describe the flammability hazards.

| Code | Explanation |
|------|---|
| 4 | Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air. Shut off flow of gas or liquid and keep cooling water streams on exposed tanks or containers. Use water spray carefully in the vicinity of dusts so as not to create dust clouds. |
| 3 | Liquids which can be ignited under almost all normal temperature conditions. Water may be effective on these liquids because of their low flash points. Solids which form coarse dusts, solids in shredded or fibrous form that create flash fires, solids that burn rapidly, usually because they contain their own oxygen, and any material that ignites spontaneously at normal temperatures in air. |
| 2 | Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors. Water spray may be used to extinguish the fire because the material can be cooled to below its flash point. |
| 1 | Materials that must be preheated before ignition can occur. Water may cause frothing of liquids' with this flammability rating number if it gets below the surface of the liquid and turns to steam. However, water spray gently applied to the surface will cause a frothing which will extinguish the fire. Most combustible solids have a flammability rating of 1. |
| 0 | Materials that will not burn. |

3. The following codes describe the reactivity hazards. (A dash (—) means identity to be developed)

| Code | Explanation |
|------|---|
| 4 | Materials which are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures. Includes materials which are sensitive to mechanical or localized thermal shock. If a chemical with this hazard rating is in an advanced or massive fire, the area should be evacuated. |

| <i>code</i> | <i>Explanation</i> |
|-------------|---|
| 3 | Materials which are capable of detonation or of explosive decomposition or of explosive reaction, but which require a strong initiating source or which must be heated under confinement before initiation. This includes materials which are sensitive to thermal or mechanical shock at elevated temperatures and pressures or which react explosively with water without, requiring heat or confinement. Fire fighting should be done from a protected location. |
| 2 | Materials which are normally unstable and readily undergo violent chemical change but do not detonate. This includes materials which can undergo violent chemical change at elevated temperatures and pressures, and materials "which may react violently with water or which may form potentially explosive mixtures with water. In advanced or massive fires, fire fighting should be done from a protected location. |
| 1 | Materials which are normally stable but which may become unstable at elevated temperatures and pressure or which may react with water with some release of energy, but not violently. Caution must be used in approaching the fire and applying water. |
| 0 | Materials which are normally stable even under <i>fire</i> exposure conditions and which are not reactive with water. Normal fire fighting procedures may be used. |

4. The following codes describe the specific hazards.

| <i>code</i> | <i>Explanation</i> |
|-------------|--|
| A | Corrosive Acid (ACID) |
| B | Corrosive Alkali (ALK) |
| C | Corrosive material other than acid and alkali (COR) |
| D | Oxidizing Material (OXY) |
| E | Use No Water in Fire Fighting (W*) |
| F | Corrosive Acid; Use No Water in Fire Fighting (ACID W*) |
| G | Corrosive Alkali; use no water in fire fighting (ALK W*) |
| H | Corrosive material other than acid and alkali; use no water in, fire fighting (COR W*) |
| J | Oxidizing material other than acid and alkali; use no water in fire fighting (OXY W*) |
| K | Oxidizing Acid (ACID OXY) |
| L | Oxidizing Alkali (ALK OXY) |
| M | Corrosive Oxidizing Material (COR OXY) |
| N | Corrosive Oxidizing Material; Use no water in fire fighting (COR OXY W*) |
| O | No specific hazard. |

*This symbol will include a dash on the identification label.

5. The following codes describe the storage compatibility group.

| <i>Code</i> | <i>Explanation</i> |
|-------------|---|
| A | Items in this group will be stored in the flammable storage building with separation as indicated in the Table of Hazardous Materials. |
| B | Items in this group will be stored in acid storage building, with separation as indicated in the Table of Hazardous Materials. |
| C | Items in this group will be stored in the compressed gas cylinder storage facility, with separation as indicated in the Table of Hazardous Materials. |

- D Items in this group may be stored in general purpose warehouse, with separation as indicated in the Table of Hazardous Materials.
- E Items in this group require special facilities and handling. Consult the installation Fire and Safety Officers and other appropriate personnel of the respective service for specific storage and fire protection requirements.
- S Items in this group shall be kept in a locked storage space accessible to authorized personnel only.
- W Items in this group shall be stored in a non-sprinkler protected space.

6. The following codes describe the most suitable extinguishing agents in the form of portable extinguishers.

| <i>Code</i> | <i>Extinguishing Agent</i> |
|-------------|------------------------------|
| 1 | Water |
| 2 | Foam |
| 2a | Alcohol Foam |
| 3 | Carbon Dioxide |
| 4 | Dry Chemical |
| 5 | Dry Chemical for Metal Fires |

7. The following codes describe the class liquids.

| <i>Code</i> | <i>Explanation</i> |
|-------------|--|
| 1A | Liquids having flashpoints below 73° F (22.8° C) and having a boiling point below 100° F (37.8° C). |
| IB | Liquids having flashpoints below 73° F (22.8° C) and having a boiling point at or above 100° F (37.8° C). |
| IC | Liquids having flashpoints at or above 73° F (22.8° C) and below 100° F (37.8° C). |
| 11 | Liquids with flashpoints at or above 100° F (37.8° C) and below 140° F (60° C) except any mixture having components with flashpoints of 200° F (93.3° C) or higher, the volume of which make up 99 percent or more of the mixture. |
| 111 | Liquids with flashpoints at or above 140° F (60° C). |
| 111A | Liquids with flashpoints at or above 140° F (60° C) and below 200° F (93.3° C) except any mixture having components with flashpoints of 200° F (93.3° C) or higher, the total volume of which make up 99 percent or more of the total volume of the mixture. |
| IIIB | Liquids with flashpoints at or above 300° F (150° C). |