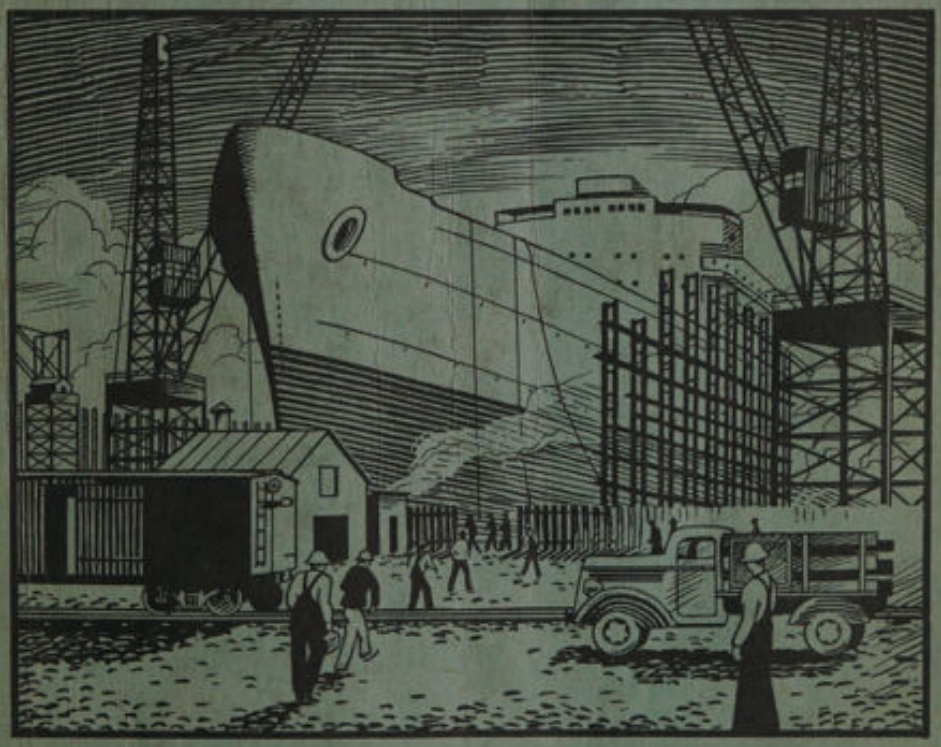
Principles of sanitation applicable to the construction of new vessels.

Principles of Sanitation

applicable to

THE CONSTRUCTION OF NEW VESSELS



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PRINCIPLES OF SANITATION

APPLICABLE TO THE

CONSTRUCTION OF NEW VESSELS

June 1, 1949

FEDERAL SECURITY AGENCY
Public Health Service
Division of Sanitation
Washington, D. C.

FOREWORD

The principles of sanitation contained in this document have been formulated after consultation with individuals and groups concerned with the design, construction, operation, and maintenance of vessels. They express those practical standards of sanitation receiving general support, and their application will aid in the prevention of the transmission of disease and in the promotion of the health and welfare of those using the vessels.

The Public Health Service is keenly interested in the provision of a sanitary environment on all types of new vessels, regardless of their intended service. For the benefit of those owners who may have a specific interest in only one phase of a vessel's environment, sanitation categories have been established to include: Potable water system, wash water system, waste disposal, food sanitation facilities, ratproofing, and others such as swimming pools.

The Vessel Sanitation Branch, upon request, will assist vessel owners, naval architects, and shipbuilders in the development of those parts of specifications and plans for new vessels which relate to the entire sanitation problem, or to one or more of the categories enumerated, by reviewing all plans submitted to compare them with the principles contained herein. Following review, constructive recommendations will be made.

During the course of construction in the shipyard, the Vessel Sanitation Branch is prepared to offer, through its field representatives, inspectional service and guidance on those parts of the vessel's structure and its facilities which bear upon future sanitation conditions aboard. This field service can likewise encompass the total environment or only those categories elected by the owner. To those newly constructed vessels meeting the principles of sanitation contained herein, the Public Health Service will give a Certificate of Sanitary Construction following the completion of adequate work.

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1.[1] POTABLE WATER SYSTEM

1.1[1] GENERAL

The term potable water as used herein means water meeting the requirements of the United States Public Health Service Drinking Water Standards.[2]

One water system supplying potable water for drinking, cooking, dishwashing, ablutionary, hospital and laundering purposes should be installed when practicable. If dual systems are installed, potable water should be piped to outlets which may be used for drinking, cooking, dishwashing and medical care purposes (exclusive of hydrotherapy in those spaces), but it need not be piped to slop sinks, lavatories, laundry facilities, bath tubs, showers, water closets, and bibb connections used for deck flushing purposes.

It is preferable from a public health standpoint that water for potable water purposes be secured from approved shore supplies. When that is done, the responsibility for water purification rests upon a trained, professional waterworks operator who has laboratory facilities, equipment, supplies, and expert advisory service available when needed.

When purification on board becomes necessary, the method selected for use should be that best suited to the water to be treated and most easily understood by the operating officers and seamen.

1.2 LOADING FACILITIES

1.21[1] Hose. A separate hose should be provided for loading potable water from shore sources. The hose should be durable, have a smooth impervious lining, and be equipped with the necessary fittings for fastening it to the filling line and the hydrant. It is preferable that the fittings be different from those on other hoses on the vessel and that suitable adapters be stowed for connecting them to hydrants. Potable water loading hose should be provided on the vessel unless hoses are maintained by the vessel operating company at all piers of ports of call where potable water is loaded. If the specific needs of the vessel are not known, at least two 50-foot sections should be provided.

1.22 Hose Stowage. The potable water loading hose and such hydrant adapters as are required should be stowed near the vessel's filling line connection unless the operator elects to provide stowage facilities at all piers where potable water is to be loaded. They should be stowed in a closed cabinet, on a rack or reel, or they should be placed under a deckhead or on the upper part of a bulkhead of an interior passageway. The cabinet, rack, or reel should be at least 18" above the deck and

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(1) A whole figure designates a Part; a figure with one decimal, a Subpart; one with two decimals, a Section.

(2) Interstate Quarantine Regulations, as amended February 25, 1948.

used for no other purpose. If stowed on a rack or reel or hung on brackets, means should be provided to secure the hose in them, or to the bulkhead. If the hose is not stowed in a closed cabinet, its ends should be plugged or capped with threaded metal fittings. The hose cabinet or stowage space should be clearly labeled with a sign reading "POTABLE WATER HOSE ONLY".

1.23 Filling Line. All potable water storage tanks which are regularly or occasionally filled by hose should be provided with independent filling lines to which a hose can be attached. This line should not be cross connected with any line of a non-potable water system, nor pass through a non-potable liquid.

The filling line should begin, horizontally or in a gooseneck pointing downward, at a point at least 18" above the top of the tank or the deck it penetrates. Screw threads or other devices permitting hose attachment on the end of the filling line should preferably be different from the threads or devices on other filling lines and on fire hydrants. The filling line should be provided with a screw cap or plug which is fastened by a chain to the line or an adjacent bulkhead in such a manner that the cap or plug will not touch the deck when it is allowed to hang. Each filling line should be clearly labeled at or near the point of hose connection with a sign reading "POTABLE WATER FILLING". The filling line within the vessel should be painted or stenciled as recommended in Sec. 1.56, p. 8.

1.3 STORAGE

1.31 Capacity. Adequate storage should be provided for potable water. The amount should be determined by a consideration of the size of the crew and the number of passengers to be accommodated, the frequency with which water can be loaded from approved sources, the availability of water suitable for treatment and the facilities for treating it, and the types of water systems aboard.

The consumption values given in Table I are intended for use only as guides in determining the amount of storage required. The unit values may vary depending upon the type of vessel and the service in which it is engaged.

The capacity of the storage tanks should be considered as the volume between the maximum level of the water before it overflows and the lowest level from which water may be drawn for distribution.

The amount of storage may be decreased if the potable water supply is to be supplemented with water purified aboard but only by such an amount as can be dependably supplied daily by the purification process.

When the entire potable water supply is obtained by evaporation and distillation of overboard water or by chlorination of overboard fresh water, there should be provided sufficient storage to preclude the need for treating overboard water from harbors or other heavily contaminated areas, and to allow time for maintenance and repair. The treatment of water from heavily contaminated areas can be avoided by loading from approved

Table I. Suggested Minimum Rates of Consumption of Domestic Water on Vessels

Item	Gallons per person per day		
	Drinking-cooking system	Wash water system	Combined system
Drinking water			
Crew; passengers	0.7		0.7
Cooking water			
Cooking; vegetable and fruit washing	0.8		0.8
Dishwashing	5.0		5.0
Washing			
Baths		16.0	16.0
Lavatory		5.0	5.0
Laundry		1.0	1.0
Cleaning in galley, pantry, and dining room	1.5		1.5
Totals	8.0	22.0	30.0

shore sources while in port or by the treatment of water from wash water tanks which have been filled while the vessel is in satisfactory raw water areas. In the latter case, total storage requirements can be made up of a combination of raw water storage and potable water storage but in no case should the potable water storage be less than a 2-day supply.

1.32 Tanks. Potable water should be stored in one or more tanks constructed, located, and protected so as to be safeguarded against any contamination from the outside. They should be constructed of metal or other suitable material. No structural member should impede complete drainage of a tank.

The tank should be independent and have no common partition with a tank holding non-potable water or other liquids. It should be independent of the shell of the ship unless the bottom of the tank is at least 2' above the maximum load water line and all shell seams and connections, including frames, in way of the tank are continuously welded on the inside of the tank. There should be no rivets in that part of the shell or shell connections which form the side of the tank.

A deck may be used as the top of a potable water tank provided there are no access or inspection openings therein and the seams are continuously welded on the inside of the tank. There should be no rivets in that part of the deck which forms the top of the tank. No toilet or urinal should be installed on or directly above that part of a deck which forms the top of a potable water tank. A deck may form the bottom of a potable water tank provided it does not also form the top of a tank which holds non-potable water or other liquids.

If the potable water tank is located in the lower part of the ship, the bottom of the tank should be at least 18" above the top of inner

bottom tanks used for the storage of liquids. (See Fig. 1,A) If an operating deck, platform, or grating is installed in the vicinity of the potable water tank and near the inner bottom plating, it is preferable that the bottom of the potable water tank be above such operating deck, platform, or grating. (See Fig. 1,B) In the absence of inner bottom plating, the bottom of the potable water tank should be at least 18" above the lowest point of the bilge space (not a sump or drain well). (See Fig. 1,C) The bottom of a potable water tank may be formed by the inner bottom plating if

(1) an 18-inch deep void space is fitted underneath,

(2) there are no means whereby the void might be filled, and

(3) the void space and the inner bottom plating around the tank are provided with means for adequate drainage. (See Fig. 1,D)

In cases where the material of which a tank is constructed requires coating, such coating should not render the water stored therein unfit for human consumption. Objections will not be raised to the use of a particular tank lining until such time as tests reveal that it is adversely affecting the quality of the potable water.

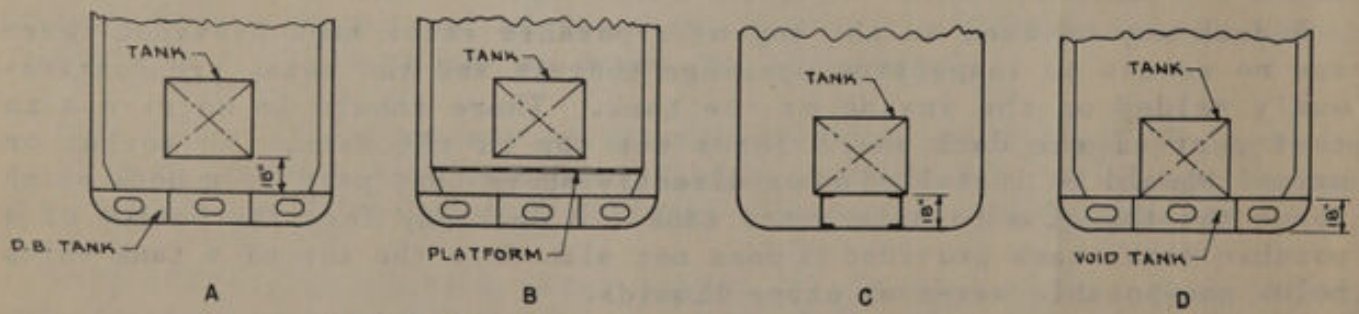
No deck or sanitary drain, or pipe carrying wash or salt water or other non-potable liquid should pass through the tank or directly above any manholes in it. Tunnels through potable water tanks for such pipe should be completely drainable. Horizontal tunnels should be made of heavy plate and placed on a continuous slope, and the pipe therein should be extra-heavy with butt-welded joints.

The potable water tank should be conspicuously labeled "POTABLE WATER".

Vessels using tanks not meeting the recommendations relative to the shell of the ship, decks, inner bottom plating, common partition, and bilge should provide suitable treatment for water drawn from those tanks prior to its use as potable water.

1.4 STORAGE TANK APPURTENANCES

1.41 Vents. The potable water storage tank should be provided with a vent of adequate size, preferably not less than 1½" in diameter, located, constructed, and screened so as to prevent the entrance of insects, rodents, dust, water, or other contaminating substances. Screen on the



ACCEPTABLE LOCATION OF POTABLE WATER TANKS
IN RELATION TO BILGE OR INNER BOTTOM TANK

FIG. 1

opening should be 16-mesh or finer and corrosion-resistant. The vent should not be connected with the vent of any tank holding non-potable liquid.

Vents and overflows from potable water tanks may be combined. A single pipe without take-offs may be used as a combined vent and overflow. The vent or combined vent and overflow should terminate with the free end pointing downward. It may terminate at the side of the tank near the bottom of the ship as specified in Sec. 6.22, p.26, at least 18" above the top of the potable water tank, or 18" or more above a weather deck in a sheltered space. When the end must be exposed to wave action, it should be equipped with a backwater (check) valve.

1.42 Overflows. The potable water tank should be provided with an overflow. It should be so located that the design capacity of the tank is maintained and the diameter of the overflow should be equal to or greater than the diameter of the filling line. The overflow should be constructed and protected in the same manner as recommended for vents in Sec. 1.41, p. 4, and, in addition, should not penetrate the skin of the vessel. If it terminates out in the weather, the line should be screened as recommended in Sec. 1.41, p. 4.

An overflow may be combined with a vent if the provisions described for the construction and protection of vents and overflows are both satisfied.

1.43 Manholes. The potable water tank should be provided with a manhole located in the side or in the top when the top is not formed by a deck. When located in the top, the manhole should be provided with a coaming or curb raised at least ½" above the tank top. The cover should extend to the outer edge of the curb or flange and be provided with a gasket and a device for securing it in place. Flush manholes will be acceptable in the sides of tanks.

If a hinged or slip-on cover is used on a curbed manhole, it should overlap the outer edge of the curb and extend downward all around for a distance of at least 1". Provision should be made for bolting or locking this type of cover. It should not be installed on tanks located where an accidental overflow will create an insanitary condition.

1.44 Water-level Gauges. If a means is provided for determining the depth of water in the potable water tanks, its construction should be such as to prevent the entrance of contaminated substances or liquids into the tanks.

Among the devices which are considered satisfactory for determining the water level in a potable water tank are the following:

(1) Water gauge glass with shutoff valve on a side of the tank.

(2) Petcocks at appropriate intervals on the side of the tank.

(3) Petcocks installed in a vertical off-set pipe connected to the tank near the bottom.

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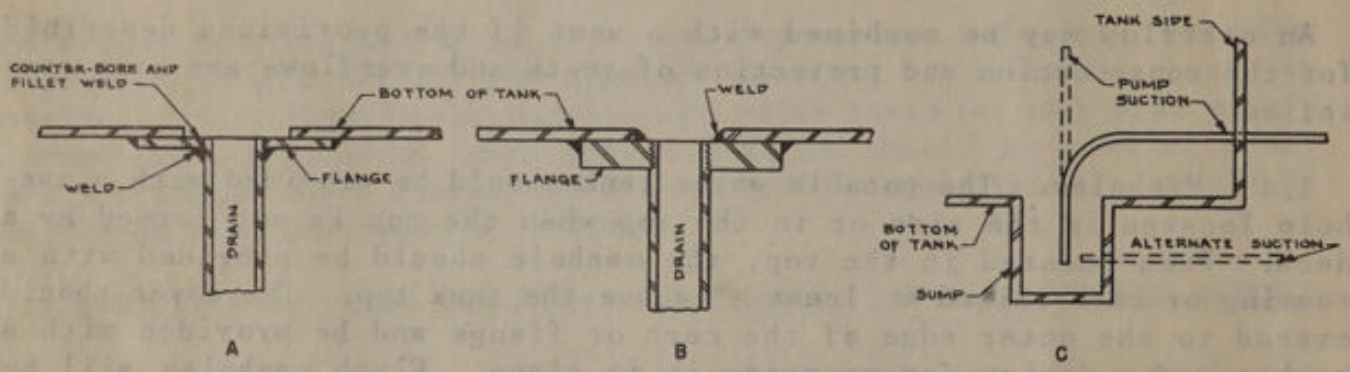
(4) Water-level indicators actuated by air pressure. The air may be supplied by a hand pump, an independent compressor, or through a "press-on" valve with a filter or liquid trap installed in the supply line from the main compressed-air system.

(5) An enclosed float gauge.

(6) A water-operated pressure gauge.

1.45 Drains. The potable water tank should be provided with a means whereby the tank can be completely drained. The drain opening should be large enough to facilitate flushing the tank and at least 1½" in diameter. If drainage is by gravity flow, the opening should be in the bottom of the tank and should terminate flush with or below the inner surface of the tank bottom. The installation should be such as to avoid a reinforcing plate, a raised welding bead, or a protruding pipe in way of the hole which would prevent complete drainage. This can be accomplished as shown in Fig. 2,A and B. If a potable water pump suction line is used as a drain line and cannot be installed the same as a gravity drain, then it should draw from a sump as shown in Fig. 2,C.



TANK DRAINS

FIG. 2

A screw plug or capped nipple should be installed as a drain only when it is easily accessible and the water can be wasted directly therefrom. A pipe drainage system should be independent of all other water systems and should be protected as specified in Sec. 6.22, p. 26. If a locking-type valve is not provided, the end of the drain line should be plugged or capped to prevent the loss of water in case the drain valve is loosened by vibration. The screw plug or the drain cap should be secured to the pipe or bulkhead by means of a keeper chain to prevent it from dropping to the deck.

The discharge to waste should be from the discharge main at a point before any branches take off to the distribution system. A valve should be installed on the main immediately beyond the drain line take-off.

1.5 DISTRIBUTION

1.51 Pump Suction or Feed Line. The suction line of the potable water pump should not be cross connected with the piping or storage tank of any non-potable water system either directly or through a manifold. There

should be no blind or spectacle flanges, or removable or swing sections of pipe in the line whereby such a connection can be made.

The suction line should be located as high as practicable, preferably above a working deck or platform, with the purpose in view of preventing submergence in bilge water. It should not pass through tanks provided for non-potable liquids.

1.52 Pumps. The potable water pump should have adequate capacity for service demands and should be used for no purpose other than pumping potable water. The installation of a stand-by pump is recommended to take care of emergencies or a break down in the main unit serving the potable water system.

Hand pumps, which are installed on some vessels to serve galleys, pantries, and the like, for emergency or routine use as a supplement to pressure outlets, should be constructed and installed so as to prevent the entrance of contamination into the potable water storage tank or into the water being pumped. In the case of the bar-handle type of lift pump,

(1) the pump head should be the enclosed type with a stuffing box around the pump rod and should have a downward-directed, enclosed spout,

(2) the pump base should be designed to support the pump and the drop pipe should be a solid, one-piece, recessed type, cast integrally with or threaded to the pump column or stand, and

(3) the water cylinder should be so constructed and installed that hand priming will not be necessary.

Pump heads with slotted tops and pitcher-type pumps should not be installed.

1.53 Pneumatic (Pressure) Tank. If compressed air is to be introduced into a pneumatic tank, it should be supplied by a "snifter" (air intake) air valve on the potable water pump, an independent compressor, through a "press-on" valve with a filter or liquid trap installed in the supply line from the main compressed-air system, or an equivalent device to prevent contamination of the potable water.

1.54 Distribution System. The potable water distribution system should be independent of all other water systems. Locked valves, blind or spectacle flanges, or removable sections of pipe should not be used as a means of separating a potable water system from one conveying water of lower quality.

The distribution system should be protected against the introduction of contamination by backflow as specified in Sec. 6.22, p. 26.

A direct or continuous connection from the potable water system should not be made to operate an aspirator or ejector or other hydraulically-operated devices, or for the cooling of machinery. A hot water heating,

air-cooling, or air-conditioning circulating water system should not be supplied directly from the potable water system unless it is a closed system with no non-potable water connections, and the water is not used for heat exchange purposes in a unit containing toxic materials.

Cold potable water should not be used for cooling boiler water for testing purposes unless it is supplied to the cooler through an air gap or is discharged from the cooler through an air gap.

1.55 Services. Potable water outlets should be provided in or near passenger, officer and crew quarters, and in the engine and boiler rooms. Drinking water fountains (See Sec. 6.23, p. 27) should be installed if practicable. Drinking fountains in engine and boiler rooms should be of the self-cooling type or installed on or within 24" of an adequately insulated, cooled water, circulating line so as to prevent wastage of potable water.

Coolers which permit direct contact of ice with the water and coolers which consist of a cooling chamber into which a water-filled bottle is inserted in an inverted position should not be used for dispensing drinking water.

Hot and cold potable water should be piped to the galley, pantry, and scullery.

Hot and cold potable water should be piped to the hospital and other medical care spaces for hand washing and medical care purposes (but not necessarily for hydrotherapy, toilet and bedpan flushing, or body bathing).

Only potable water should be piped to the freezer for making ice for drinking and cooking purposes.

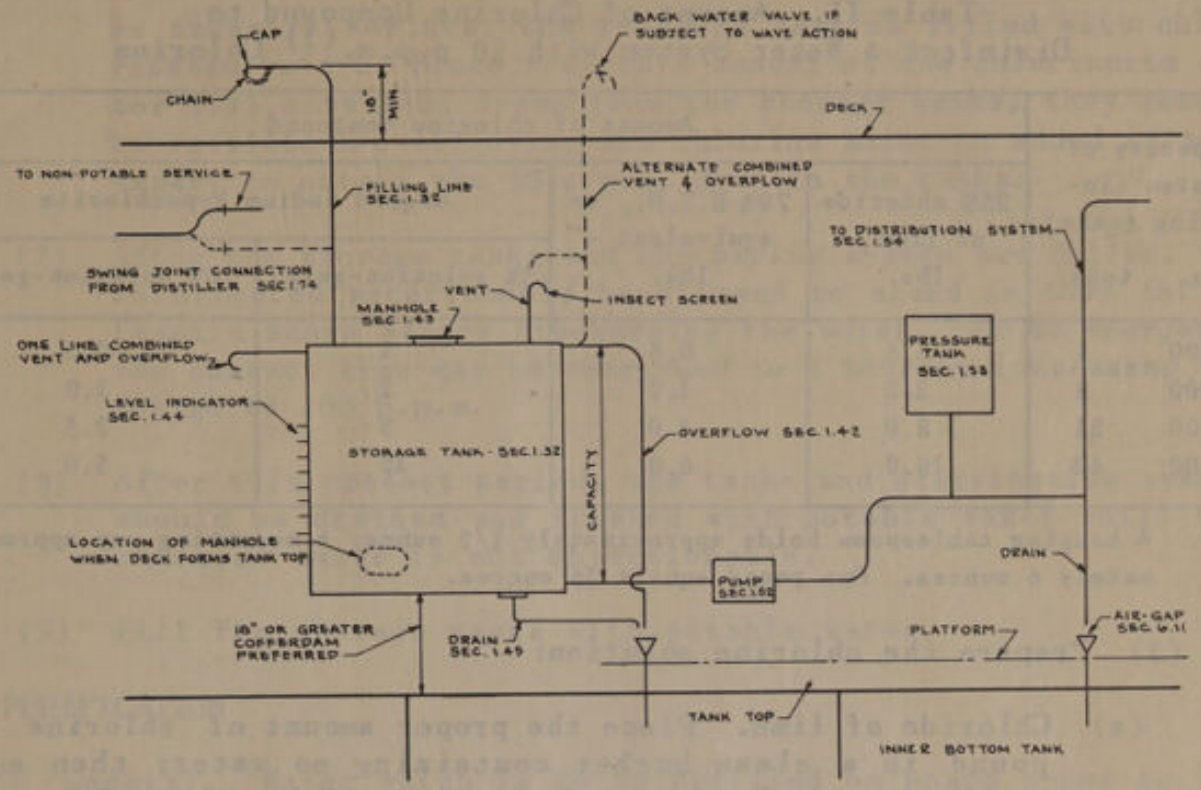
1.56 Identification and Marking. The piping of the potable water system, including the filling line, should be suitably stenciled, painted light blue, or striped with 6-inch light blue bands at fittings, on each side of partitions, decks, and bulkheads, and at intervals not to exceed 15' in all spaces except quarters, dining rooms, salons, and like public places where the interior finish would be marred by such marking.

The bodies of valves installed in that part of the potable water system which is marked should be painted light blue or the valve wheel appropriately labeled.

In some cases, potable and non-potable water faucets may be located so that one may not be distinguishable from the other. To avoid confusion it is advisable to label the potable water outlet "POTABLE WATER". All non-potable water faucet outlets should be labeled "UNFIT FOR DRINKING".

1.6 DISINFECTION OF WATER TANKS AND DISTRIBUTION SYSTEM

1.61 General. The potable water storage tank and distribution system should be cleaned, disinfected, and flushed prior to being put into service. Where a water distiller is connected to the potable water tank or



TYPICAL INDEPENDENT WATER SYSTEM

FIG. 3

system, the pipe and appurtenances between the distiller and the potable water tank or system should be disinfected by the same treatment as is given the potable water system.

1.62 Procedure for Disinfection. Chlorine compounds which are used for disinfecting water systems are chlorinated lime, high-test hypochlorite (H.T.H., Perchloron, Pittchlor, or equivalent), or commercially prepared liquid sodium hypochlorite (Chlorox, Zonite, or equivalent). Chloride of lime and liquid sodium hypochlorite can be purchased at almost any grocery or drug store. As these compounds deteriorate on exposure to air, they should be purchased in small containers and the tops of the cans or bottles tightly replaced after use. All products should be kept in a cool, dark place. The instructions that follow should be utilized in the disinfection of potable water systems by the use of chlorine compounds:

(1) Thoroughly scrub the storage tanks and flush the tanks and distribution system with potable water.

(2) Determine the volume of water necessary to completely fill the tanks and distribution system. The amount of disinfecting agent that will be required may be secured from Table II.

When chlorine compounds or solutions other than those noted in the table are used, the dosage should be:

$$\text{Dosage of powder} = \frac{70\%}{\%\ \text{chlorine in compound}} \times \text{dosage in 70\% column}$$

$$\text{Dosage of liquid} = \frac{5\%}{\%\ \text{chlorine in liquid}} \times \text{dosage in 5\% column}$$

Table II. Amount of Chlorine Compound to Disinfect a Water System with 50 p.p.m.(1) Chlorine

Capacity of system (including tanks)		Amount of chlorine compound			
		25% chloride of lime - lbs.	70% H.T.H., or equivalent - lbs.	Liquid sodium hypochlorite	
gals.	tons			5% solution-gals.	10% solution-gals.
1,000	4	1.6	0.6	1	0.5
2,000	8	3.2	1.2	2	1.0
5,000	21	8.0	3.0	5	2.5
10,000	42	16.0	6.0	10	5.0

Note: A heaping tablespoon holds approximately 1/2 ounce; a measuring cup approximately 6 ounces. One pound equals 16 ounces.

(3) Prepare the chlorine solution:

(a) Chloride of lime. Place the proper amount of chlorine compound in a clean bucket containing no water; then add a small amount of water and mix to a thick paste. Dilute the paste by adding water gradually and stirring constantly until a gallon or two of solution is obtained. Warm water is better than cold for this purpose. Allow the solution to stand for 30 minutes so that the undissolved particles may settle to the bottom. Pour off the clear liquid (which is the chlorine solution) and, if necessary, filter it through muslin or cheesecloth.

(b) H.T.H., Perchloron, Pittchlor, or equivalent. Place the proper amount in a bucket, fill within a few inches of the top, and stir until the powder is dissolved. (Disregard slight turbidity, if any.)

(c) Liquid sodium hypochlorite. These solutions require no preparations.

(4) Introduce the chlorine solution into the potable water storage tanks.

(5) Immediately after introducing the chlorine solution into the tanks, they should be completely filled with potable water. Sufficient mixing will usually be obtained by the whirling action of the incoming water.

(6) Open the taps and outlets on the distribution system nearest the storage tanks and allow them to flow until chlorinated water appears. After opening the nearest taps, the process should be continued outward from the tanks until all taps and outlets have been flushed with chlorinated water. Care should

(1) Parts per million.

be taken to see that the pressure tank is filled with chlorinated water. Since a certain amount of the chlorinated water will have been drawn from the storage tanks, they should be refilled to overflowing and chlorine solution added if necessary to obtain the 50 p.p.m. dose in the tanks.

(7) After the storage tanks and the piping system are filled, the chlorinated water should be allowed to stand in them for at least 4 hours before discharging the water. In an emergency the contact time may be shortened to 1 hour by increasing the dosage to 100 p.p.m.

(8) After this contact period, the tanks and distribution system should be drained and flushed with potable water until the chlorine taste is not objectionable.

(9) Fill the storage tanks with potable water.

1.7 PURIFICATION

1.71 General. Water which is to be purified on board prior to its use as potable water may be stored in tanks formed by the shell of the vessel provided such tanks are free of apparent leakage, have no sanitary drains passing through them, and are adequately protected against both the backflow and the discharge thereto of bilge or highly contaminated water.

Treatment facilities, where provided, should be suitable for the water to be purified, and should be designed to ensure efficient operation and the production of a potable water which conforms to the United States Public Health Service Drinking Water Standards. Overboard water treated on vessels should be taken from areas relatively free of contamination and pollution. River water should be distilled for the production of potable water. Lake water that is properly chlorinated will be acceptable as potable water. By-passes should not be installed around necessary treatment units. A sufficient supply of vital and fragile parts of the treatment apparatus should be furnished.

The water storage capacity in connection with a purification system should be as recommended in Sec. 1.31, p. 2.

When water from overboard is treated on board, the discharge of sewage in relation to the water intake should be as specified in Sec. 6.31, p. 27.

1.72 Chlorination. When water is to be regularly disinfected with chlorine, the chlorine should be applied in the form of a hypochlorite solution by means of a commercial hypochlorinator of satisfactory design to produce the desired results. The hypochlorinator should be constructed or equipped so that the flow of the hypochlorite solution may be observed. Its capacity should be determined on the basis of the maximum rate of flow of water and the treatment required to produce a satisfactory chlorine residual (not less than 0.2 p.p.m. free chlorine or 1.0 p.p.m. chloramine). A sampling cock should be provided at an appropriate place

in the system for taking test samples to check the chlorine dosage and the operating efficiency of the feeder. A commercial testing kit for determining the chlorine residual should be secured with the hypochlorinator.

When water is treated regularly by chlorination, provision should be made for a baffled holding tank of sufficient capacity to provide a suitable contact period for the chlorine and water. This period of contact should be provided before any water is delivered to the next successive treatment unit or to the distribution system and should be figured on the basis of maximum rate of flow through the contact tank. When a normal dosage of chlorine is applied, the contact period should be at least 20 minutes. When superchlorination is practiced, a lesser period of contact may be satisfactory.

When the water is treated regularly by superchlorination and dechlorination with sodium thiosulfate, a mechanical means should be provided for injecting the sodium thiosulfate. Granular activated carbon for dechlorination should not be used unless the plans covering its use are approved in each case. The rate of flow through the activated carbon units should not exceed 1 gallon per square foot per 10-inch depth of carbon. Steam lines should be provided at the bottoms of the units for periodic disinfection of the filtering medium.

1.73 Filtration. Filtration should be practiced only when it is a necessary part of a purification process which includes a bactericidal treatment. Pressure sand filters used in the treatment of water should be constructed substantially and should be capable of withstanding the pressure to which they will be subjected. Necessary handholes or manholes should be provided. The filtering medium should consist of at least 24" of hard filter sand, crushed quartz, or other suitable filtering material, supported either on a porous, stone, filter bottom or a 12-inch bed of gravel. There should be a freeboard space above the sand of not less than 24".

The design should be such as to permit an optimum rate of filtration of 2 gallons per minute per square foot of sand bed area and there should be provided the necessary means for automatically controlling the rate of flow. The control may be effected by using a pump, the maximum discharge of which equals the rated capacity of the filter.

Means should be provided for backwashing the filter at a rate not less than 15 gallons per minute per square foot of filter bed area and with water of a quality equal to the filtrate or treated product. It should be possible to backwash the filter for at least 10 minutes. The filter should be equipped with a loss-of-head gauge.

The valve nest or multiple port valve controlling the operation of the filter should be designed so that the filter cannot be by-passed unless the water is prechlorinated and filtration is not, in fact, a necessary part of the purification process.

Filters utilizing filtering media other than sand may require less freeboard, and may permit a higher filtration rate and a lower backwash rate

than sand filters. Plans covering particular installations should be approved in each case.

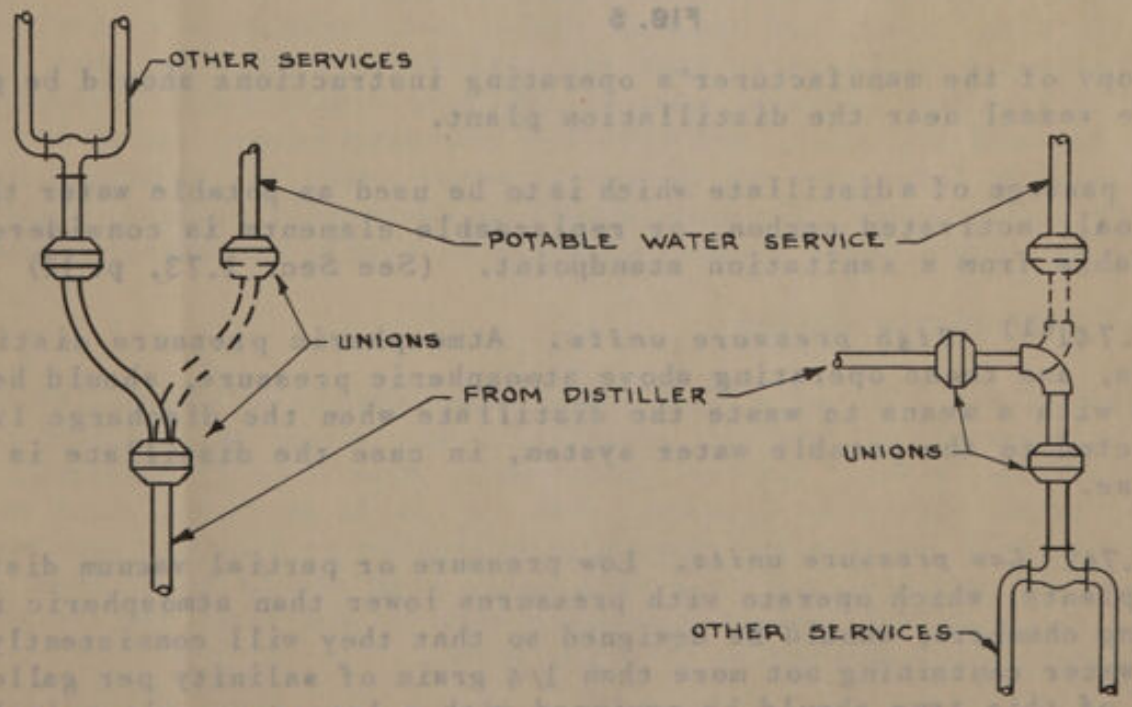
Suitable storage should be provided for the coagulant used in conjunction with a filtration process.

Water which is of potable quality should not be given any further treatment prior to use. Filtration of such water through charcoal, activated carbon, or replaceable elements is considered undesirable. If installed, a satisfactory means should be provided for the disinfection of the filtering media after it has been placed in the filter, and for periodic disinfection thereafter.

1.74 Distillation. If a distilling plant is used for supplying water to the potable water system, the plant should be of such design that it will uniformly produce potable water.

Provisions should be made in the evaporator to prevent flooding, and to minimize foaming or the carry-over of water into the distiller condenser. The steam coil or tubes in the evaporating chamber, and the cooling coils in the distiller condenser and the condensate cooler should be arranged to facilitate inspection to detect corrosion, pitting, or leaks.

If the plant is to produce water for non-potable water systems as well as for the potable water system, provision should be made to avoid cross connections. This should be accomplished by the use of a swing connection (reversible ell) as shown in Fig. 4, an air gap (See Sec. 6.11, p. 25), or any other approved device. If a swing connection is used, it should

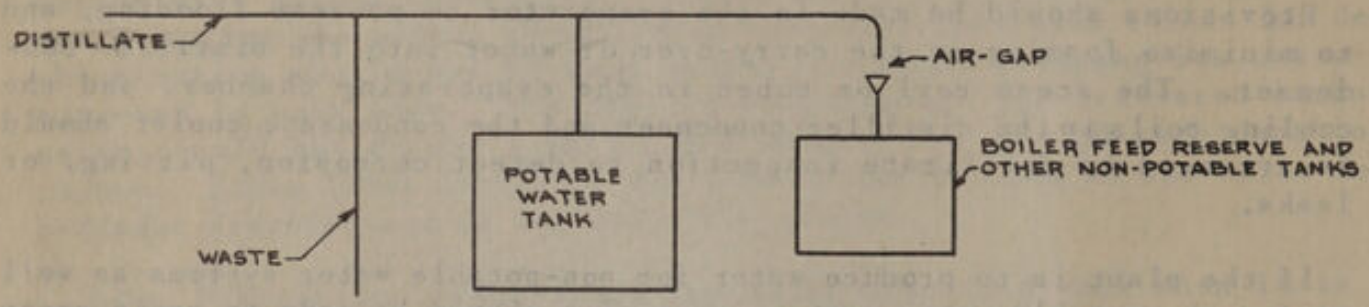


SWING CONNECTION

FIG. 4

be arranged so that the discharge from the distilling plant is connected only to the potable water system when water is being discharged to that system. It should be placed in the primary discharge line at any point beyond the condensate pump, or beyond the test tank when delivery to the point of usage is by gravity flow and it should be located in the space occupied by the distillation plant. It should be equipped with easily operated fittings and should be readily accessible for changing from one position to the other. The receiving end of the potable water connection should be in a horizontal position, or in a vertical position pointing downward. A plug should be provided for the receiving end of the potable water line.

If air gaps are provided in the discharge lines to all non-potable systems, a direct connection may be made to the potable water system. (See Fig. 5)



AIR-GAP PROTECTION OF DIRECT DISTILLATE DELIVERY TO POTABLE WATER TANK

FIG. 5

A copy of the manufacturer's operating instructions should be posted on the vessel near the distillation plant.

The passage of a distillate which is to be used as potable water through charcoal, activated carbon, or replaceable elements is considered undesirable from a sanitation standpoint. (See Sec. 1.73, p. 12)

1.741(1) *High pressure units.* Atmospheric pressure distilling plants, and those operating above atmospheric pressure, should be provided with a means to waste the distillate when the discharge line is connected to the potable water system, in case the distillate is unfit for use.

1.742 *Low pressure units.* Low pressure or partial vacuum distillation plants, which operate with pressures lower than atmospheric in the boiling chambers, should be designed so that they will consistently produce water containing not more than 1/4 grain of salinity per gallon. A plant of this type should be equipped with a low-range, electrical, salinity indicator for determining the salinity of the distillate at a

(1) A figure with three decimals also designates a Section. (See footnote (1), p. 1)

point beyond the final condensate cooler. A flow diversion valve should be provided to divert the flow of water from the potable water tanks when the salinity of the distillate exceeds 1/4 grain per gallon. This valve should operate instantaneously and should be controlled by a salinity cell located in the discharge line beyond the final condensate cooler. The electrical control for this valve should be arranged so that the valve will operate regardless of the position of the selector switch on the salinity indicator panel, and the flow of water should be diverted from the potable water tank when the current is off. In addition, an alarm should be provided to warn the operator when the salinity of the condensate exceeds 1/4 grain per gallon.

When evidence is lacking of the dependability of a low pressure plant to produce water of 1/4 grain salinity under operating conditions, then one of the following measures should be taken:

(1) Maintain a temperature of 165° F. or higher in the boiling chamber; or

(2) Make provisions to heat the distillate to 165° F. or higher. This heating of the distillate should be thermostatically controlled and means of recirculating or wasting underheated distillate should be provided at a point immediately following the thermostat.

When fresh or brackish water feed is used, the plant should operate at a temperature of 165° F. or higher in the boiling chamber.

2. WASH WATER SYSTEM

2.1 GENERAL

One water system supplying potable water for drinking, cooking, dishwashing, ablutionary, hospital and laundering purposes should be installed when practicable. If a wash water system in addition to a potable water system, is installed, wash water may be piped to slop sinks, lavatories, laundry facilities, bath tubs, showers, water closets, and bibb connections used for deck flushing purposes.

Water of the Great Lakes and of similar lakes, which is taken from areas therein not affected by contaminated drainage from the shores or vessels is generally satisfactory to use as wash water without prior treatment. When water for washing purposes is to be taken from rivers, equipment should be installed to provide filtration and chlorination of the water prior to its use. In connection with such treatment, Secs. 1.72 and 1.73, pp. 11 and 12, should be applied with these exceptions:

(1) The contact tank will not be necessary if provision is made for a dosage of chlorine of at least 5 p.p.m.

(2) The filtration rate through sand can be increased safely to 3 gallons per square foot per minute.

2.2 STORAGE TANKS.

Wash water storage tanks should be constructed so as to minimize the possibility of the water therein being contaminated. Double bottom, fore and aft peak, wing, and topside tanks, and tanks with a side common to another non-potable water tank are satisfactory provided such tanks are free of apparent leakage, have no sanitary drains passing through them, have covered manholes, and have all sounding tubes capped or plugged. When a deck forms the top of a wash water tank, all openings should be curbed and covered. The tank should be adequately protected against the backflow or discharge thereto of bilge or highly contaminated water.

2.3 DISTRIBUTION SYSTEM

The suction line of a wash water pump should be connected directly to the storage tank and not directly to any system or manifold which may handle bilge water. Ballast pumps which draw from or discharge to wash water tanks should be provided with manifolds or lines which are independent of the suction and discharge manifolds or lines of the wash water pump. The suction line to a wash water pump should be as high as practicable, preferably above a working deck or platform, for the purpose of preventing its submergence in bilge water.

There should be no cross connection between the wash water distribution system and any overboard, bilge, fire, or other highly contaminated liquids. Drains

to bilges or waste pipes, and discharges to systems of lower quality and to fixtures handling sewage wastes should be protected against backflow as specified in Sec. 6.22, p. 26.

Wash water may be piped into the hospital or other medical treatment space for use in hydrotherapy and for purposes other than hand washing and medical care.

Wash water may be used for garbage disposal provided the delivery line is protected against backflow. (See Sec. 6.22, p. 26) Wash water should not be piped into the galley, pantry, or scullery for dishwashing. All faucets on a separate wash water system should be clearly posted with signs reading "UNFIT FOR DRINKING".

2.4 SALT WATER BATHS

Salt water service to bath tubs and showers should be independent and there should be no cross connection to either the potable water or the wash water system. The supply line should originate at a point in the salt water system where adequate flushing will occur between the time the vessel leaves polluted water and the time water will be drawn for bathing purposes. Adequate flushing can best be assured by having the supply line originate at or near the pump. A shutoff valve should be installed so that this service can be made inoperative while the vessel is in polluted water. This shutoff valve should be installed just beyond the point of take-off from the vessel's main salt water system and it should be labeled "KEEP CLOSED WHILE IN HARBOR". The principle is the same as shown for swimming pools in Fig. 13.

3. SANITARY (OVERBOARD) WATER SYSTEM

3.1 GENERAL

The sanitary (overboard) water system should be independent of the potable water system and the wash water system. All faucets on the sanitary (overboard) water distribution system should be clearly labeled with a sign reading "UNFIT FOR DRINKING" Overboard water should not be piped into the galley or pantry for floor flushing purposes. Water from the sanitary system may be used for garbage disposal provided that part of the pipe which is within the galley is properly labeled or painted orange. There should be no outlets from the sanitary water system in the hospital or other medical treatment spaces except those for flushing waste disposal units such as toilets, bedpan washers, and slop sinks.

4. VESSEL-TO-SHORE PRESSURE WATER CONNECTION

4.1 GENERAL

When facilities are installed on a vessel whereby it will be possible to connect any non-potable water system on the vessel to a potable water system on a pier for the purpose of utilizing the pressure from the pier system, there should be installed on the vessel, at or near the inlet end of the non-potable system to be so implicated, a standard device to prevent flow of water from the vessel to the shore.

5. GALLEYS, PANTRIES, SCULLERIES, AND FOOD HANDLING AND STORAGE SPACES

5.1 STRUCTURAL

5.11 Decks. The decks or flooring of all spaces in which food or drink is stored, prepared, or served should be constructed so as to be easily cleaned. When deck drains are installed, they should be provided with traps and the deck or flooring should be graded to drain properly to them. A gutterway may be placed around the outer edge of the galley, provided it is not behind any equipment which might be installed against the bulkhead and is accessible for cleaning. If cover plates are installed over the gutterway, they should be portable and made of heavy expanded metal, open mesh material, or perforated plate.

5.12 Bulkheads and Deckheads. Bulkheads and deckheads of spaces in which food is stored or prepared should have smooth, light-colored, and washable surfaces. In galleys, pantries, and sculleries they should have a hard finish and should preferably be of metal.

Fibrous insulation should be sheathed in such a manner as to prevent particles of the insulation from falling upon food. Cloth or plaster surfacing is not satisfactory.

Fibrous air filters should not be installed in the deckhead or over food processing equipment.

All enclosures, such as double bulkheads and deckheads, should be ratproofed and should be constructed so as to minimize the harborage for other vermin.

Perforated accoustical material should not be installed in galleys, pantries, sculleries, and food handling and storage spaces; it will be satisfactory in dining spaces if the sound-absorbing material is of such a nature, or is so sheathed beneath, as to prevent particles from falling through the holes and seams. (See Sec. 22.222, p. 91)

5.13 Piping in Deckheads. Pipe in unsheathed deckheads over spaces where food is stored or prepared or utensils are washed, or over portions of spaces from which food is regularly dispensed should be insulated if condensation is likely to form on the pipe.

Drainage lines in the deckheads of these spaces should be avoided where possible. Where unavoidable, they should be constructed as specified in Sec. 6.31, p. 27.

5.14 Drainage of Space. Butcher shops, galleys, sculleries, and similar food preparation spaces, the decks of which require flushing for adequate cleanliness, should be provided with one or more drains and the flooring should be sloped thereto.

5.15 Insect Screens. An effective means should be provided for the exclusion of flies from spaces in which food is prepared or served while the vessel is in port during the seasons of the year when flies are prevalent. All structural openings from food spaces to the outer air should

be effectively screened with 16-mesh or finer wire, or plastic cloth. Door screens should preferably open outward wherever practicable. Skylights above food spaces which can be opened should be equipped with removable insect screens. On seagoing ships, it may be necessary to provide portable screened frames which can be placed in the openings when needed. Window and door screens should be tight-fitting.

Either the inlet or the supply outlet opening in natural draft ventilating ducts in food spaces should be covered with insect screening. Forced draft ventilation openings into food spaces do not require insect screening. Tight-fitting, self-closing louvers are satisfactory in lieu of mesh cloth in the outlets of forced draft exhaust openings.

5.16 Toilet and Lavatory Facilities. Adequate toilet facilities should be located convenient to food handling spaces. It is preferable that toilet rooms should not open directly into spaces where food is stored, prepared, or served. If this is not possible, the doors separating such spaces should be self-closing and tight-fitting.

Hand washing facilities, including hot and cold, running, potable or wash water, and means of dispensing soap and single-use, individual towels should be provided in or convenient to toilets and should preferably be installed in each galley and pantry or combinations thereof. A sign reading "WASH HANDS AFTER USING TOILET" should be provided so as to be readily observable by food handlers. Scullery sinks or vats for the washing of cooking utensils, and slop sinks are not satisfactory as hand washing facilities for food handlers.

5.2 SERVICES

5.21 Water Supply. Only potable water should be piped into spaces where food is stored, prepared, or served except as indicated in Sec. 2.3, p. 16 . The potable water system should be protected against backflow as recommended in Sec. 6.22, p. 26 .

Hot and cold potable water should be piped to all spaces in which food is prepared or utensils are washed.

5.22 Steam for Cooking. Steam from a vessel's boiler system can be used with safety for indirect heating or cooking of food. Boiler steam is satisfactory as a means of heating potable water if indirectly applied, such as through a coil, tubes, or a separate chamber. Steam which is to be applied directly to food should be made from potable water.

5.23 Lighting. All working surfaces in spaces where food or drink is prepared, or where utensils are cleaned should be provided with light of an intensity not less than 10 foot-candles. This intensity of lighting does not apply to the dining room. Storage rooms should be lighted with an intensity of at least 4 foot-candles measured at a distance of 30" from the floor.

5.24 Ventilation. All spaces in which food is prepared should be adequately ventilated. Natural ventilation should be supplemented by adequate exhaust fans and stove hoods. (For standards of good practice, see Appendix A, p. 93)

5.25 Disposal of Wastes. Proper means should be provided for the storage and disposal of putrescible wastes. (See Sec. 10.2, p. 35) Food storage spaces and food handling equipment should be protected against the backflow of waste as described in Sec. 6.34, p. 28.

5.3 EQUIPMENT

5.31 Construction and Arrangement. All utensils and working surfaces used in the preparation, storage, and serving of food or beverage, and in the cleaning of food utensils should be so constructed as to be easily cleaned and self-draining.

Utensils containing, or plated with cadmium or lead should not be used except that solder containg lead may be used for jointing.

Fixtures of open-base type should be elevated at least 6" above the deck to permit easy cleaning; otherwise, the base should be set in cement or a plastic material to make a vermin and insect-proof bond between the base of the fixture and the deck, and the space within the base should be completely covered with a tight-fitting metal plate or filled with a light weight concrete. When a fixture is installed against a bulkhead, the space or crack created back of the fixture should be sealed.

No equipment should be installed that will permit food or drink to come in contact with threaded surfaces consisting of non-rounded, V-type threads. Rotating shafts which pass through surfaces touched by food or drink should fit closely.

5.32 Steam Kettles. The lid of a steam kettle should be constructed with a lip arrangement that will overlap the hinge seam to prevent foreign matter from dropping into the kettle when the lid is opened.

Vent lines from steam kettles terminating on the weather deck should be screened with a portable, 16-mesh, corrosion-resistant wire.

5.33 Washing and Bactericidal Treatment Facilities. Adequate facilities for washing and for the bactericidal treatment of eating, drinking, and food handling utensils[1] should be provided, and only potable water should be piped thereto.

Facilities for scraping and pre-rinsing used dishes should be provided. Sinks in which utensils are pre-rinsed should be located after the scraping point but before a dishwashing machine. This arrangement will increase the likelihood that pre-rinsing will be performed and will also facilitate the flow of utensils to the dishwashing machine.

Water of 110° F. to 120° F. temperature is best suited for washing utensils by hand. A temperature somewhat higher should be provided for the washing process in dishwashing machines but it should not exceed 140° F. Suitable thermometers should be provided to indicate the temperature of the wash water in dishwashing machines.

(1) As here and after used the term "utensil" includes any kitchenware, tableware, glassware, cutlery, containers, or equipment with which food or drink comes in contact during storage, preparation, or serving.

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After washing eating and drinking utensils, they should be subjected to a bactericidal treatment by one of the following methods listed in order of preference:

(1) By immersion of the utensils or equipment for at least 2 minutes in clean, hot water at a temperature of at least 170° F., or for 1/2 minute in boiling water. With this procedure there should be provided a 2 or preferably a 3-vat sink. The second vat, or the second and third vats, should be deep enough and should have sufficient cross-sectional area to accommodate a deep wire basket in which to submerge the dishes. All vats of the sinks should be at least 18" by 18" in cross dimensions with the wash vat at least 12" deep and the rinse and bactericidal vats (or a combination thereof) at least 16" deep. Where the bactericidal treatment is to be effected by this method, means should be provided for maintaining the water in the proper vat at a temperature of 170° F. or more while utensils are being given the bactericidal treatment. To overcome the loss of heat to the utensils, to avoid frequent replacement of the water, and to avoid the wasting of water which has cooled in the delivery line, it is usually essential that there be installed a heating device which is integral with the bactericidal vat. These objectives may be accomplished by the use of one of the following devices:

(a) A steam or electrically-heated jacket under or around the vat.

(b) Steam coils within the vat provided the unit is removable or can be rotated to a vertical position for routine cleaning.

(c) A removable, immersion-type, electrical unit in the vat.

(d) One or more steam injectors at the bottom of the vat, installed in such a manner as to effect thorough mixing of the steam and the water. Boiler steam is satisfactory for use in this connection.

(e) A gas jet under the vat.

(f) A steam, electric, or gas-heated recirculation unit attached directly to the bactericidal vat.

To avoid delay due to the time required to raise the temperature of the water in the bactericidal vat initially and after subsequent replacements of the water, particularly where large numbers of utensils are being treated, the water should be delivered to the sink at a temperature of at least 170° F.

All heating devices should preferably be thermostatically controlled.

Suitable thermometers should be provided to indicate the temperature of the water in the bactericidal vats, and of the rinse water of dishwashing machines. Thermometers serving sink vats should preferably be of the dial type with the dial attached to the splash plate of the sink or the adjoining bulkhead. If necessary for cleaning purposes, the thermal unit should be removable from the sink.

Deep wire baskets should be provided with each sink installed for, or likely to be used for, rinsing and the bactericidal treatment of eating and drinking utensils. Means should be provided for the removal of the baskets from the bactericidal treatment vat without submerging the hands. Long handles of the fixed, folding, or detachable type or any other devices serving the same purpose are acceptable.

(2) By immersion of the utensils or equipment in a lukewarm chlorine bath containing at least 50 p.p.m. of available chlorine if hypochlorites are used, or a concentration of equal bactericidal strength if chloramines are used. With this method of bactericidal treatment 3 vats should be provided. One vat is for washing, the second for rinsing, and the third for chlorine immersion. The depth of sinks should conform to those indicated in (1) next above.

(3) By exposure of the utensils or equipment in a steam cabinet at a temperature of at least 170° F. for at least 15 minutes, or at a temperature of 200° F. for at least 5 minutes.

(4) By exposure of the utensils or equipment in an oven or hot air cabinet at a temperature of at least 180° F. for at least 20 minutes.

(5) In the case of utensils or equipment so designed or installed as to make immersion or exposure impractical, the equipment may be treated for the prescribed periods of time either at the temperatures or with chlorine solutions as specified above,

(a) with live steam from a hose if the steam can be confined,

(b) with boiling rinse water, or

(c) by spraying or swabbing with chlorine solution.

(6) Any other method which, upon application, has been determined to be effective in the prevention of the spread of communicable disease.

Drinking glass rinsers are satisfactory as an addition to, but not as a substitute for, washing and bactericidal treatment. The potable water line supplying them should be protected against backflow as specified in Sec. 6.22, p. 26.

Dishwashing machines, if installed, should be of a design which will effectively clean and disinfect utensils. They should be subject to easy inspection and cleaning. Multi-compartment machines are preferable to single-compartment ones; the latter should be installed only where space limitations require it. Automatic detergent dispensers are recommended, particularly for single-compartment machines. Only potable water should be used in dishwashing machines, and the water service should be installed as recommended in Sec. 5.21, p. 20.

Facilities for the bactericidal treatment of eating and drinking utensils will not be required in the captain's or master's pantry as this space is considered as being used by an individual rather than a group.

If a scullery is located in proximity to a galley or a pantry, facilities for washing utensils need not be provided in either of the latter spaces as it can be reasonably assumed that this operation would be performed in the scullery.

5.34 Stowage of Equipment. Adequate provision should be made for the stowage of all dishes, containers, and utensils in a clean, dry place above the deck for protection against contamination. Drain racks, trays, and shelves should be made of corrosion-resistant material.

Sufficient stowage space should be provided near the steward's department for the cleaning gear used in food preparation spaces.

5.4 REFRIGERATION

Provision should be made for the stowage of all readily perishable food or drink at or below 50° F. Thermometers should be provided to indicate temperatures and they should be installed in the upper portion of a refrigerator and away from the cooling element or cold air flow.

To prevent the improper stowage of perishable foods on the decks of refrigerators of ship's stores, shelving should be installed within these spaces.

5.41 Defrosting of Refrigeration Coils. If salt water from contaminated harbors or other areas is used to defrost exposed coils within the refrigerated space, the salt water should be heated to 165° F. After the salt water has been heated to 165° F., it can be cooled to the desired temperature for the defrosting operation. Heating salt water to 165° F. will not be required when open sea water which is relatively free of contamination is used.

The use of salt water without treatment by heat for defrosting will be acceptable when the defrosting operation is performed within an enclosed refrigeration unit located in the fan room space apart from the stored cargo.

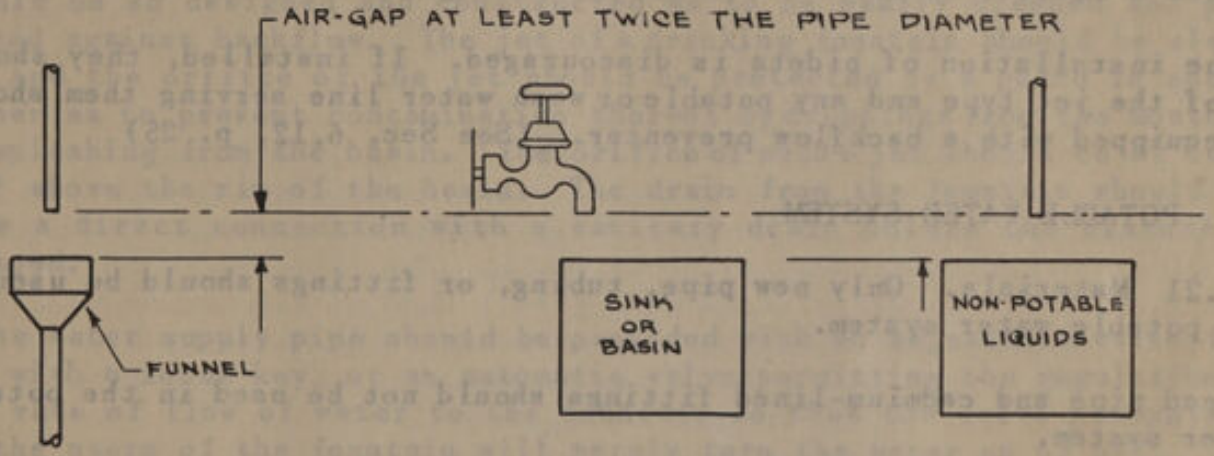
Drains from refrigerated spaces should be protected against backflow as indicated in Sec. 6.34, p. 28.

6. PLUMBING

6.1 SPECIAL EQUIPMENT

6.11 Air Gaps. An air gap is the unobstructed vertical distance through the free atmosphere between the lowest opening from any supply pipe or fixture drain and the flood-level rim of the receiving receptacle.

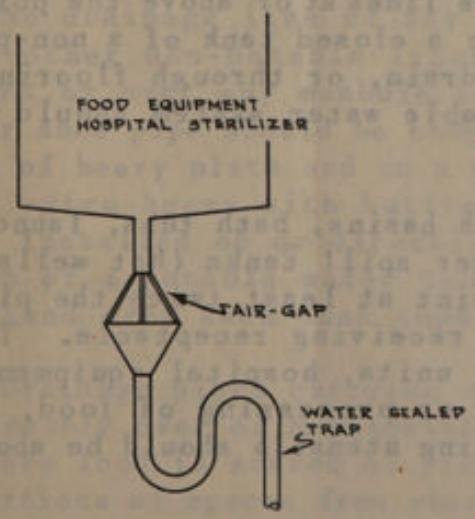
An air gap should be at least twice the diameter of the delivery pipe or drain which is being protected. When a receiving funnel is provided, its vertical sides may be extended upward provided the gap is measured from the top of the extended side of the funnel to the end of the pipe or drain. (See Fig. 6)



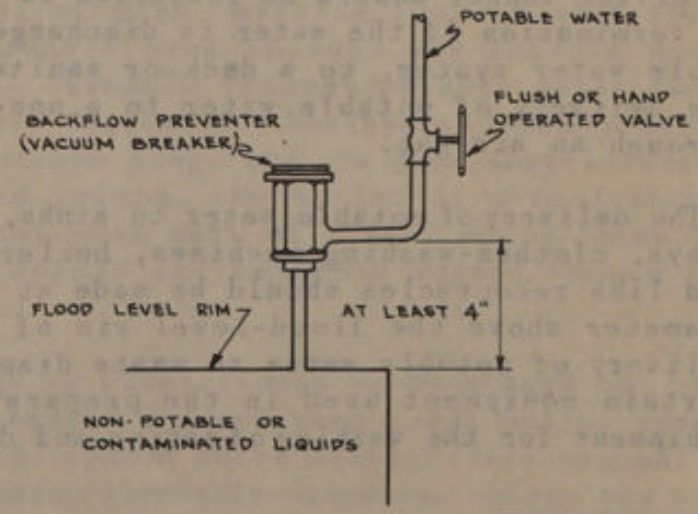
AIR-GAP FOR POTABLE WATER SERVICE LINES

FIG.6

6.12 Backflow Preventers (Vacuum Breakers). When an air gap cannot be provided in the water supply line to a fixture, a suitable backflow preventer should be installed in the supply line on the discharge side of the control valve and at least 4" above the flood-level rim of the fixture as shown in Fig. 7. The backflow preventer should be so designed



AIR-GAP IN WASTE



VACUUM BREAKER

FIG. 7

that a complete cycle of moving parts, if any, is made each time the control valve in the supply line is opened and closed. Backflow preventers which meet the specifications set forth in American Standard Backflow Preventers in Plumbing Systems, 1943,[1] are recommended.

6.13 Backwater Valve. A backwater valve is a mechanical device installed in a soil or waste line to prevent the reversal of flow under conditions of back pressure. In the check-valve type, the flap should swing into a recess when the line is flowing full to preclude obstructing the flow.

6.14 Fixtures. All fixtures should be resistant to corrosion by salt water and the atmosphere over salt water. Fixtures should be designed so as to function efficiently and be easy to clean. Internal corners within a fixture should be rounded wherever practicable.

The installation of bidets is discouraged. If installed, they should be of the jet type and any potable or wash water line serving them should be equipped with a backflow preventer. (See Sec. 6.12, p. 25)

6.2 POTABLE WATER SYSTEM

6.21 Materials. Only new pipe, tubing, or fittings should be used in the potable water system.

Lead pipe and cadmium-lined fittings should not be used in the potable water system.

6.22 Prevention of Backflow into the Potable Water System. The potable water system should not be cross connected to any non-potable water system and no provisions should be made for such a connection. Overflows, vents, and drains from tanks, and drains from the distribution system including any treatment plant, should not be directly connected to a deck or sanitary drain nor should the ends of such lines terminate in the normal bilge space. When extended toward the bottom of the vessel, they should terminate at least 18" above the inner bottom plating or the lowest point of the bilge in the absence of such plating, and the ends should be readily accessible for inspection in both instances. An air gap and receiving funnel should be installed in these lines at or above the point of termination if the water is discharged to a closed tank of a non-potable water system, to a deck or sanitary drain, or through flooring. The delivery of potable water to a non-potable water system should be through an air gap.

The delivery of potable water to sinks, wash basins, bath tubs, laundry trays, clothes-washing machines, boiler water spill tanks (hot wells), and like receptacles should be made at a point at least twice the pipe diameter above the flood-level rim of the receiving receptacle. The delivery of potable water to waste disposal units, hospital equipment, certain equipment used in the preparation or processing of food, or equipment for the washing of eating and drinking utensils should be above

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(1) American Standards Association, 70 East 45th Street, New York, New York.

the rim or through an air gap, except that where such is mechanically impracticable or water under pressure is required in the unit, a backflow preventer should be installed. If the potable water piped to the vegetable steamer or cooker does not come in contact with the food or other liquids, an air gap will not be needed in the supply line. If above-the-rim delivery or a vacuum breaker on the discharge side of the control valve is impracticable on a drinking glass rinser, vegetable peeler, or a like flow-through unit, a 1-1/2-inch or larger waste drain or an overflow opening at a point at least twice the water pipe diameter below the water inlet will be suitable if the waste discharge is through an air gap immediately below the unit. A direct connection of the potable water system to a coffee urn or to the top of a steam kettle is satisfactory.

6.23 Drinking Fountains. Bowls or basins of drinking fountains, and coolers should be constructed of impervious non-oxidizing material and should be so designed and constructed as to be easily cleaned and protected against backflow. The jet of a drinking fountain should be slanting and the orifice of the jet should be protected by a guard in such a manner as to prevent contamination thereof by droppings from the mouth or by splashing from the basin. The orifice of such a jet should be at least 1/2" above the rim of the basin. The drain from the fountain should not have a direct connection with a sanitary drain unless the fixture is trapped.

The water supply pipe should be provided with an adjustable valve fitted with a loose key, or an automatic valve permitting the regulation of the rate of flow of water to the fountain so that the valve manipulated by the users of the fountain will merely turn the water on or off.

The waste opening and pipe should be of sufficient size to carry off the water promptly and should be provided with a strainer.

6.3 DRAINAGE SYSTEMS

6.31 General. Drain, soil, and waste pipes should be of adequate size and so constructed as to prevent clogging and subsequent backflow of sewage or contaminated waste into the fixtures and spaces served. Adequate provisions should be made to prevent these pipes from freezing.

No drainage line of any kind, or pipe carrying wash or salt water or other non-potable liquid, should pass through any potable water tank or over any manhole in it. Tunnels through potable water tanks for such pipe should be completely drainable. Horizontal tunnels should be of heavy plate and on a continuous slope and the pipe therein should be extra-heavy with butt-welded joints. No toilet or urinal should be installed on or directly above that part of a deck which forms the top of a potable water tank. Toilet and bathroom spaces should not extend over such tank tops.

Drainage pipes carrying sewage or other liquid waste should not pass directly over or horizontally through refrigerated cargo holds, spaces where food is stored or prepared, spaces where utensils are washed, or portions of spaces from which food is regularly dispensed unless the pipe is extra-heavy, galvanized steel or galvanized standard wrought iron with

welded joints, and is hydrostatically tested for leakage at the maximum head obtainable in the line. The joint may be butt-welded if steps are taken to prevent or remove any welding bead within the pipe. Butt-welding may be avoided by the application of a sleeve coupling which is welded at the ends of the sleeve but not at the ends of the pipe.

When water from overboard is treated aboard a vessel for use as potable water, sanitary drainage preferably should not be discharged on the same side forward of the overboard water intake. When avoidance of this is impracticable, the waste discharge should be as high as possible and the water intake as low and as far forward as possible.

Waste containing sewage, food particles, or putrescible matter should not be discharged to the bilge.

6.32 Vents and Traps. Drainage systems which receive sewage, ablutionary water, or putrescible waste should be provided with the necessary vents and water-sealed traps to prevent gases or obnoxious odors from entering any space served.

The drains from all fixtures, including urinals, toilets, showers, bathtubs, wash basins, drinking fountains, sinks, and other equipment in food handling spaces should be provided with water-sealed traps designed to minimize the deposition of settleable solids. The trap should be the same size as the drain to which it is connected. When an air gap is installed in the drain, the trap should be installed below the air gap. A garbage grinder drain or a garbage chute may be provided with a backwater valve in lieu of a trap when discharged independently.

6.33 Cleanouts. Cleanout and "rodding" plugs should be installed at appropriate places in the drainage system. Means of opening and cleaning traps should be provided.

Cleanout and "rodding" plugs should not be installed in those parts of drainage systems which are over potable water tanks, over spaces where food or eating utensils are stored or handled, or in refrigerated cargo holds.

6.34 Prevention of Backflow of Waste. Individual air gaps should be installed in the drain lines from certain types of fixtures such as water-bath sterilizers, hospital water stills, autoclaves, steam kettles, drinking glass rinsers, vegetable peelers, coffee urns, as well as all hospital and food handling equipment which may be subject to sub-atmospheric pressure.

Air gaps should be installed in the individual drain lines from refrigerated cargo holds or boxes, ship's stores refrigerators, dry stores space, dishwashers, and equipment used in the preparation or processing of food, if drainage is to a deck drainage system or one which receives human sewage(1) or hospital wastes. Individual air gaps will not be essential in these drain lines if one of the following conditions is satisfied:

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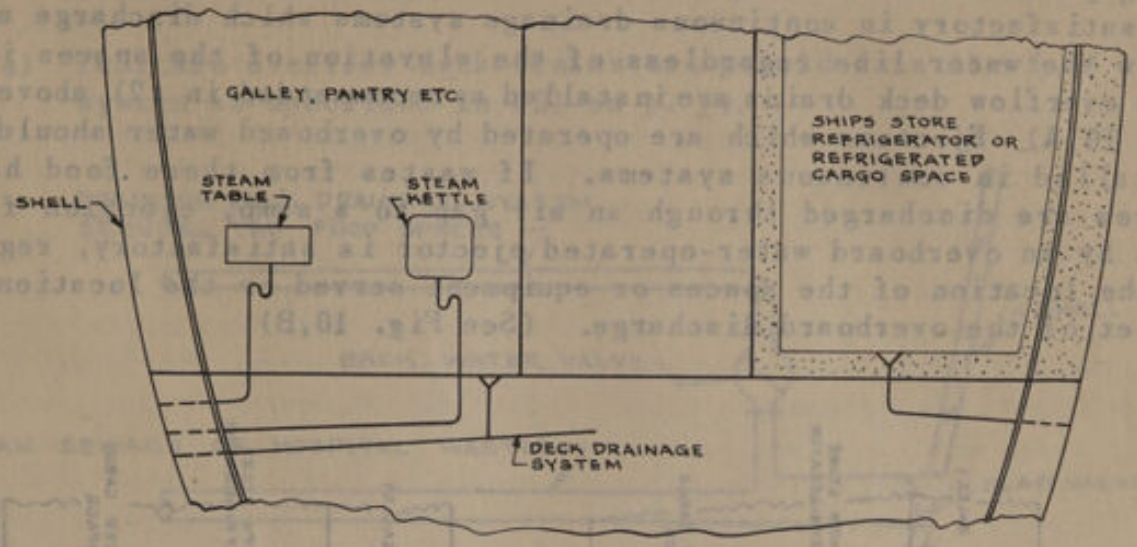
(1) Human sewage is defined as liquid wastes containing human excreta; excreta includes feces, urine, secretions from the skin and spittle.

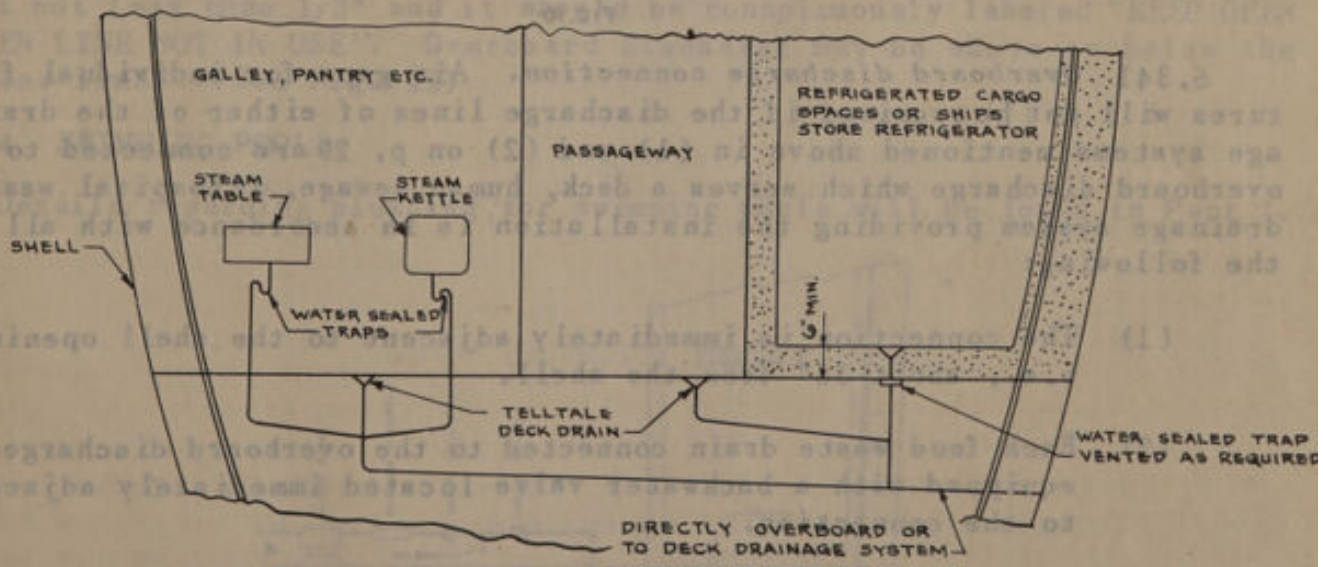
(1) The drains are independent of each other and of all other drainage systems. (See Fig. 8)



INDEPENDENT GRAVITY DRAINAGE

FIG. 8

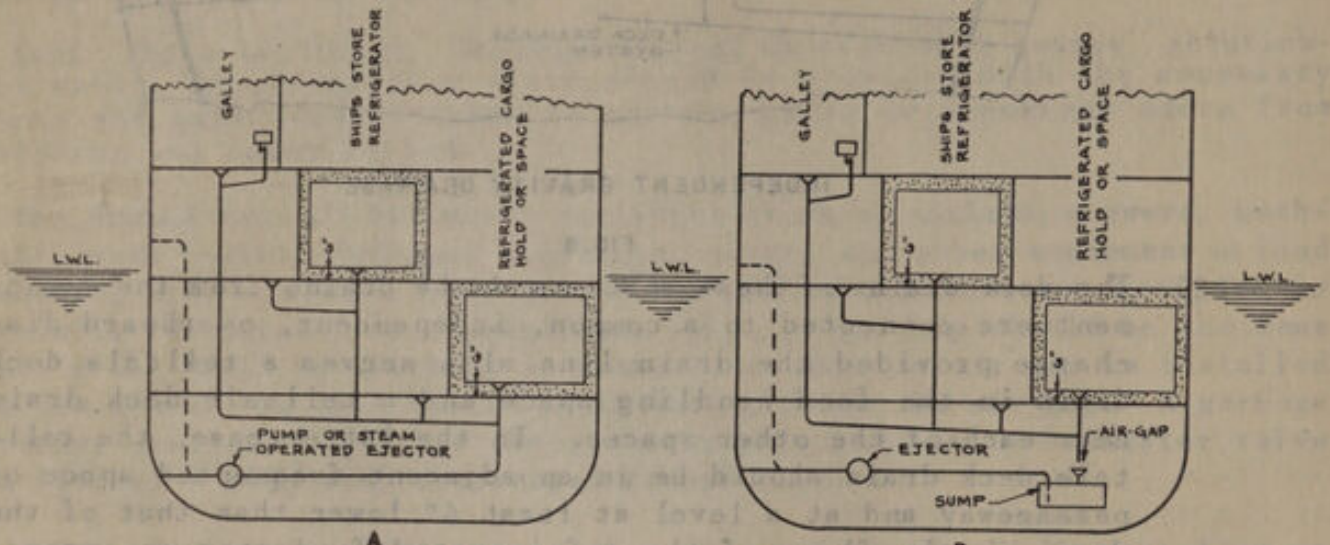
(2) The deck drains of these spaces and the drains from the equipment are connected to a common, independent, overboard discharge provided the drain line also serves a telltale deck drain in the food handling space and a telltale deck drain near each of the other spaces. In the latter case, the telltale deck drain should be in an adjacent frequented space or passageway and at a level at least 6" lower than that of the drain in the floor of the refrigerated food storage spaces. (See Fig. 9) This system should not be connected to a deck drainage, or a human sewage or hospital waste drainage system except as stated in Sec. 6.341, p. 30. Refrigerated spaces on the same deck level need not be protected with telltale drains if not connected to other drainage systems.



COMBINED GRAVITY DRAINAGE

FIG. 9

Either of the food wastes drainage systems mentioned next above in (1) and (2) may safely discharge by gravity directly overboard or through air gaps to other drainage systems. Pumps or steam-operated ejectors are satisfactory in continuous drainage systems which discharge above or below the water line regardless of the elevation of the spaces if telltale overflow deck drains are installed as recommended in (2) above. (See Fig. 10,A) Ejectors which are operated by overboard water should not be installed in continuous systems. If wastes from these food handling spaces are discharged through an air gap to a sump, ejection from the sump by an overboard water-operated ejector is satisfactory, regardless of the location of the spaces or equipment served or the location of the outlet of the overboard discharge. (See Fig. 10,B)



PUMP AND EJECTOR DISCHARGE

FIG. 10

6.341 *Overboard discharge connection.* Air gaps for individual fixtures will not be required if the discharge lines of either of the drainage systems mentioned above in (1) and (2) on p. 29 are connected to an overboard discharge which serves a deck, human sewage, or hospital wastes drainage system providing the installation is in accordance with all of the following:

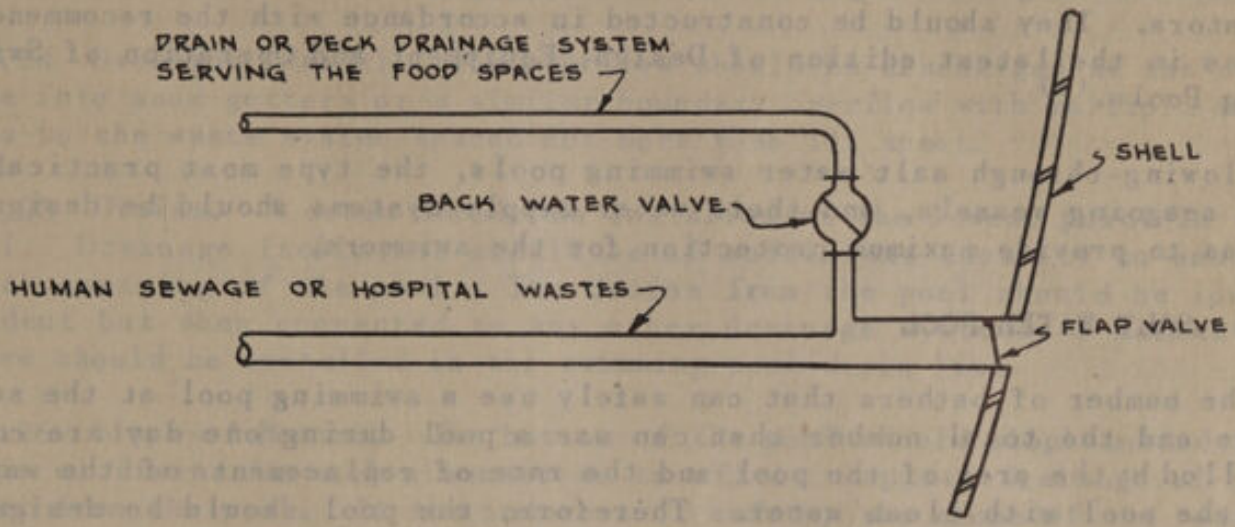
(1) The connection is immediately adjacent to the shell opening; i.e., about 36" from the shell.

(2) Each food waste drain connected to the overboard discharge is equipped with a backwater valve located immediately adjacent to the connection.

(3) The overboard discharge carrying the combined drainage is free of checks and other obstructions (except the usual flap valve at the shell) and the diameter is at least 4" and not less than the diameter of the largest line serviced. (Valves

required for other purposes should be inboard of the junction on the soil line and inboard of the backwater valve on the food waste drain.)

(4) Telltale overflow deck drains are provided in the food waste system as specified in (2) on p. 29.



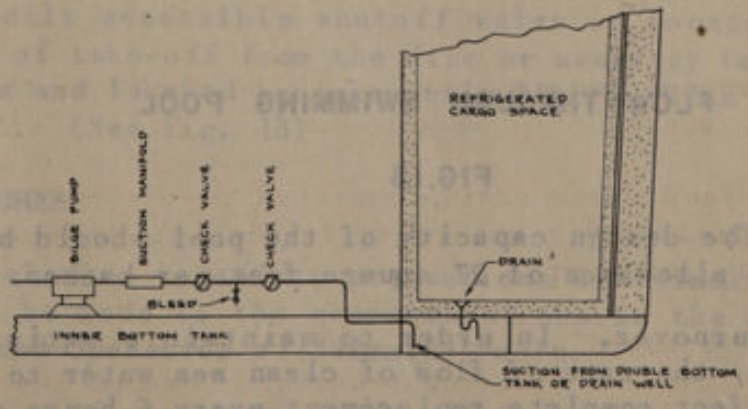
COMBINED OVERBOARD DISCHARGE

FIG. 11

When refrigerated cargo spaces are located on the inner bottom plating and it is impracticable to comply with the previous recommendations, and drainage is effected by direct connection to a separate pump or steam-operated ejector or a bilge pump, there should be installed in the suction line 2 check valves with a valve-controlled bleed (backflow waste) between them. The check valves should be above the inner bottom plating and near the pump or its suction manifold. The diameter of the bleed should be at least one-fourth of the diameter of the suction pipe but not less than 1/2" and it should be conspicuously labeled "KEEP OPEN WHEN LINE NOT IN USE". Overboard discharge may be above or below the water line. (See Fig. 12)

6.4 SWIMMING POOLS

Details regarding plumbing for swimming pools will be found in Part 7.



DRAINAGE OF INNER BOTTOM DRAIN WELL

FIG. 12

7. SWIMMING POOLS

7.1 GENERAL

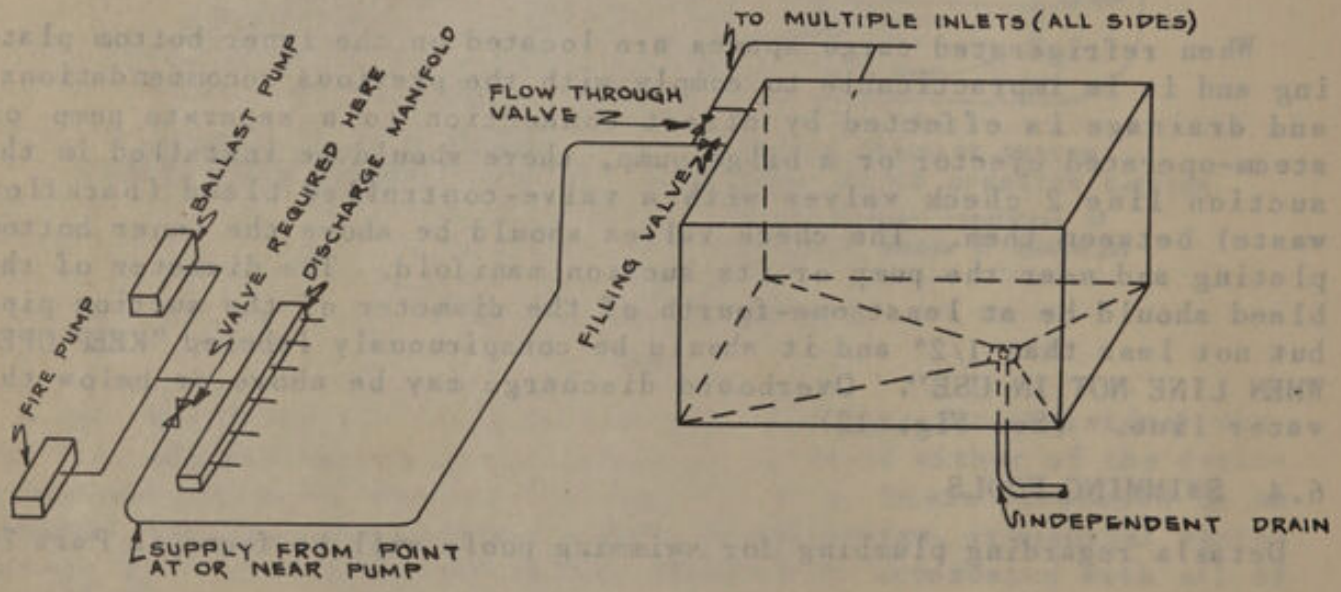
Fill-and-draw swimming pools should not be installed.

Recirculating swimming pools should be equipped with filters and chlorinators. They should be constructed in accordance with the recommendations in the latest edition of Design, Equipment and Operation of Swimming Pools.(1)

Flowing-through salt water swimming pools, the type most practicable for seagoing vessels, and their water supply systems should be designed so as to provide maximum protection for the swimmers.

7.2 SALT WATER POOL

The number of bathers that can safely use a swimming pool at the same time and the total number that can use a pool during one day are controlled by the area of the pool and the rate of replacement of the water in the pool with clean water. Therefore, the pool should be designed with due attention to the probable peak bathing load and the maximum space available for the construction of a pool. The following principles should be applied in the design of flowing-through salt water pools.



FLOW-THROUGH SWIMMING POOL

FIG. 13

7.21 Area. The design capacity of the pool should be judged on the basis of an area allowance of 27 square feet per bather.

7.22 Water Turnover. In order to maintain a satisfactorily clean water in the pool, the rate of flow of clean sea water to the pool should be such as to effect complete replacement every 6 hours or less.

(1) American Public Health Association, 1790 Broadway, New York, New York.

7.23 Inlets. The flowing-through water should be delivered to the pool through multiple inlets located so as to ensure uniform distribution. These inlets should be served by a branch taking off from the main supply line at the pressure side of the filling valve near the pool. This branch should be designed to effect at least a 6-hour replacement of the water in the pool when flowing full. Control of the flow should be independent of the shutoff valve on the branch.

7.24 Overflow (Waste). The overflow should be discharged at the surface into scum gutters or a similar boundary overflow with multiple outlets to the waste system spaced not more than 10' apart.

7.25 Drains. A drain should be installed at the lowest point in the pool. Drainage facilities should be of sufficient capacity to ensure quick emptying of the pool. The drains from the pool should be independent but when connected to any other drainage systems, a backwater valve should be installed in the swimming pool drain line.

7.26 Slope of Bottom. The bottom of the pool should slope toward the drain or drains in such a manner as to effect complete drainage of the water from the pool. In the interest of safety, the slope of the bottom of any part of the pool where the water is less than 6' deep should not be more than 1' in each 15'. There should be no sudden change of slope within the area where the water depth is less than 5'.

7.3 WATER SUPPLY SYSTEM

It is preferable to have a separate water supply system, including the pump, and to locate the water intake at the forward end of the vessel and forward of all sewage outlets. However, on the assumption that the pool will be filled and the flowing through will occur only when the vessel is under way, it will be satisfactory to have this service rendered by the fire or sanitary (overboard water) pumps or a combination of these pumps, provided:

(1) The delivery line to the pool is independent, originating at or near the discharge of the pump or the valve manifold, or at a point where the maximum or near-maximum flushing of the fire or sanitary (overboard water) pump and main is routinely effected after leaving polluted waters.

(2) A readily accessible shutoff valve is located close to the point of take-off from the fire or sanitary (overboard) water system and labeled conspicuously "CLOSE WHILE IN CONTAMINATED WATER". (See Fig. 13)

7.4 SAFETY FEATURES

For guidance relative to safety precautions in swimming pool design, reference should be made to the recommendations in the publication Design, Equipment and Operation of Swimming Pools.

8. ACCOMMODATIONS

8.1 GENERAL

Existing regulations and laws pertaining to passenger and crew accommodations are enforced by other Federal agencies. Accommodations should be such as to protect the health of the occupant and to prevent the introduction, transmission, and spread of communicable diseases.

9. HEATING, LIGHTING, AND VENTILATION

9.1 GENERAL

Heating, lighting, and ventilation should be adequate for the control of communicable diseases. Lighting and ventilation as aids in the maintenance of sanitary conditions in food storage and handling spaces should be as recommended in Secs. 5.23 and 5.24, p. 20.

In Appendix A, p. 93, there are set forth principles which are considered good practice in marine construction and it is recommended that designers consult them for guidance.

10. GENERAL SANITATION

10.1 CONSTRUCTION IN FOOD AND LIVING SPACES

Surfaces, including flooring, within food and living spaces should be constructed so as to facilitate cleaning. Molding or molded coves should be installed in corners wherever practicable, particularly in those formed by bulkheads and decks, or by sheathing and floor covering.

Living quarters should be constructed so as to prevent places of harborage for vermin. It is preferable that they be formed of single bulkheads and deckheads.

Perforated, sound-proofing sheathing over voids or insulation should not be installed in food preparation or storage spaces. (See Sec. 22.222, p. 91) Its use in quarters and passageways creates harborage for small vermin and may result in serious vermin infestation. If installed, the material should be adequately treated before installation, and with sufficient frequency thereafter, to control infestation. Its use in other spaces is not particularly hazardous.

Lockers should be constructed where practicable as an integral part of a bulkhead, deck, or deckhead of a compartment. When lockers are designed as separate fixtures, they should be of smooth metal, elevated above the deck, and have a sloping top upon which trash and waste cannot accumulate and which can be readily inspected. The corner angles should not be extended above the top.

Beds and bunks should preferably be of open-type construction. They should be constructed and installed so as to minimize harborage for rats and other vermin. When tubular material is used in the construction of either the bed or the spring frame, such tubes should be blocked with cement or metal at suitable places in order to prevent the entrance of vermin. All holes in the tube should be sealed.

Drain holes in the top and bottom edges of hollow metal doors need not be ratproofed.

10.2 WASTE STORAGE AND DISPOSAL

Adequate provisions should be made for the storage and disposal of waste. Cans with tight-fitting covers should be provided for the collection of garbage in galleys, pantries, sculleries, and other spaces where food and utensils are cleaned. Unless provisions are made for the incineration of garbage on the vessel, special facilities for its storage while in port should be provided if:

(1) The disposal of garbage from the ship to land or overboard is prohibited by local ordinances or plant quarantine law.

(2) Collection service at the pier is not available.

Garbage grinders should not be connected to potable or wash water lines unless an air gap is installed in the supply line; if water from the

sanitary water system is used, the line should be stenciled or painted orange. (See Subpart 3.1, p. 18)

10.3 PROTECTION OF FRESH DOMESTIC WATER INTAKES FROM VESSEL WASTES

Vessels which operate on fresh water lakes and rivers should not contaminate domestic water intakes by the discharge of sewage or contaminated ballast water in the vicinity of such intakes or in restricted areas established by State law or municipal ordinance. When necessary to use toilets while the vessel is within such areas, the requirements for the particular area should be followed. When not otherwise specified, means should be provided to retain all the sewage in suitable tanks for subsequent discharge in unrestricted areas, or to retain the settleable solids and chlorinate the effluent before discharging it into the restricted area. When it is necessary to discharge ballast water which has been drawn from polluted areas at points near water intakes or in restricted areas, the ballast water should be chlorinated before being discharged.

In both cases, chlorine should be applied by a commercial hypochlorinator and the chlorinated sewage effluent or ballast water should be given a dosage of at least 15 p.p.m., with a contact period of at least 30 minutes before being discharged.

20. RATPROOFING; GENERAL[1]

20.1 PRINCIPLES OF RATPROOF CONSTRUCTION

The ratproof construction of a vessel can be accomplished by designing and building it in such a manner as to eliminate or render inaccessible to rats those spaces affording harborage where they may shelter, nest, breed, or obtain food. Open-type construction which eliminates enclosed spaces, opens to view partially enclosed places, and effects visibility by the proper location and arrangement of service lines, machinery, equipment, furniture, fixtures, and similar features is preferred to protective ratproofing. Where void spaces, including those filled with insulation, and uninspectable places are unavoidable, it is preferable that they be sheathed or enclosed with plate, sheet metal, or 1/2-inch mesh metal material.

When non-ratproof material is installed and is to be made resistant to rats, it should preferably be completely covered with sheet metal. However, where this in impracticable, flashing of all gnawing edges as indicated hereinafter is generally satisfactory.

The control of rat infestation on vessels is also concerned with preventing the passage of rats from one section of a vessel to another. Such sections as cargo holds, engine rooms, forepeaks and afterpeaks, chain lockers, tonnage and bunker spaces, auxiliary machinery spaces, food and other storage spaces, refrigerated spaces, and galleys and pantries should be completely isolated with dependable ratproofing. Double decks and deckheads, sheathing over a void or insulation, and double bulkhead partitions within these sections and within living quarters, dining rooms, and other public places should be ratproofed. Ratproofing of single bulkhead boundaries of living quarters, dining rooms,. and other public places, is not essential but such boundaries and partitions should be made resistant to the easy passage of rats.

20.2 MAXIMUM OPENINGS IN RATPROOF OR RATPROOFING MATERIAL

All square and round openings, snipe and drain holes, and slots should be not greater than 1/2". It is preferable that slots be not greater than 3/8" wide.

20.3 MATERIALS

20.31 Ratproofing Materials. Materials used for ratproofing should be hard and resistant to the gnawing of rats. Sheet lead, wood, fiber board, plaster board, and like materials are not resistant to rat gnawing. Sheet metal should be thick enough to resist tearing by rats and to withstand blows to which it might be subjected; it should be noncorrosive, galvanized, or painted. Perforations in sheet metal and the mesh of steel wire and hardware cloth should not exceed 1/2". The following materials are suitable for ratproofing within space limitations

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(1) For additional information on composition board, see Part 22.

subsequently indicated: Steel plate, sheet iron or steel[1], sheet aluminum or other metal alloy of suitable hardness and strength, perforated sheet iron, expanded metal, flattened expanded metal, wire or hardware cloth, and metal lath.

Metal lath weighing at least 3.4 pounds per square yard is satisfactory in certain spaces provided it is covered with an approved hard material with a smooth-surface finish. However, it must be stated that metal lath will corrode, and that then its usefulness as a rat barrier underneath a hard material having a smooth finish will deteriorate.

When aluminum is substituted for sheet iron, it should have a thickness by the Brown and Sharpe gauge[2] next greater than the thickness specified for sheet iron; for example, aluminum of 16 gauge by Brown and Sharpe is suitable to replace sheet iron of 18 gauge by U. S. Standard.

Aluminum having the following tempers and alloys will be acceptable: 52S-1/4H, 52S-1/2H, 52S-3/4H, 61S-W, and 61S-T.

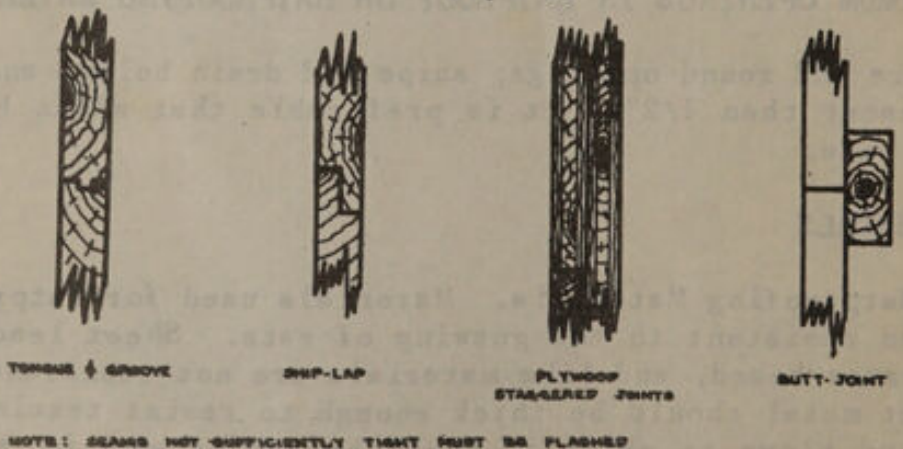
Cements, putties, certain plastic sealing compounds, and lead should not be used as ratproofing in lieu of metal ratproofing, except that hard-setting cements may be suitable for closing openings around cables within ferrules at bulkheads.

20.32 Non-ratproof Materials. The following non-ratproof materials are satisfactory when

(1) they comply with the general recommendations in Secs. 20.321 and 20.322, p. 39,

(2) they are of ample thickness to withstand the normal blows to which they are subjected in the space in which installed, and

(3) the boundaries and miscellaneous gnawing edges are flashed as recommended in Sec. 20.42, p. 39.



LAP AND BUTT JOINTS

FIG. 14

(1) Subsequently sheet steel will be included in any reference to sheet iron.

(2) Gauges subsequently given are U. S. Standard for sheet iron and expanded metal, Brown and Sharpe for aluminum, and American Steel and Wire for wire cloth.

20.321 *Wood* should be dry or seasoned, and free of warp, splits, and knots. If splits, loose knots, or knot holes exist, they should be flashed. Wood should preferably be tongue-and-groove, shiplap or other overlapping joints, or plywood. Shiplap should have an overlap of at least 3/4". Plywood should be resin bonded and waterproof.

20.322 *Composition board* of suitable hardness and smoothness will be satisfactory in certain spaces. For recommendations regarding the use of this material see Part 22, p. 90.

20.4 RATPROOFING OF NON-RATPROOF SURFACES

Although metal construction is recommended, wood and certain other non-ratproof materials may be used satisfactorily if properly ratproofed. Both exposed surfaces of all double bulkheads or deckheads should be ratproofed. Where ratproofing of a single bulkhead is required, only one surface need be treated but the ratproofing material should be placed on that surface of the bulkhead which is outside the space being ratproofed. In the case of double bulkheads, it is preferable that ratproofing material be placed on visible surfaces to facilitate inspection and reinspection. Where protection against damage or appearance is a primary factor and good workmanship can be assured by supervision and inspection, it is satisfactory to conceal ratproofing material. It can be placed between contacting layers of the non-ratproof material or behind it if it is placed in direct contact with the back of the material being ratproofed. When the ratproofing material is concealed, the recommendations for flashing should be followed.

Details regarding the thicknesses of sheathing and the gauges of ratproofing materials are given in Table III. Composition board recommendations are given in Part 22, p. 90.

20.41 Complete Coverage. The most dependable ratproofing of surfaces of wood or other non-ratproof materials which cover void spaces or insulation, or form the perimeter of stowage spaces is complete coverage with sheet iron or complete backing with expanded metal, flattened expanded metal, or wire mesh. Protection of this type is particularly desirable in spaces where the surface is vulnerable to damage and where means of approach for a rat to almost any part of the surface is regularly or periodically provided, and in spaces where food is readily available such as cargo holds and stowage spaces.

Where complete coverage is impractical, protective ratproofing of such surfaces by flashing the boundaries and gnawing edges is satisfactory.

20.42 Flashing. Flashing, as herein applied, should consist of capping or covering corners, boundaries, and gnawing edges with a strip of sheet iron or other material which is dependably resistant to gnawing rats. The flashing strip should be wide enough to cover adequately the gnawing edge or edges and to ensure the firm fastening of the borders of the flashing material. It should be a continuous strip insofar as practicable; numerous short pieces in a continuing line or curve are not satisfactory. Its width will depend upon the location. Flashing need not be placed over tightly fitted tongue-and-groove, shiplap, or similar overlapping joints except where such joints are within 6" of a deck or floor grating and certain horizontal ledges.

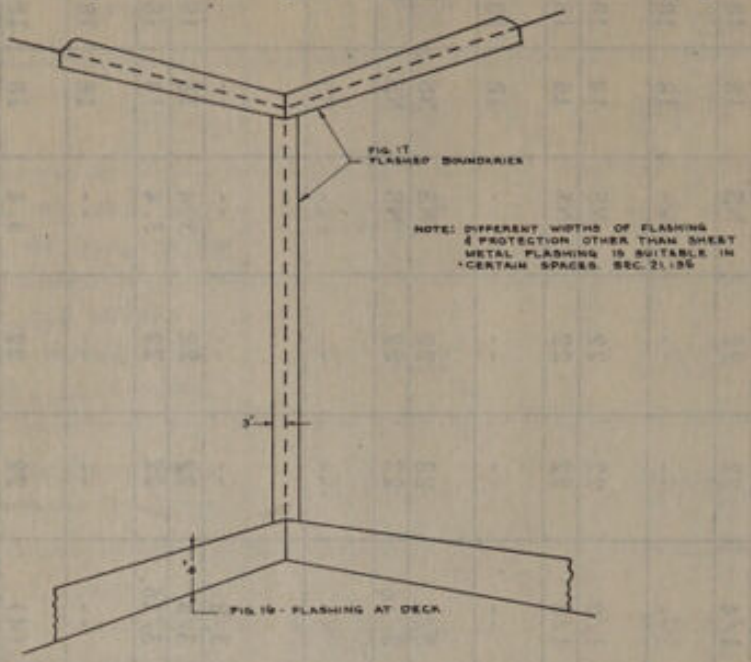
Table III. Minimum Thicknesses of Ratproofing Materials for Bulkheads, Deckheads, and Sheathing

Space	Sheet iron			Wood with tight overlapping joints (1) (2) (finished size) in inches	Waterproof plywood (1) (2) in inches	Acceptable composition board (1) in inches	Gauge of sheet iron		1/2" mesh or less			
	Perforated	Without solid backing								Expanded metal		
		Without batten protection	With batten protection				Complete coverage when required	Flashing in lieu of complete coverage (3)	Metal lath in lbs. per sq. yd.	Raised	Flattened	Wire mesh
a. General cargo holds												
Bilge and ballast ceiling	--	--	--	2-5/8	NS(5)	NS	16	16	--	--	--	--
Bulkheads	--	14	16	2-5/8	NS	NS	16	16	NS	--	--	--
Screen bulkheads	--	14	16	2-5/8	NS	NS	16	16	NS	--	--	--
Sheathing over insulation	--	14	16	2-5/8	NS	NS	16	16	NS	(4)	(4)	(4)
Deckheads	--	16	18	1-5/8	--	NS	18	18	NS	(4)	(4)	(4)
Covering-uninspectable spaces	12	14	--	--	--	--	--	--	--	12	12-14	11
b. Refrigerated cargo holds												
Cargo pad over insulation	--	--	--	2-5/8	--	--	--	--	--	--	--	--
Sheathing over insulation												
Coil-cooled	--	16	18	1-5/8	1	NS	18	18	NS	(4)	(4)	--
Air-cooled, exposed	--	16	18	1-5/8	1	NS	18	18	NS	(4)	(4)	--
Air-cooled, within duct	--	22	--	1-5/8	1	3/4	22	22	3.4	18	18-20	--
Duct bulkhead												
Catwalk type	(Substantially built)					NS	--	--	--	--	--	--
Non-catwalk type	--	--	--	1-3/16	1	NS	18	18	--	--	--	--
Deckhead	--	18	22	13/16	3/4	NS	22	22	NS	(4)	(4)	--
Flooring (See detailed recommendations in Sec. 21.41, p. 76)												
Cooler room bulkhead	--	18	--	13/16	3/4	NS	22	22	NS	18	18-20	--
Cooler room deckhead	--	22	--	13/16	3/4	NS	22	22	NS	18	18-20	--
Covering-uninspectable spaces	16	18	--	--	--	--	--	--	--	14	16-18	14

c. Ship's stores refrigerators												
Exterior bulkheads	--	18	--	1-1/8	7/8	3/4	22	22	(4)	(4)	(4)	--
Interior bulkheads	--	18	--	1-1/8	7/8	3/4	22	22	3.4	18	18-20	--
Deckheads	--	22	--	13/16	3/4	1/2	22	22	3.4	18	18-20	--
Covering-uninspectable spaces	16	18	--	--	--	--	--	--	--	18	18-20	14
d. Dry food stowage												
Bulkheads	--	18	--	13/16	3/4	1/2	22	22	NS	18	18-20	--
Deckheads	--	22	--	13/16	1/2	1/4	22	22	NS	18	18-20	--
Covering-uninspectable spaces	16	18	--	--	--	--	--	--	--	18	18-20	14
e. Boatswain's stowage												
Bulkheads	--	18	--	13/16	3/4	1/2	22	22	NS	18	18-20	--
Deckheads	--	22	--	13/16	1/2	1/4	22	22	NS	18	18-20	--
Covering-uninspectable spaces	16	18	--	--	--	--	--	--	--	18	18-20	14
f. Galley												
Bulkheads	--	22	--	13/16	3/4	3/8	22	22	NS	NS	NS	--
Deckheads	--	22	--	13/16	1/2	3/16	22	22	NS	NS	NS	--
Covering-uninspectable spaces	NS	22	--	--	--	--	--	--	--	NS	NS	NS
g. Living quarters and public places												
Single bulkheads	--	--	--	13/16	1/2	3/8	--	--	--	--	--	14
Double bulkheads	--	22	--	13/16	1/2	3/8	22	22	3.4	18	18-20	--
Deckheads	--	22	--	13/16	3/8	3/16	22	22	3.4	18	18-20	--
Covering-uninspectable spaces	18	22	--	--	--	--	--	--	--	18	18-20	16
h. Engine and boiler-room casing												
Bulkheads	--	22	--	NS	NS	(4)	22	22	3.4	18	18-20	--
Deckheads	--	22	--	NS	NS	(4)	22	22	3.4	18	18-20	--
Covering-uninspectable spaces	18	22	--	--	--	--	--	--	--	18	18-20	16

(1) See Sec. 21.135, p. 53 for special recommendations.
(2) Two layers satisfactory in (b) and (c) spaces.
(3) For the general principles of flashing, see Sec. 20.42, p. 39.
(4) Should be considered on merits of construction and protection.
(5) NS means not satisfactory.

The general principles in Secs. 20.421 through 20.424, pp. 42, 43, and 44, are applicable wherever flashing is placed on bulkheads, deckheads, or sheathing over insulation or void spaces which are formed by wood or other non-ratproof material. Recommended substitutions for sheet metal flashing in certain spaces are given in Sec. 21.135, p. 53.



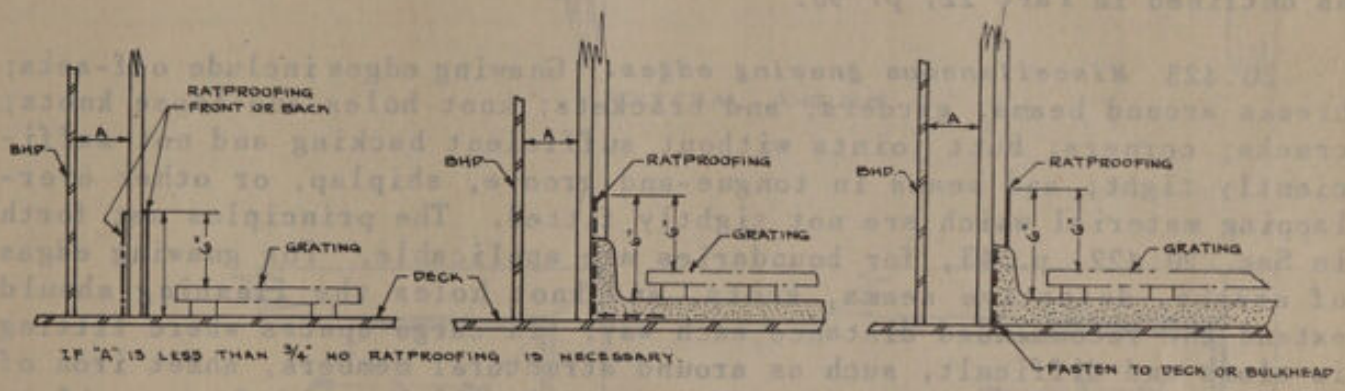
GENERAL PRINCIPLES OF RATPROOFING - DECK AND BOUNDARIES

FIG. 15

20.421 *Flashing at decks.* Non-ratproof material within 6" of the deck or deck covering should be effectively ratproofed. If portable flooring or deck grating is installed, the ratproofing material should be extended upward to a point 6" above the surface on which a rat might stand to gnaw. The ratproofing may consist of placing a strip of sheet iron on the surface of the non-ratproof material, between layers of it, or behind it; or the placing of 1/2-inch mesh hardware cloth or expanded metal between layers of the non-ratproof material or immediately behind it. When the material is placed behind the sheathing, it should be attached to the deck or embedded in cement or composition flooring and stretched over and fastened to the outer surface of the furring strips to which the sheathing is attached. (See Fig. 15)

Curbs or coves of concrete or special material which form or are adjacent to non-ratproof surfaces should be ratproofed as described in the preceding paragraph or by embedding in the curb 1/2-inch mesh, 18-gauge steel wire or hardware cloth; 18-gauge expanded metal; or 18 to 20-gauge, flattened expanded metal. This ratproofing should be securely fastened to the bulkhead or the deck, or extended into the composition flooring. If the flooring is ratproofed, the ratproofing material may be extended into or behind the curb or sheathing. (For ratproofing of flooring over cork see Sec. 21.41, p. 76.) If the top of the curb is less than 6" above the top of the deck grating, or of the deck in the absence of a grating, the lower portion of the sheathing should be ratproofed to the proper height by extending the hardware cloth or expanded metal upward

between or behind the sheathing or by ratproofing the sheathing independently. If a plain butt joint occurs at the top of the curb, the non-ratproof sheathing should be ratproofed as above, regardless of the height of the curb, unless the butt joint is closely fitted and is backed by solid wood at least 3/4" thick. (See Fig. 16)



RATPROOFING AT DECK

FIG. 16

For the protection of acceptable composition boards at the deck, see Part 22, p. 90.

20.422 *Boundaries except at decks.* Terminal edges, and internal and external angles of non-ratproof surfaces should be flashed for a distance sufficient to cover adequately the gnawing edge or edges and to ensure the firm fastening of the borders of the flashing material. The minimum dimensions of metal flashing should be as shown in Table IV.

Table IV. Width of Flashing to Protect
Gnawing Edges and to Permit Secure Fastening

Space	Minimum overlap from gnawing edge	Minimum distance beyond corner
General and refrigerated cargo, boatswain's stores, and food stowage	2"	3"
Other	1"	1-1/2"
	Both conditions should be satisfied.	

In cases where the non-ratproof material butts against a bulkhead of steel or other ratproof material, the flashing strip is necessary only on the non-ratproof surface. At all corners and angles of two non-ratproof surfaces, one piece of sheet iron should be applied and it should

be bent to conform to the angle made by the surfaces being ratproofed. At external angles with miter joints and at all internal angles, the flashing strip should extend an equal distance on each side of the corner. At external joints formed by square-cut material (not mitered), one leg of the flashing angle should be of sufficient additional length to provide minimum protection of the seam between the two surfacing materials. Two strips of sheet iron of proper width should be used to protect the gnawing edge of a portable panel and the edge of the opening. (See Fig. 17)

Boundaries in living quarters, dining spaces, and other public places of hard, smooth-surface, composition board are satisfactory if protected as outlined in Part 22, p. 90.

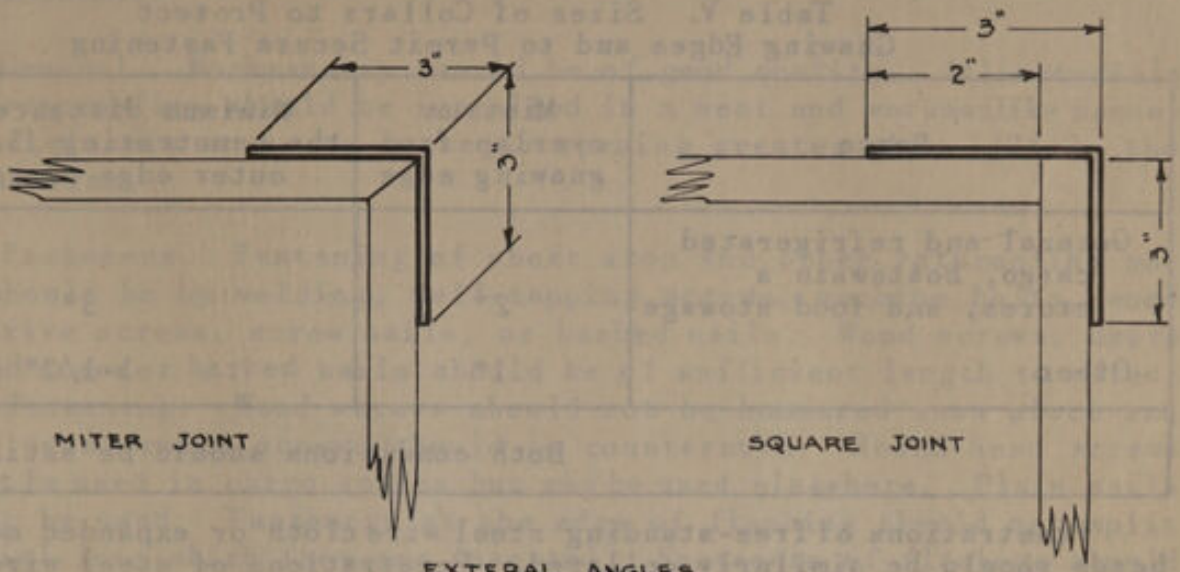
20.423 *Miscellaneous gnawing edges.* Gnawing edges include off-sets; breaks around beams, girders, and brackets; knot holes and loose knots; cracks; corners; butt joints without sufficient backing and not sufficiently tight; and seams in tongue-and-groove, shiplap, or other overlapping material which are not tightly fitted. The principles set forth in Sec. 20.422, p. 43, for boundaries are applicable. For gnawing edges of cracks, defective seams, knots, and knot holes the flashing should extend the recommended distance each way. In cargo spaces where fitting is close and difficult, such as around structural members, sheet iron of a gauge next lighter than that recommended will be satisfactory if it will not be subjected to damaging blows and does not extend more than 3" beyond the member.

Butt joints in wood, including plywood, should be flashed unless they are fitted tightly and backed by solid wood or wood with tongue-and-groove, shiplap, or similar overlapping joints of thickness at least equal to the sheathing. A 3/8-inch by 1-3/8-inch wood sealing strip, or a 1-3/8-inch half-round molding is considered satisfactory in lieu of metal flashing in certain spaces. (See Fig. 15)

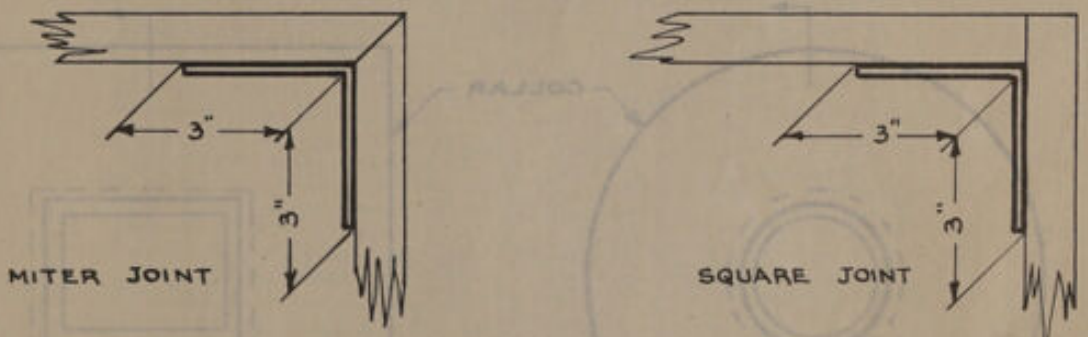
Butt joints at the ends of boards which are within 6" of ledges and fixtures should be flashed if without sufficient backing and not tightly fitted.

20.424 *Collars at penetrations.* The perimeter of the opening in non-ratproof materials caused by the penetration of structural members, pipes, ducts, cables, cable casings, sleeves, stuffing tubes, and the like should be ratproofed by placing a sheet iron collar around the penetrating fixture and fastening it to the surface penetrated. The collar should be of such a width as to cover adequately the gnawing edge and to ensure the firm fastening of the outer edge of the collar. The minimum dimensions should be as shown in Table V.

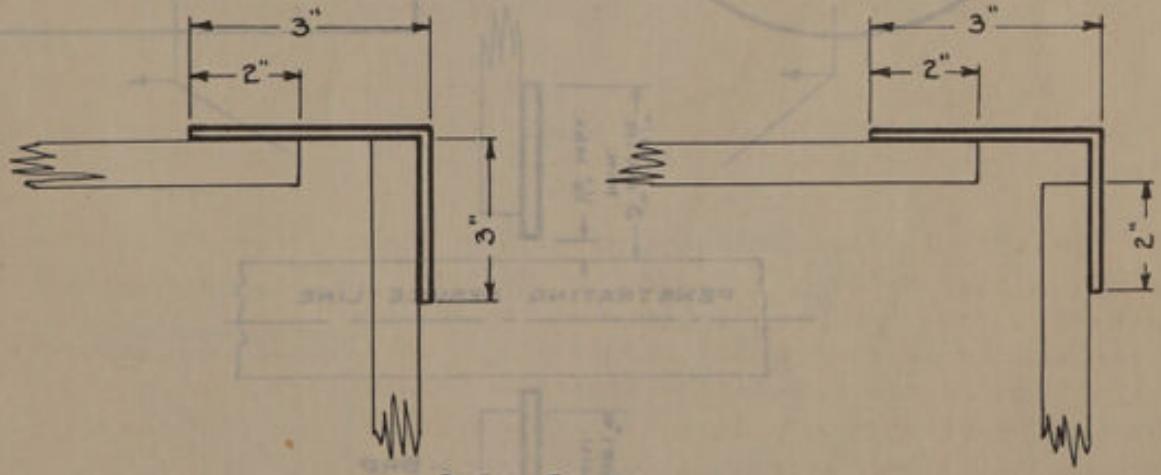
Collars should be fitted to within 1/4" of the penetrating fixture and fastened as specified in Sec. 20.52, p. 47.



EXTERAL ANGLES



INTERNAL ANGLES



OPEN JOINTS

NOTE: DIMENSIONS SHOWN ARE MINIMUM FOR GENERAL & REFRIGERATED CARGO & STOWAGE SPACES.

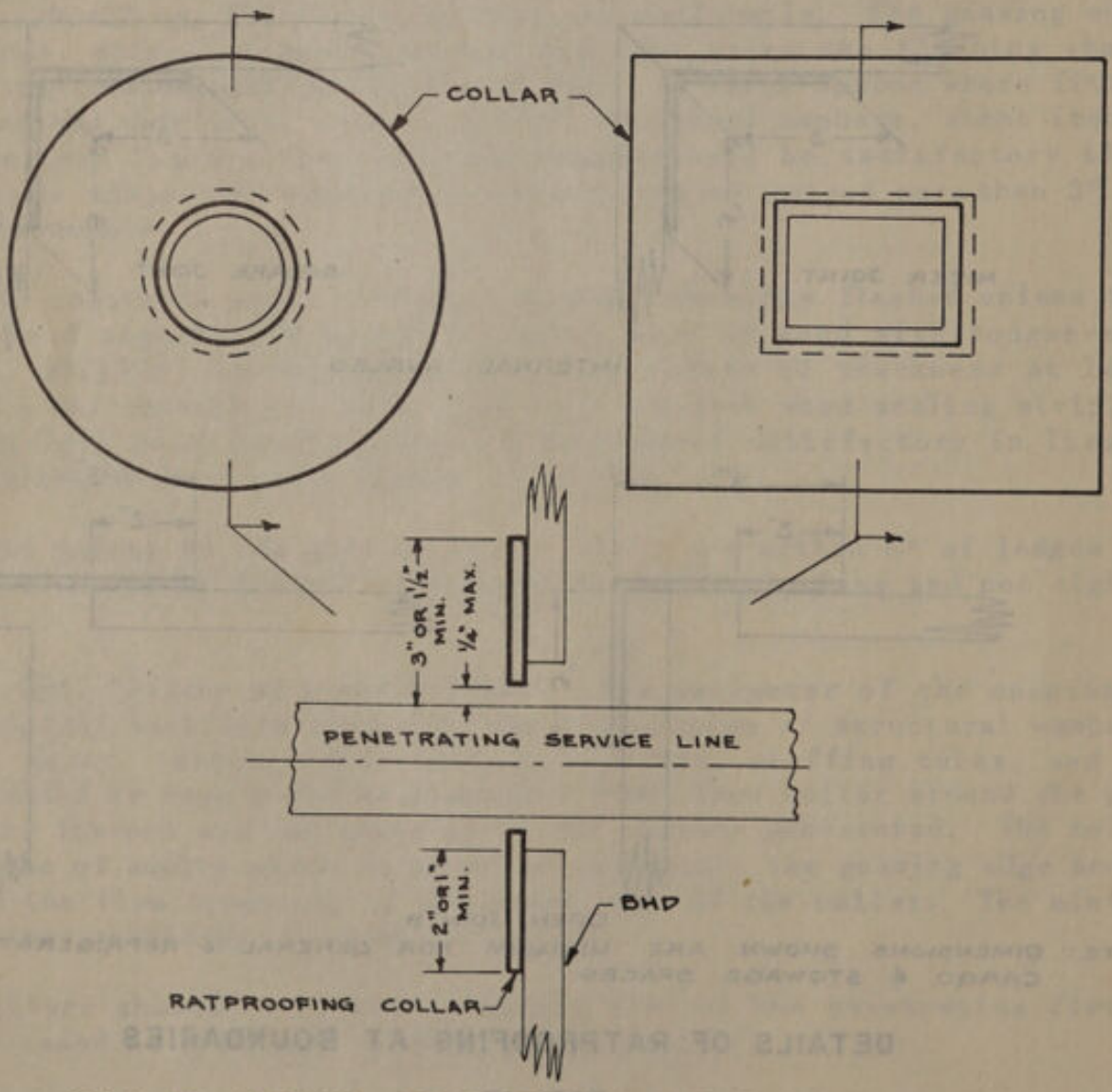
DETAILS OF RATPROOFING AT BOUNDARIES

FIG. 17

Table V. Sizes of Collars to Protect Gnawing Edges and to Permit Secure Fastening

Space	Minimum overlap from gnawing edge	Minimum distance from the penetrating fixture to outer edge of collar
General and refrigerated cargo, boatswain's stores, and food stowage	2"	3"
Other	1"	1-1/2"
Both conditions should be satisfied.		

Penetrations of free-standing steel wire cloth or expanded metal bulkheads should be similarly collared. Penetrations of steel wire cloth or expanded metal sheathing over insulation need not be collared if the material is fitted around the penetrating fixture so as to leave no opening greater than 1/2".



COLLAR AROUND PENETRATION OF BULKHEAD

FIG. 18

20.5 WORKMANSHIP

20.51 General. Workmanship should be of good quality. All materials used for ratproofing should be installed in a neat and workmanlike manner and fitted closely so as to leave no opening greater than 1/2" in the least dimension.

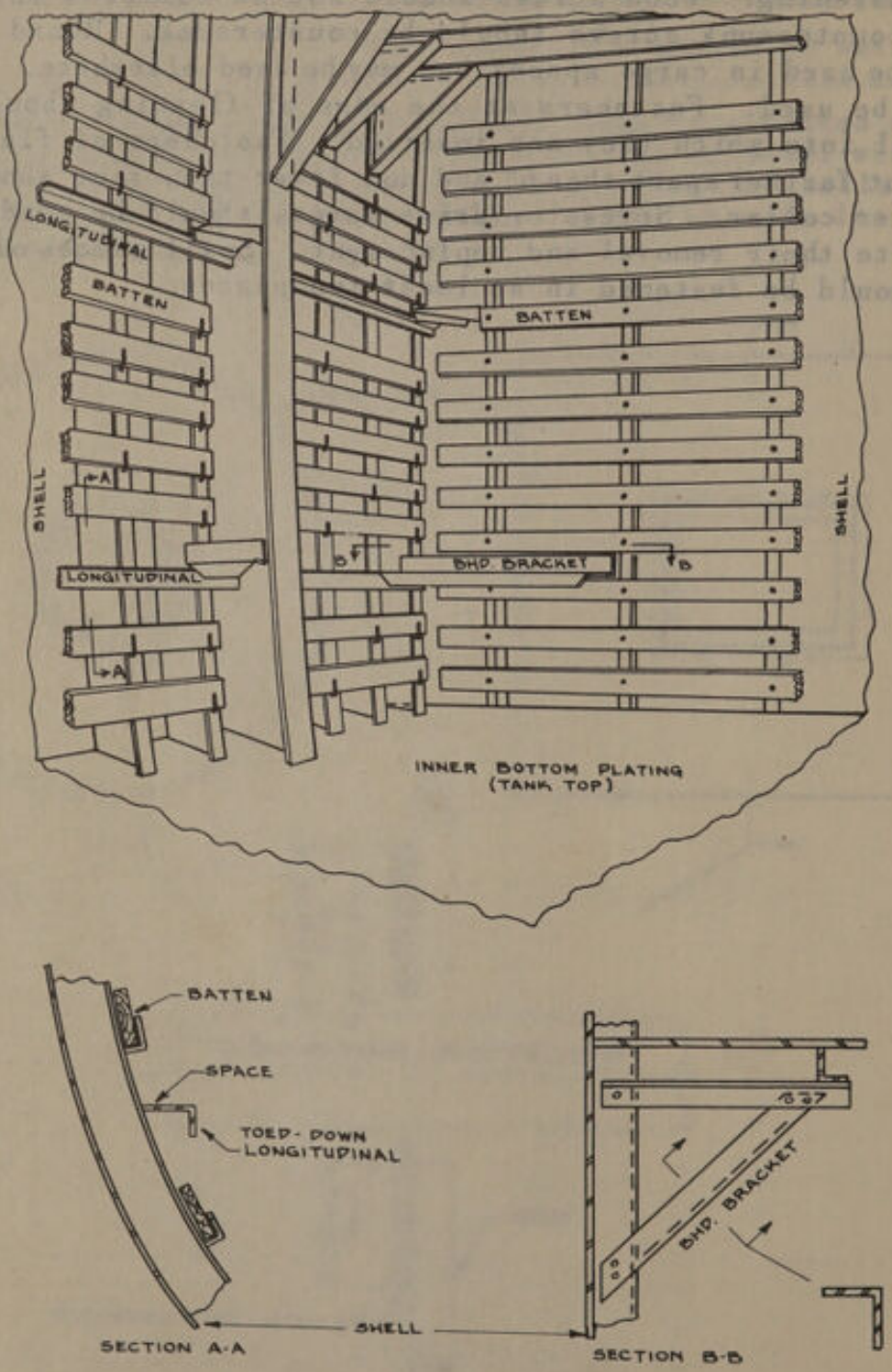
20.52 Fasteners. Fastening of sheet iron and other ratproofing materials should be by welding, self-tapping screws, machine bolts, wood screws, drive screws, screw nails, or barbed nails. Wood screws, drive screws, and screw or barbed nails should be of sufficient length to effect a secure fastening. Wood screws should not be hammered into place and holes for countersunk screws should be countersunk. Round head screws should not be used in cargo spaces but may be used elsewhere. Plain nails should not be used. Fasteners at the edge of flashing should not split the material into which they are inserted. Fasteners of flashing should be placed not farther apart than 6" and not fewer than four should be placed in a circular collar. Screws or drive screws should be used for collars to facilitate their removal and replacement. Small pieces of ratproofing material should be fastened in at least two places.

21. RATPROOFING; DETAILED (1)

21.1 STRUCTURAL FEATURES

21.11 Hull and Supports

21.111 *Shell and bulkhead stiffeners* including structural members over doors and cargo ports should be installed toe down wherever practicable to eliminate the partially hidden area formed behind the flange when it is placed toe up.



CARGO BATTENS - LONGITUDINALS

FIG. 19

(1) For additional information on composition board, see Part 22.

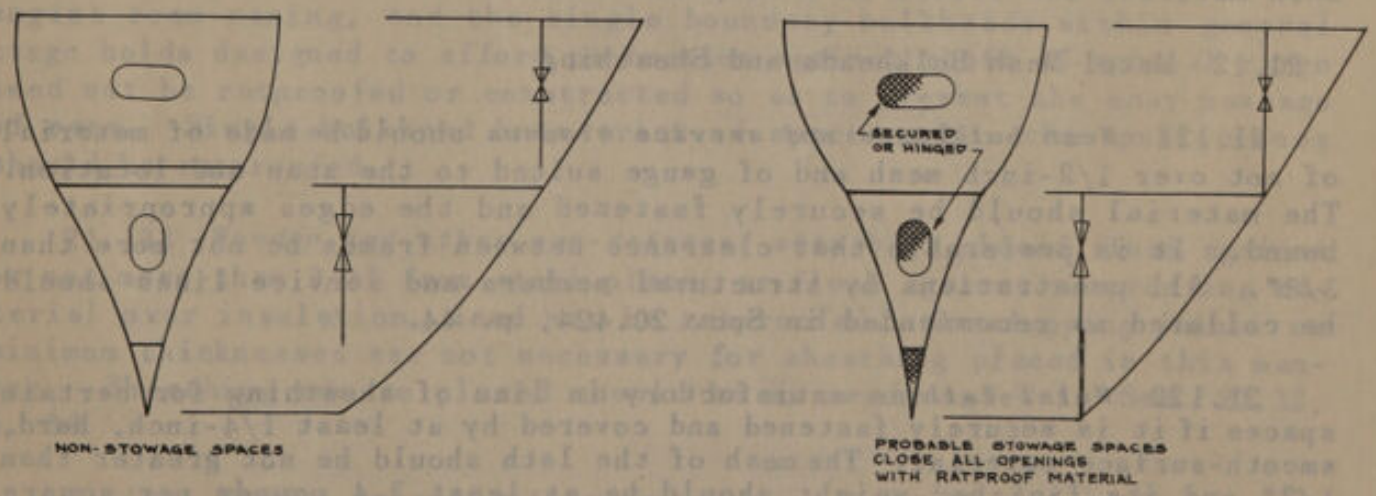
21.112 *Structural pockets.* When deep recesses are not open for inspection or when structural pockets are created by the intersection or close approach of several structural members, the space should be enclosed with plate.

21.113 *Lightening holes and void spaces.* Lightening holes as a means of opening spaces and making surfaces visible should be used only where they open the space sufficiently to make it easily visible and unattractive to rats as a nesting place.

In no case should lightening holes be placed where they will adversely affect the strength of structural members.

Void or concealed spaces, such as cofferdams, spaces around the chain lockers or tanks and between the breasthooks, and those spaces opened by lightening holes should either be made accessible, easy to inspect, and open to light, or they should be adequately ratproofed. If the space is intended to be used for the stowage of dunnage, gear, or miscellaneous material, it should be enclosed and provided with hinged entrance doors or manhole covers with means of securing them. It is preferable that these doors and manhole covers be hinged at the top and be self-closing. If made of mesh material, the cut edges should be substantially bound with steel bars or sheet metal crimped over the edges. Drain or ventilation holes or slots in solid sheet metal skirts around void spaces should not be greater than 1/2".

21.114 *Steel plate stiffeners* located in that portion of the fore or after peak not within the tanks, in which lightening, access, or structural holes are present, should terminate at least 6" above the breasthook or deck which they approach. If preferable, a half-moon having at least a 6-inch radius can be cut in the stiffener above the breasthook or deck. If these void spaces are of such a nature as to create potential rat harborage, they should be ratproofed as indicated in Sec. 21.113, p.49. (See Fig. 20)



STRUCTURAL VOIDS IN FORE AND AFTER PEAKS

FIG. 20

21.115 *Steel tank tops in lower hold.* Where practicable to do so, the steel tank top should be extended to the ship's side to avoid the creation of an open bilge space and the necessity to install a bilge ceiling. Pipe at the ship's side can be protected by battens. Cover plates over open drain wells should be of perforated or slotted plate with openings not greater than 1/2". (See Fig. 19)

21.116 *Chain lockers* should be designed to retain rats which might enter by way of the chain pipe. The bulkhead surrounding the locker should be of metal and free of holes larger than 1/2". A bulkhead dividing the locker into two compartments need not be ratproofed. Entrance doors into a chain locker and lightening holes into the spaces on each side of the locker should be constructed or ratproofed according to Sec. 21.113, p. 49. If the chain stowage space is not partitioned from the forepeak, the entire space should be considered the chain locker, and ratproof lockers should be provided if any stowage is to be effected therein.

21.117 *Independent tanks.* The construction of independent tanks should be such as not to create spaces which may become rat harborages. If the spaces above, beneath, or at the sides of the tank create potential rat harborage, they should be ratproofed as indicated in Sec. 21.113, p. 49.

21.118 *Steps and stairways* should preferably be constructed so as not to create enclosed spaces. When enclosed spaces do occur, they should be ratproofed. Sheet iron used for coverage or flashing should be at least 22 gauge.

21.119 *Tonnage openings* in cargo hold bulkheads which serve as barriers to rats should be ratproof when closed. Portable battens used to close such an opening should be of adequate strength and fitted so as to leave no hole larger than 1/2". If the battens are of wood, the edges of each piece should be bound with 16-gauge sheet metal which is attached by countersunk screws. Metal or mesh doors should be of 1/2-inch mesh material and fitted in a ratproof manner.

21.12 Metal Mesh Bulkheads and Sheathing

21.121 *Mesh bulkheads and service windows* should be made of material of not over 1/2-inch mesh and of gauge suited to the span and location. The material should be securely fastened and the edges appropriately bound. It is preferable that clearance between frames be not more than 3/8". All penetrations by structural members and service lines should be collared as recommended in Sec. 20.424, p. 44.

21.122 *Metal lath* is satisfactory in lieu of sheathing for certain spaces if it is securely fastened and covered by at least 1/4-inch, hard, smooth-surface material. The mesh of the lath should be not greater than 1/2" and its finished weight should be at least 3.4 pounds per square yard. Ribbed metal lath should be used where additional strength is needed. The use of metal lath in engine casings is discouraged because of the many penetrations by beams, stiffeners, brackets, cables, and the like and it should not be used in food handling spaces. (See Table III) Metal lath should be inspected just before the plaster is applied to ensure against holes larger than 1/2".

21.123 *Expanded metal* of 1/2-inch mesh is satisfactory as ratproofing when placed continuously over insulation. It is particularly desirable back of non-ratproof sheathing and screen bulkheads which are subject to damage and changing means of approach and attack by rats. If used as ratproofing over insulation in cargo spaces, it should be constructed and protected as recommended in Sec. 21.422, p. 77. When used to cover insulation in spaces other than those for cargo, it should be covered with a tough but pliable material. However, such material, with or without a thin plaster coating, is not particularly desirable as an outer surfacing because it is difficult to paint and clean. For this reason it should not be used in this manner in food handling spaces.

21.13 Wooden or Other Non-ratproof Bulkheads, Screen Bulkheads, and Sheathing over Voids or Insulation.

21.131 *General.* When ratproofing is needed for wooden or other non-ratproof material, complete coverage with sheet iron is recommended. Complete coverage is particularly desirable in cargo and stowage spaces where a means of approach by a rat to any part of the surface may occur. When wood is completely covered the recommendations of Sec. 20.321, p. 39, will not apply.

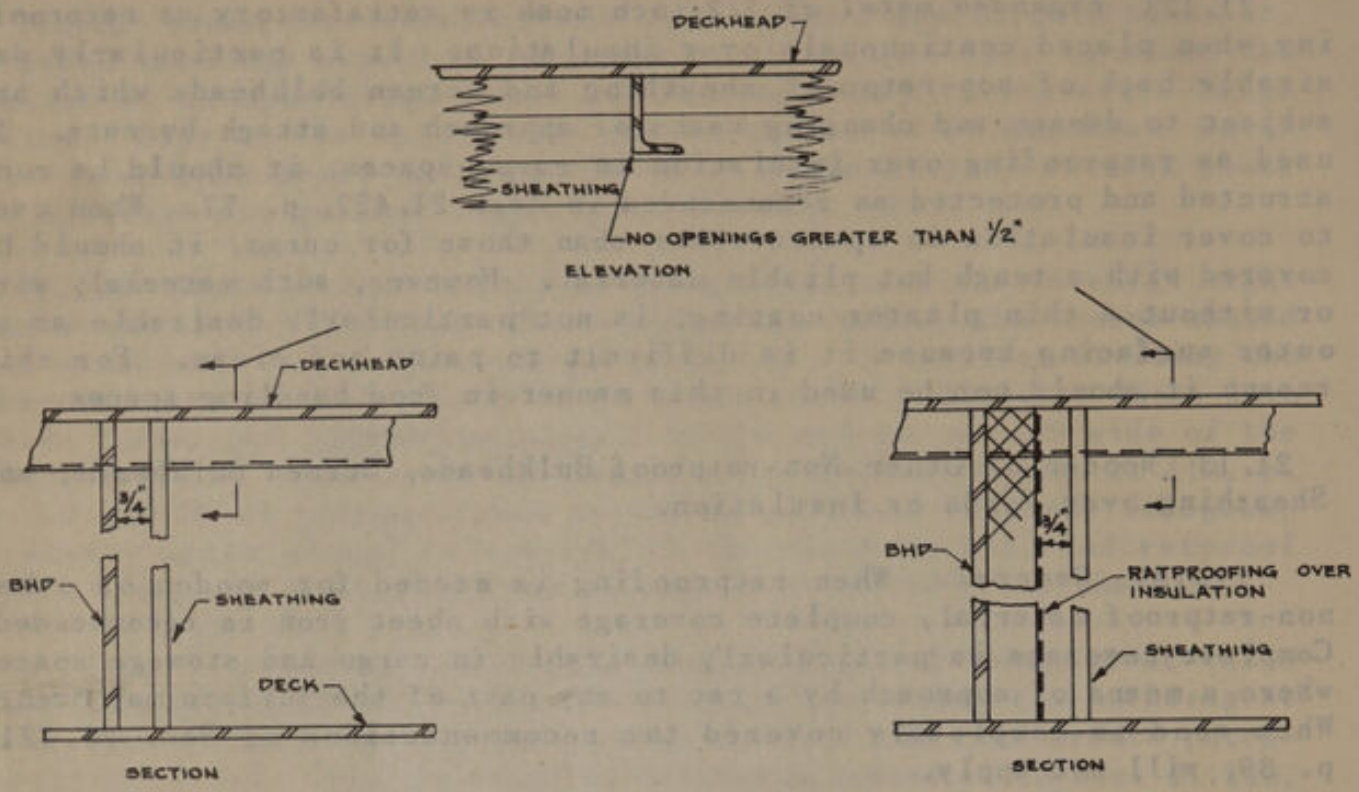
When the bulkhead, screen bulkhead, or sheathing is not located and constructed so as to be exempt from ratproofing, or it is impracticable to effect complete coverage, flashing may provide adequate protection. The recommendations of Subpart 20.3, p. 37, should be followed.

21.132 *Single bulkhead boundaries* of and single partitions within living quarters, dining rooms, mess halls, and like public places, and single bulkhead partitions within any ratproof space need not be ratproofed. These bulkheads should be constructed so as to prevent the easy passage of rats from one space to another. Holes greater than 1/2" may be closed with the material of which the bulkhead is constructed or any other suitable material. Sub-divisional bulkheads in galleys and pantries, the single boundary bulkheads of the machinery workshop in the engine room casing, and the single boundary bulkheads within general cargo holds designed to afford protection against theft of special cargo need not be ratproofed or constructed so as to prevent the easy passage of rats. Single bulkhead boundaries of spaces other then public ones should be ratproofed.

21.133 *Wooden and other non-ratproof sheathing* placed flush against or not more than 3/4" from steel plate, or flush against ratproofing material over insulation, need not be ratproofed. Overlapping joints or minimum thicknesses are not necessary for sheathing placed in this manner. Sheathing not so placed should be as recommended in Sec. 20.32, p. 38.

21.134 *Wooden screen bulkheads* need not be ratproofed if they are placed flush against or not more than 3/4" from steel plate or ratproofing material (See Fig. 22), or are constructed as follows:

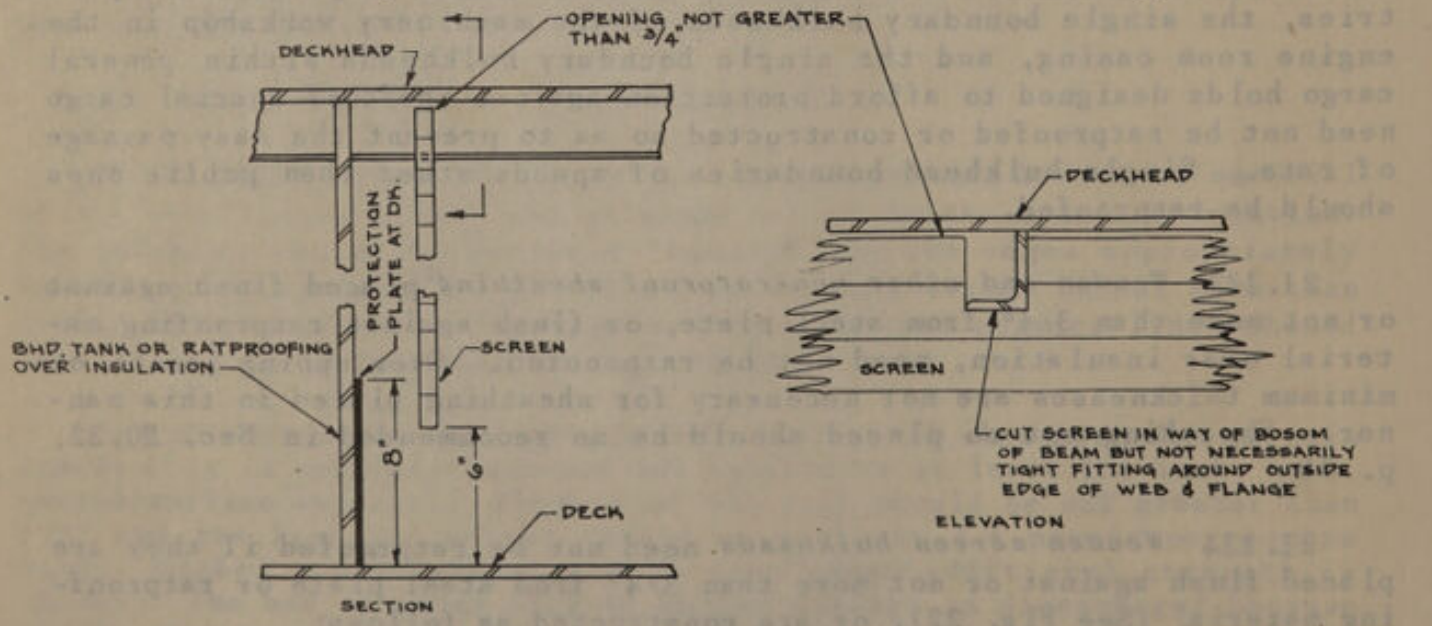
The screen bulkhead is on at least 4-inch vertical bearers and terminates at least 6" above the deck or other horizontal ledge



RATPROOF EXEMPT SHEATHING

FIG. 21

which may be behind or intersect it and the top of the screen is extended to within 3/4" of the deckhead but is not extended into the bosoms of the beams, girders, or brackets. When so constructed, overlapping joints in the screen bulkhead are not necessary. If additional protection is required behind the 6-inch opening at the bottom for the bulkhead, tank side, or ratproofing over insulation, a strip of 1/8-inch plate or heavier sheet iron should be placed over this surface; it should be at least 2" wider than the opening at the bottom. From a ratproofing standpoint, this type of screen bulkhead is preferred to metal-sheathed or flashed types.

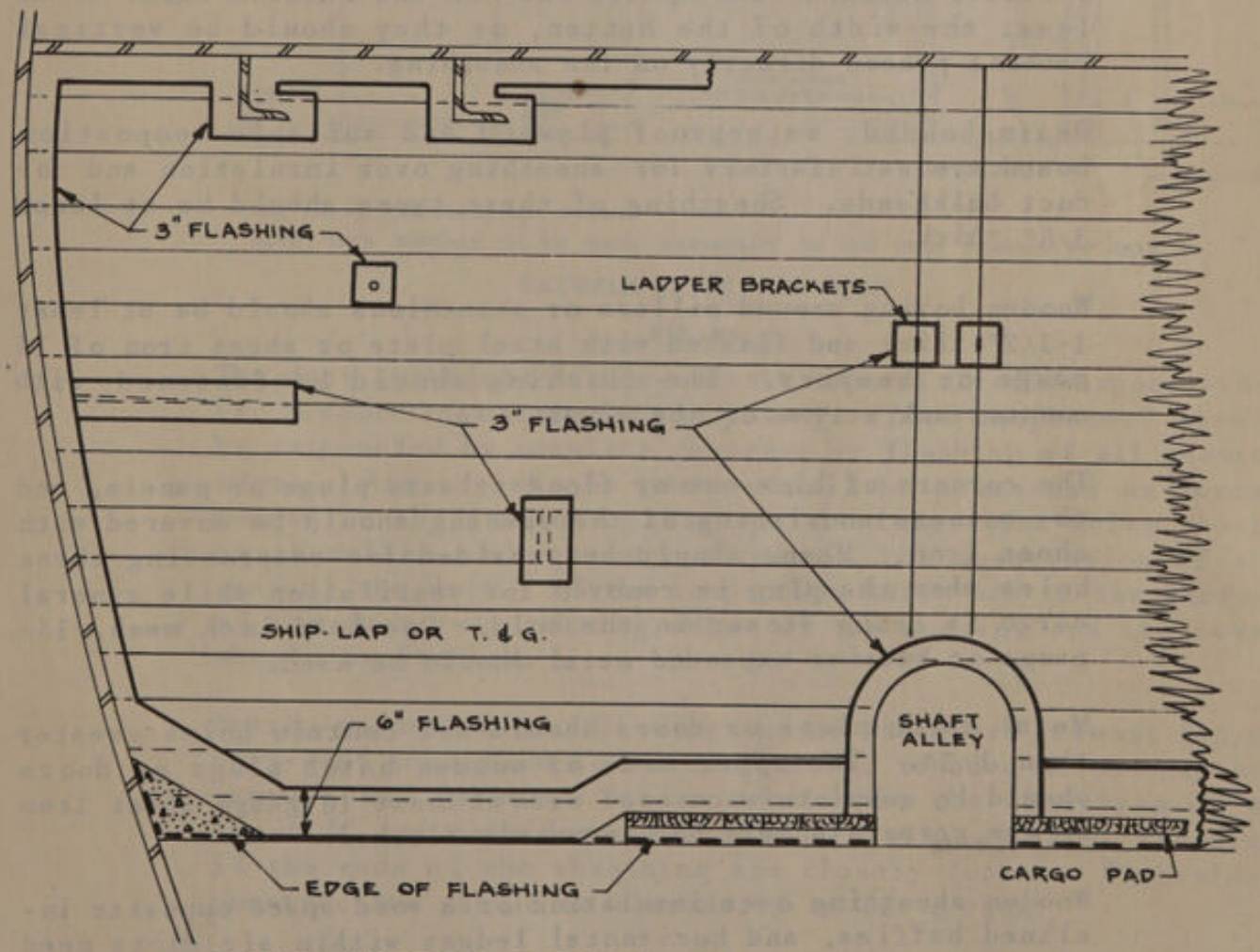


RATPROOF EXEMPT SCREEN BULKHEAD

FIG. 22

21.135 *Special recommendations for particular spaces.* The following information is to be used in connection with that already set forth in this section, and in Subpart 20.3, p. 37.

(1) General cargo holds. Exposed boundaries and corners, particularly external corners, of wooden and non-ratproof bulkheads, screen bulkheads, and sheathing should be protected with 1/8-inch thick steel bars or structural angles screwed or bolted into place. However, sheet metal flashing may provide adequate protection if it is maintained in good condition. Wooden strips or molding should not be used in lieu of sheet iron flashing. Particular attention should be given to gnawing edges of wooden screen bulkheads or of sheathing in cargo spaces. Wherever a wooden cargo pad, a portable wooden flooring, or a temporary installation of concrete ballast touches or is near wooden sheathing or a screen bulkhead, the flashing should extend from the steel deck to a point at least 6" above the upper surface of the cargo pad, flooring, or concrete. (See Sec. 20.421, p. 42) Single partition bulkheads within general cargo holds designed to afford protection against theft of special cargo need not be ratproofed.



SOLID WOODEN SCREEN BULKHEAD IN CARGO HOLD

FIG. 23

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(2) Refrigerated cargo holds; coil-cooled or air-cooled. Sheathing over insulation, whether exposed or within an air-flow duct, should be ratproofed. In the case of non-ratproof material, metal flashing or molding is preferred but 1-3/8-inch quarter-round wooden molding may be adequate in lieu of sheet metal flashing in internal corners of the bulkheads and deckheads within the hold or air duct. If sheet metal flashing is used for internal corners within the hold or air duct, 22-gauge material instead of 18-gauge is satisfactory. Metal ratproofing should be applied at the deck and over external corners of the interior bulkheads and deckheads of the space. Metal ratproofing should be applied at the deck, over all corners, and over all miscellaneous gnawing edges of exterior bulkheads of non-ratproof material. Plain, continuous butt joints and butt joints formed by the ends of two boards in exposed sheathing should be flashed if not tightly fitted and backed by wood of thickness equal to the sheathing. Butt joints in sheathing within air-flow ducts and cooler rooms require flashing only when within 6" of a surface on which a rat might stand to gnaw.

Exposed sheathing over insulation and its flashing should be protected by battens. The battens should be horizontal on vertical bearers with spaces between the battens equal to at least the width of the batten, or they should be vertical battens placed directly on the sheathing.

Resin-bonded, waterproof plywood and suitable compostion board are satisfactory for sheathing over insulation and for duct bulkheads. Sheathing of these types should be at least 3/8" thick.

Wooden boxing around pillars or stanchions should be at least 1-1/2" thick and flashed with steel plate or sheet iron of 11 gauge or heavier. The flashing should be fastened with countersunk screws or the equal.

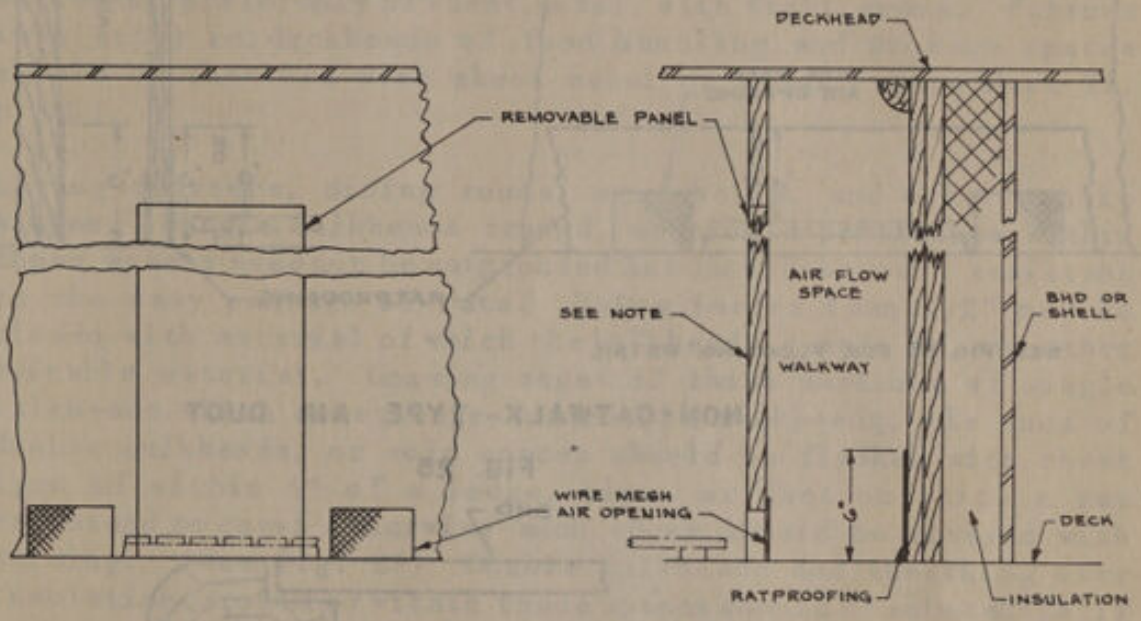
The corners of blow-out or flood release plugs or panels, and the corners and lining of the opening should be covered with sheet iron. Means should be provided for ratproofing these holes when the plug is removed for ventilation while general cargo is being stowed in the hold. One-half-inch mesh, 16-gauge or heavier expanded metal should be used.

Metal hatch plugs or doors should not contain holes greater than 1/2". The upper side of wooden hatch plugs or doors should be completely covered with at least 18-gauge sheet iron or the corners should be adequately flashed.

Wooden sheathing over insulation or a void space opposite inclined baffles, and horizontal ledges within air ducts need not be flashed unless seams and joints therein are not tight.

For information on the ratproofing of flooring over insulation see Sec. 21.41, p. 76.

The duct bulkhead of the catwalk type of air-flow space need not be ratproofed but it should be substantially built and closely fitted to prevent the easy passage of rats. Corners and butt joints should be protected by the application of wooden molding. The air outlets or ports should be covered with at least 16-gauge perforated metal, 16-gauge expanded metal, 16 to 18-gauge flattened expanded metal, or 14-gauge steel wire cloth. Portable panels to permit the entrance of an inspector should be provided.



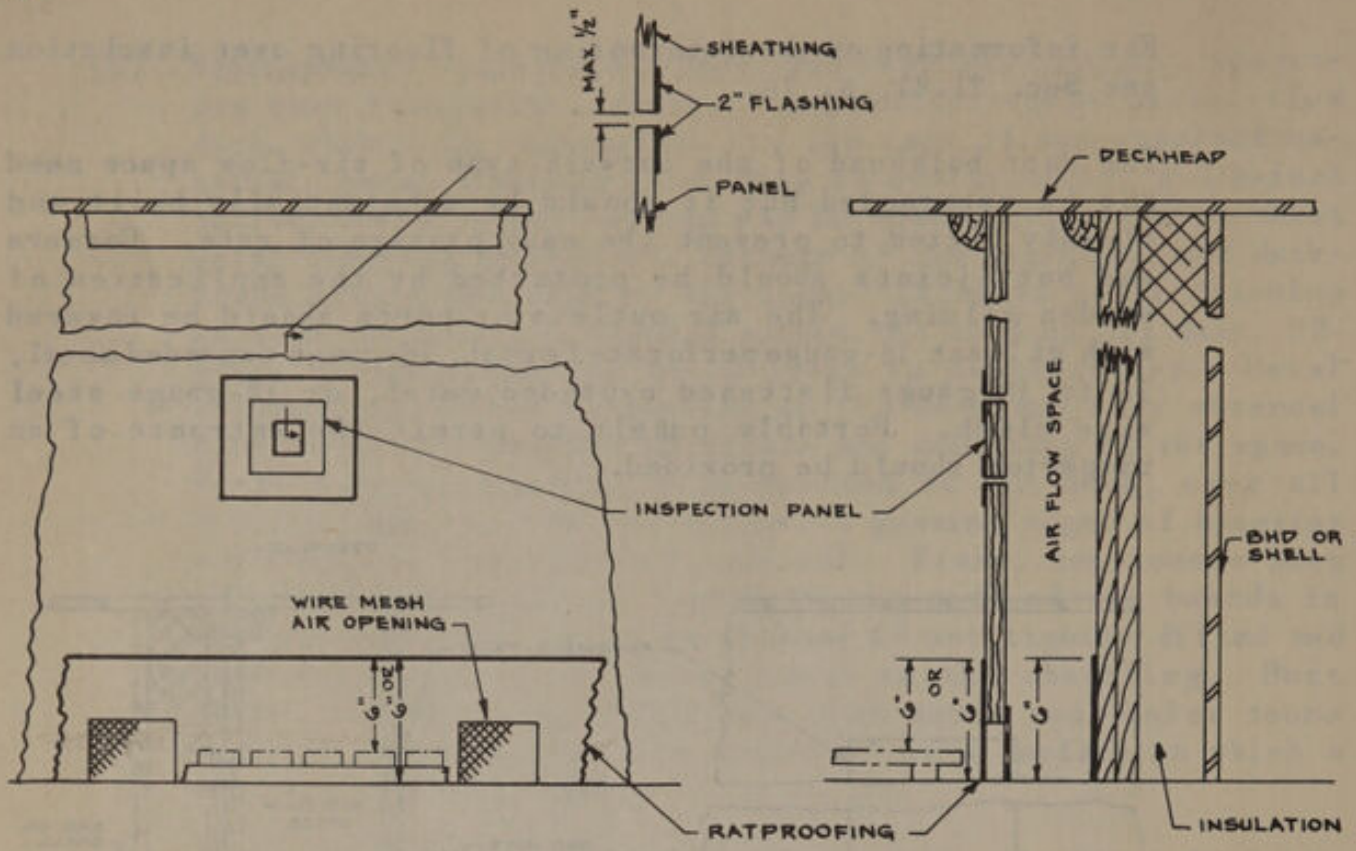
SEE FIG. 45 FOR FLOORING DETAIL
NOTE: THIS SURFACE TO BE MADE RESISTANT TO THE EASY PASSAGE OF RATS

CATWALK TYPE AIR DUCT

FIG. 24

The duct bulkhead of a non-catwalk type of air-flow space (that is, any part too narrow for the passage of an inspector) should be ratproofed by complete coverage or flashing of all gnawing edges. Air outlets or ports should be protected as recommended in the previous paragraph and inspection holes should be installed as necessary to permit the observation of all runs of the duct. If the inspection holes are in the surface of the duct, all gnawing edges of the opening and the cover should be flashed.

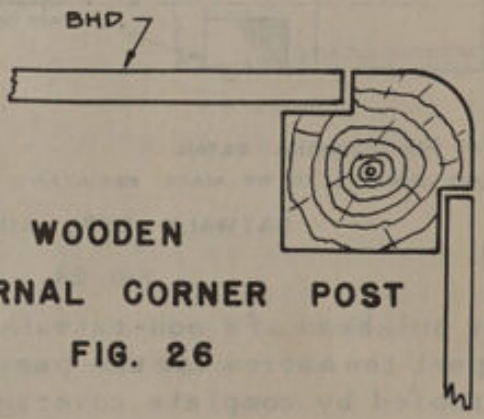
Solid, wooden, external corner posts which are at least 3-5/8" by 3-5/8" in finished cross dimensions, rounded at the exposed corner, and rabbeted for an overlap by the sheathing of at least 1" are considered satisfactory without metal flashing if the ends of the sheathing are closely fitted. Equivalent construction should be considered on its merits.



SEE FIG. 45 FOR FLOORING DETAIL

NON-CATWALK TYPE AIR DUCT

FIG. 25



SOLID WOODEN EXTERNAL CORNER POST

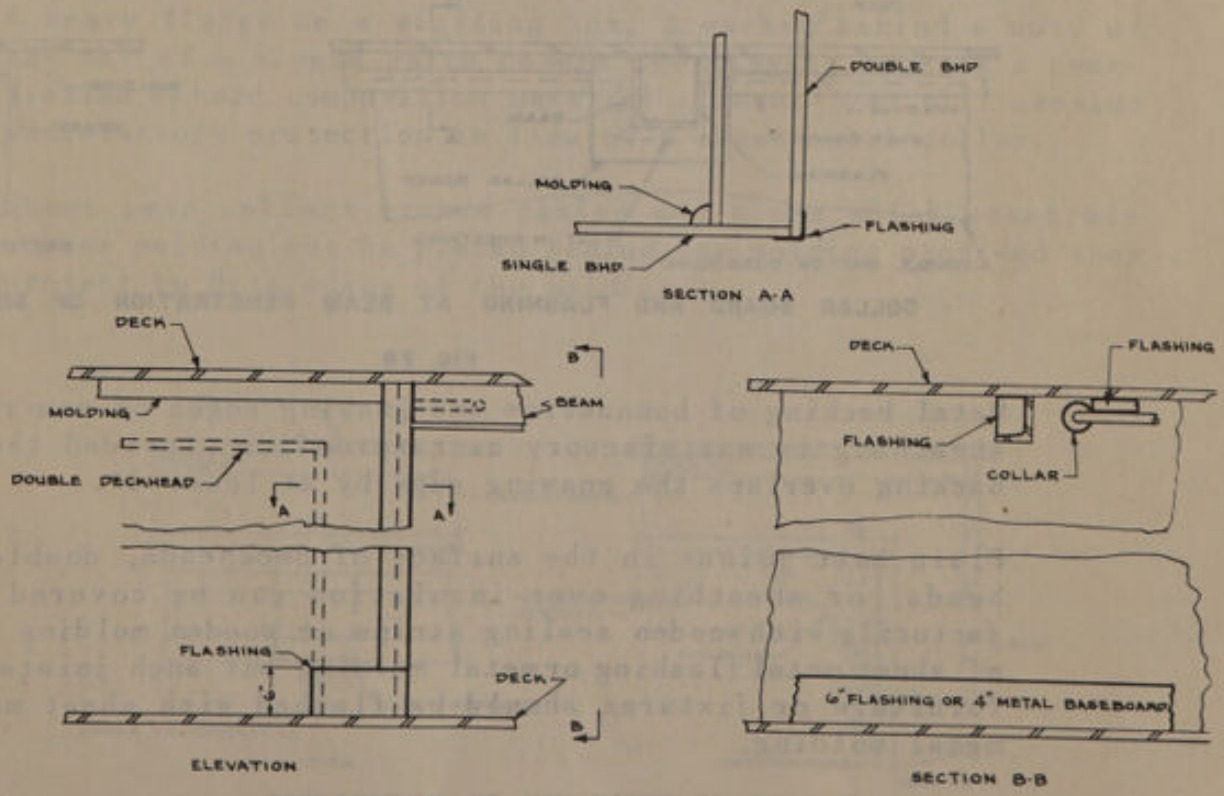
FIG. 26

(3) Ship's stores refrigerator. All concrete or composition curbs and all non-ratproofed sheathing within 6" of the deck, flooring ridges, or deck grating should be ratproofed with sheet metal or mesh material. The lead pan is not considered to be ratproofing. Internal angles in the interior of the space may be protected satisfactorily by covering with 1-3/8-inch (finished size), quarter-round, wooden molding in lieu of flashing. Metal lath, composition board, and prefabricated panels may be used satisfactorily in ship's stores refrigerated spaces in lieu of wood. (For the ratproofing of flooring in refrigerators see Sec. 21.41, p. 76.) When the exterior bulkhead of a refrigerated space is of wood or other non-ratproof material, all boundaries and gnawing edges should be flashed with sheet metal. (See Part 22, p. 90)

(4) Stowage spaces. Boatswain's, engineer's, provision (dry food), and baggage stowage spaces are particularly subject to rat infestation and therefore should be carefully ratproofed. The boundaries of all such places should preferably be of steel plate, sheet metal, or metal mesh material. However, substantially built bulkheads of wood or other non-ratproof material are satisfactory if adequately flashed. Doors and doorways in such bulkheads should be ratproofed as recommended in Sec. 21.172, p. 63. (See Part 22, p. 90)

(5) Galley, pantry, and other food handling spaces. Bulkheads and deckheads in these spaces should have hard, smoothly finished surfaces, preferably of sheet metal, with tight seams. Fibrous insulation in deckheads of food handling and stowage spaces should be sheathed with sheet metal or equal. (See Part 22, p. 90)

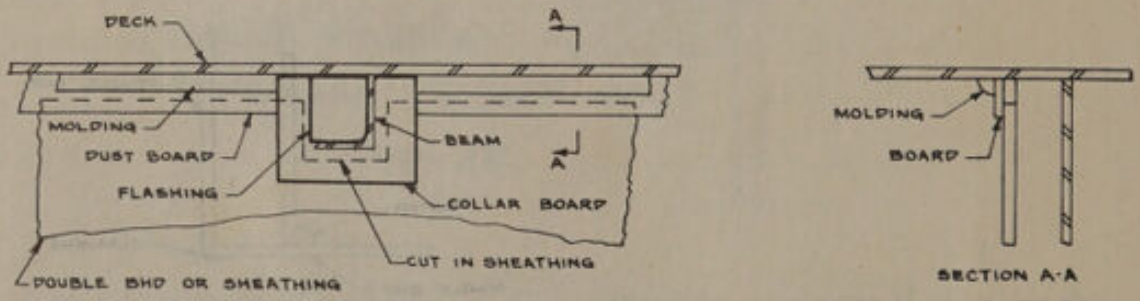
(6) Living quarters, dining rooms, mess halls, and other public places. Single bulkheads around, or single partitions within these spaces need not be ratproofed but should be made resistant to the easy passage of rats. Holes larger than 1/2" may be closed with material of which the bulkhead is made or any other suitable material. Gnawing edges of those portions of single bulkheads which cover edges of double deckheads, the ends of double bulkheads, or void spaces should be flashed with sheet iron if within 6" of a ledge, pipe, or duct on which a rat can stand to gnaw; otherwise such edges should be covered with molding. (See Fig. 27) Double bulkheads and sheathing over insulation around or within these spaces should be substantially constructed and adequately ratproofed.



SINGLE AND DOUBLE BULKHEADS IN LIVING QUARTERS & PUBLIC SPACES
FIG. 27

Where a free cut is made in, or a block of material is removed from, non-ratproof sheathing to accommodate structural members which penetrate the sheathing, the opening should be covered with a collar board. The collar board may be of the same material and thickness as the sheathing (but not necessarily thicker than 3/4") and it should overlap all edges of the cut in the sheathing sufficiently to ensure a secure fastening. If the collar board is fitted closely to the structural member and adjoining metal bulkhead or deckhead, the edges need not be flashed unless the spot can be easily reached by rats. As the moving of furniture or the addition of new service installations may create a means of approach for a rat to deckhead beams which penetrate sheathing, such sheathing or collar board should be flashed with 22-gauge sheet iron within the bosom of the beams. Eighteen-gauge collar plate is suitable in lieu of the collar board. Screws should be used for the attachment of the metal and also for the attachment of the collar board wherever the backing is not sufficiently firm to permit the use of nails. The same principles are applicable in cases of double bulkheads and of single bulkheads which form the boundaries of ratproof spaces. (See Fig. 28)

Quarter-round, cove, or other suitable solid molding is satisfactory in internal angles in lieu of sheet metal flashing. External corners may be covered satisfactorily with solid molding in lieu of flashing. Metal molding is preferred but wooden molding is satisfactory if it is at least 3/4" finished size.

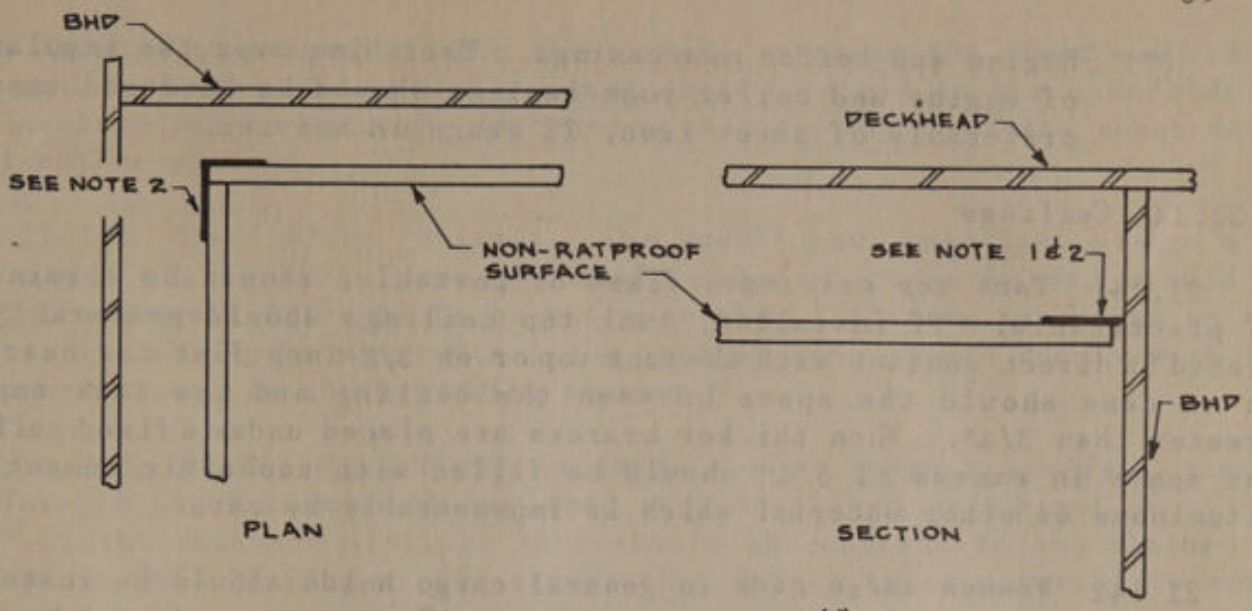


COLLAR BOARD AND FLASHING AT BEAM PENETRATION OF SHEATHING

FIG. 28

Metal backing of boundaries and gnawing edges of non-ratproof sheathing is satisfactory as ratproofing provided the metal backing overlaps the gnawing edge by at least 1".

Plain butt joints in the surface of deckheads, double bulkheads, or sheathing over insulation can be covered satisfactorily with wooden sealing strips or wooden molding in lieu of sheet metal flashing or metal molding but such joints behind furniture or fixtures should be flashed with sheet metal or metal molding.



NOTE 1: NO OPENINGS GREATER THAN ½"

NOTE 2: RATPROOFING SHALL OVERLAP GNAWING EDGE BY AT LEAST 1"

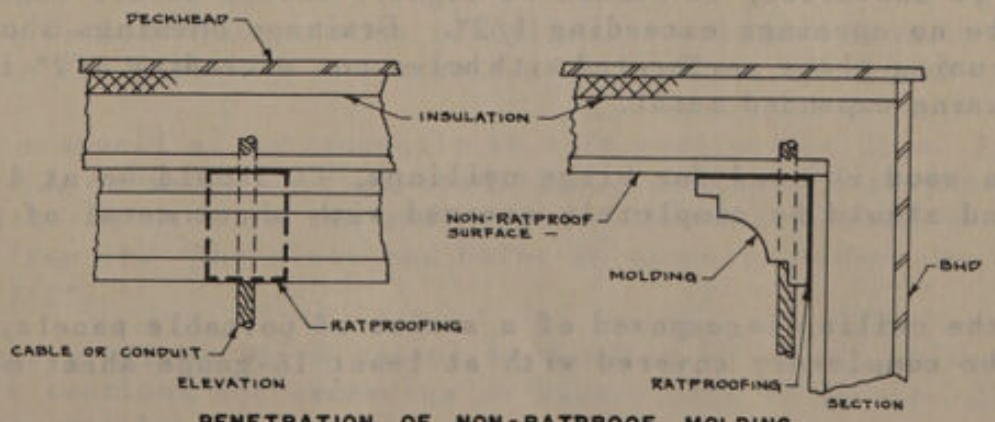
METAL BACKING OF BOUNDARIES

FIG. 29

Instead of flashing the surface of non-ratproof bulkheads or sheathing at the deck with sheet metal, the lower 6" can be ratproofed by placing 1/2-inch mesh, 18-gauge hardware cloth or 18 to 20-gauge flattened expanded metal on the face of the furring strip and immediately behind the sheathing. A 4-inch high sheet iron baseboard of at least 22 gauge will suffice in lieu of either the sheet iron flashing or the concealed ratproofing. The height of the baseboard will vary with different composition boards. (See Part 22, p. 90)

A heavy flange on a stuffing box, a washer behind a nut, or the nut of a nipple which covers the gnawing edge of a penetration of hard composition material at least 1/4" will provide satisfactory protection in lieu of a sheet metal collar.

Sheet iron collars around cables and pipes which penetrate corner molding may be placed behind the molding provided they project to both edges of the molding.



PENETRATION OF NON-RATPROOF MOLDING

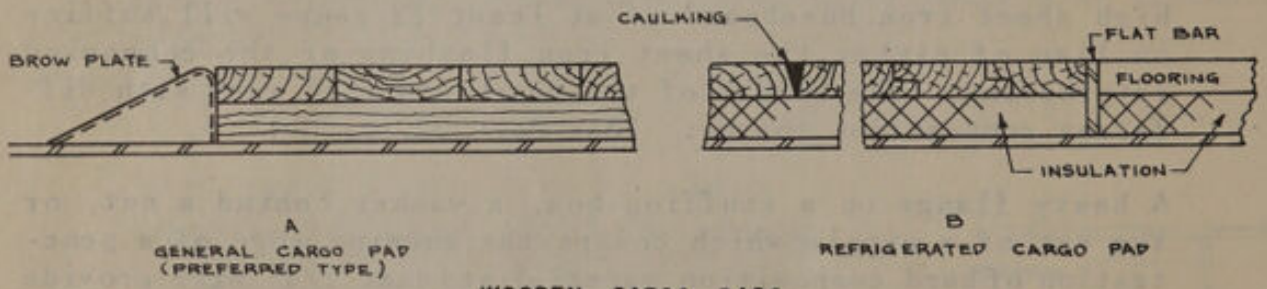
FIG. 30

(7) Engine and boiler room casings. Sheathing over the insulation of engine and boiler room casings should be hard and smooth, preferably of sheet iron, 22 gauge or heavier.

21.14 Ceilings

21.141 *Tank top ceilings*, fixed or portable, should be eliminated if practicable. If installed, tank top ceilings should preferably be placed in direct contact with the tank top or on 3/8-inch flat bar bearers. In no case should the space between the ceiling and the tank top be greater than 3/4". When thicker bearers are placed under a fixed ceiling, the space in excess of 3/4" should be filled with asphaltic cement, or bituminous or other material which is impenetrable by rats.

21.142 *Wooden cargo pads* in general cargo holds should be installed as specified above for tank top ceilings. Cargo ramps should be constructed of steel plate with no hole greater than 1/2". If of wood, they should be completely covered with 11-gauge sheet iron if the space beneath is greater than 3/4". (See Fig. 31,A) Wooden cargo pads over cork insulation in refrigerated cargo holds should be at least 2-5/8" thick and the wood should comply with the recommendations in Sec. 20.321, p. 39. They should be bound by steel. It is preferable that 18-gauge or heavier steel wire cloth be placed between the ceiling and the cork but ceiling with tightly-fitted shiplap or caulked butt joints is generally suitable. (See Fig. 31,B)



WOODEN CARGO PADS

FIG. 31

21.143 *Bilge ceilings* should be eliminated and open-type protection, such as battens, should be provided for frame brackets, pipe, and the like. If permanent bilge ceilings are required, they should be constructed of steel plates wherever practicable. When a steel plate bilge ceiling is installed, it should be tightly fitted at all edges and there should be no openings exceeding 1/2". Drainage openings should be provided by using plate perforated with holes not exceeding 1/2" in diameter; not by using expanded metal.

When wood is used for bilge ceilings, it should be at least 2-5/8" thick and should be completely covered with sheet metal of at least 16 gauge.

If the ceiling is composed of a series of portable panels, each panel should be completely covered with at least 16-gauge sheet metal. With

this type of construction, the sheet metal covering the fixed wood ceiling and that over the portable panel should extend to the underside of the members and be securely fastened so that the edges of the sheet metal will not be exposed.

21.144 *Shaft alley ceilings.* The wooden pad, sometimes placed over the steel plate which forms the shaft alley in cargo holds, should be laid flush against the plate or not more than 3/4" from any point on the plate; if this space is greater, the installation should comply with the recommendations in the preceding section.

21.145 *Deckhead ceilings in cargo spaces,* when installed, should preferably be of metal. When of wood and not placed in contact or within 3/4" of the deckhead plating, they should be constructed and flashed as stated in Sec. 21.143, p. 60, except that 2-inch thick material is suitable.

21.146 *Miscellaneous ceilings.* Ceilings over deep tanks, drain channels, or large wells or other voids should be as recommended in Sec. 21.143, p. 60.

21.15 Flooring and Deck Grating.

21.151 *Flooring, raised or portable,* placed on decks should be ratproof. Raised flooring is particularly hazardous from a rat infestation standpoint unless the space beneath it is less than 3/4". Allowance should be made for the welding beads of butt joints and the difference in the elevation of plates which are lap-welded. In some cases the adjustment can best be made by the use of 1/2-inch hardwood or 3/8-inch metal bearers.

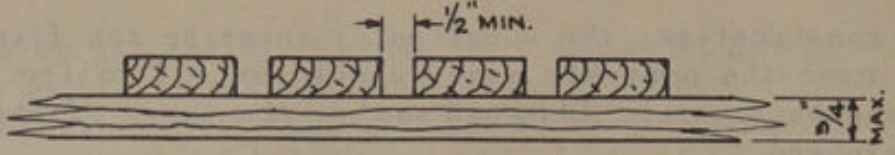
Solid portable flooring is objectionable from a general sanitary standpoint but it may be satisfactory if it meets the ratproofing recommendations for raised flooring, it is substantially built, and all sections are of such size and weight as to be easily handled. In general cargo holds, each portable section should preferably not exceed 75 square feet in area and should be provided with at least one flush ring for the attachment of a hoist cable.

21.152 *Flooring over cork or like insulation* including concrete and special composition flooring is discussed in Sec. 21.41, p. 76.

21.153 *Deck gratings,* when installed, should be constructed so as not to create rat harborage or spaces for the collection of food or debris.

Except as specified subsequently in this section and Secs. 21.154 and 21.155, p. 62, or under special conditions, deck gratings should be in contact with the deck or the underside of the slat should be not more than 3/4" from it. The slots and holes in these gratings should not be less than 1/2".

All deck gratings which cannot be handled by hoist cable should be in portable sections not exceeding 36 square feet in area or 120 pounds in weight to facilitate removal by one man.

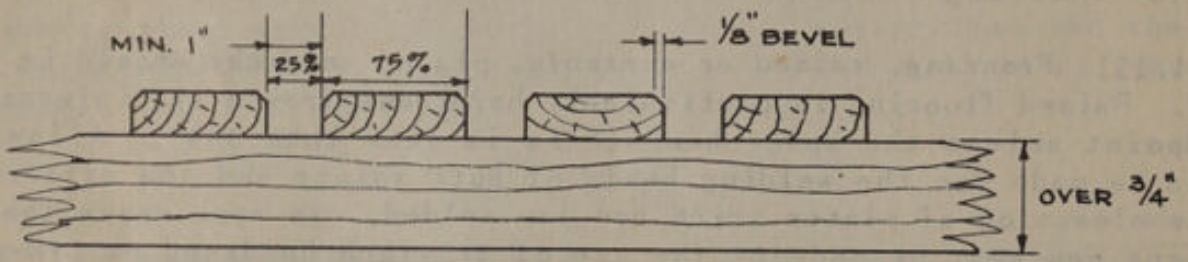


CONTACT DECK GRATING

FIG. 32

To facilitate ventilation in air-cooled refrigerated spaces and drainage on bridge wings, it is often necessary for the bearers under such gratings to be greater than 3/4". Raised gratings in other spaces should be considered on the basis of evidence of the necessity therefor.

Raised deck gratings are undesirable. When installed, the slats should be as narrow as practicable and the slots or holes wide enough to effect complete visibility of the deck under each slat. The slot or hole should be not less than 1". The openings should be uniform and their area should equal at least 25% of the entire surface. With a 1-inch slot, the slat should not be wider than 3". The upper corners of each slat should be beveled at least 1/8" by 1/8". Each section of deck grating in refrigerated cargo holds should be limited in area to 36 square feet.



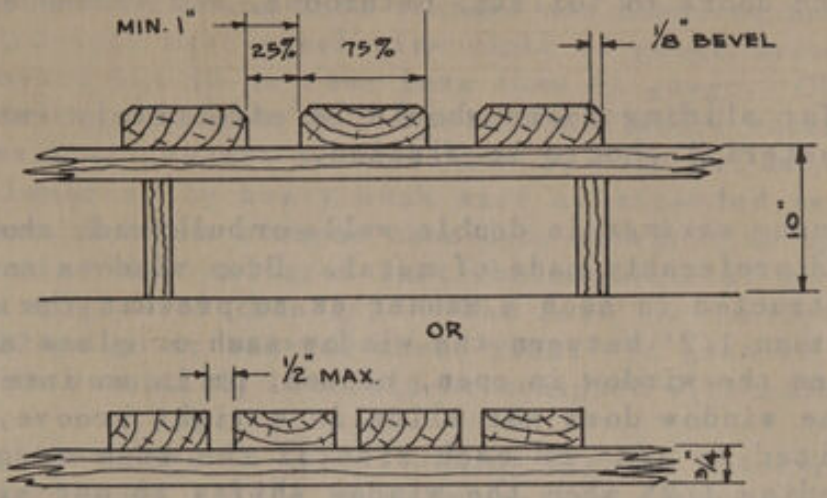
RAISED DECK GRATING

FIG. 33

The slat and slot recommendations are not essential in the case of narrow walkway gratings, such as may be found in front of switchboards and equipment.

21.154 *Liquid cargo tanks.* Gratings over coils in liquid cargo tanks will be acceptable if the carrying of dry cargo is not for an extended period of time and the gratings are constructed in accordance with the requirements for raised gratings. If the space is continuously used for dry cargo and the coils are not removed, the void space should be covered with a ceiling constructed as indicated in Sec. 21.143, p. 60.

21.155 *Boatswain's storeroom gratings* should preferably be elevated at least 10" above the deck and the space beneath should not be used for stowage. The slats and slots should comply with the recommendations for deck gratings in refrigerated cargo spaces. Where necessary to facilitate cleaning, the grating should be in portable sections. The horizontal width of the space underneath the elevated grating should not exceed 6'. Where necessary, aisles should be provided to accomplish this. If an elevated grating is impracticable, a deck grating will be satisfactory if the slats touch the deck or if they are not more than 3/4" from it, and the slots are not more than 1/2" wide. It is recommended that elevated gratings be portable.



ELEVATED BOATSWAINS STORE GRATING

FIG. 34

21.16 Machinery Foundations. Bases or foundations of machinery other than in the engine room should be designed and installed so as to eliminate any partially enclosed spaces. Open-type structural steel foundations are preferred. Where lightening holes are not sufficient to permit proper inspection and cleaning, and additional lightening holes cannot be cut, the existing openings should be closed. Openings between the top of box foundations and the base of machinery exceeding 1/2" should be closed. For information regarding machinery and deck equipment see Subpart 21.5, p. 82.

21.17 Miscellaneous Construction.

21.171 *Elevator or dumb-waiter shaftways* should be of tight, well-fitted construction with closely fitted doors. Means should be provided for opening the bottom of the shaftway well to facilitate cleaning and inspection. The bottom of the shaftway well should be flush with the bottom of the clean-out opening. A ratproof door hinged at the top should be provided for this opening.

21.172 *Doors* of non-ratproof material leading into stowage spaces should be closely fitted and flashed on the outside lower edge with a 6-inch wide strip of 22-gauge or heavier sheet iron. Crash strips should be installed if essential to ratproofing. If the casings of such doors are installed in openings in double bulkheads, the casing should be ratproofed from the deck to a point at least 6" above the sill of the doorway. The casing will be satisfactorily ratproofed if flashed on the outside with 22-gauge sheet iron or if 18-gauge hardware cloth is placed directly behind the casing in contact with its inner surface.

Construction holes left in the top and bottom edges of prefabricated metal doors need not be ratproofed.

Slots in louvers, and the space between the sill and the bottom of entrance doors and of doors within living quarters, dining rooms, passageways, and like public spaces should be less than 1/2" and preferably not over 3/8", except that this space limitation is not essential in the

case of entrance doors to toilets, bathrooms, and wardrobes within these spaces.

Recesses for sliding doors should be effectively ratproofed. All non-ratproof material should be flashed.

21.173 *Window casings* in double walls or bulkheads should be tightly constructed and preferably made of metal. Drop windows and window wells should be constructed in such a manner as to prevent the existence of a space greater than 1/2" between the window sash or glass and the edge of the opening when the window is open, closed, or in an intermediate position. When the window does not slide in a tight groove, this opening should be limited to 1/4" on each side of the sash or glass to avoid openings exceeding 1/2" when the window shifts to one side. If it is impracticable to avoid openings exceeding 1/2" between the window and the sill in all positions of the window, the well should be completely lined with suitable ratproof material. A lead lining is not ratproof and therefore not suitable. Window sash should drop to within 1/2" of the bottom of the window well to prevent the existence of a space below the sash large enough for the harborage or the nesting of a rat. If this is impracticable as in the case of mechanically-operated windows, a removable inspection panel should be provided. If the top of the window well is left open when the window is in the closed position, a hinged cover should be provided for the window well. Windows that slide horizontally into a double wall or bulkhead should pass into a pocket constructed the same as the window well recommended above.

21.174 *Ballast*, when permanent, should be so installed as to avoid the creation of harborage. Solid block, gravel, or sand ballast should be sheathed completely with a layer of reinforced concrete or cement mortar of adequate thickness. If permanent gravel, sand, or block ballast is sheathed with wood, the sheathing should be at least 2-5/8" thick in finished size. If the sheathing has square butt joints, the entire surface should be covered with metal. Horizontal surfaces on which cargo is placed, particularly under cargo hatches, should be covered with steel plate. If not completely covered with sheet metal but flashed instead, the sheathing should be shiplap and should otherwise comply with Sec. 20.32, p. 38. The lining of access manhole wells should be ratproofed in the same manner and the edges of the covers of these wells should be completely bound with 16-gauge or heavier sheet metal. Structural steel angles are preferable at vulnerable corners in cargo holds.

21.175 *Troughs for indirect lighting* in public places should not extend continuously through any bulkhead or partition. If not closed at each end within each space, 18-gauge steel wire or hardware cloth, 18-gauge expanded metal, or 18 to 20-gauge flattened expanded metal should be placed over the opening at the bulkhead or partition. Gnawing edges of non-ratproof material in a double wall within 6" of the trough should be flashed with 22-gauge sheet iron except as specified for certain composition board materials in Part 22, p. 90. The electric cable entering from a double bulkhead or through the boundary of a ratproof space should be collared with 22-gauge sheet iron.

21.176 *Skylights* serving food storage and handling spaces should be screened with 1/2-inch mesh steel wire cloth of gauge suited to the span, space, and exposure but in no case less than 18 gauge. Other skylights except those over engine rooms should be screened where essential. Copper or corrosion-resistant insect screens are not ratproof and when used they should be supplemented by heavy mesh wire or expanded metal. Control rods which pierce skylight screens should be designed to operate through a hole of such size when collared that the movement of the rod will not create an opening greater than 1/2". The hole in the screens should be collared with 22-gauge or heavier sheet iron. If greater lateral movement of the rod is essential, it should be equipped with a floating collar.

21.177 *Deckhead hangers* for attaching lights, motors, blowers, and cables to the deckheads should be of open-type construction and should not form pockets with structural members. Lighting fixtures which penetrate double deckheads or bulkheads should have a flange to cover the edge of the cut made in the sheathing. If not flanged, the gnawing edge should be flashed or protected in accordance with the practice in the particular space. Where more rigid attachment is necessary such as for motors, blowers, and other machinery, and where structural angles are used, they should be toed down and located so as not to create harborages or uninspectable pockets or ledges. Strap hangers and backing-plate hangers for cables should be as recommended in Sec. 21.33, p. 71.

21.178 *Manhole protective covers or guards* should preferably be made of steel plate with no opening greater than 1/2". If made of wood and the void spaces created by them when they are in place are greater than 3/4" in any dimension, the entire inside should be lined with 22-gauge sheet iron.

21.179 *Deep tank protective covers* should preferably be made of steel plate. When made of wood, they should comply with the recommendations for portable bilge ceilings in Sec. 21.143, p. 60.

21.2 PROTECTION OF STRUCTURES, PIPES, CABLES, AND CONTROL RODS

21.21 General. Structures and installations should, whenever practicable, be protected with open, slot-type barriers rather than with those of box or enclosed-type. The box-type, particularly when made of wood, is a potential rat harborage and it should not be used unless its purpose is to retain insulation.

21.211 *Battens.* Steel flat bar, half-round bar, channel or angle battens are preferred in the order mentioned but wooden battens are satisfactory. Battens should be installed so as not to form troughs or partially hidden pockets over structural members, cables, or wireway casings. (See Fig. 35) Steel or wooden battens should be at least 2" apart and at least 4" from any adjoining pipe or bulkhead. There should be sufficient space between them to ensure visibility but never less than the width of the batten except in the case of vertical pipe battens.

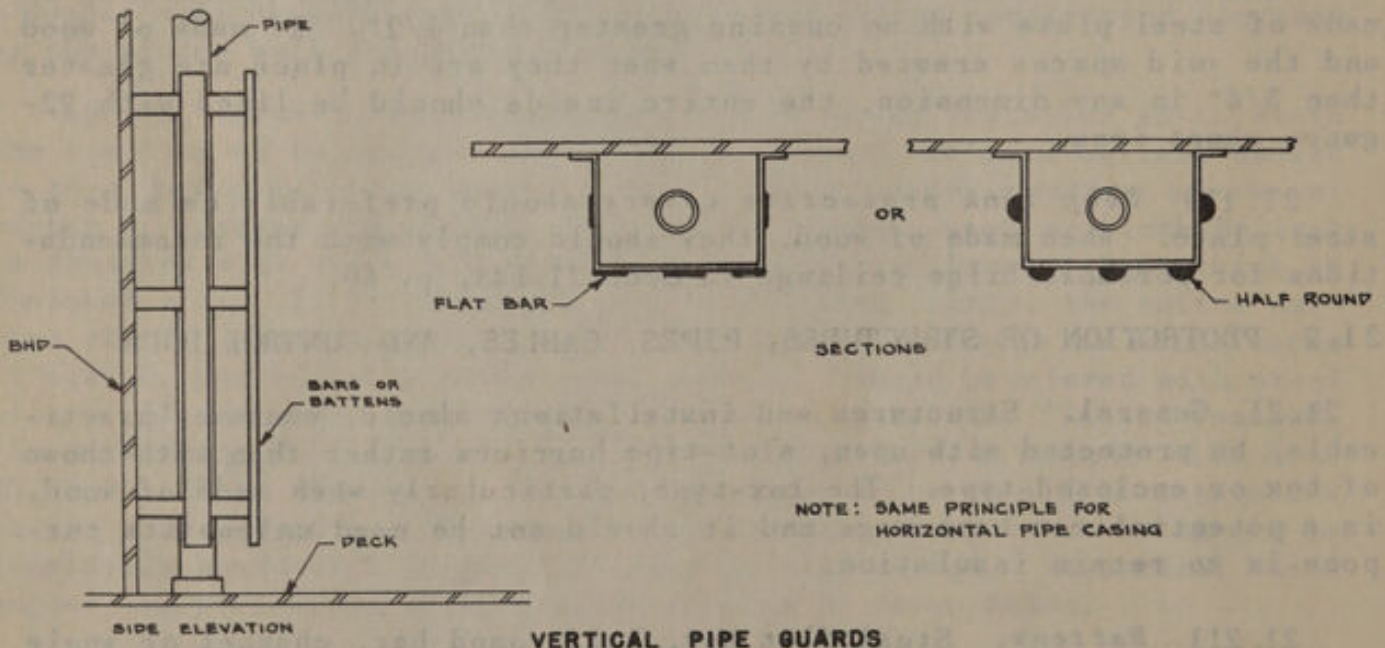
21.212 *Vertical battens* should not be on horizontal bearers unless the bearers are not wider than 2" and there is a space of at least 4" between the bearer and the surface being protected. Battens should have a minimum clearance of 6" from the deck except that the cargo face may

extend to the deck. Vertical, channel-iron pipe guards and closely adjoining angle-iron pipe guards which extend to within 6" of a deck or tank top should have half-moon inspection holes at the bottom of the guard.

21.213 *Horizontal battens* should be fastened to vertical bearers or clips which are at least 4" deep and should have a minimum clearance of 6" above the deck or tank top which they parallel.

21.214 *Plate guards.* Wide plate guards are generally undesirable because they exclude light, interfere with inspection, hide rat runways, and create rat harborage. When installed, they should be carefully located and provided with sufficient lightening holes to overcome these objections.

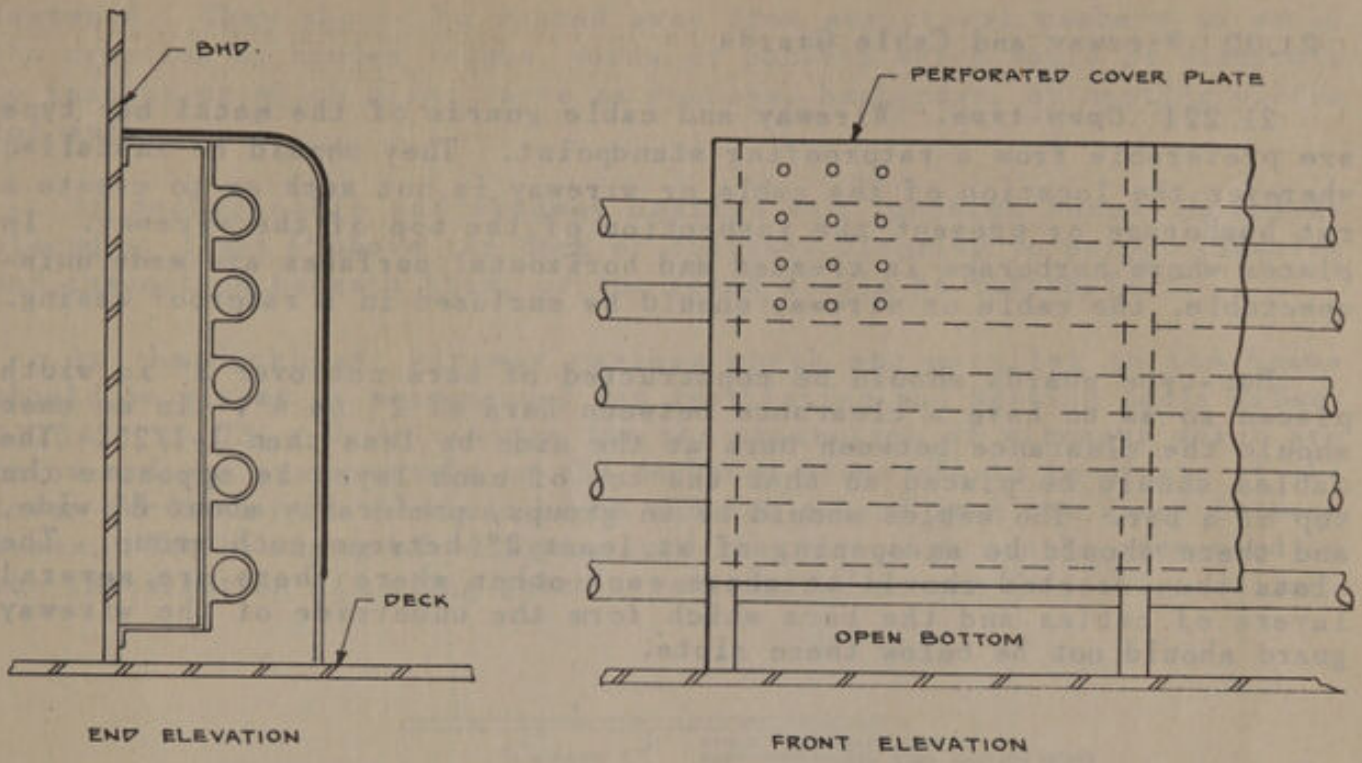
21.215 *Semi-circular, channel, and angle-type guards* when in a horizontal position should be toed down and placed so as not to hide a surface which might serve as a rat runway. These shapes when toed up create hidden rat runways and nesting troughs or ledges. Channels and angles in a horizontal position should not be toed in unless the ledge created by the lower flange is readily visible. Channels should not be used where they hide the upper surface of or space between horizontal pipes, cables, and the like.



VERTICAL PIPE GUARDS

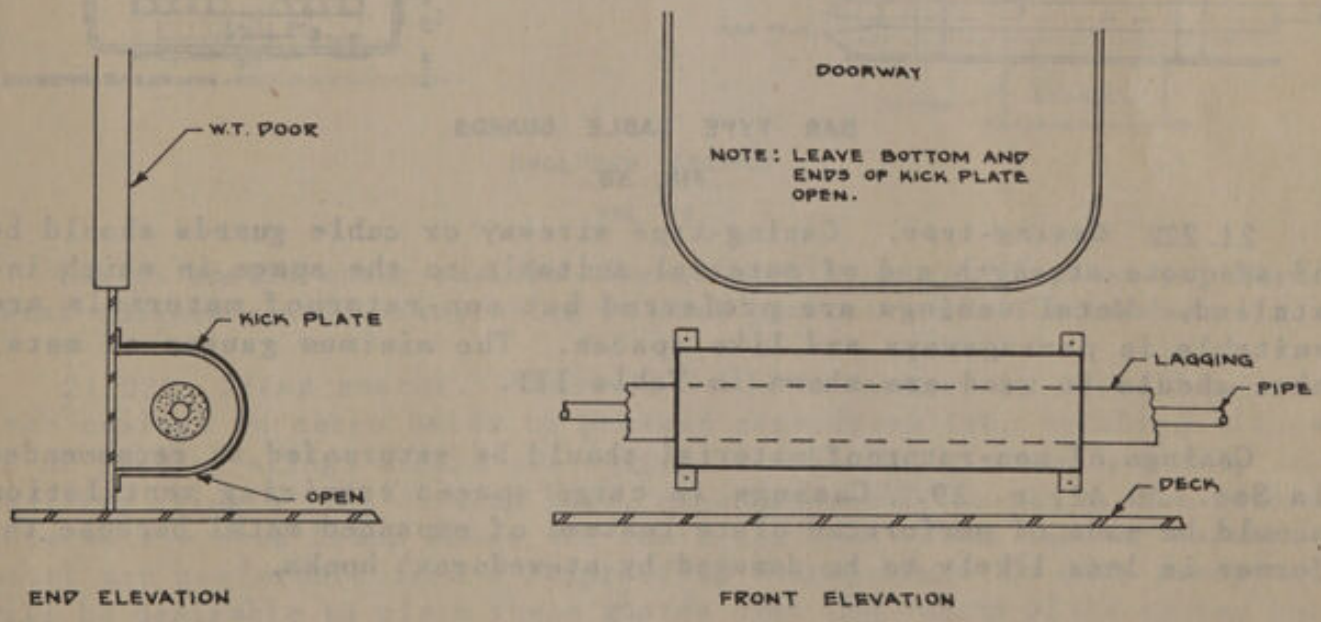
FIG. 35

21.216 *Protective covers for heating pipes or coils and for kick plates in way of doors* should not extend to the deck or horizontally beneath the pipe or coil. It is preferable that protective covers for pipe terminate at least 6" above the deck and that they be open at both ends. If complete enclosure is necessary, there should be no holes in the casing larger than 1/2".



PROTECTIVE COVER FOR HEATING PIPE OR COILS

FIG. 36



KICK PLATE

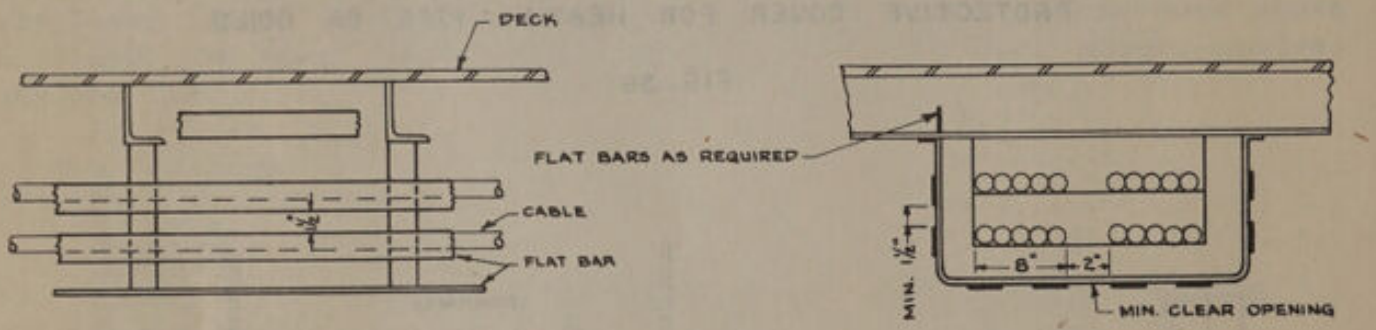
FIG. 37

21.217 *Casing or box-type guards of wood* should not be installed unless their purpose is to retain insulation. Ratproofing them should be done by flashing with at least 16-gauge sheet iron in cargo spaces, 18-gauge in refrigerated cargo spaces, and 22-gauge in other spaces. When they are located where the box casing will be subject to damaging blows, the corners should be protected with structural angles at least 1/8" by 3" or 6", or be flashed with at least 11-gauge sheet iron.

21.22 Wireway and Cable Guards

21.221 *Open-type.* Wireway and cable guards of the metal bar type are preferable from a ratproofing standpoint. They should be installed wherever the location of the cable or wireway is not such as to create a rat harborage or prevent the inspection of the top of the wireway. In places where harborage is created and horizontal surfaces are made uninspectable, the cable or wireway should be enclosed in a ratproof casing.

Bar-type guards should be constructed of bars not over 2" in width placed so as to have a clearance between bars of 2" to 4". In no case should the clearance between bars at the side be less than 1-1/2". The cables should be placed so that the top of each layer is opposite the top of a bar. The cables should be in groups, preferably about 8" wide, and there should be an opening of at least 2" between each group. The slots thus created should be above each other where there are several layers of cables and the bars which form the underside of the wireway guard should not be below these slots.



BAR TYPE CABLE GUARDS

FIG. 38

21.222 *Casing-type.* Casing-type wireway or cable guards should be of adequate strength and of material suitable to the space in which installed. Metal casings are preferred but non-ratproof materials are suitable in passageways and like spaces. The minimum gauges of metal that should be used are shown in Table III.

Casings of non-ratproof material should be ratproofed as recommended in Sec. 20.42, p. 39. Casings in cargo spaces requiring ventilation should be made of perforated plate instead of expanded metal because the former is less likely to be damaged by stevedores' hooks.

Wireway casings should consist of portable sections. The weight and size of each section and the method of attachment should be such as to facilitate removal and replacement.

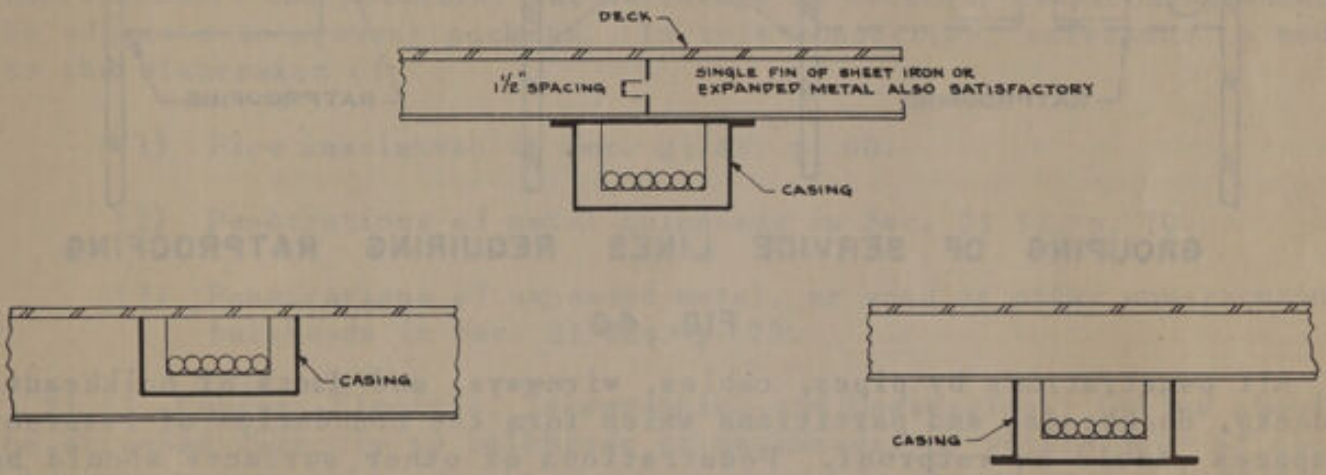
Casings should extend continuously through ratproof boundaries or double bulkheads, or the opening in these bulkheads through which the cables pass should be ratproofed.

Casings should be placed so as to avoid penetration by structural members. When such penetrations are unavoidable, the casing should be tightly fitted against the member and its edges adequately reinforced and

fastened. They should be spaced away from structural members to avoid the creation of hidden ledges, voids, or pockets which would be difficult to inspect or which might serve as runways, harborage, or nesting places for rats.

At decks, cable and wireway casings and junction boxes should be placed at least 6" above the deck or finished flooring to permit cleaning and inspection beneath them, or the space should be ratproofed.

At the deckhead, wireway casings which are parallel to the beams should be placed as recommended for ventilating and heating ducts in Sec. 21.342, p. 73. Those casings for the protection of wireways which are below and run transversely to the deckhead beams should terminate at the lower surface of the deckhead beams and not extend into the space between beams. The hitching of slings around these casings can be prevented by the installation of a sling guard as recommended in the following section.



ENCLOSED CASINGS

FIG. 39

Cables should enter casings through nipples or stuffing tubes. Sheet metal collars should be installed at such penetrations of expanded metal.

21.223 *Sling guards.* Wherever it is necessary to install guards over casings in cargo holds to prevent stevedores from hitching slings to or placing slings around the casing, it should be accomplished by installing a single line of flat bars, expanded metal, or sheet iron plates between the deck beams above the cable casings. Flat bars or expanded metal are preferable from a ratproofing standpoint. In most cases, it will be desirable to place these guards over the center of the casing but they should be placed at or toward one side if such will facilitate inspection. These single plates need not be rat-tight. (See Fig. 39)

21.23 Control-rod Guards. Bar, mesh, or solid casing guards for control rods should be installed in the same manner as recommended for pipe and cable guards in Secs. 21.21 and 21.22, pp. 65 and 68. Semi-circular troughs for control rods and chains should be installed only where they are readily accessible for inspection. (See Sec. 21.215, p. 66)

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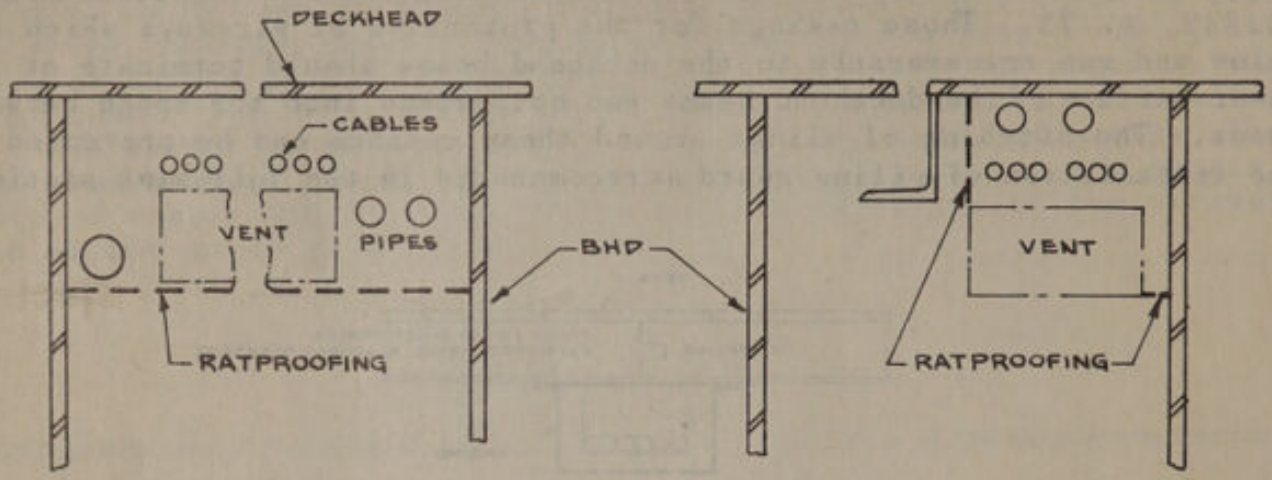
21.3 SERVICE INSTALLATIONS

21.31 General. Care should be exercised in the design and installation of service lines to avoid combinations which create rat harborages and spaces which cannot be inspected, cleaned, or painted. Where this is unavoidable and inspection for rat nesting and harborage is impracticable, service lines should be completely encased. When enclosure is necessary in passageways, the service lines should be high enough to make it possible to install portable panels of expanded metal under the lines and above all doorways and fixtures which might interfere.



GROUPING OF SERVICE LINES REQUIRING RATPROOFING

FIG. 40

All penetrations by pipes, cables, wireways, and ducts of bulkheads, decks, deckheads, and partitions which form the boundaries of ratproof spaces should be ratproof. Penetrations of other surfaces should be closed to prevent rats from using the service lines as runways. In closing spaces around penetrating service lines, the possibility of the lines shifting to one side of the hole, making the aperture larger than would be the case if the line remained centered, should be taken into account. Minimization of the freedom of movement of rats, particularly on overhead structures, aids greatly in the control of them.

21.32 Pipes. All exposed pipes outside of propelling and refrigerating machinery spaces should be installed well away from corners, stiffeners, bulkheads, bosoms of beams, brackets, and the like. They should be kept sufficiently spaced with respect to one another to permit easy inspection and to prevent the creation of a surface on which dirt and trash may collect and rats may nest. There should be at least 2" between pipes and a like space between a pipe and any surface that parallels it. (See Fig. 41)

When it is necessary to place pipes in contact with each other in horizontal layers, the grouping should be limited to about 8" in width with 2" between each group. When these provisions are impracticable and uninspectable surfaces and rat harborages are created, enclosure may be essential.

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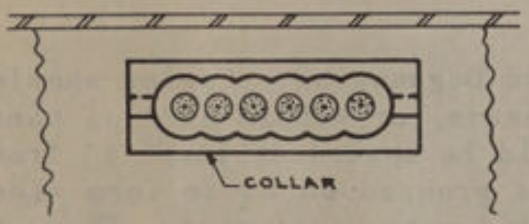
When an open, inspectable type of cable installation is impossible and rat harborage is created, the cables should be enclosed as recommended in Sec. 21.222, p. 68.

It is preferable that cables pass through stuffing tubes, thimbles, or nipples where they penetrate bulkheads, deckheads, and partitions, or enter closed wireway guards and pull, fuse, or switch boxes. Direct penetrations of metal surfaces by individual cables should be ratproofed as recommended in Sec. 21.31, p. 70.

Lead, Portland cement mortar, putty, and certain plastic sealing compounds are not suitable for ratproofing openings around cables. Special cements and plastics which become hard and are resistant to abrasion and cracking may be satisfactory for closing openings around wireways within ferrules at bulkheads.

When sheet iron collars are installed, they should fit to within 1/4" of the outer surface of the individual cable or the group of cables. When placed around a wireway, the inner edge of the collar should be cut to conform to the outer surface of the wireway. A strip of sheet lead can be placed around the cable or wireway as a safeguard against the insulation being cut by the collar. Placing the two halves of the collar tightly against the cables prevents vibration and cutting.



SHEET METAL COLLAR FITTED WITHIN 1/4" OF CABLES. LEAD FERRULE MAY BE APPLIED

COLLAR AROUND INDIVIDUAL CABLE

CABLE COLLARS

FIG. 43

Penetrations of wood or other non-ratproof surfaces should be collared as recommended in Sec. 20.424, p. 44.

A heavy flange on a stuffing box, a washer behind a nut, or the nut of a nipple which covers the gnawing edge of a penetration of hard composition material at least 1/4" will provide satisfactory protection in lieu of a sheet metal collar. (See Part 22, p. 90)

21.34 Ventilating, Air-cooling, Air-conditioning, and Heating Systems.

21.341 *Mushroom and torpedo ventilators* in the superstructure should be continuous when passing through double bulkheads or deckheads. Where necessary, the sleeve of the ventilator should be extended by the addition of sheet metal. Penetrations of non-ratproof bulkheads, deckheads, or sheathing should be collared as recommended in Sec. 20.424, p. 44.

21.342 *Air ducts* should be constructed and located so as to be ratproof and not to create rat harborages. They should be continuous when passing through double bulkheads and insulation. Non-ratproof materials are suitable for certain spaces other than general cargo holds if all gnawing edges are flashed. Air ducts which traverse the void space within double bulkheads or deckheads should be ratproof.

Round ducts or ducts having circular tops should be used where practicable and should be placed at least 2" away from parallel structural members.

Rectangular air ducts should be installed either tight against or well away from deckheads and bulkheads. When flush against the deckhead plate, the side should be in contact with the flange or be sufficiently away from the bosom of the beams to permit inspection of the flange of the beam. Rectangular air ducts may be placed flush against the back or side of channel or angle sections or 2" or more from it. If not flush with the deckhead plate, the ducts should be lowered so that their tops are sufficiently below the deckhead beams to permit inspection but in no case less than 2" when the casing runs parallel with the deck supports. In passageways and like spaces, it may be necessary to place the ducts between beams but not flush with the deckhead. In that event the space on the side should be at least 10" wide and the space above the casing at least 6" in order to permit inspection.

Lightening holes in adjoining structural members to facilitate inspection should not be resorted to unless good visibility can be secured thereby. In no case should lightening holes be installed where they will adversely affect the strength of a structural member.

Spaces created by the placement or arrangement of ventilating or heating ducts which cannot be observed and cleaned should be completely enclosed with sheet iron of at least 16 gauge in general cargo holds, 18 gauge in refrigerated cargo holds, and 22 gauge in other spaces. Expanded metal or wire cloth in lieu of sheet iron is suitable in spaces other than cargo spaces, if of equivalent strength.

In this connection, reference is made to the discussion of:

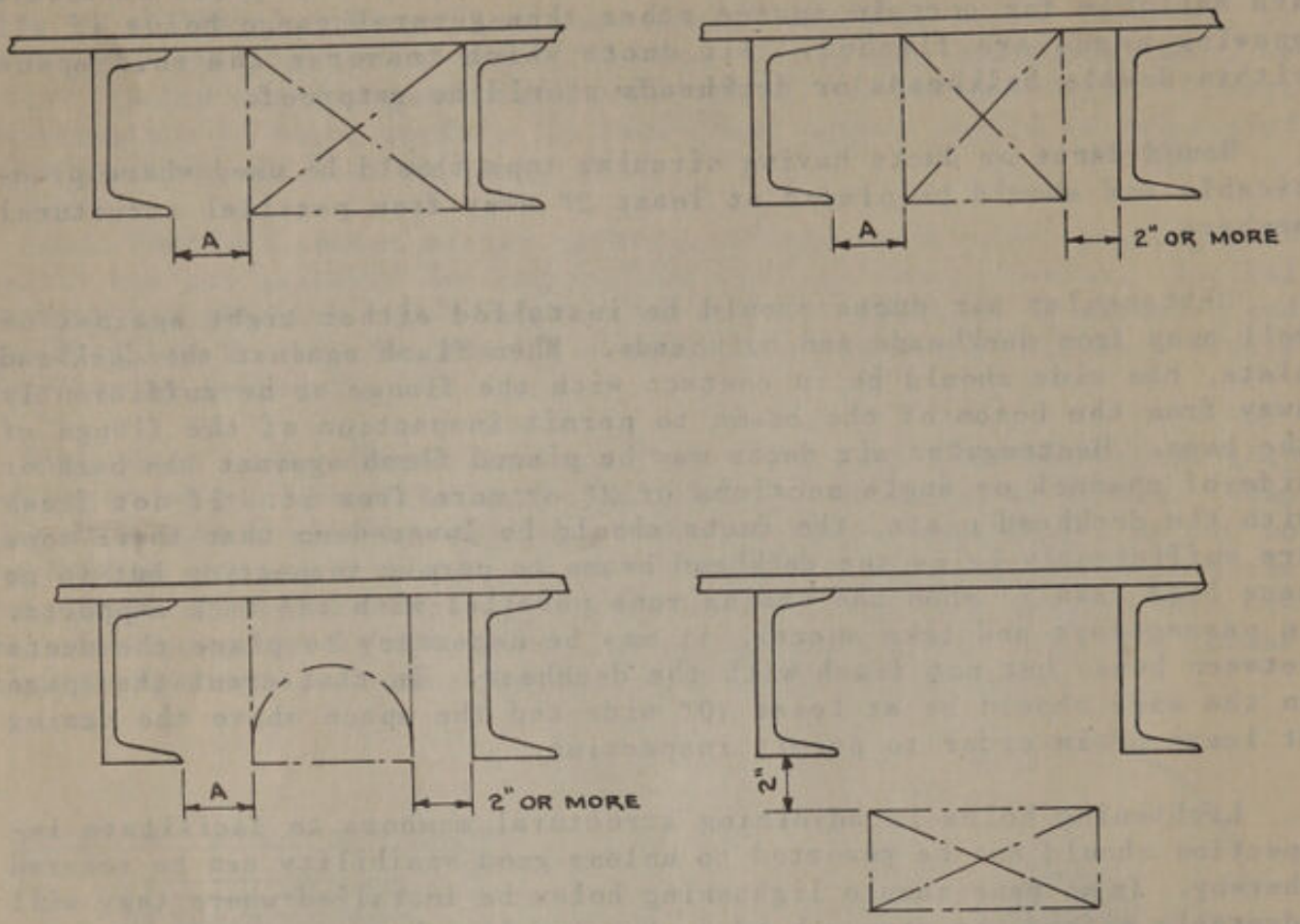
(1) Penetrations of non-ratproof bulkheads in Sec. 20.424, p. 44.

(2) Refrigerated cargo space ducts in Sec. 21.135, p. 53.

(3) Ratproofing of insulation on ducts in Sec. 21.44, p. 82.

21.343 *Intakes, exhausts, and outlets* should be ratproofed by the installation of ratproof screening unless the opening is equipped with a substantially built louver which has no slot or hole greater than 1/2". Insect screening is not satisfactory as ratproofing.

All gravity and forced draft intake and exhaust openings should be ratproofed. An individual gravity ventilator or forced draft duct which passes directly into one compartment need be ratproofed only on the intake end. The outlet end of such a ventilator need not be ratproofed



NOTE: DIMENSION "A" SHOULD BE SUCH AS TO PERMIT VISUAL INSPECTION OF THE ENCLOSED SPACE

VENTILATION DUCTS

FIG. 44

unless rat harborage is created by a horizontal extension of the duct. Ducts extending from the weather deck directly to the cargo holds, with no horizontal extensions, need not be ratproofed at either end. The service outlets of a cold air or hot air system which serves more than one compartment should be ratproofed. Ventilation louver openings in living quarters, dining rooms, and other public spaces need not be ratproofed if they are located in the deckhead near the center of the space, there are no avenues of approach, and there is little likelihood of one being provided.

In all cases where it may be necessary to have access to the interior of an air-flow ventilator or duct, a portable screen should be installed. The frame should be substantially built and fastened at not fewer than four points. The frame may be made of 1/8-inch steel bar, or a 1-1/2-inch or wider strip of sheet iron may be crimped over the edge of the screen. It should be fastened with bolts or self-tapping screws. Where a frame is not required, the ratproofing material should be welded, bolted, or screwed to the opening at not fewer than four points.

The perforations in, or mesh of the ratproofing material should be no greater than 1/2" and the gauge should be no less than that given in Table VI.

Table VI. Gauges of Ratproofing Materials for Protecting Air Intakes, Exhausts, and Outlets

Service	Perforated sheet iron	Expanded metal		Wire cloth	Sheet iron frame[1]
		Raised	Flattened		
Intakes and exhausts	16	16	16-18	14	18
When exposed to weather	14	13	13-15	13	16
Outlets					
General cargo holds	16	16	16-18	14	18
Refrigerated cargo holds	16	16	16-18	14	18
Into other spaces	18	18	18-20	16	22
Intake, exhausts and outlets					
Through large unprotected (structurally) grills	14	13	13-15	13	18

[1] When doubled and crimped over the edge of the screening material, the next lighter even gauge may be suitable but none lighter than 22 gauge should be used.

21.344 *Ventilating hoods and canopies* should terminate flush with the deckhead or slope toward the open deck space. They should be screened as specified in Sec. 21.343, p. 73 . Pipes, cables, air ducts, and the like over tops of hoods should not be massed so as to form spaces or

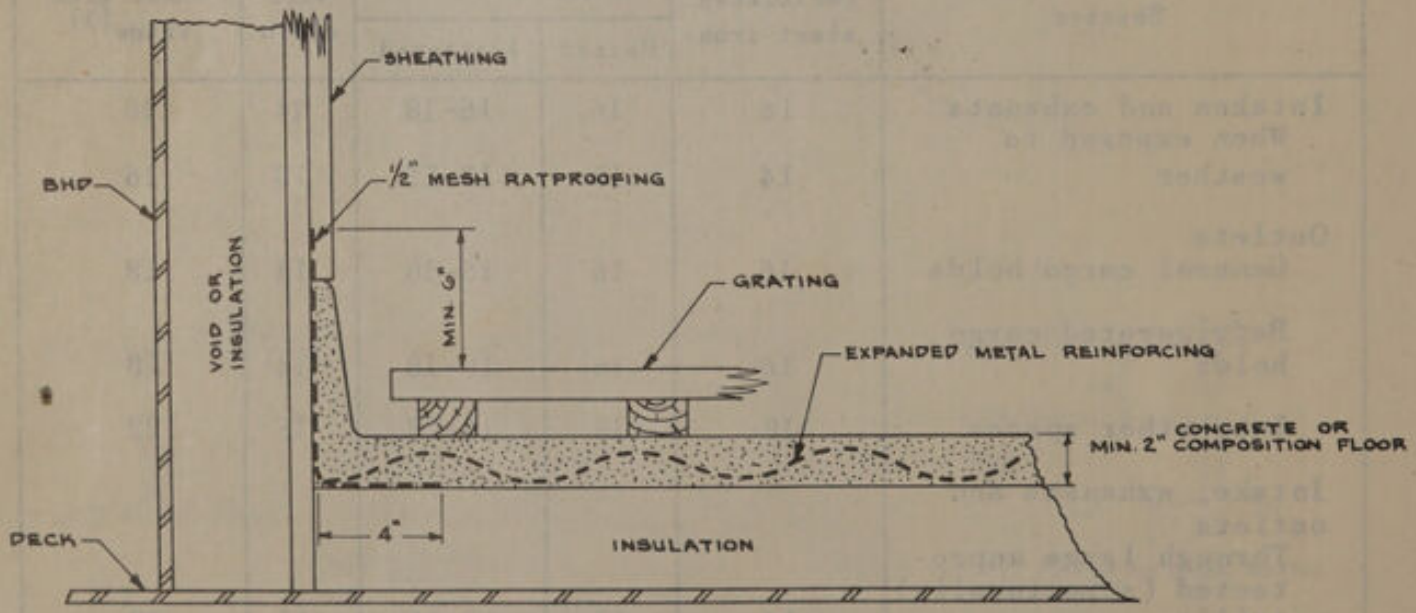
pockets inaccessible for ready inspection. Any spaces so formed should be completely closed with sheet iron of 18 or 22 gauge according to the need.

21.4 INSULATION

21.41 Deck. Deck insulation of cork or other material thicker than 3/4" should be sheathed in a manner that will prevent the entrance of rats into the insulation. When the substantiality of the flooring is not such as to obviate the need of ratproofing, the insulation should be completely covered with 1/2-inch mesh material (18-gauge expanded metal, 18 to 20-gauge flattened expanded metal, or 16-gauge steel wire cloth in refrigerated spaces and the next lighter even gauge in public places). When ratproofing mesh material is essential, it is satisfactory to place it just above the insulation or within or between layers of the covering material.

Flooring of concrete or of hard composition material over voids or insulation thicker than 3/4" should be not less than 2" thick and should be reinforced with bars in both directions or with large mesh expanded metal. When a layer of concrete and a layer of composition material are laid, each should be at least 1-1/2" thick and one of the layers, preferably the upper, should be reinforced.

In all cases, the cove at the boundaries and the curb or sheathing above the flooring and grating should be ratproofed as recommended in Sec. 20.421, p. 42.



FLOORING OVER INSULATION

FIG. 45

21.42 Bulkhead, Deckhead, Shipside, and Engine and Boiler Room Casing.

21.421 *Ratproofing of insulation.* Rats have been observed to burrow through, and harbor and raise young in all existing types of insulation commonly used on surfaces of vessels. Insulation 1" or less in thickness which is placed in contact with the surface being insulated and which is not sheathed need not be ratproofed. All insulation thicker than 1"

should be ratproofed unless the insulation is within a ratproof void space. Insulation, regardless of its thickness, which is placed so as to create a void space behind it should be ratproofed or covered by ratproof sheathing if the combined void and insulation thickness is greater than 1". Non-ratproof sheathing over insulation thicker than 3/4" should be ratproofed.

It is preferable from a ratproofing viewpoint to completely cover insulation or its sheathing with ratproof material. However, flashing of sheathing is satisfactory if the sheathing and flashing are in accordance with the recommendations in Sec. 20.32, p. 38.

Expanded metal (1/2-inch mesh) is satisfactory as sheathing of insulation in spaces other than galleys and pantries. The insulation should be placed directly upon the web and flanges of structural members and not upon expanded metal placed across the bosom of the channel, angle, or beam. If the insulation is thicker than 1" or the bosom of the structural member is completely filled with insulation, the surface of the insulation should be covered with expanded metal. This expanded metal should extend to within 1/4" of structural plate or join other ratproofing material. If the expanded metal is to be covered with a plaster coat, the plaster should not be applied until the expanded metal has been inspected. (See Fig. 46)

A ratproof bulkhead or partition, flashing, or ratproofing material which is placed at right angles to the surface of unsheathed insulation 1" thick or less should extend through the insulation to within 1/4" or less of the metal backing. When metal or wood furniture is placed flush against 1-inch thick insulation, a strip of 22-gauge sheet metal should be placed entirely around the furniture and extended through the insulation to within 1/4" of the metal behind the insulation. (See Fig. 46, Note 1)

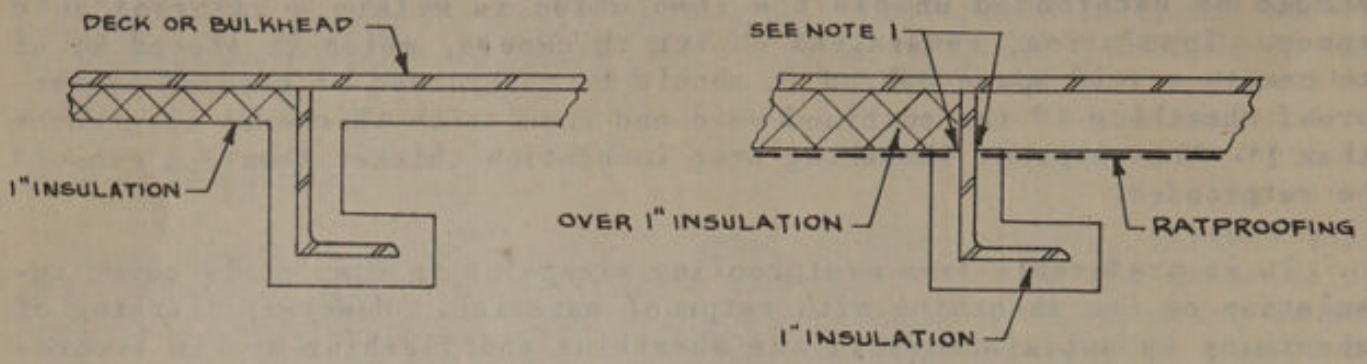
Care should be exercised to close or ratproof all snipe and construction holes in bulkheads, beams, or other structural members which form a boundary (covers the edge) of insulation thicker than 1". (See Fig. 46, Note 2)

21.422 *General cargo holds.* Insulation in general cargo spaces should be ratproofed by placing ratproofing material directly on the insulation. If special protection of the ratproofing material is provided, the insulation can be covered satisfactorily with at least 16-gauge sheet iron, 16-gauge expanded metal, 16 to 18-gauge flattened expanded metal, or 14-gauge steel wire cloth. These ratproofing materials, if not completely sheathed, should be protected against damage from cargo by:

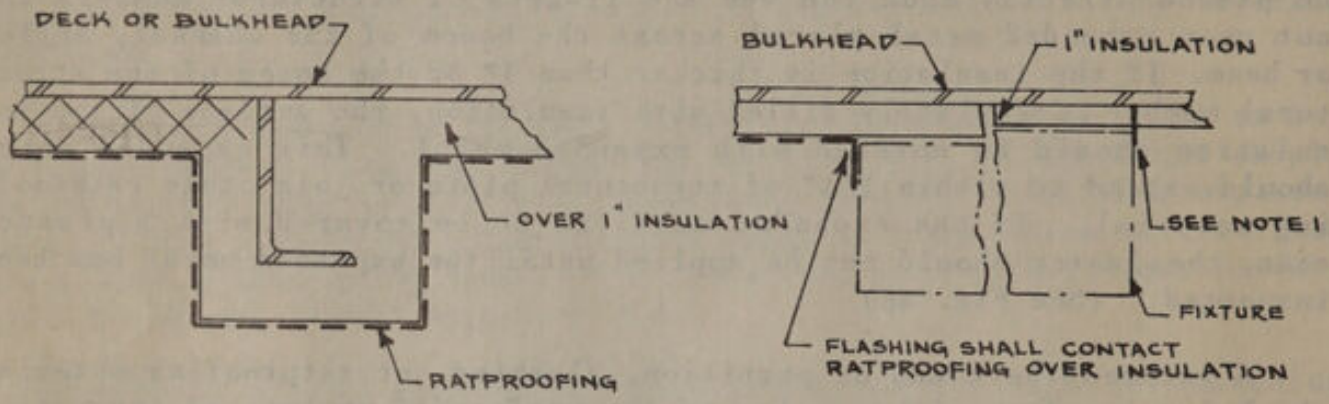
(1) Battens as recommended in Sec. 21.211, p. 65.

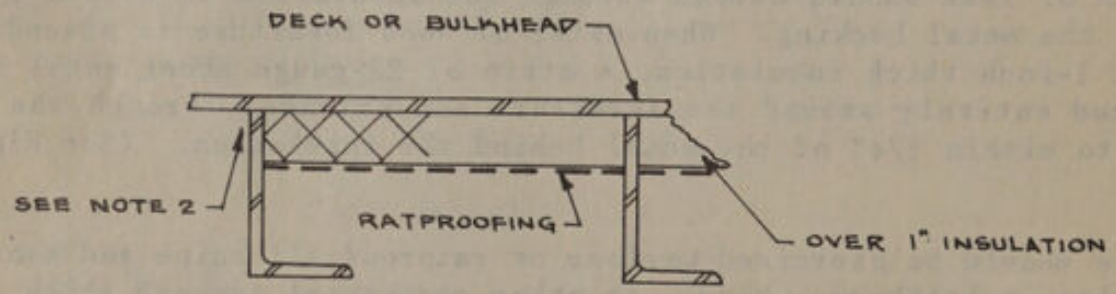
(2) Sheathing or screen bulkhead as recommended in Secs. 21.131, 21.133, and 21.134, p. 51.

21.423 *Refrigerated cargo spaces.* Insulation on exposed surfaces within refrigerated cargo spaces should be ratproofed by complete coverage with sheet iron or flashed sheathing. Expanded metal of 1/2-inch mesh



RATROOFING NOT REQUIRED





NOTE 1: RATPROOFING REQUIRED WITHIN 1/4" OF WEB OR BULKHEAD
NOTE 2: CLOSE OR RATPROOF ALL SNIPE HOLES.

RATPROOFING OF UNSHEATHED INSULATION

FIG. 46

on exposed surfaces is suitable if adequately supported and protected by a plaster coat and battens. Insulation within air ducts of refrigerated cargo spaces can be protected by coverage with expanded metal or metal lath properly surfaced, or by flashed sheathing. Where batten protection of the ratproofing on an exposed surface is needed, it should be as recommended in Sec. 21.211, p. 65, except that vertical battens 2" by 2" or larger may be placed directly on solid sheathing. Further reference is made to the discussion of:

(1) Detailed recommendations for this type space in Sec. 21.135, p. 53.

(2) Metal lath in Sec. 21.122, p. 50.

21.424 *Refrigerating machinery space.* Insulation on machinery, pipe, pipe manifolds, valve cabinets, and the like within refrigerating machinery spaces can be exempted from ratproofing if the boundary bulkheads and deckhead, the sheathing over voids or insulation therein, and the penetrations of bulkheads and the deckhead are ratproofed and the door is conspicuously labeled "KEEP CLOSED".

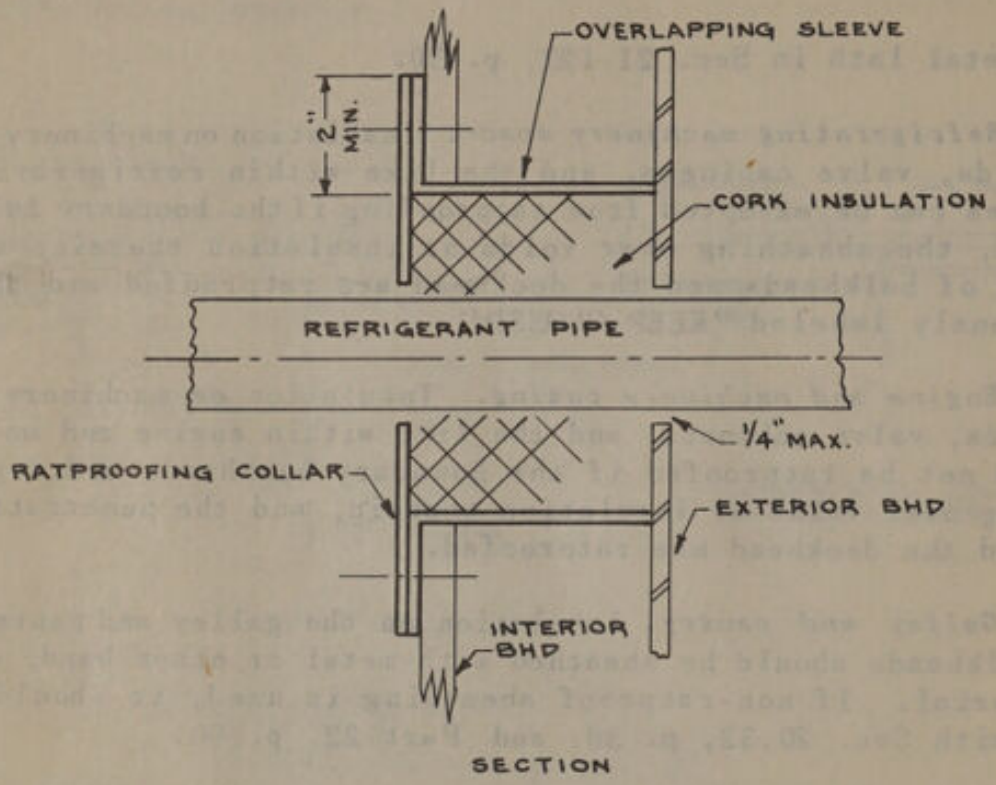
21.425 *Engine and machinery casing.* Insulation on machinery, pipe, pipe manifolds, valve cabinets, and the like within engine and machinery casings need not be ratproofed if the boundary bulkheads and deckhead, the sheathing over voids or insulation therein, and the penetrations of bulkheads and the deckhead are ratproofed.

21.426 *Galley and pantry.* Insulation on the galley and pantry deckheads and bulkheads should be sheathed with metal or other hard, smooth-surface material. If non-ratproof sheathing is used, it should be in accordance with Sec. 20.32, p. 38, and Part 22, p. 90.

Cloth-covered, fibrous insulation 1" or less in thickness and plaster-covered expanded metal or metal lath having a combined thickness greater than 1" are not satisfactory in galleys and pantries; neither are sealing compounds used to close openings around fixtures penetrating deckhead insulation. This is due to the danger of fibrous material falling into food through breaks in the surfacing material.

21.427 *Sleeves around insulation on pipe which passes through double bulkheads and deckheads of refrigerated spaces.* It is preferable that service lines to refrigerated spaces pass through the double bulkhead or deckhead within stuffing tubes. If stuffing tubes are not provided, the service lines should be protected so as to prevent the entrance of rats into the insulation around the pipe or the insulation within the double deckhead or bulkhead. The cork or other insulation around that part of a pipe or tube which is within a deckhead or between double bulkheads should be enclosed in a sleeve of at least 22-gauge sheet iron or equivalent. The sleeve should extend the full length of the pipe insulation and should terminate at the outer surface of the bulkhead or deckhead in which the hole has been cut for the insertion of the pipe insulation. The sleeve should be securely fastened.

In addition to the sleeve, sheet iron collars as described in Sec. 20.424, p. 44, should be placed around the penetrating pipe at the outer surfaces of the bulkheads if they are of non-ratproof material. These collars should be of sufficient diameter to extend from the pipe, or within 1/4" of it, to at least 2" beyond the edge of the opening in the bulkhead. If the bulkhead which is penetrated by the pipe insulation is metal, a suitable removable collar should be applied. If the external bulkhead which is penetrated by the refrigerant pipe or tube is metal, the annular space in the bulkhead around the pipe or tube should not be wider than 1/4".



SLEEVE AROUND INSULATION WITHIN DOUBLE BULKHEADS

FIG. 47

21.43 Pipes. Pipes, other than those routinely used for steam, should preferably be insulated and wrapped separately and spaced so as to allow at least 2" between wrappings, if practicable. Where two or more pipes are insulated and wrapped together or insulated separately and enclosed in one wrapper, the group should be ratproofed regardless of the thickness of the insulation. Where insulation around a pipe fitting is such as to create a void space between the insulation and the fitting, such insulated fitting should be ratproofed and the ratproof material should be brought into contact with any non-ratproof branch or the closure effected by use of a collar.

Pipe and pipe fittings which carry brine or other refrigerants in spaces other than the refrigerating machinery space and which are covered with cork or hair felt insulation thicker than 2" should be judged on the basis of arrangement and location. If massed together, arranged in wide layers near the deckhead, located in a secluded place, or placed in relation to

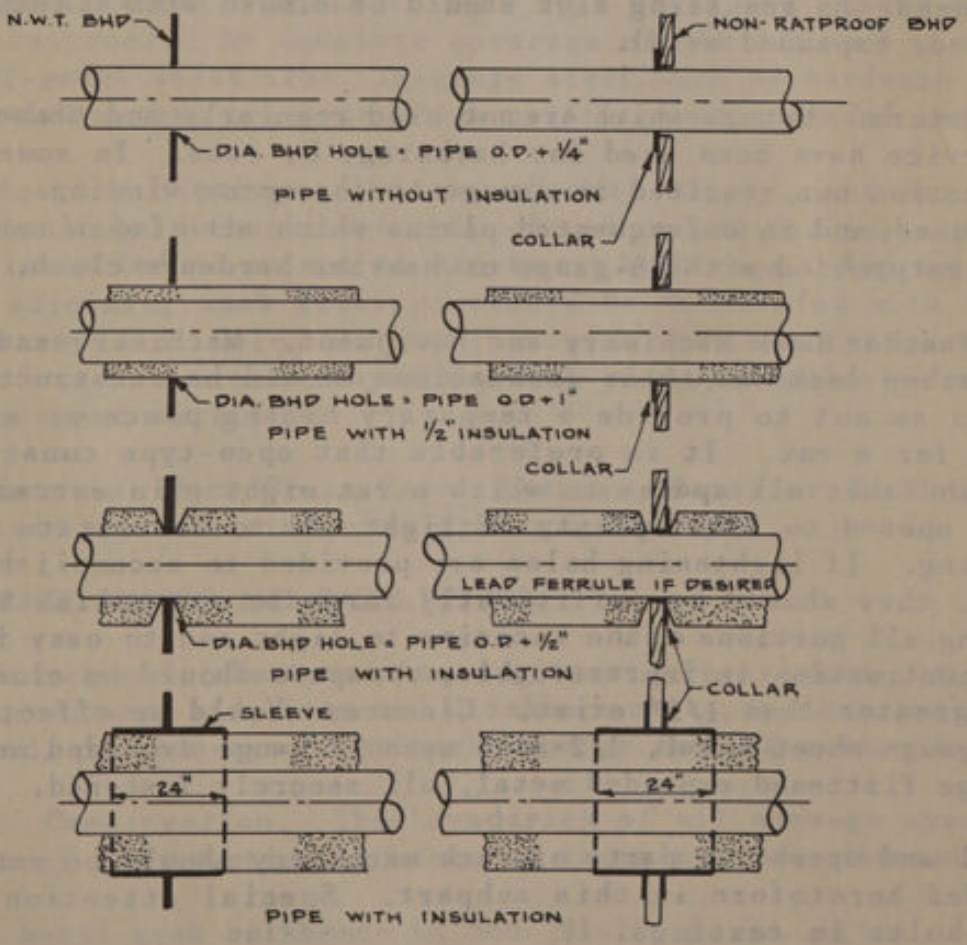
structural members so as to create a situation favorable to rat infestation of the insulation or voids, ratproofing should be applied.

When ratproofing is essential, it should consist of sheathing the pipe or pipes with at least 24-gauge sheet iron or 18 to 20-gauge, 1/2-inch mesh hardware cloth.

The wire cloth should be applied beneath the wrapping and may be embedded in the insulation not more than 1" from its outer surface.

All penetrations of non-ratproof material by insulated pipe should be collared in accordance with Sec. 20.424, p. 44, and such penetrations should comply with the following special recommendations:

> If the insulation is not thicker than 1/2", it may extend without break through bulkheads. Bulkheads of ratproof material and the collars at bulkheads of non-ratproof material may terminate at the surface of the insulation. If the insulation is thicker than 1/2", bulkheads of ratproof material and the collars at bulkheads of non-ratproof material should extend to within 1/4" of the pipe surface. If the partition is of wood, a sheet iron collar should be applied. Where the insulation is thicker than 1/2" and it is necessary to run the insulation without break through a bulkhead, there should be fitted a 22-gauge sheet iron sleeve 24" long over the insulation, centered at the bulkhead.



PIPE PENETRATION OF BULKHEADS

FIG. 48

21.44 Ventilating, Air-conditioning, and Heating Ducts. Ventilating, air-conditioning, and heating duct insulation thicker than indicated immediately below should be ratproofed unless the duct is located within double bulkheads or deckheads which are ratproof. If the insulation is sheathed with solid non-ratproof material and is thicker than 3/4", the gnawing edges of the sheathing should be flashed according to Sec. 20.42, p. 39 . If the insulation is exposed, unsheathed, and thicker than 1", it should be ratproofed by being completely covered with 24-gauge sheet metal, 1/2-inch mesh 18 to 20-gauge steel wire or hardware cloth, 20-gauge expanded metal, 20 to 22-gauge flattened expanded metal, or 3.4 pounds per square yard galvanized or painted metal lath with an acceptable hard plaster coating. The ratproofing material should be placed over the insulation and beneath any covering other than solid sheathing.

In cargo spaces the ratproofing material should be at least the next heavier even gauge.

21.5 MACHINERY AND DECK EQUIPMENT

21.51 Installation. Machinery and equipment located on the weather deck or in spaces other than the engine and boiler rooms should be installed so as not to create a rat harborage within the base or the foundation. If the foundation is continuous (box-like) and the space within is not visible from above, the space between the base of the machinery or deck equipment and its foundation should not exceed 1/2". If larger shims are used, the resulting slot should be closed with at least 18-gauge sheet iron or expanded metal.

21.52 Motors. Motors which are not used regularly and those of vessels out of service have been used for harborage by rats. In some cases the rat infestation has resulted in damage to the motor winding. Motors not regularly used, and in unfrequented places which are of open construction, should be ratproofed with 18-gauge or heavier hardware cloth.

21.53 Weather Deck Machinery and Equipment. Machinery and equipment on the weather deck and their foundations should be constructed or ratproofed so as not to provide a temporary hiding place or a permanent harborage for a rat. It is preferable that open-type construction be employed and that all spaces to which a rat might gain entrance be sufficiently opened to admit plenty of light and to facilitate inspection and cleaning. If lightening holes are provided to accomplish open construction, they should be sufficiently large to accomplish the purpose of exposing all portions of the interior to light and to easy inspection. If open construction is impracticable, the space should be closed so that no holes greater than 1/2" exist. Closures should be effected with at least 16-gauge sheet metal, 1/2-inch mesh 13-gauge expanded metal, or 13 to 15-gauge flattened expanded metal, all securely fastened.

Internal and operating parts of deck machinery should be ratproofed as recommended heretofore in this subpart. Special attention should be given to holes in castings.

Drums of deck machinery should be of open construction and the interior should be completely visible, or the opening into the drum should be closed with ratproofing material.

Hollow axles of internal diameter greater than 1" should be covered with sheet metal or plugged.

Casings of deck machinery, if not of the open type, should be constructed and fitted together to preclude any holes larger than 1/2". Special attention should be given to openings for the passage of operating levers and shafts and to the closeness of the fit between the casing and the moving parts or guards.

When the space within the foundation or beneath a solid base or cover plate can be viewed from opposite sides, the height of the space should be adequate to permit easy inspection. If less than 6" and rat harborage is created, the space should be closed.

21.54 Rope and Cable Reels. Rope and cable reels should be of metal construction and should be installed on open-type metal supports. The center core should be of solid or perforated metal. Hollow axles having a diameter greater than 1" should be plugged.

Reels on which rope or cable is usually shipped and received are of wood. Frequently such reels have holes in the sides of the core large enough to admit a rat. Reels of this type which are stowed on the ship should be ratproofed by complete coverage of the side of the core with at least 22-gauge sheet iron, 16-gauge steel wire or hardware cloth, 18-gauge expanded metal, or 18 to 20-gauge flattened expanded metal.

21.55 Mooring Fittings. Bitts, chocks, cleats, and other mooring fittings should be either completely closed or open for inspection. They should be installed so as not to create rat harborage. Any rat harborage within or adjoining such fittings should be ratproofed with heavy ratproofing material. Holes in castings greater than 1/2", such as are sometimes found in cross-shaped mooring bitts, should be sealed with metal or plugged with wood.

21.56 Interior Deck Drain Cover Plates. Interior deck drain cover plates should not contain holes greater than 1/2".

21.6 STOWAGE SPACES AND FACILITIES

21.61 Storerooms. Boatswain's, engineer's, provision, mail and baggage stowage spaces, and linen and oilskin lockers, if improperly designed and equipped, provide excellent harborage or feeding places for rats.

21.611 *Construction.* The boundaries of all stowage spaces should be of ratproof construction. Reference is made to the discussion of:

(1) Metal mesh bulkheads in Sec. 21.12, p. 50.

(2) Non-ratproof bulkheads in Sec. 21.13, p. 51.

Raised or double flooring is not recommended for installation in storerooms. If installed, flooring, deck grating, and raised slatted platforms should be constructed as recommended in Sec. 21.15, p. 61.

Stowage facilities should be such as to avoid the creation of rat harborage and to facilitate cleaning.

21.612 *Shelves or platforms* should be installed with relation to structural members so as not to create pockets or hidden places. When such places are unavoidable, they should be enclosed with sheet iron of at least 22 gauge. Shelves and platforms used for the storage of foods should be constructed of bars, slotted or perforated metal, or expanded metal. If these shelves are made of solid plate, the railing at the edge should be raised 1/2" or more above the surface of the shelf. If the rail is made by bending the outer portion of the shelf plate upward, a slot 1/2" by 6" should be cut or burned every 18" or 24" in the angle of the bend, or one or more 1-1/2-inch or larger holes cut in the shelf near the front, to facilitate brushing and washing.

The lowest shelf or raised platform should be at such a height above the deck as is necessary to facilitate inspection and cleaning and in no case less than that recommended in Sec. 21.71, p. 86. Where a tier of shelves is installed and the back of it is covered with mesh material, the arrangement should be such that debris which passes through the wire will fall to the deck where it can be removed. There should be access to the bulkhead behind the shelves for cleaning and painting.

21.613 *Bins* should not be placed against structural members in such a manner as to create rat harborage. They should be placed either flush against or well away from bulkheads and, if not flush with the deck, the space beneath them should be ratproofed as set forth in Sec. 21.71, p. 86. All bins should have tight-fitting covers, preferably of the self-closing type. Cans used for stowage should be galvanized iron trash cans with tight-fitting covers or equal.

21.62 Special Stowage Facilities

21.621 *CO_2 and like gas containers*, when grouped together, should be installed in a special ratproof space, or enclosed within 1/2-inch wire mesh bulkheads.

21.622 *Large spare parts*, such as propellers, propeller blades, shaft sleeves, chain blocks, tension springs for steering machinery, and winch drums should be stowed in a ratproof manner. It is preferable from a ratproofing standpoint that they not be encased. If not stowed in a ratproof stowage compartment, all openings in these spare parts which would provide harborage for a rat should be ratproofed. The spare part should be placed or secured in such a manner as not to create rat harborage. When necessary, a spare part should be enclosed in a ratproof casing. If the casing is of wood, the material should be of a thickness suitable to the space in which stored and should be flashed as recommended in Sec. 21.633, p. 86.

21.623 *Stowage space of ratproof construction for spare parts boxes* should be provided where it is practical to keep the boxes therein and where it is desirable to obviate the necessity of ratproofing each spare parts box. The space should be used for this particular purpose except that it can be used jointly for the stowage of boiler tube, pipe, and fire brick.

21.63 Lockers and Boxes

21.631 *General.* All lockers and boxes should preferably be of metal but they may be of wood or other non-ratproof material if properly lined or flashed. All exposed cut edges of wire cloth or expanded metal should be bound or flashed with at least 22-gauge sheet iron. Wooden lockers or boxes should be flashed in accordance with the flashing practice in the spaces in which located. (See Sec. 21.135, p. 53)

Installation of lockers or boxes should be in such a manner as not to form rat harborages at the deck, deckhead, or with adjacent structures. If not placed flush with the deck, the locker or box should be elevated at least 6" (regardless of shear and camber), or the space closed with sheet iron of at least 22 gauge, or 18 gauge when subject to damage.

POTATO LOCKER MADE ENTIRELY OF METAL WITH NO INTERIOR GRATING

FIG. 49

21.632 *Lockers* which approach the deckhead should be extended to the deckhead without forming an enclosed space at the top of the locker.

Lockers of wood or metal located in living quarters need not be ratproofed but it will be necessary to ratproof the boundaries of a locker

in way of a void space created by fixed false bottoms. If the covering over the void is portable, no ratproofing will be necessary regardless of the locker location.

Built-in lockers should be constructed so as not to create openings into double bulkheads or deckheads. In living quarters, only the sides and top of the locker which are part of the double bulkhead or deckhead need be ratproofed.

21.633 *Boxes*

(1) Weather deck boxes of solid wood should be ratproofed over the entire bottom and the lowest 1-1/2" of the sides. If constructed of tongue-and-groove or shiplap, only the lower edges need be flashed for 1-1/2" on each side of the gnawing edge with at least 22-gauge sheet metal. Slotted, wooden deck boxes should be completely lined except that the top need not be covered if it is of solid construction. Twenty-two gauge sheet metal or 18-gauge wire mesh will be satisfactory if the ratproofing material is placed on the inside, with the next heavier even gauge material being used when exposed to the weather.

(2) Storeroom boxes, either solid or slotted, should be completely lined, including the top. If the solid wooden boxes are constructed of tongue-and-groove or shiplap, the edges should be flashed for 1-1/2" on each side of the gnawing edge with at least 22-gauge sheet metal.

21.7 FURNITURE AND FIXTURES

21.71 General. Furniture which may provide, or which contains potential rat harborages should preferably be of metal. When wooden furniture is installed, it should be carefully ratproofed. All furniture should be constructed ratproof insofar as practicable. It should be installed flush with the deck or elevated at least 6" above the deck; or the space beneath it should be enclosed with sheet iron.

Ratproofing of the base of wooden furniture will not be necessary if complete visibility of the interior of the base can be effected by the removal of drawers or loose false bottoms. Finger holes should not be larger than 1/2". Wherever the entire interior of the base is not visible because of a complete or partial fixed bottom, or because a drawer cannot be removed due to interference or other reason, the entire boundary should be ratproofed up to a point at least 4" above the deck by the external application of 22-gauge sheet iron, or the internal application of sheet iron, expanded metal, or hardware cloth.

Partially enclosed spaces behind attached furniture should be closed with 22-gauge or heavier sheet iron if the deck beneath the space cannot be swept with a regular broom or reached at arm's length for cleaning with a rag.

Gnawing edges of all types of bulkheads behind furniture should be flashed in the same manner as other parts of the space in which the furniture is located, except that plain butt joints between boards or wall panels of non-ratproof material should be flashed with at least 22-gauge sheet iron.

21.72 Wardrobes. Wardrobes should preferably be made of metal. Wooden wardrobes should be ratproofed as recommended in Sec. 21.71, p. 86, except when they are located in living quarters. If a side of the wardrobe is part of a double partition, that surface should be ratproofed. Shoe racks located at the base of wardrobes should meet the requirements in Sec. 21.71, p. 86.

21.73 Galley Fixtures. Fixtures in galleys and their arrangement should be such as to afford neither harborage for rats nor places for the accumulation of food. All galley fixtures should be of metal and all seams therein should be fitted closely and preferably soldered. All snipe, construction, or other holes leading into metal fixtures should be closed or reduced to 1/2". It is preferable that galley fixtures be elevated on legs.

The galley range should have a ratproof foundation. If the perimeter of the foundation and the bottom of the range do not effectively close the space, it should be covered with 18-gauge or heavier sheet iron or filled with light-weight concrete. If there is any space between the range and the bulkhead which is inaccessible, it should be enclosed with at least 18-gauge sheet iron. The hood over the galley range should be ratproofed if necessary, as recommended in Sec. 21.344, p. 75.

The bottom of other galley fixtures and the lowest shelf of a tier should be ratproofed as recommended in Sec. 21.71, p. 86.

Enclosed places beneath, back of, or beside fixtures should be avoided, enclosed with metal or the gauge recommended for ranges, or filled with light-weight concrete. Fixtures should be installed flush against or well away from bulkheads. All false bottoms or bottom shelves placed on the fixture foundation should be portable. Care should be exercised to avoid or to close openings around penetrating pipe, rods, and the like to 1/2" or less.

Plates over gutters in the deck should be portable. From a sanitation standpoint, it is preferable that they be placed across walkways only. If continuous, they should be of expanded metal.

For recommendation concerning service windows in galleys see Sec. 21.121, p. 50 .

The splash plates at the back of sinks and dressers should extend, and be attached to the bulkhead against which they are placed. If stiffeners interfere, suitable sheet metal should be used to extend the splash plate on a steep, upward angle to the bulkhead. It should be fitted closely and welded or soldered to the bulkhead and stiffeners. A portable plate should be placed around pipes where needed to facilitate repair.

21.74 Electric Refrigerators, Drinking Fountains, and Drinking Water Coolers. The machinery compartment should be solidly enclosed, screened with 16-gauge wire cloth or 18-gauge expanded metal, or equipped with 1/2-inch louvers. Where holes are cut in the mesh for the passage of water pipes or electric cables, metal collars should be provided. Front doors of machinery compartments should be tight-fitting on all sides.

21.8 MISCELLANEOUS

21.81 Lifeboats. Lifeboats are important in rat infestation control because they afford temporary harborages for rats. Ratproofing of the various structural features is in most cases difficult and might conflict with the safety requirements of other agencies. To discourage rats from gaining access to lifeboats care should be exercised to fit and secure canvas covers so that all openings are reduced to a minimum.

21.82 Fire Stations. Fire stations should be constructed in such a manner as to prevent rat harborage and facilitate inspection. This is important in the interest of rodent control as well as of safety because rats will nest even behind orderly piles of hose.

It is preferred that the fire hose be stowed in open slat-type racks which are located so that they do not create void spaces in which rats may hide and nest. This type is entirely open when installed on the rail. When the rack is installed on a bulkhead, the construction should be such as to press the hose snugly against the bulkhead.

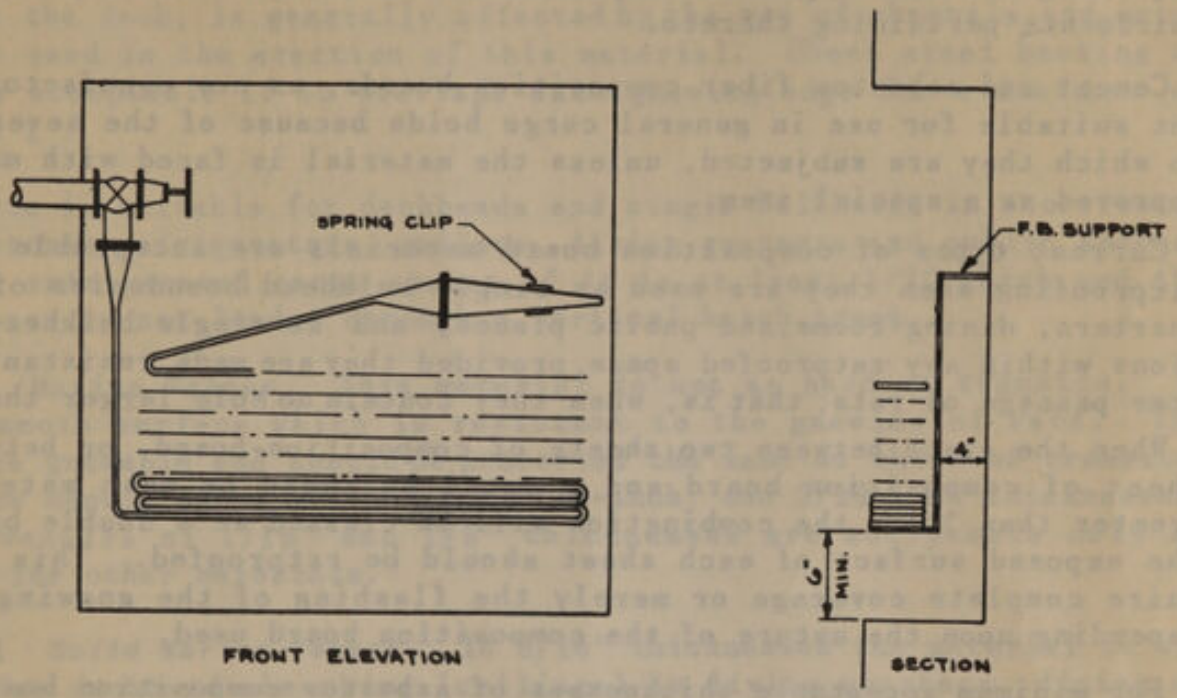
Deck hose boxes should be ratproofed as recommended in Sec. 21.633, p. 86, and means should be provided to ratproof the opening in the box through which the service line passes. This should be accomplished by extending the metal service line through a closely fitted hole in the box. The control valve may be inside or outside the box.

The swing-type of rack with cross pins from which the hose is suspended is satisfactory if the height of the box or recess is sufficient to permit hanging the hose so that the lower ends of the loops are at least 6" above the bottom of the box or recess. (See Fig. 50)

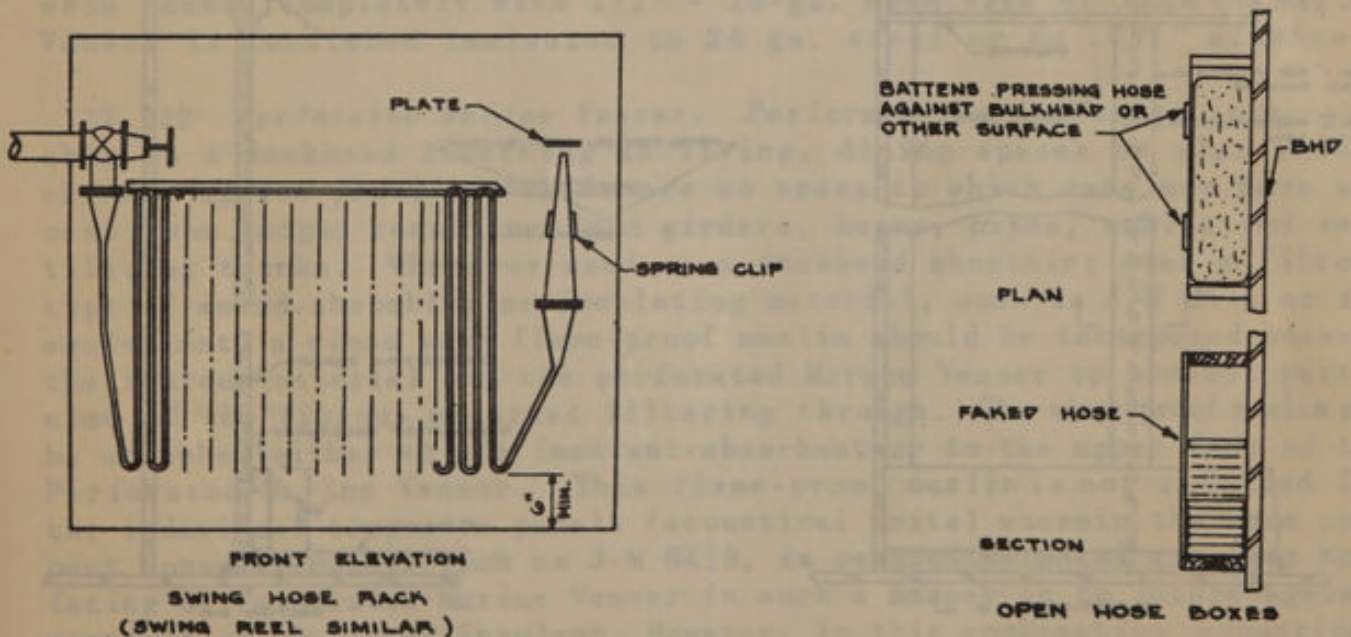
Fire stations within the interior of a vessel are often recessed into the bulkhead, without doors on the recess, and are used by placing the hose in horizontal layers beginning at the bottom of the cabinet within the recess. If battens can be provided which press the stowed hose snugly against the bulkhead, this type of stowage will be satisfactory. Otherwise, it is recommended that these fire stations be about 4" deeper than the width of the flattened hose and that the hose be stowed on a shelf of the same width as the hose. The shelf should be at the front of the cabinet and 6" above the bottom. A wire mesh backing for the stowed hose should be placed at the back edge of the shelf. The space between the hose rack and the top of the cabinet should be sufficient to permit the inspection of the space back of the rack. A clearance of 10" is desirable.

If the fire station consists of a cabinet, it should be ratproof and equipped with a well-fitted, easily-opened door or lid. The door or lid

can be made of expanded metal if visibility is desired. As the hose must remain attached to the hydrant, a metal pipe extension should enter the cabinet so that the penetration can be closely fitted or collared. The control valve may be located within the cabinet or outside it.



OPEN FRONT HOSE CABINET



SWING HOSE RACK (SWING REEL SIMILAR)

OPEN HOSE BOXES

FIRE STATIONS

FIG. 50

22. RATPROOFING; ASBESTOS COMPOSITION BOARD (1)

22.1 GENERAL

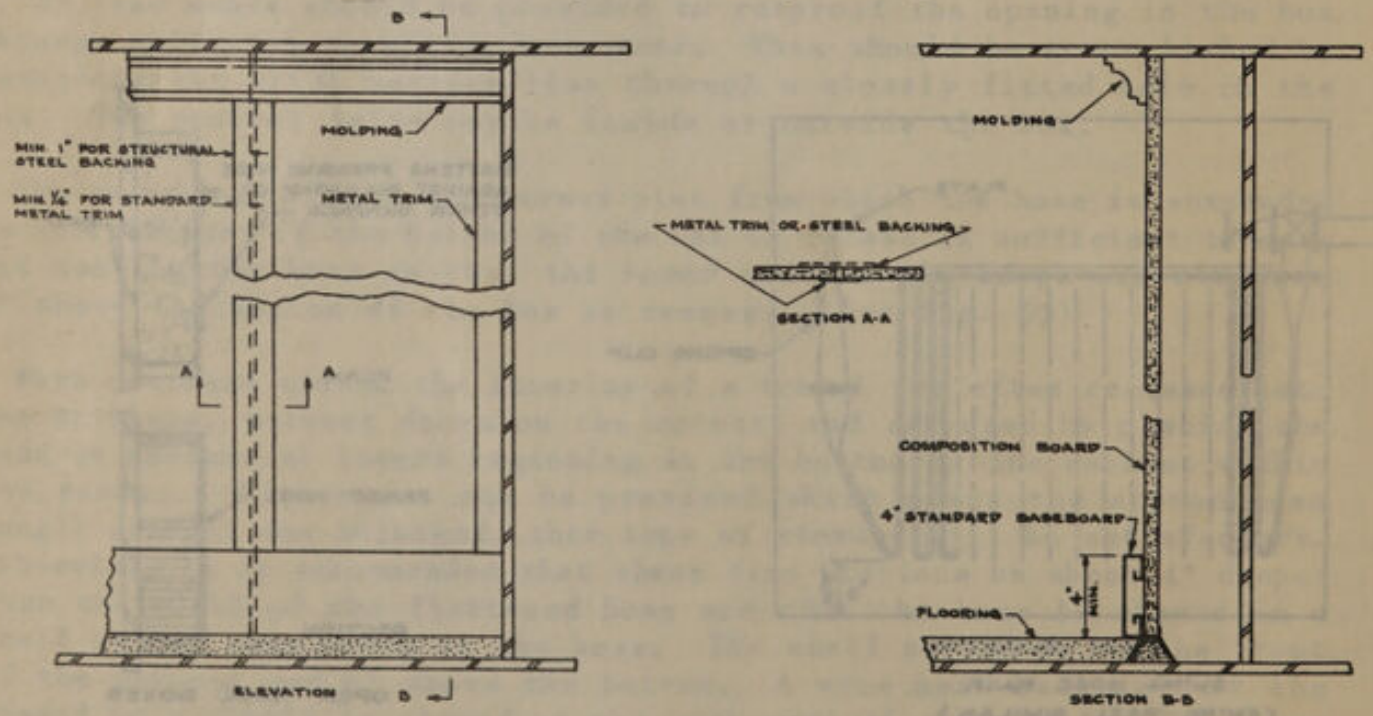
Composition board of suitable hardness and smoothness will be satisfactory in certain spaces. The following summary sets forth criteria regarding certain types of composition board, and the ratproofing requirements pertaining thereto.

Cement and asbestos fiber composition boards, as now manufactured, are not suitable for use in general cargo holds because of the severe blows to which they are subjected, unless the material is faced with metal and approved as a special item.

Current types of composition board materials are acceptable without ratproofing when they are used as single bulkhead boundaries of living quarters, dining rooms, and public places, and as single bulkhead partitions within any ratproofed space provided they are made resistant to the free passage of rats; that is, when they contain no hole larger than 1/2".

When the space between two sheets of composition-board, or between one sheet of composition board and a metal bulkhead or mesh material is greater than 3/4", the combination will be classed as a double bulkhead. The exposed surface of each sheet should be ratproofed. This may require complete coverage or merely the flashing of the gnawing edges, depending upon the nature of the composition board used.

For minimum acceptable thicknesses of asbestos composition boards, see Table III. Reference should also be made to Sec. 20.31, p. 37, for the tempers and alloys of aluminum acceptable for surfacing composition boards, if the aluminum is to provide ratproofing features.



COMPOSITION BOARD JOINER BULKHEAD

FIG. 51

(1) The trade names of only Johns-Manville products are used herein because of the lack of information about composition boards manufactured by others. Other manufacturers' products possessing similar properties and characteristics will be considered for these purposes on a comparable basis. The Public Health Service does not approve or endorse proprietary products or equipment

22.2 CONSTRUCTION DETAILS

22.21 Transite. This material is very hard and has a smooth surface. It is resistant to indentation and cracking, and the surface is resistant to the gnawing of rats. However, the edges are gnawable necessitating the edges being covered with rat-resistant metal for a distance of at least 1/4". Satisfactory coverage of the seams and edges, including those at the deck, is generally affected by the use of channels and metal moldings used in the erection of this material. Sheet steel backing of seams is acceptable if it overlaps each gnawing edge for a distance of at least 1".

Transite is suitable for deckheads and single bulkheads in storerooms, ship's stores refrigerators, galleys, living quarters and public spaces; also for refrigerated cargo spaces if it is at least 1/2" thick and the cargo space is not loaded through a vertical hatch trunk.

22.22 Marine Veneer. This material is not as hard as transite. It has a smooth surface which is resistant to the gnawing of rats. The edges are gnawable and should be protected the same as those of transite. It is now manufactured in 1/16-inch, 1/8-inch, and 3/16-inch thicknesses. Marine veneers of 1/16" and 1/8" thicknesses are acceptable only as veneers for other materials.

22.221 *Solid Marine Veneer.* In 3/16" thicknesses the material is approved for deckhead sheathing (ceilings) in living quarters, dining or public spaces. The material may be used as a curved lining in the above public spaces if it is supported on furring spaced 24" or less and the surface is protected from the deck up to chair height with ratproofing material or by furniture and fixtures placed against it. If the material is used as a straight lining in similar spaces it is acceptable only when backed completely with 1/2" - 18-ga. mesh wire or when the Marine Veneer is furnished laminated to 24 ga. steel or to .032" aluminum.

22.222 *Perforated Marine Veneer.* Perforated Marine Veneer is acceptable as a deckhead sheathing in living, dining spaces or also in machinery spaces providing there are no areas to which rats may have access from ledges resulting from girders, beams, pipes, cables and ventilating trunks. Whenever used as a deckhead sheathing over a fibrous type of sound-absorbing or insulating material, such as J-M BX-4 or its equivalent, a close mesh flame-proof muslin should be interposed between the fibrous material and the perforated Marine Veneer to prevent particles of the fibrous material filtering through. The flame-proof muslin may be attached either to the insulant-absorbant or to the upper face of the Perforated Marine Veneer. This flame-proof muslin is not required for the individual composite panels (acoustical units) wherein the more compact sound-insulant, such as J-M BX18, is secured by metal grommets to a facing of Perforated Marine Veneer in such a manner as to insure against movement of the sound-insulant. However, in this combination acoustical unit (panel) the BX18 must not extend beyond 1/4" scant of the edge of the Perforated Marine Veneer facing, unless the joint is metal-flashed. Perforated Marine Veneer is approved as a vertical lining of steel bulkheads or the shell if backed continuously with at least 1/2" 18 ga. wire mesh, but such mesh backing is not required in fan, radio or gyro rooms if the Perforated Marine Veneer is terminated at least 3' above the deck. Perforated Marine Veneer should not be installed in food handling or food storage spaces.

22.223 *Steel-laminated marine veneer:* J-M REEFERITE type MS (one sheet of 3/16" Marine Veneer laminated to 24 ga. (.0289") galvaneal steel), and type MSM (two 1/8" Marine Veneer sheets laminated to an interposed sheet of 24 ga. galvaneal steel). Current test data shows that either type has a puncture resistance in excess of 16 ga. sheet steel. Hence these materials are acceptable for use as bulkhead, lining and deckhead sheathing of refrigerated cargo holds, refrigerated ships' stores, storerooms, galleys, living quarters and public spaces. Additional ratproofing of the edges will not be required.

22.224 *Aluminum-laminated marine veneer:* J-M REEFERITE type MA (one sheet of 3/16" Marine Veneer laminated to a sheet of .032" aluminum - 52S-½ H) and type MAM (two 1/8" sheets of Marine Veneer laminated to an interposed sheet of the same aluminum). Current test data shows either type has a puncture resistance equal to 16 ga. steel if the sheathing is backed by a solid material such as cork insulation. If either type is installed in that way, it will be acceptable for refrigerated cargo spaces. When used in refrigerated ships' stores, storerooms, galleys, living quarters and public spaces, the solid backing need not be provided, nor need it be required for type MAM if as installed in refrigerated cargo spaces, it consists of two 3/16" sheets of Marine Veneer laminated to an interposed aluminum sheet of .032" - 52S-½ H. As aluminum is gnawable, the gnawing edges should be protected as specified for Transite (See Sec. 22.21, p. 91).

22.23 Marine Sheathing and Marinite. These materials are not as hard as Transite and Marine Veneer. When they are furnished with the standard base for painting or supplemental facings, they will be acceptable for use in living quarters, dining rooms and public spaces. The base should be protected with a standard metal baseboard in front at least 4" high; or 6" of sheet iron or of 1/2-inch 18-guage wire mesh immediately back of the composition board. Since Marinite is available in various densities (38#, 28#, and 23#), panels of the less dense material should be used only if faced with metal or veneer and used in areas not subject to damaging blows and in spaces continually frequented. Gnawing edges should be protected in the usual manner by the use of metal channels, trim or flashing. These materials of standard density do not require complete coverage when used in living quarters, dining or public spaces.

These materials are acceptable without ratproofing as single bulkhead boundaries or as partitions in living quarters, dining rooms and public spaces if they are installed so as to prevent the free passage of rats; that is, when they contain no hole larger than 1/2".

22.231 *Marine sheathing or marinite faced with marine veneer.* Either of these combinations has the merits of solid marine veneer with the added strength contributed by the thicker marine sheathing and marinite. In the usual installed position, with the veneer as the face of the bulkhead or deckhead sheathing, protection of the gnawing edges as prescribed for transite (See Sec. 22.21, p. 91) is the only ratproofing required. Either of these materials is acceptable in storerooms, galleys, living quarters, and public spaces.

22.232 *Marine sheathing or marinite faced with sheet steel.* If the marine sheathing or the marinite is faced with at least 26-guage sheet steel, no ratproofing is required and the materials are acceptable for use in storerooms, galleys, living quarters and public spaces.

22.233 *Marine sheathing or marinite faced with aluminum.* If the marine sheathing or the marinite is faced with at least .025" aluminum, it is suitable for use in living quarters and public spaces. This material is suitable in galleys, pantries and commissary spaces provided the seams are such as not to collect dirt and grease and are easily cleanable. The gnawing edges should be ratproofed as specified for transite. (See Sec. 22.21, p. 91).

22.234 *Asbestos composition boards faced with decorative veneer.* Composition boards, when faced with canvas, wood veneers, Flexwood or similar decorative materials will be considered on the basis of the strength of the combined materials and the space in which it is to be used.

APPENDIX A. HEATING, LIGHTING, AND VENTILATION

The following standards are considered good practice in marine heating, lighting, and ventilation.

1. HEATING

The desirable temperatures in spaces on vessels are as follows:

Staterooms; berthing, messing, and office spaces	70° F.
Working spaces and shops	60° F.
Hospital spaces	75 to 78° F.
Washrooms, showers, and baths for common use	70 to 80° F.
Toilet spaces	70° F.

Generally, no heat will be necessary in machinery spaces, galleys, laundries, and other places having their own sources of heat generation in winter except that the supply air temperature should not be too low. Where the route of the vessel indicates, a preheater delivering air at about 45° F. to 60° F. should be provided.

2. LIGHTING

The following standards of lighting are desirable as minimum values:

Storage spaces	4 foot-candles
Passageways and stairways	5 " "
Reading	25 " "
Detail chart work	50 " "
General light for other spaces	10 " "

3. VENTILATION

The following standards of ventilation are desirable:

Mechanical ventilation is preferable to natural ventilation because of better control of the distribution and quantity of air.

The minimum quantity of air required for any non-air-conditioned space which is fitted for sleeping or office work, including hospital spaces, should be that which will limit the temperature rise over the outside air conditions to not more than 10° F. but not less than 30 cubic feet per minute per person. For spaces fitted for eating, recreation, or manual work the rise may be taken at 10° F. with not less than 20 cubic feet per minute per person. When the air is mechanically cooled and provision is made for odor control so as to permit partial recirculation, the amount of fresh air supplied may be reduced in the above to 10 cubic feet per minute per person.

Toilets, washrooms, showers, and baths used in common should have mechanical exhaust ventilation capable of changing the air within the compartment in 6 minutes, plus 25 cubic feet per minute for each toilet bowl and urinal and plus 50 cubic feet per minute for each shower head. Air requirements on merchant vessels are commonly estimated on the basis

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