

important enough to justify the omission of ventilation from certain spaces which have only small heat gains and do not require fresh air for other purposes.

The relation between supply and exhaust ventilation depends on the type of space, and the space's relation to the weather. In any case, it should be remembered that positive means for supply and exhaust must always be provided. Where natural ventilation is anticipated, infiltration and exfiltration via open doors, windows, etc., cannot always be considered adequate for this purpose.

In addition to the ventilation requirements, but closely related to and usually forming an integral part of the study, is the manner in which heating shall be furnished for cold weather conditions. In all spaces which are provided with mechanical supply ventilation, where heat is also required, the simpler method and most economical from standpoint of weight is that in which duct type or blast heaters are fitted in the ventilating systems. Where this type of heating is furnished, convectors or radiators should be provided for spaces requiring heat but not furnished with mechanical supply ventilation. The most satisfactory arrangement for this method of heating, except where individual space control is essential, is zone heating. To accomplish this, the ventilation supply system, with the fan operating at slow speed (usually about 50 to 70 per cent delivery) passes the air over a preheater which raises the air to a temperature of about 40 to 60 F. This preheated air is then passed through the system and thence through one or more reheaters which are located in the ducts and so arranged that each serves a group of spaces which possess the same or similar heating requirements. It may be necessary to slightly revise the individual space air quantities, which have been determined on the basis of summer cooling, in order to bring them in line with the reheat or delivery temperature. In some cases central heating is used. By this arrangement all the air needed for heating is passed through the preheater and reheater fitted in series. This system has the disadvantage of affording poorer thermostatic control and cruder heating properties. In all installations of duct type heaters, however, care must be taken in the first stage of heating (preheater) to provide protection against freezing, either by heater design or compensating automatic valve control. Of course, many of the usual combinations or variations of duct type and convection or radiant heaters may be used with varying degrees of satisfaction, depending on basic design requirements such as weight and space limitations and economic justification for refinements.

REQUIREMENT FOR VARIOUS TYPES OF SPACE

In the paragraphs which follow the most important considerations are given for the treatment of the various spaces, but the resulting quantities of air should in all cases be checked with those shown in Table 1.

Machinery Spaces

The prime purpose of machinery space ventilation is to maintain a habitable temperature for the operating personnel. Of secondary importance is the necessity for preserving temperature conditions satisfactory for the successful operation of machinery, particularly of that designed for certain maximum ambient temperatures. High dissipation of heat, from high temperature steam equipment or from high powered electrical installations, make it more practicable to use *spot cooling* of working

TABLE 1. TYPICAL HEATING AND VENTILATION PRACTICES FOR SHIPS

SPACE	TYPE OF VENTILATION		TYPE OF HEATING	AIR CHANGE MINUTES	REMARKS
	Sup.	Exh.			
Crews Quarters.....	Mech.	Mech. or Nat.	H.B. ^a or D.R. ^b	5-6	
Toilets and Showers.....	Nat.	Mech.	D.R.	3-4	
Chart House.....	Mech.	Mech. or Nat.	H.B. or D.R.	5-6	
Passenger & Officers Qtrs.	Mech.	Mech. or Nat.	H.B. or D.R.	4-6	
Office & Similar Spaces.....	Mech.	Mech. or Nat.	H.B. or D.R.	5-6	
Mess Rooms.....	Mech.	Mech. or Nat.	H.B. or D.R.	4-6	May be exhausted through Galleys and Pantries.
Dining Salons.....	Mech.	Mech. or Nat.	H.B. or D.R.	3-6	May be exhausted through Galleys and Pantries. Tempered air Sup.
Galley and Pantry.....	Mech. & Nat.	Mech.	H.B. or D.R.	1-2	
Deck Pantries (No cooking Equipment).....	Mech. & Nat.	Mech.	H.B. or D.R.	3-6	
Stores Spaces (Adjacent to Living Quarters).....	Mech. or Nat.	Nat. or Mech.	-----	15-20	
Stores Spaces (Isolated Locations).....	Mech. or Nat.	Nat. or Mech.	-----	15-30	
Hospital Spaces.....	Mech.	Mech.	H.B. or D.R.	4	
Soiled Linens and Oilskin Lockers.....	Nat.	Mech.	-----	15-20	
Shops.....	Mech.	Mech. or Nat.	H.B. or D.R.	6-10	
Group Berthing Spaces.....	Mech.	Mech. or Nat.	H.B. or D.R.	3-6	
CO ₂ Bottle Space.....	Nat.	Mech.	D.R.	10	
Battery Room.....	Nat.	Mech.	D.R.	2	
Laundry.....	Mech.	Mech.	H.B.	1-4	Tempered air Sup.
Dry Cargo Holds.....	Mech. or Nat.	Nat. or Mech.	-----	20-30	
Steering Gear Space.....	Mech. or Nat.	Mech. or Nat.	H.B. or D.R.	2-6	Unit Heater if desired.
Dry Stores.....	Mech.	Nat. or Mech.	-----	6-10	
Gyro Room.....	Mech.	Nat. or Mech.	-----	3-6	
Theaters and Halls.....	Mech.	Nat. or Mech.	H.B. or D.R.	6-8	
Passageways.....	Nat.	Nat.	D.R.	-----	Exhausting or Supplying adjacent Quarters.
Engine & Boiler Rooms.....	Mech. or Nat.	Mech. or Nat.	-----	1-2	
Misc. Machinery.....	Mech. or Nat.	Mech. or Nat.	-----	2-4	
Resistor Spaces.....	Nat.	Mech.	-----	10	
Stair Wells.....	Nat.	Nat.	D.R.	-----	Same as passageways. Exh. at top.

^aH. B.—Hot Blast System.

^bD. R.—Direct Radiation.