Additional air is required to replace air entering chimneys through draft hoods and barometric draft dampers, and also to provide ventilation in closely confined boiler and furnace rooms.

Experience has shown that the ventilating air openings required in heater rooms depend not only on the size of the heating plant but also on the type of fuel being burned, the relative size of the equipment room, the tightness of building construction, and the operation of exhaust fans or other devices which affect the static pressure in a building.

Because of the number of variables involved in establishing air requirements, and the variations in building contruction and arrangement, there is no universally accepted rule for providing ventilating openings. However, the importance of providing proper ventilation should not be underestimated, and a failure to do so may result in erratic or even dangerous operating conditions for equipment.

Rules for providing air supply openings are found in technical standards, in state and municipal building codes and in service and installation bulletins published by various manufacturers of fuel-burning appliances.

The following brief rules may be used as a guide:

1. Residential heating equipment installed in unconfined spaces in buildings of conventional construction does not ordinarily require ventilation other than normal air infiltration.

2. Commercial heating equipment installed in unconfined spaces with inadequate infiltration requires openings to outside equal to the total area of flue outlets on all fuel-burning equipment in the space.

3. Residential heating equipment installed in confined space having unusually tight construction requires two openings to the outside. Free area must not be less than 1 sq in. per 4000 Btu per hr input with vertical ducts or 1 sq in. per 2000 Btu per hr with horizontal ducts. Upper openings should be in the ceiling or as high as possible in the side wall; lower opening should be in the floor or wall below combustion area inlet to appliance.

4. Commercial heating equipment in a small space having inadequate infiltration requires two openings to the outside, each not less than 1 sq in. free area per 5000 Btu per hr input. Openings shall be located above highest draft hood relief opening or draft regulator opening and below combustion air inlet to heating equipment respectively.

5. Operation of exhaust fans, or kitchen fans, usually requires that sufficient fresh air be admitted to the boiler room to overcome any negative pressure. Fireplaces may also require special consideration.

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CHAPTER 19

REFRIGERANTS

Physical Properties, Heat Properties, Electrical Properties, Velocity of Sound, Refrigerant Performance, Leak Detection, Effect on Materials of Construction

REFRIGERANTS are the vital working fluids in refrigeration systems. They transfer heat from one place to another usually for the purpose of cooling various substances. Heat is removed from the system by evaporating the liquid refrigerant and is added by condensing the refrigerant vapor. These processes occur in absorption systems as well as in me-

Table 1 .... ASHRAE Standard Designation of Refrigerants (ASHRAE Standard 34-57, ASA B79.1-1960)

Refrigerant Number	Chemical Name	Chemical Formula
Halocarbon Compounds		
10	Carbontetrachloride	CCl_4
11	Trichloromonofluoromethane	CCl_3F
12	Dichlorodifluoromethane	CCl_2F_2
13	Monochlorotrifluoromethane	$CClF_3$
13B1	Monobromotrifluoromethane	$CBrF_3$
14	Carbontetrafluoride	CF_4
20	Chloroform	$CHCl_3$
21	Dichloromonofluoromethane	$CHCl_2F$
22	Monochlorodifluoromethane	$CHClF_2$
23	Trifluoromethane	CHF_3
30	Methylene Chloride	CH_2Cl_2
31	Monochloromonofluoromethane	CH_2ClF
32	Methylene Fluoride	CH_2F_2
40	Methyl Chloride	CH_3Cl
41	Methyl Fluoride	CH_3F
50*	Methane	CH_4
110	Hexachloroethane	CCl_3CCl_3
111	Pentachloromonofluoroethane	CCl_3CCl_2F
112	Tetrachlorodifluoroethane	CCl_2FCCl_2F
112a	Tetrachlorodifluoroethane	CCl_3CClF_2
113	Trichlorotrifluoroethane	CCl_2FCClF_2
113a	Trichlorotrifluoroethane	CCl_3CF_3
114	Dichlorotetrafluoroethane	$CClF_2CClF_2$
114a	Dichlorotetrafluoroethane	CCl_2FCF_3
114B2	Dibromotetrafluoroethane	$CBrF_2CBrF_2$
115	Monochloropentafluoroethane	$CClF_2CF_3$
116	Hexafluoroethane	CF_3CF_3
120	Pentachloroethane	$CHCl_2CCl_3$
123	Dichlorotrifluoroethane	$CHCl_2CF_3$
124	Monochlorotetrafluoroethane	$CHClFCF_3$
124a	Monochlorotetrafluoroethane	CHF_2CClF_2
125	Pentafluoroethane	CHF_2CF_3
133a	Monochlorotrifluoroethane	CH_2ClCF_3
140a	Trichloroethane	CH_3CCl_3
142b	Monochlorodifluoroethane	CH_3CClF_2
143a	Trifluoroethane	CH_3CF_3
150a	Dichloroethane	CH_2ClCH_2Cl
152a	Difluoroethane	CH_3CHF_2
160	Ethyl Chloride	CH_3CH_2Cl
170*	Ethane	CH_3CH_3
218	Octafluoropropane	$CF_3CF_2CF_3$
290*	Propane	$CH_3CH_2CH_3$
Cyclic Organic Compounds		
C316	Dichlorohexafluorocyclobutane	$C_4Cl_2F_6$
C317	Monochloroheptafluorocyclobutane	C_4ClF_7
C318	Octafluorocyclobutane	C_4F_8

Refrigerant Number	Chemical Name	Chemical Formula
Azeotropes		
500	Refrigerants 12/152a 73.8/26.2 wt %†	CCl_2F_2/CH_3CHF_2
501	Refrigerants 22/12 75/25 wt %	$CHClF_2/CCl_2F_2$
502	Refrigerants 22/115 48.8/51.2 wt %	$CHClF_2/CClF_2CF_3$
Miscellaneous Organic Compounds		
Hydrocarbons		
50	Methane	CH_4
170	Ethane	CH_3CH_3
290	Propane	$CH_3CH_2CH_3$
600	Butane	$CH_3CH_2CH_2CH_3$
601	Isobutane	$CH(CH_3)_3$
1150**	Ethylene	$CH_2{=}CH_2$
1270**	Propylene	$CH_3CH{=}CH_2$
Oxygen Compounds		
610	Ethyl Ether	$C_2H_5OC_2H_5$
611	Methyl Formate	$HCOOCH_3$
Nitrogen Compounds		
630	Methyl Amine	CH_3NH_2
631	Ethyl Amine	$C_2H_5NH_2$
Inorganic Compounds (Cryogenic)		
702	Hydrogen (Normal and Para)	H_2
704	Helium	He
720	Neon	Ne
728	Nitrogen	N
729	Air	.210$_2$, .78N$_2$, .01A
732	Oxygen	O_2
740	Argon	A
Inorganic Compounds (Noncryogenic)		
717	Ammonia	NH_3
718	Water	H_2O
744	Carbon Dioxide	CO_2
744A	Nitrous Oxide	N_2O
764	Sulfur Dioxide	SO_2
Unsaturated Organic Compounds		
1112a	Dichlorodifluoroethylene	$CCl{=}CF_2$
1113	Monochlorotrifluoroethylene	$CClF{=}CF_2$
1114	Tetrafluoroethylene	$CF_2{=}CF_2$
1120	Trichloroethylene	$CHCl{=}CCl_2$
1130	Dichloroethylene	$CHCl{=}CHCl$
1132a	Vinylidene Fluoride	$CH_2{=}CF_2$
1140	Vinyl Chloride	$CH_2{=}CHCl$
1141	Vinyl Fluoride	$CH_2{=}CHF$
1150	Ethylene	$CH_2{=}CH_2$
1270	Propylene	$CH_3CH{=}CH_2$

* Methane, ethane, and propane appear in the Halocarbon section in their proper numerical order, but these compounds are not halocarbons.
** Ethylene and propylene appear in the Hydrocarbon section to indicate that these compounds are hydrocarbons, but are properly identified in the section Unsaturated Organic Compounds.
† Carrier Corporation Document 2-D-127, p. 1.

The general responsibility for this chapter is assigned to TC 1.9, Refrigerants and Brines, and the Task Group for Refrigerant Tables.