The factor 1076 is defined in list of symbols at Equation 17. (Sensible cooling of the water vapor is included in the factor 1076).

The only means of preventing moisture transfer is to use a vapor proof wall or to apply a special lining, which is vapor proof. All openings in moisture proof construction must be equipped with special gaskets to prevent entrance of moisture.

When moisture transfer contributes an appreciable part of the latent-heat load, it is recommended that estimates should be made intentionally liberal in order to avoid later difficulties with insufficient dehumidifying capacity. Storage spaces, for example, would require sufficient dehumidifying capacity to handle the moisture brought in with goods to be stored in addition to moisture leaking in subsequently.

MISCELLANEOUS HEAT LOADS

This designation is intended to cover the various small heat gains from exposed piping, ducts, work done by circulating fan, and unforeseen contingencies. Where sufficient data are available these various heat gains may be estimated individually. In the majority of cases, however, common practice is to lump these factors together and combine them with a *safety factor* according to the experience and judgment of the estimator. On this basis, a small safety factor is added to the calculated cooling load to compensate for miscellaneous effects. No rules can be given for this procedure as experience in air conditioning is indispensable for application of suitable safety factors.

REQUIRED AIR QUANTITY THROUGH CONDITIONING EQUIPMENT

The procedure for determining the required air quantity is based upon the thermodynamic principles of Chapter 3 and the use of the Mollier diagram supplied with THE GUIDE, or a psychrometric chart. Readers are advised to review these principles, paying particular attention to the illustrative examples of cooling load calculations, and to refer to the section on Apparatus Dew Point in Chapter 43.

Calculation of the cooling load for a conditioned space is equivalent to making a heat balance for the space, in which all heat, moisture, and outdoor air are treated as directly entering the space; and then the desired conditions are maintained by considering a certain quantity of air to be withdrawn from the space, passed through the conditioning equipment, and returned to the space with such a temperature and humidity ratio that its net effect will be to counterbalance or *remove* the given entering amounts of heat and water vapor. This quantity of *indoor air* which is considered to be circulated in this manner is called the *required air quantity* and its determination is normally part of every cooling-load estimate. The procedure is as follows:

1. Determine the total sensible and latent heat loads in Btu per hour for the space.

2. Compute the quantity called the *specific enthalpy of the water removed*, q_w, from the relation

$$q_w = \left(\frac{\text{Space sensible load}}{\text{Space latent load}}\right) \times 1076 \text{ Btu/lb.} \qquad (21)$$

Note that the ratio (Space latent load) ÷ 1076 is the equivalent of the required rate of water-vapor removal, in pounds per hour. If the rate of water-vapor removal is known, it may be used directly in Equation 21.

TABLE 24. PERMEABILITY OF VARIOUS MATERIALS TO WATER VAPOR

GROUP	MATERIAL	PERMEABILITY GRAINS PER (SQ FT) (HR) (INCH HG)
1[a]	Plaster base and plaster, ¾ in.	14.7
	Fir sheathing, ¾ in.	2.9
	Waterproof paper[b]	49.1
	Pine lap siding	4.9
	Paint film	3.4
	Sugar cane fiberboard, ¾ in.	12.5
	Brick masonry, 4 in.	1.1
2[c]	Foil-surfaced reflective insulation, double-faced	0.08 to 0.13
	Roll roofing—smooth, 40 to 65 lb per roll 108 sq ft	0.13 to 0.17
	Duplex or laminated papers, 30-30-30	1.37 to 2.58
	Duplex or laminated papers, 30-60-30	0.52-0.86
	Duplex paper, coated with metallic oxides	0.52-1.29
	Insulation backup paper, treated	0.86-3.42
	Plaster, wood lath	11.00
	Plaster, 3 coats of lead and oil	3.68 to 3.84
	Plaster, 2 coats of aluminum paint	1.15
	Plaster, fiberboard or gypsum lath	19.73 to 20.57
	Plywood, ½ in., 5-ply Douglas fir	2.67 to 2.74
	Plywood, 2 coats of asphalt paint	0.43
	Plywood, 2 coats of aluminum paint	1.29
	Gypsum lath with metallic aluminum backing	0.09-0.39
	Insulating lath and sheathing, board type	25.68 to 34.27
	Insulating sheathing, surface-coated	3.03 to 4.36
	Insulating cork blocks, 1 in.	6.19
	Mineral wool, unprotected, 4 in.	29.07
	Sheathing paper, asphalt impregnated, glossy	0.17-2.05

[a]Calculating Vapor and Heat Transfer Through Walls, by L. G. Miller (*Heating and Ventilating* 35, No. 11, 56, November, 1938).

[b]Light weight slaters felt used to keep rain from drifting through. Not used as a vapor barrier.

[c]How to Overcome Condensation in Building Walls and Attics, by L. V. Teesdale (*Heating and Ventilating*, Vol. 36, No. 4, April, 1939).

3. Locate the state point of the room air (design wet-bulb and dry-bulb temperatures) on the Mollier diagram. From this state point draw a line intersecting the saturation line, using the slope established by the protractor on the Mollier diagram for the particular value of q_w prevailing. This line is the *condition line* for the process.

4. Read the temperature where the condition line from step 3 intersects the saturation line. This is called the *apparatus dewpoint*.

5. Compute the *required air quantity* from the relation

$$Q_{ra} = \frac{\text{(Space sensible load)}}{1.08\left[\begin{pmatrix}\text{Space}\\\text{dry-bulb}\end{pmatrix} - \begin{pmatrix}\text{Apparatus}\\\text{dewpoint}\end{pmatrix}\right] \times \begin{pmatrix}\text{Coil}\\\text{efficiency}\end{pmatrix}} \qquad (22)$$

The magnitude of Q_{ra} is substantially the quantity, cfm, of cooled and dehumidified air for which the distribution system must be designed.

The numerical factor 1.08 is derived from the product 1 cfm × 60 min. × 0.244 × 0.075 $\left(1 - \frac{0.00923}{0.62}\right)$ = 1.08, assuming an average supply air dewpoint of 55 F. Since standard air density (0.075) includes the weight of the water vapor it is desirable to reduce it to the basis of dry air by the last factor where 0.00923 = humidity ratio of air at 55 F dewpoint, and 0.62 = ratio of density of water vapor to dry air at same temperature and pressure. Refer to Chapter 25 for coil selection.

Note that the product [(Space dry-bulb) − (Apparatus dewpoint)] × (Coil efficiency) is equal to the dry-bulb range through which the conditioned air is cooled. Hence, in rare instances when the *condition line* of the process may not intersect the saturation line, any other convenient reference temperature on the *condition line* may be used instead, provided that the coil efficiency is specified accordingly on the proper basis.

EXAMPLE—COOLING LOAD CALCULATION

An effective means of summarizing the calculation procedure will be the use of an illustrative example. While condensed calculation forms are commonly employed for work of this nature, an outline will be used here in order to facilitate explanatory comments.