8) Clearances between *chimneys* or *gas vents* and the surrounding construction that would permit air leakage from within the *building* into a wall or *attic or roof space* shall be sealed by *noncombustible* material to prevent such leakage.

9.25.4. Vapour Barriers

9.25.4.1. Required Barrier to Vapour Diffusion

1) Thermally insulated wall, ceiling and floor assemblies shall be constructed with a *vapour barrier* so as to provide a barrier to diffusion of water vapour from the interior into wall spaces, floor spaces or *attic or roof spaces*.

9.25.4.2. Vapour Barrier Materials

1) Except as required in Sentence (2), *vapour barriers* shall have an initial permeance not greater than 45 ng/(Pa•s•m^2).

2) When used where a high resistance to vapour movement is required, such as in wall constructions that incorporate exterior cladding or sheathing having a low water vapour permeance, *vapour barriers* shall have a permeance not greater than 15 ng/(Pa•s•m^2). (See Appendix A.)

3) Where polyethylene is installed as the *vapour barrier* required in Sentence (2), it shall conform to CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet for Use in Building Construction."

4) Membrane-type *vapour barriers* other than polyethylene shall conform to the requirements of CAN/CGSB-51.33-M, "Vapour Barrier, Sheet, Excluding Polyethylene, for Use in Building Construction."

5) Where a coating is applied to gypsum board to function as the *vapour barrier*, the permeance of the coating shall be determined in accordance with CAN/CGSB-1.501-M, "Method for Permeance of Coated Wallboard."

9.25.4.3. Installation of Vapour Barriers

1) *Vapour barriers* shall be installed to protect the entire surfaces of thermally insulated wall, ceiling and floor assemblies.

2) *Vapour barriers* shall be installed sufficiently close to the warm side of insulation to prevent condensation at design conditions. (See Appendix A.)

Section 9.26. Roofing

9.26.1. General

9.26.1.1. Purpose of Roofing

1) Roofs shall be protected with roofing, including flashing, installed to shed rain effectively and prevent water due to ice damming from entering the roof.

9.26.1.2. Alternate Installation Methods

1) Methods described in CAN3-A123.51-M, "Asphalt Shingle Application on Roof Slopes 1:3 and Steeper," or CAN3-A123.52-M, "Asphalt Shingle Application on Roof Slopes 1:6 to Less Than 1:3," are permitted to be used for asphalt shingle applications not described in this Section.

9.26.2. Roofing Materials

9.26.2.1. Material Standards

1) Roofing materials shall conform to

a) CAN/CGSB-37.4-M, "Fibrated, Cutback Asphalt, Lap Cement for Asphalt Roofing,"
b) CAN/CGSB-37.5-M, "Cutback Asphalt Plastic Cement,"
c) CAN/CGSB-37.8-M, "Asphalt, Cutback, Filled, for Roof Coating,"
d) CGSB 37-GP-9Ma, "Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing,"
e) CGSB 37-GP-21M, "Tar, Cutback, Fibrated, for Roof Coating,"
f) CAN/CGSB-37.50-M, "Hot Applied Rubberized Asphalt for Roofing and Waterproofing,"
g) CGSB 37-GP-52M, "Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric,"
h) CAN/CGSB-37.54, "Polyvinyl Chloride Roofing and Waterproofing Membrane,"
i) CGSB 37-GP-56M, "Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing,"
j) CGSB 41-GP-6M, "Sheets, Thermosetting Polyester Plastics, Glass Fiber Reinforced,"
k) CAN/CGSB-51.32-M, "Sheathing, Membrane, Breather Type,"
l) CSA A123.1-M, "Asphalt Shingles Surfaced with Mineral Granules,"
m) CSA A123.2-M, "Asphalt Coated Roofing Sheets,"
n) CSA A123.3-M, "Asphalt or Tar Saturated Roofing Felt,"

such space must be of the water repellent type. A test for water-repellency of loose-fill insulation suitable for installation in masonry cavity walls can be found in ASTM C 516, "Vermiculite Loose Fill Thermal Insulation."

A-9.25.3.1.(1) Air Barrier Systems for Control of Condensation. The majority of moisture problems resulting from condensation of water vapour in walls and ceiling/attic spaces are caused by the leakage of moist interior heated air into these spaces rather than by the diffusion of water vapour through the building envelope.

Protection against such air leakage must be provided by a system of air-impermeable materials joined with leak-free joints. Generally, air leakage protection can be provided by the use of air-impermeable sheet materials, such as gypsum board or polyethylene of sufficient thickness, when installed with appropriate structural support. However, the integrity of the airtight elements in the air barrier system can be compromised at the joints and here special care must be taken in design and construction to achieve an effective air barrier system.

Although Section 9.25. refers separately to vapour barriers and airtight elements in the air barrier system, these functions in a wall or ceiling assembly of conventional wood frame construction are often combined as a single membrane that acts as a barrier against moisture diffusion and the movement of interior air into insulated wall or roof cavities. Openings cut through this membrane, such as for electrical boxes, provide opportunities for air leakage into concealed spaces, and special measures must be taken to make such openings as airtight as possible. Attention must also be paid to less obvious leakage paths, such as holes for electric wiring, plumbing installations, wall-ceiling and wall-floor intersections, and gaps created by shrinkage of framing members.

In any case, air leakage must be controlled to a level where the occurrence of condensation will be sufficiently rare, or the quantities accumulated sufficiently small, and drying sufficiently rapid, to avoid material deterioration and the growth of mould and fungi.

Generally the location in a building assembly of the airtight element of the air barrier system is not critical; it can restrict air leakage whether it is located near the outer surface of the assembly, near the inner surface or at some intermediate location. However, if a material chosen to act as an airtight element in the air barrier system also has the characteristics of a vapour barrier (i.e. low permeability to water vapour), its location must be chosen more carefully in order to avoid moisture problems. [See Appendix notes A-9.25.1.2. and A-9.25.4.2.(2).]

In some constructions, an airtight element in the air barrier system is the interior finish, such as gypsum board, which is sealed to framing members and adjacent components by gaskets, caulking, tape or other methods to complete the air barrier system. In such cases, special care in sealing joints in a separate vapour barrier is not critical. This approach often uses no separate vapour barrier but relies on appropriate paint coatings to give the interior finish sufficient resistance to water vapour diffusion that it can provide the required vapour diffusion protection.

The wording in Section 9.25. allows for such innovative techniques, as well as the more traditional approach of using a continuous sheet, such as polyethylene, to act as an "air/vapour barrier."

Further information is available in "Moisture Problems in Houses," by A.T. Hansen, Canadian Building Digest 231, available from the Institute for Research in Construction, National Research Council of Canada, Ottawa K1A 0R6.

A-9.25.3.2. Air Barrier System Properties. Materials that have been tested and are considered to have low air permeance include:

- 2 mm smooth surface roofing membrane
- 2.7 mm modified bituminous torch-on membranes
- 1.3 mm modified bituminous self-adhesive membranes
- 12.7 mm gypsum board
- 12.7 mm cement board
- 8 mm plywood
- 12.7 mm particle board
- 11 mm waferboard
- 3.2 mm tempered hardboard
- 38 mm extruded polystyrene
- 25.4 mm foil back urethane insulation
- 24 mm phenolic insulation board
- aluminum foil
- polyethylene sheet
- reinforced non-perforated polyolefin.

Characteristics of specific products may vary significantly. *e 2*

A-9.25.4.2.(2) Increased Vapour Diffusion Resistance. Sentence 9.25.4.2.(2) indicates that where other elements in the building assembly have low vapour permeance, the vapour permeance of the element identified as the vapour barrier must be further reduced. As discussed in Appendix note A-9.25.1.2., the location or installation of elements with low air permeance and low vapour permeance requires special consideration to avoid moisture related deterioration. The following provides additional information on a variety of elements in the building assembly that may have low vapour permeance and thereby either perform as the vapour barrier or whose presence may demand more stringent requirements for the element identified as the vapour barrier.

Cladding

Different cladding materials have different vapour permeances and different susceptibilities to moisture deterioration. They are also installed in different manners which are more or less able to release moisture that may accumulate on the inner surface. Where low permeance cladding materials such as metal or vinyl siding, materials with a permeance less than 60 ng/(Pa • s • m^2), are installed with tight joints and without a vented air space, as may be the case with lock-seam metal siding the vapour barrier must provide greater control of vapour diffusion. Sentence 9.25.4.2.(2) specifies a maximum permeance of 15 ng/(Pa • s • m^2). Assemblies clad with standard residential vinyl or metal siding would not require additional protection as the joints are not so tight as to prevent the dissipation of moisture.

Low permeance cladding cannot itself serve as the vapour barrier as it will often fall to a temperature below that where saturation would occur.

Sheathing

Like cladding, sheathing materials have different vapour permeances and different susceptibilities to moisture deterioration. Again, where sheathing with a permeance less than 60 ng/(Pa • s • m^2), such as plywood, is installed, the permeance of the vapour barrier should not exceed 15 ng/(Pa • s • m^2).

Low permeance sheathing may serve as the vapour barrier if it can be shown that the interior surface of the sheathing will not fall below the temperature where saturation will occur. This may be the case where insulating sheathing is used. (See A-9.25.1.2.)

Thermal Insulation

Where low permeance foamed plastic is the sole thermal insulation in the building assembly, the inner surface of this element will be close to the interior temperature. In this case, no additional vapour barrier is needed to control condensation within the assembly. Where low permeance thermal insulation is installed on the outside of an insulated frame wall, however, the inner surface of the plastic insulation may fall below the temperature at which saturation will occur. In this case, a separate element must be installed to provide the necessary vapour diffusion protection. (See A-9.25.1.2.)

Air Barrier Systems

In residential construction, the airtight element in the air barrier system often provides the required resistance to vapour diffusion and thereby also serves as the vapour barrier. In this case, the combined air/vapour barrier must be positioned sufficiently close to the warm side of the assembly to remain above the dew point temperature of the indoor air.

Any moisture from the indoor air that diffuses through the inner layers of the assembly or is carried by air leakage through those layers is likely to be trapped at such an air barrier. This will not cause a problem if the air/vapour barrier is located where the temperature is above the dew point of the indoor air; the trapped water vapour will remain as vapour and no harm will be done. But if the air/vapour barrier is located where the temperature is below the dew point of the indoor air, the trapped water vapour will condense or freeze. If this temperature remains below the dew point for any length of time, significant moisture could accumulate. Moisture that remains in a building assembly into warmer weather can allow the growth of decay organisms. (See A-9.25.1.2.)

A-9.25.4.3.(2) Location of Vapour Barriers. Assemblies in which the vapour barrier is located partway through the insulation meet the intent of this Article provided it can be shown that the temperature of the vapour barrier will not fall below the dew point of the heated interior air.

A-9.26.2.2.(4) Fasteners for Treated Shingles. Where shingles or shakes have been chemically treated with a preservative or a fire retardant, the fastener should be of a material known to be compatible with the chemicals used in the treatment.

A-9.26.17.1.(1) Installation of Concrete Roof Tiles. Where concrete roof tiles are to be installed, the dead load imposed by this material should be considered in determining the minimum sizes and maximum spans of the supporting roof members.

A-9.27.10.2.(3) Grooves in Hardboard Cladding. Grooves deeper than that specified may be used in thicker cladding providing they do not reduce the thickness to less than the required thickness minus 1.5 mm. Thus for type 1 or 2 cladding, grooves must not reduce the thickness to less than 4.5 mm or 6 mm depending on method of support, or to less than 7.5 mm for type 5 material.

A-9.27.11.2.(2) Thickness of Grade O-2 OSB. In using Table 9.27.9.2. to determine the thickness of Grade O-2 OSB cladding, substitute "face orientation" for "face grain" in the column headings.

A-Table 9.28.4.3. Stucco Lath. Paper-backed welded wire lath may also be used on horizontal surfaces provided its characteristics are suitable for such application.