NATIONAL BUILDING CODE INFORMATIONS - 2005

PART 3 - FIRE PROTECTION, OCCUPANT SAFETY AND ACCESSIBILITY

3.1.5.12 COMBUSTIBLE INSULATION AND ITS PROTECTION

2) Foamed plastic insulation having a flame-spread rating not more than 25 on any surface

NOTE: At present there is no commercially available sprayed-in-place polyurethane foam insulation with a flame spread less than 25, which meets the Canadian Standard. Be careful to ask for the Standard where the fire properties are based on the test CAN/ULC-S102 (including the corner wall test CAN/ULC-S127) and not on the ASTM E-84, which does our Canadian Standard not accept.

3) Combustible insulation having a flame-spread rating more than 25 but not more than 500…

NOTE: Yes, sprayed-in-place polyurethane foams, which meet the Canadian Standard so the National Building Code (NBC), must have flame spreads, which meet these criteria. The sentence goes on to describe materials, which may protect our foamed plastic insulation, i.e. 12.7mm gypsum board, lath and plaster, 25mm thick masonry or concrete, or any thermal barrier, which has been tested according to CAN/ULC–S101-M " Standards Methods of Fire Endurance Tests of Building Construction and Materials"…

5) Combustible insulation, including foamed plastics, installed above roof decks, outside of foundation walls below ground level and beneath concrete slabs-on-ground is permitted to be used in a building required to be of non-combustible construction.

NOTE: This is an important note. WALLTITE can be used in various places.

3.1.11.2 FIRE STOPPING IN WALL ASSEMBLIES

1) Except as permitted by sentence 2), fire stops conforming to article 3.1.11.7 shall be provided where fire stops go.

2) Fire stops conforming to sentence 1) are not required provided

   a) The wall space is filled with insulation.

NOTE: Neither likely nor desired in a cavity wall application.

b) The exposed construction materials and any insulation within the wall space are non-combustible
c) The exposed construction materials and any insulation within the wall space have a flame-spread rating not more than 25…

NOTE: Again, there is no sprayed-in-place polyurethane foam insulation with a flame-spread rating less than 25 that meets the product standard in the NBC.

d) The insulated wall assembly contains not more than one concealed air space, and the horizontal thickness of that air space is not more than 25mm (1”).

NOTE: This is where WALLTITE fits in! By specifying that the product must be installed so that this sentence is satisfied, NO fire stopping of the cavity is required!

3.1.12 FLAME-SPREAD RATING AND SMOKE DEVELOPED CLASSIFICATION

3.1.12.1 DETERMINATION OF RATINGS

1) Except as required by sentence 2) and as permitted by sentence 3), the flame-spread rating and smoke developed classification of a material, assembly, or structural member shall be determined on the basis of not less than three tests conducted in accordance with CAN/ULC-S102, “Test for Surface Burning Characteristics of Building Materials and Assemblies”.

NOTE: In Canada, all sprayed-in-place polyurethane foam insulations must be tested according to this test method. Many products can be imported from the United States or other countries, however their standard method could be different. In the US, they are using a test called ASTM-E84. This test does not meet our Standard. Though the test method is similar to the CAN/ULC-S102 test, the S102 test requires that a thermal plastic insulation have another test performed, the CAN/ULC-S127 “Standard Corner Wall Method of Flammability Characteristics of Non-Melting Building Materials”. The flame-spread is established from the highest results.

PART 5 ENVIRONMENTAL SEPARATION

SECTION 5.3. HEAT TRANSFER

5.3.1.2 PROPERTIES TO RESIST HEAT TRANSFER OR DISSIPATE HEAT

1) Taking into account the conditions on either side of the environmental separator, materials and components installed to provide the required resistance to heat transfer or the means implemented to dissipate heat shall provide sufficient resistance or dissipation,

    a) to minimize surface condensation on the warm side of the component or assembly,
    b) in conjunction with other materials and components in the assembly, To minimize condensation within the component or assembly,
    c) in conjunction with systems installed for space conditioning, to meet the interior design thermal conditions for the intended occupancy
    d) and to minimize ice damming on sloped roofs

(See Appendix A) – Material and Component Properties and Condensation

Total prevention of condensation is generally unnecessary and its achievement is rarely a certainty at design conditions. Part 5, therefore, requires that condensation be minimized. The occurrence of condensation should be sufficiently rare, or the quantities accumulated should be sufficiently small and dry rapidly enough, to avoid material deterioration and the growth of mould and fungi.

NOTE: WALLTITE meets these criteria better than any other material and is less prone to workmanship error. The polyurethane by its nature is very seamless with a 100% adhesion. By being specified at an appropriate thickness it will prevent the migration of the dew point to a location within the assembly. Other insulation products can suffer significant insulation losses with resulting inefficiency and condensation if not installed properly. Except for the transition membranes, there is no "in conjunction with other materials". WALLTITE as a system is an insulation / air barrier and vapour barrier (under certain conditions).

5.3.1.3 LOCATION AND INSTALLATION OF MATERIALS PROVIDING THERMAL RESISTANCE

1) Where a material required by Article 5.3.1.1. is intersected by a building assembly, penetrated by a high conductance component or interrupted by expansion, control or construction joints, and where condensation is likely to occur at these intersections, penetrations or interruptions, sufficient thermal resistance shall be provided so as to minimize condensation at these locations.

2) Materials providing required thermal resistance shall have sufficient inherent resistance to airflow or be positioned in the assembly so as to prevent convective airflow through and around the material.

3) Spray-in-place polyurethane insulation shall be installed in accordance with the requirements of CAN/ULC-S705.2, ''Thermal Insulation-Spray-applied Rigid Polyurethane Foam, Medium Density, Installer's Responsibilities – Specification.''

(See Appendix A) – Position of Materials Providing Thermal Resistance

For a material providing thermal resistance to be effective, it must not be short-circuited by convective airflow through or around the material. The material must therefore be either:

- the component of the air barrier system providing principal resistance to air leakage or
- installed in full and continuous contact with a continuous low air permeance component.

NOTE: WALLTITE meets these criteria better than any other system. Our system is 100% adhered to the substrate, absolutely no gaps or cracks or seams.

WALLTITE is the sole polyurethane <u>insulation / air barrier system</u> listed by CCMC for institutional, commercial, industrial and residential. Ref:

- **CCMC # 12840-R for insulation**
- **CCMC # 12877-R for air barrier material**
- **CCMC # 12932-R for insulation / air barrier system**

Applications of our WALLTITE meet the Standard CAN/ULC-S705.2 and can only be performed by approved applicators from our Quality and Training Program, Raising Performance To New Heights® certified by Morrison Hershfield and approved by CCMC. The applicators must spray our product following the Standard procedures.

<u>SECTION 5.4 AIR LEAKAGE</u>

5.4.1.1 REQUIRED RESISTANCE TO AIR LEAKAGE

1) Where a building component or assembly separates interior conditioned space from exterior space, interior space from the ground, or

environmentally dissimilar interior spaces, the properties and position of the materials and components in those components or assemblies shall be such that they control air leakage or permit venting to the exterior so as to

a) Provide acceptable conditions for the building occupants
b) Maintain appropriate conditions for the intended use of the building
c) Minimize the accumulation of condensation in and the penetration of precipitation into the building component or assembly

APPENDIX – RESISTANCE TO AIR LEAKAGE

An air barrier system in above-grade building components and assemblies separating conditioned space from the exterior will reduce the likelihood of condensation due to air leakage, discomfort from drafts, the infiltration of dust and other pollutants and interference in the performance of building services, such as HVAC and plumbing. These problems can all lead to serious health or safety hazards.

Currently, the most obvious and significant problems are due to moisture-related material deterioration, such as rot and corrosion, which can lead to the failure of component connections. The infiltration of dust and other pollutants can lead to a wide range of health problems. Where the separator is subject to high moisture levels, the pollutants may include fungus spores. Interference with the performance of building services can lead to unhealthy conditions and potentially hazardous conditions during the heating season in many regions of the country.

There are few buildings intended for human occupancy where the interior space is conditioned but where an air barrier system is not required. Some industrial buildings, for example…

NOTE: On top of the article 5.4.1.1, the appendix described very well how important is an air barrier system. Several professionals are designing their own air barrier system. The question is, what is the performance of the system if no tests were done on it. This is why WALLTITE, as an insulation / air barrier system have been tested as per the "Technical Guide for Air Barrier Systems for Exterior Walls of Low-Rise Buildings". The tests were done on walls build from our specifications, Ref: CCMC report # 12932-R. On top, the Technical Guide is requesting the following 2 tests:

1) **Air permeance test after weathering and heat aging – Requirements: =110% of original value;**
2) **Thermal resistance after heat aging of weathered samples – Requirements: 90% retention from original value.**

The ageing for the present project consisted of an exposure to environmental conditions (weathering) for a period of six consecutive months (mid-January to mid-July). So WALLTITE could be sprayed in the falls and the exterior finish could be installed at the spring. This is definitely and advantage when the exterior finish cannot be installed due to bad weather.

5.4.1.2 AIR BARRIER SYSTEM PROPERTIES

1) Except as provided in sentence 2), materials intended to provide the principal resistance to air leakage shall have an air leakage characteristic not greater than 0.02 L/(s.m²) measured at an air pressure difference of 75Pa. (See Appendix A)

NOTE: The Appendix notes state that the air barrier will reduce the likelihood of condensation due air leakage, discomfort from drafts, the infiltration of dust and other pollutants… These problems can leads to serious health or safety hazards. In the table A-5.4.1.2 1) and 2) it was never mentioned anything about air barrier Type 1, Type 2 or Type 3. These numbers were proposed about 15 years ago but they were never accepted by the Building Code. Some individuals misinformed are still trying to use them. The appendix mentioned how difficult it is to determine the performance of an air barrier system. This is why it is recommended to get some tests done.

Building scientists estimate that 90 – 100 times (other said up to 200%) more moisture is moved across the building envelope due to air leakage than is ever transported by diffusion. WALLTITE, as an air-barrier material, obtained a value of 0.000418 L/(s.m²) and as an air-barrier system a value of 0.0054 L/(s.m²) when tested in accordance with the CCMC's Technical Guide, Air Barrier System for Exterior Walls of Low-Rise Buildings. Our CCMC # 12877-R (air-barrier material) and CCMC # 12932-R (air-barrier system) are described in our web site at www.walltite.com or www.foammasters.ca

3) The air barrier system shall be continuous

   a) across construction, control, and expansion joints,
   b) across junctions between different building assemblies and,
   c) around penetrations through the building assembly

NOTE: Given the realities of construction it is difficult to believe that any other system other than WALLTITE insulation / air barrier system could be installed in the absence of continuous inspection, to meet these criteria.

The Appendix notes discussing system requirements state that determining the leakage rate of a particular assembly is problematic. It goes on to state that there is little information on the air tightness of the many air barrier systems used in building construction, and testing requires specialized equipment and expertise. Depending on the type of test,

- **testing may not represent the performance of the complete installed system**
- **location of deficiencies may be difficult to identify**
- **rectification of deficiencies may not be feasible**

These problems do not occur with our WALLTITE. The polyurethane foam has been used for air leakage control long before the terminology for air barrier even came into use. In fact, long before sheet good materials for this use were even invented.

When the WALLTITE is installed to the specifications, rest assured, you have an air barrier system

SECTION 5.5 VAPOR DIFFUSION

5.5.1.2 VAPOR BARRIER PROPERTIES AND INSTALLATION

1) The vapour barrier shall have sufficiently low permeance and shall be positioned in the building component or assembly so as to,

   a) minimize moisture transfer by diffusion, to surfaces within the assembly that would be cold enough to cause condensation at the design temperature and humidity conditions, or

   b) reduce moisture transfer by diffusion, to surfaces within the assembly that would be cold enough to cause condensation at the design temperature and humidity conditions, to a rate that will not allow sufficient accumulation of moisture to cause deterioration…

NOTE: The vapour permeance of the polyurethane shown to be much lower than we previously thought. This was proved by National Research Council (NRC), by Bomberg and Lstiburek. In all of the test methods used for polyurethane foam the skins which form on contact with a surface and develop on the outermost surface were cut off to make a sample to fit in the test apparatus. Refer to our Section Vapour Permeance Yes or No.

PART 9 HOUSING AND SMALL BUILDINGS

SECTION 9.25. HEAT TRANSFER, AIR LEAKAGE AND CONDENSATION CONTROL

9.25.1.2 GENERAL (See Appendix A)

1) Sheet and panel-type materials shall be installed in accordance with Sentence 2), if the material

   a) has an air leakage characteristic less than 0.1L/(s.m²) at 75Pa
   b) has a water vapour permeance less than 60 ng/(Pa.s.m^2) when measured in accordance with ASTM E 96, ''Water Vapour Transmission of Materials,'' using the dessicant method (dry cup), and
   c) is incorporated into a building assembly required by Article 9.25.2.1 to be insulated.

2) Sheet and panel-type material described in Sentence 1) shall be installed

   a) on the warm face of the assembly (see also article 9.25.4.2.)
   b) except as provided in Sentence 3) to 5), at a location where the ratio between the total thermal resistance of all materials outboard of its innermost impermeable surface and the total thermal resistance of all materials inboard of that surface is not less than that required by Table 9.25.2, or
   c) outboard of an air space that is vented to the outdoors and, for walls, drained.

Appendix – Location of Low Permeance Materials

Low Air- and Vapour-Permeance Materials and Implications for Moisture Accumulation

The location in a building assembly of a material with low air permeance is generally not critical; the material can restrict outward movement of indoor air whether it is located near the outer surface of the assembly, near the inner surface, or at some intermediate location, and such restriction of air movement is generally beneficial, whether or not the particular material is designated as part of the air barrier system. However, if such a material also has the characteristics of a vapour (i.e. low permeability to water vapour) and low thermal resistance, its location must be chosen more carefully in order to avoid moisture accumulation.

Any moisture from the indoor air that diffuses through the inner layers of the assembly or is carried by air leakage through those layers may be prevented from passing right through the assembly by a low air- and vapour-permeance material.

This moisture transfer will usually not cause a problem if the material is located where the temperature is above the dew point of the indoor air: the water vapour will remain as vapour, the humidity level in the assembly will come to equilibrium with that of the indoor air, further accumulation of moisture will cease or stabilize at a low rate, and no harm will be done.

But if the low air- and vapour-permeance material is located where the temperature is below the dew point of the air at that location, water vapour will condense and accumulate as water or ice, which will reduce the humidity level and encourage the movement of more water vapour into the assembly. If the temperature remains below the dew point for any length of time, significant moisture could accumulate. When warmer weather returns, the presence of a material with low water vapour permeance can retard drying of the accumulated moisture. Moisture that remains into warmer weather can support the growth of decay organisms.

Thermal Insulation

Where low-permeance foamed plastic is the sole thermal insulation in a building assembly, the temperature of 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 due to vapour diffusion. However, where low-permeance thermal insulation is installed on the outside of an insulated frame wall, the temperature of the inner surface of the insulation may fall below the dew point. In this case, a separate element must be installed to provide the necessary vapour diffusion protection.

NOTE: As we could read, the appendix is given all the necessary information to avoid condensation problems and also the consequences. Low air and vapour permeance insulation such as polystyrenes, polyisocyanurates, and polyurethanes applied to exterior sheathing, in conjunction with fibrous batt insulations or low density polyurethane 0.5 lb/ft³ filling the stud walls, sets up a situation where any moisture from the indoor air which diffuses through the inner layers of the assembly or is carried by air leakage through those layers may be prevented from passing right through the assembly by such a material. If the sheathing is below the dew point then condensation will occur. Extended periods of condensation will result in significant accumulations of moisture, and the possibility of the growth of decay organisms. The location of this type of insulation to prevent condensation becomes critical to long-term performance of the wall assembly. The inner surface of this type of insulation can be kept above the dew point. This is achieved through the ratio of the thermal resistance values outboard and inboard of the innermost impermeable surface of the material in question.

9.25.2 THERMAL INSULATION

9.25.2.1 REQUIRED INSULATION

1) All walls, ceilings and floors separating heated space from unheated space, the exterior air or the exterior soil shall be provided with sufficient thermal insulation to prevent condensation on their room side during the winter and to ensure comfortable conditions for the occupants. (See A-9.1.1.1.(1) in Appendix A)

NOTE: The location of WALLTITE sprayed-in-place polyurethane foam insulations to prevent condensation is of primary interest to us here today.

9.25.2.2 INSULATION MATERIALS

1) Except as required in Sentence 2), thermal insulation shall conform to the requirements of

   g) CAN/ULC-S705.1, ''Thermal Insulation – Spray Applied Rigid Polyurethane Foam, Medium Density, - Material – Specification,''

NOTE: WALLTITE meet this Standard

9.25.2.3 INSTALLATION OF THERMAL INSULATION

3) Except where the insulation provides the principal resistance to air leakage, thermal insulation shall be installed so that at least face is in full continuous contact with an element with low air permeance.

NOTE: WALLTITE polyurethane foam insulation can be located as either the principal thermal insulation or act as the air barrier system and vapour barrier (Refer to our Section Vapour Permeance (Yes or No) if installed on the exterior with the transition membranes, ref: CCMC report # 12932-R

APPENDIX 9.25.2.3(3) POSITION OF INSULATION

For thermal insulation to be effective, it must not be short-circuited by convective airflow through or around the material. If low-density fibrous insulation is installed with an air space on both sides of the insulation, the temperature differential between the warm and cold sides will drive convective airflow around the insulation. If foam plastic insulation is spot-adhered to a backing wall or adhered in a grid pattern to an air-permeable substrate, and is not sealed at the joints and around the perimeter, air spaces between the insulation and the substrate will interconnect with spaces behind the cladding. Any temperature or air pressure differential across the insulation will again lead to short circuiting of the insulation by airflow. Thermal

insulation must therefore be installed in full and continuous contact with the air barrier or another continuous component with low air permeance.

NOTE: If the above doesn't scream out WALLTITE insulation / air barrier system, we don't know what else to add…

9.25.2.5 INSTALLATION OF SPRAYED-APPLIED POLYURETHANE

1) Spray-applied polyurethane insulation shall be installed in accordance with CAN/ULC-S705.2, ''Thermal Insulation – Spray-Applied Rigid Polyurethane Foam, Medium Density, Installer's Responsibilities – Specification''.

NOTE: Applications of our WALLTITE meet the Standard CAN/ULC-S705.2 and can only be performed by approved applicators from our Quality and Training Program, Raising Performance To New Heights® certified by Morrison Hershfield and approved by CCMC. The applicators must spray our product following the Standard procedures.

9.25.3. AIR BARRIER SYSTEMS

9.25.3.1 REQUIRED BARIER TO AIR LEAKAGE

1) Thermally insulated wall, ceiling and floor assemblies shall be constructed so as to include an air barrier system that will provide a continuous barrier to air leakage

    a) from the interior of the building into wall, floor, attic or roof spaces, sufficient to prevent excessive moisture condensation in such spaces during the winter, and
    b) from the exterior inward sufficient to prevent moisture condensation on the room side during winter and to ensure comfortable conditions for the occupants.

APPENDIX 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 ceilings / attics spaces are caused by the leakage of moist interior heated air into these spaces rather than by 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 systems, 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 electrical boxes, provide opportunities fir 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 electrical wirings, plumbing installations, wall-ceiling and wall-floor intersections, and gaps created by shrinkage of framing members.

NOTE: Though vapour diffusion is important, it is not the critical factor in the performance of a wall assembly. The control of air leakage is the most important component of a wall design.

So the importance of the vapour barrier and air barrier is well described but it is also critical that the installation is done properly. WALLTITE meets these criteria better than any other material. It is less prone to workmanship error than any other material, also by its nature it is very seamless, and 100% adhered to the substrate. By being specified at an appropriate thickness it will prevent the migration of the dew point at the wrong location within the assembly. Also, the insulation / air barrier / vapour barrier with WALLTITE is not "in conjunction with other materials" except with the transition membranes and the system is installed only by approved applicators from our Quality and Training Program, Raising Performance To New Heights® certified by Morrison Hershfield.

9.25.3.2 AIR BARRIER SYSTEM PROPERTIES

1) Air barrier systems shall possess the characteristics necessary to provide an effective barrier to air infiltration under differential air pressure due to stack effect, mechanical systems or wind.

NOTE: WALLTITE is the sole polyurethane <u>insulation / air barrier system</u> listed by CCMC for institutional, commercial, industrial and residential. So our product meets these requests. Ref:

- **CCMC # 12840-R for insulation**
- **CCMC # 12877-R for air barrier material**
- **CCMC # 12932-R for insulation / air barrier system**

9.25.3.3 Continuity of the Air Barrier System

1) Where the air barrier system consists of an air-impermeable panel-type material, all joints shall be sealed to prevent air leakage.

2) Where the air barrier system consists of flexible sheet material, all joints shall be

   a) sealed or
   b) lapped not less than 100 mm and clamped, such as between framing members, furring or blocking and rigid panels

3) Where an interior wall meets an exterior wall, ceiling, floor or roof required to be provided with air barrier protection, the air barrier system shall extend across the intersection.

4) Where an interior wall projects through a ceiling or extends to become an exterior wall, spaces in the wall shall be blocked to provide continuity across those spaces with the air barrier system in the abutting walls or ceiling.
5) Where an interior floor projects through an exterior wall or extends to become an exterior floor, continuity of the air barrier system shall be maintained from the abutting walls across the floor assembly.

6) Penetrations of the air barrier system, such as those created by the installation of doors, windows, electrical wiring, electrical boxes, piping or ductwork, shall be sealed to maintain the integrity of the air barrier system over the entire surface.

7) Access hatches installed through assemblies constructed with an air barrier system shall be weatherstripped around their perimeters to prevent air leakage.

NOTE: As we could read, an air barrier system is not an easy job to reach. WALLTITE is less prone to workmanship error than any other material. Given the realities of construction it is difficult to believe that any other system than WALLTITE insulation / air barrier system could be installed in the absence of continuous inspection, to meet these criteria. With WALLTITE, we combined a high insulation value with an air barrier system continuity enables heating, ventilating and air-conditioning system to perform to specification and keep occupants more comfortable. We will achieve a gap-free, airtight, monolithic envelope of low permeability that adheres tenaciously to virtually all surfaces, smooth or irregular.

9.25.4 VAPOR 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) Vapour barriers shall have a permeance not greater than 60 ng/(Pa.s.m^2) measured in accordance with ASTM E 96, “Water Vapour Transmission of Materials,” using the desiccant method (dry cup).

NOTE: WALLTITE at a certain thickness applied on certain substrate sprayed on the exterior side meet this criteria so it should be located properly within the wall assembly because our product will act as the vapour barrier. (Refer to our Section Vapour Permeance (Yes or No) and also on our Technical Data sheet where all the information is available.