BASF
WALLTITE®

VAPOUR PERMEANCE

The use and specifications of **WALLTITE®** sprayed-in-place polyurethane foam as a vapour barrier must be accomplished in a manner appropriate for the occupancy of the building.

Buildings designed according to Parts 3,4,5, and 6 for Group A through F occupancies (of specified area or height) allow greater flexibility in materials and systems than is provided by equivalent requirements in Part 9, Housing and small buildings.

Issues relating to the vapour permeance of **WALLTITE®** sprayed-in-place polyurethane foam focus primarily on its ability to perform the function as the vapour barrier in a wall assembly. Testing at the National Research Council of Canada (NRC) definitively establishes that sprayed-in-place polyurethane foam insulation meets the intent of the National Building Code 1995 with respect to vapour barriers. Herein we will define and discuss the issues, beginning with a review of the pertinent NBC 1995.

PART 5 OF THE NBC 1995 deals with wind, water and vapour protection in a building. **APPENDIX NOTE A-5.3.1.2** " Material and Component Properties and Condensation" reads... " 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 mold and fungi". Condensation occurs on or within a material whose temperature is at or below the dew point. Moisture transfer occurs through two processes, namely air leakage (which accounts for over 90% of moisture movement through the building envelope) and vapour diffusion. Since **WALLTITE®** is approved as an air barrier system under **CCMC # 12932-R,** with **WALLTITE®** spray-applied polyurethane foam, air leakage has already been addressed.

SECTION 5.5.1.1 of the 1995 NBC states...

1.) "...Where a building component or assembly will be subjected to a temperature differential and a differential in water vapor pressure, the component or assembly shall include a vapour barrier."

2.) "...A vapour barrier is not required where it can be shown that uncontrolled vapour diffusion will not affect any of...
- A.) The health and safety of the building users
- B.) The intended use of the building, or:
- C.) The operation of building services".

SECTION 5.5.1.2 VAPOUR BARRIER PROPERTIES AND INSTALLATION states...

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 content by diffusion, to surfaces within the assembly that would cause condensation at the design temperature and humidity conditions, to a rate that will not

allow sufficient accumulation of moisture to cause deterioration or otherwise adversely affect any of...
i.)The health or safety of building users
ii.)The intended use of the building, or
iii.)The operation of building services".

2) "...Where materials installed to provide the required resistance to vapour diffusion are covered in the scope of the standards listed below, the material shall conform to the requirements of the respective standards:
a) CAN/CGSB-51.33-M, Vapour barrier sheet, excluding polyethylene, for use in building construction and…
b) CAN/CGSB-51.34-M, Vapour barrier, polyethylene sheet for use in building construction".

NOTE: Clearly since **WALLTITE®** is not a prefabricated sheet material and therefore not covered in the scope of the above standards, it must meet the criteria outlined in article **5.5.1.2(1)** stated above with respect to vapour permeance.

APPENDIX NOTE A-5.5.1.2 (2) states... "It is important to note that sentence **5.5.1.2 (2)**, pertaining to materials intended to provide resistance to vapour diffusion, is stated in such a fashion that the selection of materials **is not limited** to those traditionally recognized as vapour barrier materials or those for which a standard is identified. This approach permits more flexibility than is provided by the equivalent requirements in Part 9. **So long as the selected material meets the performance requirements provided elsewhere in the Section, the material may be used to provide the necessary resistance to vapour diffusion".**

NOTE: It should be noted that references to either a Type 1 or Type 2 vapour barrier are not included in this section as the designations are used to classify sheet vapour retarders **only.**
1)This section of article **5.5.1.2** does not relate to sprayed polyurethane foam.

2)Coatings applied to materials other than gypsum wallboard to provide required resistance diffusion shall be shown to conform with the requirements of sentence (1) when tested in accordance with **ASTM E-96,** "Test methods for water vapour transmission of materials" by desiccant method (dry cup).

NOTE: The issues today surround the contention that a vapour barrier must have a permeance of 15 ng/pa•s•m^2 to perform the function of a vapour barrier in a wall assembly. We know that this is not the case. The performance based specification of **Part 5** and the appendix of the NBC 1995 further acknowledge this!

Testing was performed at the National Research Council of Canada on sprayed-in-place polyurethane foam applied to concrete block wall surfaces. These tests included first measuring vapour permeance on the whole system (a composite of the foam and the substrate) and subsequently, measuring vapour permeance on each of its components separately. Each test involved three specimens tested in accordance with **ASTM E-96**:

RESULTS (AVEG)

MATERIAL	**THICKNESS (mm)**	**PERMEANCE Ng/Pa•s•m^2**
SPRAY POLYURETHANE	**26.5**	**143**
CONCRETE BLOCKS (web)	**21.8**	**271**
POLYURETHANE ON BLOCK	**48.3**	**36.4**

The results clearly showed that the sprayed-in-place polyurethane foam applied to the surface of concrete blocks has a much higher resistance toward water vapour transmission than the

sum of the values obtained on each of the components tested separately. The vapour permeance of the interface layer and the masonry substrate is very significant. The study estimates that this interface layer alone can provide resistance to diffusion of 60 ng/Pa.s.m^2.

Further, the study goes on to calculate that the vapour permeance for the following thickness of sprayed-in-place polyurethane foam (**SPUF)** on concrete block back-up:

50 mm SPUF/CONCRETE BLOCKS	**29.5 ng/Pa.s.m^2**
75 mm SPUF/CONCRETE BLOCKS	**24.6 ng/Pa.s.m^2**

50 mm SPUF/EXTERIOR DRYWALL	**52 ng/Pa.s.m^2**
75 mm SPUF/EXTERIOR DRYWALL	**39 ng/Pa.s.m^2**

The NRC then applied these results to a hygrothermal computer model of vapour diffusion through this system. They used climatic conditions for the island of Montreal for a 52 week period. The analysis of the results obtained concludes that the SPUF progressively became drier throughout the year covered by the simulation. These studies without a doubt demonstrate that the SPUF applied to concrete block back-up meets the 1995 NBC requirement stipulated in **sentence 1 and 4 of section 5.5.1.2 (Vapour barrier properties and installation).**

We have taken this one step further by having **Trow Consulting Engineers Ltd.** Accompany us to perform two separate site investigations in the London, Ontario area, (**Trow project: L05112BSC).** Retained samples were sent to ORTECH for analysis **(Report # 98-IMS-022**).

This investigation looked at core samples taken from cavity wall installations, left exposed to the elements to facilitate a thorough investigation. The results for the "Labourers Training Facility" an institutional building, installed in December 1994, show that **WALLTITE®** had a moisture content by weight of **0.72%.** What does that mean? Well, at 2.37 lb/ft^3 in-situ density measured from the sample, the weight of foam would be 0.3 lbs, and the weight of the water in the sample would be **0.002 lbs!** To put this in perspective, this is equivalent to **0.0000341 gallons** of water per square foot of wall area. **Trow's** investigation also revealed that the foam was "well adhered to the substrate, dry to the touch with no visible evidence of moisture on the sample or in the hole", the interface between the foam and the concrete block wall was dry!

The results of our tests and the research of the NRC (published in the "Journal of Thermal Insulation and Building Envelopes" Vol. 21, issue 3, 1998) are conclusive: even a thin application of sprayed-in-place polyurethane foam will perform the function of vapour barrier for institutional buildings.

BENEFITS

WALLTITE® sprayed-in-place polyurethane foam is the premium insulation/air barrier system and vapour barrier (under certain conditions) system being installed for many applications in the building envelope today. None is more critical than masonry cavity walls, a very popular wall design for any number of buildings ranging from institutional through commercial and industrial. **WALLTITE®** has been used extensively for this application for many years. Its success has not been an accident.