NEW TEST METHOD PROTECTIVE COVERINGS FOR FOAMED PLASTICS

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TOPICS

- Building Code
- Why the need for a new method
- Thermal Barriers vs. Protective Coverings
- CAN/ULC S-124 vs. CAN/ULC S-145
- Results of NRC testing acceptable solutions

BUILDING CODE

9.10.17.10. Protection of Foamed Plastics

1) foamed plastics that form part of a wall or ceiling assembly shall be protected from adjacent space in the *building*,
    a) by one of the interior finishes described in Subsections 9.29.4. to 9.29.9.,
    b) provided the *building* does not contain a Group C *major occupancy*, by sheet metal
    c) by any thermal barrier that meets the requirements of Sentence 3.1.5.15.(2).

BUILDING CODE

3.1.5.15. Foamed Plastic Insulation

2) is permitted in a *building* required to be of *noncombustible construction*, provided the insulation is protected by a thermal barrier consisting of

a) not less than 12.7 mm thick gypsum board mechanically fastened to a supporting assembly independent of the insulation,

b) lath and plaster, mechanically fastened to a supporting assembly independent of the insulation,

c) masonry,

d) concrete, or

e) any thermal barrier that is tested in conformance with CAN/ULC-S124, "Standard Method of Test for the Evaluation of Protective Coverings for Foamed Plastic."

BUILDING CODE

3.1.5.15. Foamed Plastic Insulation

3) permitted in the **exterior walls** of a *building* required to be of *noncombustible construction* **that is not *sprinklered*** and is **more than 18 m high,** provided the insulation is protected from adjacent space in the *building* by a thermal barrier consisting of

a) gypsum board not less than 12.7 mm thick,

b) lath and plaster, fastened to a supporting assembly independent of the insulation,

c) masonry or concrete not less than 25 mm thick, or

d) any thermal barrier that does not develop an average temperature rise **more than 140°C or a maximum temperature rise more than 180°C** at any point on its unexposed face within 10 min

BUILDING CODE

3.1.5.15. Foamed Plastic Insulation

4) is permitted in the **interior walls, within ceilings and within roof assemblies** of a *building* required to be of *noncombustible construction* that **is not *sprinklered*** and **is more than 18 m high,** provided the insulation is protected by a thermal barrier consisting of

a) Type X gypsum board not less than 15.9 mm thick,

b) non-*loadbearing* masonry or concrete not less than 50 mm thick,

c) *loadbearing* masonry or concrete not less than 75 mm thick, or

d) any thermal barrier that does not develop an average temperature rise more than **140°C or a maximum temperature rise more than 180°C** at any point on its unexposed face within 20 min, and remains in place for not less than 40 min.

WHAT ARE THERMAL BARRIERS

1

While the term *thermal barrier* is not a defined term in the building code in Canada, a thermal barrier is generally considered to be a product which has been tested and classified in accordance with CAN/ULC-S124 as described in the building code.

2

The overall intent of the building code is: To protect the foam plastic insulation in order to limit the probability that the foam plastic insulation will **ignite and contribute to early fire growth and spread of fire.**

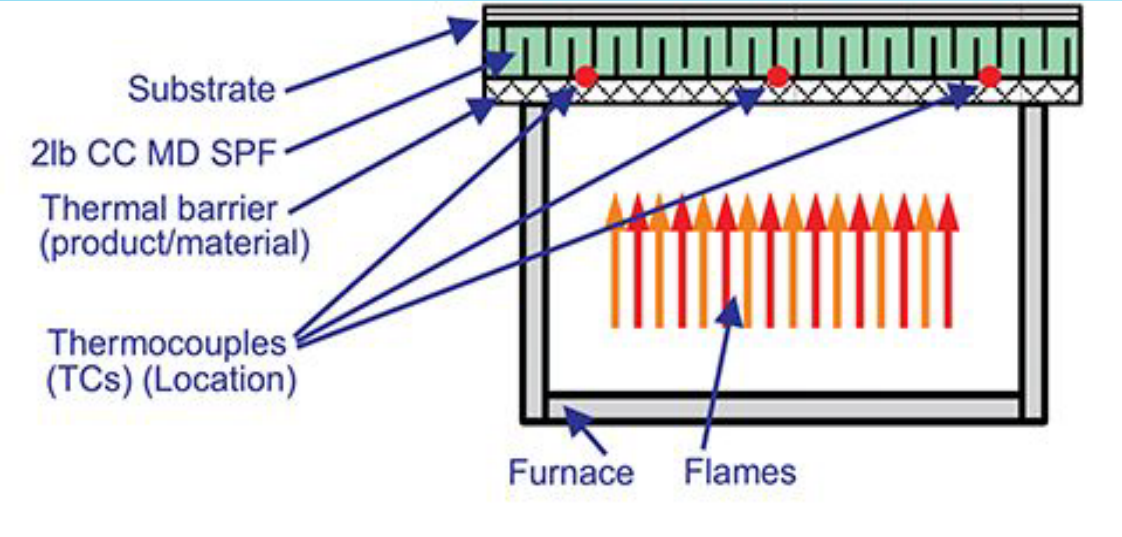
3

Thermal barrier test methods are based on the concept that if the polyurethane foam insulation, at the interface with the protection, does not reach an average temperature rise of 140°C, then it will not contribute to early fire growth.

4

The prescriptive criterion of temperature rise is based on measurements of traditional panel products, i.e gypsum board or plywood coverings.

CAN/ULC S-124 THERMAL BARRIER TEST METHOD



- Small Scale 700 mm X 700 mm exposed area
- Measures temperature at interface of foam plastic and thermal barrier
- developed to respond to the need for a small-scale cost-effective test to assist in the evaluation of the materials used as thermal barriers.
- No provision for flame spread or smoke development (needs ULC S-102 assembly test)
- **It needs to be noted that some performance characteristics, such as the stability of the protective covering is not evaluated in this test method.**

SO WHY THE NEED FOR A NEW METHOD

Intumescent coatings typically do not satisfy thermal barrier criteria since they require temperatures above the limitations of S-124 to react to the heat, expand to form a char layer which insulates and protects the substrate.

This does not mean intumescent coatings cannot be effective; it simply means that the test methods have been developed with certain types of products in mind. (thermal mass)

During this initial period, the temperature rises at the interface between the intumescent coating and the foam plastic may exceed those specified in CAN/ULC-S124.

Intumescent coatings must be applied at significantly higher thickness to “shield” the temperature sensor from the heat source during its initial heating. While more coating may seem like a safer solution it is critical to understand the thicker wet film application rate will result in a significantly thicker intumescent, which may negatively impact the products ability to remain in place.

DEVELOPMENT OF THERMAL BARRIER TEST METHOD

During the original research that was conducted at the National Research Council (NRC) in the development of the thermal barrier test method, later becoming CAN/ULC-S124, several experiments were conducted on different board products under two scenarios:

- A room corner test complete with two 8-foot-high walls, a ceiling and a burner in the corner at floor level. The set-up represents a fire starting in the corner of a room in a wastepaper basket or other similar item burning.

AND

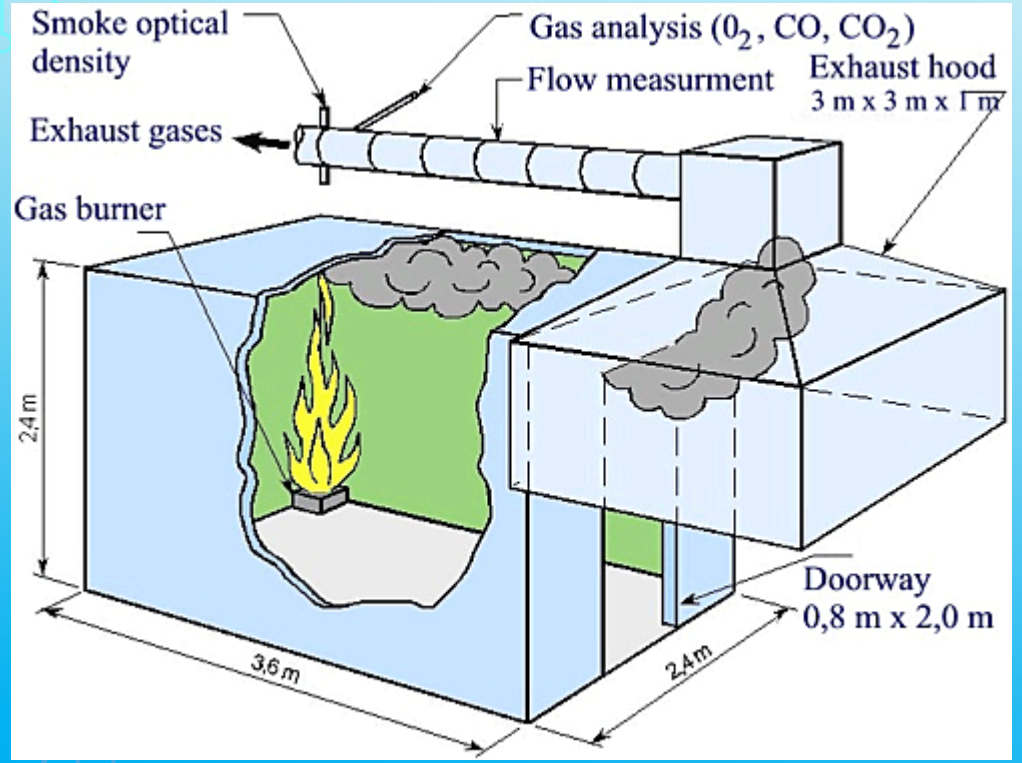
- A small electric vertical furnace which exposes a section of wall to the same fire exposure as that used in CAN/ULC-S124.

The research found that the temperature between the gypsum board protection and the foamed plastic insulation was comparable between the furnace exposure and the hottest location measured in the room corner test.

ENTER CORNER ROOM TESTING CAN/ULC S-145

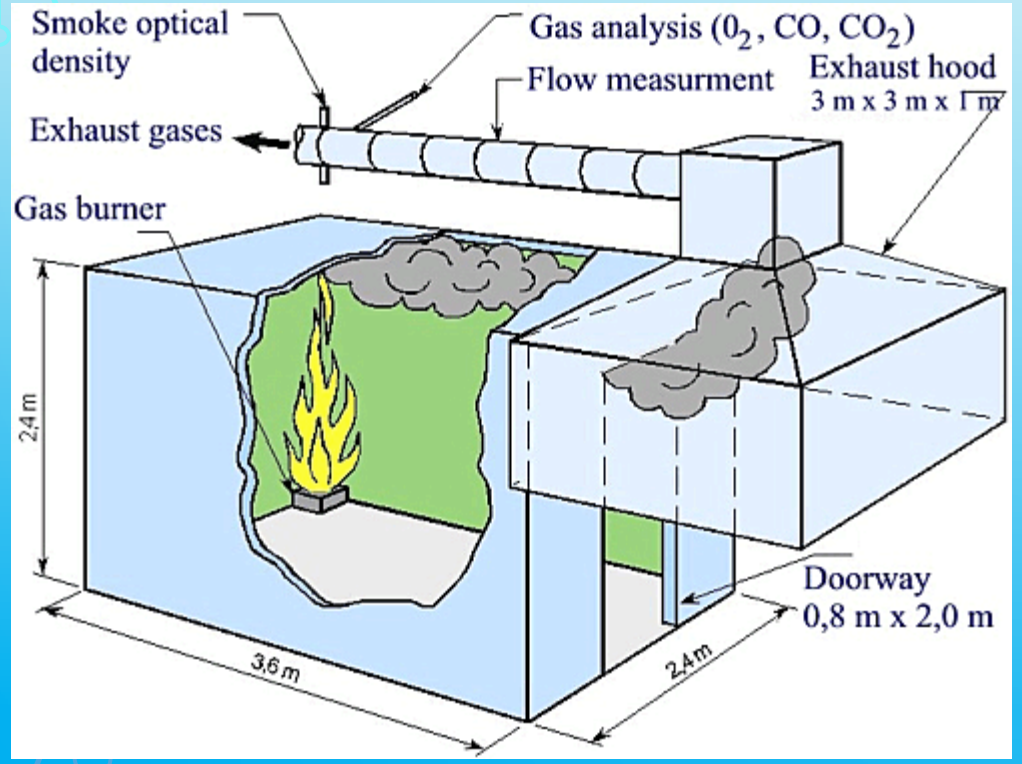
- "T.T. Lie. Fire Study - Contribution of protected foam plastics to fire growth." reports the thermal protection provided by barrier products was evaluated **in the furnace test and the room corner test and was found to be comparable.**
- Corner room testing already referenced in NBCC Section 3.1.5.7 which specifies the CAN/ULC-S138, "Standard Method of Test for Fire Growth of Insulated Building Panels in a Full-Scale Room Configuration,"
- Given the CAN/ULC-S124 criteria is based on room corner test results and NBCC already recognizes corner room as an acceptable test method, if there are reasons why a product cannot be tested to CAN/ULC-S124, clearly the room corner test is the appropriate test method to demonstrate performance
- **CAN/ULC S-145-18 STANDARD METHOD OF TEST FOR THE EVALUATION OF PROTECTIVE COVERINGS FOR FOAMED PLASTIC INSULATION – FULL-SCALE ROOM TEST**

CAN/ULC S-145 FULL SCALE ROOM TEST PROTECTIVE COVERINGS



- Large Scale test specimen 3.6M X 2.4M X 2.4M Room
- Fully evaluates the fire protection performance as well as the ability for the protection to remain in place for the specified duration.
- Determines the contribution to fire growth of protective coverings over **specific types** of foamed plastic insulation.
- This test method measures the time to flashover under specified test conditions.

CAN/ULC S-145 FULL SCALE ROOM TEST PROTECTIVE COVERINGS



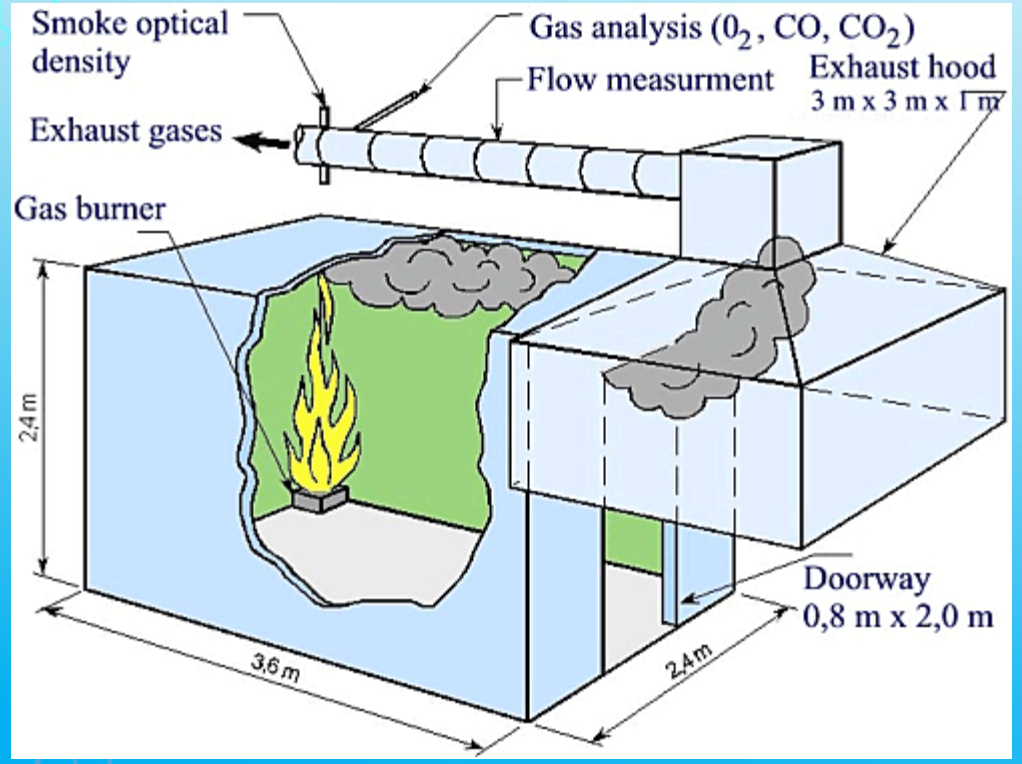
IGNITION SOURCE

- The ignition source shall be a propane gas burner having a square top surface layer of a porous, inert material. e.g. sand.
- The burner shall be placed on the floor in a corner opposite to the doorway wall. The burner walls shall be in contact with the specimen

BURNER OUTPUT

- The net heat output shall be 100 kW during the first 10 min after ignition and
- then shall be increased to 300 kW for an additional 10 min.

CAN/ULC S-145 FULL SCALE ROOM TEST PROTECTIVE COVERINGS



- Instrumentation in the room and exhaust flue measures heat release rate (kW), total heat release (MJ) and smoke production rate (m^2/s).
- The flashover phenomenon, flame spread and burning droplets, toxic gases are also measured.
- This test method provides for classifications of 10 min for use in combustible construction and 20 min for use in non-combustible construction,
- are not the same as classifications prescribed in CAN/ULC-S124, Standard Method of Test for the Evaluation of Thermal Barriers for Foamed Plastic

FLASHOVER TIMES FOR TESTED MATERIALS

NBC prescribed *Acceptable Solution*			CCMC-evaluated DC315 *Alternative Solution*		
Code provision	**Acceptable material**	**Full-scale fire performance (m:ss)**	**Primer**	**DC315**	**Full-scale fire performance (m:ss)**
3.1.5.15.(2)(a)	12.5 mm regular gypsum	20:00	3 mil	24 mil	20:00
3.1.5.15.(2)(b)	Lath and plaster	--			
3.1.5.15.(2)(c)	Masonry	--			
3.1.5.15.(2)(d)	CAN/ULC-S124 compliant thermal barrier	14:10			
9.29.4	Plastering	--		20 mil	11:00
9.29.5	9.5 mm Gypsum board	--			
9.29.6	Plywood	1:18 to 3:03			
9.29.7	Hardboard	--			
9.29.8	Insulating fibreboard	0:59			
9.29.9	Particleboard	2:20 to 2:36			
	Oriented strand board (OSB)	2:15			
	Waferboard	--			

CORNER ROOM TEST WITH ULC S-124 THERMAL BARRIER

CORNER ROOM TEST WITH INTUMESCENT COATING PROTECTIVE COVERING

COMPARATIVE FIRE PERFORMANCE OF INTUMESCENT COATING TO PART 9 PRESCRIPTIVE SOLUTIONS

- Generic interior finish materials lasted between 1 minute and 3 minutes when tested to CAN/ULC S-145 corner room test
- In the intumescent coating test no flashover was observed in the initial 10 minute test period with the 100 kW burner output, the results indicate that the intumescent coating limited the ignition of the foamed plastic insulation and its involvement in the fire such that the contribution of the foamed plastic insulation was less than that for typical cellulosic board materials that are acceptable solutions in the NBCC
- Therefore, the intumescent coated foamed plastic insulation system exceeds the performance of typical cellulosic board materials specified in NBC 9.10.17.10 and 3.1.4.2. for use as coverings for foamed plastic in combustible construction.

COMPARATIVE FIRE PERFORMANCE OF INTUMESCENT COATING TO ½” GYPSUM BOARD

12.7 mm gypsum board prescribed in 3.1.5.15 (2) met the full 20 minute duration of the CAN/ULC S-145

- In the intumescent coating test no flashover was observed in 20 minutes, the results indicate that the intumescent coating limited the ignition of the foamed plastic insulation and its involvement in the fire to the extent that it was comparable to regular 12.7 mm thick gypsum board allowed to be used as thermal barriers.
- As such, the intumescent coated foamed plastic insulation system provides comparable performance to 12.7 mm regular gypsum board specified as a thermal barrier for foamed plastic in NBC 9.10.17.10, 3.1.4.2 and 3.1.5.12.(2) and (3)

COMPARATIVE FIRE PERFORMANCE OF INTUMESCENT COATING TO ULC S-124 MATERIAL

CAN/ULC S-124 material prescribed in 3.1.5.15 (2) failed at 14 minutes when tested to CAN/ULC S-145 whereas the Intumescent Coating met the full 20-minute duration of CAN/ULC S-145.

- When the burner stopped at 20 min, the gas temperature dropped rapidly.
- The oxygen concentration returned to the ambient concentration when the burner stopped.
- The HRR measurement followed the heat output of the ignition burner, which indicated minimal burning of the SPF during the test.
- The temperatures measured between the intumescent coating and the SPF on the ceiling were much lower than the gas temperatures measured near the ceiling of the room.
- This indicates that the interior materials were not ignited although they were exposed to the heat from the ignition burner for 20 min.

COMPARATIVE FIRE PERFORMANCE OF INTUMESCENT COATING TO CAN/ULC S-124 COMPLIANT MATERIAL

- In comparison with the performance of the intumescent coating in the room scale fire test did not result in flashover at 20 minutes, while the CAN-ULC S 124 compliant cementitious coating demonstrated lesser performance lasting 14 minutes when flashover occurred.
- Since flashover was observed during the cementitious coating test, the results indicate that the cementitious coating failed to limit the ignition of the foamed plastic insulation and its involvement in the fire.
- The contribution of the foamed plastic insulation to fire growth was quite significant in the cementitious coating test, unlike the intumescent coating test in which the foamed plastic insulation was protected for the 20 min test duration.
- These results also indicate that the corner room test method is more severe than the CAN-ULC S 124 as the intent is to provide equivalent performance to 12. 7 mm gypsum board.
- These results confirm that performance-based CAN/ULC S-145 full-scale room test method is an appropriate test method to properly evaluate the performance of a protective covering in limiting contribution of SPF to fire growth and severity.

CONCLUSION

- Corner room testing is seen as Gold Standard by International Community
- Far more robust test that CAN/ULC S-124
- Fully evaluates ability of covering to remain in place for specified duration
- Includes requirements for and limits the maximum amount of smoke developed during the test
- Comparative fire testing establishes performance to current acceptable solutions
- Applicable to specific type of foamed plastic tested i.e thermoset vs. thermoplastics
- Unanimously approved by standing committee on fire protection for addition to 2024 NBCC

NEW TEST METHOD PROTECTIVE COVERINGS FOR FOAMED PLASTICS

THANK YOU!