Tests by Test Type

SECTION ONE
Fire Retardant Tests

A. UBC 26-3, FM 4880 Room Corner Test

This test was originally designed to evaluate a product's ability to reduce or eliminate fuel contribution, flame spread and prevention of flashover within a room.
The test is performed inside an 8'x12' room with 8' ceilings using an ignition source consisting of a 30-pound wood crib. The walls and ceiling of each room was paneled with plywood, which is commonly found in building structures, as many buildings have wood paneling in their interiors. Additionally, wood is highly combustible, thus making the test a worst-case scenario.

To our knowledge, no other product has passed the UBC 26-3 room corner test on the following substrates:

- 5 ½" low density open-cell foam.
  - Report Number RAD-3321

- 5/8" AC plywood
  - Report Number WFC 0400

B NFPA 286 Room Corner Test

This test standard is designed to evaluate a product's ability to reduce or eliminate fuel contribution, flame spread and prevention of flashover of foam products within a room.
The test is performed inside an 8'x 12' room with 8' ceilings using an ignition source consisting of a gas powered sand burner generating a 50kw heat source for 5 minutes and 160kw for 10 minutes. The walls and ceiling of each room are coated with 3 inches of foam on the walls and 51/2 inches of foam on the ceiling, with a foam coating thickness variation of plus or minus ½ inch. This stringent test standard has been adopted by NFPA as a result of the dramatic foam fires that have occurred and continue to occur with the increased use of foam products in building structures.

- 1.9 lb density closed cell polyurethane foam.

C. UBC 8-2, Room Corner Test

This test was originally designed to evaluate a product's ability to reduce or eliminate fuel contribution, flame spread and prevention of flashover within a room. The test is performed inside an 8'x12' room with 8' ceilings using an ignition source consisting of a gas powered sand burner generating a 40kw heat source for 5 minutes and 150kw for 10 minutes. Firefree 88 was tested on numerous highly volatile wood substrates shown below and, in each case, the test showed no material flame spread, smoke development or room flashover

- 5/8" Douglas fir; test resulted in no flame spread, smoke or room flashover. University of California, Forest Products Laboratories @ Berkeley.
- ½" Masonite board siding. University of California, Forest Products Laboratories @ Berkeley.
- Cedar shingles. University of California, Forest Products Laboratories @ Berkeley.
- ¼" Mahogany paneling. University of California, Forest Products Laboratories @ Berkeley.
- 7/16" Oriented Strand Board siding. University of California, Forest Products Laboratories @ Berkeley.
- 7/16" Lap siding. University of California, Forest Products Laboratories @ Berkeley.

D. FM 4975 Ceiling Test

This test measures the rate at which fire will travel on a ceiling and shows a product's ability to prevent smoke, flame spread and heat release across an expansive ceiling area such as would be found in a large industrial building. In the tests we used highly combustible substrates to show the product's ability to perform on other substrates, which are less combustible. To our knowledge, no other coating has ever passed this test for this range of substrates. The substrates tested, and passed, were:

- 1x4 T&G Fir
- ½" cellulose ceiling ties
- ½" gypsum

E. ASTM E-84, Steiner Tunnel Test

The first generation of fire coatings ("fire retardants") were based on the now obsolete concept that fires spread mainly horizontally. Thus, these coatings were designed to slow the horizontal progress of a fire and were only required to pass the ASTM E-84, Steiner Tunnel Test.

The E-84 test is used as a means of measuring flame spread and smoke over a horizontal surface for a period of 10 minutes with an 80kw energy source, resulting in either a class A, B or C rating. With the use of Firefree 88 coating, the following materials have been tested under this criteria and have a class A rating.

- 1x4” T&G Douglas fir. Report No. Omega 15810-111045
- 7/16” Oriented Strand Board. Report: UL 14654
- 1/2” Cement board. Report: OMEGA 15810-110128
- 1 ½” Fiberglass/Foam PVC acoustic panels. Report: (SW Laboratories) SWRI 01-6739-144a
- 2” Foam Co-polymer. Report: OMEGA 16941-118444

SECTION TWO
Fire Resistant Tests
(ASTM E-119 CAN & ULC-S101, AS1530.4)

This test is the standard time/temperature curve based on post flashover conditions. The test measures the ability of wall and partition systems, floor ceiling and roof ceiling systems to stop flame or hot gases penetrating thru the assembly. Assemblies are tested under time (1 hour or more) and temperature (1800°F or more) conditions. Assemblies are tested under loaded and non-loaded conditions.

The test is conducted as follows: The wall or ceiling assembly is placed either vertically or horizontally on one side of an oven. Thermocouples (temperature recorders) are placed on the exterior side of the assembly to record temperatures passing thru the wall and ceiling assemblies. On the opposite side, 24 gas flames that can reach over 2,000 degrees blast away at the assembly for up to two hours or more. These flames are thrown at the wall trying to incinerate the entire wall. In almost all cases, an unprotected wall will collapse. What makes FF88 so impressive is that our coating reflects the heat away from the wall keeping the temperature of the wall in a safe range. The wall or ceiling is kept structurally intact. Firefree88 testing is always conducted in “real world” conditions.

I. WALL ASSEMBLIES - 1 HOUR

A. Sheetrock

- ½” sheetrock 2x4 wood studs @ 16” o.c. Report number WFC 00089 T1&T2
- ½” non-rated sheetrock over 1 ½” metal studs @ 16 oc. non-load bearing. Test performed at CSIRO, Australia.
- 5/8” sheetrock 2x4 wood studs @ 16”o.c. (Gypsum lawsuit). Report number WFC 99064

B. Lath & Plaster

- 1" thick plaster attached to metal wall studs @ 16"o.c. WFC engineering analysis; 666 Folsom Street project. San Francisco, CA.
- ½" wood lath & plaster, 2x4 wood studs @ 16"o.c. Report number WFC 01084

C. Wood

- 5/8" fire treated plywood each side of 6" metal studs. WFC engineering analysis; Meyer store # 222 project.

- ¾" T & G wood veneer over 5/8 gypsum, over wall studs. WFC engineering letter. Nordic Log Homes project. .

- (12.5mm) ½" T&G pine weatherboard at both sides of 90mm x 45mm (2"x4") studs @ 450mm on center (16"o.c.). Testing performed @ CSIRO Australia Standard (1530-4). Report FSV-0989

- ½" Exterior plywood shear wall over 2x6 studs @ 16" o.c. WFC engineering letter. Plywood shear walls project. Seattle, WA.

- 7/16" timberline hardboard siding on stud wall. Report: WFC No. 01003

II. WALL ASSEMBLIES - 2 HOURS

A. Sheetrock

- 1 layer 5/8" sheetrock non-load bearing on 2x4 wood studs @16"o.c.
  - WFC engineering letter.

- 2 layers 5/8" sheetrock, loaded stud wall with 9 built in defects.
  - Report: SIP No. 35.04.439 University of California, Forest Laboratory.

- 10 gage metal plate
  - Report WFC 99053

III. CEILING ASSEMBLIES – 1 HOUR

A. Sheetrock

- 5/8" type-X sheetrock, single layer on 2x10 joists @ 16"o.c. with defective nailing, with 5/8" T &G Plywood sub-floor. Report: WFC No. 99053 3.T1

- 5/8" single layer 5/8" type-X sheetrock on 2x10 joists @ 24"o.c. with defective nailing with 5/8" T &G Plywood sub-floor. Report: WFC No. 99053 2.T3.

- Single layer 5/8" type-X sheetrock over RC channel @ 24"o.c. with 2x8 joists @ 16"oc. with ¾" T&G Plywood sub-floor. Report: WFC No. 99067 T4.

- Single layer 5/8" type-X sheetrock over RC channel @ 24"o.c. with 9 ½"-250 series TJI @ 19.2"oc. Report: WHI-495-PSH-0245, Intertek Testing Services.

- Single layer 5/8" type-X sheetrock on BCI 450 series. I joists @ 16"o.c. with defective nailing. Report: WFC No. 00019 T3.

B. Wood

- Exposed 2x6 T &G Pine with 3" Polyisocyanurate foam, 2x4 sleepers & ½" CDX Plywood sheathing. Report: WFC No. 99079 T2.

- Exposed full dimensional 2x10 joists @ 16"o.c. with 1 3/4" wood sub-floor with 3 ½" fiberglass insulation @ joists. WFC engineering letter. Mercy Gardens project. San Diego, CA

- Exposed full dimensional 2x10 joists @ 16"o.c. with exposed 1¾" wood sub-floor.
  WFC engineering letter. Structural engineering calculations: Ron Loar, P.E. Women's Facility Center project, Tacoma, WA

- 2x14 joists @ 16"o.c. with 2 layers. ¾" Plywood sub-floor with 3 ½" mineral wood insulation between joists with suspended sheetrock ceiling. WFC engineering letter. 37 & 39 South 1st Street project, San Jose, CA.

- 2x4 web trusses @ 24" o.c. with ¾" plywood roof sheathing with 3 ½" polyisocyanurate foam and roof membrane. WFC engineering letter. Ruby's Dinner project, Washington, DC.

- Assorted glue lam beams; 2 ¼" minilams; 2x10 joists and 5/8" OSB floor sheathing. Structural engineering calculations: Ron Loar, P.E. Avignon Apartments project, San Jose, CA.

- Roof system, glue lams. Structural engineering calculations: Ron Loar, P.E. Abundant Life Church project, Mountain view, CA.

C. Plaster

- 7/8" plaster over metal lath fastened to trusses @ 24"o.c. with R-30 insulation. WFC engineering letter. Woodland Church project, Sacramento, CA.

D. Embossed Tin

- Embossed tin attached to 1"x2" wood @ 4x10 joists @ 12"o.c. with 1½" wood flooring. Report number 00050 T1

IV. CEILING ASSEMBLIES – 2 HOURS

A. Sheetrock

- Defective U.L assembly BXUV-G524 where ½" type-C was required & ½" non-rated was installed. WFC engineering letter. Sagamore Towers project, Quincy, MA

- Single layer 5/8" type-X sheetrock with nominal 2x10 joists @ 16"o.c. with ¾" plywood sub-floor & ¾" gypcrete. WFC engineering letter. Residence Inn project.

B. Wood

- Exposed 3x10 joists @ 16"o.c. with 4 ¾" wood layered sub-floor. Report number WFC 00124 T1

C. Embossed Tin

- Embossed Tin over 3/8" rock board attached to nominal 3x10 joists @ 16"o.c. with ¼" wood sub-floor with suspended T-Bar ceiling. WFC engineering letter and Structural engineering calculations: Ron Loar, P.E. Westwood Church project.

D. Concrete

- 2 ¾" concrete slab-floor. Report number WFC 01011

V. SHAFT WALLS - 1 HOUR

- ½" Oriented Stand Board (OSB) over 3x6 wood studs @ 16"o.c. with one layer, 5/8" type-X sheetrock @ opposite interior wall. WFC engineering letter. Student/Housing project

VI. DOORS

The test used is the **UBC-7-2**, which is the standard for rating door assemblies for periods of time (20, 45, 60 90 minutes and more). The ASTM E-119 time temperature curve is used in the test criteria as it relates to the length of the test.

- 1 3/8" non-rated solid core door, ASTM E-119, 45 minutes at negative pressure. Warnock Hersey No. WHI-495-1569

- 5/16" mahogany plywood panel (5) in solid wood (1 ¾") rails, 30 minutes at positive pressure. (Singapore) SISIR Report No. 96003

VIII. FOAM/FOAM COMPOSITE PANELS

UBC 26-2, Thermal Barrier Test. This test is performed in a horizontal oven using the first 15 minutes of the ASTM E-119 time temperature curve. The test duration is 15 minutes and used on foam and foam composite panels. The test is designed to test a product's ability to slow the temperature rise of foam during fire situations. The test procedure is the same as used in testing a floor-ceiling or roof-ceiling assembly on the horizontal oven.

- 24 gauge steel exterior skin polyurethane foam interior.
  - Report WFC 99063

- 7/16" Oriented Stand Board (OSB) exterior skin, polystyrene foam interior.
  - Report: WFC 99070

- ¼" Gypsum board skin, polyurethane foam 1/16" fiberglass skin.
  - Report: WFC 01084.T3

- 5 ½" low density open-cell foam.
  - Report No. Rad-3321

SECTION Three – Exterior (Weatherization and Fire testing).

US/California. The exterior weatherization and fire testing program has been established by the California State Fire marshal's office as a means to address fire safety issues concerning the exterior of structures located within the Urban Wildland Interface. The testing criteria is based on studies by the State Fire Marshal's office that determined the major time of a structure's vulnerability from a fire falls within the first 15 minutes from start of both Radiant exposure and flame exposure. It is expected that most states in the US will follow California's lead and set up similar requirements considering the Urban WildLand Interface that encompasses 37% (42M homes) in the US. In addition to other states within the US, Australia, New Zealand, Canada and Europe are following this particular fire code as a model for their states and countries.

The test criteria falls into two categories, (1) weatherization and (2) fire testing.

Weatherization: ASTM D 2898. Using the Method B standard, measures both wet and dry cycles as well as UV (ultraviolet light) to determine the performance time of the coating as to the coating's endurance performance in holding up to weather over time.

Fire Testing: 15 Minute Eave/Wall panel Test This test criteria has been established by the California State Fire Marshall's Office as a fire testing standard in which products are tested upon completion of the ASTM D 2898 weatherization testing. The exterior fire test standard consists of testing a minimum three (3)- four (4) foot wide by eight (8) foot high wall panels with a built in eave overhang as would be found in a typical home or other building construction. The test wall/eave panels are subjected to a 35Kwm2 radiant exposure with a 150Fw flame source hitting the face of the panel and eaves for a period of 15 minutes. This test mimics the critical fire exposure structures are subjected to within the first 15 minutes of a wildland fire.

- Wall/Eave panel test. Western Fire Center.
  - 5/8" T-111 plywood siding
  - Masonite/hardboard siding
  - Redwood/cedar siding
  - Cedar shingles

International. FF Exterior is also fully tested and proven under International Standards. It is the first and only coating to pass the AS/NZS 3837 International standard for weatherization / fire test standard). IFRS selected BRANZ Laboratories, an Internationally recognized weatherization and fire testing laboratory, to obtain approvals for use in the Urban WildLand Interface both in the US and Internationally.

AS/NZS 3837 This test stand has been established by Australia and New Zealand to include both the ASTM D 2898 weatherization testing and the ASTM # 1354-94 Cone Calorimeter fire testing standard to determine a coating products viability to pass both the exterior weathering and fire standards for use as an exterior fire coating. The Cone calorimeter is used to test the coating, upon completion of weatherization testing, to specific radiant exposures to determine the fire performance rating of the coating.

- AS/NZS 3837 Bushfire standard, including ASTM D 2898. Branz Laboratories, New Zealand

SECTION FOUR – International Electric Cable

USA: FM 3971

- Ampacity
- Current carrying capacity
- Salt water exposure
- Dielectric strength
- Flammability test

France: Arrete Ministeriel

- Flammability test

Germany: SOLAS

- Ship approval Germanischer Lloyd

Germany: IEC 332-3

- Flame propagation on coated cables

Great Britain: BS 476,9.7

- Flame spread

Norway: NT Fire 004

- Fire spread

SECTION FIVE - Other Tests

TOXICITY TESTS

A. <u>BSS-7239-88, Boeing Toxicity Test</u>

This test measures materials and products under flaming and non-flaming conditions for levels of carbon monoxide, hydrogen fluoride, hydrogen chloride, nitrogen oxides, sulfur dioxide and hydrogen cyanide. Testing was performed at Omega Laboratories; three of the tested items registered Zero (0). Three of the tested items registered 80%-90% below the minimum safety levels. Omega Laboratories Report # 15810-103929.

- **<u>University of Pittsburgh Test for Combustion Product Toxicity</u>**

This test is performed under flammable smoke conditions in a central chamber using live rats and hampsters to measure the toxicity levels of the product or material being tested. **All animals survived the test procedure.** Anderson Laboratories Report # 497.

B. <u>ASTM E-662-97, Smoke Density Test</u>

This test is used to measure specific optical density of smoke generated by solid materials. Specimens are tested in a closed chamber to both flaming and non-flaming conditions. The test is used by the Department of Transportation in testing foams, fiberglass and other cellular materials. The following materials have been tested and passed the listed criteria.

- Polyurethane foam filters
- Report: OMEGA 16288-108753
- 1/8” fiberglass transit panels
- Report: SGS 164641-2

C. ASTM E-3675-98, Radiant Panel Test

This test is used to measure and compare surface flammability of materials when exposed to a prescribed level of radiant heat energy. The test is used by the Department of Transportation in testing foams, fiberglass and other cellular materials. The following materials have been tested and passed the listed criteria.

- Polyurethane foam filters
  - Report: OMEGA 16288-108756
- 1/8” fiberglass transit panels
  - Report: SGS 164641-1

D. ASTM E-1623, Intermediate Scale Calorimeter (I-Cal)

This test measures heat release, rate of smoke release, heat of combustion and heat of gasification (vaporization). The test also measures ignition temperature and critical flux levels; it is a tool that provides necessary data for computer fire modeling. The following materials were used to determine the comparative performance of coated versus uncoated materials used in a controlled house burn and as an R&D tool to determine the relative performance of coated materials.

- Medium cedar shakes. WFC 98054
- 5/8” T-111 Douglas fir siding
- 5/8” AC plywood
- ½” OSB
- 5/8” sheetrock
- 1/2” cellulose ceiling tiles
- 1/4” mahogany paneling
- 1/4**”** steel plate. WFC 98054
- 2” Polyurethane foam

E. ASTM E-1354-94, Cone Calorimeter

This test measures heat and smoke release rates for materials and products. This test provides a reasonably priced screening method for materials and products in a small scale, laboratory condition to check viability of such materials and products to meet fire code requirements before any full scale fire testing. The following material has been tested under this criteria.

- ¼” fiberglass panels
  - Report: OMEGA 15810-102686