

WSHP Hoses: The Importance of a UL Fire Rating

By Joseph Dorney

Water Source Heat Pump with stainless steel braid and polymeric tubing rated for UL 94.

The demand for fire-rated hoses has increased rapidly in recent years, due to heightened safety awareness, globalization of markets and an increasing emphasis on the use of flame-retardant products. The Water Source Heat Pump (WSHP) system must be effective worldwide, while also satisfying federal, state and municipal fire safety regulations.

Water Source Heat Pump hoses are composed of a few major components. The hose fittings on either end link the hose from the branch line to the heat pump or fan-coil unit. A stainless steel braid on the exterior of the hose itself and the actual tube component make up the remainder. The tube is typically a polymeric material used for fire-rating testing by the American Society for Testing and Materials (ASTM) or Underwriters Laboratories Inc. (UL). This polymer tube component is the most significant and important component of the hose assembly.

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The *International Mechanical Code*® (IMC) requires flexible connectors used in hydronic piping systems to be of an approved type. Additionally, the IMC requires materials within plenums to have a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723.

On Nov. 21, 1980, the second largest life-loss hotel fire in U.S. history devastated the MGM Grand Hotel and Casino in Las Vegas. Eighty-five people died and more than 700 were injured as smoke filled the 26-story highrise structure. This shocking tragedy provided a much-needed wake-up call for the HVAC industry to improve fire safety standards in hotels around the country.

As Richard Best stated in [his investigative report on the fire](#), "Smoke movement through the highrise corridors and into guest rooms through fan-coil units was a significant problem. NFPA 90A prohibits the use of corridors as supply portions of the HVAC system, as was the case in this incident." One significant factor contributing to the fire's rapid spread was the rubber water hose connections through the precast concrete rooms. The building codes were changed substantially to require fire resistance and retardance.

It was around this time that WSHP/fan-coil hose

suppliers began supplying hoses with a stainless steel braid and polymeric/plastic tubing. This setup has quickly become a standard in the WSHP industry, as the flexible hose connections are fire rated. It is a common misconception within the HVAC industry that a hose that has a stainless steel braid is fire rated. This is not always the case.

There are two main fire ratings used within the industry today: UL 94 and ASTM E84. The majority of the HVAC industry publishes that their hoses meet the ASTM E84 testing method. The ASTM E84 test observes flame spread along the surface of development measurements of building materials with that of select-grade red oak flooring and inorganic reinforced cement board surfaces under specific fire exposure conditions. While this test is used to measure the flame spread of a material, this is not the most applicable test method for the industry for a number of reasons. The test is intended for flat specimens, not hose products. Therefore, some hose manufacturers publish their ratings based on a modified ASTM E84 testing procedure.

These modifications include, but are not limited to, leaving a homogenous specimen untested; failure to test a product covering the required area (nominal length of 24 feet, width of 20 inches); and conduct-

ing the test with water flowing through the hose prior to and during the test. These sorts of modifications decrease the validity of a fire-rated hose, and engineers, contractors and inspectors should not accept them.

The ASTM E84 test requires the specimen material cover a nominal 24-foot-long by 18-inch-wide area and is tested for more than 10 minutes. During that time, flames spread over the material's surface, and development of the resulting smoke is measured and recorded. These results then are computed relative to a red oak specimen (which has a rating of 100) and inorganic reinforced cement board (which has a 0 rating), with the results expressed as "Flame Spread" and "Smoke-Developed" indices. Because this test is designed for a flat specimen, coupled with the idea that the results are compared to a sample of red oak/cement board combination, it is obvious that this test is not the best method to determine a fire-rated hose.

A more relevant and applicable standard in the industry is UL 94, a plastics flammability standard released by Underwriters Laboratories in the United States. This standard classifies plastics according to how they burn in various orientations and thicknesses. UL 94 is a vertical burn test widely used for rubber and



plastic materials. In the test, five vertically mounted samples are exposed to two successive 10-second bottom ignitions from a 3/4-inch Bunsen flame. Flame resistance is then classified according to: a) the time for the flame to self-extinguish; and b) the duration of the afterglow.

This test classifies plastics according to how they burn in various orientations and thicknesses – from lowest (least flame-retardant) to highest (most flame-retardant). The classifications are:

- **HB** – slow burning on a horizontal specimen; burning rate <76 mm/min for thickness <3 mm.
- **V2** – burning stops within 30 seconds on a vertical specimen; drips of flaming particles are allowed.
- **V1** – burning stops within 30 seconds on a vertical specimen; drips of particles allowed as long as they are not inflamed.
- **V0** – burning stops within 10 seconds on a vertical specimen; drips of particles allowed as long as they are not inflamed.
- **5VB** – burning stops within 60 seconds on a vertical specimen; no drips allowed; plaque specimens may develop a hole.
- **5VA** – burning stops within 60 seconds on a vertical specimen; no drips allowed; plaque specimens may not develop a hole.



ICC-ES Certification to ASTM E84

ICC Evaluation Service (ICC-ES), the premier building-product certification agency, has been certifying products to the requirements of ASTM E84 for decades. ICC-ES is accredited by the American National Standards Institute (ANSI) and the Standards Council of Canada (SCC). Therefore, ICC-ES' evaluation of products to ASTM E84 is subject to monitoring by these highly respected outside agencies.

The latest edition of the E84 standard is 11a, entitled, "Standard Test Method for Surface Burning Characteristics of Building Materials." The standard provides test methods for surface flame spread and smoke density. The standard compares the aforementioned with that of select grade red oak and fiber-cement board surfaces under certain fire exposure conditions. The specimen tested normally measures 24 feet by 20 inches. Using controlled airflow, fire is introduced along the entire length of the specimen. The test is conducted with the specimen face down in the so-called "ceiling" position. The test results are reported in the form of indices.

ASTM E84 is referenced in a variety of codes, as well as performance standards and other test methods. The normal failure criteria in such codes and standards for many building materials is an index of more than 25 for flame spread and an index of more than 50 for smoke density. However, there are some materials afforded much higher indices.

About ICC-ES

A non-profit, limited liability company, ICC-ES is the United States' leading evaluation service for innovative building materials, components and systems. The ICC-ES [Evaluation Reports \(ESRs\)](#) and [PMG Listings](#) provide evidence that products and systems meet requirements in codes and standards. ICC-ES also issues environmental reports verifying that products meet specific sustainability targets defined by today's codes, standards, green rating systems and industry-reviewed [ICC-ES guidelines](#). The environmental reports take into account codes, such as the [International Green Construction Code™ \(IgCC\)](#) and the [California Green Building Standards Code \(CALGreen\)](#). ICC-ES is a subsidiary of the [International Code Council \(ICC\)](#).

Tests generally are conducted on a 5-inch by 1/2-inch (12.7 cm x 1.27 cm) specimen of the minimum approved thickness. The requirements of UL 94 tests serve as an indication of acceptability with respect to flammability within the HVAC industry. Because UL 94 (yellow card listing number QMFZ2.E80017) tests the flammability of polymeric materials, it is clear that this is the more authoritative and applicable test in determining a WSHP hose fire rating.

There are many reasons why HVAC contractors and engineers should require the UL 94 test instead of the ASTM E84 fire rating. The UL 94 test is more applicable to the industry, as it is used for rubber and plastic materials (ex: EPDM), while the ASTM E84 is used to test the relative burning behavior of any material, with the results being compared to that of red oak flooring/cement board. Additionally, the UL 94 is a more rigorous and thorough test, thus ensuring a much higher-quality product, which inevitably improves the safety of any HVAC system.

In conclusion, the following factors should be considered when choosing a supplier for your HVAC hose assemblies:

- Encourage your local inspector and contractor to move toward UL 94 instead of ASTM E84. Encourage them to request paperwork and test reports on hoses that claim to be fire rated.
- Engineers need to begin “spec-ing” in a quality fire rating, and the inspectors and contractors need to help enforce this movement.
- Spread the word that an HVAC hose with a stainless steel braid is not automatically fire rated.

It is very common for building specs to specifically call for “fire-rated hoses,” but more and more people are spec-ing in UL 94, the more comprehensive of the two main tests. Always make sure that your building has the best safety features available and that the required specifications are being met. **bsj**

Editor’s note: *The flame spread requirement for materials used in plenums in the International Mechanical Code is based on testing in accordance with ASTM E84. ICC is not aware of any analysis of the viability of UL 94 as an alternative to ASTM E84.*

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As always, your articles, ideas and submissions are welcome. Send them to foliver@iccsafe.org along with a daytime phone number at which to contact you with questions.