

Terminal Units



January, 2005



Natural Fiber Duct Liner

This document is intended to educate and prepare you should you find yourself in competition with the Titus Enviroloc liner option. Price does not plan to offer this natural material as a standard or optional terminal unit liner until more research into the accuracy of its performance specifications is completed.

Questionable long term durability

This insulation is made from cotton fibers treated with boron based additives for fire resistance and protection against mold growth. The boron based additives are water soluble so any exposure to moisture may cause disintegration of the most critical properties of the insulation. To make things worse the material exceeds the 3% water absorption ratio allowed by ASTM C 1071 for duct liners. Over time and with excessive moisture gain, the material may become flammable and / or begin to rot, which would constitute a major failure.

Questionable compliance to standards

The natural fiber liner is not registered with EPA and not listed by UL so it is not subject to a certification program, which would require periodical tests of production samples. The manufacturer tested it initially by independent labs, and using the UL and ASTM standards that are listed in its specifications. Due to the lack of UL listing, there is no assurance that production quality is equal to the sample that was tested.

We have obtained two documents alleging that the insulation has failed independent tests, which bring its published specifications into question.

- 1) John's Manville, a nationally recognized manufacturer of liner systems introduced a marketing bulletin in September 2003 (see attachment). In essence, this document:
 - questions long term flammability and molds resistance based on random, independent tests against standard ASTM C 1071 as conducted by several NAVLAP accredited laboratories.
 - elaborates about dramatically escalated moisture gain, and failed corrosion tests, specifically for liner adhered with water based adhesives.
 - indicates non compliance with EPA regulations.
- 2) NAIMA (North American Insulation Manufacturers Association) periodical "Insulation Facts #73" (see attachment) further discusses natural fiber liners as follows:
 - describes escalated water absorption issues and subsequent duct work corrosion propagated by the cotton liner
 - based on independent testing NAIMA discovered that the moisture gain of cotton liner exceeds industry standards by a factor of 16! ASTM C1071 (which every duct liner must meet) allows 3% moisture absorption. Tests conducted by NAIMA indicated 50% absorption in the case of Bonded Logic material. This is most significant when the liner is exposed to the transient moisture from condensation on cold surfaces (e.g. cooling coils). The liner could cause accelerated corrosion of dampers, ductwork, and other metal components within the HVAC system.

Terminal Units



Proprietary Specifications

The Titus Enviroloc liner is currently made by only one manufacturer - Bonded Logic - who has been manufacturing building insulation materials but has very limited experience in HVAC applications. The material is known under three different names:

- Titus - Enviroloc
- Reflectix - Ultra Natural Fiber Duct Liner
- Bonded Logic - Natural Cotton Fiber insulation - Ultra Touch

NOTE: We have seen engineering specifications listing all above as acceptable alternatives. This is misleading and locks specifications into one manufacturer only. Bonded Logic is the sole manufacturer, who distributes this material exclusively through different channels, in various colors (white or blue), and under various brand names as listed above.

No acoustical or thermal advantage

As stated by Titus and confirmed in tests conducted in Price labs, the cotton liner has no acoustical advantage over fiberglass. Thermal conductivity is also consistent with fiberglass.

Misleading claims regarding contribution to LEED certification

The potential for cotton liner to contribute towards LEED credits is not much more significant than any other fiberglass liner.

Titus makes the following claims regarding cotton liners and LEED credits:

1. Credits for regional materials - job site needs to be within 500 miles radius of the plant manufacturing the terminals. Any other liner applied in our factory could qualify for the same credit as long as the job site is not farther away than 500 miles from a Price factory.
2. Credit for Indoor Environmental Quality - job site contractor has to make arrangements to store all absorptive materials to protect them from moisture damage prior to installation. Also, once construction is complete, the building must be flushed out for at least 2 weeks with 100% outside air prior to occupancy. We do not see how the type of terminal unit liner used will make a difference in obtaining this credit.
3. Credit for innovation in design - this could actually be applied to cotton liner more easily than to fiberglass, since cotton could be considered a new technology in HVAC, but the actual magnitude of such a claim is minimal, specifically if the cotton insulation is applied to Terminals only.

Sustainability and recycled content - Products with any recyclable content can contribute to earning LEED credits. The Enviroloc liner material itself could be considered sustainable, since it can be 100% recycled. It is questionable though how much of it could be considered sustainable after adhered into VAV terminals, if any. Fiberglass insulation also has approximately 20% of recyclable content which could contribute towards LEED credit for sustainable materials. The actual cost of each material with recycled content is weighted against the total cost of all building materials and if a certain percentage is reached, LEED points can be awarded. The potential contribution of the Enviroloc liner in VAV terminals towards LEED credit relative to the scale of a complete building is overrated and insignificant.

Terminal Units



Formaldehyde free or Greenguard products - The cotton liner and various fiberglass insulation materials are now available as formaldehyde free and marketed as “low emitting”. (Volatile Organic Chemical VOC). LEED recognizes that all insulation products are low emitting so there are no extra points available for Greenguard or formaldehyde free insulation products. “Low emitting points” usually apply to adhesives, carpets, paint etc.

Other considerations

1. Fiberglass is not considered carcinogenic – In October 2002, following a review of all available scientific literature by a working group of the world’s leading experts on the health and safety of man-made vitreous fibers, the International Agency for Research on Cancer (IARC) has removed glass, rock and slag wool fibers from its lists of substances “possibly carcinogenic to humans”.

IARC emphasizes that “Epidemiologic studies published during the 15 years since the previous IARC monographs review of these fibers in 1988 provide no evidence of increased risks of lung cancer or of mesothelioma (cancer of the lining of the body cavities) from occupational exposures during manufacture of these materials and inadequate evidence overall of any cancer risk”. IARC further stated that “the more commonly used vitreous fiber wools including insulation glass wool, rock (stone) wool and slag wool are now considered not classifiable as to carcinogenicity to humans (Group 3).

2. Cotton based material misapplied in HVAC industry

The cotton duct liner has been developed by simply adding a fabric facing to a cotton insulation meant for building applications. The fabric facing helped to meet air erosion test according to standards such as UL 181. Otherwise, the insulation does not appear to have been re-formulated to match the specific requirements of HVAC applications. HVAC duct liner is directly exposed to the air flow, which is eventually distributed to occupied zones in the building. Building insulation on the other hand is meant to be encapsulated within walls with vapor barriers and very limited exposure to moisture or moving air. Proper development of HVAC liners requires a different scientific approach and involves tests against application specific standards. Price has been in contact with highly reputable HVAC insulation manufacturers, who have tested Bonded Logic material and found it to fail against HVAC standards. This manufacturer attempted to develop a similar liner but has yet to pass all requirements. They may release a new fiberglass free, synthetic liner but a cotton-based equivalent to Enviroloc may never be developed due for the most part, to these issues.

Price must develop confidence in the cotton duct liners currently available on the market before recommending, or endorsing their use.

Terminal Units



Price liner alternatives:

In addition to fiberglass insulation, Price offers a wide variety of liners that have been successfully applied and proven over many years:

- FF - fiber free polymer based foam
- FB - aluminum faced fiberglass
- CRAF - aluminum faced fiberglass with metal angles and end caps covering all insulation edges
- SM - solid metal liner with complete fiberglass coverage
- PM - perforated metal liner with partial fiberglass coverage for acoustical advantage

Final Note:

The most effective way to deflect this competitive threat is to reach specifiers first, and help them see that natural fiber insulation is not a suitable alternative to traditional and proven liners.

A handwritten signature in cursive script that reads "Bogna Gryc".

Bogna Gryc
Design Engineering Manager for Terminals

- encl. 1) John's Manville Marketing Bulletin
- 2) NAIMA insulation facts #73



Terminal Units



Johns Manville

PERFORMANCE MATERIALS

Johns Manville
Performance Materials Division
717 17th Street (80202)
P.O. Box 5108
Denver, CO 80217-5108
303 978-2000

September, 2003

MARKETING BULLETIN

Bonded Logic UltraTouch Duct Liner

This information is being provided to assist JM Territory Managers, Fabricators and their OEM customers as they consider marketing claims made from the scrap cotton duct liner insulation being marketed under the name "UltraTouch" and manufactured by Bonded Logic. This product is being evaluated for both HVAC and acoustic OEM applications.

UltraTouch Physical Property Deficiencies

- Random samples of 1/2" and 1" UltraTouch were subjected to the ASTM C 1071 test series at several NAVLAP accredited laboratories. Results showed significant moisture gain, dramatically beyond the 3% allowed under ASTM C 1071. With prolonged moisture gain, questions should be asked regarding the long-term flammability if the fire retardant additives leach out of the product.
- The product failed the ASTM C-665 corrosion test, a subset of the C 1071 test series. This is a critical test for a material adhered with a water-based adhesive to a metal substrate.

Noncompliance with EPA Regulations

- UltraTouch is advertised in a flyer entitled "Got Mold" in which Bonded Logic states that their product resists mold. JM is informed by U.S. EPA Region 8 legal enforcement officials that they consider the "Got Mold" flyer to be outside the treated article exemption in 40 CFR 152.25 and therefore in violation of Section 12(a)(1)(A) the Federal Insecticide, Fungicide, and Rodenticide Act, 7 U.S.C. Section 136j(a)(1)(A).

Potential Fabricator Difficulties

Bonded Logic cotton product selling prices are consistent with regional pricing for rotary based mat faced equipment liner. This means that the OEM must carefully weigh quality and ease of fabrication in making any purchasing decision. With this in mind, we have learned about several characteristics of UltraTouch that will significantly increase overall OEM costs in comparison with fiber glass:

- The fiber core of UltraTouch is difficult to cut cleanly without creating a substantial amount of dust resulting in potential line/assembly worker irritability and lost productivity.
- Widths are limited to a few common sizes creating the likelihood of substantial scrap for most OEM applications.
- The material does not compress when packaging – rolls are very large and bulky, again producing higher costs due to increased freight and storage costs.
- UltraTouch utilizes a black mat over a white core, a combination that makes highly visible any dirt and damage that can occur from handling and installation.

PRICE®

INSULATION
FACTS
#73

NAIMA
NORTH AMERICAN INSULATION
MANUFACTURERS ASSOCIATION



www.naima.org

Terminal Units

Moisture & Corrosion Performance of Cotton Duct Liner Materials in HVAC Ducts

In this issue, NAIMA reveals the results of moisture and corrosion tests conducted on cotton duct liner

Moisture and corrosion performance characteristics are a major consideration when selecting materials for use in HVAC systems. Properly designed and maintained HVAC systems are subject to high humidity during normal operation. Ducts can be exposed to transient moisture from condensation on cold surfaces such as air conditioning coils and other cold metal surfaces. Cotton is an organic fiber that can absorb and hold moisture for an extended period of time - for this reason duct insulation products made from cotton must be carefully evaluated.

Description

Cotton duct liner insulation is made mostly of recycled denim and cotton fibers that are bonded together using a thermal process.¹ The air stream surface is overlaid with a fire-resistant black facing, which provides additional strength to the product. The materials are chemically treated for fire and microbial resistance.

ASTM Standard C 1071

ASTM is an organization that sets standards for duct liner materials used in commercial and residential construction. The ASTM Standard C 1071 Specification for Fibrous Glass Duct Lining Insulation contains criteria for water vapor sorption (ASTM C 1104) and corrosion (ASTM C 665).

Material Testing

The moisture and corrosion tests required by the ASTM C 1071 standard were conducted to determine if cotton duct liner materials comply with the standard as claimed in product literature.¹ These tests were performed in accordance with the applicable ASTM test standards at testing labs operated by Johns Manville and Owens Corning. These labs are certified by the National Voluntary Laboratory Accreditation Program (NAVLAP). This publication summarizes the results from these tests conducted at the aforementioned labs.

Test #1 — Water Vapor Sorption²

Three samples of 1/2" thick cotton duct liner were tested by NAVLAP-certified labs for water vapor sorption in accordance with ASTM C 1104. This test determines how much water vapor is retained in a sample of the material after being exposed to high humidity.

The cotton duct liner material was exposed to a relative humidity of 95% for 96 hours. The water vapor sorption is equal to wet weight minus dry weight divided by dry weight. In these tests by the NAVLAP-certified labs the cotton materials had an average weight gain of 49%, which is 16 times higher than the 3% allowed by ASTM C 1071. (See Table 1).

Test #2 — Corrosion³

Materials used in HVAC systems are in direct contact with metal in nearly every application. Samples of cotton duct liner were tested on steel, copper and aluminum in accordance with the corrosion test requirements in ASTM C 665. This test demonstrates a material's likelihood to cause corrosion on steel, copper and aluminum.

In addition to the materials listed in the ASTM C 665, galvanized steel was also tested as it is the material that is typically used to fabricate sheet metal duct work.

Specially cleaned plates of steel, galvanized steel, and aluminum were sandwiched between samples of the cotton duct liner material and placed in a chamber maintained at $95 \pm 3\%$ relative humidity and a temperature of $120 \pm 3^\circ\text{F}$. The steel samples were tested for 96 ± 2 hours while the aluminum and galvanized steel samples were tested for 720 ± 2 hours.

The test samples were then assessed by NAVLAP-certified labs against a set of comparative plates. The comparative plates consisted of identical metal test plates that were sandwiched between pieces of washed sterile cotton and exposed to the same temperature and humidity conditions for the same period of time.



Terminal Units

Table 1: ASTM C 1104 Water Vapor Sorption Test

| Sample | Initial Weight (g) | Final Weight (g) | % Weight Gain |
|----------------|--------------------|------------------|---------------|
| 1 | 27.10 | 42.90 | 58.30 |
| 2 | 27.93 | 39.92 | 42.93 |
| 3 | 27.60 | 40.83 | 47.93 |
| Average | | FAIL | 49.72 |

The maximum percentage of water vapor sorption allowed by ASTM C 1071 is 3%
 Source: Johns Manville Technical Center Report

The photographs in Figure 1 show the difference between the corrosion caused by the cotton duct liner and the sterile cotton controls which were the results of the ASTM C 665 tests performed by the NAVLAP-certified lab. The cotton duct liner materials failed the ASTM test due to corrosion of the steel, aluminum and galvanized steel test coupons.

Conclusion

The ability of materials to absorb water combined with their corrosion performance must be considered when specifying duct liner materials.

The maximum percentage of water vapor sorption allowed by

ASTM C 1071 is 3% and the cotton duct liner samples tested by the NAVLAP-certified lab had an average of 49%. These materials had more than 16 times the water vapor sorption allowed by the ASTM standard.

The ASTM C 665 corrosion criteria state that "the insulation shall show no corrosion greater than the comparative plates in contact with sterile cotton which has been tested in the same manner." All of the metal coupons shown in Figure 1 below from the ASTM tests performed at a NAVLAP-certified lab had more corrosion than their comparative plate and therefore the product did not meet the requirements of ASTM C 665.

The cotton duct liner material shown in these tests by a NAVLAP-certified lab absorbed water and caused corrosion on two types of metal commonly used in HVAC systems, steel and galvanized steel.

In addition to corrosion, the possibility of long term mold growth should be considered due to the water sorption characteristics of the materials. Mold can occur when duct liner materials become wet and do not dry quickly.⁴ While cotton duct liner does not grow mold when new, the long-term performance after exposure to a variety of climatic conditions has not been demonstrated.

References:

1. Reflectix Submittal Sheet November 2004.
2. Johns Manville Technical Center Report, February 5, 2003.
3. Owens Corning ASTM C 665 Test Report April 30, 2003.
4. "Mold: Cause, Effect and Response," FWCI, March 2002, p. 31. <http://www.awci.org/mold-series-1.pdf>

Figure 1: Difference Between Corrosion Caused by Cotton Duct Liner and Sterile Cotton Controls Based on ASTM C 665 Test



NOTE: Copper was also tested, but showed no corrosion. Copper is rarely in contact with duct liner materials.

Source: Owens Corning ASTM C 665 Test Report

About NAIMA

NAIMA is the association for North American manufacturers of fiber glass, rock wool, and slag wool insulation products. Its role is to promote energy efficiency and environmental preservation through the use of fiber glass, rock wool, and slag wool insulation, and to encourage the safe production and use of these materials.

For additional information or copies of the test results contact:

NAIMA
 44 Canal Center Plaza, Suite 310
 Alexandria, VA 22314
 Phone: 703-684-0084
 Fax: 703-684-0427
www.naima.org

NAIMA AIR HANDLING COMMITTEE MEMBERS:

CertainTeed Corp.
 P.O. Box 860
 Valley Forge, PA 19482
 800-233-8990

Johns Manville
 P.O. Box 5108
 Denver, CO 80217
 800-654-3103

Knauf Insulation
 One Knauf Drive
 Shelbyville, IN 46176
 800-825-4434

Owens Corning
 One Owens Corning Parkway
 Toledo, OH 43659
 800-GET-PINK