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Examination Standard for Fabric Ducts and Insulation Lined HVAC Ducts

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Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

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1. INTRODUCTION

1.1. PURPOSE

1.1.1. This standard states testing and certification requirements for fabric ducts and insulation lining of heating, venting and air conditioning (HVAC) ducts.

1.1.2. Testing and certification criteria may include performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance program.

1.2. SCOPE

1.2.1. This standard applies to fabric ducts, and insulation lined ducts used in HVAC duct systems.

1.2.2. This standard sets the fire performance requirements for fabric ducts and insulation lined HVAC ducts and evaluates the potential for a horizontal spreading fire in parallel runs of HVAC ducts. To qualify for certification as a product of low fire hazard, not requiring automatic sprinkler protection of itself, the duct must perform satisfactorily in all tests as outlined in this standard.

1.2.3. In addition to resisting flame spread, any flaming and glowing material that fall from the horizontal segment during the test shall extinguish when coming into contact with the floor.

1.2.4. No limit is placed on the diameter of HVAC ducts that may be certified under this standard.

1.2.5. Rigid metallic HVAC ducts with combustible external insulation are examined in accordance with FM 4924.

1.3. BASIS FOR REQUIREMENTS

1.3.1. The requirements of this standard are based on experience, research and testing, and/or the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists was also considered.

1.3.2. The requirements of this standard reflect tests and practices used to examine characteristics of fabric ducts and insulation lined HVAC ducts for the purpose of obtaining certification.

1.4. BASIS FOR CERTIFICATION

Certification is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

1.4.1. Examination and tests on production samples shall be performed to evaluate:

- the suitability of the product;
- the performance of the product as specified by the manufacturer and required for certification; and,
- the durability and reliability of the product.

1.4.2. An examination of the manufacturing facilities and audit of quality control procedures may be conducted to evaluate the manufacturer's ability to consistently produce the product, which is examined and tested, and the marking procedures used to identify the product. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme to ensure ongoing compliance.

1.5. BASIS FOR CONTINUED CERTIFICATION

The basis for continual certification may include the following based upon the certification scheme and requirements of the certification agency:

- production or availability of the product as currently certified;
- the continued use of acceptable quality control procedures;
- compliance with the terms stipulated by the certification; and
- satisfactory surveillance audits conducted as part of the certification agency's product surveillance program

1.6. EFFECTIVE DATE

The effective date of this certification standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this standard is the publication date of the standard for compliance with all requirements.

1.7. SYSTEM OF UNITS

Units of measurement used in this standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10.

1.8. NORMATIVE REFERENCES

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the cited edition applies:

ANSI/IEEE/ASTM SI 10, American National Standard for Metric Practice

ASTM C167, Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations

ASTM C303, Standard Test Method for Dimensions and Density of Preformed Block or Broad-Type Thermal Insulation

ASTM D240, Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter

ASTM D482, Standard Test Method for Ash from Petroleum Products

ASTM E1252, Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis

ASTM D1622, Standard Test Method for Apparent Density of Rigid Cellular Plastics

ASTM E1642, Standard Practice for General Techniques of Gas Chromatography Infrared (GC/IR) Analysis

ASTM E2058, Standard Test Methods for Measurement of Material Flammability Using a Fire Propagation Apparatus (FPA)

ISO 12136, Reaction to Fire Tests - Measurement of Material Properties Using a Fire Propagation Apparatus

1.9. TERMS AND DEFINITIONS

For purposes of this standard, the following terms apply:

Critical Heat Flux (CHF)	Maximum heat flux at or below which there is no ignition.
Fabric Duct	Lightweight and flexible air duct which allows for uniform air dispersion making it a comfortable, quiet and efficient alternative to traditional metal ductwork providing efficient heating, cooling, or ventilating.
HVAC	Heating, Ventilation and Air Conditioning.
Metal	A solid material that is typically hard, shiny, malleable, fusible, and ductile, with good electrical and thermal conductivity (e.g., iron, gold, silver, copper, and aluminum, and alloys such as brass and steel).
Multiple Ingredient Change	A multiple ingredient change is two or more significant component changes, deemed by the certification agency, from the original formulation utilized for satisfying all required performance tests under this standard. One component change may be considered a multiple ingredient change if it is the second ingredient change from the original formulation utilized for satisfying all required performance tests under this standard. Changes deemed by the certification agency as insignificant are not considered a multiple ingredient change.
Significant Ingredient Change	A change to a formulation of a certified product that has been reviewed by the certification agency and categorized as either a single ingredient change or a multiple ingredient change. Significant ingredient changes include, but are not limited to, changing an ingredient, changing a supplier of an ingredient, and/or changing manufacturing tolerances of ingredients of an existing certified formulation.
Single Ingredient Change	A single ingredient change is one significant component change, deemed by the certification agency, from the original formulation utilized for satisfying all required performance tests under this standard. Changes deemed by the certification agency as insignificant are not considered a single ingredient change.
Thermal Response Parameter (TRP)	Thermal Response Parameter is an indicator of the ignition resistance of a material.

2. GENERAL INFORMATION

2.1. PRODUCT INFORMATION

2.1.1. Duct materials may be, but are not limited to, insulation lined metal, rigid board type, fabric and insulated fabric ducts.

2.1.2. Ducts covered by this standard are used in heating, venting, and air conditioning (HVAC) systems to circulate conditioned air within a building to maintain its thermal and humidity environment.

2.1.3. Various energy codes (e.g. ASHRAE 90.1[1]. IECC [2]. etc.) require the HVAC ducts to be insulated to a certain extent, based on the local climate, to reduce the thermal energy loss and improve the acoustical performance of the building.

2.1.4. The purpose of this standard is to evaluate the fire hazards of Insulation lined and fabric HVAC ducts in tests that represent their end-installation.

2.1.5. Experience has shown that insulated or fabric duct materials may transmit fire from one area to another, even when they obtain relatively low flame spread ratings from other test methods. To achieve a representative fire test, the actual end use configuration of the duct materials must be considered under conditions of normal use.

2.2. CERTIFICATION APPLICATION REQUIREMENTS

The manufacturer shall provide the following information with any request for certification consideration:

- a complete list of all models, types, sizes, and options for the products or services being submitted for certification consideration;
- general assembly drawings, complete set of manufacturing drawings, materials list, anticipated marking format, nameplate format, brochures, sales literature, spec. sheets, installation, operation and maintenance procedures, etc....; and
- the name, contact information and location of duct, duct resin system and components manufacturing facilities.

All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All documents shall be provided with English translation.

2.3. REQUIREMENTS FOR SAMPLES FOR EXAMINATION

2.3.1. Following authorization of a certification examination, the manufacturer shall submit samples for examination and testing based on the following:

- Sample requirements to be determined by the certification agency

2.3.2. Requirements for samples may vary depending on design features, results of prior or similar testing, and results of any foregoing tests.

2.3.3. The manufacturer shall submit samples representative of production.

2.3.4. It is the manufacturer's responsibility to provide any necessary test fixtures, such as those which may be required to evaluate the insulated HVAC ducts.

2.4. ADDITIONAL REQUIREMENTS

2.4.1. The requirements of this standard shall be used to measure and describe the fire performance of fabric ducts or insulation lined HVAC ducts in response to exposure from fire. The results of these controlled exposures shall not be used to describe or appraise actual exposure conditions, since such conditions vary widely.

2.4.2. The certification examination includes fire tests and other such tests as noted. A complete review of construction and applications specifications shall be conducted to assure, as far as possible, a practical and reliable installation. Inspection of the product manufacturing facility shall be conducted to assure conformance with the required tests and specifications.

3. GENERAL REQUIREMENTS

3.1. REVIEW OF DOCUMENTATION

3.1.1. During the initial investigation and prior to physical testing, the manufacturer's specifications and details shall be reviewed to assess the ease and practicality of installation and use. The certification examination results may further define the limits of the final certification.

3.2. MARKINGS

3.2.1. Each section of duct, elbows and fittings and label accompanying the product, shall include the following information:

- name and address of the manufacturer or marking traceable to the manufacturer;
- date of manufacture or code traceable to date of manufacture or lot identification;
- model number, or trade name, etc., as appropriate.

When hazard warnings are needed, the markings should be universally recognizable.

3.2.2. The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the certification agency's mark of conformity.

3.2.3. The certification agency's mark of conformity shall be displayed visibly and permanently on the product as appropriate and in accordance with the requirements of the certification agency. Each section of duct shall carry permanently the certification agency's mark. One (1) certification agency's mark is required for sections less than or equal to 6.5 ft (2.0 m). These symbols must be placed at intervals of not more than 6.5 ft (2.0 m) for sections longer than 6.5 ft (2.0 m). The manufacturer shall exercise control of this mark as specified by the certification agency and the certification scheme.

3.2.4. All markings shall be legible and durable.

3.3. MANUFACTURER'S INSTALLATION AND OPERATING INSTRUCTIONS

3.3.1. The manufacturer shall:

- prepare instructions for the installation, maintenance, and operation of the certified duct assembly;
- provide facilities for repair of the product and supply replacement parts, if applicable; and
- provide services to ensure proper installation, inspection, or maintenance for the product where it is not reasonable to expect the average user to be able to provide the installation, inspection, or maintenance.

3.4. CALIBRATION

3.4.1. Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment is required. The certificate shall indicate that the calibration was performed against working standards whose calibration is certified and traceable to an acceptable reference standard and certified by an ISO/IEC 17025 accredited calibration laboratory. The test equipment shall be clearly identified by label or sticker showing the last date of the calibration and the next due date. A copy of the service provider's accreditation certificate as an ISO/IEC 17025 accredited calibration laboratory should be available.

3.4.2. When the inspection equipment and/or environment is not suitable for labels or stickers, other methods such as etching of control numbers on the measuring device are allowed, provided documentation is maintained on the calibration status of thus equipment.

3.5. FORMULATION CHANGES

3.5.1. All formulation changes of a certified insulated HVAC ducts shall be reviewed by the certification agency prior to implementing a change. Formulation changes include, but are not limited to:

- ingredient change(s),
- changing a supplier of an ingredient, and/or
- changing manufacturing tolerances of ingredients of an existing certified formulation

Formulation changes shall be determined by the certification agency as significant or insignificant. Significant changes will be categorized by the certification agency as either a single or multiple ingredient change.

3.5.1.1. A single ingredient change is one significant component change from the original formulation utilized for satisfying all required performance tests under this standard. A single ingredient change may require Flammability Characterization testing.

The chemical heat of combustion (ΔH_{CH}), critical heat flux for ignition ($\dot{q}''_{cr}$), thermal response parameter (TRP), and convective flame spread parameter (FSP_C) shall be determined.

3.5.1.2. Only one single significant ingredient change shall be allowed from the original formulation utilized for satisfying all required performance tests under this standard. Any further ingredient changes shall be considered a multiple ingredient change.

3.5.1.3. A multiple ingredient change is two or more significant components changes from the original formulation utilized for satisfying all required performance tests under this standard. A multiple ingredient change requires all applicable performance tests under this standard to be conducted.

3.5.1.4. An alternate supplier of an ingredient shall be reviewed by the certification agency in order to determine if any testing is necessary. At the discretion of the certification agency, alternate suppliers may be considered a single or multiple ingredient change as detailed above.

3.5.1.5. All changes to the manufacturing tolerances of ingredients of an existing certified formulation shall be reviewed by the certification agency. Changes to tolerances that require testing may be considered a single or multiple ingredient change as detailed above.

3.5.1.6. All changes to the formulation shall be submitted with adequate information for review. This information can include, but is not limited to the following: safety data sheets, technical data sheets, formulation details, etc.

4. PERFORMANCE REQUIREMENTS

4.1. HORIZONTAL DUCT FIRE TEST

4.1.1. Requirement

The ability of the horizontally installed segment of duct material to resist flame propagation and maintain its structural integrity. The test arrangement used to obtain this data shall be the Horizontal Apparatus for the evaluation of duct work. The apparatus is designed to test a representative section of the duct for which certification is desired. The fire test conditions are intended to simulate building fire conditions. A fire exposure is placed directly below the inlet of a duct. During the test the fire is then drawn into the duct where it may or may not ignite the duct and propagate the full length of the duct.

The Horizontal test apparatus consists of a 24 ft (7.3 m) length of horizontal duct 12 in. (305 mm) in diameter or size, incorporating at least two field-assembled joints, if applicable, a centrifugal exhaust blower with an adjustable damper, a draft-free enclosure or draft shield containing the fire exposure, and supporting framework with supports spaced in accordance with the manufacturer's installation instructions. The duct is supported approximately 32 in. (0.8 m) above the floor to simulate an actual field installation. The duct intake end is inserted into a 4 ft × 4 ft × 7 ft (1.2 × 1.2 × 2.35 m) high draft shield (3 walls and a roof), flush with the inside surface of the enclosure wall. The exhaust end is connected through a transition piece to the blower which pulls air through the duct at the required air velocities.

The fire exposure consists of a square steel pan 1 ft × 1 ft × 8 in. (0.3 m × 0.3 m × 0.2 m) deep, containing 4 in. (100 mm) of heptane on 3 in. (75 mm) of water. At the start of the test the liquid surface is 24 in. (0.6 m) below the inside bottom surface of the duct. The pan itself is positioned so that it is centered directly below the central axis of the duct, and its closest vertical surface is 1½ in. (38 mm) ahead of the duct opening. Four thermocouples are positioned 1 in. (25 mm) below the top inside surface of the duct, directly above the central axis, monitor temperatures during the test. The four points of measurements are 6 in. (152 mm), 6 ft (1.8 m), 12 ft (3.7 m), and 23 ft (7.0 m) from the fire exposed end of the duct.

The induced draft velocity through the duct is measured at the center of the horizontal duct 6 ft (1.8 m) from the exhaust end. The velocity measurement is taken at ambient temperature before each test and is adjusted to 600 ft/min (3 m/sec) for testing HVAC ducts. The fire exposure source shall be kept covered while the draft velocity is obtained and until the test is started. The fire exposure source is ignited to start the test. Observations of the performance of the duct and the temperatures achieved within the duct are made continuously for the full 15 minutes of the test.

4.1.2. Test/Verification

Performance shall be considered satisfactory if all the following conditions are met during the 15 minute duration of the test:

- flaming shall not spread on the interior or exterior of the duct from the fire exposed end to the 23 ft (7.0 m) point;
- the interior duct temperature recorded at the 23 ft (7.0 m) point shall not exceed 1000°F (538°C);
- the duct and all field applied joints, if applicable shall maintain their structural integrity without developing any through openings;
- there shall be no flaming on the exterior of the duct due to autoignition or temperature transmission from the interior of the duct. In cases where flaming appears on the exterior surface as a result of the external fire exposure, the flaming shall be intermittent in nature and shall not propagate beyond 4 ft (1.2 m) from the fire exposure end of the duct;
- flaming or glowing portions of the duct material that may fall, drip or melt off the test sample during the test shall extinguish when coming into contact with the floor.

4.2. FLAMMABILITY CHARACTERIZATION

The following series of tests is designed to allow monitoring of quality controls exercised in the manufacturing process and/or to characterize individual nonmetallic materials used in the make-up of the duct assembly.

4.2.1. Requirement

The chemical heat of combustion (ΔH_{CH}), critical heat flux for ignition ($\dot{q}''_{cr}$), thermal response parameter (TRP), and convective flame spread parameter (FSP_C) shall be determined.

Note: This test is conducted to establish a base from which requests for formulation revisions are evaluated. The certification agency places no limits on the values obtained.

4.2.2. Test/Verification

Flammability Characterization using a Fire Propagation Apparatus per ASTM E2058, Standard Test Methods for Measurement of Synthetic Polymer Material Flammability Using a Fire Propagation Apparatus (FPA) or ISO 12136, Reaction to Fire Tests - Measurement of Material Properties Using a Fire Propagation Apparatus.

4.3. DENSITY OF INSULATING CORES

4.3.1. Requirement

The density of the insulating core (with no adhesives or facers) shall be determined for insulation lined HVAC ducts.

4.3.2. Test/Verification

ASTM C167, Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations, ASTM C303, Standard Test Method for Dimensions and Density of Preformed Block or Broad-Type Thermal Insulation or ASTM D1622, Standard Test Method for Apparent Density of Rigid Cellular Plastics.

4.4. IDENTIFICATION TESTS – STANDARD PRACTICE FOR GENERAL TECHNIQUES FOR OBTAINING INFRARED SPECTRA FOR QUALITATIVE ANALYSIS (OPTIONAL)

4.4.1. Requirement

For combustible material used in the make-up of the duct assemblies, FTIR spectra shall be determined and reported at the sole discretion of the certification agency.

Note: These tests are conducted for identification purposes. The certification agency places no limits on the values obtained.

4.4.2. Test/Verification

Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis, ASTM E1252

4.5. IDENTIFICATION TESTS – THERMAL DESORPTION GAS CHROMATOGRAPHY MASS SPECTROMETRY (TD/GC/MS) OPTIONAL

4.5.1. Requirement

For combustible material used in the make-up of the duct assemblies, TD/GC/MS Spectrograms shall be determined and reported at the sole discretion of the certification agency.

Note: These tests are conducted for identification purposes. There are no limits on the values obtained.

4.5.2. Test/Verification

ASTM E1642, Standard Practice for General Techniques of Gas Chromatography Infrared (GC/IR) Analysis

5. MANUFACTURER'S REQUIREMENTS

5.1. DEMONSTRATED QUALITY CONTROL PROGRAM

5.1.1. A quality assurance program is required to assure that subsequent batch of resin or duct and fittings produced by the manufacturer shall present the same quality and reliability as the specific duct and resin sample(s) examined. Design quality, conformance to design and performance are the areas of primary concern.

- Design quality is determined during the examination and tests and may be documented in the certification
- Report.
- Continued conformance to this standard is verified by the certifier's surveillance program.
- Quality of performance is determined by field performance and by periodic re-examination and testing.

5.1.2. The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:

- Existence of corporate quality control guidelines
- Incoming assurance, including testing
- In-process assurance, including testing
- Final inspection and tests
- Equipment calibration
- Drawing and change control
- Packaging and shipping
- Handling and disposition of discrepant materials.

5.1.3. Documentation/Manual

There should be an authoritative collection of procedures/policies. It should provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system should require that sufficient records are maintained to demonstrate achievement of the required quality and verify operation of the quality system.

5.1.4. Records

To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.

5.1.5. Drawing and Change Control

- The manufacturer shall establish a system of product configuration control that shall allow no unauthorized changes to the product. Changes to critical documents, identified in the certification report, may be required to be reported to, and authorized by the certification agency prior to implementation for production.
- Records of all revisions to all certified products shall be maintained.

5.2. SURVEILLANCE AUDIT

5.2.1. An audit of the manufacturing facility may be part of the certification agency's surveillance requirements to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to ensure a uniform product consistent with that which was tested and certified.

5.2.2. Certified products or services shall be produced or provided at, or provided from, location(s) disclosed as part of the certification examination. Manufacture of products bearing a certification mark is not permitted at any other location prior to disclosure to the certification agency.

5.3. PRODUCT MODIFICATIONS

5.3.1. The manufacturer shall notify the certification agency of changes in product construction, components, raw materials, physical characteristics, coatings, component formulation or quality assurance procedures prior to implementation.

6. BIBLIOGRAPHY

ISO/IEC 17025, General Requirements for the Competence of Testing and Calibration Laboratories.