



Industry Standards Compatibility

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Introduction

As a new product, the Rheia system is a departure from the current HVAC air distribution technologies installed in today's residential new construction homes, which challenges how it is evaluated by code officials and other authorities having jurisdiction (AHJs). This document details how Rheia complies with the relevant industry standards referenced by the various code bodies.

Referenced Standards

The International Residential Code (IRC) and the International Mechanical Code (IMC) and their state-modified versions reference several industry standards that affect the air distribution system:

Standard	Description
UL 181 Factory-Made Air Ducts and Air Connectors	This standard applies to materials for the fabrication of air duct and air connector systems for use in accordance with the International Mechanical Code (IMC), International Residential Code (IRC), and Uniform Mechanical Code (UMC), Standards of the National Fire Protection Association (NFPA) No. 90A, and No. 90B.
UL181B Standard for Closure Systems for Use With Flexible Air Ducts and Air Connectors	This standard covers pressure-sensitive tapes, mastic systems, and non-metallic mechanical fasteners for use as a part of the closure system of factory-made flexible air ducts or air connectors complying with the Standard for Factory-Made Air Ducts and Air Connectors, UL 181.
UL2043 Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces	This is a fire test method for determining the fire performance response of discrete products (including, but not limited to electrical, mechanical, and plumbing equipment) intended to be installed in air handling spaces, such as above suspended ceilings or below floors.
UL723 Test for Surface Burning Characteristics of Building Materials	This method of test for surface burning characteristics of building materials is applicable to any type of building material that, by its own structural quality or the manner in which it is applied, is capable of supporting itself in position or being supported in the test furnace to a thickness comparable to its intended use.
NFPA 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems	The standard covers the construction, installation, operation, and maintenance of systems for warm air heating and air conditioning, including filters, ducts, and related equipment to protect life and property from fire, smoke, and gases resulting from fire or from conditions having manifestations similar to fire.
North American Insulation Manufacturers Association (NAIMA) Fibrous Glass Duct Construction Standards, fifth edition	Optional industry standard as a recommended method of fabricating and installing air transmission ducts in buildings using fibrous glass material.



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Rheia's new technology, uses materials and components previously not fully covered in any current standard defined in the building codes, requiring the development of a new standard UL 181C which will be adopted by the code bodies in the future. In addition, Rheia ensured that the components and duct met the other standards currently defined in the current codes.

UL 181 Factory-Made Air Ducts and Air Connectors

This standard applies to materials for the fabrication of air duct and air connector systems for use in accordance with the International Mechanical Code (IMC), International Residential Code (IRC), and Uniform Mechanical Code (UMC), Standards of the National Fire Protection Association for the Installation of Air-Conditioning and Ventilating Systems, NFPA No. 90A, and the Installation of Warm Air Heating and Air-Conditioning Systems, NFPA No. 90B. UL 181 comprises 17 tests that apply to air ducts.

Test	Air Ducts		Air Connectors	Joining Materials
	Rigid	Flexible		
Surface Burning Characteristics	x	x	x	-
Flame Resistance	-	-	-	x
Flame Penetration	x	x	-	-
Burning	x	x	x	-
Corrosion	x	x	x	x
Mold Growth and Humidity	x	x	x	x
Temperature	x	x	x	-
Puncture	x	x	-	-
Static Load	x	x	x	-
Impact	x	x	-	-
Erosion	x	x	x	-
Pressure	x	x	x	-
Collapse	x	x	x	-
Tension	-	x	x	-
Torsion	-	x	x	-
Bending	-	x	x	-
Leakage	x	x	x	-

Rheia Response:

Rheia's 3" and 4" duct are UL181 listed and labeled¹ as is required by IRC.

¹ Listing File No. MH8698



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UL181A Closure Systems for Use With Rigid Air Ducts

This standard covers closure systems for use with factory-made rigid air ducts or air connectors complying with the Standard for Factory-Made Air Ducts and Air Connectors, UL 181. Closure systems consist of pressure sensitive tapes, heat-activated tapes, and mastics.

Rheia Response:

Rheia exclusively uses flexible air ducts so this standard does not apply.

UL181B Closure Systems for Use With Flexible Air Ducts and Air Connectors

This standard covers pressure-sensitive tapes, mastic systems, and non-metallic mechanical fasteners for use as a part of the closure system of factory-made flexible air ducts or air connectors complying with the Standard for Factory-Made Air Ducts and Air Connectors, UL 181.

Rheia Response:

Rheia uses a mechanical connection and sealing system integral to the geometry of its plastic components. Since the required air tightness of the system as required by building code or energy rating standard, the use of additional sealing methods is not required so this standard is not applicable.

UL2043 Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces

This is a fire test method for determining the fire performance response of discrete products (including, but not limited to electrical, mechanical, and plumbing equipment) intended to be installed in air handling spaces, such as above suspended ceilings or below floors. This test may be used to determine fire performance and smoke characteristics of discrete, non-continuous building materials where the Test for Surface Burning Characteristics of Building Materials, UL 723, is not applicable (due to test specimen size requirements) since flame spread and smoke developed indices cannot be determined.

Rheia Response:

The definition of an 'air handling space' is not defined in this standard, but despite that, RHEIA pursued UL 2043 listing of its connector components (fittings). Since UL181C is not yet referenced in the IRC or IMC, Rheia took the cautious approach and independently certified the fittings assembly to standard UL 2043. UL 2043 listing² was also obtained for the 4" Ferrule.

UL723 Test for Surface Burning Characteristics of Building Materials

This method of test for surface burning characteristics of building materials is applicable to any type of building material that, by its own structural quality or the manner in which it is applied, is capable of supporting itself in position or being supported in the test furnace to a thickness comparable to its intended use. The purpose of the test is to determine the comparative burning characteristics of the material under test by evaluating the spread of flame over its surface and the density of the smoke developed when exposed to a test fire.

Rheia Response:

This test is applicable to the ductwork and not the Rheia plastic components which are covered under UL2043.

² Classified with the ETL listed mark, control number 5016806



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NFPA 90B 2018 Standard for the Installation of Warm Air Heating and Air-Conditioning Systems

The standard covers the construction, installation, operation, and maintenance of systems for warm air heating and air conditioning, including filters, ducts, and related equipment to protect life and property from fire, smoke, and gases resulting from fire or from conditions having manifestations similar to fire.

NFPA 90B Applicable Sections	Rheia Response
4.1.1.1 Supply Ducts. Supply ducts shall be made of either of the following materials: (1) Class 0 or Class 1 rigid or flexible air ducts tested in accordance with ANSI/UL 181.	Rheia's 3" and 4" ducts are UL 181 listed and lab
4.1.1.4 A Class 0 or Class 1 rigid or flexible air duct shall not be used as a vertical air duct that is more than two stories in height.	Rheia designs will comply with the requirement.
4.1.1.5 A Class 0 or Class 1 rigid or flexible air duct shall not be used in an air duct containing air at a temperature in excess of 121 deg. C (250 deg. F).	All residential systems operate under this temperature limit.
4.1.1.2 Supply ducts shall be installed in conformance with the following: (1) The conditions of their listing, (2) SMACNA Fibrous Glass Duct Construction Standards, (3) SMACNA HVAC Duct Construction Standards – Metal and Flexible, (4) SMACNA Residential Comfort System Installation Standards Manual.	Rheia provides detailed installation guidelines that follow SMACNA construction standards where applicable.
4.3.2.5 Closure systems for use with rigid and flexible air ducts tested in accordance with ANSI/UL 181 shall have been tested and listed in accordance with ANSI/UL 181A or ANSI/UL 181B.	These closure system requirements are not applicable to Rheia. Rheia uses a self-contained attachment system engineered into the connections of the components.
4.3.5.1 Registers shall be made of a material classified as 94 V-0 when tested in accordance with ANSI/UL 94.	All of Rheia's plastic components are made using a V-0 rated material.
4.3.5.3 Electric or fuel-fired furnace systems shall have at least one register or grille without a closable shutter.	Rheia diffusers do not include a closable shutter, so are in compliance.
4.3.5.3.1 The duct leading thereto shall be without a damper.	If requirement is adopted, a damper can be removed from a boot to comply.
4.3.5.3.2 Dampers and shutters shall be allowed where they cannot shut off more than 80 percent of the duct area.	Rheia's damper assembly complies with this requirement.
4.3.5.4 Fittings connecting the registers to the duct system shall be constructed of one of the following: (1) Metal, (2) Materials that comply with the requirements of Class 0 or Class 1 ducts in ANSI/UL 181, (3) Materials that comply with the requirements of ANSI/UL 2043.	All Rheia's fittings (Ferrules, Elbows and Couplers) are UL 2043 listed.

UL181C Outline of Investigation for Non-Metal Joining Accessories for Flexible Air Ducts and Air Connectors

These requirements apply to non-metal accessories, such as collars and sleeves, used to join or attach flexible air ducts and air connectors that comply with the requirements of UL 181, Factory-



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Made Air Ducts and Air Connectors. The air ducts and air connectors with their joining accessories are intended to be installed in accordance with the International Mechanical Code (IMC), International Residential Code (IRC), Uniform Mechanical Code (UMC), and/or NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems. This standard requires that the assembly passes the following series of tests:

Test	Description	Status
Impact Test	Evaluates the resistance to the impact of 15 lb. sand bag without a 20 percent reduction in cross-sectional area.	Pass
Tension Test	Evaluates the resistance to a force of a 25 lb. weight on an air duct and fitting when installed in accordance with the manufacturer's installation instructions. A 25 lb. Test duration of 24 hours. The start and end height difference from the floor is measured.	Pass
Torsion Test	Evaluates the resistance to torsion forces on an air duct and fitting when installed in accordance with the manufacturer's installation instructions. A torque of 25 Ft-lb, or sufficient torque to rotate the sample 180-deg, whichever occurs first.	Pass
Pressure Test	Evaluates the resistance to positive pressure on an air duct and fitting when installed in accordance with the accompanying installation instructions.	Pass
Leakage Test	Evaluates the resistance to leakage on an air duct and fitting when installed in accordance with the manufacturer's installation instructions.	Pass
Puncture Test	A puncture test is conducted on the assembly. The samples shall prevent the complete penetration through the wall of the sample of the plunger head falling through a distance of 20 inches.	Pass
Mold Growth and Humidity Test	Evaluates the components' resistance to material degradation due to exposure to mold and high humidity. Evaluates the materials ability to limit the growth of mold. There must be no visible growth after 60 days.	Pass
High and Low Temperature Test	Evaluates the components' resistance to material degradation due to exposure at high and low temperatures. Visual observation for deformation and deterioration when exposed to air maintained at not less than 125 deg. F on the exterior and not less than 265 deg. F on the interior and maintained for a period of 60 days.	Pass
Smoke and Heat Release Test	UL 2043 Fourth Edition, "Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Pass Accessories Installed in Air-Handling Spaces"	Pass

Rheia Response: UL developed 181C to account for the lack of applicable standards for plastic components in HVAC air distribution systems utilizing most of the tests from UL 181 and UL 2043 to certify components. UL designated Rheia's Ferrule, Elbow Extension, and Coupler as the fittings



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required to be tested. RHEIA gained UL 181C listing of the fittings as an assembly; the only system on the market with this designation.

Plastic Components Specification

Rheia specified high-performing engineering thermoplastics to meet the stringent standards in UL181C and UL2043. The following table describes the material choices for each group of components based on their performance requirements.

Rheia Component	Material Type	Material Characteristics
Elbow, 3" Ferrule, Coupler, 4" Ferrule	Injection Molded PC/ABS V-0 flammability rating. UL 181C and UL 2043 listed.	UL-94 Flammability Rating: V-0 Heat Deflection Temperature @66psi: 259 deg. F Notched Izod Impact Strength @ 73 deg. F: 21 Ft-lb/in ²
Register Boots and Dampers	Injection Molded PC/ABS	UL-94 Flammability Rating: V-0 Heat Deflection Temperature @66psi: 217 deg.F Notched Izod Impact Strength @ 73deg. F: 11 Ft-lb/in ²
Manifold Takeoffs	Injection Molded PC/ABS V-0 flammability rating	UL-94 Flammability Rating: V-0 Heat Deflection Temperature @66psi: 217 deg.F Notched Izod Impact Strength @ 73deg. F: 11 ft-lb/in ²
Wall and Ceiling Diffusers	Injection Molded ABS	UL-94 Flammability Rating: HB UV stable material

Manifold Specifications

Rheia requires all manifolds to be specified using UL181-listed duct board and that manifolds be fabricated following the North American Insulation Manufacturers Association (NAIMA) Fibrous Glass Duct Construction Standards, fifth edition, as required in the IRC (Duct Systems, Duct Construction, Installation, Joints and Seams). A key benefit of duct board for the Rheia Manifold application is it's r-value prevents condensation build up and a reduction in energy loss versus sheet metal trunk solutions.

Fibrous glass insulated duct systems are acceptable for use in the following model codes and most other applicable codes:

- International Mechanical Code
- International Building Code
- International Residential Code for One and Two Family Dwellings
- International Energy Conservation Code



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Relevant NAIMA requirements

Because a Rheia Manifold is similar in construction to a fibrous glass duct the NAIMA standard serves as a recommended set of methods to fabricate and install Rheia manifolds. The following material specifications relate to key performance characteristics:

Characteristic	NAIMA Specification	Rheia Comments
Maximum Static Pressure	Up to 2 inch WC. (500 Pa), positive or negative in the duct.	Rheia air supply systems are designed to operate with conventional 'low static pressure' equipment. Supply air designs typically range from 0.15 to 0.4 inch WC.
Water Vapor Sorption	Water vapor sorption of the duct board shall not exceed 5% by weight under conditions of 120°F (49°C) dry bulb at 95% relative humidity for 96 hours' duration when tested in accordance with ASTM C 1104 Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.	Rheia recommends duct board products available in the market that pass ASTM C 1104. Refer to the manufacturer's data sheet for more information.
Temperature Limits	-40°F (-40°C) minimum inside duct. 250°F (121°C) maximum inside duct. 150°F (66°C) maximum duct surface temperature.	Rheia recommends duct board products that meet these requirements. Refer to the manufacturer's data sheet for more information.
Closure (Sealing)	Closure materials (pressure sensitive tapes, heat activated tapes, glass fabric and mastic) shall conform to UL 181A. When installed in accordance with manufacturers' instructions, closure systems will conform to UL 181 Class 1 Air	Rheia requires that duct board manifolds are assembled per: NAIMA Fibrous Glass Duct Construction Standards Fifth Edition 2002
Bacteria and Fungal Growth Resistance	Fibrous glass duct products meet fungal and bacterial growth requirements when subjected to microbial attack as described in UL 181 and in ASTM C 1338 (no-growth procedure). Standard practices ASTM G 21 (fungus test) and G 22-95 (bacteria test) are also used to evaluate microbial growth.	Rheia recommends duct board products that meet these requirements. Refer to the manufacturer's data sheet for more information.

Sealing the manifold is to be achieved using UL 181 tape or mastic per NAIMA's requirements

Duct Specifications

The Rheia-specified duct is manufactured by Thermaflex in South Carolina. This duct is listed and labeled³ as a Class 1 Air Duct with a specified flame-spread index not over 25 without evidence of continued progressive combustion and a smoke-developed index not over 50. This specification is determined via the Standard for Test for Surface Burning Characteristics of Building Materials, UL 723 (ASTM E34), commonly referred to as the Steiner Tunnel test, which is part of the UL 181 test protocol.

³ Listing File No. MH8698