RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF LICENSING AND REGULATORY AFFAIRS
LANSING

STEVEN H. HILFINGER
DIRECTOR

BOARD OF MECHANICAL RULES
BUREAU OF CONSTRUCTION CODES

Conference room 3, First Floor
2501 Woodlake Circle
Okemos, Michigan 48864

AGENDA
May 18, 2011
9:00 a.m.

1.	Call to Order and Determination of Quorum	R. Jagenberg
2.	Approval of Agenda (Page 1)	R. Jagenberg
3.	Approval of Minutes – (February 23, 2011) (Pages 2 - 6)	R. Jagenberg
4.	Good Moral Character Appeals (Pages 7 - 8) Langfeldt, Thomas E. M #11-002	K. Kalakay 9:15
5.	New Products (Pages 9 - 76) Watts Radiant Onix Heat Transfer Tubing MA #11-001	K. Kalakay 9:45
6.	Chiefs Report	K. Kalakay
7.	Old Business	R. Jagenberg
8.	New Business	R. Jagenberg
9.	Public Comment	R. Jagenberg
10.	Next Meeting – August 24, 2011	R. Jagenberg
11.	Adjournment	R. Jagenberg

The meeting site and parking is accessible. Individuals attending the meeting are requested to refrain from using heavily scented personal care products in order to enhance accessibility for everyone. People with disabilities requiring additional services (such as materials in alternative format) in order to participate in the meeting should call Misti Blackburn at (517) 241-9325 at least 10 working days before the event.

Providing for Michigan's Safety in the Built Environment

BUREAU OF CONSTRUCTION CODES
P.O. BOX 30254 • LANSING, MICHIGAN 48909
Telephone (517) 241-9325 • Fax (517) 241-9308
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RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENERGY, LABOR & ECONOMIC GROWTH
LANSING

ANDREW S. LEVIN
ACTING DIRECTOR

BOARD OF MECHANICAL RULES
DEPARTMENT OF ENERGY, LABOR AND ECONOMIC GROWTH
BUREAU OF CONSTRUCTION CODES

Conference Room 3
2501 Woodlake Circle
Okemos, Michigan 48864

MINUTES
February 23, 2011
9:00 a.m.

MEMBERS PRESENT

Mr. H. Edward Bartram
Mr. Kevin Carden
Mr. Raymond Coy
Mr. Lawrence Hale
Mr. Robert Jagenberg
Mr. Patrick Maher
Mr. Mark Mangione
Mr. George B. Shields
Mr. William Steele
Mr. Christopher Stockwell

MEMBERS ABSENT

Mr. Gary VanOchten
Mr. Charles Wash
Mr. Ronald Farr
Vacant - ICBO
Vacant – Professional Engineer Position

MICHIGAN DEPARTMENT OF ENERGY, LABOR & ECONOMIC GROWTH PERSONNEL ATTENDING

Mr. Irvin J. Poke, Director
Ms. Beth Aben, Deputy Director
Mr. Kevin Kalakay, Chief, Mechanical Division
Mr. Jon Paradine, Assistant Chief, Mechanical Division
Mr. Norwood Bates, Senior Inspector, Mechanical Division
Ms. Michele Ramsey, Secretary, Plumbing
Ms. Misti Blackburn, Secretary Mechanical Division

OTHERS IN ATTENDANCE

Mr. Lynn Briggs, Contractors Legislative Services
Mr. Mark Kidd, MIACCA
Ms. Cindy Maher, MPMCA

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1. CALL TO ORDER AND DETERMINATION OF QUORUM

Chairperson Jagenberg called the meeting to order at 9:00 a.m. A quorum was determined present at that time.

2. APPROVAL OF AGENDA

A **MOTION** was made by Board Member Bartram and Supported by Board Member Hall to remove Mr. Abu Baker Al Mufti, Mechanical Contractor Appeal, Document M-10-09 from the Agenda. He called to notify the Board that he was unable to appear before the board. **MOTION CARRIED.**

3. APPROVAL OF MINUTES

A **MOTION** was made by Board Member Bartram and supported by Board Member Mangione to approve the minutes of the August 18, 2010 meeting. **MOTION CARRIED.**

4. ELECTION OF OFFICERS

A **MOTION** was made by Board Member Maher and supported by Board member Hale to nominated H. Edward Bartram as Vice Chairperson. **MOTION CARRIED UNANIMOUSLY.**

A **MOTION** was made by Board Member Steele and supported by Board member Hale to nominate Patrick Maher as Secretary. **MOTION CARRIED UNANIMOUSLY.**

5. APPLICANTS APPEARING BEFORE THE BOARD

Mr. Joseph Ricord, Mechanical Contractor Appeal, Document M-11-01, appeared before the Board requesting permission to take the Mechanical Contractor Examination.

If Mr. Ricord is able to provide the Mechanical Division with further documents such as work orders from his former employer verifying his Mechanical work experience then he would be able to get scheduled to appear before the Board of Mechanical Rules at their next available board meeting.

After a discussion with Mr. Ricord regarding his qualifications to take the Mechanical Contractor Examination, a **MOTION** was made by Board Member Mangione and supported by Board Member Hale to deny Mr. Ricord to take the Mechanical Contractor Examination

due to lack of experience required by law. **MOTION CARRIED.**

6. GOOD MORAL CHARACTER APPEALS

None

7. CONSTRUCTION CODE APPEALS REQUEST

None

8. NEW PRODUCTS

None

9. CHIEF'S REPORT

Mr. Kalakay provided information on the following issues:

1. A joint plumbing and mechanical meeting for residential sprinklers took place several months ago for consideration of a product certification. An earlier BCC Code Works article identified that the plumbing contractor and mechanical contractor pull the permit and licensed plumbers complete the installation for multi purpose systems. A letter was sent to the manufacturer requesting additional information and we received a reply back on February 22, 2011. The letter will be copied and distributed to the appropriate members for their review prior to another meeting.

2. There has been no movement on the Forbes Mechanical Act, 1984 PA 192. The Bureau is behind it, and is currently waiting on sponsorship.

3. Mr. Kalakay provided a copy of the discipline report for 2010 fiscal year. This yearly report was distributed to the Board. There where 8 licensing violations.

4.Mr. Steele asked what action the Bureau is taking when someone who isn't licensed is able to obtain a permit or perform work with a permit. Ms. Aben indicated that the Bureau is encouraging and educating local units of government about correct permit issuance and asking them to rescind permits issued in error. The Bureau will continue to issue cease and desist letters when appropriate.

10. OLD BUSINESS

None

11. NEW BUSINESS

1. A **MOTION** was made by Board member Shields and supported by Board member Steele to approve the Meeting Schedule for 2011. **MOTION CARRIED**.

2. Ms. Aben informed the Board of a change in regards to tabling. According to Robert's Rule the correct method is to postpone an issue rather than table it. This will allow the Board to move forward when issues arise where applicants or issues are not available to correctly or accurately handle them.

3. Ms. Aben informed the Board that 14 people retired as of December 31, 2010. Ms. Aben is retiring and her effective date is April 1, 2011. The Department of Civil Service is currently hiring under the 2 for 1 policy, and reviewing which positions can go without being filled.

4. Ms. Aben informed the Board of the changes in the Boiler Division; Mr. Mark Moore was promoted to the Assistant Chief for the Boiler Division.

5. Mr. Kalakay thanked Ms. Aben for her 35.5 years of service.

6. Mr. Poke thanked Ms. Aben for her service and wished her well.

7. Mr. Poke asked the Board to provide the staff for more direction for the Appeals process. Specifically what type of information the Board is looking for to make their decision so the staff can provide them a clear and concise answer when asked what type of information they should provide.

12. PUBLIC COMMENT

Ms. Aben announced that the new Director of DELEG is Mr. Steven H. Hilfinger effective February 28, 2011 and will appoint a Deputy Director at that time. DELEG will also be undergoing a re-organization. The Regulation and Licensing Departments will be separate. It was also announced that Mr. Tom Martin retired.

13. NEXT MEETING

The next Board meeting will be held on May 18, 2011.

14. ADJOURNMENT

A **MOTION** was made by Board Member Bartram and supported by Board Member Maher to adjourn the meeting at 10:00 AM Standard Eastern Time.
MOTION CARRIED.

APPROVED:

_____ _____

Mr. Robert Jagenberg, Chairperson Date

RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF LICENSING AND REGULATORY AFFAIRS
LANSING

STEVEN H. HILFINGER
DIRECTOR

April 27, 2011

M-11-002

TO: Member of the Board of Mechanical Rules

FROM: Kevin D. Kalakay, Chief, Mechanical Division

SUBJECT: Appeal Request for Examination

APPLICANT REPRESENTATIVE: THOMAS LANGFELDT

AUTHORITY:

The Forbes Mechanical Contractors Act of 1984 as Amended, being Act 192 of the Michigan Compiled Laws.

REQUEST:

Applicant appeals denial of application for license examination. Application was denied based on good moral character.

APPLICABLE RULE:

R 338.981. The Forbes Mechanical Contractors Act of 1984 as Amended, being Act 192 of the Michigan Compiled Laws.

RECOMMENDATION:

Staff has no recommendation.

RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENERGY, LABOR & ECONOMIC GROWTH
LANSING

STEVEN H. HILFINGER
DIRECTOR

April 20, 2011

Mr. Thomas Langfeldt
5178 N. US 31 Highway
Scottville, MI 49454

Dear Mr. Langfeldt:

I am writing in response to your appeal requesting to appear before the Board of Mechanical Rules regarding your denial for Mechanical Contractor License Examination.

The Mechanical Division is scheduling you to appear before the board at the next scheduled meeting. That meeting will be held on **May 18th, 2011** at the Michigan Department of Energy, Labor & Economic Growth, Bureau of Construction Codes, 2501 Woodlake Circle, Conference Room No. 3, Okemos, Michigan. Your appointment is at **9:15a.m.** Eastern Standard time. A map is enclosed for your convenience.

Upon completion of the board's review, the applicant shall be informed of the board's decision. Applicants approved by the board shall be scheduled for the next available Mechanical Contractor License Examination. Applicants denied by the board will be informed of the appeal process methodology.

The meeting site is accessible, including handicapped parking. Individuals attending the meeting are requested to refrain from using heavily scented personal care products, in order to enhance accessibility for everyone. People with disabilities requiring additional accommodations in order to participate in the meeting should contact the Mechanical Division at 517/241-9325 at least (10) working days before the event.

If you have any questions or are unable to attend, contact this division at (517) 241-9325.

Sincerely,

Kevin D. Kalakay, Chief
Mechanical Division

KDK/mdb

RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF LICENSING AND REGULATORY AFFAIRS
LANSING

STEVEN H. HILFINGER
DIRECTOR

April 26, 2011

TO: Members of the State Board of Mechanical Rules

FROM: Kevin D. Kalakay, Chief, Mechanical Division

SUBJECT: Product Approval for Onix Heat Transfer Tubing

The applicant has requested consideration of a product approval to provide product acceptance through approval clarification.

APPLICANT REPRESENTATIVE:

Mr. Chris Haldiman

APPLICANT:

Watts Radiant
4500 E. Progress Place
Springfield, Missouri 65803

AUTHORITY:

Section 21 of Act 230, 1972 being section 125.1521 of the Michigan Compiled Laws.

PRODUCTS:

Onix Heat Transfer Tubing.
Sizes 3/8", 1/2", 5/8", 3/4", and 1" (ID)

APPLICATION:

Non-potable water radiant heating and snow melting applications.

TEST REPORTS:

Underwriters Laboratories – Report # MH17193
333 Pfingsten Road
Northbrook, IL 60062

IAPMO - Report # 815-06001
5001 East Philadelphia St.
Ontario, CA 91761

ICC-ES - Report # 95-47.02
5360 Workman Mill Rd.
Whittier, CA 90601

CONDITIONS OF USE AND INSTALLATION:

1. Shall comply with the provisions of the Michigan Mechanical Code and the Michigan Plumbing Code.

2. Shall be installed in accordance with the manufacturer's installation instructions.

RECOMMENDATION:

Staff has requested additional information from the manufacturer

KDK/mb

RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF LICENSING AND REGULATORY AFFAIRS
LANSING

STEVEN H. HILFINGER
DIRECTOR

April 26, 2011

Mr. Chris Haldiman
Watts Radiant
4500 E. Progress Place
Sprir.gfield, Missouri 65803

Dear Mr. Haldiman:

The Bureau of Construction Codes, Mechanical Division, has received your Product Approval application for Onix Heat Transfer Tubing.

Your request will be scheduled for the State Board of Mechanical Rules meeting. The next meeting will be held on **May 18, 2011**, located at 2501 Woodlake Circle, Okemos, Michigan. Your appointment is at **9:45 a.m.**, Eastern Standard Time. A map is enclosed for your convenience. If approved by the board, your product will be referred to the Construction Code Commission for final approval. Please call this office for attendance information should you desire to represent your product at the Construction Code Commission meeting.

This office is dealing with this particular installation acceptance in the form of a Certificate of Acceptance. You have wisely chosen that methodology rather than a code appeal. For that reason we are requesting greater involvement on behalf of the manufacture.

Please contact me at 517/241-9325, if you have any further questions in this matter prior to providing the requested information.

Sincerely,

Kevin D. Kalakay, Chief
Mechanical Division

KDK/mb

Enclosure

Petition Application for Approval of Material, Product or Method

Michigan Department of Energy, Labor & Economic Growth
Bureau of Construction Codes
P.O. Box 30255, Lansing, MI 48909
www.michigan.gov/bcc

Agency Use Only: MA #11-001

Application Fee: $500.00

Authority: 1972 PA 230
Completion: Mandatory
Penalty: Use of material, product or method will not be approved

DELEG is an equal opportunity employer/program. Auxiliary aids, services and other reasonable accommodations are available upon request to individuals with disabilities.

PRODUCT INFORMATION

NATURE OF APPLICATION

☐ Material ☑ Product ☐ Method of Manufacture or Construction ☐ Component

CODE UNDER WHICH APPROVAL IS SOUGHT

☐ Building (140) ☐ Electrical (115) ☑ Mechanical (130) ☐ Plumbing (98)

NAME OF MATERIAL, PRODUCT OR METHOD OF MANUFACTURE (Limit To One Item Per Application)

Watts Radiant Onix Heat Transfer Tubing

Tran Info:130 1650720-1 01/24/11
Chk#: 691754 Amt: $500.00
ID: WATTS

OTHER IDENTIFICATION (Model Number)

Model is size. 3/8" (ID), 1/2" 5/8", 3/4" and 1"

DESCRIPTION (Use Additional Sheets If Necessary)

EPDM Composite Rubber Tubing with Aramid Cord and Aluminum O2 Barrier

INTENDED USE (Use Additional Sheets If Necessary)

Onix tubing is used for transporting heat from a heat source to it's intended palce of use. This is accomplished primarily in 3 methods. 1) Supply/Return lines to/from the boiler, 2) Radiant Floor Heating and 3) Snowmelting installations.

DATA SUBMITTED

☑ Letter
☑ Manual
☑ Standards
☑ Installation Instructions
☐ Display Catalog

Reports
☑ ICC - NES
☐ BOCA - NES
☐ ICBO
☐ SBCC
☐ NRB
☑ Other

☐ Product Sample or Model
☑ Prior Approvals by Other Agencies
☐ Recommendations by Model Code Bodies

LABORATORY TEST BY

UL - MH 17193, IAPMO Report 815-06001

PILOT SERVICE EXPERIENCE AND CONDITIONS (Use Additional Sheets If Necessary)

All test results are positive an all product passed all requirements. Product has been manufactured and installed in the US since 1996.

RESTRICTIONS FOR USE (Use Additional Sheets If Necessary)

Maximum operating temperature/pressure rating is 100 PSI @ 180 degrees F.

APPLICANT (Note: All correspondence will be sent to this address)

NAME OF COMPANY	APPLICANT NAME
Watts Regulator Company, d/b/a Watts Radiant	Chris B. Haldiman Technical Manager

ADDRESS: 4500 E. Progress Place

CITY	STATE	ZIP CODE	TELEPHONE NUMBER (Include Area Code)
Springfield	Missouri	65803	

APPLICANT SIGNATURE (Must be an original signature)	DATE	FAX NUMBER (Include Area Code)
	Jan 10, 2011	

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Radiant floor heating and snow melting systems for various applications and control strategies, using Onix™ (EPDM) tubing and appropriate fittings.

1.2 RELATED SECTIONS

A. Section 02551 – Underground Hydronic Piping

B. Section 03300 – Concrete

C. Section 06100 – Rough Carpentry

D. Section 07210 – Insulation

E. Section 15093 – Sleeves and Sleeve Seals for HVAC Piping

F. Section 15181 – Hydronic Piping

1.3 REFERENCES

A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

B. Sections of ASTM International Standards:
   1. ASTM D380 Standard Test Methods for Rubber Hose
   2. ASTM D395 Standard Test Methods for Rubber Property – Compression Set
   3. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
   4. ASTM D413 Standard Test Methods for Rubber Property – Adhesion to Flexible Substrate
   5. ASTM D471 Standard Test Method for Rubber Property – Effect of Liquids
   6. ASTM D573 Standard Test Method for Rubber – Deterioration in an Air Oven
   7. ASTM D1149 Standard Test Method for Rubber Deterioration – Surface Ozone Cracking in a Chamber

C. International Code Council (ICC):
   1. ICC Evaluation Service (ES) Legacy Report No. 95-47.02

D. Watts Radiant
   1. Onix Installation Manual
   2. RadiantWorks Professional Software

1.4 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Onix (EPDM) Tubing/Pressure Ratings:
      a. Tubing shall be rated for continuous working pressures of 100 psi (689 kPa) and 180° F (82° C).
      b. Tubing shall have a short term burst pressure of not less than 800 psi (5516 kPa) at 70° F (21° C) or 600 psi (4137 kPa) at 180° F (82° C).

B. Performance requirements: Provide Hydronic system that is manufactured, fabricated and installed to comply with regulatory agencies and authorities with jurisdiction, and maintain performance criteria stated by the tubing manufacturer without defects, damage, or failure.

1.5 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
B. Product Data: Submit manufacturer's product submittal data and installation instructions for each product.

C. Shop Drawings – Hydronic System
   1. Provide engineering analysis using manufacturer's proprietary software.
   2. Provide installation drawings indicating tubing layout, manifold locations, zoning requirements, and manifold schedules with details required for installation of the system.
   3. Provide mechanical schematic indicating heat source, mechanical piping and accessories from heat source to manifolds, circulators, water tempering, and zone controls. Indicate supply water temperatures and flow rates to manifolds.

D. Samples: Submit selection and verification samples of primary materials.

E. Documentation:
   1. Provide manufacturer's detailed instructions for site preparation and product installation.
   2. Provide manufacturer's electrical power requirements and heat output in watts delivered to the structure.
   3. Provide documentation indicating the installer is trained to install the manufacturer's products, as needed.

F. Closeout Submittals – Submit the following:
   1. Warranty documents specified
   2. Operation and maintenance data
   3. Manufacturer's field reports as specified in this document
   4. Final as-built tubing layout drawing

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Manufacturer shall have a minimum of ten years experience in similar systems.
   2. Manufacturer shall provide products of consistent quality in appearance and physical properties.
   3. Manufacturer shall use the highest quality products in the production of systems and components referenced in this document.
   4. Materials shall be from a single manufacturer to ensure consistent quality and compatibility.

B. Installer Qualifications:
   1. Use and installer with demonstrated experience on projects of similar size and complexity and/or documentation proving successful completion of familiarization training hosted/approved in writing by the system manufacturer.
   2. Electrical rough-in and connections shall be done by a licensed electrician.

C. Certifications: Provide letters of certification as follows:
   1. Installer employs skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trades person.

D. Regulatory Requirements and Approvals – Hydronic Systems: Provide a radiant system that complies with the following requirements:
   1. International Code Council (ICC):
      a. International Mechanical Code (IMC)
      b. International Building Code (IBC)
   2. International Association of Plumbing and Mechanical Officials (IAPMO):
      a. Uniform Mechanical Code (UMC)

E. Pre-installation meetings
   1. Verify project requirements, substrate conditions, excavation conditions, system performance requirements, coverings, manufacturer's installation instructions, and warranty requirements.
   2. Review project construction timeline to ensure compliance or discuss modifications as required.
   3. Coordinate with other trade representatives to verify areas of responsibility.
   4. Establish the frequency (during construction phase of the project) the engineer intends for site visits and inspections by the manufacturer's representative.

F. Mock-up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work

1.7 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 1 Product Requirements Section.

B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

C. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

D. Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer:
   1. Store tubing in cartons or under cover to avoid dirt or foreign material from entering the tubing.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Morter-set Systems: Mortar shall cure for 25 days (or time specified by mortar manufacturer) prior to starting heating systems.

1.9 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty – Hydronic Systems
   1. Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official.
   2. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.
      a. Warranty covers the repair or replacement of any tubing or fittings proven defective.
      b. Warranty may transfer to subsequent owners.
      c. Warranty Period for Tubing is 25-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of manufacture.
      d. Warranty Period for Manifolds and Fittings is 2-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of manufacture.
      e. Warranty period for Controls and Electrical components is a 2-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of manufacture.

1.10 SYSTEM START-UP

A. Do not start the system for a minimum of 25 days or as specified by mortar, concrete and/or covering manufacturer as applicable.

B. Verify all electrical components are installed per local and National Electrical Code (NEC) prior to start-up.

1.11 OWNER'S INSTRUCTIONS

A. Instruct Owner about operation and maintenance of installed system.

B. Provide Owner with manufacturer's installation instructions for installed components within the system.

C. Provide Owner with all operating instructions/documents for sensors and controls.

D. Provide Owner with copies of any detailed layout drawings and photos of installed product before coverings are installed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer:

Watts Radiant, Inc.
4500 E. Progress Place
Springfield, MO 65803
(800) 276-2419; (417) 864-6108; Fax: (417) 864-8161
Web: http://www.wattsradiant.com

B. Substitutions: not permitted

2.2 PRODUCT CHARACTERISTICS

A. Material: Spiral-braided multi-composite design constructed of:
1. a Durel inner tube,
2. an Aluminum AlumaShield solid oxygen diffusion barrier,
3. a contour extrusion layer,
4. an Aramid reinforced fiber, and,
5. an outer cover of HiGuard.

B. Pressure Ratings: Refer to Design requirements.

C. Temperature/Pressure Ratings:
1. Tubing shall be capable of withstanding temperatures of -35°F (-37°C) to 325°F (163°C) intermittently without delamination.
2. Tubing shall be listed to 180°F (82°C) at 100 psi (689 kPa).
3. Tubing shall remain flexible at temperatures down to -35°F (-35°C).

D. UV Resistance: Tubing shall be UV resistant.

E. Crushability: Tubing shall be crush-proof, recovering its original cross-section area after flattening due to construction, site, or installation abuse.

F. Minimum Bend Radius:
   1. ⅜" (9.53 mm) Onix has a 3" (76 mm) bend radius
   2. ½" (12.7 mm) Onix has a 4" (102 mm) bend radius
   3. ⅝" (15.88 mm) Onix has a 5" (127 mm) bend radius
   4. ¾" (19.05 mm) Onix has a 6" (152 mm) bend radius
   5. 1" (25.4 mm) Onix has a 8" (203 mm) bend radius

G. Barrier Tubing Type: Watts Radiant Onix Tubing
   1. Tubing shall have an oxygen permeation barrier.
      a. The oxygen barrier shall be completely encapsulated in the tubing, protected by an outside cover.
      b. The oxygen barrier shall be made of a solid aluminum material.
      c. The resistance shall be consistent across the entire temperature rating 0 to 180°F (-18 to 82°C).
   2. Nominal Inside Diameter: Provide tubing with the following nominal inside diameters:
      a. ⅜" (9.53 mm)
      b. ½" (12.7 mm)
      c. ⅝" (15.88 mm)
      d. ¾" (19.05 mm)
      e. 1" (25.4 mm)

2.3 MANIFOLDS AND FITTINGS

A. Manifolds (Residential and light Commercial, Stainless Steel)
   1. For system compatibility, use 1 or 1½" (25 – 38mm) Stainless Steel manifolds offered by the respective tubing manufacturer.
   2. Manifolds shall provide individual flow control for each loop of the manifold through valve actuators available from the manifold supplier.
   3. Manifolds shall feature manual flow balancing capability within the manifold body for balancing unequal loop lengths across the manifold. Balance valves shall not be ball valves.
   4. Manifolds accommodate ⅜ - ¾" (9.5 – 19 mm) Onix tubing.
   5. Each manifold location shall have the ability to vent air manually from the system.
   6. Stainless Steel 1" (25 mm) Manifolds
      a. Heavy-duty, DIN Standard, 304 stainless steel
      b. Matching fittings and accessories are made of solid brass and are heavily plated with nickel to match the appearance of the manifold trunk.
      c. Internal balancing valves
      d. 0 - 2½ gpm (0 – 0.16 L/sec)flow meters
      e. Manifold brackets
      f. All connections are BSP (British Standard Pipe) or straight thread and require the use of the included gasket.
      g. 2⅛" (54 mm) OC circuit spacing
      h. 12 gpm (.75 L/sec) maximum flow rate

i. 167°F (75°C) maximum operating temperature
j. 87 psi (600 kPa) maximum operating pressure
k. 2½ gpm (0.16 L/sec) per circuit maximum flow rate

7. Stainless Steel 1½" (38 mm) Manifolds
   a. Heavy-duty, DIN Standard, 304 stainless steel
   b. Matching fittings and accessories are made of solid brass and are heavily plated with nickel to match the appearance of the manifold trunk.
   c. Internal balancing valves
   d. 0 - 4 gpm (0 – 0.25 L/sec)flow meters
   e. Manifold brackets
   f. All connections are BSP (British Standard Pipe) or straight thread and require the use of the included gasket.
   g. 2⅛" (54 mm) OC circuit spacing
   h. 22 gpm (1.4 L/sec) maximum flow rate
   i. 167°F (75°C) maximum operating temperature
   j. 87 psi (600 kPa) maximum operating pressure
   k. 4 gpm (0.25 L/sec) per circuit maximum flow rate

B. Manifolds (Commercial, Copper)
   1. Provide 1" (25 mm) or larger Copper manufactured from L-copper and offered by the respective tubing manufacturer for system compatibility.
      a. Install manifolds with optional isolation valves located on both the supply and return manifold.
      b. Each manifold location shall have the ability to vent air manually from the system.
   2. Provide Copper manifolds approved for use in systems free of ferrous materials, or isolate ferrous material to eliminate corrosion damage due to oxygen diffusion.
   3. Balancing:
      a. Design individual loop lengths across the manifold with 10% of each other in length.
      b. Install supply and return piping to the manifold in a reverse-return configuration to ensure self-balancing.
      c. Where the supply and return piping is in direct-return configuration, use manifolds with balancing valves or balance flow setters on the return leg of each manifold to the mains.

C. Manifold Mounting Boxes
   1. Sizes – Watts Radiant manifold mounting boxes come in 3 sizes:
      a. 16" by 29" by 4½" (400mm by 724 mm by 108 mm)
      b. 24" by 29" by 4½" (622mm by 724 mm by 111 mm)
      c. 40" by 29" by 4½" (1003mm by 724 mm by 111 mm)
   2. Each box shall be designed to be recessed into a 6" (152 mm) stud wall.
   3. Included elevators can raise the box from 1½" to 4½" (38 – 114 mm) off of the floor.
   4. Each manifold box is constructed of powder-coated sheet metal, providing increased resistance to corrosion and job-site abuse.
   5. Inside Manifold Mounting Brackets:
      a. Manifold boxes come with 2 fixed horizontal attachment rails and 2 adjustable rails.

b. Each Watts Radiant manifold option will utilize different rail positions, depending on the bracket used.

D. Fittings
1. For system compatibility, use fittings offered by the tubing manufacturer.
a. Watts Radiant barbed insert fittings shall be provided.
b. Only Watts Radiant SelfTite constant-tension spring clamps or TorqueTite screw clamps are approved.
c. Available connections:
1) Sweat
2) NPT
3) BSP
d. Material:
1) UNS 31400 Copper Alloy
2) UNS 36000 Copper Alloy
3) UNS 37700 Copper Alloy

2.4 SUPPLY AND RETURN PIPING

A. Supply-and-Return Piping to the Manifolds (above ground piping):
1. Properly size supply and return distribution piping for the given volume and velocities required at system design.
2. Use compatible distribution pipe material for all supply fluid temperatures and flows in systems with ferrous components.
a. When using Watts Radiant Onix, do not exceed 180°F (82°C) at 100 psi (689 kPa).
3. Use fittings compatible with piping material. Fittings shall transition from distribution piping to system manifolds.

B. Supply and Return Piping to the Manifolds (below ground piping):
1. Properly size supply and return distribution piping for the given volume and velocities required at system design.
2. Use suitable distribution piping material for all supply fluid temperatures and flows in systems with ferrous components.
a. When using Watts Radiant Onix, do not exceed 180°F (82°C) at 100 psi (689 kPa).
3. Use fittings compatible with piping material. Fittings shall transition from distribution piping to system manifolds.

2.5 ROOM TEMPERATURE CONTROLS

A. Room Temperature Controls:
1. Thermostat: DualTemp, air/floor, digital, 24V
2. Thermostat: DualTemp, air/floor, digital, battery
3. Thermostat: DualTemp, air/floor, non-digital, 24V
4. Thermostat: Digital, programmable, air, 24V
5. All thermostats shall operate within a one degree differential temperature incorporating pulse-width modulation action.
6. Install a Watts Radiant Thermostat (heat only) with digital display in each room or zone as required.

a. The Watts Radiant DualTemp thermostat shall have the ability to sense the temperature of the air, floor, or a combination of air and floor.
b. Each DualTemp shall be equipped with an internal air sensor.

7. For multiple-zoning control, install the loop(s) per zone and install the individual valve actuators on the respective loop(s) at the manifold.
   a. Electro-thermal Actuators
      1) Watts Radiant Thermal Actuators are a four-wire actuator designed for use with Watts Radiant Stainless Steel manifolds.
         (a) Actuators are normally closed and will open when power is applied.
         (b) Actuators shall consume no more than 2.5 watts.
         (c) Travel time for the actuators is approximately 90 seconds to close the end switch.
         (d) Each actuator consists of 4 wires, 2 for poser and 2 for an end switch.
   b. Zone Valve Actuator Control Module: Zone valve actuator controls operate zone valves or circuit thermal actuators by supplying 24VAC.
      1) No more than three 2.5 VA actuator valves can be connected to any single zone terminal block.
      2) The control system shall be designed for use with the following models of thermostats:
         (a) Watts Radiant DualTemp (3 or 4 wire)
         (b) Watts Radiant Air Only thermostats
         (c) Use only Watts Radiant non-programmable thermostat if using Optional Timer
         (d) Any 2 wire thermostats with internal battery poser
         (e) 2 wire thermostats that consume poser shall not be used, as damage to either the thermostat or controller may occur.
            (1) Never connect a power consuming 2 wire thermostat to the control as damage to the thermostat and/or control may occur.
      3) External 24/120 VAC transformer (not included) is required to operate these controls.
         (a) A 40 VA transformer for a maximum of 12 actuators
         (b) A 60 VA transformer for a maximum of 18 actuators
      4) Master Controls:
         (a) Equipped with valve and thermostat terminals
         (b) Incoming 24 volt power connection
         (c) Two 8 amp, dry contact terminals for pump and boiler operation
            (1) With end-switch capability, the Zone Control Module activates other relays or controls as required by system control strategy.
            (2) Control does not use the end-switch wires of a 4 wire actuator
            (3) Both 2 wire and 4 wire actuators may be used.
      5) Slave Controls:
         (a) The use of Slave units allows the control of more zones utilizing the same pump and boiler.
         (b) Up to 2 Slave controls can connect to a Master
            (1) Allows for a maximum of 18 separate zones or thermostat connections
            (2) Both 2 wire and 4 wire actuators may be used.

2.6 HYDRONIC RADIANT SNOW MELTING CONTROLS

A. Use sensors/controls provided by manufacturer:
   1. HSC-5 Snow Melting Slab Detector
      a. Slab / Pavement mounted
      b. Senses actual pavement conditions
      c. Microprocessor control eliminates ice-bridging
      d. Provides a low-amperage output relay contact
      e. Heavy-duty machined brass housing
      f. Removable top cover
      g. Plug-in electronic assembly
      h. 24 VAC
   2. LCD-1H Automatic Snow Switch
      a. Pole-mounted
      b. Senses both temperature and precipitation
      c. Isolated 3 Amp resistive/1 Amp inductive relay contact
      d. 24 VAC

2.7 ACCESSORIES

A. Provide accessories associated with the installation of the radiant heating system as recommended by or available from the tubing manufacturer.
   1. IsoTherm: The IsoTherm provides mixing control and zone pumping all in a compact, unique package that conveniently connects directly to Watts Radiant Stainless Steel manifolds.
      a. The IsoTherm module includes the following items:
         1) Mix Valve
         2) 3 speed 1/25 hp Circulator
         3) Temperature Guage
         4) Maximum Temperature Sensor
         5) Trunk Isolation Valves
         6) BSP to NPT Transition Nipple
      b. Mounting:
         1) The IsoTherm can be wall mounted with standard cush clamps or other copper pipe mounted brackets.
         2) The IsoTherm can be integrated into a standard Watts Radiant manifold box.
      c. Capacity:
         1) Full heat capacity of 51,000 BTU/h with a minimum boiler temperature of 158°F (70°C).
   2. Pressure Differential By-pass Valve (for use with 1" Stainless Steel Manifolds only):
      a. Use Watts Radiant Pressure Differential By-pass Valve with the manifolds incorporating actuators to avoid noise due to excessive water velocity.
         1) Eliminates water velocity noise and water hammer.
         2) Increases pump life because of minimal pressure surging as actuators open and close.
         3) There is always correct and constant flow regardless of the number of actuators or zone valves open.
         4) Water flow through the DBP valve shall be 25-30 % of the total flow:

(a) The over-pressure shall not exceed 10-15 % of the system pressure drop.
(b) If the zones to be by-passed have a maximum pressure drop of 0.5 psi (3.5 kPa), the DBP valve shall be set to accommodate this pressure plus 10-15 %.
(c) The DBP valve needs to be installed 'downstream' of the main circulator.
(d) Install before the system zones
(e) Should connect the supply line with the return line

3. FlowGuard:
   a. FlowGuards shall be of commercial-quality, non-electronic flow indicator and flow setter.
   b. Cast brass construction
   c. Accurate visual flow indication in GPM
   d. Ability to set fluid flow
   e. FlowGuards shall allow zone-by-zone control and optimization.
   f. No special training or electronic instrumentation required,
   g. Sizes:
      1) 1" (25 mm) MNPT ends: 0.5 – 4 gpm (0.03 to 0.25 L/sec) flow meter
      2) 1" (25 mm) FNPT ends: 1 – 13 gpm (0.06 to 0.8 L/sec) flow meter
4. Tempering Valves:
   a. MixTemp 180 Mixing Valve:
      1) The MixTemp 180 is a 3 port, non-electric nix valve for use in Hydronic heating systems.
         (a) Hot, cold, and mix ports are clearly marked "H," "C," and "M."
      2) This mix valve shall be capable of delivering water temperatures ranging from 90° to 160°F (32° to 71°C) +/- 3° F.
      3) The Hydronic mix valve shall have a cast bronze body.
      4) Copper, stainless steel and EPDM internal parts
      5) There are no ferrous components to corrode.
      6) The actuator for the piston shall have lineal expansion characteristics, and shall be completely filled with a temperature-sensitive wax.
      7) Each port on the MixTemp has a union to allow for easy servicing
      8) Available in ¾" (19 mm) and 1" (25 mm) female NPT fittings.
         (a) ¾" Cv = 3.1
         (b) 1" Cv = 3.2
      9) These mixing valves are not anti-scald valves since they do not have positive shut-off in case of failure of hot or cold water supply. We do not recommend their use for shower service.
      10) Shall have a source of return water cooler than the desired mix temperature to operate properly.
      11) The mix valve shall not be heated in excess of 200°F (93°C) to prevent the liquid-filled actuator from rupture.
         (a) To prevent damage, temporarily remove the mixing valve from the unions before soldering near the mix valve.
   b. AllTemp Mixing Valve:
      1) The AllTemp shall be a non-electric, 3 port mix valve for use in hydronic heating systems.
      2) Valve shall be capable of delivering water temperatures ranging from 100 – 200°F (38 – 93°C).

3) The hydronic mix valve shall have a cast bronze body.
4) Chrome-plated bronze piston
5) The actuator for the piston shall have linear expansion characteristics, and shall be completely filled with a temperature-sensitive liquid communicating with the hydraulically formed brass bellows.
6) The AllTemp is available in 1¼" (32 mm), 1½" (38 mm), and 2" (51 mm) female NPT fittings.
   (a) 1¼" Cv = 6.1
   (b) 1½" Cv = 6.2
   (c) 2" Cv = 9.1
7) Mixing valves are not anti-scald valves since they do not have positive shut-off in case of failure of hot or cold water supply. Do not use for shower service.
8) Shall have a source of cooler return water to operate properly.
9) The mix valve shall not be heated in excess of 230°F (110°C), or the liquid-filled actuator may rupture.
   (a) To prevent damage, temporarily remove the actuator assembly from the valve body before soldering near the mix valve.

5. Staples: Watts Radiant Foamboard Staples
6. Terminal 90-degree Exit Bend: Terminal Bend Supports

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions:
   1. Verify that site conditions are acceptable for installation of the system. Refer to manufacturer's installation manual for information.
   2. Do not proceed with installation of the system until unacceptable conditions are corrected.

3.2 INSTALLATION OF FLOOR HEATING SYSTEMS

A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including the following:
   1. Installation manuals
   2. Design software engineering and analysis

B. Slab-On-Grade Installation:
   1. Fasten the tubing to the flat mesh or reinforcing bar in accordance with the tubing manufacturer's installation recommendations.
   2. Use closer tubing on-center distances along exterior walls. Increase tubing on-center distances as the installation moves away from the exterior wall as determined by manufacturer analysis.
   3. Staple the tubing to the insulation board.
   4. Install edge insulation where the heated panel directly contacts an exterior wall or panel.
   5. Install tubing at a consistent depth below the surface elevation. Ensure sufficient clearance to avoid control joint saw cutting.

6. Where tubing crosses metal expansion joints in the concrete, ensure the tubing passes below the joints or is sleeved through the joint.

C. Pre-Cast Plank Construction with a Cap Pour:
   1. Fasten the tubing to the flat mesh or reinforcing bar, or snap into Triple-track or Single-track RailWays in accordance with the tubing manufacturer's installation recommendations.
   2. Use closer tubing on-center distances along exterior walls. Increase tubing on-center distances as the installation moves away from the exterior wall.
   3. Staple the tubing to the insulation board.
   4. Install edge insulation where the heated panel directly contacts an exterior wall or panel.
   5. Install tubing at a consistent depth below the surface elevation. Ensure sufficient clearance to avoid control joint saw cutting.
   6. Where tubing crosses metal expansion joints in the concrete, ensure the tubing passes below the joints or is sleeved through the joint.

D. Wood Floor Construction with a Lightweight Gypsum Topping:
   1. Staple tubing to the wood sub-floor in accordance with the tubing manufacturer's installation recommendations. The attachment method shall not cause abrasions on the tubing.
   2. Use closer tubing on-center distances along exterior walls. Increase tubing on-center distances as the installation moves away from the exterior wall.
   3. Ensure the depth of the lightweight pour is a minimum of ¾" (19 mm) over the outside dimension of the tubing, 1" typical overall thin-slab thickness.
   4. Install reinforcing mesh within the pour for finished flooring of tile or linoleum.
   5. Install wood sleepers along the room perimeter and between the tubing to provide a nailing surface for finished wood floors or carpet tack strips as required. Refer to Section 06100.
   6. Allow lightweight gypsum concrete pour to cure in accordance with the applicator's instructions. Once cured, seal the surface of the floor topping to protect surface from moisture.
   7. Install insulation in the joist cavity below the floor in accordance with the submitted radiant floor design. Refer to Section 07210.
   8. Install edge insulation if the heated panel directly contacts an exterior wall or panel. Refer to Section 07210.

E. Wood Floor Construction with UnderFloor Heating (Onix tubing attached directly to wood sub-floor):
   1. Install tubing attached directly to the underside of the wood sub-floor in accordance with the tubing manufacturer's recommendations. The attachment method shall not puncture or cause abrasions to the tubing.
   2. Do not exceed 8" (203 mm) on center tube spacing. Refer to the submitted radiant floor design.
   3. Comply with the tubing manufacturer's installation procedures on proper joist drilling.
   4. Install foil-faced insulation in the lower portion of the joist cavity. Allow an air gap of 2 – 3" (51 – 76 mm) between the wood sub-floor and the top of the insulation. Refer to Section 07210.

5. Use the recommended amount of insulation in the joist cavity below the floor in accordance with the submitted radiant floor design. Refer to Section 07210.
6. Use edge insulation equal to the amount of underfloor insulation if the heated panel directly contacts an exterior wall or panel. Refer to Section 07210.

F. Wood Floor Construction with Joist Heating (tubing suspended in the joist bay):
1. Install tubing within the joist cavity in accordance with the tubing manufacturer's recommendations. The attachment method shall not cause abrasions to the tubing.
2. Do not exceed 8" (203 mm) on center. Refer to the submitted radiant floor design.
3. Do not allow tubing within the joist cavity to contact the wood sub-floor.
4. Refer to the tubing manufacturer's installation procedures on proper joist drilling.
5. Install foil-faced insulation in the lower portion of the joist cavity. Allow an air gap of 2 – 3" (51 – 76 mm) between the wood sub-floor and the top of the insulation. Refer to Section 07210.
6. Use the recommended amount of insulation in the joist cavity below the floor in accordance with the submitted radiant floor design. Refer to Section 07210.
7. Use edge insulation equal to the amount of underfloor insulation if the heated panel directly contacts an exterior wall or panel. Refer to Section 07210.

G. Wood Floor Construction with SubRay:
1. Install SubRay on top of the wood sub-floor according to the tubing manufacturer's instructions.
2. Coordinate the finished floor covering layout direction with the direction of the SubRay layout. Comply with the tubing manufacturer's instructions.
3. Install insulation in the joist cavity below the floor according to the submitted radiant floor design. Install the insulation tight against the wood sub-floor. Refer to Section 07210.
4. Use the recommended amount of insulation in the joist cavity below the floor in accordance with the submitted radiant floor design. Refer to Section 07210.
5. Use edge insulation equal to the amount of underfloor insulation if the heated panel directly contacts an exterior wall or panel. Refer to Section 07210.

H. Glycol and Water Solution:
1. Provide premixed glycol and water solutions.
2. Do not use ethylene glycol due to toxicity issues. Provide inhibited propylene glycol for hydronic radiant floor heating systems. Refer to the boiler manufacturer's recommendations.

3.3 INSTALLATION OF HYDRONIC SNOW MELTING SYSTEM

A. Slab-On-Grade Installation:
1. Fasten the tubing to the rewire or rebar in accordance with the tubing manufacturer's installation recommendations.
2. Install tubing at a consistent depth below the surface elevation. Ensure sufficient clearance to avoid control joint saw cutting.
3. Install an extruded polystyrene insulation board at the edge of, and optionally under, the slab, depending on site conditions.

4. Where tubing crosses metal expansion joints in the concrete, ensure that the tubing passes below the joints or is sleeved through the joints in accordance with manufacturer's instructions.

B. Slab over Steel Deck Installation:
   1. Fasten tubing to either rewire or rebar, or snap tubing into Triple or Single-track RailWays in accordance with manufacturer's installation instructions.
   2. If rewire or rebar is not used, install the tubing perpendicular to the ribbing on the steel deck.
   3. Install either spray-on insulation or insulation board under the steel deck as per the manufacturer's directions.

C. Brick Pavers over Concrete Slab Installation:
   1. Fasten the tubing to the rewire or rebar in accordance with the tubing manufacturer's installation recommendations.
   2. Install tubing at a consistent depth below the surface elevation.
   3. Install the brick pavers on top of the concrete according to proper masonry practice and guidelines for this application.

D. Brick Pavers over Sand or Stone Dust Installation:
   1. Fasten the tubing to the rewire or rebar in accordance with the tubing manufacturer's recommendations for installation in base material.
   2. Install tubing at a consistent depth below the surface elevation.
   3. Place a layer of sand over the tubing to a depth that results in the manufacturer's recommended minimum depth when compacted.
   4. Install the brick pavers on the compacted material according to proper masonry practice and guidelines for this application.

E. Asphalt Installation:
   1. Fasten the tubing to the rewire or rebar in accordance with the tubing manufacturer's recommendations for installation in sub-base material.
   2. Install tubing at a consistent depth below the surface elevation.
   3. Ensure that there is a minimum of 2" (51 mm) of material covering the installed tubing.

3.4 FIELD QUALITY CONTROL AND TESTING

A. Site tests:
   1. To ensure system integrity, pressure test the system before covering tubing in concrete or when other trades are working in the vicinity of the tubing.
   2. Test all electrical controls in accordance with respective installation manuals.
   3. System shall be checked after 3 years of operation and every year thereafter. System shall be checked for pH levels to ensure that it is operating within suggested guidelines.

3.5 SYSTEM ADJUSTING

A. Balancing Across Manifold: Balance all loops across each manifold for equal flow resistance based on actual loop lengths and total manifold flow.

B. Balancing between manifolds is accomplished with a flow control device installed on the return piping leg from each manifold when direct return piping is used for the supply and return mains or the circuits deviate by more than 10%.

3.6 CLEANING

A. Remove temporary coverings and protection of adjacent work areas.

B. Repair or replace damaged installed products.

C. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

D. Remove construction debris from project site and legally dispose of debris.

3.7 DEMONSTRATION

A. Demonstrate operation of system to Owner or Owner's personnel.

B. Instruct the Owner or Owner's personnel about the type, concentration and maintenance of the glycol and water solution.

C. Provide Owner or Owner's personnel with manufacturer's installation, operation, and maintenance instructions for installed components within the system.

3.8 PROTECTION

A. Protect installed work from damage caused by subsequent construction activity on the site. Provide Owner with copy of photos and drawings of product locations to assist.

WattsRadiant
Floor Heating & Snowmelting
A subsidiary of Watts Water Technologies, Inc.

4500 E. Progress Place
Springfield, MO 65803-8816
800-276-2419/417-864-6108 (Phone)
417-864-8161 (Fax)
www.wattsradiant.com

Onix™ Submittal

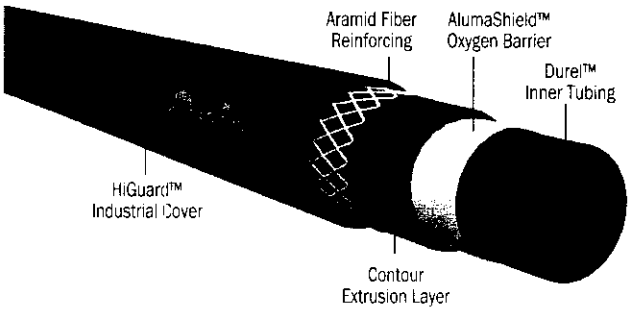
PROJECT NAME: _____

WATTS RADIANT REPRESENTATIVE: _____

Unit Tag No.: _____ Order No.: _____ Date: _____

Engineer: _____ Submitted by: _____ Date: _____

Contractor: _____ Approved by: _____ Date: _____



PRODUCT DESCRIPTION

Onix is a polymer-rich, multi-layer, industrial-grade hose used for hydronic heating and snowmelting applications. It contains five distinct structural layers. The Durel inner tube is a peroxide-cured, cross-linked EPDM (Ethylene Propylene Diene Monomer). This layer is wrapped with a ductile 00 grade aluminum oxygen barrier, called AlumaShield. A contour layer of Durel (EPDM) is extruded over the AlumaShield. Spiral reinforcing cords of Aramid fibers are applied over the contour layer. This reinforcing is covered with the outer HiGuard cover composed of sulfur-cured, cross-linked EPDM.

OPERATING TEMPERATURE AND PRESSURE

Onix has a maximum working temperature of 180°F at 100 psi. Burst pressure is greater than 800 psi at 70°F; greater than 600 psi at 180°F.

ONIX ACCESSORIES

Several accessories are associated with Onix. Please reference other Watts Radiant documents for more information.

APPROPRIATE APPLICATIONS

Onix is used for hydronic heating and snowmelting applications. Please reference the Onix Master Specification, RadiantWorks® Reports and installation manual and guidelines for information concerning design, sizing, installation and application.

MANIFOLDS

Manifolds for Onix are made of copper, cast brass, and stainless steel, and are available in a variety of types and sizes. Refer to Watts Radiant's Onix Manifolds Submittal for more details (see reverse).

CONNECTIONS

Onix is connected to the Onix manifolds with barbed Onix fittings using Watts Radiant SelfTite™ or TorqueTite™ clamps. SelfTite clamps should be installed using SqueezeTite™ pliers.

INSTALLATION

Onix must be installed in accordance with all Watts Radiant installation procedures, including information provided in Watts Radiant's Onix installation manual and guidelines. Refer to RadiantWorks design information and design plans.

CODES, LISTINGS, AND STANDARDS

ASTM: Onix is tested to relevant portions of ASTM standards.

BOCA: Provide radiant tubing carrying the BOCA certification mark, as approved by the BOCA research report number 95-47.1.

Uniform Plumbing Code: Provide radiant tubing carrying the UPC certification mark, as approved by the International Association of Plumbing and Mechanical officials.

RPA: Install radiant tubing in compliance with the Standard Guidelines for Radiant Panel Installations, as approved by the Radiant Panel Association.

ONIX TUBING SPECIFICATIONS

Quantity	Product	Model No.	Nominal Tubing Size I.D.	Nominal Tubing Size O.D.	Maximum Lengths	Bend Radius	Fluid Capacity Per 1,000 ft.
	3/8" Onix	086061	3/8"	11/16"	200 ft.[1]	3"	6.25 gal.
	1/2" Onix	086081	1/2"	7/8"	300 ft.[2]	4"	10.25 gal.
	5/8" Onix	086101	5/8"	1"	600 ft.[2]	5"	16.00 gal.
	3/4" Onix	086121	3/4"	1-1/8"	350 ft.[2]	6"	25.00 gal.
	1" Onix	086161	1"	1-3/8"	200 ft.[3]	8"	43.50 gal.

[1] Available in 20-ft. increments.
[2] Available in 25-ft. increments.
[3] Available in 100-ft. increments.

WattsRadiant
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417-864-8161 (Fax)
www.wattsradiant.com

Onix™ Manifold Submittal

PROJECT NAME: _____

WATTS RADIANT REPRESENTATIVE: _____

Unit Tag No.: _____ Order No.: _____ Date: _____

Engineer: _____ Submitted by: _____ Date: _____

Contractor: _____ Approved by: _____ Date: _____

OPERATING TEMPERATURE AND PRESSURE

Watts Radiant Onix Manifolds are manufactured in several styles for radiant floor heating and snowmelting applications: Custom Tubular, Swedged, CustomCut™, Stainless Steel, and CazzBrass™. Manifolds are constructed of either copper, cast brass, or stainless steel as shown in the schedule below. All brass barbed branches are constructed of solid brass to accept Onix tubing. Manifolds and manifold components are assembled by brazing and/or soldering. *Ribbed branches are spaced at 2" on center (o.c.) on all Custom Tubular Manifolds. Branches on CustomCuts are spaced at either 3" or 4" o.c. Three inches are allowed on ends of manifolds, including union if supplied. Stainless Steel Manifolds have a branch spacing of 2-1/8" o.c., CazzBrass Manifolds have a spacing of 2".* All mani-folds have a maximum operating pressure of 100 psig at 200°F. Several options are available as described below.

OPTIONAL MANIFOLD FEATURES

1. Mini Ball Valves (MBVs) are supplied for system purging, balancing, and isolation. MBVs are made of brass construction with stainless steel ball and Teflon seats. MBVs are installed on the return manifold (BVR), or the supply and return manifold (BVSR) of Custom Tubular Manifolds. Swedged and CustomCut Manifolds are supplied either with or without MBVs.

2. Unions can be installed on Custom Tubular Manifolds for ease of installation and system maintenance. 1" all-brass unions are constructed entirely of solid brass and come with a rubber O-ring to assure a tight seal. 1-1/4" to 3" unions are constructed of brass nuts with copper sleeves and an O-ring seal.

3. Vent-and-purge Assemblies or End Assemblies are available for purging air and/or water from the radiant zone(s). These assemblies are constructed of a "key" type manual vent and drain valve for system purging.

4. Other specialized components as described and verified by manufacturer: _____

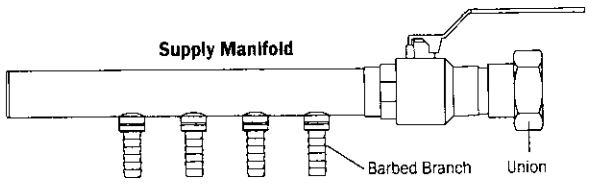
Qty. ✓	Manifold Model Name	Trunk I.D. (Nom.)	Trunk Material	Onix Barb Sizes	Optional Mini Ball Valves ✓		Optional Trunk Ball Valves ✓	Optional Unions ✓	Optional Vent/ Purge Assembly
	Custom Tubular	1"	Copper	3/8"-5/8" Onix	BVR	BVSR	TBV	Brass	Brass/SS
	Custom Tubular	1-1/4"-3"	Copper	3/8"-1" Onix	BVR	BVSR	TBV	Copper/Brass	Brass/SS
	Swedged	1"	Copper	3/8"-5/8" Onix	MBV	N/A	N/A	N/A	Brass/Copper/SS
	CustomCut	1"-1-1/2"	Brass	3/8"-3/4" Onix	MBV	N/A	N/A	N/A	Brass/Copper/SS
	CazzBrass	1-1/4"	Brass	3/8"-3/4" Onix	BVR	BVSR	N/A	Brass	Brass/SS
	Stainless Steel	1"	Stainless	3/8"-3/4" Onix	BVR	BVSR	N/A	Brass	Brass/SS

*The exact part number is based on the type of connection size and number of branches. Place a check mark in the appropriate column for optional components.

MBV = mini ball balves, BVR = mini ball valves on return manifold, BVSR = mini ball valves on supply and return manifolds, TBV = trunk ball valves, and N/A = not available.

MANIFOLD ACCESSORIES

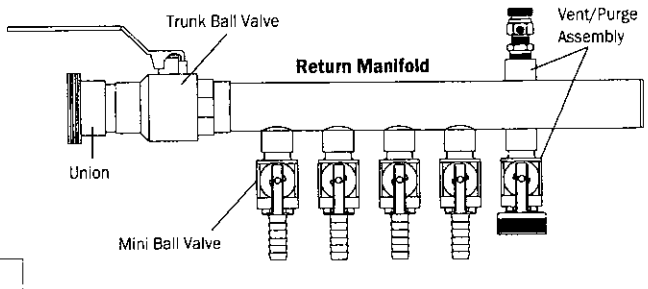
- ☐ Universal Mounting Brackets.
- ☐ Pressure Test Kits are manufactured of copper construction with integral pressure gauge, boiler drain, Schraeder air fitting and standard hose fitting. Sizes provided to match manifolds.
- ☐ Manifold Boxes.



MANIFOLD FITTING/CONNECTION SYSTEM

Watts Radiant manifolds are constructed for connection to Onix tubing. Note that some fitting systems are not available in certain sizes. Please specify connection/fitting system:

Fitting Type	3/8" Onix	1/2" Onix	5/8" Onix	3/4" Onix	1" Onix
SelfTite™					N/A
TorqueTite™					



MANIFOLD FLUID FLOW CAPACITIES

Nominal I.D.	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"
Flow Capacity (maximum)	10 gpm	16 gpm	24 gpm	45 gpm	70 gpm	100 gpm

ONIX™
HEATING & SNOWMELTING WARRANTY

From Watts Radiant™

1. Watts Radiant warrants its Onix™ energy transfer hose and factory manufactured manifolds and fittings to be free of defects in material and workmanship. Onix hose is warranted for a period of twenty-five years from the date of manufacture. Manifolds and fittings manufactured or distributed by Watts Radiant are warranted for a period of two years from the date of manufacture. All other Onix accessories are warranted for one year after date of installation.
2. Watts Radiant's obligation will be to repair or replace, at its discretion, any material proven to be defective when such material is covered under the following limited warranty.
3. Watts Radiant may, at its discretion, pay the freight to return defective material, pay the freight to send out replacement material, and pay a reasonable pre-approved labor charge to replace defective material.
4. In order to qualify for a labor allowance under the terms of the preceding paragraph, you must contact Watts Radiant in advance and receive a written authorization for this allowance. **Labor and freight expenses not authorized in advance by Watts Radiant's Claim Department will not be compensated.**
5. In the event of a system malfunction or leak caused by defective materials (and not by incorrect installation procedures or damage from handling procedures/jobsite conditions) repair materials and a reasonable labor allowance will be allowed. In the event of a leak occurring in a factory manifold, you may contact Watts Radiant for either a free replacement manifold or any needed parts (freight prepaid). A reasonable labor allowance for any needed repair work may be provided.
   Note: Watts Radiant does not warrantee its piping unless Watts Radiant branches and clamps are used in the installation. In the case of field-assembled manifolds, Watts Radiant warrants the quality and serviceability of the individual components sold by Watts Radiant that the contractor incorporates in that manifold, but Watts Radiant cannot warrantee the complete manifold assembly. That is the responsibility of the installing contractor.
6. To qualify for the above warranty you must do the following:
   a. Use good construction techniques to install our materials, as specified in our current design and installation guidelines and technical notes. This must include field pressure testing our materials before they are covered by concrete or otherwise made inaccessible, and make this test data available if a warranty claim is made.
   b. Install our materials according to any specific instructions that we furnish for your job.
   c. Install Onix in a system that will not normally operate at temperatures exceeding 180°F.
7. Evidence of tampering, mishandling, neglect, accidental damage, freeze damage, or unauthorized repairs that cause damage to Watts Radiant products will void any warranty coverage for those particular damages, although it will not void warranty coverage for unrelated items. Field repair joints and hose-to-manifold connections are specifically excluded from the terms of this warranty.

   WATTS RADIANT DISCLAIMS ANY WARRANTY NOT PROVIDED HEREIN, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. WATTS RADIANT FURTHER DISCLAIMS ANY RESPONSIBILITY FOR SPECIAL, INDIRECT, SECONDARY, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING FROM OWNERSHIP OR USE OF THIS PRODUCT, INCLUDING INCONVENIENCE OR LOSS OF USE. THERE ARE NO WARRANTIES THAT EXTEND BEYOND THE FACE OF THIS DOCUMENT. NO AGENT OR REPRESENTATIVE OF WATTS RADIANT HAS ANY AUTHORITY TO EXTEND OR MODIFY THIS WARRANTY.

8. Some states do not allow the exclusion or limitation of incidental or consequential damages, and some states do not allow limitations on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights, which vary from state to state.

Effective: ***April 26, 2010***
This warranty applies to all products purchased after this date.

WattsRadiant™
Floor Heating & Snow Melting

4500 E. Progress Place
Springfield, MO 65803-8816
800-276-2419 / 417-864-6108 (Phone)
417-864-8161 (Fax)
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Northbrook, Illinois • (847) 272-8800
Melville, New York • (631) 271-6200
Santa Clara, California • (408) 985-2400
Research Triangle Park,
North Carolina • (919) 549-1400
Camas, Washington • (360) 817-5500

Underwriters Laboratories Inc.®

NORTHBROOK OFFICE

August 21, 2003

Watts Radiant Inc.
Mr. Chris Haldeman
3131 W Chestnut Expy.
Springfield, MO 65802

Reference: MH17193, 03NK22489

Subject: IAPMO Report for Onix Radiant Heating Hose

Dear Mr. Haldeman:

The attached Report covers tests on Radiant Heating Hose and Hose Assemblies conducted by Underwriters Laboratories Inc., 333 Pfingsten Rd., Northbrook, IL, Ph 847-272-8800, Fax 847-272-8129. The Report covering these tests was issued June 26, 1997 and supplemented by Test Records issued 10-22-97, 5-24-99 and 8-21-2003. Each page is identified by the File No. MH17193 and the report issue date of June 26, 1997. There are a total of 26 pages in the Report.

Tests were conducted for Watts Radiant Inc., 3131 W Chestnut Expy, Springfield, MO 65802 on samples manufactured by Dayco Products Inc, 400 South St., PO Box 1448, McCook, NE 69001 and submitted by Watts Radiant Inc.

Testing was to establish Listing by Underwriters Laboratories Inc. in the Category - Radiant Heating Hose and Hose Assemblies in accordance with the Subject 2156 Outline of Investigation for Rubber Hose for Radiant Heating, Issue No. 2 dated August 7, 1997. Supplemental testing covered by Test Record No. 4, Issued 8-21-2003, was to additionally meet requirements of IAPMO Standard for Aramid Reinforced Rubber Hose for Use in Non-Potable Water Radiant Heating & Snowmelting, PS 107-98.

All portions of each test were under the continuous, direct supervision of the laboratory.

The radiant heating hose covered by the attached Report complies with the requirements of the Subject 2156 Outline of Investigation for Rubber Hose for Radiant Heating, Issue Number 2, dated August 7, 1997 and with the IAPMO Material and Property Standard for Aramid Reinforced Rubber Hose for Use in Non-Potable Water Radiant Heating & Snowmelting, PS 107-98.

Report by:

Tom Grant
Staff Chemist
Conformity Assessment Services
3015ENBK

Reviewed by:

Thomas A. Skowera
Engineering Group Leader
Conformity Assessment Services
3015ENBK

MH17193
8/21/2003
2 of 1

COVER PAGE CONTAINS 3 PAGES PLUS REPORT CONTAINS 26 PAGES

TEST LABORATORY LOCATION:			
[X]UL or Affiliate	[]WTDP	[]CTDP	[]OTHER
Company Name	Underwriters Laboratories Inc.		
Address	333 Pfingsten Road, Northbrook, IL, 60062		
Telephone	847-272-8800		
Fax:	847-272-8129		

TEST CONDUCTED FOR:	
Company Name	Watts Radiant Inc.
Address	3131 W. Chestnut Expy, Springfield, MO 65802

MANUFACTURER AND/OR SOURCE OF PRODUCT TESTED:	
Company Name	Dayco Products Inc,
Address	400 South Street, PO Box 1448, McCook, NE 69001

DESCRIPTION OF PRODUCT:	
Radiant Heating Hose	3/8, ½, 5/8, ¾, and 1 inch trade sizes

DATE SAMPLES RECEIVED: 7-25-03

Description of Tests	Per Standard No.	Subject 2156 Outline of Investigation for Rubber Hose for Radiant Heating Issue Number 2, dated August 7, 1997
	Per Standard No.	IAPMO Material and Property Standard for Aramid Reinformced Rubber Hose for Use in Non-Potable Water Radiant Heating & Snowmelting, PS 107-98.
Tests Conducted by +	Tim Towson	
Reviewed and accepted by Responsible Engineer	Thomas Grant	
Reviewed by:	Thomas Skowera	

TESTS CONDUCTED:			
		Test Name	The following tests were conducted in accordance with the Subject 2156 Outline of Investigation for Rubber Hose for Radiant heating, Issue No. 2, dated August 7, 1997, except as noted
Construction			
		Internal Diameter - Sec. 4	
		Tube and Cover - Sec. 5	
		Reinforcement - Sec. 6	
Performance			
		Proof Pressure Test - Sec. 7	
		Hydrostatic Strength - Sec. 8	
		Adhesion - Sec. 9	
		Tensile Strength and Elongation Test of Tube and Cover - Sec. 10	
		Accelerated Air Oven Aging Test of Tube and Cover - Sec. 11	
		Ozone Exposure - Sec. 12	
		Immersion Tests of Rubber - Sec. 13	
		Deformation by External Loading - Sec. 14	
		Deformation by Bending - Sec. 15	
		Hydrostatic Strength After Accelerated Air-Oven Aging - Sec. 16	
		Hydrostatic Strength After Exposure to Heat Transfer Fluids - Sec. 17	
		Hydrostatic Strength After Exposure to Abnormal Temperatures - Sec. 18	
		Proof Pressure per Sec. 5.4 of IAPMO Standard PS 107-98	
		Cold Flex Test per Sec. 5.3 of IAPMO Standard PS 107-98	

Test Equipment- See "TEST EQUIPMENT INFORMATION"

File MH17193
Project 96NK30194

June 26, 1997

REPORT

on

RADIANT HEATING HOSE AND HOSE ASSEMBLIES

Chiles Power Supply, dba Heatway
Springfield, MO

DESCRIPTION

PRODUCT COVERED:

*"Onix" (formerly "Entran Onix") radiant heating hose, 3/8, 1/2, 5/8, 3/4 and 1 in. sizes.

GENERAL:

The hose consists of an ethylene propylene (EPDM) rubber tube, a thin layer of aluminum foil, a layer of EPDM rubber, a reinforcement of two Aramid spiraled plies, and an EPDM cover.

The hose is intended for use with heat transfer fluids in radiant heating systems for floors and driveways at a maximum working pressure of 100 psig and a maximum temperature of 82°C (180°F). The hose is intended to be installed in accordance with manual entitled "Entran Onix Installation".

CONSTRUCTION OF HOSE:

Sizes - 3/8, 1/2, 5/8, 3/4 and 1 in. nominal internal diameters. The internal diameter is trade size $\pm$ 1/32 in.

Tube - The inner tube or lining of the 3/8, 1/2, 5/8 and 3/4 in. size hose is constructed from a black ethylene propylene (EPDM) rubber, Dayco Compound No. JB9490 or JB9490B. The minimum thickness is 0.047 in.

The inner tube or lining of the 1 in. size hose is constructed from a black ethylene propylene (EPDM) rubber, Dayco Compound No. JB9490B. The minimum thickness is 0.060 in.

Foil - A 0.001 in. thick aluminum foil is applied directly over the tube. A layer of black ethylene propylene (EPDM) rubber is applied between the foil and the spiraled reinforcement. The compound is the same as the tube.

Reinforcement - The reinforcement of the hose consists of two spiraled plies of Aramid yarn. The plies are helically wound in opposite direction to each other and are applied over the rubber layer.

Cover - The cover of the hose is constructed from a black ethylene propylene (EPDM) rubber, Dayco Compound No. JB9494 applied over the spiraled reinforcement. The minimum thickness is 0.040 in.

MARKING:

*The hose is marked with the company name "Heatway", "Onix", "Maximum Working Pressure (or Max. Press.) 100 psig", and "Maximum Temperature (or Max. Temp.) 180°F" or "Maximum Temperature (or Max. Temp.) 82°C (180°F)", and date of manufacture.

LW/WS:rrr
NKDLS

T E S T R E C O R D N O. 1

SAMPLES:

Representative samples of the 3/8, 1/2, 5/8 and 3/4 in. trade sizes of radiant heating hose were furnished by the manufacturer. Samples included 2 ft coupled lengths and uncoupled lengths of each size. The tube and outer cover of the hose were made from Dayco Compound Nos. JB9490 and JB9494, respectively.

GENERAL:

These test results relate only to the items tested.

INSIDE DIAMETER:

METHOD

The inside diameter of the hose was determined in accordance with the test method described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 4.

RESULTS

Size of Hose, in.	Inside Diameter, in.
3/8	25/64
1/2	31/64
5/8	41/64
3/4	48/64

THICKNESS OF TUBE AND COVER:

METHOD

The thickness of the tube and cover was determined in accordance with the test method described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 5.

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NKDLS

RESULTS

Size of Hose, in.	Thickness, in. Tube	Cover
3/8	0.063	0.037
1/2	0.068	0.050
5/8	0.062	0.045
3/4	0.088	0.058

ADHESION TEST:

METHOD

Specimens from the hose were subjected to the adhesion tests outlined in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 9.

RESULTS

Size of Hose, in.	Rate of Separation, in./min Between Tube and Reinforcement	Between Cover and Reinforcement
3/8	0.00	(1)
1/2	0.00	0.00
5/8	0.00	0.00
3/4	0.00	0.00

(1) - Cover could not be removed sufficiently to conduct test. Adhesion considered to comply with requirements.

TENSILE STRENGTH AND ELONGATION OF TUBE AND COVER:

METHOD

Buffed specimens of the tube and cover were subjected to tensile strength and elongation tests, using the apparatus and methods described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 10.

RESULTS

	Tube	Cover
Average tensile strength, psig	1049	1138
Average elongation, percent	360	240

LW/WS:rrr
NKDLS

ACCELERATED AIR OVEN AGING TEST OF TUBE AND COVER:

METHOD

Buffed specimens of the tube and cover were subjected to accelerated air oven aging tests, using the apparatus and methods described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 11. In addition, specimens of the tube were subjected to air oven aging for 70 h at 100°C (212°F) and specimens of the cover were subjected to air oven aging for 70 h and 14 days at 100°C (212°F), 28 days at 110°C (230°F), 14 days at 121°C (250°F), and 7 days at 136°C (277°F).

RESULTS

The results of the air oven aging tests are tabulated in Table I.

OZONE EXPOSURE:

METHOD

Specimens from the cover of the hose were exposed for 70 h to an atmosphere regulated to give an ozone partial pressure of 100 mPa at a temperature of 40°C (104°F) in accordance with UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 12.

RESULTS

The exposed cover showed no sign of cracking when examined with a hand 7-power magnifying glass.

IMMERSION TESTS OF RUBBER TUBE:

METHOD

Specimens from the tube of the hose were immersed for 7, 28 and 56 days in (1) deionized water, (2) solution of 50 volumes of ethylene glycol and 50 volumes of deionized water, and (3) solution of 50 volumes of propylene glycol and 50 volumes of deionized water, maintained at 100°C (212°F); in accordance with the methods described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 13.

RESULTS

The results of the immersion tests are tabulated in Table II.

DEFORMATION BY EXTERNAL LOADING:

METHOD

Specimens from each size hose were subjected to external loading, using the apparatus and methods described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 14.

RESULTS

Size of Hose, in.	Decrease in Vertical Axis of Hose, Percent
3/8	39
1/2	45
5/8	34
3/4	49

DEFORMATION BY BENDING:

METHOD

Samples of each size hose were subjected to bending in accordance with the methods described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 15.

RESULTS

Size of Hose, in.	Radius of Bending, in.	Reduction of Outside Dimension of Hose, Percent
3/8	3	0.4
1/2	4	0.4
5/8	5	5.4
3/4	6	4.1

LW/WS:rrr
NKDLS

PROOF PRESSURE TESTS:

METHOD

Coupled lengths of each pipe hose were subjected to a hydrostatic pressure of 200 psig for 5 min., using the apparatus and method described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 7.

RESULTS

The samples withstood the test pressures without leakage, ballooning, or rupture.

HYDROSTATIC STRENGTH TESTS:

METHOD

Coupled lengths of each size hose were subjected to hydrostatic pressure until failure occurred, using the apparatus and test method described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 8.

RESULTS

Size of Hose, in.	Sample No.	Hydrostatic Burst, psig at 25°C	at 82°C
3/8	1	900	680
	2	820	680
1/2	1	910	630
	2	940	680
5/8	1	1090	750
3/4	1	1100	880

HYDROSTATIC STRENGTH AFTER ACCELERATED AIR-OVEN AGING:

METHOD

Coupled lengths of each size hose were conditioned for 56 days in an air oven at 100°C (212°F) and then subjected to a hydrostatic pressure of 600 psig, using the apparatus and methods described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 16.

RESULTS

The hoses withstood the test pressures without leakage, ballooning, or rupture.

HYDROSTATIC STRENGTH AFTER EXPOSURE TO HEAT TRANSFER FLUIDS:

METHOD

Coupled lengths of the 3/8 and 3/4 in. size hose were filled with (1) deionized water, (2) solution of 50 volumes of ethylene glycol and 50 volumes of deionized water, and (3) solution of 50 volumes of propylene glycol and 50 volumes of deionized water, conditioned for 56 days at 100°C (212°F), and then subjected to a hydrostatic pressure of 600 psig, using the apparatus and methods described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 17.

RESULTS

The hoses withstood the test pressure without leakage, ballooning, or rupture.

HYDROSTATIC STRENGTH AFTER EXPOSURE TO ABNORMAL TEMPERATURES:

METHOD

Coupled lengths of the 3/8 and 3/4 in. size hose were conditioned for 168 h at 121°C (250°F), empty, and filled with (1) deionized water, (2) solution of 50 volumes of ethylene glycol and 50 volumes of deionized water, and (3) solution of 50 volumes of propylene glycol and 50 volumes of deionized water and then subjected to a hydrostatic pressure of 600 psig, using the apparatus and methods described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 18.

RESULTS

The hoses withstood the test pressure without leakage, ballooning, or rupture.

TABLE I

RESULTS OF AIR OVEN AGING TESTS ON TUBE AND COVER

As-Received	Tube	Cover
Average tensile strength, psi	1049	1138
Average elongation, percent	360	240
After 56 Days Air Oven Aging at 100°C (212°F) -		
Average tensile strength, psi	1047	1200
Percent of original tensile strength	100	105
Average elongation, percent	340	230
Percent of original elongation	94	96
After 70 h Air Oven Aging at 100°C (212°F) -		
Average tensile strength, psi	1061	1146
Percent of original tensile strength	101	101
Average elongation, percent	370	240
Percent of original elongation	103	100
After 14 Days Air Oven Aging at 100°C (212°F) -		
Average tensile strength, psi	-	1208
Percent of original tensile strength	-	106
Average elongation, percent	-	240
Percent of original elongation	-	100
After 28 Days Air Oven Aging at 110°C (230°F) -		
Average tensile strength, psi	-	1136
Percent of original tensile strength	-	100
Average elongation, percent	-	220
Percent of original elongation	-	92
After 14 Days Air Oven Aging at 121°C (250°F) -		
Average tensile strength, psi	-	1126
Percent of original tensile strength	-	99
Average elongation, percent	-	220
Percent of original elongation	-	92
After 7 Days Air Oven Aging at 136°C (277°F) -		
Average tensile strength, psi	-	1075
Percent of original tensile strength	-	94
Average elongation, percent	-	220
Percent of original elongation	-	92

LW/WS:rrr
NKDLS

TABLE II

RESULTS OF IMMERSION TESTS ON TUBE SPECIMENS

As-Received	
Average tensile strength, psi	1049
Average elongation, percent	360
After 7 Days Immersion in Deionized Water at 100°C (212°F) -	
Average tensile strength, psi	1105
Percent of original tensile strength	105
Average elongation, percent	390
Percent of original elongation	108
Volume change, percent	1.2
After 28 Days Immersion in Deionized Water at 100°C (212°F) -	
Average tensile strength, psi	1126
Percent of original tensile strength	107
Average elongation, percent	430
Percent of original elongation	119
Volume change, percent	2.6
After 56 Days Immersion in Deionized Water at 100°C (212°F) -	
Average tensile strength, psi	1130
Percent of original tensile strength	108
Average elongation, percent	440
Percent of original elongation	122
Volume change, percent	14.3
After 7 Days Immersion in 50 Percent ethylene Glycol Solution at 100°C (212°F) -	
Average tensile strength, psi	1101
Percent of original tensile strength	105
Average elongation, percent	410
Percent of original elongation	114
Volume change, percent	1.0

(Table Continued)

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TABLE II (Continued)

RESULTS OF IMMERSION TESTS ON TUBE SPECIMENS

After 28 Days Immersion in 50 Percent Ethylene Glycol Solution at 100°C (212°F) -	
Average tensile strength, psi	985
Percent of original tensile strength	94
Average elongation, percent	420
Percent of original elongation	117
Volume change, percent	1.2
After 56 Days Immersion in 50 Percent Ethylene Glycol Solution at 100°C (212°F) -	
Average tensile strength, psi	952
Percent of original tensile strength	91
Average elongation, percent	420
Percent of original elongation	117
Volume change, percent	6.1
After 7 Days Immersion in 50 Percent Propylene Glycol Solution at 100°C (212°F) -	
Average tensile strength, psi	1086
Percent of original tensile strength	104
Average elongation, percent	420
Percent of original elongation	117
Volume change, percent	1.1
After 28 Days Immersion in 50 Percent Propylene Glycol Solution at 100°C (212°F) -	
Average tensile strength, psi	1002
Percent of original tensile strength	96
Average elongation, percent	400
Percent of original elongation	111
Volume change, percent	1.2
After 56 Days Immersion in 50 Percent Propylene Glycol Solution at 100°C (212°F) -	
Average tensile strength, psi	1063
Percent of original tensile strength	101
Average elongation, percent	410
Percent of original elongation	114
Volume change, percent	0.6

LW/WS:rrr
NKDLS

T E S T R E C O R D N O. 2

SAMPLES:

Representative samples of the 3/8, 1/2, 5/8, 3/4 and 1 in. trade sizes of radiant heating hose were furnished by the manufacturer. Samples included 2 ft coupled lengths of the 1 in. size and uncoupled lengths of each size. The tube and reinforcement is the same as the hose covered by Test Record No. 1 of this Report, except the tube (Compound No. JB9490B) of the 1 in. size hose has been modified to facilitate processing. The curing system of the cover has been changed. Only the following tests were considered necessary.

GENERAL:

These test results relate only to the items tested.

INSIDE DIAMETER:

METHOD

The inside diameter of the hose was determined in accordance with the test method described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 4.

RESULTS

Size of Hose, in.	Inside Diameter, in.
3/8	25/64
1/2	32/64
5/8	40/64
3/4	48/64
1	64/64

THICKNESS OF TUBE AND COVER:

METHOD

The thickness of the tube and cover was determined in accordance with the test method described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 5.

LW/WS:rrr
NKDLS

RESULTS

Size of Hose, in.	Thickness, in. Tube	Cover
3/8	0.052	0.053
1/2	0.061	0.055
5/8	0.063	0.058
3/4	0.064	0.063
1	0.088	0.061

ADHESION TEST:

METHOD

Specimens from the hose were subjected to the adhesion tests outlined in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 9.

RESULTS

Size of Hose, in.	Rate of Separation, in./min Between Tube and Reinforcement	Between Plies of Reinforcement	Between Cover and Reinforcement
3/8	0.00	0.00	0.00
1/2	0.00	0.00	0.00
5/8	0.00	0.00	0.00
3/4	0.00	0.00	0.00
1	0.00	0.00	0.00

TENSILE STRENGTH AND ELONGATION OF TUBE AND COVER:

METHOD

Buffed specimens of the tube and cover of the 1 in. size hose were subjected to tensile strength and elongation tests, using the apparatus and methods described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 10.

RESULTS

	Tube	Cover
Average tensile strength, psi	1116	1404
Average elongation, percent	290	440

LW/WS:rrr
NKDLS

ACCELERATED AIR OVEN AGING TEST OF TUBE AND COVER:

METHOD

Buffed specimens of the tube and cover of the 1 in. size hose were subjected to accelerated air oven aging tests, using the apparatus and methods described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 11. In addition, specimens of the tube and cover were subjected to air oven aging for 70 h at 100°C (212°F).

RESULTS

The results of the air oven aging tests are tabulated in Table I.

OZONE EXPOSURE:

METHOD

Specimens from the cover of the 1 in. size hose were exposed for 70 h to an atmosphere regulated to give an ozone partial pressure of 100 mPa at a temperature of 40°C (104°F) in accordance with UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 12.

RESULTS

The exposed cover showed no sign of cracking when examined with a hand 7-power magnifying glass.

IMMERSION TESTS OF RUBBER TUBE:

METHOD

Specimens from the tube of the 1 in. size hose were immersed for 7, 28 and 56 days in (1) deionized water, (2) solution of 50 volumes of ethylene glycol and 50 volumes of deionized water, and (3) solution of 50 volumes of propylene glycol and 50 volumes of deionized water, maintained at 100°C (212°F); in accordance with the methods described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 13.

RESULTS

The results of the immersion tests are tabulated in Table II.

DEFORMATION BY EXTERNAL LOADING:

METHOD

Specimens from each size hose were subjected to external loading, using the apparatus and methods described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 14.

RESULTS

Size of Hose, in.	Decrease in Vertical Axis of Hose, Percent
3/8	49
1/2	39
5/8	47
3/4	45
1	37

DEFORMATION BY BENDING:

METHOD

Samples of each size hose were subjected to bending in accordance with the methods described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 15.

RESULTS

Size of Hose, in.	Radius of Bending, in.	Reduction of Outside Dimension of Hose, Percent
3/8	3	0.8
1/2	4	0.1
5/8	5	3.2
3/4	6	1.0
1	7	3.4

LW/WS:rrr
NKDLS

PROOF PRESSURE TESTS:

METHOD

Coupled lengths of each size hose were subjected to a hydrostatic pressure of 200 psig for 5 min., using the apparatus and method described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 7.

RESULTS

The hoses withstood the test pressures without leakage, ballooning, or rupture.

HYDROSTATIC STRENGTH TESTS:

METHOD

Coupled lengths of 1 in. size hose were subjected to hydrostatic pressure of 800 psig while at room temperature and a hydrostatic pressure of 600 psig while at 82°C (180°F) using the apparatus and test method described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 8.

RESULTS

The hoses withstood the test pressures without leakage, ballooning or rupture.

HYDROSTATIC STRENGTH AFTER ACCELERATED AIR-OVEN AGING:

METHOD

A coupled length of the 1 in. size hose was conditioned for 56 days in an air oven at 100°C (212°F) and then subjected to a hydrostatic pressure of 600 psig, using the apparatus and methods described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 16.

RESULTS

The hose withstood the test pressure without leakage, ballooning or rupture.

HYDROSTATIC STRENGTH AFTER EXPOSURE TO HEAT TRANSFER FLUIDS:

METHOD

Coupled lengths of the 1 in. size hose were filled with (1) deionized water, (2) solution of 50 volumes of ethylene glycol and 50 volumes of deionized water, and (3) solution of 50 volumes of propylene glycol and 50 volumes of deionized water, conditioned for 56 days at 100°C (212°F), and then subjected to a hydrostatic pressure of 600 psig, using the apparatus and methods described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 17.

RESULTS

The hoses withstood the test pressure without leakage, ballooning or rupture.

HYDROSTATIC STRENGTH AFTER EXPOSURE TO ABNORMAL TEMPERATURES:

METHOD

Coupled lengths of the 1 in. size hose were conditioned for 168 h at 121°C (250°F), empty, and filled with (1) deionized water, (2) solution of 50 volumes of ethylene glycol and 50 volumes of deionized water, and (3) solution of 50 volumes of propylene glycol and 50 volumes of deionized water and then subjected to a hydrostatic pressure of 600 psig, using the apparatus and methods described in UL's Outline of Investigation for Rubber Hose for Radiant Heating, Subject 2156, Sec. 18.

RESULTS

The hoses withstood the test pressure without leakage, ballooning or rupture.

TABLE I

RESULTS OF AIR OVEN AGING TESTS ON TUBE AND COVER

As-Received	Tube	Cover
Average tensile strength, psi	1116	1404
Average elongation, percent	290	440
After 56 Days Air Oven Aging at 100°C (212°F) -		
Average tensile strength, psi	1079	1628
Percent of original tensile strength	97	116
Average elongation, percent	250	320
Percent of original elongation	86	73
After 70 h Air Oven Aging at 100°C (212°F) -		
Average tensile strength, psi	1102	1453
Percent of original tensile strength	99	103
Average elongation, percent	280	410
Percent of original elongation	97	93

LW/WS:rrr
NKDLS

TABLE II

RESULTS OF IMMERSION TESTS ON TUBE SPECIMENS

As-Received	
Average tensile strength, psi	1116
Average elongation, percent	290
After 7 Days Immersion in Deionized Water at 100°C (212°F) -	
Average tensile strength, psi	1182
Percent of original tensile strength	106
Average elongation, percent	330
Percent of original elongation	114
Volume change, percent	4.3
After 28 Days Immersion in Deionized Water at 100°C (212°F) -	
Average tensile strength, psi	1134
Percent of original tensile strength	102
Average elongation, percent	330
Percent of original elongation	114
Volume change, percent	10.7
After 56 Days Immersion in Deionized Water at 100°C (212°F) -	
Average tensile strength, psi	1210
Percent of original tensile strength	108
Average elongation, percent	340
Percent of original elongation	117
Volume change, percent	15.0
After 7 Days Immersion in 50 Percent ethylene Glycol Solution at 100°C (212°F) -	
Average tensile strength, psi	1171
Percent of original tensile strength	105
Average elongation, percent	320
Percent of original elongation	110
Volume change, percent	2.9

(Table Continued)

LW/WS:rrr
NKDLS

TABLE II (Continued)

RESULTS OF IMMERSION TESTS ON TUBE SPECIMENS

After 28 Days Immersion in 50 Percent Ethylene Glycol Solution at 100°C (212°F) -	
Average tensile strength, psi	1134
Percent of original tensile strength	102
Average elongation, percent	320
Percent of original elongation	110
Volume change, percent	6.6
After 56 Days Immersion in 50 Percent Ethylene Glycol Solution at 100°C (212°F) -	
Average tensile strength, psi	983
Percent of original tensile strength	88
Average elongation, percent	320
Percent of original elongation	110
Volume change, percent	10.6
After 7 Days Immersion in 50 Percent Propylene Glycol Solution at 100°C (212°F) -	
Average tensile strength, psi	1124
Percent of original tensile strength	101
Average elongation, percent	290
Percent of original elongation	100
Volume change, percent	3.4
After 28 Days Immersion in 50 Percent Propylene Glycol Solution at 100°C (212°F) -	
Average tensile strength, psi	1154
Percent of original tensile strength	103
Average elongation, percent	320
Percent of original elongation	110
Volume change, percent	6.2
After 56 Days Immersion in 50 Percent Propylene Glycol Solution at 100°C (212°F) -	
Average tensile strength, psi	1065
Percent of original tensile strength	95
Average elongation, percent	340
Percent of original elongation	117
Volume change, percent	17.4

LW/WS:rrr
NKDLS

Test Record Summary:

The results of this investigation indicate that the product(s) evaluated comply with applicable requirements, and therefore, such products are judged eligible to bear UL's Mark as described on the Conclusion Page of this Report.

Test Record by:
LEON M. WALKER
Staff Chemist

Reviewed by:
W.H. SMYTH
Engineering Team Leader

LW/WS:rrr
NKDLS

TEST RECORD NO. 3

The applicant requested a change in the tradename of the hose from "Entran Onix" to "Onix". Since there were no changes in the construction of the hose, no tests were necessary.

Test Record Summary:

The results of this investigation indicate that the product(s) evaluated comply with the applicable requirements, and therefore, such products are judged eligible to bear UL's Mark as described on the Conclusion Page of this Report.

Test Record by:
LEON M. WALKER
Staff Chemist

Reviewed by:
W. H. SMYTH
Engineering Group Leader

LW/WS:rrr
NKDLS

TEST RECORD NO. 4

SAMPLES:

Representative samples of the 3/8, 1/2, 5/8, 3/4 and 1 in. trade sizes of radiant heating hose were furnished by the manufacturer for testing in accordance with IAPMO Standard for Aramid Reinforced Rubber Hose for use in Non-Potable Water Radiant Heating& Snowmelting, PS 107-98. Only the following tests were considered necessary.

GENERAL:

These test results relate only to the items tested.

PROOF TEST

METHOD

Samples of the 3/8, 1/2, 5/8, 3/4 and 1 in. trade sizes of radiant heating hose were subjected to a proof pressure of 400 psi at 82°C for 5 minutes in accordance with Sec. 5.3 of IAPMO Standard for Aramid Reinforced Rubber Hose for use in Non-Potable Water Radiant Heating& Snowmelting, PS 107-98.

RESULTS

All samples of hose withstood the test pressure without leakage, ballooning or rupture.

COLD FLEX TEST

METHOD

Samples of the 3/8, 1/2, 5/8, 3/4 and 1 in. trade sizes of radiant heating hose were subjected to temperature of -40°C then bent around a mandrel having a diameter of 10 times the internal diameter of the hose in accordance with Sec. 5.4 of IAPMO Standard for Aramid Reinforced Rubber Hose for use in Non-Potable Water Radiant Heating& Snowmelting, PS 107-98. The samples were then subjected to the Proof Test described in Sec. 5.3 of this Standard.

RESULTS

All samples were bent around the mandrel after cooling without cracking or breaking of the tube or cover. All samples then satisfactorily withstood the proof pressure of 400 psi for 5 minutes without leakage. Ballooning or rupture.

LW/WS:rrr
NKDLS

Test Record Summary:

The results of this investigation indicate that the product(s) evaluated comply with the applicable requirements, and therefore, such products are judged eligible to bear UL's Mark as described on the Conclusion Page of this Report.

Test Record by:
Tom Grant
Staff Chemist

Reviewed by:
Thomas A. Skowera
Engineering Group Leader

LW/WS:rrr
NKDLS

C O N C L U S I O N

Samples of the product covered by this Report has been found to comply with the requirements covering the class and the product is judged to be eligible for Listing and Follow-Up Service. The manufacturer is authorized to use the Laboratories' Mark on such products which comply with the Follow-Up Service Procedure and any other applicable requirements of Underwriters Laboratories Inc. Only those products which properly bear the Laboratories' Mark are considered as Listed by Underwriters Laboratories Inc.

Report by: Reviewed by:

LEON M. WALKER
Staff Chemist

D. M. OATES
Associate Managing Engineer

LW/WS:rrr
NKDLS

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS

MATERIAL and PROPERTY STANDARD

FOR

ARAMID REINFORCED RUBBER HOSE FOR USE IN NON-POTABLE WATER RADIANT HEATING & SNOWMELTING

PS 107-98

1. PURPOSE

1.1 The purpose of this standard is to establish an acceptable standard for aramid reinforced rubber hose that is to be used for radiant heating and snowmelting in both residential and commercial applications. Its purpose is to serve as a guide for producers, distributors, architects, engineers, contractors, installers, inspectors and users; to promote an understanding regarding materials, manufacture and installation; and to provide for identifying aramid reinforced rubber hose that conforms to this standard.

1.2 The provisions of this standard are not intended to prevent the use of any alternate material, or method of construction, provided that any such alternate meets or exceeds the intent of this standard.

2. SCOPE

2.1 This standard covers material, performance and dimensional requirements and test methods, together with the method of marking and identification.

3. REFERENCED STANDARDS

ASTM D380	Methods of Testing Rubber Hose
ASTM D413	Test Methods for Rubber Property - Adhesion to Flexible Substrate
ASTM D471	Test Methods for Rubber Property - Effect of Liquids
ASTM D622	Methods of Testing Rubber Hose for Automotive Air and Vacuum Brake System

4. GENERAL REQUIREMENTS

4.1 **Dimension & Tolerance Requirements.** The hose is to be manufactured with inside diameters (ID) of 3/8" (9.5 mm), 1/2" (12.7 mm), 5/8" (15.9 mm) 3/4" (19 mm) and 1" (25.4 mm).

4.2 **Reinforcement**. The hose shall have double spiral wound aramid reinforcement in sufficient quantity to meet a minimum burst requirement of 600 psi (4137 kPa) at 180°F (82°C).

4.3 **Oxygen Barrier**. The hose shall contain a protective layer for the purpose of controlling oxygen permeation.

4.4 **Flexibility**. The hose shall remain flexible over a temperature range of -40 to 210°F (-40 to 98.9°C).

4.5 **Workmanship**. The hose shall be free from defects in material and workmanship.

5. TEST METHODS

5.1 **Burst**. Hose shall be tested according to ASTM D380, Methods of Testing Rubber Hose, Section 16 with a minimum burst rating of 600 psi (4137 kPa) at 180°F (82°C) and 800 psi (5516 kPa) at 70°F (21°C).

5.2 **Adhesion**. Hose shall be tested according to ASTM D413, Test Methods for Rubber Property - Adhesion to Flexible Substrate using ring specimens. The junction between the rubber and reinforcement shall withstand a load of 8 lb/in width without any evidence of separation. The junction between the protective barrier and the rubber layers shall withstand a load of 10 lb/in width without any evidence of separation.

5.3 **Proof Test**. Hose shall be tested according to section 17.3 of ASTM D380, Methods of Testing Rubber Hose, and shall be able to hold 400 psi (2758 kPa) for five (5) minutes at 180°F (82°C) without any leakage or damage.

5.4 **Cold Flex**. Hose shall be tested according ASTM D622, Methods of Testing Rubber Hose for Automotive Air and Vacuum Brake System, section 18, entitled "Cold Test" and shall be able to be bent over a mandrel of ten times the ID of the hose without cracking or breaking of the tube or cover. After bending, the hose shall not leak at a proof test pressure of 400 psi (2758 kPa) at 70 °F (21°C).

5.5 **Bend Collapse**. Hose shall be tested according ASTM D622, Methods of Testing Rubber Hose for Automotive Air and Vacuum Brake System, and shall be capable of being bent per section 20 of ASTM D622 with no more than 20% collapse.

5.6 **System Fluid Compatibility**. Hose shall be tested according to ASTM D471, Test Method for Rubber Property - Effect of Liquids, sections 11 and 15 excluding changes in hardness, and shall be compatible with ethylene and propylene glycol used as system fluid freeze protectant. The test shall be performed at 212 ± 4°F (100 ±2°C) using deionized water, 50% ethylene glycol and water solution and 50% propylene glycol and water solution for 7, 28 and 56 days. After exposure to each medium for 7, 28 and 56 days, samples shall be tested and shall comply with the following requirements.

Property	Maximum Allowable Change
tensile strength	-20%
ultimate elongation	-60%
volume	+20%, -10%

5.7 **Dimensions.** Hose ID shall be measured in accordance with ASTM D380, section 6 and shall comply with the following requirements.

Size (inches)	Inside Diameter (inches)

3/8	3/8 ±1/32
1/2	1/2 ±1/32
5/8	5/8 ±1/32
3/4	3/4 ±1/32
1	1 ±1/32

6. IDENTIFICATION AND MARKINGS

6.1 Hose shall be clearly and permanently marked with the following:

(a) Manufacturer's name or trademark;
(b) Model number;
(c) Date of manufacture; and
(d) Any other required marking.

Adopted: 9/98

TEST REPORT

Ph: 909.472.4100 • Fax: 909.472.4243 • Web: www.iapmo.org
5001 East Philadelphia Street • Ontario, California 91761-2816 – USA

Report Number: 815-06001 **IT&S Project No.:** 13010

Report Issued: May 05, 2006 **IAPMO R&T File No.:** 2774

Client: Watts Radiant.
4500 Progress Place.
Springfield, MO 65803 **Contact:** Mr. Chris Haldiman

Source of Sample: On March 16, 2006, during a routine audit at the manufacturer's facility in Springfield, MO, an IAPMO R&T auditor selected 1 roll of the model 086121 Onix ¾" radiant heating tubing for testing. The sample was sent by the manufacturer and received by IAPMO Testing and Services, LLC on March 23, 2006. The sample was received in good condition with stickers intact.

Date of Testing: May 02, 2006 through May 05, 2006.

Sample Description: 3/4" radiant heating tubing, model # 086121, consisted of:

- A rubber HiGuard industrial cover
- An Aramid Fiber Reinforcing
- An AlumaShield Oxygen barrier
- A Durel Inner tubing.

Scope of Testing: The purpose of the testing was to determine if the samples tested of the ¾" radiant heating tubing complied with the applicable requirements of IAPMO PS 107-1998, entitled "Material and Property Standard for Aramid Reinforced Rubber Hose for Use in Non-Potable Water Radiant Heating & Snowmelting".

CONCLUSION: The samples tested of the 3/4" radiant heating tubing, model # 086121 from Watts Radiant COMPLIED with the applicable requirements of IAPMO PS 107-1998, EXCEPT Marking.

By our signatures below, we certify that all the testing and sample preparation for this report was performed under continuous, direct supervision of IAPMO Testing and Services, LLC.

Tested, Reviewed by,

Sean Vuu, P.E., Manager, Specialty Projects

SV: sv

Primary Standards: **IAPMO PS107-1998 Sections tested / evaluated:**

4. General Requirements
5. Test Methods
6. Identification and Markings.

Test Results: All tests and evaluations were conducted per the written procedures specified in the standard.

4. **General Requirements – COMPLIED.**

4.1 Dimension & Tolerance Requirements

The hose was to be manufactured with inside diameter (ID) of 3/4" (19 mm).

4.2 Reinforcement

The hose had double spiral wound aramid reinforcement in sufficient quantity to meet a minimum burst requirement of 600 psi at 180 ° F.

4.3 Oxygen Barrier

The hose contained a protective layer (AlumaShield) for the purpose of controlling oxygen permeation

4.4 Flexibility

The hose remained flexible over a temperature range of -40 ° F to 210 °F

4.5 Workmanship

The hose was free from defects in material and workmanship.

5. **Testing Method**

5.1 **Burst** – COMPLIED

Hose was tested according to ASTM D380-2000, Method of Testing Rubber hose, Section 16 with a minimum burst rating of 600 psi at 180 ° F and 800 psi at 70 ° F.

5.2 **Adhesion** – COMPLIED

Hose was tested according to ASTM D413-1998, Test Methods for Rubber Property-Adhesion to Flexible Substrate using ring specimens. The junction between the rubber and reinforcement withstood a load of more than 8 lb/in width without any evidence of separation. The junction between the protective layer and the rubber layers withstood a load of more than 10 lb/in width without any evidence of separation.

5.3 **Proof Test** – COMPLIED

Hose was tested according to section 17.3 of ASTM D380-2000, Methods of Testing Rubber Hose, and was able to hold 400 psi for five (5) minutes at 180 ° F without any leakage or damage.

5.4 **Cold Flex** – COMPLIED

Hose was tested according to ASTM D622-2005, Methods of Testing Rubber Hose for Automotive Air and Vacuum Brake System, section 18, entitled "Cold Test" and was able to be bent over a mandrel of ten times the ID of the hose (7.5" diameter) without cracking or breaking of the tube or cover. After bending, the hose was proof test of 400 psi and at 70° F for 5 minutes without leakage.

5.5 **Bend Collapse** – COMPLIED

Hose was tested according to ASTM D622-1999, Methods of Testing Rubber Hose for Automotive Air and Vacuum Brake System, and was capable of being bent per section 20 of ASTM D622 with no more than 20% collapse (9.4%).

5.6 **System Fluid Compatibility** – NO TEST CONDUCTED (per the Director of Continuous Compliance).

5.7 **Dimensions** – COMPLIED

Hose ID was measured in accordance with ASTM D380, section 6 and complied with the following requirements:

Size (inches)	Inside Diameter (inches)
¾	0.747 (3/4 ± 1/32)

6. **Identification and Markings – NOT COMPLIED**

6.1 Hose was clearly and permanently marked with the following:

a) Manufacturer's name: Onix ™ by Watts Radiant®

b) Model number **(no model number)**

c) Date of manufacture **(no date of manufacture)**

d) UPC, Max Temp 180° F, Max Press 100 psig, ASTM D380, 395, 412

5001 E. Philadelphia Street, Ontario, CA 91761-2816 (909) 472-4100 F. (909) 472-4250

INSTRUCTIONS FOR TESTING CONTINUOUS COMPLIANCE INSPECTION SAMPLES

Sample Description (use separate form for each sample set): 3/4" TUBING (RAIDIANT HEATING)

Date of Manufacture of Samples: 1/20/06

File #: 2774 Collection Date: 3/16/06 Inspector: KEVIN CARROTHERS

Name of Listee: WATTS RADIANT

Name of Manufacturer (if different from Listee): SAME

Plant Address: 4500 E. PROGRESS PLACE

City, State & Zip: SPRINGFIELD, MO 65803

Plant Contact: CHRIS HALDIMAN Phone: 417-864-6108

Testing to be Performed by:

Name of Laboratory: IAPMO T & S

Address: 5001 E. PHILADELPHIA ST.

City , State & Zip: ONTARIO, CA 91761-2816 Phone: 909-472-4100

Laboratory shall perform the following tests:

TEST IN FULL PER IAPMO PS 107-98 STANDARD

Three copies of finished test report to be sent by laboratory to Director of CC at IAPMO. A completed copy of this form must be attached by laboratory to each finished test report.

The Plant Cont testing indicated before work is st refuse to pay for instructions. the isting or uous Compliance for further

FILE #: 2774 INSPECTOR: KEVIN

Plant Contact a DLLECTION DATE: 3/16/06 DESTINATION: IAPMO collection date by the fastest available means. ess to notify IAPMO immediately in writing and explain the reason for the delay. If Listee wishes to use an IAPMO listed laboratory other than the one named above, Plant Contact agrees to notify IAPMO of the changes in writing before the samples are shipped.

Plant Contact 3/16/06 Date

1301 U

4/7/06 Urn on Chris' voicemail to call back. JB (Per DAD, Find out if they have a test report for similar product) JB

4/12/06 s/w Chris Haldiman & he confirmed that there has been no testing done therefore we should continue with the testing. JB

From: Chris Haldiman
To: jenny.bituin@iapmort.org
Date: 5/17/2006 5:05:26 PM
Subject: File 2774

Jenny,

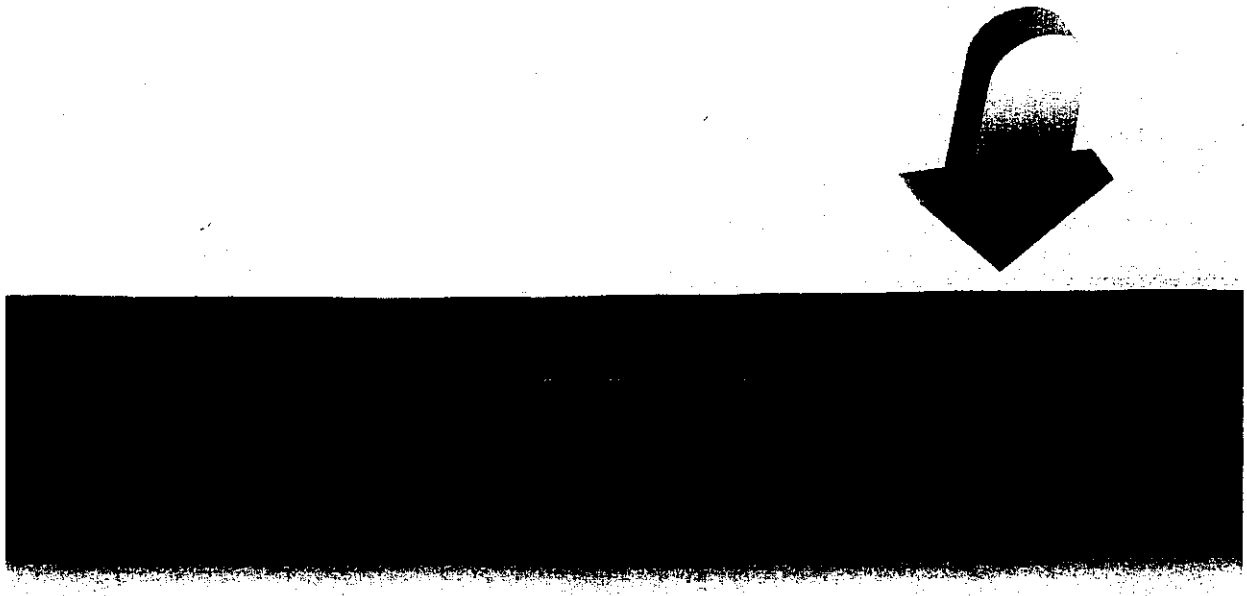
Thank you for your time this afternoon. Please find attached pictures of our Onix hose with notes indicating the "Model" and Date Code of manufacture.

Please let me know if there is any further action required by me.

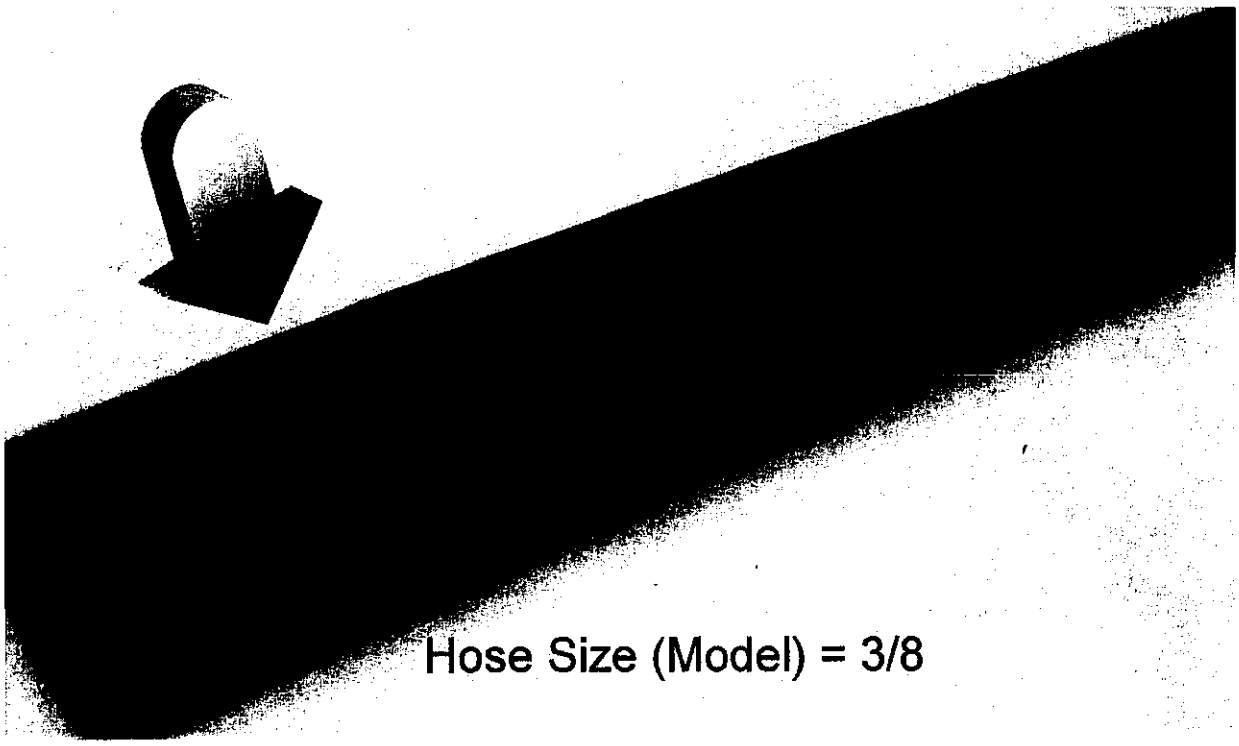
Thank you again,

Chris B. Haldiman
Watts Radiant, Inc.

CC: Mary Burney



Date Code
April 10, 2006
(Julian)


Hose Size (Model) = 3/8

IAPMO RESEARCH AND TESTING, INC.

5001 E. Philadelphia Street, Ontario, CA 91761-2816 • (909) 472-4100 • Fax (909) 472-4244 • www.iapmo.org

CERTIFICATE OF LISTING

IAPMO Research and Testing, Inc. is a product certification body which tests and inspects samples taken from the supplier's stock or from the market or a combination of both to verify compliance to the requirements of applicable codes and standards. This activity is coupled with periodic surveillance of the supplier's factory and warehouses as well as the assessment of the supplier's Quality Assurance System. This listing is subject to the conditions set forth in the characteristics below and is not to be construed as any recommendation, assurance or guarantee by IAPMO Research and Testing, Inc. of the product acceptance by Authorities Having Jurisdiction.

Effective Date : May 2010 Void After: May 2011

Product: **Tubing (Radiant Heating)** File No. 2774

Issued To : WATTS RADIANT, INC.
4500 E. PROGRESS PL.
SPRINGFIELD, MO 65803

IDENTIFICATION: Manufacturer's name, date of manufacture or trademark permanently marked on header and UPC® certification mark.

CHARACTERISTICS: Composite polymer reinforced hose for radiant heating of concrete floors or slabs. May be directly embedded in or under a slab. No joints or headers are permitted in or under the slab. Headers are Type M copper tubing.

Systems may contain liquids other than potable water. Therefore, the system is charged through a valve or hose bibb with markings or labels to indicate that this valve is for charging a heating system, and is not a potable water valve. To be installed with other IAPMO listed fittings in accordance with the manufacturer's instructions and the provisions of the latest editions of the applicable sections of the Uniform Plumbing Code, Uniform Solar Energy Code and the Uniform Mechanical Code.

Products comply with the applicable sections of the latest edition of the Uniform Plumbing Code® and the International Plumbing Code®. Manufactured in compliance with IAPMO PS 107-98.

Products listed on this certificate have been tested by an IAPMO R&T recognized laboratory. This recognition has been granted based upon the laboratory's compliance to the applicable requirements of ISO/IEC 17025.

MODELS:

Onix - Energy transfer hose w/DIN Standard O2 Barrier

ADDITIONAL COMPANY INFO:

David McKinney
Chairman, Product Certification Committee

Russ Chaney
CEO, The IAPMO Group

Print This Document

LEGACY REPORT

95-47.02

Reissued August 1, 2007

ICC Evaluation Service, Inc.
www.icc-es.org

Business/Regional Office ■ 5360 Workman Mill Road, Whittier, California 90601 ■ (562) 699-0543
Regional Office ■ 900 Montclair Road, Suite A, Birmingham, Alabama 35213 ■ (205) 599-9800
Regional Office ■ 4051 West Flossmoor Road, Country Club Hills, Illinois 60478 ■ (708) 799-2305

Legacy report on the 1998 *International Mechanical Code*®

DIVISION: 15—MECHANICAL
Section: 15180—Heating and Cooling Piping

REPORT HOLDER:

WATTS RADIANT, INC.
4500 EAST PROGRESS PLACE
SPRINGFIELD, MISSOURI 65803
www.wattsradiant.com

EVALUATION SUBJECT:

ONIX RADIANT HEATING HOSE:
(3/8, 1/2, 5/8, 3/4 AND 1 INCH I.D.)

EVALUATION SCOPE:

Compliance with the following code:

1998 *International Mechanical Code*®

- Section 105.2 Alternative materials and equipment
- Section 1202.4 Material standards
- Section 1202.3 Material rating
- Section 1209.1 Materials

DESCRIPTION

Onix radiant heating hose is constructed of an ethylene propylene diene monomer (EPDM) rubber tube, a layer of aluminum foil, a layer of EPDM rubber, a spiral braided aramid reinforcement wrapping and a black EPDM cover. The tubing is manufactured with $^{3}/_{8}$-, $^{1}/_{2}$-, $^{5}/_{8}$-, $^{3}/_{4}$- and 1-inch (9.5, 12.7, 15.9, 19.1 and 25 mm) nominal inside diameter sizes. The hose is used as a radiant floor heating hose in hydronic heating systems which use water or glycol/water solutions as the transfer fluid. The hose is connected to supply and return manifolds, provided by the manufacturer, which provide the transition between the hoses and the heat source supply piping.

Application

Onix radiant heating hose is installed by embedment in concrete floor slabs or cementitious toppings with a minimum covering thickness of $^{3}/_{4}$-inch (19.1 mm) above the hose, by attaching directly to the underside of wood floor sheathing in wood frame construction, or by installing between sleepers in wood frame construction. See Figure 1 of this report for diagrams of installation types.

CONDITIONS OF USE

This report is limited to the applications and products as stated in this report. The ICC-ES Subcommittee on National Codes intends that the report be used by the code official to determine that the report subject complies with the code requirements specifically addressed, provided that this product is installed in accordance with the following conditions:

- The piping contained in this report is limited to use in systems with a maximum operating pressure of 100 lbf/in^2 (690 kPa) and a maximum design temperature of 180 degrees F (82 degrees C).
- This report is limited to the evaluation of Onix in hydronic systems using a transfer fluid of water, 1:1 ethylene glycol/water or 1:1 propylene glycol/water.
- The piping installation shall not contain joints or splices, except for the connections to the manifolds.
- The piping system shall be pressurized to a minimum pressure of 50 lbf/in^2 (345 kPa), prior to encasement in concrete or cementitious decks. During pouring, the pipe shall be maintained at the proposed operating pressure.
- Use of the Onix as potable water supply piping is beyond the scope of this report.
- The Onix shall not be exposed to temperatures less than -40 degrees F (-40 degrees C).
- Installation instructions shall be provided and available on the job site at all times. These instructions shall include, but not be limited to, product handling precautions and any other precautions needed for the proper installation of the Onix.
- This report is subject to periodic re-examination. For information on the current status of this report, contact the ICC-ES.

ITEMS REQUIRING VERIFICATION

The following items are related to the installation of the report subject, but are not within the scope of this evaluation. However, these items are related to the determination of code compliance.

✔ All system manifolds shall be located so as to be accessible for servicing and maintenance.

✔ Where used in hydronic systems supplied by a potable water supply, the system shall be designed and installed to prevent contamination of the potable water supply through cross-connection or backflow, in accordance with Section 608.0 of the 1997 *International Plumbing Code®* and the 1998 *Supplement to the International Plumbing Code.*

✔ Review of boilers, valves, manifolds, fittings, controls, accessories and potable water supply piping of hydronic systems is beyond the scope of this report.

INFORMATION SUBMITTED

- Underwriters Laboratories Inc., File Number MH17193, dated October 22, 1997, containing results of long term pressure tests on a 1-inch-diameter (25 mm) sample of the Onix. The sample was subjected to a 56-day air oven, deionized water, 50 percent ethylene glycol and 50 percent propylene glycol solution test at 212 degrees F. (100 degrees C.).

- Bodycote Material Testing, Ltd., Report No. S800978, dated March 27, 1998, containing results of hydrostatic testing of the Onix. Results indicate that the $^{3}/_{8}$-, $^{1}/_{2}$-, $^{5}/_{8}$-, $^{3}/_{4}$- and 1-inch-diameter (9.5, 12.7, 15.9, 19.1 and 25 mm) tube withstood an internal pressure of 100 lbf/in^2 (690 kPa) at 180 degrees F. (82 degrees C) without bursting, leaking or developing other defects during the 1,000 hours test period.

- Underwriters Laboratories Inc., File MH17193, dated October 22, 1997, containing results of performance characteristic testing of the Onix. Results indicate that the Onix has been tested for the end use characteristics to verify the suitability of the hose for hydronic applications. Tests include adhesion, tensile strength, ozone exposure, external loading, bending deformation, hydrostatic strength and exposure to heat transfer fluids.

APPLICATION FOR PERMIT

To aid in the determination of compliance with this report, the following represents the minimum level of information to accompany the application for permit:

- The language "See ICC-ES Legacy Report No. 95-47", or a copy of this report;

- Details of hydronic piping installation, including installation of piping in or to flooring, type and spacing of piping hangers or supports, location of manifold, type and size of piping used, maximum operating pressure and temperature of the system, and system transfer fluid type.

- Specifications for material and installation requirements.

PRODUCT IDENTIFICATION

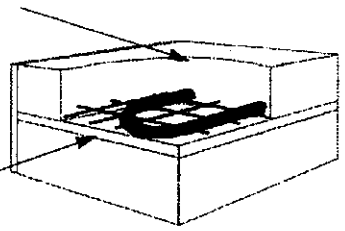
All Onix radiant heating hose manufactured in accordance with this report shall bear the following identification:

- "See ICC-ES Legacy Report No. 95-47."

In-Slab

A 2" minimum of slab covering above the hose is required in residential applications and a 3" minimum covering for snowmelting and commercial applications. Greater slab thicknesses may be required depending on structural loading.

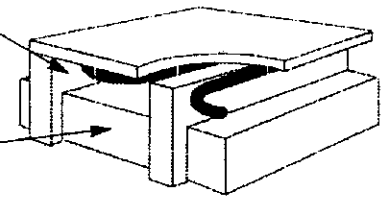
Use a quality extruded polystryne insulation board.



Staple Under Frame Floor

A 2" minimum air space is required between the foil-faced insulation and the floor.

The use of foil-faced insulation (face up) is necessary to reflect energy upward.

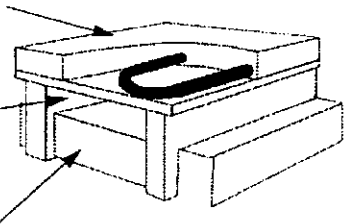


ThinSlab Over Frame Floor

A 3/4" minimum of slab above the hose is required in residential radiant floor applications, and 2" minimum coverage for commercial applications

A 2" minimum air space is required between the foil-faced insulation and the floor.

The use of foil-faced insulation (face up) is necessary to reflect energy upward.

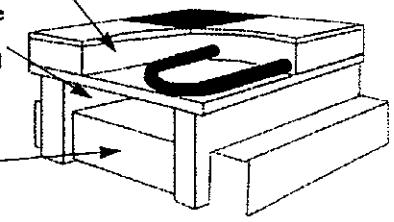


In Mudset Over Frame Floor

A 3/4" minimum of slab above the hose is required in residential radiant floor applications, and 2" minimum coverage for commercial applications.

A 2" minimum air space is required between the foil-faced insulation and the floor.

The use of foil-faced insulation (face up) is necessary to reflect energy upward.



Built Into Frame Floors with Sleepers

1/2" to 3/4" plywood sleepers are used depending on the outside diameter (O.D.) of the hose.

A 2" minimum air space is required between the foil-faced insulation and the floor.

The use of foil-faced insulation (face up) is necessary to reflect energy upward.

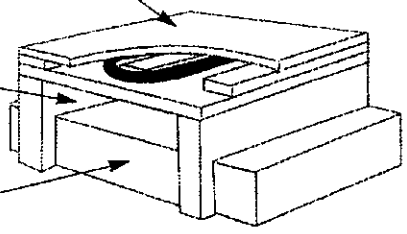


FIGURE 1*

*THIS DRAWING IS FOR ILLUSTRATION PURPOSES ONLY. IT IS NOT INTENDED FOR USE AS A CONSTRUCTION DOCUMENT FOR THE PURPOSE OF DESIGN, FABRICATION OR ERECTION.

LRQA
Business Assurance

CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

Watts Radiant
Springfield, Missouri, USA

has been approved by Lloyd's Register Quality Assurance
to the following Quality Management System Standards:

ISO 9001:2008

The Quality Management System is applicable to:

**Design and Manufacture of Electric,
Radiant/Hydronic Heating and Solar Components.**

Approval
Certificate No: UQA 4001065

Original Approval: December 30, 2010

Current Certificate: December 30, 2010

Certificate Expiry: December 29, 2013

Issued by: Lloyd's Register Quality Assurance, Inc.

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