



Expansion Joint Spacing - Hot Service Insulation

Insulation Application

- 1. ESLIN™ Industrial Insulation shall be applied in a minimum number of layers using commercially available thicknesses.
2. When E-Glass Fiber Pre-formed Pipe Insulation (ESLIN™) is applied, pipe insulation shall be secured with wire or strap ties on center and 12" (300mm) from center.
3. Multi-Layer sectional pipe insulation (where required) shall be applied with all joints staggered and shall have both layers secured by wire or strap.
4. Expansion Joint filler material shall be ESLIN™ 1/2" thick Needle-Mat E-Glass FELT inserted into the circumferential gap-joint of the expansion joints.
5. Expansion joint spacing shall be as shown in the following chart:

Table with 5 columns: PIPE OPERATING TEMPERATURE, CARBON & LOW ALLOY STEEL (meters, feet), and AUSTENITIC STAINLESS STEEL (meters, feet). Rows include temperatures from 93°C to 538°C.

Note: Pipe expands when heated. In fact, a carbon steel pipe when heated from 70°F (21°C) will grow 3.62 inches (92 mm) in length per 100 feet (30 m) at 500°F (260°C) and 8.89 inches (225 mm) in length per 100 feet at 1000°F (538°C).



THERMAL EXPANSION JOINT PERFORMANCE TEST



Visionary Industrial Insulation Inc

June 10, 2019

Approved Technical Document by Jang Jun Kwon /Chief Technical Officer

1. PREFACE

This report was specially prepared by VII R&D to provide the performance of the ESLIN™ Thermal Expansion Design which can eliminate un-necessary double layer nesting during thermal insulation design & installation. Since there is no recommended procedure or recommended method for the thermal expansion related by ASTM, VII had to develop a unique thermal expansion test concept with simulated test device setup.

VII recommends single layer design up to 4" thickness of ESLIN™ insulation. This report will provide enough evidence and the technical reason why the single layer design & installation with ESLIN™ Expansion Design can provide value to the customer who chooses to use ESLIN™ in the high temperature thermal insulation application.

2. DATES OF TESTING

Date: May 28-31, 2019

3. TEST PLACE

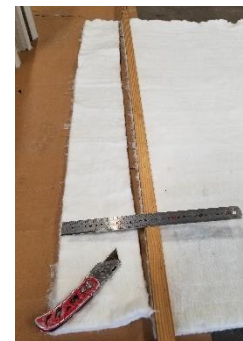
R&D Test Room

Visionary Industrial Insulation Inc

1415 W. Johnson St. Ste 102 & 103, Denison TX 75020 USA

4. TEST SETUP

- Test Machine: VII Proprietary Thermal Test Device(VII TT-021)
- 3" Norminal SS pipe with internal heating coil
- Thermal Imaging Camera: HTI HT-18
- (4) Type-E thermocouples
- Test Material:
- (2) 3" x 2" Single Layer NCUI Pipe Cover, 20" Long
- 3" x 2" Double Nested NCUI Pipe Cover (3" x 1" + 5" x 1"), 24" Long & 12" Long
- Pre-cut Dounut Shape Expansion Joint, 13.5mm(0.53") Thick E-Glass Felt, 150kg/m3(=9.375lb/ft3) Density
- Pre-cut Rectangular Shape Expansion Joint, 13.5mm(0.53") Thick E-Glass Felt, 150kg/m3(=9.375lb/ft3) Density-To be used in pipe size bigger than 10"



5. TEST PROCEDURE

Single Layer Standard Cold Installation and Heating up

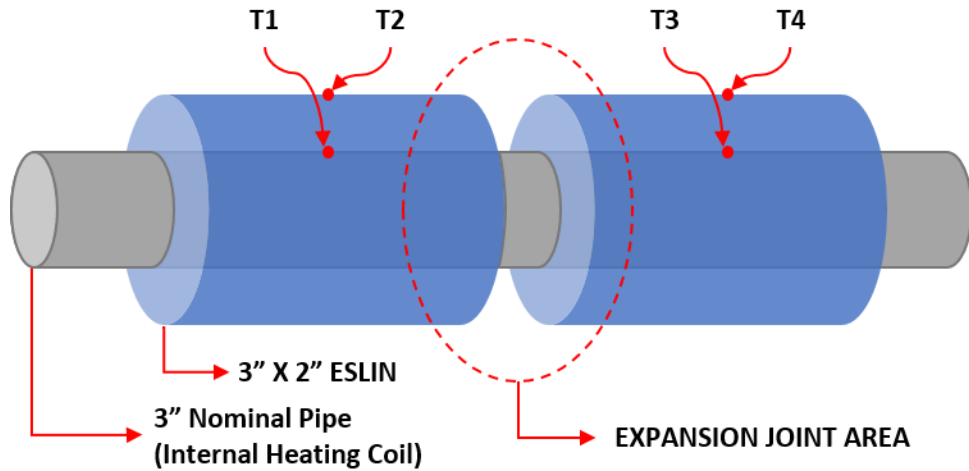
- Install One 3" x 2" Single Layer NCUI Pipe Cover over test pipe
- Install (2) Donut shape Pre-cut 13.5mm(=0.53") E-Glass Felt Expansion Joints
- Install One 3" x 2" Single Layer NCUI Pipe Cover over test pipe
- Compress expansion joint by pressing 3" x 2" along with axial direction
- Install 50mm spacer insulation piece at the end of insulation (cold installation)
- Measure the expansion joint gap length (This should be 17mm=0.67")
- Turn on PID temperature controller with 300 degC (=572 degF) target.
- Wait 6 hours until all system is stabilized with steady process and steady insulation temperature of 300 degC (=572 degF)
- Record all temperature measurements from the test device
- Take a thermal imaging picture for the expansion joint area
- Remove spacer insulation piece and install 40mm spacer to simulate hot process condition
- Measure the expansion joint gap length (This should be 27mm=1.06")
- Wait 4 hours until all system is stabilized with steady process and steady insulation temperature of 300 degC (=572 degF)
- Record all temperature measurements from the test device
- Take a thermal imaging picture for the expansion joint area

Double Layer Cold Installation and Heat up

- Install 3" x 1", 24" Long Inner Layer NCUI Pipe Cover over test pipe
- Install 3" x 1", 12" Long Inner Layer NCUI Pipe Cover over test pipe with 27mm gap in between inner layers
- Install 5" x 1", 12" Long Outer Layer NCUI Pipe Cover over 3" x 1", 24" Long Inner Layer
- Install 5" x 1", 24" Long Outer Layer NCUI Pipe Cover over 3" x 1", 12" Long Inner Layer
- Turn on PID temperature controller with 300 degC (=572 degF) target.
- Wait 4 hours until all system is stabilized with steady process and steady insulation temperature of 300 degC (=572 degF)
- Record all temperature measurements from the test device
- Take a thermal imaging picture for the inner opening area and outer opening area

Note: All test were executed without outside metal jacket to evaluate expansion joint thermal leak indication purpose.

6. DATA COLLECTION AND THERMAL IMAGING POINTS



T1, T3 : Hot Pipe Surface Temperature
T2, T4 : Insulation Outside Surface Temperature



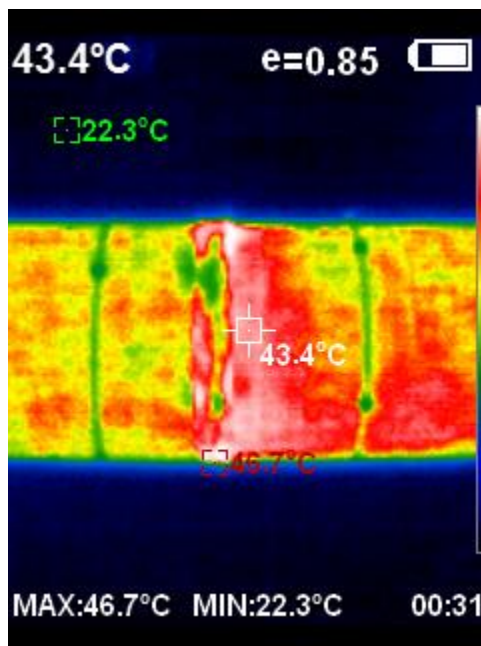
VII Proprietary Thermal
Test Device: VII TT-021
Setup for Single Layer



VII Proprietary Thermal
Test Device: VII TT-021
Setup for Double Layer
Installation

7. THERMAL IMAGING ANALYSIS

Single Layer: 3" x 2", **Compressed, 17mm (=0.67") Expansion Gap**

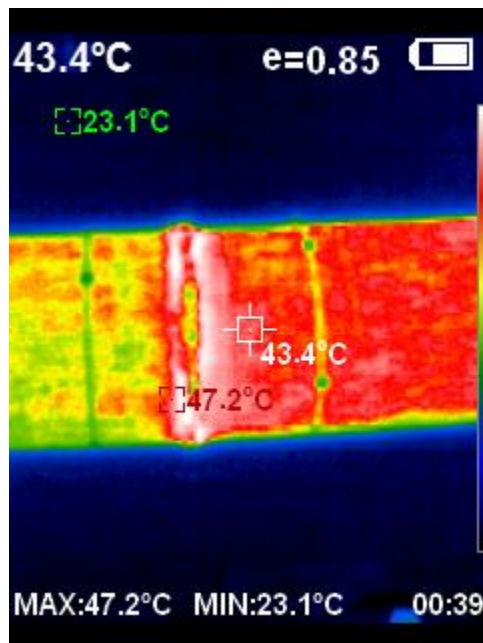


Process Temperature: 300 degC

Insulation Surface: 43.4 degC

**Expansion Joint Surface
Temperature: 46.7 degC**

Single Layer: 3" x 2", **Expanded Condition, 27mm (1.06") Expansion Gap**



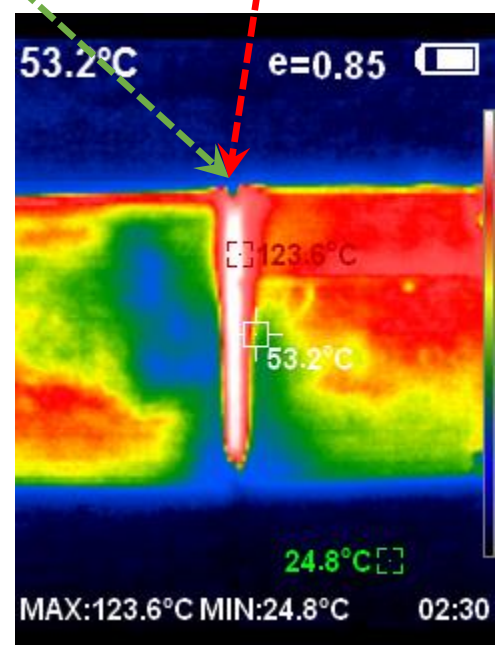
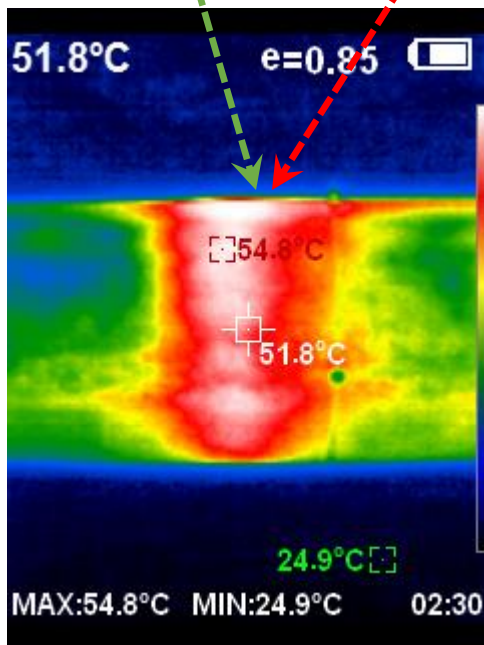
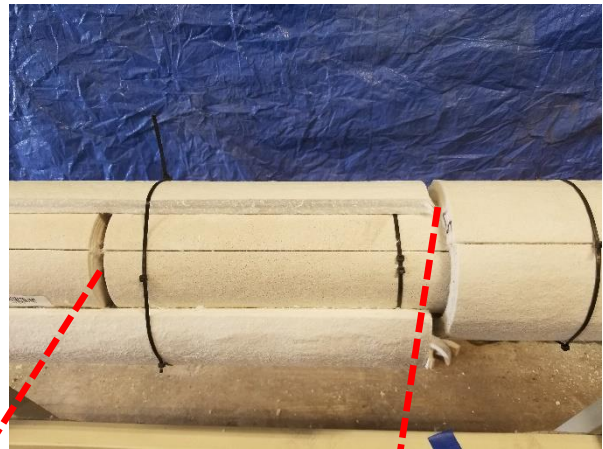
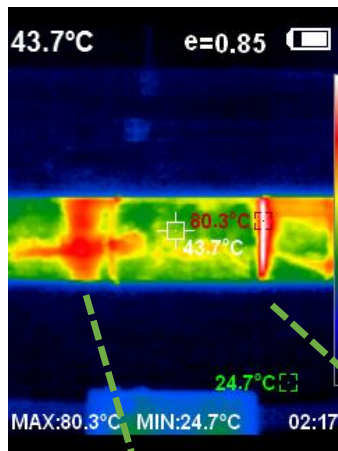
Process Temperature: 300 degC

Insulation Surface: 43.4 degC

**Expansion Joint Surface
Temperature: 47.2 degC**

- **It was monitored that there is no significant heat leak through the expansion area when there was expansion joint material installed.**

Double Layer: 3" x 2" (3" x 1" + 5" x 1") w/o Expansion Joint Material,
Gap: 27mm (=1.06") for Inner layer Expansion and Outer Layer Expansion



- ❖ It was monitored that there is excessive heat leak through the expansion area when there was no expansion joint material installed, and double layer design didn't provide enough heat conservation without proper expansion joint material installation.

8. CONCLUSION

No significant temperature changes were monitored in the single layer ESLIN™ Expansion Joint area in between both “Compressed” and “Expanded”. Due to the flexibility characteristic of E-Glass felt expansion joint material, proper compression over the joint area will prevent hot exposure to the air.

Thermal expansion design options in the hot process temperature processes were historically restricted by the types of materials and available thicknesses from the common insulations such as Cal-Sil, Mineral Wool, Perlite, etc. ESLIN™ Thermal Expansion Design can minimize thermal leak through the gaps in between each insulation sections when the process temperature reaches its normal operating condition.

Key Factors in ESLIN™ Thermal Expansion Design

- ESLIN™ is ridged and strong enough to withstand compression stress in addition to axial direction expansion without deformation.
- ESLIN™ provides single layer thickness up to 4”
- VII recommends E-Glass felt(150kg/m³ density) for the ESLIN™ Thermal Expansion design for the best result
- It was monitored and confirmed that there is no excessive thermal leak through the use of ESLIN™ Thermal Expansion Joint through VII R&D test.
- Customer can reduce construction time frame and installation costs by including ESLIN™ Thermal Expansion Design up to 4” of a single layer design concept.
- ESLIN™ Expansion Joint Material will have a superior life cycle and will not loose its flexibility nor effectiveness over the material life cycle.

Attachment

ESLIN™ Expansion Joint Spacing – Hot Service Insulation