

# TECHNICAL BULLETIN

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## Insulating VRV® and VRF Systems

Armacell Insulation Products: Ideal for VRV and VRF Systems

### Introduction

VRV and VRF systems have been used extensively in markets outside of the United States. In recent years, these systems have become more popular in the US as building operators and owners realize the energy efficiency of these systems and the flexibility, they offer for climate control in multi-zone buildings.

### System Operating Conditions

Due to the large temperature fluctuations in refrigerant temperature, both the vapor and liquid lines of VRV and VRF systems must be insulated. As with traditional HVAC systems, the refrigerant lines are insulated with closed cell, elastomeric insulation. The difference is that the manufacturers of VRV and VRF systems have suggested in their installation manuals that the insulation should be able to withstand temperatures of 248 – 250°F. To comply with this guideline, installers are unnecessarily limited in product choices for the insulation because the normal operating refrigerant temperature will never exceed 150°F. Here's why:

All VRV and VRF systems use R410A as the refrigerant. Based on the saturation properties of this refrigerant, the pressure would need to be over 1700 psi to reach 250°F during normal operation of the system. No VRV or VRF system will ever get close to this pressure. In reality, the high-pressure side of VRV and VRF systems will operate at about 420 psi and every system has safety controls that will never allow the pressure to get above 600 psi. This corresponds to an operating refrigerant temperature of about 120°F and a maximum refrigerant temperature of about 150°F: both well below the 220°F maximum usage temperature of AP ArmaFlex. In fact, Table 1 lists the working pressure of ACR copper tubing and the corresponding R410A saturation temperature. This shows that the maximum pressure rating of nearly all refrigerant piping is not high enough to reach 220°F. Therefore, refrigerant piping used with R410A is not designed to get above 220°F. As a result, AP ArmaFlex, with a design temperature of 220°F, matches perfectly with the design pressures of the refrigerant piping.

For systems operating above 250 °F, the recommended product is ArmaFlex® UT. ArmaFlex UT is EPDM based flexible closed cell insulation especially designed for VRF systems. The maximum for the ArmaFlex UT is 300 °F.

Table 1: Maximum working pressure of copper tubing according to “The Copper Tube Handbook” – Copper Development Association Inc.

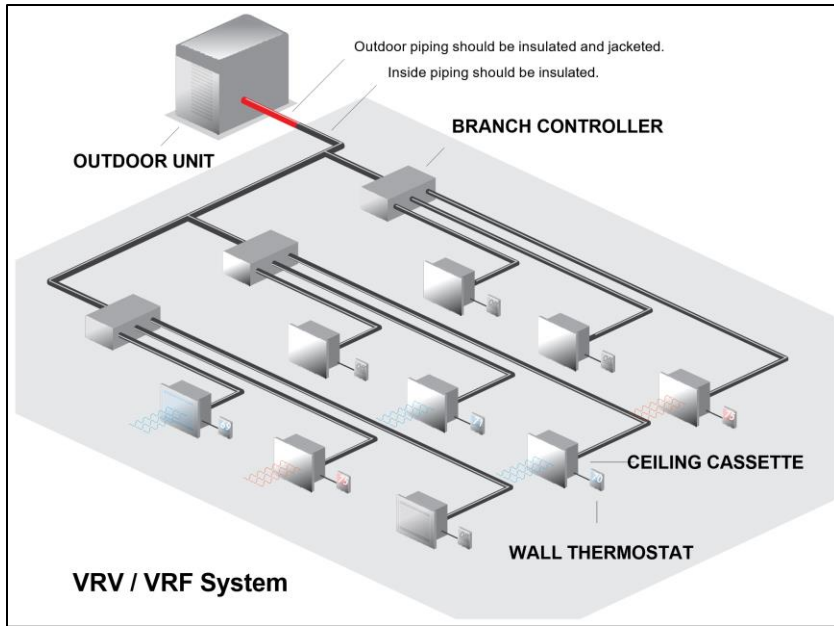
<b>Annealed Copper Working Pressure</b>		
Tube Size (in)	Max Working Pressure (PSI) <sup>1</sup>	R410 A Temp (°F)
3/8	731	165
1/2	625	151
5/8	579	145
3/4	506	134
7/8	467	128
1-1/8	396	115
1-3/8	352	107

<sup>1</sup>Only annealed values are shown because according to The Copper Development Association, “When welding or brazing is used to join tubes, the annealed ratings must be used, since the heating involved in these joining processes will anneal (soften) the hard tube” (Copper Tube Handbook, 2014).

The only situation where the refrigerant in a VRV or VRF system would exceed the continuous upper use temperature of AP ArmaFlex is when there is a problem with the system and repair is required. In this temporary situation, refrigerant may become superheated and reach temperatures up to 250°F before the unit shuts down automatically. The time that the refrigerant temperature would be above the upper use temperature of AP ArmaFlex would be minimal and likely less than 10 minutes. AP ArmaFlex has been tested to ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation, where it is subjected to 250°F for 96 hours. During this test, AP ArmaFlex shows no signs of sagging, surface cracking, warping, or delamination and the insulation remained flexible and easy to handle. In addition, there is no smoking, flaming, glowing, or smoldering on the inner diameter of the insulation. Since ASTM C411 proves that AP ArmaFlex can handle 250°F for 96 hours, it can handle the short amount of time VRF or VRV refrigerant may be at 250°F during faulty, abnormal operation.

**Conclusion**

ArmaFlex UT is designed for VR systems as the maximum service temperature is 300 °F. During normal operation, refrigerant temperatures for VRV and VRF systems will never get above 220°F: the upper use temperature of AP ArmaFlex. In addition, AP ArmaFlex can withstand the short time periods when refrigerant temperature could be above 220°F due to faulty system operation. Therefore, ArmaFlex UT or AP ArmaFlex can be used safely on VRV and VRF refrigerant lines. As a result, installers and owners can take advantage of Armacell’s industry leading quality and customer service.



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