EPA-Regulated Refrigerant Phasedowns and Mechanical Pipe Insulation

Hydrofluorocarbons (HFC's) are known ozone-depleting substances that generate exponentially greater greenhouse gas emissions than the same quantity (1 kilogram) of CO_2. Greenhouse gases catalyze the depletion of the earth's ozone, resulting in global warming (climate change).

For decades, most refrigerants utilized in refrigeration and HVAC systems contained HFC's. To mitigate the negative impacts on the environment and human health by refrigerants, the United States government enacted The American Innovation and Manufacturing Act of 2020 (AIM Act). It authorizes the U.S. Environmental Protection Agency (EPA) to regulate the phasedown of HFC's by 85% through 2036.

Industries that have traditionally utilized HFC refrigerants, such as supermarkets, are actively transitioning away from common ozone-depleting refrigerants (i.e. R410-a) to several alternatives with ultra-low global warming potential (GWP); R-290 (propane), R-744 (CO_2), and R-717 (ammonia). These low GWP refrigerants offer abundant availability, a lower long-term cost, and low regulatory risk.

CO_2 is gaining adoption by the supermarket industry since it is a naturally occurring substance with no regulatory constraints, coupled with a low long-term cost. Unlike traditional refrigerants that cycle between a liquid and gas, CO_2 remains a gas and must operate at significantly higher pressure (~ 7x) than refrigerants. At up to 1,000 – 1,500 PSI, refrigeration system components, such as piping, fittings, valves, and compressors, must be engineered to handle higher pressure. Technicians must also attain a high-pressure certification.

Mechanical pipe insulation on refrigerant suction lines has, and always will, reduce heat gain on below-ambient (cold) refrigerant piping, thereby reducing unnecessary loads on compressors. However, insulation is a critical component of CO_2 systems due to a phenomenon known as "flash gas". Flash gas reduces system efficiency, and the correct insulation (and thickness) reduces flash gas generation.

The right pipe insulation, thickness, and vapor barrier play a critical role with ensuring that high-pressure CO_2 systems operate efficiently while minimizing downtime. This is especially pronounced with low-temperature suction lines that operate at -20ºF to -30ºF. Depending on the operating environment of the CO_2 system, the temperature difference between the ambient and operating temperature can be up to 100ºF. Increasing insulation thickness prevents heat gain, reduces flash gas generation, and controls condensation.

Thicker insulation is required for specific piping & equipment that operate at very cold temperatures (-20ºF to -30ºF). It is not unusual for 1-1/2" thick to be specified for conditioned spaces (climate controlled). However, the insulation thickness must increase in unconditioned environments, such as mechanical rooms and exterior applications (rooftops), to prevent heat gain, reduce flash gas, and control condensation.

Insulation for CO_2 systems must also maintain a complete vapor barrier to prevent vapor drive from reaching the cold piping & equipment. Some insulation types offer an integrated vapor barrier, while others require an insulation jacket.

An important consideration when selecting insulation for refrigerant piping is water vapor permeability (WVP). This measures the ability of insulation to resist vapor drive without a vapor barrier. WVP is usually reported as "perm-inch"; for example, 0.02 perm-inch. Like a golf score, the lower the number, the better. The ASHRAE Refrigeration Handbook specifies that refrigerant pipe insulation with a perm rating of ≤ 0.02 perm-inch does not require a vapor barrier.

One of the most common failure points of an insulation system is at the seams. All insulation seams must be sealed with the manufacturer's recommended adhesives or sealants. The other is at pipe support locations (i.e., hangers and struts). Rigid pipe insulation inserts are necessary to prevent insulation compression and are commercially available through mechanical insulation distributors.

Facility owners that operate and maintain refrigerant systems as a vital component of their business can realize one of the most rapid returns on investment (ROI) with the proper refrigerant insulation, thickness, and vapor barrier system.

AEROFLEX EPDM™ closed-cell elastomeric insulation offers a built-in vapor retarder and is available in preformed tubes (standard and pre-slit), sheets, and rolls up to ***2" thick*** and in two colors – black and white/gray. With a low ***perm rating of 0.02 perm-inch***, an additional vapor barrier (jacket) is not required for most applications.

Aerofix® insulated pipe supports are manufactured by Aeroflex, available in pipe sizes from ¼" to 12" IPS, up to ***2" thick***, and are covered by the AEROFLEX® express limited warranty.

To learn more, click here.

Sources:
EPA –
https://www.epa.gov/hfcs/frequent-questions-phasedown-hydrofluorocarbons
https://www.epa.gov/sites/default/files/2016-12/documents/international_transitioning_to_low-gwp_alternatives_in_commercial_refrigeration.pdf
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