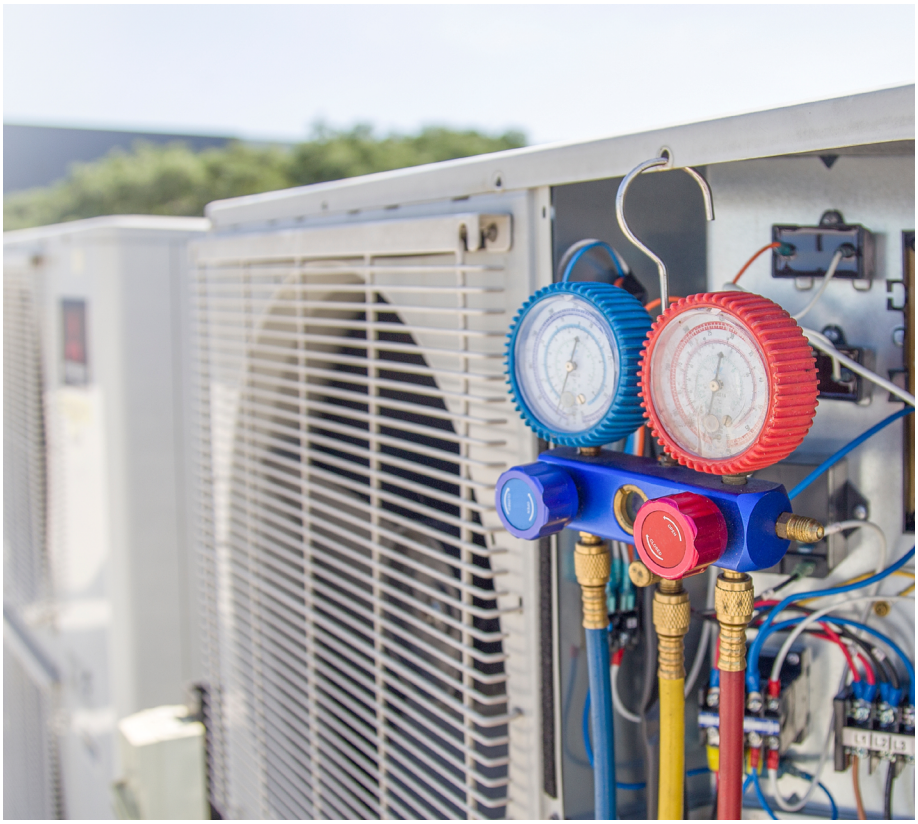


SEALED CONNECTORS: ENHANCING HVAC SYSTEM PERFORMANCE AND LONGEVITY

HVAC systems can be essential for maintaining comfortable indoor environments, but they operate under increasingly demanding conditions. Extreme temperatures, fluctuating humidity levels, and exposure to dust and debris can all take their toll, leading to decreased efficiency, premature wear, and even system failure. In this challenging environment, the importance of reliable connectors cannot be overstated. These components play a crucial role in enabling seamless operation and longevity for HVAC systems. As temperatures soar or plummet, connectors must withstand thermal shock without compromising performance. Moreover, they must effectively seal against moisture ingress to help prevent corrosion, mold growth, and the proliferation of harmful bacteria.

TE Connectivity (TE) recognizes these challenges and offers a comprehensive range of signal and power connectors designed to excel in harsh environments. With their environmental ingress protection (IP) rated sealing against water, dust, and debris, these connectors can help safeguard the HVAC system, enhancing system reliability and extending equipment lifespan.

In this article, we delve deeper into the unique challenges faced by HVAC systems and explore how sealed connectors can mitigate these risks, providing optimal performance and peace of mind for both manufacturers and end-users alike.

STRATEGIES FOR UPPORTING ROBUST CONNECTOR PERFORMANCE

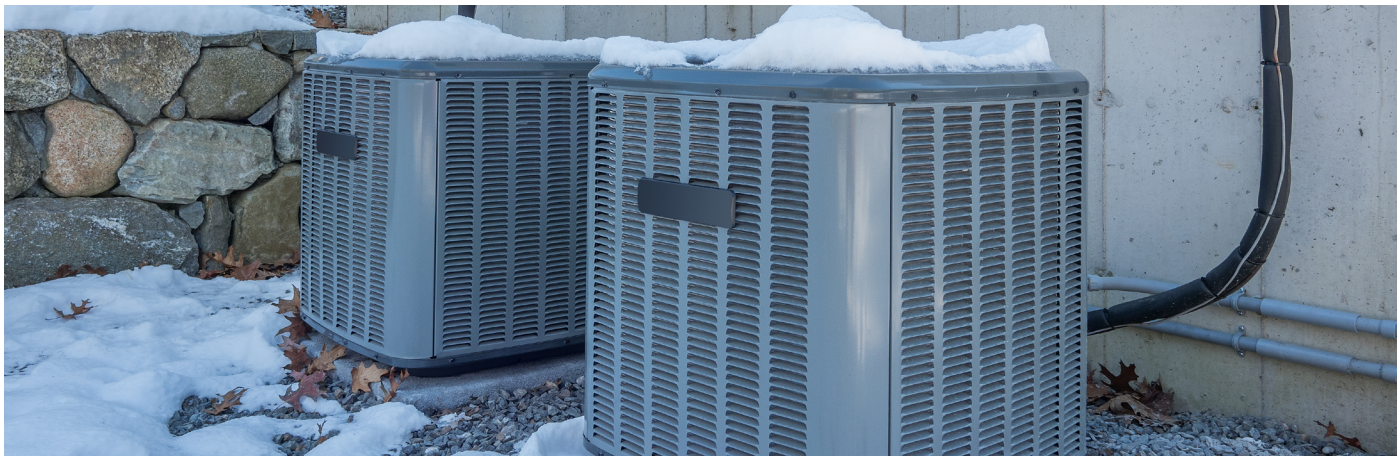
Airborne contaminants like dust, pollen, and other particles pose significant threats to HVAC systems, clogging filters and infiltrating internal components. In areas with high pollution or salt content, these effects worsen. Outdoor units are vulnerable to damage from strong winds, rain, hailstorms, floods, hurricanes, and other natural disasters, potentially causing electrical shorts, corrosion, and physical damage to condenser coils and fins, requiring costly repairs or replacements.

Given the harsh operating conditions, HVAC systems and their components must withstand thermal shock, condensation, and humidity to mitigate corrosion effectively, ensuring uninterrupted operations and providing safe, comfortable environments for occupants of residential, commercial, and industrial buildings alike. Avoiding connector performance issues can be paramount in maintaining HVAC system reliability. This can involve employing appropriate design principles, utilizing IP-rated sealed connectors, selecting durable materials, leveraging advanced plating technology, and employing secure locking methods—these are techniques utilized by TE in the development of its connector portfolio.

WHAT CAN LEAD TO CONNECTOR FAILURE?

Considerations to solve your harsh environment application requirements.

CONCERN	SOLUTION
IMPROPER SELECTION Moisture and undersized connectors can lead to decreased connector life or potential failure.	**ENVIRONMENTAL SEALING** Select appropriate Ingress Protection (IP) rating and seals to protect against dust and moisture in extreme environments.
OPERATING TEMPERATURE Connectors not rated for extremely high or low temperatures may eventually fail.	**MATERIAL SELECTION** Select materials suitable for the application environment to prevent potential failure.
MATING FACTOR Frequent mating and unmating of a connector can potentially cause failure.	**PLATING TECHNOLOGY** Select connectors with appropriate mating cycles, durability, and performance.
IMPROPER DESIGN AND INSTALLATION Shock or other damaging motions along with improper mounting may result in damage to connector contacts, mating shells and cables.	**CONNECTOR DESIGN / CUSTOMIZATION** Consider connector's shape, size, mating mechanism, and pin positioning.
VIBRATION / LOOSE WIRING High vibration in industrial applications can cause the terminal wires to loosen, resulting in broken or intermittent connections.	**LOCKING / COUPLING METHODS** Select the appropriate locking/coupling mechanism to provide secure connection points in harsh environments.



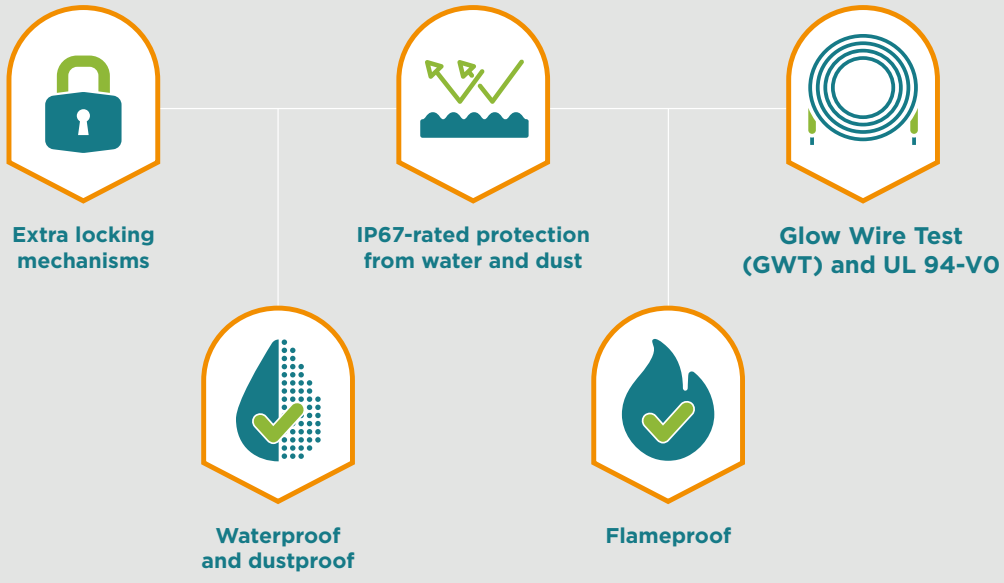
EMBRACING LOW GWP REFRIGERANTS IN HVAC SYSTEMS

Stringent environmental regulations and protocols worldwide are driving the phase-out of refrigerants with high global warming potential (GWP).[1] While this transition promises more sustainable heating and cooling technology, it presents a significant change management hurdle for the industry.

As key players in the industry, HVAC manufacturers play a crucial role in staying current with evolving regulations, identifying and adopting new low GWP options, and redesigning systems to accommodate these alternatives. Meanwhile, commercial and industrial building operators must navigate the implementation of new systems, adjust operational practices, and safely dispose of legacy refrigerants. Additionally, they must familiarize themselves with the handling and storage protocols for A2L refrigerants, which carry mild flammability risks.

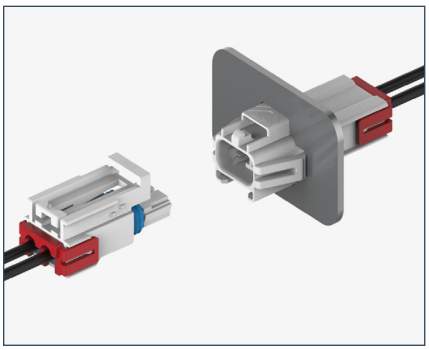
Furthermore, the shifting climate patterns, characterized by increased frequency of extreme weather events and rising temperatures, are likely to compound existing challenges and introduce new complexities for HVAC and component manufacturers. This necessitates continuous innovation in refrigerants, connectors, and other solutions to address emerging needs for improved resilience and efficiency of HVAC systems in the face of evolving environmental demands.

WHAT TO LOOK FOR IN COMPONENTS

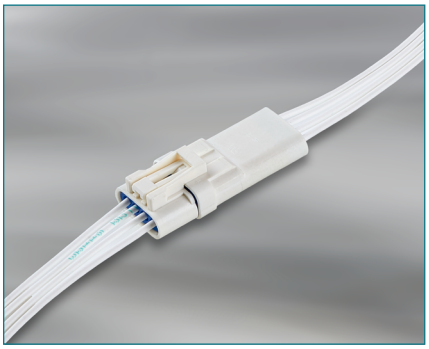


SEALED CONNECTOR PORTFOLIO FOR ENHANCED SYSTEM SEALING

Engineers must design for safety and durability while meeting global industry safety standards. At TE, we offer comprehensive connectivity solutions that address diverse application requirements with a single connection. Our portfolio of sealed connectors offers extra locking mechanisms, water and dust proof capabilities, flameproof materials, and glow wire tested (GWT). Seal the deal and explore our power and signal connector components.



Power Versa-Lock connectors offer high-performance, wire-to-wire power with IP67-rated protection from water and dust. A mounting clip secures free-hanging connectors, and a twist and lock (TNL) cap allows moisture to drip away from the connection. Housings meet UL 94 V-0 and glow wire test (GWT) flammability standards. The maximum temperature is 125 degrees C. There are also a secure tab and receptacle contact system and optional terminal position assurance (TPA) devices. Sub-applications include the control board, human-machine interface, the power board, and the fan/step motor.



2.5mm Sealed Signal Double Lock connector offers design flexibility to create compact, durable connections in low power and signal applications. The product line includes many optional features to help protect against during manufacture and product end-use. These features include a double lock plate to ensure complete mating during assembly, a high-profile header for use on printed circuit boards (PCB) with conformal coatings, and IP67-rated sealed connectors for reliable performance in high humidity and wet environments.

Universal MATE-N-LOK connectors include terminal position as (TPA) to ensure terminals are fully seated and cannot back out for 2-5 positions. Cap and plug housings enable mixing of pin and socket contacts within the same housing for enhanced flexibility. They are useful in HVAC sub-applications such as control board, human-machine interface, power board and sensors.Splash proof sealed version.

DRIVING FORCES BEHIND THE GROWTH OF THE HEAT PUMP MARKET

HVAC system reliability is paramount in any environment. However, the colder climates of the European Union (EU) and North America amplify the necessity for highly reliable and energy-efficient heating equipment to ensure the comfort of building occupants and facilitate safe commercial and industrial operations.

In Europe, there's a concerted effort to promote the adoption of heat pumps, with the EU aiming to install an additional 60 million heat pumps by 2030. This initiative aligns with EU targets to reduce gas demand in buildings by 40% and decrease the energy import bill by EUR 60 billion. Similarly, in the U.S., federal clean energy tax credits cover 30% of the cost of heat pumps, complemented by consumer home energy rebates. Additionally, state governments are setting ambitious targets, such as quadrupling the number of heat pumps in U.S. homes by 2030. *(Source: Markets & Markets Mordor intelligence).*

These trends all point towards the ongoing expansion of the heat pump market, underscoring the growing demand for rugged sealed connectors that offer environmental resistance, reliability, and superior performance.

HOW SEALED COMPONENTS ARE USED IN HVAC

Here are some examples of how sealed connectors are used in HVAC systems:

Electrical connections
Sealed connectors can connect wires and cables to electrical components, such as compressors, motors, and control boards.

Refrigeration
Sealed connectors play a crucial role in HVAC refrigeration systems by providing reliable electrical connections and protection against environmental factors such as moisture, dust, and other contaminants.

Sensor connections
Sealed connectors can join sensors to components, such as thermostats and humidity sensors.

[1] *Examples of these protocols include the Montreal Protocol of 1987, the Kyoto Protocol of 1997, the Montreal Amendment of 2017, and the Kigali Amendment of 2016. Examples of relevant regulations include the European Union F-Gas Regulation, The American Innovation and Manufacturing (AIM) Act, and Japan's Law Concerning the Recovery and Destruction of Fluorocarbons.*

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