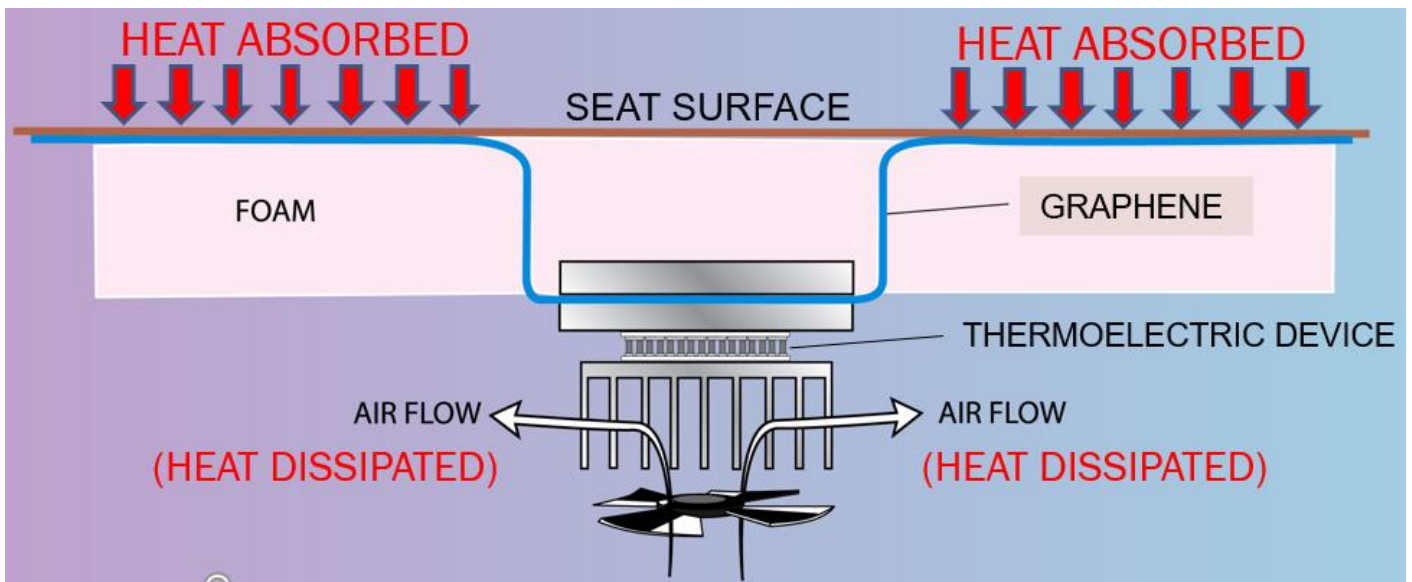




Overview of Seat Cooling & Heating Technology

THERMAVANCE™ technology uses a thermoelectric device (eg. a “Peltier” device) coupled with graphene to 'pump' heat in or out of a seat occupant. Graphene is strong, lightweight, flexible and is an excellent conductor of heat. Thermoelectric Devices are electronic systems that take advantage of the Peltier Effect to bi-directionally move heat. The combination of these technologies enables a THERMAVANCE-equipped seat to efficiently cool or heat seat occupants who are exposed to the weather.



Heat Transfer of Touch: Provides efficient conductive heat transfer where the occupant is in direct contact with a cooled or heated seat surface.

Enables Weather Friendly and Washable Seating Surfaces: THERMAVANCE™ is ideal for applications requiring reliable operation in both outdoor and indoor applications.

Single System Convenience: Cooling or heating with an intuitive switch

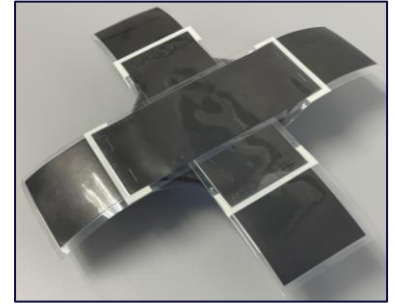
Specifications:

Operating Voltage:	11 to 15.8 VDC
Power Consumption (per seat):	150 Watts maximum
Thermal Engine Dimensions:	300mm x 300mm x 50mm
Weight:	380 grams
Control:	Programmable Temp set points (factory set) Heat/Cool/Off with High/Medium/Low settings

Overview of Seat Cooling & Heating Technology

System Components

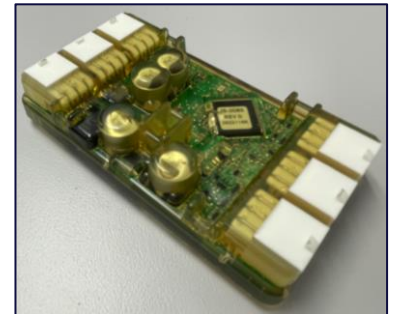
Thermal Engines: Includes an energy efficient Thermal Electric (*Peltier*) Device coupled with Thermally Conductive Graphene.



Switch Control: The system offers high, medium, and low settings for both cooling & heating modes. Blue and Red LED lighting indicate the level of cooling and heating operation.



Electronic Control Module: Automotive grade circuitry incorporates pulse width modulation to enable high/medium/low operating settings. The controller is sealed in over-mold material and is IP-56 rated allowing for robust weather resistance and power-washing.



Blowers: Each thermal engine is configured with a blower to dissipate thermal energy from the heat sink when the system is operated in cooling. The blowers are IP-67 rated and able to withstand full water immersion.



Rigorously Tested Design: Validation testing includes thermal cycling, fog/salt-spray, gravel bombardment, vibration, 10,000 cycle knee intrusion, electromagnetic compatibility, etc.

After 3 years of development, THERMAVANCE™ technology was successfully launched in the powersports market by Polaris Industries in 2020. The technology is patented and approximately 10,000 units are in service.



Overview of Seat Cooling & Heating Technology

FAQ's

Q: Does the system make any noise?

A: The only moving component that produces sound during system operation is a blower that is packaged in the cushion underneath each seating location. Generally, the blower cannot be easily heard by the seat occupant due to other background noise. The blower only operates when the system is in cooling mode.

Q: Does air get blown on the seat occupant?

A: Air does not blow on the seat occupant. The blower is necessary to move air over a heat sink that is packaged within the seat.

Q: May the seat be power washed?

A: Yes. The Thermavance system is designed with components and electrical connectors that will keep out water spray as well as rain.

Q: How long until the seat occupant feels heating?

A: Customers typically feel the system heating within 2 minutes. Like seat heaters in cars, the clothing worn by the seat occupant can affect time-to-sensation of heating.

Q: How hot does the system get?

A: The system is designed to meet SAE J3407 requirements which defines maximum seat surface temperatures and exposure times. Generally, this temperature is 43°C, or approximately 108°F.

Q: How cold of a day will the system provide heating?

A: Thermavance technology will provide comfortable heating performance down to -17°C (0 °F).

Q: How long until the seat occupant can feel cooling?

A: Customers typically feel the system cooling within 2 minutes. Clothing worn by the seat occupant can affect time-to-sensation of cooling. On hot days, normally seat occupants wear lighter clothing that provides less of an insulating barrier for moving heat out of their body.

Q: How cold does the system get?

A: The sensation depends on ambient temperature and the load. With no load the system can achieve 15°C (27°F) below ambient. With a person sitting in the seat, the system can produce surface temperatures that are 10-15°C (18-27°F) below the occupant's body temperature of approximately 37°C (98.6°F).

Overview of Seat Cooling & Heating Technology

FAQ's (continued)

Q: How hot of a day will the system provide cooling?

A: Perception of cooling can be subjective and vary greatly between individuals. However, Promethient tests each seat design in a thermal chamber at an elevated ambient temperature of 43°C (108°F). The presence of direct sunlight and/or elevated humidity will tend to exacerbate the thermal effects on hot days.

Q: Does the system remove humidity?

A: No. Since the system does not blow air on the seat occupant, there is no evaporative cooling effect.

Q: How durable is the graphene and the entire system?

A: The graphene and entire Thermavance system have undergone knee load durability, ingress/egress durability, and vibration testing with our production partners.

Q: How do you ensure that comfort is not degraded?

A: The engineering team at Promethient utilizes pressure mapping both before and after installation of the system to ensure comfort is not affected or diminished.

Q: What is the difference between Thermavance technology and the cooled/heated seat that is in a car?

A: There are two types of systems used in cars to provide heating and/or cooling.

Resistive Heating: Automotive seat heaters use electrical wires that get hot when a current passes through them. Like Thermavance technology, this approach provides conductive heating, but it *cannot* provide any cooling.

Ventilated Seating: Some automobiles are equipped with ventilated seats that feature a perforated seating surface. Air is either blown out or drawn into hundreds of small holes in the seat. This approach uses less efficient convective heat transfer that relies on air and, critically, it *cannot* be used outdoors or exposed to water.

Q: Where is the system manufactured?

A: Thermavance systems are engineered and manufactured at Promethient's Corporate Headquarters located in Traverse City, Michigan.

Q: Is the Thermavance system patented?

A: Yes. Promethient's first patents were issued in 2020.

Overview of Seat Cooling & Heating Technology

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