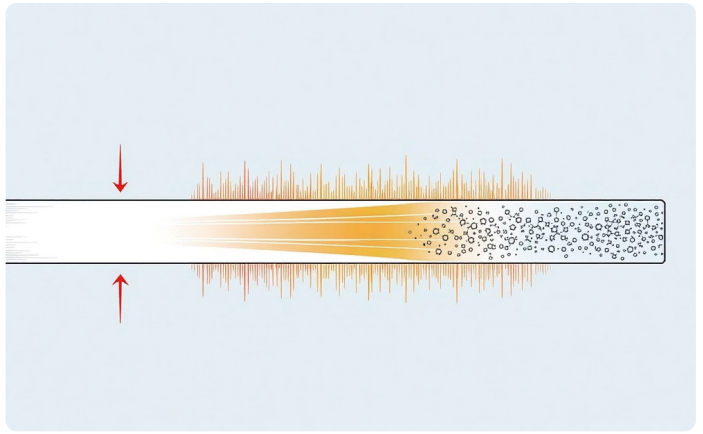
HEAVIS Radiant Heater : Performance Analysis and Comparison with Competitors and Heat Pumps

This report provides an in-depth analysis of the core principles of radiant heating technology and presents a detailed comparison with competing products and heat pump systems. Ultimately, it highlights the technical superiority of our HEAVIS model.

Heat Transfer Mechanisms of Radiant Heating

To fully understand the performance of radiant heaters, it is crucial to first grasp the three distinct modes of heat transfer. Each plays a unique role in creating an optimal indoor thermal environment.

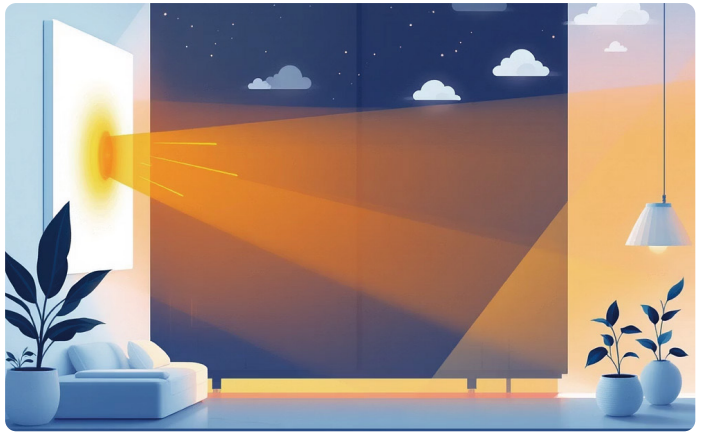


Conduction

Thermal energy is transferred through direct contact as vibrating atoms and molecules collide within a substance. In a radiant heater, this process moves heat from internal components to the surface of the heating panel.

Convection

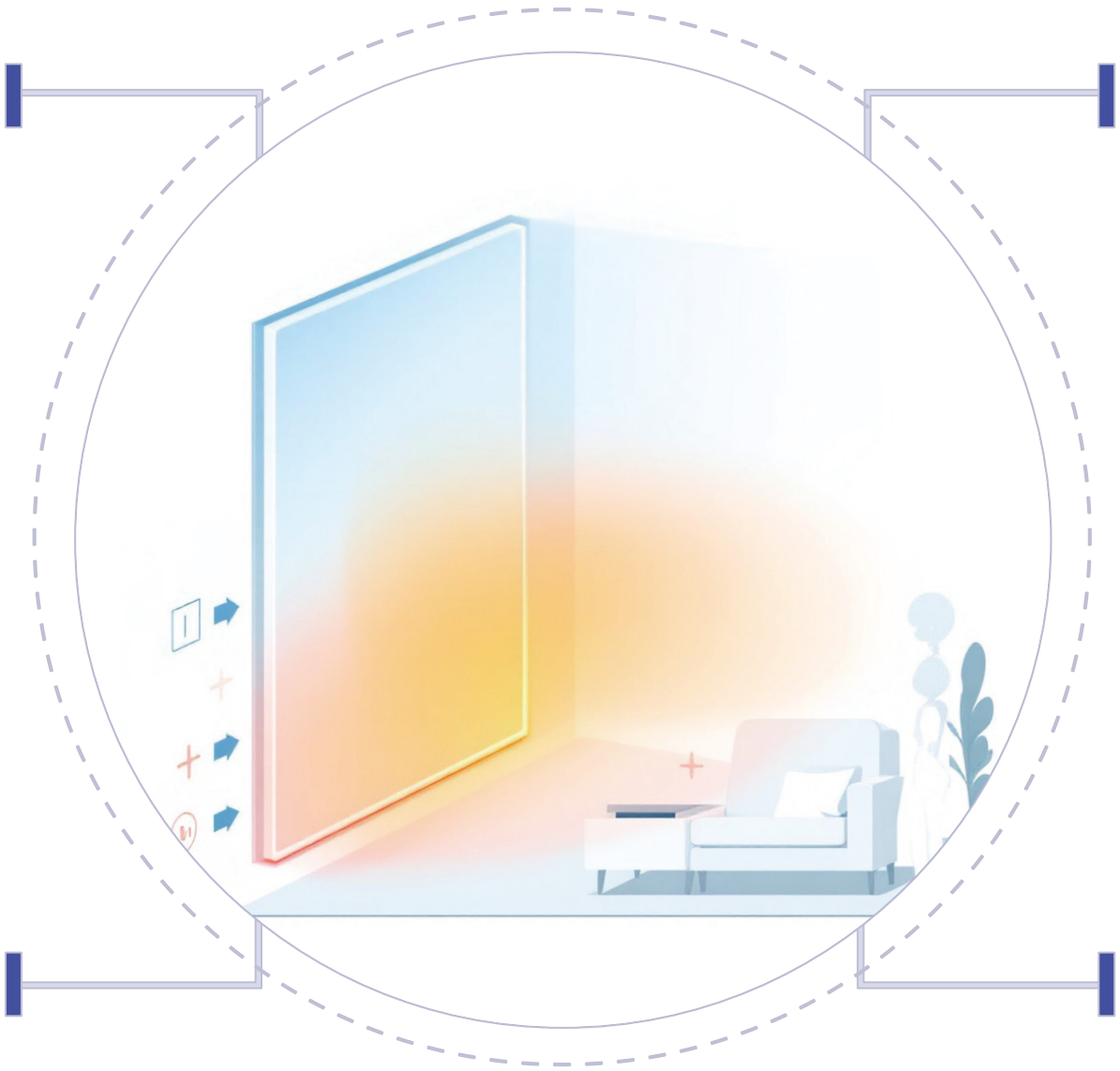
Heat is transferred through the movement of fluids, such as air. Warm air rises and cooler air sinks, creating a natural circulation. This is the primary mode of air-based heating, which can lead to significant temperature differences between the upper and lower parts of a room.



Radiation

Heat travels as electromagnetic waves, specifically infrared radiation, requiring no medium for transfer. Similar to sunlight, it directly warms surfaces and objects regardless of the ambient air temperature.

Radiant Heating: Principles and Key Advantages



Operating Principle

Radiant heating warms indoor spaces by emitting radiant energy from the panel surface. Inside the panel, a heating element generates heat, which is then conducted to the panel surface, raising its temperature. From the heated surface, infrared radiant energy is directly transferred to the walls, floor, furniture, and occupants of the room. These objects subsequently warm the surrounding air indirectly, creating a consistent and comfortable thermal environment.

Since radiant heating primarily warms objects rather than directly heating the air to high temperatures, temperature variations between the upper and lower parts of a room are minimized. A higher mean radiant temperature allows occupants to feel warm and comfortable even if the actual air temperature is somewhat lower than with traditional heating systems.

Key Technical Advantages

- **Uniform Thermal Environment:** By directly heating all indoor surfaces through radiant energy, radiant systems create a stable and uniform temperature distribution throughout the space, minimizing uncomfortable hot or cold spots.
- **Resilience to External Air Infiltration:** Unlike convection heating, radiant systems keep walls and floors warm. This helps prevent a drastic drop in perceived temperature even when windows are open.
- **Flexible Installation:** Wall-mounted radiant panels offer various installation options, making them easy to integrate into existing spaces. This is particularly effective for targeted zone heating.
- **Energy Efficiency:** Radiant heating requires a lower ambient air temperature to achieve the same perceived warmth, reducing energy consumption and increasing overall efficiency compared to systems that primarily heat the air.

Introducing HV-HP-350 :
Key Specifications and Technical Advantages

Our HV-HP-350 wall/ceiling radiant heater is an optimized solution that expertly integrates a heating element, insulation, safety devices, and a robust casing structure. This design is specifically engineered for wall-mounted applications, striking a perfect balance between thermal efficiency, safety, and durability.

Carbon Crystal Heating Element

Provides uniform and long-term stable heating with strong resistance to repeated temperature changes. The FR4 substrate-based structure significantly reduces the risk of hot spots.

Ultralight Melamine Foam Insulation

Ensures excellent insulation performance despite its thin 21mm profile. Offers superior fire safety with a UL94 V-0 flame retardant rating, and its lightweight design minimizes structural load on walls.

SEKI 125°C Bimetallic Thermostat

An essential safety feature that automatically shuts off the device at 125°C in case of overheating. This UL-certified component provides reliable protection, rated at 7A for AC 250V.

Powder-Coated GI Front Panel

Offers exceptional mechanical strength, corrosion resistance, and an attractive surface finish. The IP44 rating ensures reliable and safe operation in environments exposed to dust and splashing water.

350W

Rated Power Consumption

Optimized for efficient heating of small to medium-sized spaces, typically used in 1-2 panel configurations.

5.4kg

Lightweight Design

Ensures easy installation and minimal stress on mounting surfaces.

95°C

Maximum Surface Temperature

Achieves optimal radiant efficiency while adhering to strict safety standards.

100K+

Design Lifespan (hours)

Guarantees reduced replacement and maintenance costs over many years of operation.

Comparative Analysis with Competitor Panel Products

We compared our HV-HP-350 radiant heater against a competitor's product, the Company F, based on technical specifications and performance for similar applications. The HV-HP-350 offers a competitive advantage with higher heat output and superior component reliability.

Feature	HV-HP-350 (Our Product)	Company F (Manufacturer : Europe)
Product Dimensions	21mm (Thickness) × 600mm × 600mm Optimized for standard ceiling module installation	30mm (Thickness) × 592mm × 592mm 42% thicker than AB-350
Weight	5.4kg (Lightweight Design)	5.7kg
Rated Power Consumption	350W	300W
Max Surface Temperature	Approx. 89°C (±5°C) Enhanced radiant heating efficiency	Approx. 82°C 7°C lower than HV-HP-350
Heating Element	Carbon Crystal + FR4 Ensures uniform heating and high durability	Carbon Fiber + Vinyl Potential for localized overheating
Insulation Material	Melamine Foam (UL94 V-0) Lightweight with high insulation performance	Ceramic Fiber Non-flammable
Temperature Control Device	SEKI 125°C Thermostat UL certified, domestically produced	Unbranded T113 No certification information provided
IP Rating	IP44	IP44
Durability	Guaranteed lifespan of over 100,000 hours	Information not provided

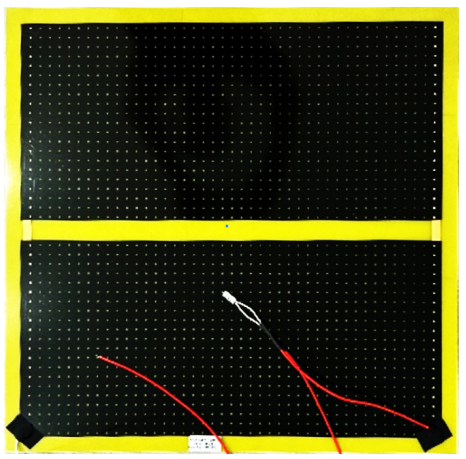
Key Conclusion: For the same installation area, the HV-HP-350 provides higher heat output (350W vs 300W) and surface temperature. This allows for meeting heating loads with fewer panels or providing faster and more consistent heating. Additionally, the certified components used in the HV-HP-350 offer a clear advantage in terms of long-term reliability and safety.

Technical Excellence of Key Components

The superior performance and durability of our product are a direct result of the careful selection of heating elements, safety devices, and insulation, combined with optimized structural design. This section compares the key components used in our product with those of competing products, focusing on their structure, material properties, and the resulting performance advantages.

Heating Element Comparison: Carbon Crystal (FR4) vs. Carbon Fiber (Vinyl)

HV-HP-350



Carbon Crystal (FR4)

Company F

Carbon Fiber (Vinyl)

Mechanical Structure

HV-HP-350: A 1mm Carbon Crystal heating layer is integrated with an FR4 substrate, ensuring uniform heat distribution across a robust surface.

Company F: Uses carbon fiber with vinyl insulation. Localized overheating can occur depending on the fiber arrangement.

Heat Distribution & Durability

HV-HP-350: Designed to minimize hotspots. Its robust board support structure withstands repeated expansion and contraction without performance degradation.

Company F: Prone to performance degradation at the fiber-vinyl interface over time, potentially leading to reduced insulation performance during long-term use.

Insulation & Safety

HV-HP-350: Features a sealed structure utilizing FR4 (a highly insulative, heat-resistant PCB material), preventing foreign matter ingress. Holds CE and CB certifications.

Company F: Relies solely on vinyl for insulation. The fibrous structure allows dust and foreign particles to penetrate. No certification information is provided.

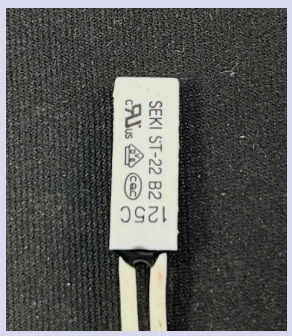
Power Connection Reliability

HV-HP-350: Employs mechanical fastening and crimping methods to ensure stable electrical contact.

Company F: Uses a stitching method for connections, posing a risk of contact failure after extended use.

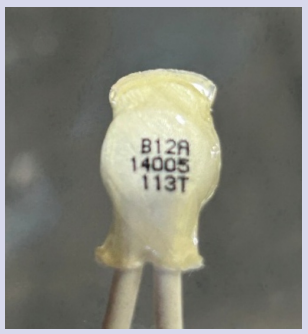
Safety Device (Bimetal) Comparison

Overheat Protection Bimetal



HV-HP-350 (SEKI 125°C):

- Manufactured by a South Korea leading domestic company.
- Set temperature of 125°C (±5°C).
- Rated 7A @ AC 250V.
- UL, VDE, CQC, KC certified.



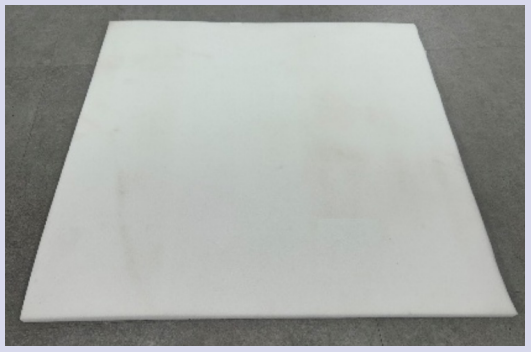
Company F (No-name T113):

- Manufacturer unknown.
- Set temperature of 113°C.
- No rating or tolerance information available.
- No certifications.

Our product uses internationally certified bimetal components, ensuring precise design tolerances and a robust safety margin.

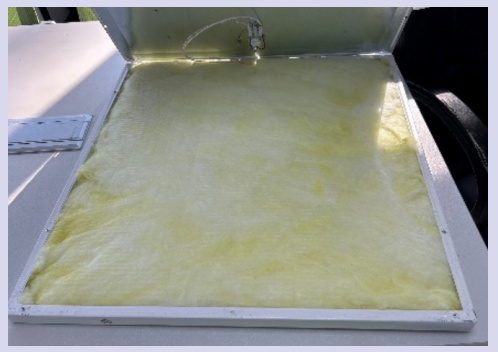
Insulation Material Comparison

Insulation Material



HV-HP-350 (Melamine Foam):

- Thermosetting melamine resin, open-cell structure.
- Thermal conductivity f 0.035 W/m·K.
- Achieves UL94 V-0 flame retardancy rating.
- Approximately 18mm thick.



Company F (Glass Fiber):

- Glass fiber mat structure.
- Thermal conductivity f 0.035 W/m·K.
- Non-combustible material.
- Approximately 30mm thick.

Our product provides equivalent insulation performance with a much thinner profile (18mm vs. 30mm), offering advantages in terms of light weight, slim aesthetics, ease of installation, and recyclability.

Conclusion: Technical Superiority of HV-HP-350

This analysis clearly demonstrates the comprehensive superiority of the HV-HP-350 radiant heater.

Superior Thermal Performance and Comfort

The HV-HP-350 provides rapid preheating and a consistently comfortable thermal environment through balanced radiant and convective heating. It achieves surface temperatures 7-9°C higher than competing products.

Robust Component Reliability

Its internationally certified heating elements (CE, CB, UL, etc.) and sophisticated, stable protection mechanisms ensure long-term reliability.

Effortless Installation

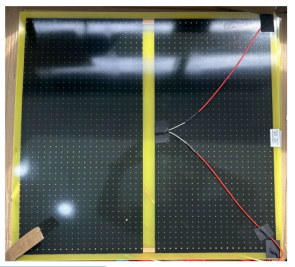
Its slim design (21mm thickness, 5.4kg weight) and standard modular dimensions allow for quick and easy installation without additional construction, making it ideal for renovation and remodeling projects.

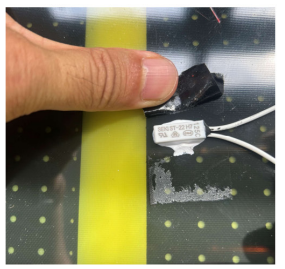
Exceptional Economic Efficiency

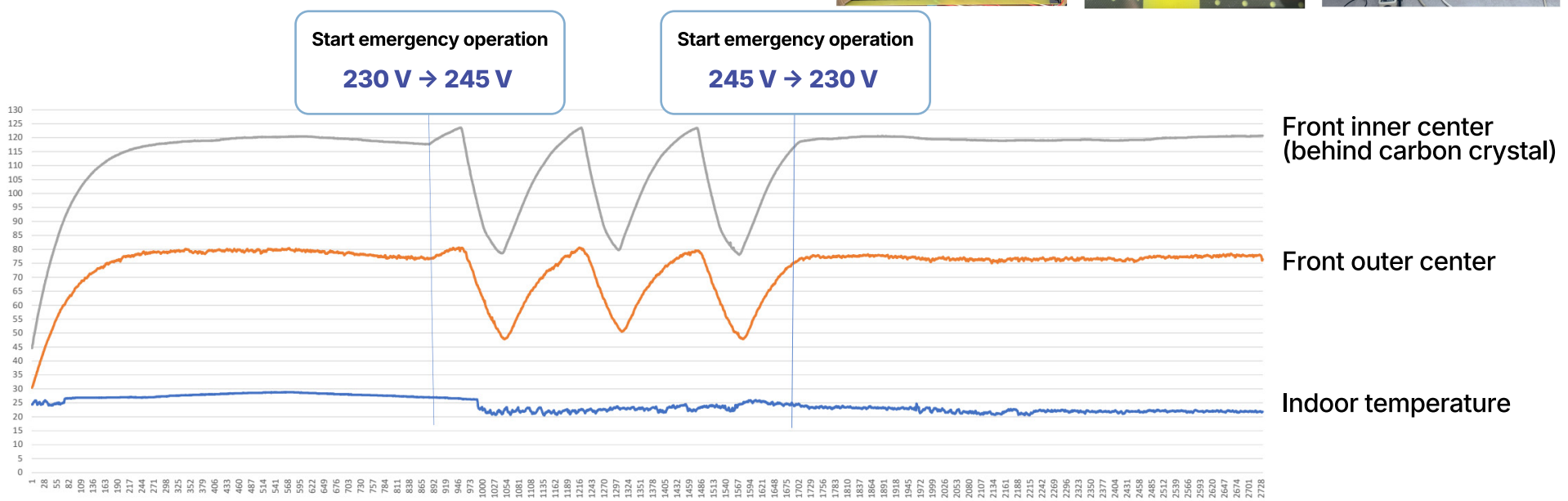
With an extended lifespan of over 100,000 hours and an optimized heat distribution design, the HV-HP-350 significantly reduces operating and maintenance costs.

Results of Normal and Emergency Operation Tests for Our Product

- **Bimetal :** 125°C
- **Test Voltage :** 230 V → 245 V → 230V
- **Bimetal Location :** Center (Carbon Section)
- **Purpose :** To verify bimetal operation durinh emergency operation







Review

- **During normal operation (230V),** the bimetal does not operate and the system runs stably within the designed temperature range.
- **During emergency operation (245V),** the bimetal operates normally at the set temperature and shuts off the power.
- When the voltage is returned to **230V (normal condition)**, the bimetal automatically resets and the system operates stably without additional actions.

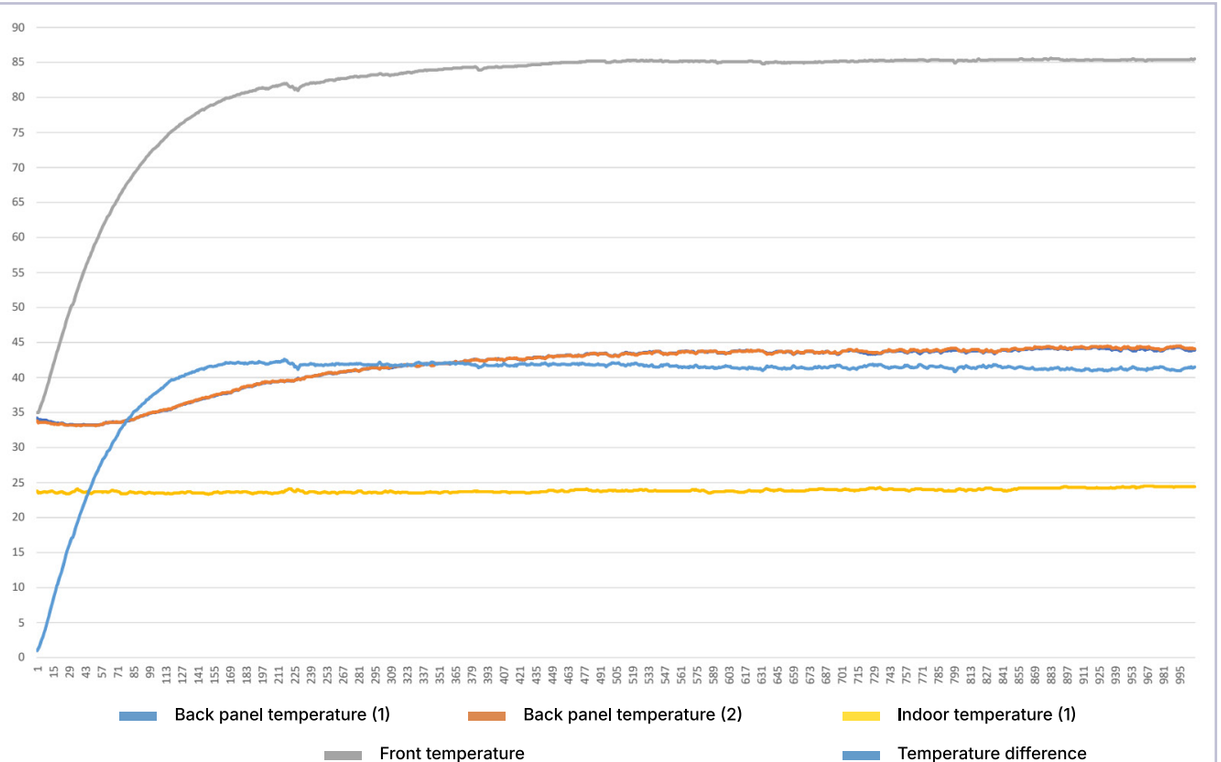
Conclusion

- During emergency operation, the bimetal operates immediately to prevent product overheating and protect users from burns.
- The operating cycle of the bimetal during emergency operation is approximately 25 minutes, securing sufficient safety margin without excessive activation of the protection function.

Temperature Rise Comparison Test of Company F Product

Company F Radiant Heater 300 W

- **Heating Element : Carbon**
- **Insulation Material : Fiberglass**
- **Dimensions : 30t * 592 * 592 mm**



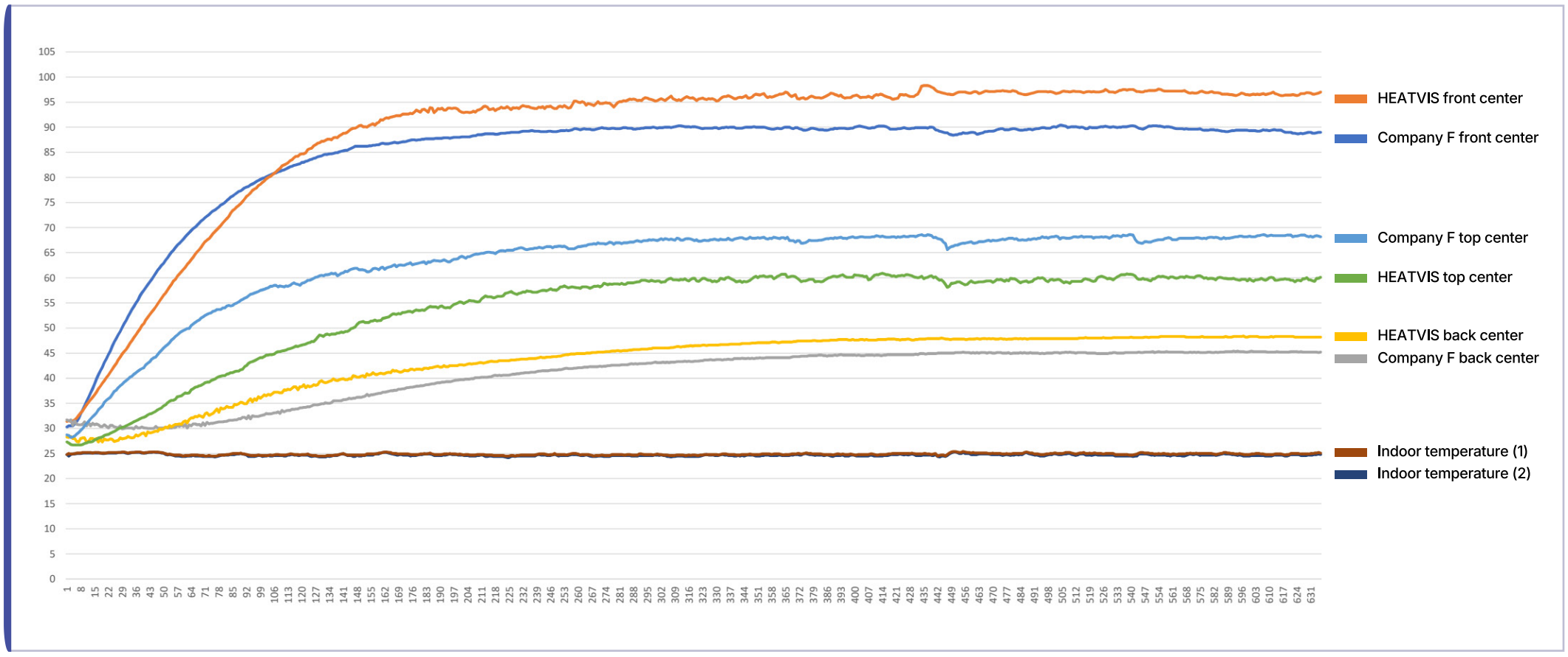
Review

- The target temperature is reached **approximately 45 minutes after operation begins,** and afterward the temperature remains stable.

Conclusion

- Under normal operating conditions, it takes a relatively **long time to reach the target temperature,** indicating low initial heating responsiveness.

Temperature Rise Comparison Test Between Our Product and Company F Product



Review

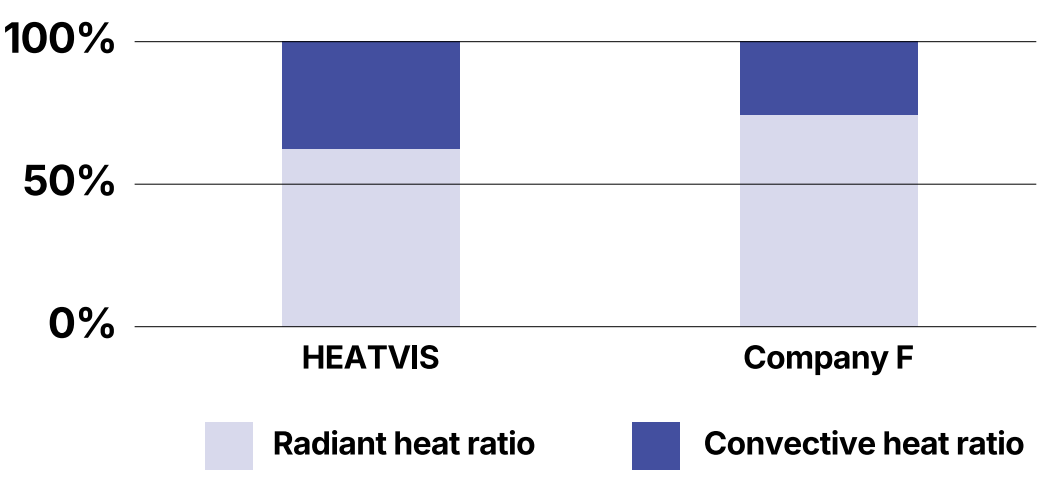
- Both products show a stable temperature rise and saturation pattern over time.
- Although our product has 50W higher power consumption compared to Company F product,

  The maximum temperature measured at the central front surface is about 7°C higher
  (Our product: approx. 97°C, Fenix: approx. 90°C),

  And **the temperature at the upper front surface is about 9°C higher**
  (Our product: approx. 69°C, Fenix: approx. 60°C).

- The target temperature reaching time is similar for **both products at approximately 24 minutes.**

HEATVIS VS Company F Heat Ratio Comparison



Conclusion

Our product appears to generate a relatively higher proportion of convective heat compared to Company F product, which contributes to an increase in indoor air temperature and an expanded heating coverage area.

As convection heat also contributes to actual heating energy, **the radiation-to-convection ratio of our product is considered to be properly designed.**

In terms of total heat output, **our product secures sufficient heating performance compared to the competitor,** enabling potential energy-saving benefits.

Although the maximum temperature of our product is higher, the time to reach the target temperature is similar (approx. 24 minutes), **indicating that our product releases more heat within the same period and is therefore evaluated to be more efficient.**

Comprehensive Comparison with Heat Pump Systems

Heat pumps are widely recognized for their high energy efficiency (COP 3-4), but they are not always the optimal choice. This analysis comprehensively compares heat pumps with radiant heating panels across key aspects such as ease of installation, operating costs, comfort, and maintenance.

System Configuration and Installation Complexity

Radiant Heating Panels: Require minimal structural changes, typically involving wall mounting and power connection. Ideal for renovation projects and supplementary heating in existing buildings.

Heat Pumps: Complex systems including indoor and outdoor units, ducts, refrigerant lines, drainage, and electrical connections. They necessitate external wall penetrations and dedicated outdoor unit space, leading to higher initial design and construction complexity, and longer installation times.

Initial Investment (CAPEX) and Operating Costs

Radiant Heating Panels: Lower initial capital expenditure (CAPEX) for smaller spaces. Highly efficient for localized heating, offering excellent cost-effectiveness for intermittent or partial usage patterns.

Heat Pumps: Incur high CAPEX due to indoor/outdoor units, ducts, and installation labor. While they offer superior heat production efficiency per unit of power (COP 3-4), the entire system typically needs to operate for maximum effect. Heat pumps are most advantageous for whole-building heating and long-term continuous operation.

Heating Method and Comfort

Radiant Heating Panels: Directly warm occupants, walls, and floors through radiant heat. High average radiant temperatures ensure comfort even at lower ambient air temperatures. Minimal air circulation reduces dust dispersion and prevents dryness.

Heat Pumps: Convection-based systems that rely on circulating warm air. This often results in temperature stratification (significant temperature differences between ceiling and floor). Strong airflow can circulate dust, cause dryness, and create uncomfortable drafts, making them less suitable for environments sensitive to these issues.

Zoning and Control Flexibility

Radiant Heating Panels: Easy individual control for each room or zone, with simple addition or relocation of panels. This makes them efficient for heating one or two rooms and offers excellent flexibility for changing usage patterns.

Heat Pumps: Provide central control or individual indoor unit control. Sharing an outdoor unit makes them inefficient for partial use. Expansion impacts the entire system, including outdoor unit capacity and ductwork, reducing flexibility for specific areas.

Maintenance and Lifespan

Radiant Heating Panels: Contain fewer components, such as heating elements, bimetallic switches, and electrical connections. Designed for a long lifespan of over 100,000 hours. Maintenance primarily focuses on visual and electrical inspections, resulting in low long-term maintenance costs and risks.

Heat Pumps: Include complex components like compressors, fan motors, valves, sensors, and refrigerants. Major component replacement is typically required within approximately 10 years. Regular inspections of refrigerant pressure, leaks, drainage, and filters are essential for optimal performance and lifespan.

Noise and Installation Environmental Constraints

Radiant Heating Panels: Operate silently (no fans or compressors) and do not require an outdoor unit. Only indoor power supply is needed, making them ideal for noise-sensitive environments like residential spaces, hospitals, and studios.

Heat Pumps: Generate noise from both indoor and outdoor units. Require dedicated outdoor unit space and clear duct paths, posing significant installation constraints in high-rise apartments, densely populated urban areas, and other challenging environments.

Radiant Heating vs. Heat Pump: Choosing the Right System

When Radiant Heating Panels Excel

Renovations and Existing Buildings

Ideal for supplementary heating where extensive ductwork or structural modifications are impractical.

Customized Zone Heating

Suitable for residential or office spaces where specific rooms or zones are frequently used and require individual temperature control.

Environments with Infrastructure Constraints

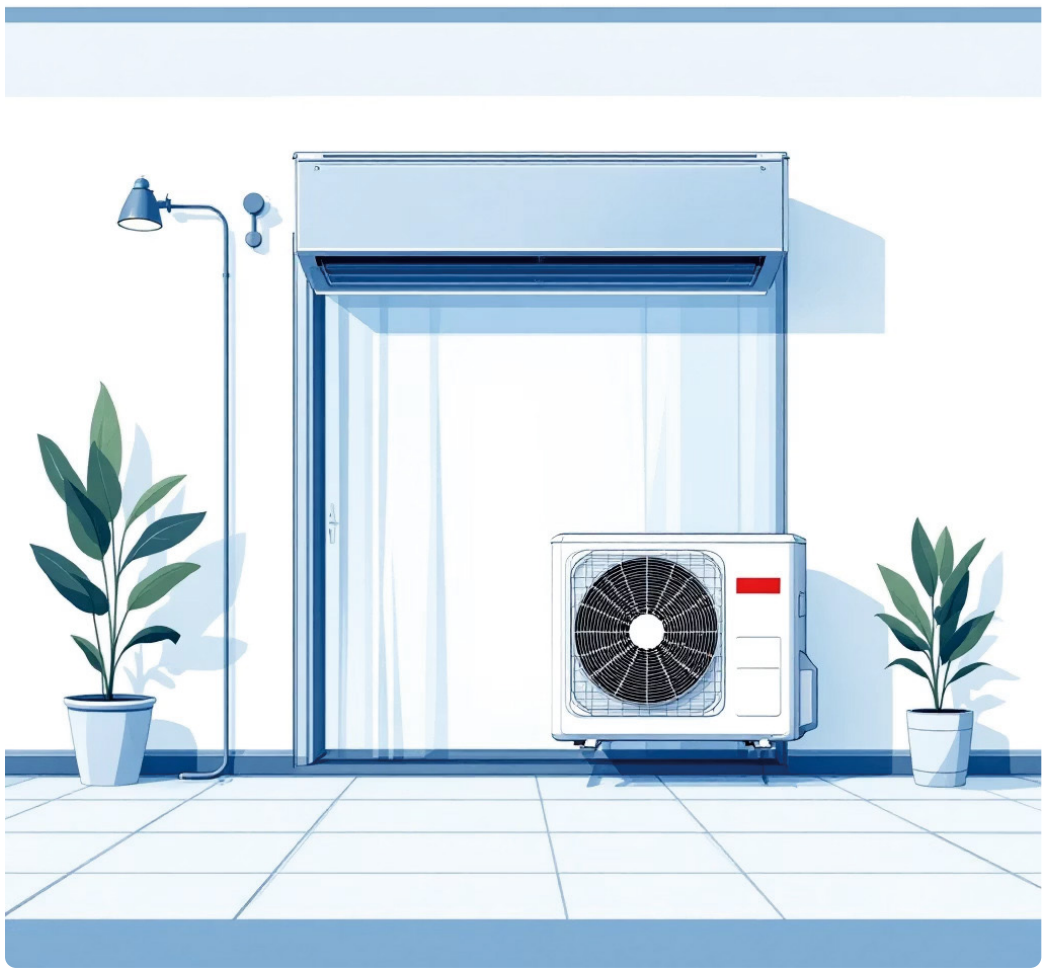
Appropriate for apartments or small commercial spaces with limitations on outdoor unit installation or complex piping.

Spaces Prioritizing Comfort

Best suited for sensitive environments like homes, hospitals, and kindergartens, where minimizing noise, drafts, dust, and dryness is crucial.

Minimal Maintenance Requirements

An excellent choice for small buildings or individual units desiring low maintenance and long-term operational cost savings.



When Heat Pumps Are Preferred

Integrated Whole-Building Management

Optimal for detached houses or medium to large buildings requiring integrated heating and cooling operation across all spaces.

Long-Term Continuous Operation

Suitable for commercial or public buildings that require centralized heat source management and consistent temperature regulation.

Feasibility of High Initial Investment

Preferred when a significant upfront investment budget is available, along with easy access to maintenance personnel and a robust service network.

Combined Heating and Cooling Needs

Essential when both heating and cooling functions are required, offering an integrated year-round climate control solution.