

THERM GLASS GROUP

WARM-EDGE VACUUM INSULATED GLASS (VIG) SOLUTIONS

Prepared For: Carrier Commercial Refrigeration
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THERMAL RESISTANCE R-10 to R-22 ▲ Up to 3.4x Baseline	GLASS THICKNESS 8.3 mm ▼ 70% Slimmer Profile	RAIL HEATER LOAD 0 - 2 W/ft ▼ 85% to 100% Power Cut	DOOR MASS INDEX 3.2 lbs/ft² ▼ 57% Weight Savings
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1. EXECUTIVE SUMMARY & ENGINEERING INTENT

Commercial reach-in display cases and walk-in freezers encounter severe thermal differentials between low-temperature interiors (0°F to -15°F) and store environments (75°F / 55% RH). Traditional triple-pane Insulating Glass Units (IGUs) rely on thick gas cavities and perimeter metallic spacers that introduce cold-spot edge conduction, forcing system designers to utilize high-wattage electric anti-sweat heaters.

Warm-Edge Vacuum Insulated Glass (VIG) replaces bulk gas spaces with a micro-evacuated high-vacuum chamber (≈ 0.1 mm) and inorganic edge matrix. This achieves solid-wall equivalent thermal insulation in an ultra-slim profile—drastically lowering compressor duty cycles, eliminating perimeter condensation, and protecting hardware longevity.

2. SIDE-BY-SIDE PERFORMANCE COMPARISON

Engineering Attribute	Standard Triple-Pane IGU Industry Baseline	Warm-Edge Monolithic VIG Ultra-Slim Profile	Warm-Edge Hybrid VIG VIG + Gas Cavity
Total Glass Assembly Thickness	28 mm - 32 mm (1.10" - 1.25")	8.3 mm (0.32")	18 mm - 20 mm (0.71")
Glass Mass / Weight Index	≈ 7.5 lbs/ft² (100%)	≈ 3.2 lbs/ft² (43%)	≈ 5.2 lbs/ft² (69%)
Center-of-Glass U-Factor (W/m²·K)	0.85 - 1.10	0.40 - 0.55	0.25 - 0.35
Thermal Resistance (R-Value)	R-5.2 - R-6.7	R-10.3 - R-14.2	R-16.2 - R-22.7
Edge-of-Glass U-Factor (U _{edge})	1.25 - 1.50 (Thermal Bridge)	0.50 - 0.65	0.35 - 0.45
Visible Light Transmittance (VLT)	62% - 66%	74% - 78%	68% - 72%
Inner Surface Temp (0°F Freezer)	38°F - 42°F (Edge Cold Spot)	58°F - 62°F	64°F - 67°F
Anti-Sweat Rail Heater Requirement	8 - 14 W/ft (Full Load)	0 - 2 W/ft (90% Reduction)	0 W/ft (100% Elimination)
Annual Energy Consumption Impact	Baseline (100%)	-32% to -40% kWh/yr	-45% to -55% kWh/yr

3. STRUCTURAL & PROFILE COMPARISON

Standard Triple-Pane IGU (30mm)

- High mechanical mass creates hinge fatigue.
- Cold edge bridges require continuous rail heat.

Warm-Edge Monolithic VIG (8.3mm)

- Slim profile enables streamlined frame extrusions.
- Uniform surface temperature prevents sweating.

4. KEY ENGINEERING ADVANTAGES

- A. Anti-Sweat Heater Elimination & Energy Savings**

Traditional glass doors suffer perimeter temperature drops near metal spacers. Under $75^{\circ}\text{F} / 55\% \text{ RH}$ store conditions, edge temperatures fall below the dew point ($\approx 58^{\circ}\text{F}$), requiring constant electric frame heating. Warm-Edge VIG maintains edge temperatures within 3°F of center-of-glass, enabling total shut-off or dramatic reduction of electric rail heat.
- B. Extended Mechanical Service Life & Seal Integrity**

Reducing glass mass from 7.5 lbs/ft^2 to 3.2 lbs/ft^2 cuts rotational torque on continuous pivots, auto-closers, and magnetic gaskets by $>50\%$. This mitigates door sag and maintains a continuous seal over high-frequency customer openings.
- C. Superior Optics & Merchandising Presentation**

Eliminating extra reflection planes present in multi-cavity triple glazing boosts Visible Light Transmittance (VLT) up to 78% , offering clearer product visibility, reduced glare, and improved illumination distribution.

5. RECOMMENDED APPLICATION MATRIX

Application Target	Recommended Glazing Setup	Glass Stack Build	Target Operational Outcome
Medium-Temp Coolers (35°F to 38°F)	Monolithic Warm-Edge VIG	4mm Low-E + 0.3mm Vac + 4mm Clear	$U \leq 0.50 \text{ W/m}^2\text{K}$, 100% Zero-Heater door operation.
Low-Temp Freezers (0°F to -15°F)	Warm-Edge Hybrid VIG	4mm VIG + 10mm Argon + 4mm Clear	$U \leq 0.30 \text{ W/m}^2\text{K}$, zero edge condensation at $60\% \text{ RH}$.
High-Humidity Islands ($75^{\circ}\text{F} / 65\% \text{ RH}$)	Warm-Edge Hybrid VIG	4mm VIG + 12mm Spacer + 4mm Low-E	Maximum condensation margin with full frame heat shut-off.

Quality Assurance & Compliance Testing: Thermal Performance verified via Guarded Hot Box testing (ASTM C1363 / ISO 12567). Vacuum seal integrity ($< 10^{-2} \text{ Pa}$) maintained under rigorous accelerated cyclic weathering tests (-30°C to $+60^{\circ}\text{C}$).

