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CAUSES AND REMEDIES FOR THERMAL-EXPANSION “POPPING” IN ALUMINUM CURTAIN WALLS

OVERVIEW

Thermal-expansion “popping” is a common but often misunderstood phenomenon in aluminum curtain wall systems. While not typically a sign of structural failure, it indicates that movement within the framing system is being restrained. This bulletin outlines the mechanisms behind the noise, diagnostic steps, and both design-stage and remedial strategies to address the issue.

1. CAUSES OF THERMAL-EXPANSION “POPPING”

Thermal-expansion “popping” in aluminum curtain walls occurs when temperature-driven movement is restricted within the framing system. The table below outlines the primary mechanisms behind this phenomenon, describing how each develops, the conditions that typically trigger it, and the expected magnitude of movement based on aluminum’s thermal properties. Understanding these causes is the first step in diagnosing noise sources and implementing effective design or remedial solutions.

MECHANISM	WHAT HAPPENS	TYPICAL TRIGGERS
Bulk thermal growth	Aluminum’s high linear coefficient of thermal expansion (≈ 23×10^{-6} / °C) means even modest temperature swings can produce several millimetres of movement in a tall mullion.	Dark finishes, west/south façades, rapid solar gain.
Differential movement	The frame attempts to expand/contract but is restrained by anchors, splice sleeves, fixing bolts, or adjacent materials. Stored stress releases suddenly in a “stick-slip” event.	Over-tight or non-slotted anchors, improperly shimmed stack joints.
Thermal bowing / panel oil-canning	Temperature gradients between exterior and interior flanges cause bending. As the load reverses, the member snaps back.	Hot/cold weather fronts, glazed-in dark spandrels, internal heat sources.
Moisture-assisted effects	Ice or absorbed water in cavities expands, amplifying friction and binding.	North façades, wet seasons, blocked drainage/weep systems.

RULE-OF-THUMB MOVEMENT FORMULA:

$\Delta L = \alpha \cdot L \cdot \Delta T$
Example: A 3 000 mm mullion, $\Delta T = 70$ °C → $\Delta L \approx 4.8$ mm

2. FIELD CLUES & DIAGNOSTIC CHECKLIST

Pinpointing the cause of movement-related noise in aluminum curtain walls requires careful observation and targeted investigation. Field indicators help distinguish between localized installation issues, system design constraints, and temperature-driven effects. Combining site checks with specialized diagnostic tools ensures accurate identification of the root cause before corrective measures are applied.

- **Time-of-day pattern:** Popping at first solar exposure or after sunset suggests bulk thermal growth.
- **Localized vs. Whole façade:** Single bay = anchor/splice issue; whole elevation = insufficient overall movement allowance.
- **Listen at joints:** Use a mechanic's stethoscope on stack-joint covers; sound transfer often points to stick-slip at anchor brackets.
- **Check anchor details:** Compare as-built conditions to drawings. Look for missing slotted holes, PTFE washers, shim packs, or oversized clearances.
- **Infra-red scanning:** Identify mullions or spandrels with high ΔT where bowing is likely.

3. DESIGN-STAGE REMEDIES (NEW BUILD)

Minimizing movement-related noise and stress in aluminum curtain walls begins with well-informed design. Incorporating movement allowances, low-friction interfaces, and temperature-control measures enables systems to adapt to temperature changes without compromising performance. The following best-practice actions support long-term durability, occupant comfort, and reliable operation.

DESIGN ACTION	KEY POINTS
Movement allowance per AAMA/CWCT	Size joints and mullion splices for –17 °C to +82 °C surface temperature without stressing glass, seals, or fixings.
Slotted/oversized anchor holes	Provide vertical slots ≥ 4 mm longer than calculated ΔL; use back-face plate washers to prevent bolt pull-through.

Low-friction sliding interfaces	Install PTFE-faced bearing pads under load anchors to allow silent movement.
Thermal breaks & ventilation	Use deeper polyamide thermal breaks and pressure-equalized cavities to reduce flange temperature differentials.
Dark-colour mitigation	Choose high-reflectance powder coats or add architectural fins/shading devices.
Anchor flexibility	Adopt a “fixed at one end / floating at the other” strategy per AAMA TIR-A9.
Compliance testing	Conduct full-scale mock-up cycling per ASTM E1233 to verify movement performance.

4. REMEDIAL OPTIONS (EXISTING FAÇADES)

When movement noise is present in an installed façade, targeted measures can often resolve the issue without full replacement. Proven remedial options range from simple adjustments and friction reduction to temperature control and monitoring; each addressing the root cause to restore smooth operation and reduce occupant disruption.

OPTIONS		KEY ACTIONS
1	Verify & enlarge clearances	▪ Remove stack-joint covers, check sleeve gaps; re-machine if clearance is < 3 mm. ▪ Slot anchor plates in-situ where feasible.
2	Introduce slide pads	▪ Install PTFE or dimpled-HDPE shims under brackets to reduce static friction.

3	Retorque fixings (avoid overtightening)	▪ Use torque-and-turn or load-indicator washers; bolts should be snug, not clamped.
4	Lubricate contact points	▪ Apply silicone-based dry film to splice liners or gasket webs; typically, effective for 3–5 years.
5	Control cavity temperature	▪ Add interior blinds, low-e retrofit films, or exterior brise-soleil to keep mullion surface temperatures below 70 °C.
6	Maintain drainage/weeps	▪ Clear debris to prevent water or ice build-up.
7	Monitoring	▪ Install clip-on thermocouples and MEMS acoustic sensors to log conditions and verify fix effectiveness.

5. MOVEMENT-CONTROL HIERARCHY

Effective frame movement management follows a clear hierarchy: allowing natural expansion, then reducing, guiding, and damping as needed. This sequence outlines best-practice strategies to ensure long-term performance while minimizing noise and occupant disturbance.

1. **Allow it:** Provide generous joint gaps, slotted anchors, and flexible gaskets.
2. **Reduce it:** Lower ΔT through shading, colour selection, and thermal breaks.
3. **Guide it:** Use low-friction pads and properly shimmed splice sleeves.
4. **Damp it:** Add elastomeric isolators if minor snaps persist.
5. **Warn occupants:** Use acoustical linings only as a last resort after addressing root causes.

KEY TAKE-AWAYS

Addressing movement at its source improves façade performance without costly interventions. Proper detailing, movement allowance, and early testing ensure curtain walls operate quietly, efficiently, and reliably for years.

- Popping is typically not a structural failure, but a sign of restrained movement.
- Most remedies involve friction reduction and improving joint detailing, not heavier anchors.
- Early-stage movement analysis ($\Delta L = \alpha L \Delta T$) and mock-up testing can prevent costly retrofits.

If you have any questions, please contact us at sales@aeroframe.com.