Manual J Engine Validation Report

Verification of the Kouzouki heating-load engine against a published, peer-reviewed worked example

Engine	Kouzouki Manual J (ANSI/ACCA Manual J simplified HTM method)
Module	static/js/engine/manualj.js — designManualJ()
Report date	2026-06-06
Result	**PASS**

1. Published reference

Heat Loss Calculations and Principles — A. Bhatia, P.E..
CED Engineering M05-003, Section 3 worked example (Montreal office building).
https://www.cedengineering.com/userfiles/M05-003%20-%20Heat%20Loss%20Calculations%20and%20Principles%20-%20US.pdf

This reference was selected because it states each surface U-value directly and applies the steady-state conduction relation Q = U × A × ΔT. Feeding the engine the same published U-values and areas therefore yields a direct, non-circular check of the conduction calculation.

2. Inputs as entered into the tool

Indoor design temperature **70°F**, outdoor design temperature **-20°F**, heating design temperature difference **ΔT = 90°F**. Infiltration entered as 2457.6 CFM (ACH 1.0 over a 147,456 ft³ volume).

Surface	U (BTU/h·ft²·°F)	Area (ft²)	ΔT (°F)
Exterior walls	0.09	7,776	90
Windows	0.70	2,592	90
Roof	0.04	5,120	90

3. Engine output vs. published values

Component	Published (BTU/h)	Engine (BTU/h)	Diff
Exterior walls	62,986	62,986	0.00%
Windows	163,296	163,296	0.00%
Roof	18,432	18,432	0.00%
Conduction subtotal	**244,714**	**244,714**	**0.00%**
Infiltration *	238,879	243,302	1.85%
Total heating load	**483,573**	**488,016**	**0.92%**

* Infiltration: the published example uses the air-property constant **1.08** (= 0.075 lb/ft³ × 0.24 BTU/lb·°F × 60 min/h), while this engine uses the more common **1.10**. The ratio 1.10/1.08 = 1.0185 fully explains the 1.85% infiltration difference and the resulting 0.92% difference in the total. This is a known, accepted constant choice — not a calculation error. The conduction calculation, which is the substantive test, matches the published value exactly.

4. Conclusion

VALIDATED — conduction reproduces the published example exactly; the only deviation is a documented air-constant choice.

The Kouzouki Manual J engine, given the published design conditions, U-values and surface areas from CED M05-003, computes the surface-by-surface conduction heat loss exactly (244,714 BTU/h, 0.00% deviation). Total heating load agrees within 0.92%, a difference traceable entirely to the air-density constant used in the infiltration term. The engine is confirmed to correctly implement the steady-state heat-loss methodology.

Reproduce: **node scripts/validate_manualj_published.mjs** → **python scripts/make_validation_pdf.py**. This report is for verification/demonstration purposes; results are for preliminary design and must be confirmed against current code and engineering judgment.