

347V / 277V LED Retrofit Neutral Audit Field Checklist

For E&I professionals auditing 600Y/347V (Canadian) and 480Y/277V (US) lighting panels after LED retrofit. Catches the triplen-harmonic neutral overload that phase ammeters can't see.

WHEN TO USE THIS CHECKLIST

Any 347V or 277V lighting panel that has had an LED retrofit in the last 10 years. Any wye-system panel where SMPS-driven nonlinear load is now sharing a multi-wire branch circuit (MWBC) neutral that wasn't re-sized. Any panel with recurring "loose connection" or "ballast failure cause unknown" service tickets — these are often misdiagnosed triplen-neutral overload.

0. Tools and PPE

Required tools

- **True-RMS clamp meter** — minimum 200A range. NOT averaging type.
- **Power quality analyzer** — 3Ø 4-wire, current and voltage THD up to 50th harmonic (e.g. Fluke 1735 or equivalent)
- **True-RMS digital multimeter** — for voltage verification
- **Insulated screwdriver set** — 1000V class minimum
- **Infrared thermometer or thermal camera** — for transformer / conductor hot-spot check
- **Single-line diagram** of the panel and feeder under audit

PPE per CSA Z462 / NFPA 70E

- Arc flash boundary calculated for the panel and PPE category confirmed
- Voltage-rated gloves with leather protectors, rated for the line-to-neutral voltage (347V class for Canadian 600Y/347V; 277V class for US 480Y/277V)
- Arc-rated clothing and face shield per the calculated incident energy
- Energized work permit reviewed and signed (live measurement only — full work requires LOTO)

LETHAL HAZARD — READ BEFORE OPENING ANY 347V PANEL

An open neutral on an energized 347V MWBC turns the neutral into a hot conductor at 347V phase-to-ground. Worker contact = electrocution mechanism, not just shock. Verify neutral continuity with the panel breaker OFF before any work that could disturb the neutral path.

1. True-RMS Neutral Current Measurement

Open the panel cover. With the panel under typical operating load, clamp the True-RMS meter onto each conductor in turn.

- Phase L1 current: _____ A
- Phase L2 current: _____ A
- Phase L3 current: _____ A
- NEUTRAL current: _____ A
- Confirm meter is True-RMS (not averaging). If the meter face does not say "True RMS," it under-reads distorted current by 30-50% — repeat with a True-RMS meter.
- Calculate ratio: $\text{NEUTRAL} \div \text{MIN}(\text{L1}, \text{L2}, \text{L3}) =$ _____

ACTION THRESHOLD: If neutral-to-phase ratio ≥ 1.3 , the neutral is carrying significant triplen content. Proceed to Section 2 immediately. Do not assume the panel is safe just because phase breakers haven't tripped — phase overcurrent devices do not protect the neutral.

2. Harmonic Spectrum Analysis

Connect the power quality analyzer to the panel as a 3Ø 4-wire measurement. Capture for a minimum of 5 minutes during typical load. Record peak values:

- Current THD at L1: _____ %
- Current THD at L2: _____ %
- Current THD at L3: _____ %
- Current THD at NEUTRAL: _____ %
- Voltage THD at panel bus: _____ %
- 3rd harmonic content on neutral (as % of fundamental): _____ %
- Save the analyzer capture file with timestamp and panel ID for the work order

ACTION THRESHOLD: Voltage THD $> 5\%$ indicates system-level harmonic propagation; sensitive equipment will misbehave. Neutral 3rd harmonic content $> 30\%$ on a panel with shared-neutral MWBCs is a clear triplen-overload signature. Either condition triggers escalation to engineering review for K-factor transformer specification and neutral re-sizing.

3. Conductor and Transformer Thermal Check

Use the IR thermometer or thermal camera at the panel terminations and at the upstream transformer (if accessible).

- Neutral conductor surface temperature at panel landing: _____ °C
- Phase conductor (worst-case) surface temperature at same panel: _____ °C
- Difference (NEUTRAL – PHASE): _____ °C
- Feeder transformer top-oil or case temperature (if accessible): _____ °C
- Transformer K-factor rating from nameplate: K-_____ (record: 1 / 4 / 13 / 20 / other)
- Photograph any thermal anomaly — terminal lugs, splices, the neutral landing point

ACTION THRESHOLD: K-1 transformer feeding heavy nonlinear load is a design gap — specify K-13 minimum (K-20 for data-center-style loads). Neutral running > 10°C above phase conductors at the same panel indicates conductor I²R rise from harmonic loading; tag for re-sizing.

4. MWBC Pigtailing Verification — 347V Circuits (CRITICAL)

This section is non-optional for any 347V multi-wire branch circuit. The hazard if pigtailling is missing is electrocution, not fire.

- Identify all devices on each MWBC under audit (record count): _____ devices
- For each device: confirm neutral conductor is pigtailed at the device, NOT terminated through the device's pass-through terminal
- All receptacles on the MWBC: neutrals pigtailed
- All luminaires on the MWBC: neutrals pigtailed
- Any switch, contactor, or device that interrupts a phase conductor: confirm neutral path is unaffected by device removal
- Verify with breaker OFF: disconnect any one device — neutral continuity to all other devices on the MWBC must remain intact (test with continuity meter)

STOP WORK IF ANY FAIL

Any device on the 347V MWBC where neutral continuity depends on the device's pass-through is a lethal hazard. Do not re-energize. Tag the panel out, document the deficiency in the work order, and escalate immediately for pigtail correction. The CEC and IHSA both treat this as a non-negotiable requirement.

5. Documentation and Sign-off

Complete this section before leaving site. Attach the analyzer capture file, thermal images, and any device-level photos to the work order.

- Photograph the panel interior, neutral landing, and any thermal anomalies
- Record fixture count, driver brand and model, and retrofit date if known
- Note any recommended remediation in the work order (neutral re-sizing, K-factor transformer specification, MWBC pigtail correction, harmonic mitigation)
- If escalation is required, route to plant electrical engineering with the analyzer capture and thermal images attached

INSPECTOR SIGN-OFF

—
PANEL ID / LOCATION

—
WORK ORDER #

—
INSPECTOR NAME (PRINT) —
CERT / LICENSE # —
DATE

—
SIGNATURE

—
OUTCOME (PASS / FAIL / ESCALATE)

FOR MORE ON THIS HAZARD

Read the full investigation: "**The Harmonic Your Neutral Can't Handle — Why 277V and 347V Neutrals Burn in Industrial Facilities, and Why You're Blaming the Wrong Drive.**" Includes the complete 10-mode FMEA, code references (CEC Section 4 / Section 14 / Section 10, NEC Article 220 / Article 210, IEEE 519, IEEE 142, IHSA 347V bulletin), and the field measurement playbook this checklist is drawn from. safetyblog.eli-intelligence.com