

Compressor Electrical: Ohming, Megohm, Start Gear & the Honest Verdict (Unit 6 Capstone)

YES Electric • Arc Workforce Academy HVAC Apprenticeship

Draft 1 (October 2026). This lesson is under review. Videos are made by other companies, not YES Electric; follow this lesson and your journeyman where they differ. Boxes marked "Shop photo coming" will get real photos from our shop in a later version.

Unit 6 • Electrical for HVAC II • Appendix A Comp 20 COMPLETES — Comp 19 field-deepened Class time: ~4.5 hrs (1.5 video + 3 bench) — Unit 6 written + practical exam follows

1. What you'll be able to do

- Run the full **compressor electrical exam**: ID C-S-R terminals by resistance (the two smallest readings add to the biggest), windings vs spec, **shorted-to-ground megohm test**, internal overload recognition (the cool-down acquittal).
- Diagnose the three electrical deaths and their courtroom evidence: **OPEN winding** (OL one pair), **GROUND**ED (winding-to-shell continuity — and what the megohmmeter adds), **LOCKED ROTOR** (windings perfect, hums + trips at LRA amps).
- Decide **hard-start kits** like an adult (the myths-busted lesson): legitimate for locked-rotor rescue attempts and long-line/low-voltage starts — not vitamins for healthy compressors.
- Tell **electrical death from mechanical death from refrigerant-circuit death** (valves gone: runs smooth, LOW amps, pressures barely split — the 5.7 normal/normal mystery solved here).
- Deliver the verdict + next step honestly: rescue attempt, replacement quote with the burnout protocol (acid test, drier, the 5.6 referee), or system-replacement talk on aged equipment (1.7 economics).

2. Tools & materials

- Compressor graveyard: open-winding, grounded, locked (we keep all three), plus the healthy bench compressor
- Meters + **megohmmeter** (the Fluke-vs-cheap video pair if we have both), amp clamp w/ inrush
- Hard-start kits (universal 2-wire + the relay/cap 3-wire), the donor condenser

- Terminal-venting safety cover (and the lecture that goes with it)

3. Watch first

Order	Video	Channel	Length	Why
1	Testing: Shorted to Ground, Open, or Overload Tripped	AC Service Tech	11:06	The three deaths, tested
2	Find Common, Start, Run on a PSC Compressor	AC Service Tech	3:11	The C-S-R trick
3	Compressor Won't Run Diagnosis	HVAC School	21:32	The full decision tree
4	Diagnosing a Locked Compressor 3D + Grounded Compressor 3D	HVAC School	10:02 / 6:30	Inside the failures
5	Capacitor & Hard Start Myths Busted	HVAC School	28:41	The adult conversation
6	Wiring a Universal Hard Start Kit	HVAC School	6:13	The legit install
7	3 Rookie Compressor Diagnosis Mistakes	HVAC School	7:26	The error catalogue

4. The idea

The terminal map and the windings exam

NO LABELS?
Measure all 3 pairs

'THE COMPRESSOR ELECTRICAL EXAM'

trick card
Measure all 3 pairs — the two **SMALLEST** readings **SUM** to the **LARGEST**
• the pair **WITHOUT C** is the biggest (S-R)
 $1.1 + 3.9 = 5.0$

SHELL TEST

ANY continuity = **GROUNDED** = condemned

megohm ladder strip

>100	✓ >100 MΩ	healthy
500	✓	
200	✓	
100	! <20 MΩ	degrading
50	! <5 MΩ	plan replacement
20	! <5 MΩ	plan replacement
5	! <5 MΩ	plan replacement
0	! <5 MΩ	plan replacement
~0	! <5 MΩ	the breaker already told you

OPEN — OL one pair (**COLD!**) — silent

hot OL at C may be the **INTERNAL OVERLOAD**: cool 1–3 hrs, retest (the July acquittal)

GROUNDED — winding to shell
— breaker trips instantly
— replace +

BURNOUT PROTOCOL

LOCKED ROTOR — windings PERFECT, hums at LRA (5–7× RLA on inrush clamp)
— one honest hard-start rescue attempt

HUMMMM

THE 4TH HORSEMAN ISN'T ELECTRICAL: dead valves = LOW amps + pressures barely split ✓ perfect windings

Single-phase hermetics: **Common**, **Start**, **Run** terminals feeding two windings (start = high resistance, run = low) joined at C. The no-label trick: measure all three pairs — **the two SMALLEST readings sum to the LARGEST** (C-R + C-S = S-R); the pair NOT involving C is the biggest. Typical magnitudes: run winding ~0.5-2 Ω, start ~2-8 Ω (size-dependent — the spec sheet rules).

The exam, on a DEAD, discharged, wires-off compressor (3.2/3.5 rituals): 1. **Three pair readings** → map terminals, compare to spec: OL on any pair = **open winding** (or the internal overload — see below); wild imbalance = partial short. 2. **Each terminal to the SHELL** (bare metal, scratch a point): ANY continuity on the ohmmeter = **grounded = condemned**. The **megohmmeter** (500 V test) catches the dying-not-dead: healthy >100 MΩ realistic floor; **<20 MΩ = degrading; <5 MΩ = plan the replacement; ~0 = the breaker already told you**. 3. **The overload acquittal**: OL between C-and-everything on a HOT compressor may be the internal thermal overload OPEN (it's in series with C). **Cool it 1-3 hours, re-test** — half the "open winding" verdicts in July are tripped overloads on cooked-but-alive compressors (then ask WHY it overheated: condenser airflow, charge, voltage — 5.7's witnesses).

The three deaths, in the field

Death	Windings exam	Behavior	Verdict path
Open	OL one pair (cold!)	silent, no draw	replace (after the cool-down acquittal attempt)
Grounded	continuity/low MΩ to shell	breaker trips instantly (3.8's pattern)	replace + burnout protocol
Locked rotor	windings PERFECT	hums, draws LRA (5-7× RLA, the inrush meter proves), thermal trips	hard-start rescue ATTEMPT → if it breaks free, investigate WHY (migration? bearings going?) → if not, replace

And the fourth horseman that ISN'T electrical: **dead valves** — runs quietly, **amps well UNDER RLA**, suction barely drops/head barely rises (pressures "equalize-ish"), normal windings. The compressor spins but pumps nothing. (5.7's "normal/normal, poor capacity" row — solved.) No electrical test catches it; the gauges + clamp pair convicts.

Hard starts — the adult rules

What a kit IS: a start capacitor + relay (potential relay classic, or the 2-wire electronic) that boosts starting torque then exits. **Legitimate**: breaking free a stuck-but-savable rotor (one honest rescue attempt), long linesets/low-voltage starts per OEM guidance, single-phase compressors that genuinely need start assist by design. **Not legitimate**: taped-on vitamins for a healthy unit ("it helps it last" — the myths video), or as a mask over a dying compressor's worsening starts (the rescue that buys August buys a planned replacement, not a cure — SAY that to the customer). Wiring: per kit diagram (2-wire across the run cap's HERM-C typically) — and LABEL the install.

The burnout protocol (when grounded = yes)

A grounded winding burned oil into acid through the whole circuit. Replacement WITHOUT cleanup = the new compressor inherits the poison: **acid-test the oil**, suction-line filter-drier + liquid drier (changed after burn-in hours), thorough recovery (5.3) and evacuation (4.6), weigh-in (5.6), and the follow-up visit to swap driers. Skip it and warranty the sequel.

5. Bench procedure

1. **C-S-R blind drill:** unlabeled terminals on three compressors — map by the sum trick, all students, no peeking at diagrams.
2. **The graveyard exam:** all three dead units, full exam each (pairs + shell + megohm), verdicts with evidence. Includes the HOT trap — the "open" that acquits after the cool-down (we pre-heat one with a lamp).
3. **Megohm calibration:** healthy bench compressor vs the degrading one — see 400 M Ω vs 8 M Ω ; discuss the "schedule the replacement" conversation that 8 M Ω buys.
4. **Locked-rotor live (instructor-controlled):** the locked unit on the bench supply through proper protection: hear the hum, catch **LRA on the inrush clamp**, watch the overload do its job. Then the hard-start rescue attempt — ours breaks free (it's selected for the demo): now the SPEECH: "we bought time, here's the plan."
5. **Hard-start install:** wire the 2-wire kit on the donor condenser per diagram, label, verify start behavior + run amps.
6. **Dead-valves recognition:** the rigged/bypassed bench unit: clamp LOW amps + gauges barely split + perfect windings = the verdict no ohmmeter gives.

Checkout (Unit 6 practical, cumulative): LOTO + one motor diagnosis (6.2) + one board trial (6.6) + one full compressor exam with honest verdict & next-step speech. **Comp 20 SIGNS (full); Unit 6 complete.**

6. Field gotchas

- **Terminal venting is real:** a compromised terminal can blow out under pressure — never pull wires off a RUNNING or pressurized suspect compressor's terminals without the cover strategy; stand aside, kill power first, always.
- **Diagnosing through the wires at the contactor** saves opening the terminal box — but a corroded terminal connection then reads as a "bad winding": confirm AT the terminals before the death certificate.
- **July overload trips** acquit hundreds of compressors a season — the cool-down test is patience that saves \$2,000 mistakes. Find what overheated it or it re-convicts itself.
- **Megohm before the season** on aging fleet equipment (maintenance contracts) = replacements planned in April, not Fourth-of-July emergencies. That's the 8 M Ω conversation.
- **Three-phase compressors** (12.2): three equal windings, no C-S-R, rotation matters — the scroll-screams-backwards note from 6.1 returns there.

- **The death certificate includes the autopsy:** grounded = burnout protocol; locked = why; open = age/heat history. "Compressor bad" without a cause invites the same death for the replacement.

7. Competency link

- **Comp 20 — SIGNED (full).** Comp 19 field-deepened (caps/start gear). **UNIT 6 COMPLETE** — written + practical exam.
- Feeds: 7.10 (AC-side service), 8.6 (the valve-vs-compressor split on heat pumps), 9.8 (inverter compressors test by THEIR rules — equal phases, drive-side logic), 12.5 (commercial).

8. Check yourself

1. The C-S-R sum trick — state it and use it: readings 1.1, 3.9, 5.0 Ω . Which pair is S-R? Which terminal is C?
2. The three deaths + the meter evidence for each.
3. The overload acquittal: when, how long, and the follow-up question if it acquits.
4. Megohm ladder: healthy, degrading, plan-replacement, dead — rough numbers.
5. Locked rotor: what do windings read, what does the clamp catch, and what's the honest rescue speech?
6. Dead valves: the three-instrument signature no ohmmeter sees.
7. Hard-start kits: two legitimate uses, two illegitimate ones.
8. The burnout protocol, all five elements, and what skipping it does.
9. Why confirm at the terminals before condemning — and the safety rule about terminal covers.
10. An 11-year-old R-410A unit, grounded compressor, \$2,400 quote. Frame the repair-vs-replace conversation (1.7 + 5.1 economics).

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