ISLAND BREEZE TECHNICIAN CERTIFICATION PROGRAM

Maintenance and Tune-Up

MODULE C21 | CORE SYSTEMS | PREREQ C17

The scene: It is a mild morning in late April. No one's house is broken. The customer who answers the door is not sweating, not angry, not standing in a 90 degree living room. She booked a maintenance visit because her system is seven years old and she wants it to survive the summer. In the next 60 to 90 minutes you will either find the weak run capacitor, the half-clogged drain, and the cottonwood mat on her condenser coil, or you will miss them, and one of them will become her July emergency and your company's callback. Maintenance is the one call where the system is not yelling at you. You have to go find the problems while they are still quiet.

In C17 you learned to set a refrigerant charge three ways: weigh-in, superheat on fixed orifice systems, and subcooling on TXV systems, all of them with gauges connected. This module flips that skill around: you will learn to VERIFY that a charge is healthy without connecting gauges at all, using temperature alone, and to know exactly when connecting gauges is justified. Around that skill we build the complete maintenance visit: a fixed sequence that starts at the customer's front door and ends with readings and photos in the job record. Learn the sequence cold. A tune-up done in a consistent order catches problems; a tune-up done from memory in a random order misses one thing per visit, and you never know which thing.

Short Version

A maintenance visit is failure prevention with a clipboard. The single most common AC failure, the run capacitor at about 21 percent of all service calls, is also the most predictable: it weakens before it dies, and a microfarad reading catches it months early. The visit runs in one fixed order: greet the customer and ask what they have noticed, thermostat and filter first, indoor inspection (blower, evaporator coil, condensate system with a real float switch test), start the system and let it run, outdoor unit with power off (capacitor against the minus 6 percent rule, contactor, wiring), clean the condenser coil from the inside out with the right chemistry, power back on for amp draws and voltage checks, then verify refrigerant health without gauges using the temperature split (18 to 22F target) and line temperatures, connecting gauges only when those numbers say something is wrong. Everything measured gets recorded, the job closes with a full photo set, and anything that needs repair gets documented and quoted separately. A tune-up is an inspection and a cleaning, never a silent repair.

Key Values

ITEM	VALUE	NOTES
Capacitor failure share	About 21 percent of AC service calls (52 of 242 logged calls)	The number one preventable failure; test on every visit

ITEM	VALUE	NOTES
Capacitor replace rule	More than 6 percent below rated microfarads = replace	A 45 MFD section fails below 42.3; a 5 MFD section fails below 4.7
Capacitor under-load formula	MFD = (amps x 2652) / volts	Tests the part at real operating voltage, no shutdown needed
Temperature split target	18 to 22F (return air minus supply air, dry bulb)	Verify airflow and filter before judging charge from the split
Split red flags	Below 16F or above 24F after airflow is verified	Triggers deeper diagnosis, and possibly gauges
Suction line feel and temp	Cold to the touch, roughly 45 to 60F surface temp	Should sweat in humid air; in dry Phoenix air it may not
Liquid line temp	Roughly 10 to 20F above outdoor ambient	Hot liquid line (30F+ over ambient) points at a dirty coil or overcharge
Refrigerant leak location	About 80 percent of leaks are in the indoor A-coil	Why the indoor coil inspection earns its minutes
Dirty condenser coil cost	20 percent airflow loss raises head pressure 15 to 20 percent and cuts efficiency 10 to 15 percent	The case for cleaning on every visit
Coil rinse direction	Inside out, opposite the airflow that loaded the debris	Pushing dirt deeper into the coil makes it worse
Contactor voltage drop	About 2V across closed contacts acceptable; more than 5V = replace	Measured under load
Amp draws	Compressor vs nameplate RLA, fan motors vs FLA	At or over nameplate = investigate, document, quote
Drain slope and pipe	3/4 inch PVC at 1/4 inch per foot	Float switch test on every visit, with water, not by lifting the float
Blower airflow context	400 CFM per ton nominal	A loaded filter or dirty blower wheel steals it

Field Checklist

The full visit in order. Do not skip steps and do not reorder them.

Arrival

1. Greet the customer. Ask: any rooms not cooling, any noises, any water stains, any breaker trips since the last visit. Write the answers down before touching anything.

2. Thermostat: record current settings and room temperature, confirm mode operation, check batteries where fitted.
3. Filter: pull it, photograph it, note the size, replace or wash per filter type. Arrow points toward the air handler.

Indoor

1. Blower: wheel condition through the access opening, debris on blades, hub set screw secure, motor mount tight. No oil ports on modern motors; do not improvise.
2. Evaporator coil: inspect with light and mirror through the access available. Look for dust matting, microbial growth, and oil stains (oil at a joint or U-bend is a leak flag, 80 percent of leaks live here).
3. Condensate: inspect pan for standing water and rust or algae, flush the drain line, confirm flow at the termination, treat the line, then test the float switch by pouring water until it trips. Confirm the system actually shuts off.
4. Start a cooling call and let the system run while you work outside. Minimum 10 to 15 minutes of runtime before performance readings.

Outdoor, power OFF

1. Pull the disconnect, verify dead with your meter, lock it out where the disconnect allows.
2. Capacitor: discharge, photograph wiring, test each section in microfarads against rating. Apply the minus 6 percent rule. Record the numbers.
3. Contactor: inspect points for pitting and debris, check the coil connections, look for chatter marks.
4. Wiring: insulation condition, tightness at lugs, rub-outs where wires cross sheet metal, signs of heat at terminals.
5. Coil cleaning: remove debris by hand, rinse from the inside out, apply non-acid foaming cleaner if dirt remains, rinse thoroughly. Straighten flattened fins with a fin comb. Keep water out of the electrical panel.

Outdoor, power ON

1. Restore power, let the unit restart and stabilize.
2. Amp draws: compressor vs RLA, condenser fan vs FLA. Inside, blower vs FLA.
3. Voltage: supply voltage at the contactor, voltage drop across the closed contacts (2V fine, over 5V replace).
4. Capacitor under load where the design allows: MFD = (amps x 2652) / volts, cross-check against the bench reading.

Refrigerant verification, no gauges first

1. Temperature split: return air minus supply air, target 18 to 22F.
2. Line temps at the condenser: suction line cold (about 45 to 60F), liquid line warm (about 10 to 20F over ambient).
3. All three in range: charge verified, do not connect gauges. Any of them out of range after airflow is confirmed: gauges are now justified, and you switch from maintenance to diagnosis.

Close-out

1. Record every reading. Photograph per the close-out standard. Summarize findings for the customer: what passed, what is wearing, what needs repair. Repairs are documented and quoted as separate work, never silently folded into the tune-up.

> **IB STANDARD**
>
> The Island Breeze maintenance visit records these values in ServiceTitan on every tune-up, no exceptions: outdoor ambient, return and supply temps with the calculated split, suction and liquid line temps, each capacitor section in microfarads against its rating, compressor amps vs RLA, condenser fan amps vs FLA, blower amps vs FLA, and supply voltage at the contactor. A tune-up without recorded numbers is an opinion, not a maintenance record. The numbers are also the system's medical history: next year's tech reads this year's readings and sees the trend.

Full Breakdown

Why maintenance exists: the math of quiet failures

Recall the failure data from F8: one instructor logged 242 of his own AC service calls and found run capacitors caused 52 of them, about 21 percent. Here is what makes that number a maintenance lesson instead of just a repair lesson: capacitors almost never die instantly. They fade. A capacitor at minus 4 percent in April is a capacitor at minus 10 percent in August, because heat is what kills them and August is when the heat arrives. A maintenance tech with a meter catches the fade. A system without maintenance announces the fade at 5 PM on the year's hottest day.

The same logic runs through the whole visit:

- **Refrigerant leaks** start small. About 80 percent of them live in the indoor A-coil, and a pinhole leaks for months before the system loses enough charge to stop cooling. An oil stain spotted at a coil joint in spring is a scheduled repair; the same leak found in July is an emergency.
- **Condensate drains** clog on a schedule. Algae and sludge build through the cooling season, and the clog finishes the job when condensate volume peaks. A flushed and treated drain plus a proven float switch turns a ceiling stain into a non-event.
- **Dirty condenser coils** tax everything. A coil with 20 percent airflow blockage pushes head pressure up 15 to 20 percent and cuts efficiency 10 to 15 percent. Higher head pressure means higher amp draw, hotter windings, a hotter capacitor, and shorter life for every electrical part in the cabinet. Cleaning the coil is not cosmetic. It is life extension for the compressor.

The U.S. Department of Energy treats correct charge and airflow as requirements for rated efficiency, not suggestions, and a typical home's central AC consumes more than 2,000 kWh per year. A neglected system pays that bill plus a penalty every month. The maintenance visit is where the penalty gets removed.

One framing to carry into every tune-up: you are not there to make the system run. It already runs. You are there to find the three things that will stop it from running later, and to leave behind a written record proving what you found.

The visit sequence, and why the order is the order

Every step in the sequence exists to set up a later step. That is why the order is fixed:

- **Customer intake comes first** because the customer has months of observation you cannot reproduce in an hour. "The back bedroom never gets cool" or "it makes a clunk when it starts" aims your inspection before you open a single panel. Ask, listen, write it down.
- **Thermostat and filter come before everything mechanical** because they are the two most common performance thieves and because every reading you take later assumes they are right. A temperature split measured through a loaded filter is a lie. Replace the filter first and your split means something.
- **Indoor inspection comes before the run test** so the system can be started once and left running, stabilizing toward steady state while you work outside.
- **Power-off electrical checks come before coil cleaning** so the panel is already open and verified dead before water starts flying.
- **Coil cleaning comes before the performance readings** so the amps and line temps you record describe the system you are leaving behind, not the dirty one you found.
- **Refrigerant verification comes last** because the split and line temps are only valid on a clean, stabilized, properly-filtered system. Every earlier step protects the accuracy of this one.

> **IB STANDARD**
>
> Island Breeze techs run this sequence in this order on every maintenance visit, every time, on every system, regardless of how new or clean the equipment looks. The sequence is the product. A customer who watches you work the same disciplined order every visit is watching the reason to stay a member.

Thermostat and filter: the two minute steps that protect every reading

At the thermostat, record what you found before changing anything: setpoint, mode, displayed room temperature. Run the modes briefly: cooling call pulls in the condenser, fan call runs the blower alone. Replace batteries where the stat uses them, because a dead-battery no-cool in July is the silliest possible emergency call.

The filter gets pulled, photographed, and judged. The teaching from the troubleshooting data holds: medium-grade pleated filters are the right answer for most systems. Loose fiberglass passes too much dust to the coil; the densest high-MERV filters strangle airflow on systems whose blowers were never designed for them. The airflow arrow on the frame points toward the air handler. Note the size in the record so the next visit, and the customer, never has to guess.

A loaded filter is also your first diagnostic clue. A filter that is fully matted at the 6 month mark says something about the home's dust load, the duct return design, or a filter grade mismatch, and it predicts what you will find on the blower wheel and coil.

Indoor inspection: blower, coil, and the leak you can see

Blower. Look at the wheel through the access opening with a light. Dust loading on the blades is the thing to catch: a blower wheel loses capacity as the blade cups fill with compacted dust, and the system quietly drifts away from its 400 CFM per ton design airflow. Check that the hub is tight on the shaft and the motor mounts are secure. Listen on startup later for bearing noise.

Evaporator coil. Inspect what the access allows with a flashlight and an inspection mirror. You are looking for three things: dust matting on the fins (airflow theft), microbial growth (an air quality flag and a cleaning recommendation), and oil. Oil matters most. Refrigerant carries a small amount of compressor oil with it everywhere it goes, so when refrigerant escapes through a pinhole, oil comes with it and stays behind as a dark, dust-catching stain. An oil stain at a U-bend or a brazed joint is a leak announcing itself early. Remember the number: about 80 percent of system leaks are found in this coil. The two minutes with the mirror are the highest-value leak search in maintenance.

If the coil needs cleaning, indoor coils get no-rinse (self-rinsing) cleaner only: a foaming product designed to liquefy and drain off with the condensate. Outdoor coil chemistry, covered below, never comes inside. There is no garden hose option above a finished ceiling.

Condensate management: the system that protects the house

The cooling coil pulls water out of the air, and that water has to leave the house through a gravity drain that nobody looks at for months at a time. Treat the condensate system as its own inspection, not a glance:

1. **Pan:** standing water in the primary pan with the system off means the drain is already slow. Rust streaks, algae mats, and mineral crust are history lessons: this pan has held water before.
2. **Drain line:** the standard is 3/4 inch PVC falling at 1/4 inch per foot, continuously, no bellies. Flush the line with water and confirm flow at the termination outside. The most common clog point is the first fitting after the pan, where the slime settles. Clear it mechanically or with a wet vacuum at the termination; compressed nitrogen through the line works where the layout allows, but only after the float switch wiring is protected and you know where the far end terminates.
3. **Treatment:** drop time-release pan treatment tablets (or an equivalent drain treatment) into the primary pan on every visit. They suppress the algae and slime that build the next clog.
4. **Float switch:** test it with water, every visit. Pour water into the pan or the switch's tee until the float rises and the system shuts down. A float switch that has been hanging in dry air for a year can stick, and a stuck float switch protects nothing. Lifting the float with a finger proves the switch works; pouring water proves the INSTALLATION works, including the switch height and the wiring. Pour the water.
5. **Secondary pan and line, where fitted:** attic installations carry a secondary pan under the unit with its own drain terminating somewhere visible. Water dripping from that termination is a designed-in alarm that the primary has failed. Make sure the customer knows what that drip means.

> **IB STANDARD**
>
> The float switch test is a pour test on every Island Breeze maintenance visit, with the trip and the system shutdown both confirmed and the result recorded in ServiceTitan. Island Breeze installs a float switch on every system it touches; a maintenance visit that finds a system without one documents it as a recommended correction.

PHOENIX FIELD NOTE

Phoenix drains clog on a monsoon schedule. June is dry heat and long runtimes, building biofilm. Then July through September monsoon humidity multiplies condensate volume just as the season's accumulated slime matures, which is why August and September are clogged-drain season. Spring maintenance is when you prevent it: flush hard, treat the line, prove the float switch. There is a second Phoenix-only enemy: hard water. Valley municipal water commonly runs very hard, in the range of 200 to 350 ppm of dissolved calcium and magnesium, and any place that water repeatedly sits and evaporates grows scale. Pans and drains that have been topped up by humidifier bleed-off or cleaned with hose water grow mineral crust that narrows the drain like plaque in an artery. Scale in the pan is a flag to flush more aggressively and check the drain's full length, because the same crust is forming where you cannot see it.

The outdoor coil: condition, cleaning, and chemistry

The condenser coil's job, from F4, is to reject every BTU the system collected indoors plus the compressor's heat of work. It does that with airflow through thin aluminum fins, and everything that blocks those fins (dust, lint, grass clippings, cottonwood fluff, mineral scale) forces head pressure up. The cleaning is the single most physically productive task in the tune-up.

Read the coil first. Walk around the unit before touching it. The dirtiest face is usually the one you cannot see, the side facing the house wall, where the gap traps debris and nobody ever looks. Note what the fouling IS, because the material decides the method: dry dust and fluff rinse off, greasy film needs cleaner, white crusty scale is a different problem entirely.

Rinse direction: inside out. The condenser fan pulls air in through the coil from outside, so debris embeds into the outer face, driven inward. Water from a garden hose should travel the opposite direction, from inside the cabinet outward through the coil, pushing debris back out the way it came in. Rinsing from the outside drives the dirt deeper into the fin pack where no rinse will ever reach it. Getting inside access means removing the top panel or fan assembly on many cabinets: power off, verified dead, fan wires handled with care, and the panel set where it cannot fall on the fins. Use a gentle fan-spray. Never a pressure washer: pressure washers flatten fins in one pass, and a coil with flattened fins has been made permanently worse by its cleaning.

Chemistry, in escalation order:

1. **Water alone** handles fresh dust, pollen, and fluff. Most well-maintained coils never need more.
2. **Non-acid foaming coil cleaner** (an alkaline detergent that foams on contact) is the standard for embedded grime: wet the coil, apply, let the foam push debris out of the fin pack, then rinse thoroughly until the foam and the dirt are gone. Thorough rinsing matters; cleaner residue left in the coil keeps working on the metal after you leave.
3. **Acid-based cleaners** exist for heavy scale and oxide, and the rule is: almost never. Acid brightens aluminum by dissolving its surface, which means every acid wash removes coil metal. Acid attacks the copper-aluminum joints, ruins microchannel (all-aluminum) coils outright, burns skin, and produces fumes you should not breathe. It is never used indoors, never used on microchannel coils, never used routinely, and where a coil is so scaled or corroded that acid looks necessary, the honest conversation is usually about the

coil's remaining life, not about chemistry. If an acid cleaning is ever genuinely justified, it is done with full PPE, manufacturer-diluted product, short dwell time, and a long, careful rinse.

Finish work. Straighten bent fins with a fin comb matched to the fin spacing. Clear vegetation to restore clearance around the cabinet. Confirm the coil sheds water evenly when rinsed: water channeling around a patch means the patch is still packed.

PHOENIX FIELD NOTE

Phoenix gives the condenser coil three seasonal enemies, and the fouling calendar drives what you find. April and May are cottonwood season: the fluff mats across coil faces like a furnace filter and can cost a coil much of its airflow in weeks; it rinses off easily if caught, and felts into the fins if not. July through September, monsoon dust storms drive fine dust deep into fin packs, and that dust plus storm humidity turns to a paste that usually needs foaming cleaner. The year-round enemy is hard water. Valley water at 200 to 350 ppm hardness leaves calcium scale on anything it evaporates from, and condenser coils get wetted constantly: by misting pre-cooler kits sold to cut cooling bills, by drift from rooftop evaporative coolers, by irrigation overspray, and by hose rinsing itself. The scale is a white crust that insulates the fins, blocks heat rejection, and holds moisture against the metal, accelerating corrosion. The maintenance answers are prevention first: recommend removing or properly maintaining misting kits, fix sprinkler aim, and after any rinse let the coil drain and dry. A heavily scaled coil is a documented finding and a frank conversation about coil life, not a casual acid wash.

Electrical checks: off, then on

The electrical inspection runs in two passes, and the order is a safety rule: dead checks with power verified off, then live checks with the panel buttoned up as much as the measurement allows.

Power off (disconnect pulled, verified dead with your meter, locked out where possible):

- **Capacitor.** Discharge it through a bleed resistor, photograph the wiring, pull the wires, and read each section in capacitance mode against its rating. The rule from F8 governs: replace anything more than 6 percent below rating. A 45/5 MFD dual capacitor fails if the HERM side reads below 42.3 or the FAN side below 4.7. Record the actual numbers, pass or fail, because this year's 43.5 is next year's trend line. A capacitor inside tolerance but sliding (say, minus 4 to 5 percent in spring) gets flagged in the record and mentioned to the customer with a reason: heat is coming, and this part fades under heat.
- **Contactor.** Look at the contact points: pitting, blackening, debris, insects pressed into the faces. Never file contacts; pitted means schedule replacement. Check the coil spades for heat discoloration.
- **Wiring.** Insulation cracked by UV and heat, terminals loose at the contactor lugs, wires rubbing through at sheet metal edges, signs of overheating (browned insulation at a lug is a loose connection telling its story). Tighten, sleeve, and document.

Power on (after the coil is clean and the panel is safe):

- **Amp draws.** Clamp the compressor common wire and compare against nameplate RLA (rated load amps). Clamp the condenser fan and the indoor blower against their FLA (full load amps). The pass logic: a motor at or above nameplate is overworked and gets investigated, documented, and quoted. A compressor trending upward year over year on the maintenance record is whispering about its future even while it still passes.

- **Voltage.** Supply voltage at the contactor line side, then voltage drop across each closed contact under load: about 2V is acceptable wear, more than 5V means the contacts have become a resistor and the contactor gets replaced (as a quoted repair, not a silent swap).
- **Capacitor under load.** Where the wiring layout allows, cross-check the capacitor while the system runs: measure amps through the start-winding wire and volts across the capacitor, then MFD = (amps x 2652) / volts. This tests the part at its real operating voltage and catches marginal capacitors that pass a bench test. It is the natural maintenance method because it needs no extra shutdown.

> **IB STANDARD**
>
> Pass-fail thresholds on an Island Breeze tune-up are the recorded ones: capacitor minus 6 percent, contactor 2V acceptable and 5V condemned, amps vs nameplate. A failed threshold never becomes an on-the-spot silent repair. It becomes a documented finding with a photo, a clear explanation to the customer, and a separate quoted repair, even when the part costs less than the paperwork feels like it is worth. The customer's trust in maintenance comes from knowing the tune-up and the repair are never blended.

Refrigerant verification without gauges

Here is the C17 flip. You know how to set a charge with gauges. On a maintenance visit, the question is different: is this sealed, healthy-looking system still holding the charge somebody once set correctly? You can answer that question with temperature alone in most cases, and there are two strong reasons to want to.

First, the physics of connecting gauges. Every time a hose clicks onto a service port, refrigerant is lost: the hose fills, the core depresses, and a small charge escapes at connect and disconnect. Do that twice a year for a decade and a perfectly sealed system has been bled measurably low by its own maintenance. Second, the Schrader cores themselves. Service valve cores are one of the most common leak points on residential systems, and every depression cycle is wear. A core that seals fine until its hundredth depression fails on the hundred and first, and the tech who connected gauges to a healthy system has manufactured the leak the visit existed to prevent.

So the maintenance method is non-invasive, three readings on a system that has run 10 to 15 minutes with a clean filter and clean coils:

1. **Temperature split.** Return air dry bulb minus supply air dry bulb, measured close to the air handler on both sides. Target: 18 to 22F. In Phoenix's dry air, most of the system's capacity goes to sensible cooling, so healthy systems sit solidly inside that band. A split below 16F or above 24F is a red flag, AFTER you confirm the things that fake it: a fresh filter, a clean blower, registers open, and a fully stabilized system.
2. **Suction line temperature.** At the condenser, the large insulated line should be cold to the touch, roughly 45 to 60F by clamp probe or surface thermometer, the cold-drink-can feel. In humid air it sweats; in dry Phoenix air it often will not, so do not treat the absence of sweat as a fault. A suction line at ambient temperature means little or no refrigerant is boiling in the evaporator. A suction line choked in ice means the evaporator froze, which is a symptom (low airflow or low charge), never a root cause.

3. **Liquid line temperature.** The small uninsulated line should be warm, roughly 10 to 20F above outdoor ambient. A liquid line hot enough to flinch from, 30F or more over ambient, says the condenser is failing to reject heat: dirty coil, failing condenser fan, or overcharge.

The decision logic. All three readings in range: the charge is verified, the visit stays non-invasive, and the gauges stay in the truck. Any reading out of range, with airflow already confirmed: now gauges are JUSTIFIED, because you have evidence of a refrigerant-side problem, and the visit has changed character from maintenance to diagnosis. Connecting gauges to chase a real anomaly is exactly what C17 trained you for. Connecting them to a healthy system out of habit is how healthy systems get hurt.

Gauges are also justified on a maintenance visit when: the system froze recently or the customer reports icing, there is visible oil staining at a coil or joint, the system has a documented leak history in the record, a repair was just completed and needs charge verification, or the readings cannot be explained any other way. The rule is evidence first, gauges second.

IB STANDARD

Island Breeze does not connect gauges to a healthy sealed system on a routine maintenance visit. Charge verification is by temperature split and line temperatures, recorded in ServiceTitan. Gauges come out only with a documented trigger: an out-of-range reading after airflow is verified, ice, oil staining, leak history, or post-repair verification, and the trigger is written in the job record before the hoses connect. The policy protects the customer's charge, the Schrader cores, and the meaning of the word maintenance.

Documentation: the visit is not done until it is written down

A maintenance visit produces two artifacts: numbers and photos. Both go in the job record before you leave the driveway.

The numbers are the readings listed in the IB STANDARD block under the Field Checklist: ambient, split, line temps, capacitor sections, amp draws, voltage. Their value compounds. One visit's numbers prove the system's condition today. Three years of numbers show the compressor's amps drifting up, the capacitor fading, the split sagging, and let you schedule a repair before physics schedules it for you.

The photos prove the work and the findings. The close-out set covers the visit end to end:

IB STANDARD

The 8-photo ServiceTitan close-out on a maintenance visit: (1) thermostat showing the arrival reading, (2) the filter as found, (3) the evaporator coil or blower as accessed, (4) the drain and float switch during the pour test, (5) the condenser coil before cleaning, (6) the condenser coil after cleaning, (7) the meter on the capacitor reading, (8) the final temperature split or the system running at close. Findings needing repair get additional photos of the specific component plus its nameplate. No photos, no close-out.

The customer conversation at the door is the visit's summary: what passed, what is wearing and being watched, what needs repair now. Findings are shown before anything else is discussed, with the photos doing the talking. The repair conversation itself, options and approvals, follows the company's process and is separate work, which leads to the last section.

What a tune-up does NOT include

A maintenance visit is an inspection, a cleaning, and a verification. It is not a container for quiet repairs. The boundary matters for three reasons: the customer agreed to a tune-up and deserves to approve anything beyond it, an undocumented repair is a liability with no paper trail, and silently absorbing repairs teaches customers that maintenance sometimes includes free parts, which poisons every future visit.

Inside the tune-up: everything in this module's sequence, including filter replacement, coil cleaning, drain flush and treatment, fin straightening, tightening electrical connections, and all testing and documentation.

Outside the tune-up, always documented and quoted as separate work: any failed component (capacitor beyond tolerance, condemned contactor, failed motor), any refrigerant work of any kind, any leak repair, drain repairs beyond clearing, duct repairs, and any part replacement. The tech's job on the maintenance visit is to find these, prove them with readings and photos, and hand them to the repair process. Pricing, options, and the customer's decision live entirely outside this course.

Common Mistakes

1. **Judging charge through a dirty filter or dirty coil.** A loaded filter alone can drag the temperature split out of range and fake a low-charge reading. The sequence exists to prevent this: filter, cleaning, THEN readings. Readings taken out of order are fiction with a clipboard.
2. **Connecting gauges to a healthy system out of habit.** Every connection bleeds charge and wears the Schrader cores, and over years of visits the habit creates the low-charge condition it pretends to check for. Temperatures first; gauges only with a documented trigger.
3. **Rinsing the condenser coil from the outside.** It looks clean afterward because the surface dirt moved, inward, where it will never come out. Inside out, always, gentle pressure, never a pressure washer.
4. **Using acid cleaner as a routine choice, or on microchannel coils.** Acid removes metal every time it touches the coil and destroys all-aluminum coils outright. Water first, non-acid foam second, acid almost never and never casually.
5. **Testing the float switch by lifting the float.** A finger lift proves the switch clicks. The pour test proves the pan, the switch height, the wiring, and the shutdown all work together. Only one of those protects a ceiling.
6. **Skipping the capacitor test because the unit is cooling fine.** The 21 percent statistic is made of units that were cooling fine. The microfarad reading is the entire point of preventive maintenance; a tune-up without it is a rinse and a handshake.
7. **Silently replacing a weak part during the tune-up.** It feels generous and it destroys the boundary between maintenance and repair. Findings get documented, shown, and quoted. Every time.
8. **Leaving without recording the readings.** An undocumented tune-up did not happen, as far as the next tech, the warranty, or the customer's history is concerned. The numbers are the product; the cleaning is just the visible part.

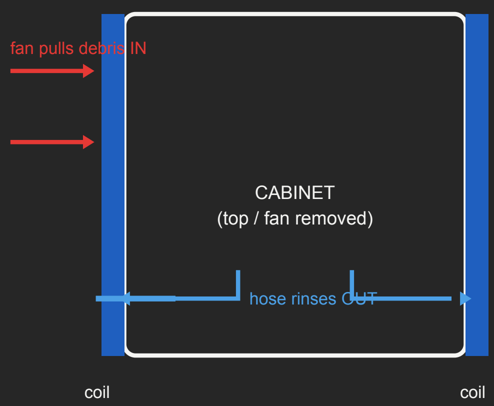
Next module: D22, The Diagnostic Mindset and Process, where the readings you learned to collect on a healthy system become the baseline for finding what is wrong with a broken one.

Module Visuals

COIL CLEANING METHODS

CONDENSER COIL CLEANING: DIRECTION AND CHEMISTRY

RINSE DIRECTION: INSIDE OUT



Water travels OPPOSITE the airflow
that packed the debris in.

Gentle fan spray. Walk every face.
Dirtiest face usually faces the house.
Done = water sheets through evenly.

Indoor evaporator coils: no-rinse cleaner ONLY.
Outdoor chemistry never comes inside.

CHEMISTRY: ESCALATE, NEVER SKIP

1. WATER ONLY
Fresh dust, pollen, cottonwood fluff.
Handles most well-maintained coils.

2. NON-ACID FOAMING CLEANER
Embedded grime, monsoon dust paste, greasy film.
Wet coil, apply, let foam push debris out,
then rinse THOROUGHLY. Residue keeps attacking metal.

3. ACID CLEANER: ALMOST NEVER
Dissolves coil metal on every use. Attacks
copper-aluminum joints. Full PPE, fumes.
NEVER on microchannel coils. NEVER indoors.
Heavy scale = coil life conversation, not a habit.

WHAT DAMAGES FINS
Pressure washers (flatten fins in one pass)
Outside-in rinsing (packs dirt deeper)
Acid etching, stiff brushes, dropped panels

ELECTRICAL CHECK POINTS

ELECTRICAL CHECKPOINTS AND PASS THRESHOLDS

Two passes: dead checks with power verified off, then live checks under load

POWER OFF (verified dead, locked out)

CAPACITOR (bench test)

Discharge, photo wiring, wires OFF, capacitance mode

Each section vs rating:

PASS: within minus 6 percent

FAIL: 45 MFD below 42.3 / 5 MFD below 4.7

CONTACTOR (visual)

Points: pitting, burning, insects pressed in faces

Coil spades: heat discoloration

Pitted = replace (quoted). NEVER file points.

WIRING

UV-cracked insulation, rub-outs at sheet metal

Loose lugs (tighten, note), browned insulation

Browning at a lug = loose connection history

POWER ON (under load)

AMP DRAWS (clamp meter)

Compressor common wire vs nameplate RLA

Condenser fan vs FLA, indoor blower vs FLA

PASS: below nameplate

At or over nameplate = investigate + document

CONTACTOR VOLTAGE DROP (closed contacts)

Meter across L1 to T1, then L2 to T2, unit running

PASS: about 2V or less

FAIL: more than 5V, contacts became a heater

CAPACITOR UNDER LOAD (cross-check)

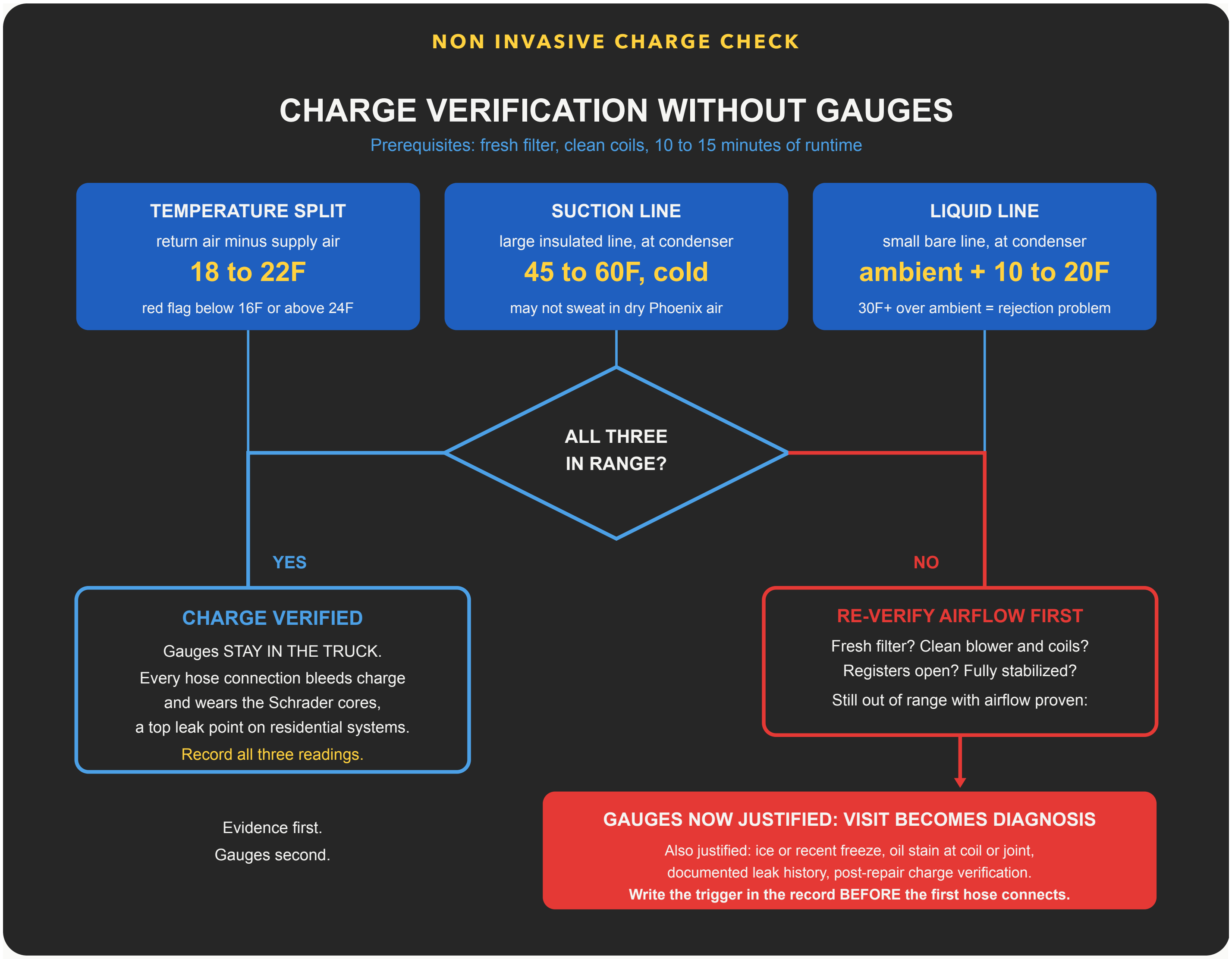
MFD = (amps x 2652) / volts

Amps through start-winding wire, volts across cap

Tests at real operating voltage, catches marginal parts

RECORD EVERY NUMBER, PASS OR FAIL. This year's reading is next year's trend line.

A failed threshold is a documented, quoted finding, never an on-the-spot silent repair.


NON INVASIVE CHARGE CHECK
CHARGE VERIFICATION WITHOUT GAUGES
Prerequisites: fresh filter, clean coils, 10 to 15 minutes of runtime
TEMPERATURE SPLIT
return air minus supply air
18 to 22F
red flag below 16F or above 24F
SUCTION LINE
large insulated line, at condenser
45 to 60F, cold
may not sweat in dry Phoenix air
LIQUID LINE
small bare line, at condenser
ambient + 10 to 20F
30F+ over ambient = rejection problem
ALL THREE IN RANGE?
YES
NO
CHARGE VERIFIED
Gauges STAY IN THE TRUCK.
Every hose connection bleeds charge
and wears the Schrader cores,
a top leak point on residential systems.
Record all three readings.
RE-VERIFY AIRFLOW FIRST
Fresh filter? Clean blower and coils?
Registers open? Fully stabilized?
Still out of range with airflow proven:
Evidence first.
Gauges second.
GAUGES NOW JUSTIFIED: VISIT BECOMES DIAGNOSIS
Also justified: ice or recent freeze, oil stain at coil or joint,
documented leak history, post-repair charge verification.
Write the trigger in the record BEFORE the first hose connects.

PHOENIX FOULING CALENDAR

THE PHOENIX FOULING CALENDAR

What the desert loads into a condenser coil, month by month

JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

ROW 1: COTTONWOOD SEASON
light pollen

COTTONWOOD
fluff mats coil faces

seed fluff gone, residue stays embedded until cleaned

ROW 2: MONSOON
dry season: normal desert dust accumulation

MONSOON DUST
haboobs pack fine dust deep

dust plus first rain = paste, also clogs condensate drains

ROW 3:

HARD WATER SCALE: ALL YEAR

Phoenix water runs roughly 200 to 350 ppm hardness. Misting systems, evaporative cooler drift, and hose rinsing leave white mineral crust on fins.

ROW 4:
moderate runtime, ideal tune-up window

PEAK RUNTIME, 110F+ AMBIENT
every point of fouling costs the most here

runtime falls, fall checks

WHY SPRING MAINTENANCE LANDS IN MARCH THROUGH MAY

The coil must enter the 110F season clean: cottonwood is caught fresh, scale and winter dust come off, and the weak capacitor is found BEFORE peak load, not by a no-cool call during it.

WHAT SCALE DOES

Mineral crust insulates the fins, so the coil holds heat instead of rejecting it. Head pressure climbs, the compressor works harder, and the crust traps moisture against the metal, accelerating corrosion. Scale does not rinse off with water. If you see white crust, find the water source: misters, cooler drift, or a sprinkler hitting the unit. Fix the source or the scale returns by the next visit.

TUNEUP FLOW

THE MAINTENANCE VISIT: ONE FIXED ORDER

Every step protects the accuracy of a later step. Never reorder.

1. ARRIVAL

Customer intake: rooms, noises, water, breakers
Thermostat: record as found, mode test
Filter: photo, replace, arrow to air handler

2. INDOOR

Blower wheel: dust load, hub, mounts
Evap coil: mirror check for dust, growth, OIL (leak flag)
Drain: flush, confirm flow, treat the line
Float switch: POUR TEST, confirm shutdown

START COOLING CALL NOW

System runs 10 to 15 minutes while you work outside. Performance readings need a stabilized system and a fresh filter.

3. OUTDOOR, POWER OFF

Disconnect pulled, VERIFIED DEAD, locked out
Capacitor: discharge, MFD vs rating, minus 6 pct rule
Contactor points, coil spades (never file)
Wire condition: insulation, lugs, rub-outs, heat marks

4. CLEAN THE CONDENSER COIL

Rinse INSIDE OUT, gentle fan spray
Non-acid foam if water alone fails, full rinse
Fin comb, clear vegetation, before and after photos

5. OUTDOOR, POWER ON

Compressor amps vs RLA, fans vs FLA
Supply voltage at contactor
Contact drop: 2V wear, over 5V replace
Capacitor under load: MFD = (A x 2652) / V

6. VERIFY CHARGE, NO GAUGES FIRST

Temp split 18 to 22F (return minus supply)
Suction line cold, about 45 to 60F
Liquid line warm, about 10 to 20F over ambient
Out of range + airflow verified = gauges justified

7. DOCUMENT AND CLOSE

Record every reading: ambient, split, line temps, capacitor MFD, amps, voltage. 8-photo close-out.
Doorway summary with photos: what passed, what is wearing, what needs repair.
Repairs are documented and quoted SEPARATELY. A tune-up is never a silent repair.