

SECOND WRENCH DIESEL SUPPORT — Tech Response

SAMPLE — a real request and the complete answer it received, in the format subscribers receive

Shop: Subscriber shop — details as submitted · **Date:** October 22, 2026

Truck: 2020 Kenworth T680 · **VIN:** 1XKYDP9X2LJ341189 · **Mileage:** not stated on the request — see "Before you order parts" below

Engine: PACCAR MX-13 (per VIN — as built) — the engine field was left blank on the request, so this answer is worked to the engine the VIN decodes to · **Engine serial:** not provided — see "Before you order parts" below

Category: Diagnosis / troubleshooting — oil in the exhaust, turbo vs. engine

The request, as submitted

"I've got a 2020 Kenworth T680 with the PACCAR MX-13 engine. The truck has been pushing a lot of engine oil out through the exhaust. We suspect the turbocharger might be going bad. I need to figure out whether the turbo is causing this or if there's something else wrong with the engine before I spend the money replacing it. What should I check, and how can I tell what's actually causing the oil to come out?"

Fault codes at intake: none confirmed. **Follow-up from the shop the same evening** added the code that organizes the whole ticket: **DTC P104C — boost pressure too low**. It is folded into the answer below, exactly the way follow-up information is folded into a live request.

Before you order parts

Three things to nail down before money moves on this truck. None of them slow the diagnosis down, and all three are cheaper than one wrong part:

- **Get the engine serial number off the engine.** It wasn't on the request, and on the PACCAR MX-13 the turbocharger, its VTG actuator, and the crankcase ventilation module part numbers all break by engine serial — the parts counter can't hand you the right unit without it. Send it back on this thread and we'll confirm the part numbers against it. One caution that rides with it: this answer is worked to the **PACCAR MX-13 (per VIN — as built)**, because the request's engine field was blank and the VIN decodes to the MX-13. If this truck has been repowered since it left the factory, tell us — send the serial of the engine that's actually in it and this answer gets reworked to that engine before anything is ordered.
- **Confirm the fastener torques in DAVIE / PACCAR service info by that serial before the job:** turbocharger mounting nuts, the turbo oil feed and return (drain) line fittings and flanges — including whether the feed-line seals/O-rings are one-time use — exhaust manifold nuts with their tightening sequence, and the charge-air (CAC) hose clamp torque. All of them are serial-specific PACCAR values, so the spec table in Section 5 flags them as confirms instead of printing numbers — a looked-up torque beats a guessed one, and no value from another engine family applies to this one.
- **Send the mileage and the engine hours.** Neither was on the request, and both matter more than usual on this ticket: the ranking in Section 3 puts turbo failure ahead of ring and bore wear

because of the boost code, but on a high-mile, high-hour engine the two climb together and the blowby step (Step 11) carries more weight. The odometer, the hours, and the oil-consumption rate (miles per quart, Step 2) tell us how hard to lean before the engine-side steps spend anybody's money.

1. The problem, in plain words — oil in the exhaust, and now a boost code

The truck is using oil and pushing it out the exhaust — wet oil at the tailpipe and in the exhaust stream, not just blue smoke on startup. The shop's question is the expensive one: is the turbocharger leaking oil past its seals, or is the engine itself carrying oil over — past the rings, down the valve guides, or through the crankcase ventilation — with the turbo only moving it along? Guessing wrong buys a turbo for an engine problem, or an in-frame conversation for a turbo problem.

Then the shop's follow-up added the fact that organizes the whole ticket:

- **P104C — inlet air pressure in the inlet manifold, data valid but too low (SPN 102, FMI 17).** Two things in that definition do real work. First, it is the ECM saying boost pressure under load is lower than the engine's model says it should be. Second, FMI 17 is a *data-valid* fault — the ECM trusts the boost sensor (it lives in the inlet manifold) and is reporting that the air really isn't there. This is not a sensor-circuit code, so 'the gauge is lying' is not where this starts.
- **One failure can now explain both complaints.** A turbocharger with worn bearings develops shaft play; play lets the seal rings leak — oil into the turbine housing (straight out the exhaust) and into the compressor housing (into the intake, burned, out the exhaust) — while the same worn, dragging, or coked-up turbo makes less boost. Oil out the exhaust PLUS boost too low is the turbo's signature written in the truck's own hand.
- **Check the coolant before you conclude anything (Step 3).** On this engine the turbo is coolant-cooled, so a turbo with failed seals can cross-contaminate — oil showing up in the coolant at the same time it's leaving by the exhaust. A five-minute look in the surge tank is one of the strongest early signposts this ticket has.
- **But the code does not close the case.** Low boost also comes from a charge-air leak, a sticking VTG (variable-geometry) mechanism or actuator, or a restricted intake — and plain engine-side oil carryover (rings, valve seals, crankcase ventilation) doesn't disappear from the list; it just has to wait its turn behind the turbo evidence. Section 3 ranks it that way, and Section 4 is built so each step separates the suspects instead of convicting the first one.
- **Why nobody should just hang a turbo on it:** published turbocharger troubleshooting warns in so many words not to assume the turbo is the cause of oil consumption and exhaust smoke — the same symptoms come from the engine side, and a new turbo on a truck with a restricted oil drain or a pressurized crankcase leaks again within the week. The separator steps cost an hour. A wrong turbo costs a comeback.

The order of battle: check the coolant with the opening moves (Step 3), prove where the oil enters the exhaust stream next (Section 4, Steps 4–6), prove the boost system after that (Steps 7–9), and only then let the engine-side tests (Steps 11–12) spend anybody's money.

2. The four doors oil can take into an exhaust — and the drain nobody checks

Engine oil reaches the tailpipe through exactly four doors. Every step in Section 4 exists to find out which door is open:

- **Door 1 — the turbo's turbine-side (exhaust-side) seal.** The turbo shaft rides on bearings fed by pressurized engine oil, held in at each end of the shaft by piston-ring-type seals — not lip seals. They seal by being a close fit in a healthy bore on a shaft that doesn't move. Worn bearings, shaft play, or a coked seal groove opens the fit and oil walks into the turbine housing and out the exhaust — wet oil on the exhaust side with a clean, dry intake is this door's fingerprint. On this engine there is a second fingerprint: the MX-13's turbo is coolant-cooled, so the same failed seals can put oil into the coolant — which is why Step 3 looks in the surge tank before anything comes apart.
- **Door 2 — the turbo's compressor-side (intake-side) seal.** The same failure on the cold end pushes oil into the compressor housing, through the charge-air cooler and intake, and into the cylinders, where it burns and exits as smoke and oil loading. Fingerprint: oil pooled in the compressor outlet pipe and the CAC, wet intake boots.
- **Door 3 — the engine's own cylinders.** Oil gets past worn or stuck piston rings (helped by blowby pressure from below) or down worn valve guides and hardened valve stem seals (pulled by intake vacuum, worst at idle and on deceleration). That oil burns in the cylinder. Fingerprint: turbo and intake dry on both ends, oil appearing only from the exhaust ports onward, and — for the ring path — crankcase pressure and blowby up with it.
- **Door 4 — the crankcase ventilation system.** The MX-13's crankcase ventilation module is a centrifugal separator: it spins oil mist out of the blowby gas and returns the oil to the sump. The ECM even watches the separator rotor's speed and the crankcase pressure (faults P140A/P140E and P1407/P1408 exist for exactly those). A sludged or failed module lets crankcase pressure climb — and that pressure pushes oil everywhere it shouldn't go: past the turbo seals (both doors at once), past gaskets, and out with the vent gas into the intake.
- **And the drain.** The turbo's oil leaves the bearing housing by gravity through a drain tube back to the crankcase. If that tube is coked, kinked, crushed, or sealed by a gasket covering part of the port, oil backs up in the housing and overwhelms healthy seals from inside. A restricted drain imitates a failed turbo perfectly — and survives a turbo replacement perfectly too. It is a ten-minute inspection (Step 10). High crankcase pressure (Door 4) fights the drain the same way — oil can't drain downhill into a pressurized crankcase — which is why Steps 10 and 11 travel together.

3. Most likely causes — in order, with P104C applied

- **Turbocharger bearing and seal failure.** Worn bearings → shaft play → both seal rings leak; the turbine-side leak puts raw oil in the exhaust, the compressor-side leak oils the intake, and the tired turbo under-delivers boost. The only suspect that explains the oil AND P104C with one part — and on this engine it can sign its work in the coolant too (Step 3). Convicted or cleared by Steps 4–8, never by reputation.
- **VTG mechanism sticking and/or VTG actuator fault.** This turbo meters boost by moving vanes in the turbine housing. Oil coke and soot in the vane ring make the vanes drag or stick — boost sags (P104C), and the oil making the coke may be the same oil leaving by the exhaust. Watch for the companion codes: P1042 (VTG control incorrect), the P1350-family actuator codes, P104D/P1057 (exhaust pressure before turbine). Step 8's commanded-vs-actual comparison is

the test.

- **Charge-air leak — split CAC, boot, or clamp.** Costs boost exactly like a dead turbo and makes the turbo overspeed to compensate. It makes no oil by itself, so it doesn't explain the whole ticket — but until Step 9 clears it, no boost reading means anything. A CAC full of oil also testifies in Step 5.
- **Restricted turbo oil drain.** Coked or kinked drain tube, or a port half-covered at the flange. Imitates turbo seal failure perfectly and is the classic reason a brand-new turbo 'fails' the same way in a week. Ten minutes to check (Step 10), inexcusable to skip.
- **Crankcase ventilation module failure / crankcase pressure too high.** The MX-13's centrifugal ventilation module sludges or its rotor drive fails, crankcase pressure climbs, and the pressure pushes oil past the turbo seals and fights the drain. Suspect it hard if oil is ALSO weeping at gaskets or the dipstick, or if P1407/P1408/P140A/P140E are in the code list. Step 11 is the test.
- **Excess blowby — rings and bores.** Real, common on tired engines, and it feeds Door 4's pressure even with a healthy ventilation module. It drops behind the turbo causes on THIS ticket because worn rings don't set a boost code — but if the turbo side proves clean and crankcase pressure is up, it climbs right back to the top (Steps 11–12).
- **Valve stem seals and guides.** Burns oil without costing a single psi of boost — so P104C pushes it down the list, not off it. Its signature is the driving pattern (Step 12): smoke worst after a long idle or on deceleration, with both ends of the turbo dry.
- **Restricted intake / air filter.** A plugged filter makes the compressor inlet pull a vacuum, and vacuum at the compressor seal pulls oil across it into the intake — while also starving boost. It's a two-minute check with the filter minder and it embarrasses people monthly. Step 2 covers it.

One suspect is deliberately NOT on this list: aftertreatment dosing hardware. The hydrocarbon/DEF dosers live downstream of the turbine and dose fuel or DEF, not engine oil — they cannot put engine oil in the exhaust. Oil found in the exhaust got there through the engine or the turbo, full stop.

4. Diagnosis steps — run them in this order

Setup for all steps: truck parked, wheels chocked, park brake set. Scan tool on the truck — a full-function generic tool (JPRO) reads the codes and most of the live data on this engine, and every step below names the generic path where one exists; PACCAR DAVIE is the maker tool and the better path for the boost and VTG grading, and it is genuinely required for a couple of specific routines — each step says which. Dial indicator with magnetic base, charge-air pressure test kit (regulated shop air, plugs, soapy water), a low-pressure manometer (water column or digital), a borescope, and an oil sample bottle within reach. Engine OFF and exhaust cool for every step that opens the intake or exhaust — the turbine housing stays burn-you hot long after shutdown.

1. **Record everything before touching anything.** Save a full health report: P104C's status and freeze frame, and EVERY other code, active or inactive — on this ticket the companions matter as much as the headliner (the full hunt list is in Section 5: VTG control/actuator, exhaust pressure before turbine, intercooler efficiency, crankcase pressure, ventilation-module rotor, oil level). Then record at warm idle: inlet manifold pressure actual AND the ECM's desired value, VTG position commanded vs. actual, crankcase pressure, oil pressure, and the dipstick level. (The desired-value channel is a DAVIE read on this engine; if your generic tool doesn't show it, record what it does show — Step 8's generic path covers the grading.) **Why:** after the repair you compare against this page — and desired-vs-actual is the ECM grading its own boost, the closest

thing to a factory boost spec there is — no published PACCAR maximum-boost number exists to print, so desired-vs-actual is the grade.

2. **Quantify the oil and do the free inspection.** Get the consumption rate in numbers, not adjectives: dipstick level now, miles and fuel since the last top-off — miles per quart is the number every later decision leans on — PACCAR judges excess consumption against its own published standards rather than a number we can print here, so this truck's measured rate is what the call gets made on. Look at the tailpipe: **wet, liquid oil** says raw oil is reaching the exhaust unburned (turbine-side leak or heavy carryover); **dry soot with blue haze** says oil is burning in the cylinders. Check the air filter and its restriction indicator — a filter at its limit climbs the suspect list (Cause #8) and gets replaced before any boost number is believed. Walk the engine for external oil at the turbo feed/drain flanges, gaskets, and dipstick tube — gasket weep plus exhaust oil is crankcase pressure introducing itself (Cause #5). And note the level itself: **overfull** (or RISING — fuel dilution, Section 9) raises carryover all by itself.
3. **Coolant cross-check — run this on every oil complaint, this one included.** Engine cool, cap off the surge tank, and look at the coolant itself and the underside of the cap. Healthy coolant is clean and translucent. **Oil in the coolant shows as a dark slick or rainbow sheen floating on top, or a mayonnaise-like emulsion under the cap.** Why it matters here: the MX-13's turbocharger is coolant-cooled — coolant runs through the bearing housing — so a turbo with failed seals can cross-contaminate, putting oil into the coolant at the same time it pushes oil into the exhaust. **Oil in the coolant alongside oil in the exhaust points hard at the turbo (Cause #1) before a single bolt turns;** clean coolant doesn't clear the turbo, but it removes one of its signatures. If the coolant IS contaminated, write it on the ticket now — the repair plan grows a drain, flush, and refill of the radiator and reservoirs (and a careful burp of the system afterward to purge trapped air), and the customer should hear about it from the estimate, not the invoice. Read this result together with the separator steps that follow: oil in the coolant + oil contained at the turbo is the turbo's signature written twice.
4. **Separator, part 1 — the compressor inlet (engine off, cool).** Pull the intake boot off the turbo compressor inlet. Look at three things. (a) **The inlet tract ahead of the turbo:** a light oil film is normal on a crankcase-vented engine; heavy wet oil or pooling ahead of the compressor points at the crankcase ventilation outlet feeding it (Door 4) — that oil arrives from the vent, not the turbo. (b) **The compressor wheel:** blades clean and sharp-edged, or nicked/eroded (a damaged wheel costs boost — P104C again); rub marks on the housing wall mean the shaft is already traveling (go straight to Step 7). (c) **Spin the wheel by hand:** it must spin freely and smoothly with no scrape, catch, or gritty feel. **A wheel that scrapes, wobbles, or won't spin free has convicted the turbo's bearings before any gauge comes out** — continue to Step 7 to document it, not to decide it.
5. **Separator, part 2 — the compressor outlet and charge-air cooler (engine off, cool).** Pull the pipe at the compressor OUTLET (turbo discharge) and look inside, then the CAC outlet pipe at the intake side. **Expected on a healthy truck: dry, or the lightest film. Oil pooled or running in the discharge pipe** means oil is crossing the compressor-side seal (Door 2) — OR being delivered there by the ventilation system through the inlet (Step 4(a) splits those: oil heavy BEFORE the compressor = vent-fed; oil starting AT the compressor with a dry inlet = the seal). **Oil that has crossed the CAC into the intake-side pipe** confirms the engine has been eating it — and warns you the CAC is holding oil that must be cleaned at repair time or the truck 'still smokes' for days after a good fix (Section 6). **A bone-dry compressor outlet with oil in the**

exhaust moves the whole case to the exhaust side — Step 6 becomes the main event.

6. **Separator, part 3 — the exhaust side (engine off, cool).** Drop the exhaust pipe at the turbine outlet (or open the first joint downstream) and look inside; borescope the turbine wheel if the angle fights you. **Wet oil inside the turbine outlet and pipe** = oil arriving through the turbine — across the turbine-side seal (Door 1) or through the cylinders and out the ports (Door 3). Split those two with the manifold: **oil wetting starting at the ports/runners means the engine is passing it; runners dry with oil starting at the turbine housing means the seal.** Borescope the intake and exhaust ports while you're here — clean ports with oil contained at the turbo and downstream of it is the inspection that rules the engine side out. If the manifold stays on, the split rides on Steps 5 + 7 + 11 together: dry compressor side + excess shaft play = turbine seal; dry compressor side + good turbo + high blowby = engine. Photograph every joint before cleaning anything — this photo set IS the diagnosis if the customer questions the bill.
7. **Turbo shaft play — dial indicator, engine off.** Mount the indicator base on the compressor housing with the plunger on the end of the shaft (through the inlet). **Axial (end) play:** push the shaft fully in, zero the dial, pull it fully out — read total travel. **Radial play:** reposition the plunger on the wheel and lift up and down — read total travel. **Pass criteria you can use without the maker's table:** the wheel must NOT touch its housing at any point under hand load in any direction, no rub marks (Step 4(b)), spin stays smooth. **Contact, rub marks, or a gritty/catching spin = the turbo has failed, write it up.** Exact millimeter limits are set by the turbocharger maker for the exact unit fitted — if play feels generous but nothing touches, get the turbo model off the ID tag and the limits before calling it either way. Excess play is not a 'monitor it' finding: play grows, seals leak worse, and the end of that road is a wheel meeting a housing at speed.
8. **Boost test under load — the P104C test.** Warm engine, scan tool logging a road test under real load — a loaded pull up a grade in a high gear, or a dyno; a free-rev in the bay makes almost no boost and proves nothing. Log four channels together: inlet manifold pressure ACTUAL, inlet manifold pressure DESIRED, VTG position COMMANDED vs. ACTUAL, and exhaust pressure before turbine. **The generic path runs this test too:** JPRO logs actual manifold pressure and VTG commanded-vs.-actual on this engine, and a mechanical boost gauge teed into the intake tract confirms the sensor's honesty — what the generic path can't always show is the ECM's desired value and the exhaust-pressure channel, and for those DAVIE is the better path. Read it like this: **(a) Actual tracks desired within a few psi through the pull and P104C stays inactive = the boost system is healthy NOW** — note it and finish the oil steps. **(b) Actual sags well under desired while the VTG is already commanding the vanes closed = the turbo cannot make pressure** — mechanical (worn/damaged wheels, bearing drag) or the pressure is escaping (Step 9). **(c) VTG actual does not follow VTG commanded = actuator or stuck vanes** (Cause #2) — check the P1042/P1350 companions from Step 1. **(d) Exhaust pressure before turbine abnormally high for the boost being made = restriction downstream** (Section 9) or vanes stuck shut. Sanity frame only: trade reports put a healthy MX-13 at roughly 30 psi at full load — a truck making 15 is sick by any table, but the verdict comes from desired-vs.-actual where DAVIE is available, and from the gauge-and-VTG picture on the generic path — not from that band alone.
9. **Charge-air leak test + intake restriction (engine off).** Cap the CAC system at the turbo discharge and intake ends with the test kit plugs, regulate shop air to about 20 psi (typical test pressure, shop practice), and walk every boot, clamp, and the CAC end tanks with soapy water and your ears. **Pass: holds pressure a full minute with no audible hiss and no bubbles at**

any joint. Any joint that bubbles or sings is a leak — that IS a boost loss; fix it and re-run Step 8 before any turbo verdict. While the intake is apart, confirm the Step 2 air-filter finding and check for a collapsed hose or a rag-shaped surprise. A boost number taken with a leak in the system is a number about the leak, not the turbo.

10. **Turbo oil drain inspection (engine off).** Pull the drain tube off the turbo's bearing housing. Look for: coke or sludge narrowing the bore, a kink or crush, a downward path that isn't (the tube must fall to the crankcase its whole run — no traps), and a flange gasket shifted over the port. Blow it through; it must pass air freely end to end. **Any restriction found = repair it and re-test the oil complaint before the turbo is condemned** — a restricted drain produces this entire complaint on a healthy turbo, both seals weeping from a flooded housing. If the drain is clean, the oil had somewhere to go and still left by the seals — that strengthens Cause #1 or Cause #5 (pressure pushing from the crankcase side, Step 11).
11. **Crankcase pressure / blowby (warm engine).** Two reads, same story. **Read one — the ECM:** live crankcase-pressure value at idle and at 1,500–2,000 rpm no-load, plus any of P1407/P1408/P140A/P140E standing in the Step 1 list — PACCAR built those codes because this system matters on this engine. (JPRO shows the crankcase-pressure reading and those codes on this engine as well; DAVIE presents it cleaner, but the generic read counts.) **Read two — the manometer:** seal it onto the dipstick tube (or an oil-fill adapter), warm engine, read at idle and again at 1,500–2,000 rpm. Field-doctrine sanity band: a healthy engine runs near zero — roughly an inch or two of water column at idle, rising modestly with rpm. **Several inches at idle, or pressure climbing hard with rpm, is excessive** — high enough to push oil past turbo seals and fight the drain (PACCAR's numeric limit is a DAVIE confirm by serial — it is not in the open service material; the ECM value is the maker's witness). Then split the cause: **pressure high + vent module sludged/stopped (inspect the module, its drive, and hoses; P140A/P140E agree) = Cause #5 — service the ventilation system first. Pressure high + module healthy = the pressure is coming from the cylinders — Cause #6, go to Step 12.**
12. **Engine-side proof — only if the turbo side came back clean.** If Steps 4–10 cleared the turbo, the drain, and the boost system, the oil is coming through the cylinders and the engine has to prove which path. (a) **Pattern interview:** valve-seal/guide oil is worst as a puff of blue after a long idle and on deceleration (high intake vacuum pulling oil down the guides); ring oil is steadier under load and travels with blowby. (b) **Leak-down / cranking compression:** shop-standard equipment per the tool maker's procedure — a cylinder leaking down heavily with air heard at the oil fill is a ring-seal failure with a name and a number; air at the intake/exhaust points at valves. (c) **Borescope the cylinders:** oil-washed crowns and wet carbon corroborate. (d) **Oil sample:** wear metals, fuel dilution, and soot either support the worn-engine verdict or send you back to Section 9. **Nobody prices rings or a head off this step alone — leak-down and borescope are the conviction; the sample is the character witness.**

Job time for diagnosis: Steps 1–2 about 40 minutes; the coolant cross-check (Step 3) about five. The separator steps (4–6) about 45 minutes — the highest-value hour on the ticket. Step 7 about 20 minutes. Step 8 road test about 30 minutes. Steps 9–10 about 45 minutes together. Step 11 about 30 minutes. Step 12, only if needed, 1.5–2 hours. Call it 2.5–3 hours to know exactly which door the oil is using — against the price of one wrong turbo, or one wrong in-frame.

5. Specs & test values for this job

Item	Spec / expected reading
Boost health verdict (DAVIE, full load)	Actual inlet manifold pressure tracks the ECM's desired value within a few psi through a loaded pull; P104C stays inactive. Actual sagging with VTG commanded closed = turbo can't make pressure or it's leaking (Steps 8–9). This desired-vs-actual comparison is the maker-grade criterion; on the generic path, grade by logged actual pressure, a mechanical gauge cross-check, and VTG commanded-vs.-actual (Step 8)
Boost, field-typical sanity band (NOT a PACCAR spec)	Roughly 30 psi at full load , high-20s to mid-30s, per trade reports — orientation only. A truck in the mid-teens at full load is sick by any table; no verdict is printed off this band
Coolant condition (surge tank, engine cool)	Clean and translucent, no film under the cap. Dark slick, rainbow sheen, or emulsion = oil in the coolant — on this coolant-cooled-turbo engine, read it as a turbo signpost alongside the separator steps (Step 3), and plan coolant service with the repair
Turbo shaft play (dial indicator)	No wheel-to-housing contact under hand load in any direction, no rub marks, smooth free spin. Numeric axial/radial limits are turbo-model specific — CONFIRM for the exact unit fitted (turbo model off the ID tag)
Crankcase pressure (manometer at dipstick tube, warm)	Field-doctrine sanity band: near zero at idle, roughly 1–2 in. water column , modest rise with rpm. Several inches at idle or climbing hard with rpm = excessive. PACCAR's numeric limit: CONFIRM IN DAVIE BY SERIAL ; read the ECM crankcase-pressure value alongside (JPRO shows it on this engine too)
Charge-air system leak test	Holds about 20 psi test pressure (shop-practice figure) for a full minute with no audible hiss and no bubbles at any boot, clamp, or CAC tank. Any leak found invalidates prior boost readings until fixed
Oil pressure (sanity check only)	Trade-published typical for the MX-13: roughly 40–65 psi at road speed, 10–20 psi at hot idle — supports or undermines the bearing-wear story; not a PACCAR spec — a labeled sanity check only
Companion codes to hunt (PACCAR published fault list, MX-13 2017–2020)	P1042 VTG control incorrect · P1350-family VTG actuator · P104D/P1057 exhaust pressure before turbine · P1110 intercooler efficiency · P1407/P1408 crankcase pressure · P140A/P140E ventilation-module rotor speed (SPN 5444) · P150F oil level low
TORQUE — turbocharger mounting nuts	CONFIRM IN DAVIE / PACCAR BY SERIAL before the turbo comes off. Set by PACCAR for the unit fitted; no value from another engine family applies.
TORQUE — turbo oil feed & return (drain) line fittings/flanges	CONFIRM IN DAVIE / PACCAR BY SERIAL. Also confirm whether feed-line seals/O-rings are one-time use on this engine before the lines come off.

TORQUE — exhaust manifold nuts (only if the manifold comes off for the Step 6 split)	CONFIRM IN DAVIE / PACCAR BY SERIAL. Include the tightening sequence — manifold hardware is sequence-sensitive.
TORQUE — charge-air (CAC) hose clamps	CONFIRM. Constant-tension clamp torque is clamp-maker specific; an over-torqued clamp cuts the boot and becomes next month's boost leak.

6. If a part proves bad — repair guides

Job time, whole ticket (shop estimates — not PACCAR SRT lookups): diagnosis 2.5–3 hours; then the repair the tests convict — turbocharger replacement on a T680 roughly 3.5–5 hours including drain service and CAC cleaning, VTG actuator alone (where it's separately serviceable) about 1.5–2.5 hours plus calibration, ventilation module service about 1–2 hours, CAC/boot repair about an hour. Ring or valve-guide work is a second conversation, priced after Step 12's proof — not guessed here.

Turbocharger — replace (Cause #1 convicted by Steps 4–8):

- Engine off, exhaust cool. Photograph the unit, line routing, and the oil evidence from Steps 4–6 before disturbing anything.
- Drain-side first: remove the oil drain tube and inspect/replace it as part of this job (Step 10's findings ride along) — a new turbo on the old restricted drain is a scheduled comeback. New gaskets at both flanges, port fully open.
- Feed line: inspect end to end for coking or a collapsing liner; a restricted feed starves the new unit's bearings in its first hour. Renew seals/O-rings per the DAVIE serial lookup (see "Before you order parts").
- Pre-lube the new unit before it goes on: fill the bearing housing inlet with clean engine oil and spin the wheel by hand until it turns wet and free. A dry first start is how new turbos die young. Then mount and torque per the values **confirmed in DAVIE / PACCAR by serial (see "Before you order parts")**, harness routed factory-style, clear of the turbine housing's heat.
- Clean the charge-air cooler and intake piping of pooled oil (Step 5 findings) — flush per the CAC maker's method, fully dry before reassembly. Oil left in the CAC burns off for days and reads exactly like a failed repair.
- If the coolant showed oil in Step 3, this job now includes the coolant service: drain the radiator and reservoirs, flush, refill with fresh antifreeze, and burp the system afterward to purge trapped air — an air-locked cooling system makes its own overheating comeback.
- If the VTG actuator is renewed with the replacement, its calibration/learn runs before the road test — DAVIE required; read the warning under the VTG heading below before the truck comes apart. An unlearned actuator makes its own boost codes.

VTG actuator — service or replace (Cause #2 convicted):

BEFORE ANYTHING COMES APART — the calibration warning for this job: a replacement VGT actuator (and a replacement turbo whose actuator comes with it) ends in a recalibration/learn before the truck can work. **Common generic tools will not perform it — JPRO included. JPRO reads this engine well and runs most of the tests in this answer, but the VGT calibration is not among them.** That routine takes DAVIE, or a dealer/mobile tech who has it. Line that support up

BEFORE teardown: a truck that is mechanically finished but waiting on a laptop is a blocked bay and a stranded customer. This warning is in the answer now, before the first bolt — not discovered at the end of the job.

Where the actuator is separately serviceable on this unit (serial-dependent — see "Before you order parts"), the repair is actuator replacement plus the DAVIE actuator learn/calibration, and a vane-movement check through the Step 8 comparison before and after. If the vanes themselves are coked stiff in the housing, the turbo comes off for cleaning or replacement — do not force the vane arm against the actuator by hand; the actuator loses that argument and sometimes takes the linkage with it.

Crankcase ventilation module — service (Cause #5 convicted): remove the module per its mounting on the engine, inspect the rotor and drive for sludge and free movement, clean or replace per what the inspection shows, and renew any sludged or collapsed vent hoses. Then re-run Step 11 before anything else is declared: crankcase pressure must fall back to the healthy band with the module serviced, or the pressure was never the module's fault and Step 12 is next.

Rings / valve guides (Causes #6–7 — only on Step 12's proof): this is engine-opening work priced after the leak-down and borescope results, not a guide this answer will fake its way through. Send us the Step 11 pressures, the leak-down numbers by cylinder, and the borescope photos and we'll scope it with you — including the honest version of 'how much longer it has if he just runs it' when that's the real question.

7. Proving the fix — and a note on derates for this fault family

First, the derate question, because every shop asks it: this complaint family carries no SCR-style inducement ladder — there is no derate countdown to exit and no reset trick to hunt for, and nobody should sell one. P104C is a performance fault; when the boost is genuinely back, the code goes inactive on its own as the diagnostic passes. (Engine-protection derates exist on this engine — P1105/P1106 territory — but they ride with protection events, not an oil complaint; if one is standing in the Step 1 list, that's a different fire — tell us.) What 'reset' this job does need: clear the codes after the repair, and if the oil loading has pushed the aftertreatment into DPF complaints, run a normal forced regen ONLY after the oil source is fixed — regenerating an oil-flooded exhaust first just bakes more oil into the filter.

Verification — every line must pass before this truck is released:

1. **Repeat the Step 8 boost test:** same road, same load. Actual inlet manifold pressure tracks desired through the pull, VTG actual follows commanded, and P104C stays inactive after clearing. Record the four channels again — this page argues with the Step 1 page, and it should win.
2. **VTG calibration confirmed (if the actuator or turbo was renewed):** the DAVIE calibration/learn is complete, VTG actual follows commanded through the pull, and no VTG codes (P1042 / P1350 family) are standing. A truck that skips this line is not verified — it's borrowed time.
3. **Re-open the separator points:** after the road test, re-check the joints you photographed — compressor outlet pipe and turbine outlet. **Expected: no fresh wet oil.** (A faint film at the turbine outlet on the first heat cycle can be residue burning out of the pipe — wet, accumulating oil is not residue.)

4. **Crankcase pressure re-check (if Step 11 found pressure):** manometer and ECM value back in the healthy band from Section 5.
5. **Oil level and consumption watch:** level set exactly at full, mileage recorded on the ticket, and the shop/driver told to report the level at the next fuel stop and at 1,000 miles. An oil-consumption repair isn't verified until the dipstick agrees over distance.
6. **Final scan:** no active boost, VTG, crankcase-pressure, or aftertreatment codes after the road test. Any line fails, the truck stays — an oil-in-exhaust truck released half-fixed comes back with a loaded DPF and a much bigger bill attached.

8. Safety — read this first

The turbine housing and exhaust stay burn-you hot long after shutdown — every step that opens the intake or exhaust waits for a cool engine, and 'cool' is checked with the back of a hand nearby, not by optimism. Never put a hand or a tool into a turbo inlet with the engine running or cranking — spin checks are fingers on a stopped wheel only. If the intake tract or CAC is holding pooled oil (Step 5), treat the first start after cleaning like it matters: pooled oil in an intake can feed an engine that won't shut off on the key — clean it out first, and know where the air shutoff is before the first start, not during it. Charge-air test pressure is regulated air, capped plugs, and nobody's face over a boot while it's pressurized. Manometer and drain work happens around a running engine in Step 11 — no loose sleeves, no hanging lanyards, chocks in, park brake set.

9. If that doesn't fix it

If the turbo proves tight on the indicator, both separator ends are dry-or-explained, the drain runs free, crankcase pressure is in the band, the boost test passes — and the truck still pushes oil out the exhaust — the branch order is: (1) **exhaust restriction after the turbo** — a loaded DPF or crushed pipe raises pressure at the turbine outlet, which works against the turbine seal from the exhaust side; the Step 8 exhaust-pressure channel and a DPF differential-pressure reading frame that check, and P104D in the code list points here too. (2) **Fuel in the oil** — a rising dipstick level (Step 2) or fuel dilution in the Step 12 sample: thinned oil carries over everywhere, and the hunt moves to injectors and the high-pressure pump. (3) **Wrong oil or chronic overfill** — ask what actually got poured in at the last service. (4) Then the deep engine path with the Step 12 evidence in hand. Send us the Step 1 health report, the separator photos, the shaft-play readings, and the Step 8/Step 11 logs and we'll work that branch with you. Follow-ups on this same problem are part of this same request — reply to the email this came on with your test results.

10. Close

Most likely outcome on this truck: one turbocharger explaining both complaints — oil past its seals and boost it can no longer make — with the drain, the ventilation module, and a charge-air leak as the supporting suspects that have to be cleared before the turbo takes the blame alone. The separator steps are the whole game: find the door the oil is using, and the parts bill writes itself. Run the steps in order, write down the readings, and send back what you find. Questions on any step come back the same way — in writing, on this same request — and the follow-up answer comes back in writing too, so the whole shop can work from it.

11. What it turned out to be

It was the turbocharger: its seals had failed, putting oil in the exhaust and in the coolant (the MX-13's turbo is coolant-cooled), while a borescope showed the intake and exhaust ports clean and the oil contained at the turbo and downstream of it — the engine side ruled out by inspection. The turbo was replaced and both complaints were fixed; the original VGT actuator then set codes and stuck, and was replaced as well — and its recalibration, which JPRO would not perform, was completed with DAVIE. The radiator and reservoirs were drained and flushed, refilled with fresh antifreeze, and the cooling system burped to clear the trapped air.

— Second Wrench Diesel Support · Sample document — a real case, shown in the format subscribers receive