



Packing it In

Over the course of a C5 twin-turbo install, Jeff Glenn's head winds up spinning faster than the turbos themselves. Pix by the blown-out author.

They sell them as "bolt-on horsepower." Some even keep a straight face while they're saying it. But unless "they" happen to be a new breed of super-mechanics, installing turbos is hardly a matter of turning a few bolts and then twisting the key. Even when they don't require cracking open the engine, large boosts in performance just never come very easily.

Take the case of Dave McNamee's C5. The car already carried big wheels, upgraded brakes, and stiffer suspension parts from the GM competition catalogue, but after a few track days Dave wanted to "bolt on" twin turbos as well. I'd already told our regular local tuners we were interested in following a turbo install as a *CM* how-to, so when Dave came to Synergy Motorsports in Fremont, I got a call from its owner, Rick Hol-

lenback. Rick's crew is well versed in turbo installs, but this would be their first time using a kit from TTI (Turbo Technology Inc.), meaning the job wasn't likely to look unrealistically easy. Sure enough, just unpacking the hardware dispelled any danger of that. I could see from the start that without a lift, a welder, a grinder, a chop saw, and maybe a full week of spare time, I wouldn't have tried this in my own garage.

The kit came with most of the new bits required: turbos, manifolds, gaskets, wastegates, downtubes, piping, hose couplers, intercooler, blowoff valve, heat-shielded replacements for various things near the turbos, a new a/c-compressor mount, and most importantly detailed instructions and numbers for tech support. So, okay, guys: Let's see what it takes to "bolt on" some power.

A: You might as well start with the easy stuff: Lift the car halfway and take off the front wheels, the battery, and the plastic divider surrounding the battery area. Drain the oil (*photo 1*), and take off the oil filter, then hit all the exhaust-system fasteners with a few shots of penetrating lube while you're in there. Remove the injector covers, sparkplugs, wires, main intake hose, MAF-sensor plug, and coil packs.

B: Loosen the exhaust-manifold fasteners at the collectors and heads. Cars with aftermarket headers (like Dave's) may or may not also require you to take out the starter or motor mounts—be prepared. Mark the steering shaft at the firewall so it can be returned in the same orientation later, then undo the shaft at the firewall (*photo 2*) and the rack. Next, raise the car fully and pull off the exhaust system all the way back to the axles (*photo 3*).

C: Drop the car back to the ground, raise the hood, and take off the alternator and serpentine belt (*photo 4*). Next comes a major decision. Technically, the turbos can be mounted with the front crossmember still in place. Experience has shown Rick's crew that this isn't worth the grief and skinned knuckles, however. The alternative is to concoct a temporary support to keep the engine in place after removing the crossmember. Hollenback fabbed out rough brackets from one-inch square tubing (*photo 5*), then attached them the alternator (*photo 6*) and belt-tensioner mounts to let the engine remain propped on the frame rails. Once the braces were in place (*photo 7*), he got ready to drop the crossmember with the steering rack, ABS modulator, and front suspension in place.

Still on board? Then undo the brake lines (*photo 8*) and electrical plug (*photo 9*) at the ABS modulator. Next, back out the low-pressure line from the steering rack (*photo 10*) and plug up the pump. Disconnect the lower shock nuts from the bottom of the A-arms (*photo 11*), then undo the four bolts holding the antiroll bar to the crossmember. This lets the bar swing down, revealing two of the main crossmember bolts (*photo 12*). Disconnect the ABS-sensor plugs at the member's front corners, then take the front brake-line brackets off of the frame rail. At the front of the crossmember, unclip the wiring loom (*photo 13*) and the power-steering hard lines; tie them up out of the way. Back out the upper A-arm bolts, noting the order and location of any washers or shims as you go (*photo 14*). You'll want to put everything back together the same way later.

With that, the crossmember is ready to come out. Support it well on a good rolling

hydraulic stand (*photo 15*) or a professional-grade tranny jack, then back out the four main mounting bolts and undo the bottom fasteners on the motor mounts. Slowly lower the jack and the unit, wiggling the shocks to break them free of their arms as you go. Once the crossmember is totally clear, roll it out of the way (*photo 16*) and toss it under a protective tarp to keep it sanitary.

D: The engine is now resting on the frame with open space all around. Don't worry—that'll get filled soon enough.

An integral part of a good turbo system is the oiling circuit, which in this case is both fed and drained out of the car's OE sump pan. To prep the pan for the return lines, remove the oil-level sensor from the right-rear of the sump and pull off the two-piece pan, loosening the 10mm bolts all around and the two long 13s at the bellhousing. While you're at it, pop off the flywheel dustcovers from both sides where the pan meets the bellhousing.

Thoroughly clean the pan on the bench in and out, then measure and mark the drill holes described in your instructions. Take the bottom section off of the pan to prevent aluminum chips from hiding inside, then drill out the holes with a new, high-quality bit (*photo 17*). Use a shop-vac to keep wild shavings in check, and grease the bit often to help it stay cool and sharp. Once cut, tap the holes (*photo 18*) and re-clean the pan using a solvent tank (*photo 19*). Attach the new fittings (*photo 20*), always using Teflon tape, and then reassemble the two halves of the pan.

E: Leaving the pan off the engine for now, it's time to deal with the oil-supply side; in our kit this meant modding the oil-transfer cover (the piece housing the receptacle for the oil-level sensor plug, right above the oil filter). Unplug the wires from this cover, then unbolt the cover and take off the temp sensor in back. Fit the cover securely in a vice, then drill out and tap holes as described in your instructions (*photo 21*). When you're done, clean the housing in solvent, screw in the fittings, pop the sensor back into place, and re-mount the cover as instructed—some kits tell you to stick it in upside-down so that the sensor plug points toward the ground (*photo 22*).

F: As you'd expect, the packaging of the turbos and piping is tight. In this case, to feed air into the compressor on the driver's side, the motor mount on that side must be relieved with a hole saw and grinder (*photo 23*) to make way for an intake tube.

At this point, somewhere—hopefully in a nice, clean area on the other side of the gar-



age—you'll by now have an expensive pile of pipes, turbos, plumbing parts, and exhaust manifolds laid out and inventoried. A little sub-assembly is now required. Take the new manifolds, install the studs on their bottom

flanges, and hit the main mating surfaces with a nice, thin film of copper RTV (*photo 24*). Mate the turbos to the manifolds as instructed, then install the new oil-supply lines (*photo 25*) and drain tubes (*photo 26*). In theory, at least,



bolting it all up now means less futzing around once these monsters are crammed up against the engine inside the car.

G: Test-fitting the manifold/turbo assemblies is a must. By trial and error, the Synergy crew found it easiest to load the left-side assembly in from the bottom, snaking and feeding it into place in a precise series of twists and motions. This is always a two-person job, with one forcing the heavy unit up from below and the second guiding it in from above (*photo 27*). In the end, the units should fit snugly against the engine and their oil drains should point straight toward the appropriate fittings on the oil pan. If even a tiny adjustment of any component—say, of the drain fitting relative to the

pan—is necessary (and trust me, it will be), take the whole assembly back out and re-align everything on the bench. (Trying to adjust fittings and re-route lines once the assemblies are in place inevitably leads to loose connections and premature leaks; it's just not worth the few extra minutes you'll save.) Keep at it until all the bits fit together the way that they should, re-fitting the pan temporarily with a few bolts and verify the geometry.

H: Our kit came with the nice added extra of heat-wrapped a/c lines and a new stand-off bracket (*photo 28*). These help the turbos and plumbing stay clear of the a/c compressor and prevent overcooking the refrigerant inside the lines. Of course, installing them also means

discharging the a/c system, capturing the existing refrigerant (*photo 29*), and recharging it again later—a job far beyond most people's abilities. Anyone doing this job at home must either call in an HVAC pro or flatbed the car to a shop for these steps.

I: Let's get back to stuffing these parts into the engine bay. Feed the righthand assembly up from below next. In our build, the righthand compressor interfered with the frame (*photo 30*), so we had to drop it back out and reshape the rail for clearance (read "whack it real hard with a big hammer"). My advice? Keep test-fitting and re-whacking until you've got more than enough clearance...and don't forget to touch up any dings in the paint (*photo 31*).



J: Once both turbo/manifold assemblies fit and are properly oriented, take them out one more time and install the downpipes for the exhaust side of the turbos, using anti-seize compound on the threads of turbos' studs and copper RTV rather than gaskets (photo 32).

K: The manifold/turbo assemblies are now ready to go in for the last time—before doing that, however, take a last look at the bottom of the engine and protect all the wires in the area against heat-soaking as best you can. Most kits will come with heat-wrapping supplies for the starter wiring (photo 33) and some of the sensors. The smartest thing is to re-route as much wiring as possible, splicing in new sections as needed to gain extra dis-

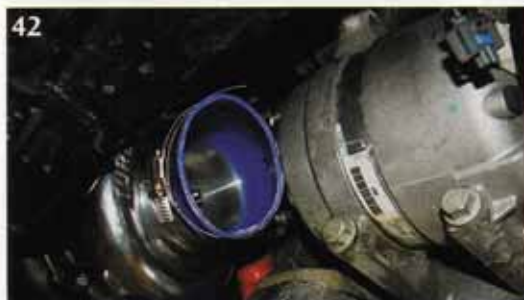
tance (photo 34). For wires you can't move, protect them as well as possible and just keep your fingers crossed.

L: Okay—it's time to start bolting down all the hardware. On the passenger's side, fish the a/c line from the compressor into place while the manifold is being lifted. Slip the supplied steel gaskets into place (photo 35), then tighten the manifolds to the heads on both sides. If all has gone well, the tabs on the downpipes should now be aligned with the existing exhaust-bracket studs (photo 36).

M: Tired of wrenching yet? Yeah, well me too. But of course on late-model Corvettes, the turbos themselves are just the beginning. To make

such a setup work effectively, you'll also need plenty of intercooling—which means a whole installation job of its own.

To start, unplug the light-housing wires and remove the front bumper cover (photo 37); there are four bolts across the top, two on each side, and two underneath. The intercooler on most aftermarket turbo kits for these cars mounts behind the front bumper and in front of the radiator, usually by attaching itself to the existing bumper-support brackets. In our case, we mounted black-rubber couplers onto either side of the intercooler unit and then mocked everything up to check the fit—it's tight in here, so it never hurts to make sure. Once everything was lined up, we marked and drilled holes to allow bolting the unit in place (photo 38).



N: Slide the provided hose couplers onto the turbo outlets (*photo 39*), then lay all the plumbing out on the ground near the engine. The formed tubes are numbered, and they all have to be oriented and installed in exactly the right way. Our kit used a total of six "hot" pipes, meaning three per side (*photo 40*), to

take compressed air from the turbos to the intercooler. On the driver's side, these ran down toward the K-member, out under the steering rack, between the A-arm and antiroll bar, and into the cooler; the passenger's side was even more snakey, heading over the original heater lines, down into the wheelwell, and

then doubling back into the cooler via an oversized U-bend (*photo 41*). When test-fitting these lines, always use plenty of silicon spray on their couplings; that keeps things moving forward at a reasonable pace.

No matter what, you're likely to run into problems here. Our kit's pipe layout interfered with the stock horn, for example, so we had to remove that and remount it elsewhere. Similarly, the big intake pipe on the passenger's side sat so close to the a/c compressor (*photo 42*) that we had to carefully oval it down in a vice to fit properly (*photo 43*).

O: Once all the ducting locations have been worked out, it's time to retighten the oil pan. Make sure to use undamaged gaskets, and hit all the sealing surfaces with black RTV to protect against leaks (*photo 44*). When bolting the pan into place, tighten the two long bolts at the rear to 116 inch-pounds; the rest get a mere 18 inch-pounds, which is barely hand-tight. Next, slide the rubber oil-drain connectors over the barbed fittings (*photo 45*) with a little spray lube, then tighten all the clamps snugly. Once the pan is in place, connect the oil-supply lines from the turbos to their new fittings just over the filter housing, snaking the passenger's-side line around the front of the pan as needed (*photo 46*).

P: Just when you were thinking "maybe I could've stuffed all this junk in there without dropping that crossmember," it's time to start hacking away at the crossmember itself. In many kits, the little pad on the top right of the member (the one that sorta looks like a raised Chevy Bow Tie) interferes with the turbo and must be ground off (*photo 47*). Meanwhile, the right edge of the member itself must be relieved to make room for piping and new hardware (*photo 48*). That's no minor task on the shop floor, let alone in the tight confines of the engine compartment.

Q: Speaking of the engine compartment, go back in there next and connect the oxygen sensors to the downpipes (*photo 49*), being careful to route their wiring clear of the hot turbo lines. On the right side, drill a couple of holes in the frame to Zip-Tie the wires in place; the lefthand wiring can be tucked away behind the brake lines.

R: Now get ready to undo some of the stuff you just did: It's time to reinstall the modified crossmember. First, relocate any pipes, wires, fluid lines, or other bits that have fallen down into the way. Once it looks clear, wheel the crossmember back up under the car and start jacking it up to the chassis (*photo 50*). As it closes in, snake through and reconnect the appropriate hard lines and wires, remember-

ing especially the clips at the front of the unit. Stick the steering shaft up in the general vicinity of the firewall for now, but don't tighten it down (*photo 51*). Before raising the crossmember completely, reattach and re-tighten the power-steering lines while you can still reach them. Also, don't forget the left-front brake line that goes to the ABS unit.

S: Now jack the crossmember the rest of the way into place (*photo 52*), making sure to align the motor mounts, guide pins, and studs at the front (*photo 53*) and also the shock bolts on the A-arms. Once everything's cool, bolt the member back into place, reconnect the motor mounts, and pull out the temporary engine braces. Now take a moment to see just how tightly the turbo and tubes are sitting relative to the frame rails and crossmember....it's good to know all that banging and grinding was done for a reason.

T: Reattach the upper control arms to the frame mounts, using the same shims in the same positions as before (*photo 54*). Take off the antiroll bar (it should still be hanging loose by its links) and worm it out of the car, undoing the tie-rod end (*photo 55*) and center hot pipe as necessary. That should open up enough space for you to final-fit all the air plumbing.

One of the tougher pieces to work back into place will be the intake tube on the driver's side, which fits between the crossmember and the steering rack. If necessary, you can detach the rack from the crossmember and, using a helper with a pry-bar, wedge the tube under the rack, twisting it in as you go (*photo 56*). Make sure the pipe isn't rubbing the harmonic balancer, then drop the rack back into place and re-tighten its bolts. On the righthand side, if the intake pipe rubs the inner fender liner, take the pipe out and radius the liner with a cutoff wheel (*photo 57*). When you reconnect the pipe later, remember to fix it in place by running a self-tapping screw through its bracket.

U: Now you're ready to start tightening everything down for good. Any piping, wiring, or air lines that are still unsecured should now be completely aligned and locked down. To reinstall the antiroll bar, thread the bar back into position through the small gap between turbo pipes (*photo 58*), undoing the righthand balljoint of the tie rod if necessary. Reattach the bar to the links on the bottom A-arms, then lift it up and re-mount its bushing clamps to the crossmember. Finally, reattach and reassemble any tie-rod pieces you had to take loose.

V: Up at the front of the car, it's time to take on the plumbing and final assembly of the in-



tercooler. Our unit had two holes on top, one for outputting cooled air and another for fitting the blowoff valve (this prevents excess pressure from blowing up the system during upshifts or throttle drops). While most of the intercooling plumbing is straightforward, the blowoff-valve mounting can be tricky. On

ours, we had to drop an O-ring into a groove on the intercooler (*photo 59*) and then install a series of elaborate clamps (*photo 60*). The top of the valve also had to receive a small hose pulling vacuum off the brake-booster line, so we needed to split and refit the latter with a special union (*photo 61*). The same line



was tapped to supply vacuum to the wastegates as well, again via special takeoff. (The wastegates, which go on at the end, set the maximum boost that can be passed down the line from the turbos. For engines with no internal mods, most builders limit this figure to something like five or six psi.) While you're

fooling around in the area, reattach and tighten the steering shaft.

W: Unless the car already has oversized fuel injectors, that's the next step. (See *CM30* for the lowdown on adding them.) Install your sparkplugs, plug wires, and coil packs next

(photo 62), bearing in mind that new plug gaps and heat ranges are probably specified by the kit maker. Once the new injectors are secured, don't forget to reconnect the fuel line.

X: Reattach the intake hose and wiring to the MAF sensor, noting the direction of airflow marked on the tube. You may need to reposition the coupling on the intercooler side a few times as well to make it mate comfortably to the intake hose and poke through the new air-deflector shield. Next, wrestle the snorkel from the kit onto the throttle body (photo 63), then mount the new air filters onto the turbo-intake pipes (photo 64).

Y: On the downstream end of the downtubes are provisions for mounting the wastegates. After installing the provided barb fittings in the holes on their bottoms, bolt the gates to their flanges (photo 65) using only a thin film of RTV—no gaskets. Once the units are in place, slip on the vacuum lines tapped to the brake-boost hose. From there, it's all just a matter of mundane reconnecting and re-mounting: Don't forget the brake and electrical lines to the ABS module, the alternator, the serpentine belt, the battery and battery shielding, the horns, the bumper fascia...blah, blah, blah. (Face it: By now, you're probably seeing this junk in your sleep.) If your kit comes with additional ducting or air flaps, put them on now. If you're still in the mood, this would be a good time to wire in a boost gauge.

Z: Reconnect the exhaust system, then double-check all the connections. Make sure the sump plug and oil filter are in place, then refill the engine with fresh oil. Now you're ready to roll the car off the lift, reconnect the battery, fire it up (photo 66), and hunt for exhaust and/or fluid leaks. After you fix what you find, make a few slow, gentle trips up the driveway to assess general durability and see what you forgot to put back on the brake and suspension systems.

This is a big and complicated job, but one that is far from impossible. Once everything seems to be hooked up and working, go out for a test drive or, better still, head for your favorite tuner and let them dial in the fuel mapping for maximum output. Using new high-flow cats, our man Rick quickly got this one cranking out 517 rear-wheel horses.

As external mods go, gaining 144 pounds of torque and 155 horses is spectacular; unlike the vast majority of "bolt-on" modifications, there's no question you'll feel the difference. Whether you want to be personally involved in this surgery is another question. Having lived through one myself now, the option of doing my next turbo job with a check wrench is mighty appealing. ○