The 1988 Callaway Twin Turbo Corvette. The Inside Story.

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The 1988 Callaway Twin Turbo Corvette is proof that America can build a sports car second-to-none. With a top speed of over 190 miles per hour, it is the fastest production car built in the U.S. This performance, coupled with a sophisticated suspension, a full range of creature comforts and everyday driveability, makes the Callaway Twin Turbo the most versatile sports car in the world.

Callaway Engineering, started in 1978, specializes in advanced engine design and development. When the Corvette Engineering group asked us to develop and market a twin-turbo version of the Corvette, the excellent reputation of the vehicle made it easy for us to agree.

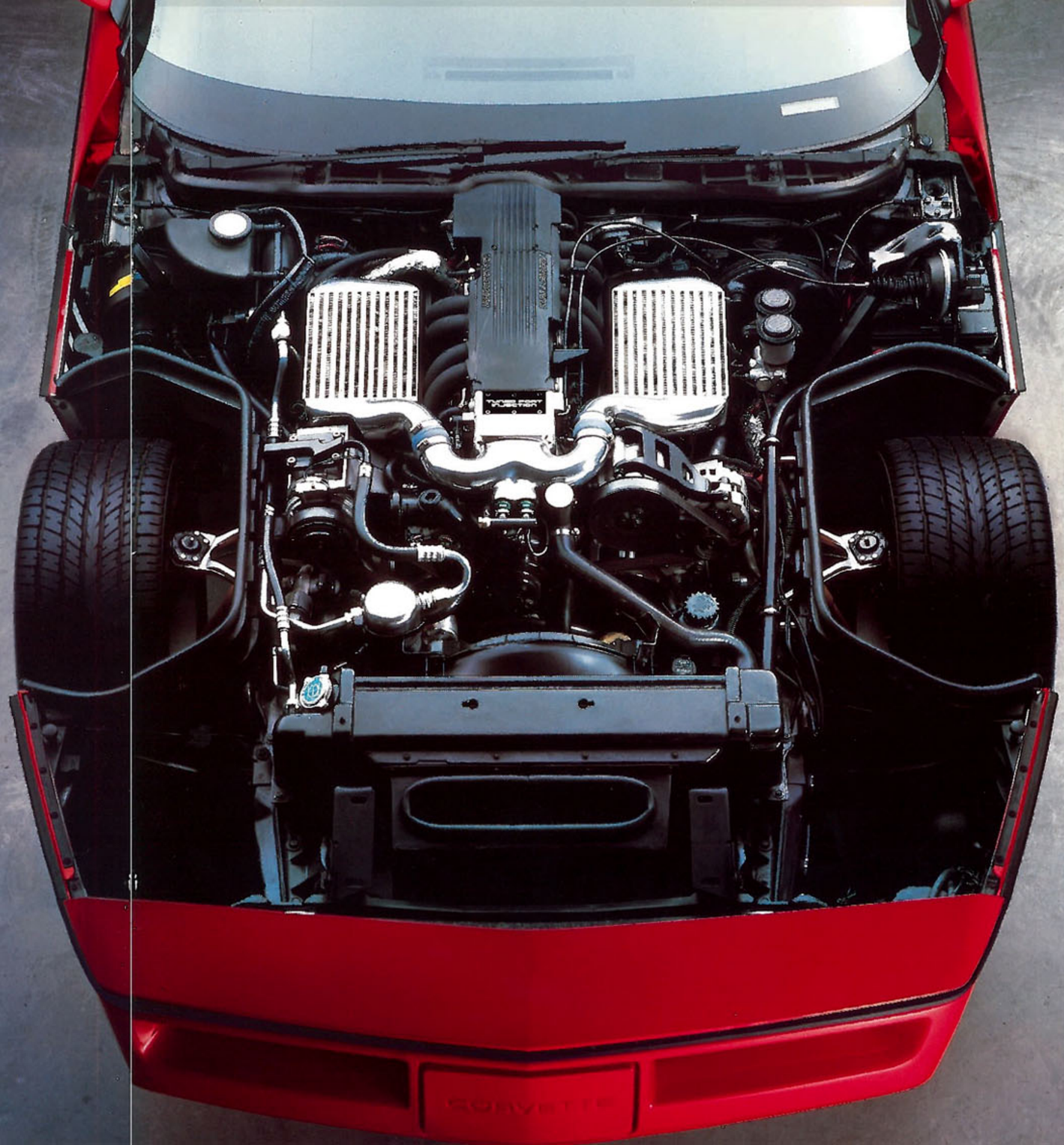
The 1988 version is a fully engineered car, whose heart is a carefully prepared version of the 350 c.i.d. Chevrolet small block. Wrapped around this core is a compact twin turbo-system, with integrated intercoolers. The Callaway Twin Turbo produces 382 hp @ 4250 rpm and 545 lb-ft of torque @ 2750 rpm. With over 400 lb-ft of torque available from 2000 to 4750 rpm, response is staggering at any speed.

Because of the extraordinary engineering refinement of the Z51 and Z52 Corvettes used in our production, all of this power is efficiently utilized. Their suspensions, oversized brakes and manual transmissions are left unchanged. There is no need to disturb the balance of this already fine automobile.

**"THIS TURBOSYSTEM WE CAN GET CLOSE TO—IT'S GOT ALL THE GOOD STUFF."**
*Dan Runkel, then Chevrolet's Chief Engineer, quoted in Automotive Industries, July 1986*

Turbocharging is the most efficient method of extracting significantly more power from a given engine. To visualize turbocharging, imagine a process in which exhaust gas energy is harnessed by a turbine, converting it to shaft power. The shaft drives an impeller, pressurizing the inlet air. More air is forced into the engine than it would normally consume. A naturally-aspirated engine normally operates at a 60-80% volumetric efficiency. Turbocharging can increase this value to more than 150%.

Other important design considerations were incorporated into the turbosystem. According to Reeves Callaway: "Our design objectives were to optimize the car's potential by tuning the electronic engine controls to match the output of the modified engine; isolating hot components from heat susceptible areas; and, directing ambient cooling air to the radiator, oil-cooler and air-to-air intercoolers. And with all of this, great care was taken to create a stunning underhood presentation, as we feel a high performance engine built without proper visual execution is unacceptable."



The block used is from the standard L98 engine. It is cleaned and visually inspected for defects and then a process called Magnafluxing is used to highlight invisible flaws. For additional strength, the block is machined to accept splayed 4-bolt main bearing caps. The main journals are line-honed for straightness. Then the cylinder bores are finished to align them with the crank centerline and to remove any taper or out-of-roundness that might exist. If necessary, the block itself is decked to correct height and alignment.

A Chevrolet Special Products race crank is used in the Twin Turbo. Forged from 1053 steel, it comes with Tuftrided journals. This hardens the journals to reduce wear. After an inspection for straightness, the crank's main journals are cross-drilled for improved oiling of both the main and rod bearing surfaces. Finally, all the journals are micropolished to optimise oiling. Mounting the race crank in the L98 block requires the use of a special adapter for the rear main seal. This adapter is machined out of solid billet 6061 T6 aluminum on our numerically-controlled milling centers and then anodized for corrosion resistance.

The turbo engine undergoes higher duty cycle loading than the standard engine, so more oil volume is required to maintain a proper lubricating film at the bearing surface. A high output Melling M55HV unit is used to increase oil pressure at all engine rpm's, with a maximum of 80 psi.

Only Mobil 1® Formula 15W-50 motor oil is used in the turbo engine, because it offers superior lubrication at all temperatures and loads. To moderate heat build-up in the oil system a separate air-to-oil cooler is installed in the nose of the car.

The connecting rods used in the Twin Turbo engine come from the same forging as LT-1 "pink" rods. Each rod is visually checked and Magnafluxed. The pin bores and bearing journals are checked for size and roundness, and honed if necessary. The rods are then weighed and matched.

To lower the compression ratio to 7.5:1, pistons of our own design are installed. The pistons are manufactured by Cosworth or Mahle, both major suppliers to Formula 1 and Indycar engine builders. For optimum sealing, plasma moly race rings are standard.

In order to meet emission standards, the camshaft and cylinder heads remain stock. However, the standard intake valves and all the valve springs are upgraded. If necessary, the cylinder heads are decked to guarantee proper flatness.

Maintaining fuel supply to the engine during high output operation is extremely important. To meet our requirements, a Bosch pump with twice the normal capacity is used. Proper fuel pressure is maintained by a manifold pressure-biased regulator built into the fuel return line.

Transfering the turbo engine's power to the road poses no problems. Each Callaway Twin Turbo is equipped with Goodyear Eagle P275/40 ZR tires mounted on 17" Dymag magnesium road wheels. We feel this combination is the best available for the Twin Turbo. The suspension of the vehicle is designed around the dynamic characteristics of the Eagle ZR, giving the Corvette remarkable roadholding ability as well as high-speed stability. Also, the Z-rating of the Eagle matches the top speed capability of the car.

Dymag's magnesium wheel represents the latest in road wheel construction. Developed for use in showroom stock racing, this wheel is a five-spoke design of exceptional strength. Its light weight—about 7 pounds lighter than the standard wheel—improves dynamic response of the suspension, increasing roadholding without adding harshness. Dymag uses a special, high-purity magnesium to reduce the natural susceptibility of the metal to galvanic corrosion. In addition, each wheel is coated with a high-density electrostatically applied paint as a further barrier to galvanic activity. The wheel accepts the standard Corvette locking center cap.

Note: Picture does not show complete system. Shown is 1987 version.

"FAT GOODYEAR EAGLES, MOUNTED ON SPECIAL MAGNESIUM WHEELS, PROVIDE SUCH GRIP THAT EVEN IN NARROW BENDS... THROTTLE CAN BE APPLIED INDISCRIMINATELY."

*sports motor and sport, April 11, 1987*

The right turbocharger configuration is a prerequisite for producing a reliable and driveable turbocharged engine. Correct sizing can fill in low-end torque, enhancing throttle response and driveability. We tested over a half dozen turbocharger configurations on the dyno before selecting Rotomaster turbos for 1988. They generate nearly 40 extra horsepower versus last year without sacrificing low-end response.

**"EXPERT TURBO INSTALLATION WORTH THE PRICE."**
*Road & Track, November 1987*

These turbochargers have liquid-cooled bearings to ensure reliability and long life. Coolant is drawn off the block and circulated through each turbo center section. From there it returns to the hot side of the radiator. This means turbo cooling functions within its own subsystem, reducing heat load within the engine. Each Rotomaster turbo features a compact integral wastegate cast into the NiResist turbine housing to properly control boost pressure.

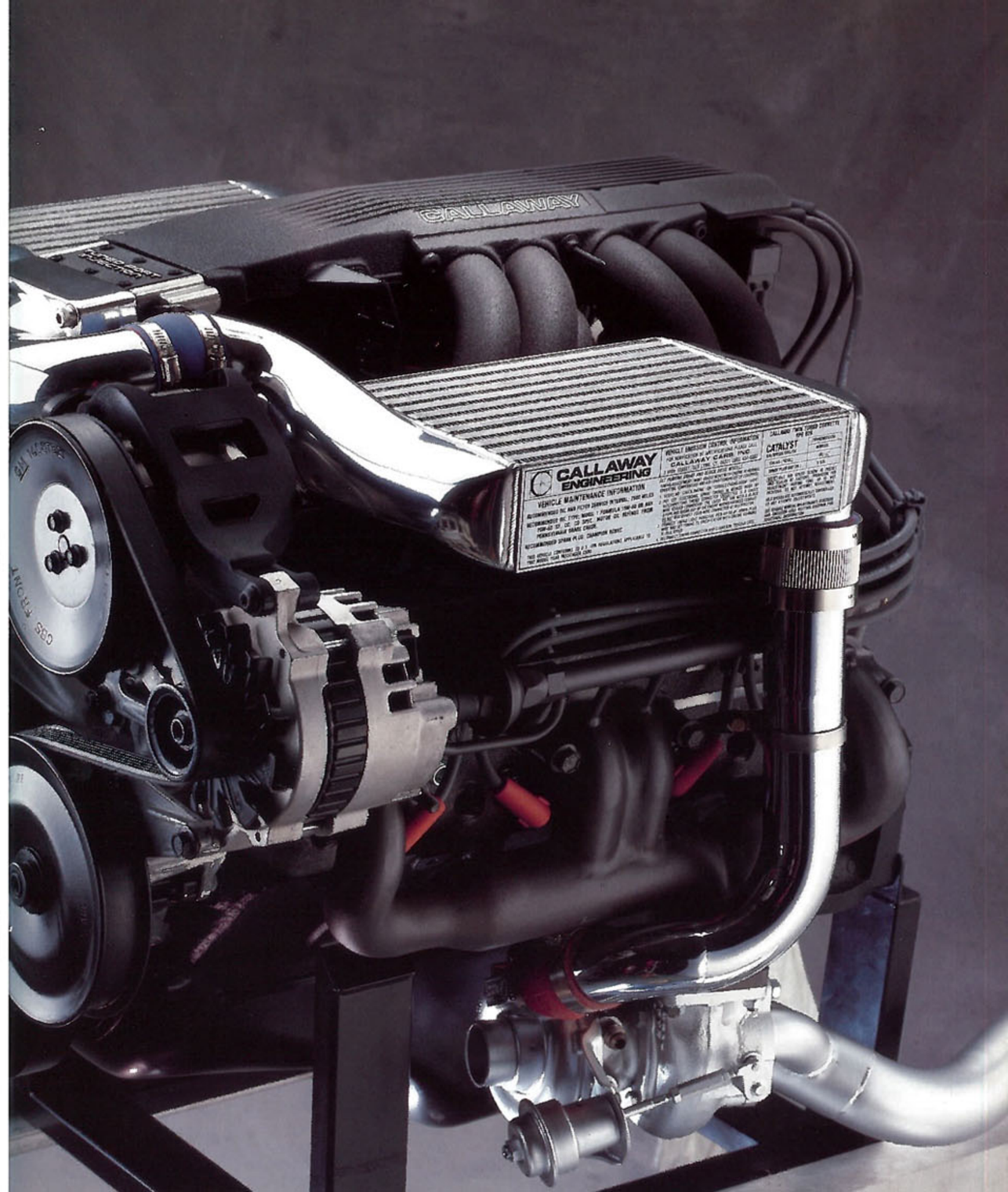
The turbochargers are mounted low on each side of the engine to keep them away from heat susceptible areas high in the engine compartment. This location dictates installation of a turbo oil sump tank evacuated by a Callaway-designed gerotor pump. This prevents lubricating oil from backing up and damaging the turbochargers. The oil is then returned to the stock oil pan. The pump is integrated into a new accessory drive belt tensioner.

Intake air is heated during its pressurization, so air-to-air intercooling is used to control charge-air temperature and increase its density. This results in more power and delays the onset of detonation. Aircraft quality air-to-air intercooler cores are used in our system. Airflow is routed through wire reinforced silicone rubber-tubing, 2" steel piping, and polished aluminum castings. Parts subject to stress are joined by Nomex-reinforced silicone hoses.

Maintaining the correct air/fuel ratio is critical, especially when it's in boost. The fuel curve in the GM electronics is adjusted to inject more fuel at high output levels, but primary fuel enrichment is provided by our Microfueler II™ Fuel Enrichment System. This discrete fuel injection system controls a pair of Bosch fuel injectors mounted in the intake air stream. The computerized system fires the injectors at rates preprogrammed to maintain the right air/fuel ratio.

Both the GM electronic engine controls and our own fuel enrichment computer are tuned on the dyno for best power; final electronic tuning takes place in the car. This melding of human sensitivity with extensive dynamometer testing makes the Twin Turbo Corvette an exceptionally driveable automobile of impressive power.

The exhaust system has been refined to take advantage of the additional power potential of the engine. This freer flowing system reduces back pressure in the exhaust tract, allowing the engine to breathe better. The combination of the new exhaust and turbos results in a 17% increase in peak torque and an 11% increase in peak horsepower versus the 1987 Twin Turbo.



Since the turbocharged engine creates additional heat, the ambient airflow through the engine compartment has been improved. Air enters through the high pressure area under the nose and is directed to the oil cooler, radiator and air-to-air intercoolers. The radiator and oil cooler share the duct in front of the engine, but tunnels grafted to the underside of the hood channel air through the two intercoolers located over the valve covers. The air then flows over the exhaust manifolds and turbochargers, cooling them.

The cooling system is upgraded as well. The standard radiator is replaced with a heavy-duty copper-brass unit, and the water pump's capacity is increased by a reduction in the pulley diameter. To match the higher flow capacity of the pump, a larger external thermostat is installed. Together, these changes ease the heat load on the cooling system.

Because the normal air filter location is used for the intercooler air inlet, engine air follows a new path. The filter is relocated to the right front corner of the engine compartment. The air then flows into the front crossbrace, splits and follows reinforced silicone rubber hoses back to the turbo compressors. The compressors force air up through the intercoolers, and in through the throttle body.

**"...ACCELERATION...IS RATHER LIKE RIDING A ROCKET OFF THE PAD AND THEN HAVING THE SECOND STAGE BOOT YOU UP TOWARD ESCAPE VELOCITY."**
*Automobile, October 1986*

To provide clear information on the engine's operation, a specially calibrated VDO manifold pressure gauge is standard. Under boost conditions this gauge reads about 50 inches of mercury absolute. When the car is operating with manifold vacuum, it will read about 12-15 inches of mercury absolute. OEM gauges normally confuse the driver by using two different scales for vacuum and boost. The Callaway gauge provides accurate information on the same scale used in Indycars and by scientists, meteorologists and pilots worldwide.

Callaway operates a separate facility for Twin Turbo Corvette production. The cars are built at separate work stations. This means that one team of technicians completes the critical process of engine installation and final assembly for each vehicle. The average age of our technicians is 32 years, 12 of which have been spent working on cars. We feel this mix of experience and relative youth is a prerequisite for building these limited edition vehicles with the thoughtfulness and care you expect.

Each car takes approximately one man-week to build. At the first work station the Dymag wheels are mounted and all fluids are drained from the car. The engine is removed and wiring, frame and fuel system modifications are completed. Next the car enters the final assembly work stations where the technicians are supplied with fully prepared engines. At that point it is typically a two day process to complete the car.

The final inspection includes a series of both visual and drive checks covering over seventy-five specific areas of the car, ensuring that the final product is up to world class standards. Each car is put through a thorough visual inspection and a break-in drive of about 30 miles. After this first drive, the car is reinspected for fit and finish and the oil is changed. A second test drive is then taken during which the car is tuned for smoothness of acceleration at partial and wide open throttle as well as at the vacuum/boost threshold. GM's Tech 1 diagnostic system is used throughout the test because this portable data acquisition device can directly monitor engine operations and store the information for later analysis. The philosophy behind this testing is to see how well each car drives. Relatively little time is spent at wide open throttle, because it's at part throttle that subtle driveability problems often show up. A minimum of 100 miles is accumulated on any given car while it's in our hands.

The vehicle is complete only when the technician team leader, inspector and test driver are satisfied that the vehicle is right. This means your car is ready to drive when it leaves Callaway. All your dealer has to do is the final dealer prep, and the car is yours.

The result of our work is a Corvette without peer, one capable of outstanding performance and built by production methods representative of exotic car exclusivity. However, the Twin Turbo Corvette demands significantly less of you in initial price and long-term maintenance than the rest of the world-class sports cars from Germany or Italy.

To ensure your continuing satisfaction, the powertrain of your Twin Turbo Corvette carries a warranty of 12 months or 12,000 miles, whichever comes first. And to help support your car, we maintain a toll-free telephone number for service and parts needs. All turbosystem parts are stocked at the plant for immediate overnight shipment to any location in the U.S. Two day delivery is available to Europe.

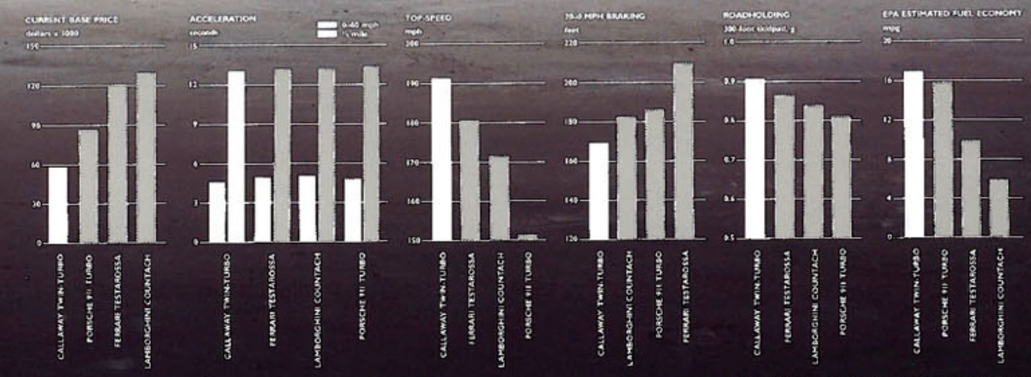
Each of our selected dealerships has a technician trained at Callaway specifically on the Twin Turbo Corvette. They spend three days at our production facility reviewing how the car is built as well as how it is serviced. This allows the Callaway-trained technician to properly diagnose problems, the basis upon which effective repairs can be made.

In addition, each car comes complete with an owner's and service manual package, including a "Quick Drive" guide.

**"DURING OUR TOP-SPEED TESTS, THE CALLAWAY WAS STREET-CAR COMFORTABLE... THE SILVER VETTE REGISTERED A ONE-WAY BEST OF 195.5 MPH."**
*Car & Driver, December 1987*

The idea behind the Twin Turbo—best expressed by our Chief Engineer, Tim Good—is simple: "A car aimed at those individuals who want to have the fastest, best-handling, best-braking car they can buy. And we're proud because it's American-made."

*Car shown equipped with optional aero-kit.*




*Figures are based on car equipped with MHS transmission with 0.60 O.D.*

**ENGINE SPECIFICATION RPO B2K**

***EQUIPMENT:*** L-98 engine block. 4 bolt main caps, splayed bolt style. Clevite engine bearings. Gas nitrided crankshaft, 60 $R_c$ journal hardness. LT-1 connecting rods, magnafluxed and blueprinted. Proprietary Cosworth or Mahle forged pistons, .006" oversize. Compression ratio, 7.5:1. High volume oil pump with direct overboard pressure relief. Engine oil cooler, air-to-oil. Aluminium cylinderheads with raised runner exhaust ports. Stainless steel inlet and exhaust valves. Upgraded valve springs, shimmed for equal pressures. Steel roller camshaft and hydraulic roller lifters. Plasma moly ring package. True roller timing chain. Specially hardened distributor drive gear. Corvette tuned port fuel injection system. Callaway Microfueler II fuel and wastegate management system. Callaway specification Memcal chip. Dry sump pump for turbo scavenge. Twin turbochargers with integral wastegates. Twin charge air coolers.

***PROCEDURES:*** Balance and blueprint all components. Magnaflux block and crank assembly. Re-machine block to accept 4 bolt splayed caps. Line hone main bearing bores. Decks squared to crank centerline. All galleries cleaned and replugged. All tapped threads are chased. Black lacquer engine block. Refinish T.P.I. with black wrinkle finish. Polished air inlet castings. Heatshielding and insulation of critical hotside components. Clean room assembly and inspection. Engines pressure tested for oil and coolant leaks before installation.

*Note: Callaway Cars, Inc. reserve the right to make changes at any time, without notice, to specifications, materials and design. Callaway Cars, Inc. does not condone exceeding posted speed limits.*


A production Twin Turbo Corvette next to the special research and development car that was proclaimed the fastest street car in America by Car and Driver. "It enables us to study road-car turbocharging, aerodynamics, and cooling at the outer reach of speed and power; all vital studies for development of the production version," says Reeves Callaway, President of Callaway Cars, Inc.

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