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SECRET REAR-ENGINE CORVETTE

Building A Legend

Corvette Fever follows the birth of ZR-1 1G1YZ23J9N5800144

text by Paul Zazarine
photography by Thomas Glatch

The Corvette is uniquely singular within General Motors. As the high-tech, high-performance two-seat sports car flagship of both Chevrolet and the corporation, it makes a statement about the General's capabilities as a manufacturer. Its fiberglass construction sets it apart from the remainder of the GM product lineup, and the Corvette Assembly Plant in Bowling Green, Kentucky, is one of the few stand-alone, single product GM facilities dedicated to building one car model — the Chevrolet Corvette.

The Bowling Green facility is one of the more modern plants in GM, and under its one million square foot roof over 1,000 people built 23,646 Corvettes in 1990. The plant opened in 1981, and produced its first Corvette on June 1, 1981. Shortly afterward, the St. Louis plant, home to the Corvette since 1954, permanently closed its doors, and since then Bowling Green

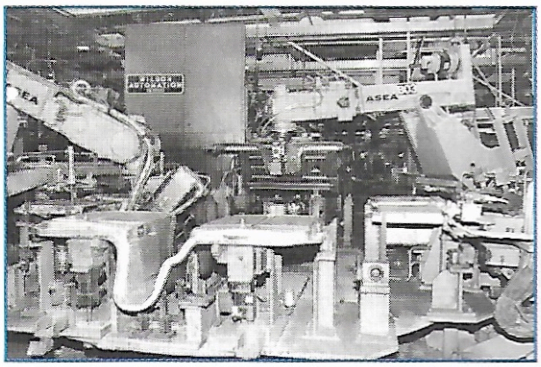
Building A Legend

has been the only source of Corvettes. Nearly 50,000 visitors tour the Corvette plant each year, making it the seventh largest tourist attraction in Kentucky.

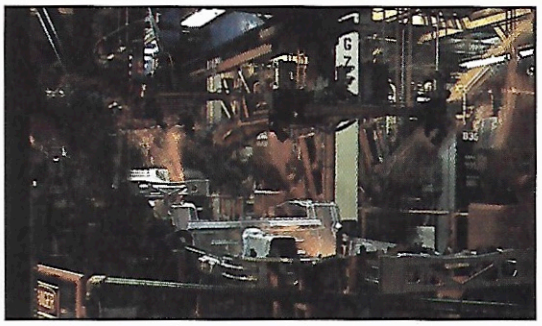
The transition from St. Louis meant more than just changing facilities. It also required the workforce to move to Bowling Green, and 90 percent of the people who work at Bowling Green started at St. Louis. And that's also another reason the Corvette is unique; the workforce is dedicated to building the best product they can. "I've never worked in a plant that attained this amount of pride in product," said Plant Manager Paul Schnoes. "I think it's because of the type of car, first of all, and secondly, because it's the only place the Corvette is built."

Talk to any of the folks on the plant floor and their pride in the car and their work is evident. Many of them

BODY

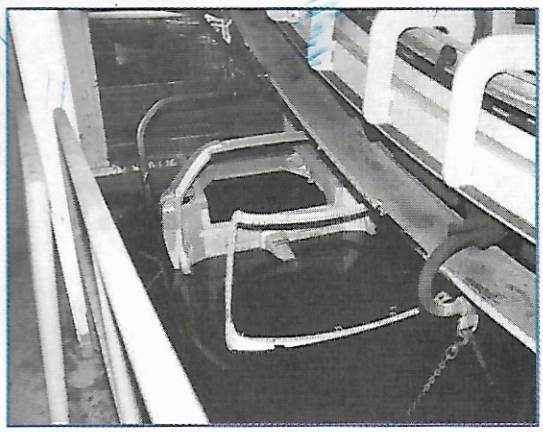


ZR-1 serial number 1G1YZ23J9N5800144 begins life as a floorpan. All of the welding operations are performed by robots as the uniframe begins to take shape around the pan. The bracings and reinforcements are manually placed on "cards" that are delivered to the robotic assembly stations. The robot arm picks the individual parts from the card, positions and then welds them in place.



The pan is now transforming into a frame. The siderails, front and rear crossmembers are installed. As the lower uniframe is taking shape, across from it is another robotic line that is building the upper frame and bird cage assembly. A transfer line separates the two areas. As the lower frame is completed, it is picked up, turned 90 degrees and placed on the transfer line. The upper section is then positioned over the lower frame, and the line carries the upper and lower sections into a large welding fixture where they are joined to become the uniframe.

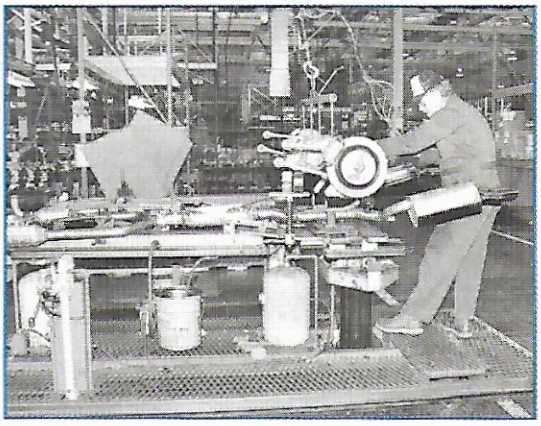
After the robotic welds are completed, the uniframe passes through several work stations where a series of MIG welds are done manually. The frame is also checked for any improper fit or bad welds. At this point, each uniframe is assigned a job number, sequenced from 0-1,000. If there is a problem, it's identified by the job number. Off to one side of the uniframe line is a "bank" of ZR-1, coupe and convertible frames to draw upon in the event a defective uniframe is pulled off the line.



After the frame is washed and dried, it's dip-primed and then moved to an oven for drying. Once dried, the uniframe is transferred to a Body shop truck (a dolly). It then goes to the Body shop for a series of sealer operations.

CHASSIS

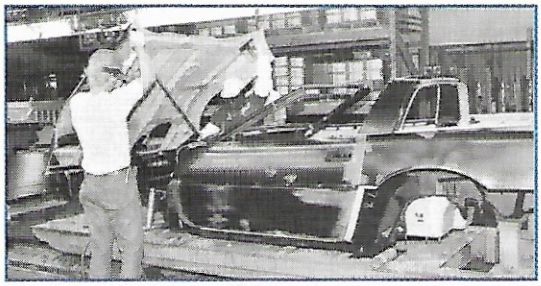
While the body begins as a single floorpan, the major components that will converge to become a chassis are assembled in separate but adjacent areas. The first step is the exhaust system, which is layed out on an assembly truck. After it's aligned properly, the exhaust is clamped and welded together. The truck then moves to meet the rear suspension, which begins as a differential and rear crossmember. From there, six-year veteran Sandy Chansler assembles the halfshafts, rotors and calipers, struts and the remainder of the rear suspension.



The completed rear is then transferred to the chassis truck by Jerry Bray. Jerry has been with GM for 20 years, first at the truck line in St. Louis and now with Corvette in Bowling Green. The truck holds the various assemblies in place until it is time to permanently join them together.

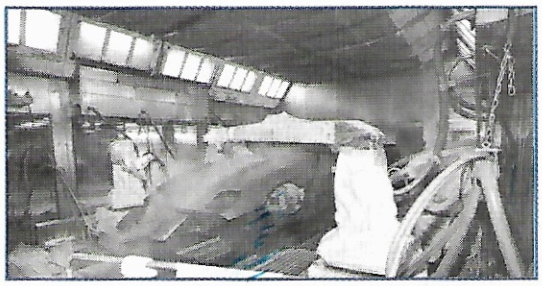
worked the Corvette line at St. Louis, although a number were employed on the truck or passenger car line as well. They refer to their fellow workers as "family" and the majority have been employed by GM for 20 to 30 years. Take Clifford Phillips, a body shop line repairman, who has built Corvettes for 30 years. He's owned his 1968 Corvette since 1977. "It will never leave my family, and my daughter's already said it will never leave hers." He's proud of his car and that he is a Corvette enthusiast. Along with the St. Louis veterans are workers who have joined the family since the plant opened 10 years ago. Most of them already have 5 to 10 years in, and their pride in the product is equal to the longtime workers. Today, 10 percent of the Bowling Green workforce are women.

It's popular to paint a broad picture of UAW

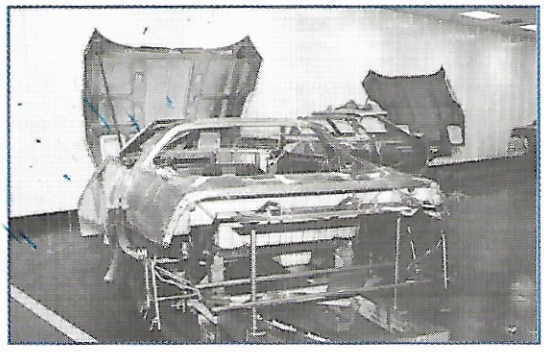


The uniframe is now ready to receive the body panels. Since the Corvette body consists of fiberglass, it is installed in sections and bonded together. The body panels are supplied by an outside source, and are inspected upon delivery to Bowling Green and sanded to remove any surface defects. They will also be inspected and sanded dozens of times as the body moves through the shop. Construction begins with the rear compartment, the door jambs and firewall. The rear deck is then bonded to the rear compartment. As it moves through the Body shop, the doors are hung. John Senn and Lennel Brooks then install the hood. After the hood latches are installed, they check the hood for proper alignment.

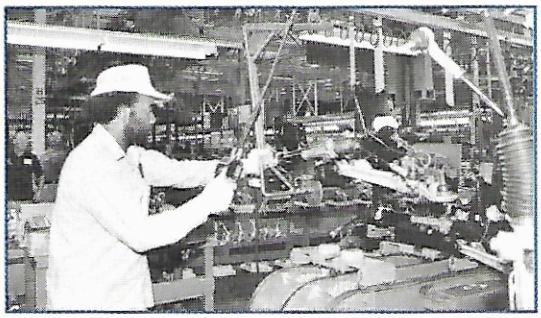
The removable hardtop now joins the body on the truck. The body moves through more sanding operations as workers inspect the surface before it goes into the Prep shop. After being wiped down with an alcohol and water solution to remove surface impurities, the headlamp doors and the fuel filler door join the body, carried on slave units on the truck. It then goes into the primer booth. The heat and light in the primer booth is intense; cool air is pumped through hoses into the suits worn by the painters. From there, it moves to an oven to dry the primer.



The primered body now enters the Paint shop where it is inspected for imperfections and again sanded and then wet-sanded, washed, dried and wiped down with a naptha-based solution. The Paint shop is closed off from the rest of the plant. It's extremely clean to eliminate airborne dust and dirt from ruining the paint, and well lit so any imperfections in the panel surface, primer or paint finish can be detected and corrected. Once in the Paint booth, six robotic arms apply two coats of base coat, wet on wet. After three minutes of flash time, six additional robotic arms down the line apply two coats of clear-coat, again wet on wet. The body then moves to a drying oven for a 30-minute session at 250 degrees.



Before the blackout process, in which the underhood and other areas are painted black, the painted surfaces are protected by a covering of clear plastic similar to Saran Wrap. This was an employee idea implemented several years ago. The plastic wrap is easier to apply than paper and leaves no lint residue. The two employees who submitted the idea received $20,000, the maximum award for implemented employee ideas. One took his $10,000 share and bought a Corvette!



In the meantime, the front suspension and engine mount crossmember are being assembled. The process starts as C.J. Thompson (a 14-year employee) installs the lower control arms to the crossmember. The ball joints are already installed from the supplier on both the upper and lower control arms. The front spring is already in place, and chains hold the lower control arm in place against the spring's tension. From there, the spindles, steering rack, rotors and calipers are installed. The upper control arm is attached to the spindle but hangs free so it won't interfere with the engine installation, which will take place farther down the line.

The engine for our ZR-1 is racked with two other LT5s in a pallet shipped from the Mercury Marine plant in Stillwater, Oklahoma. The LT5 engines are dyno-tested at Stillwater and the clutch and bellhousing installed before being bagged and shipped to Bowling Green. At the plant, the engines are unwrapped and placed on an overhead moving line.

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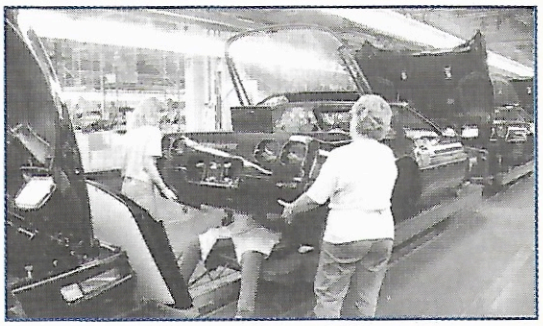
proportions. To lower costs and use space more efficiently, a "just in time" system of parts delivery began at Bowling Green four years ago. Just in time inventory limits the amount of parts kept in the plant. For example, only a day's worth of engines are inventoried. According to James Ahlers, general supervisor for Material, 2,400 separate parts are delivered to the Bowling Green plant every day. That equates to 28-30 semis unloaded per day at 12 plant docks. Of the 2,400 parts delivered daily, 178 are sequenced, so when they are unloaded and delivered to the work stations, the right part for the right model or color will be racked for the worker to install. To accomplish this, the plant locks in the build sequence three weeks prior to the actual assembly, and then advises the source of the sequence. "Take a colored part like carpets, for

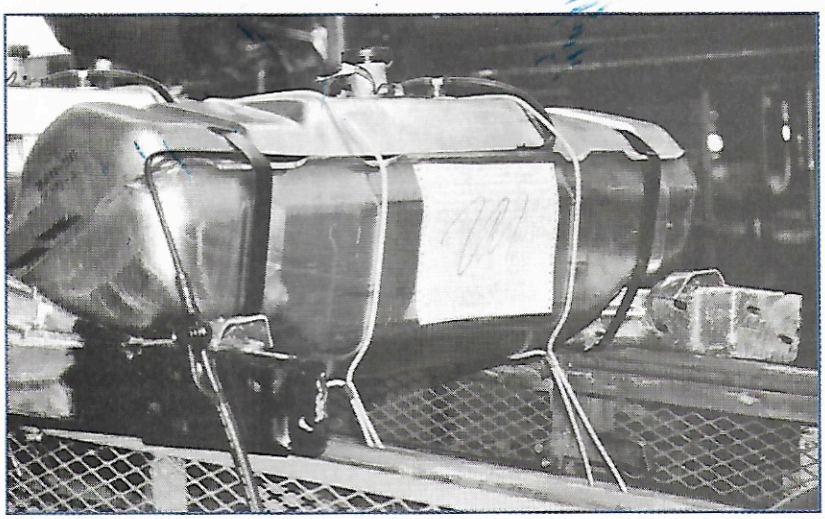
BODY

Twenty-two year employee Don Hazelwood installs the passenger door panel. At the same station, Bob Love, a 23-year veteran, installs the interior trim panels. Once it leaves their station, it will receive interior carpeting, rear speaker covers and console side covers.



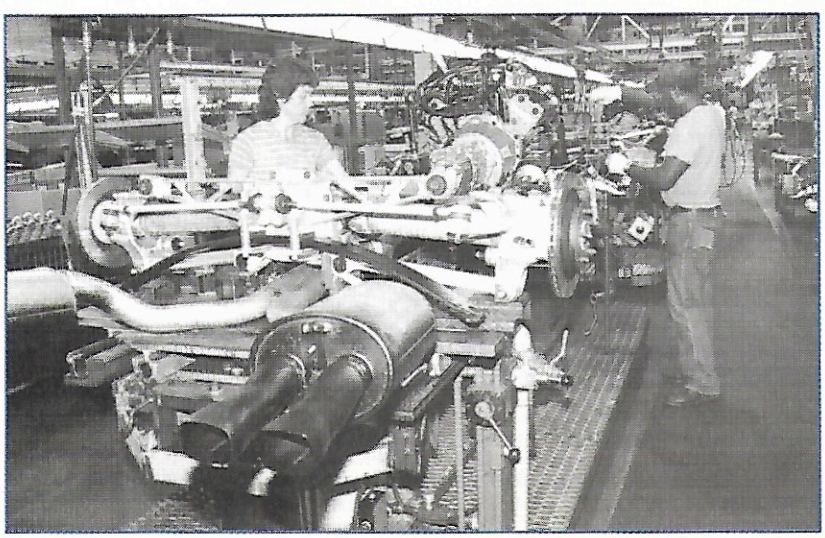
After the body side moldings, fender gill panels and coupe hatch glass weatherstripping has been installed, the rear fascia is attached. After installing the taillamps, fuel door and emblem, Cheryl Cherry and Carolyn Barnard carry the ZR-1's rear fascia to the line, where James Satterfield waits to bolt the fascia into place and connect the rear harness leads. All three workers have been with Corvette since 1984. After this, an overhead fixture will pick the body up off the trim truck and carry it across the plant floor to a mezzanine level drop point where it will descend to meet the chassis.

One of the last stops before the marriage is to install the fuel tank. The tank is placed on a movable fixture that positions it beneath the rear of the car. Rick Logsdon, Ronnie Bledsoe and Dave McKinney (all six-year employees) attach the tank while Jesse Henderson, a 22-year veteran, installs the fuel lines.



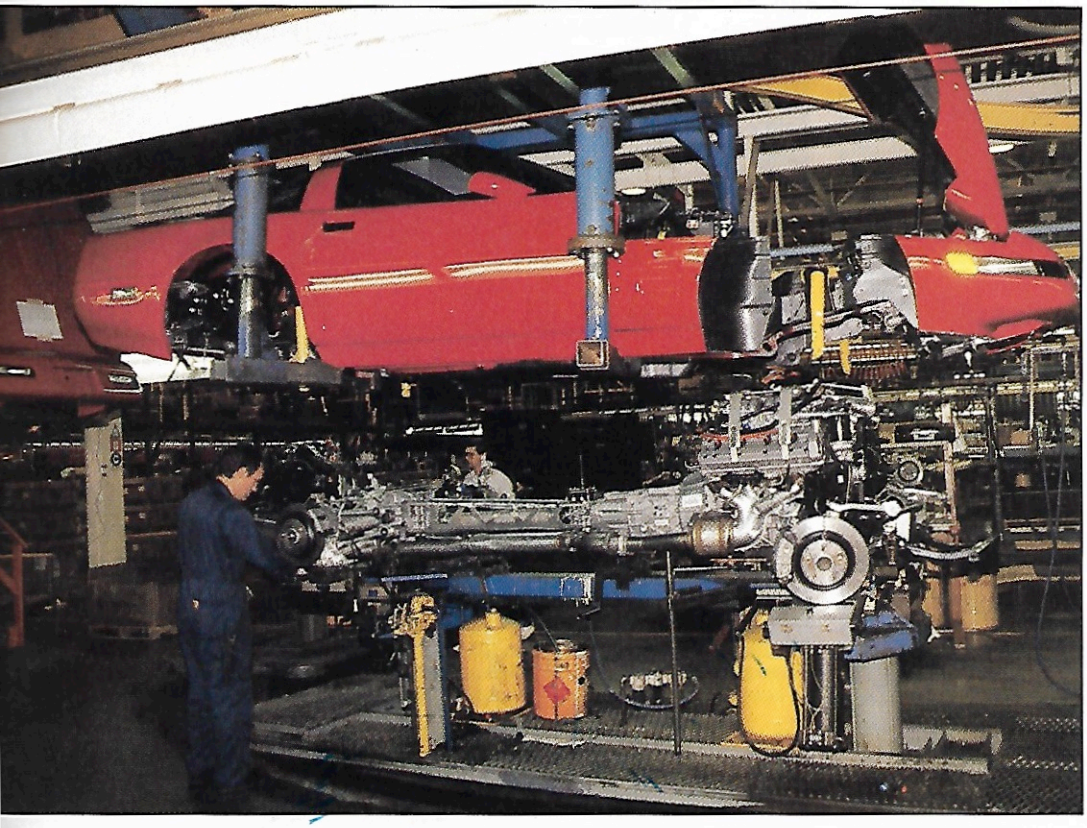
CHASSIS

Once the engine has been hoisted onto the chassis truck, Robert Pointdexter, who has spent the last 23 years with GM, and Debbie Loew, a six-year veteran, begin mating the components together. Debbie installs the driveshaft by moving the rear assembly, which is on a sliding platform, backwards, allowing her to insert the driveshaft into the transmission tailshaft. She then slides the platform back into position. As the chassis truck winds down the line, the exhaust system is attached to the engine, the brake lines are installed along with the master cylinder and the system is bled. After the chassis assembly operations are completed, the chassis truck takes a slow 90-degree turn where it will meet the body.



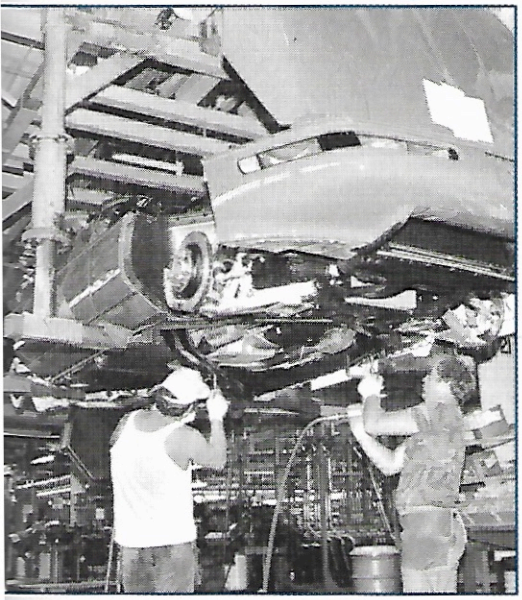
xample," said Schnoes. "Instead of seven or eight rpet piles of different colors, the source ships in one e of carpets in the sequence in which they're going come down the assembly line. It reduces our inven-ry, and assuming the source uses the same process, significantly reduces his as well."

The pride the workforce has for the Corvette is emonstrated in their determination to build a quality product. During every part of the assembly sequence, attention is paid to detail, fit and finish. For example, if a worker is installing a component and notices it won't line up, the area engineer is called in to visually inspect the part. If he detects a problem, he can take it to a check fixture to measure the component and verify it is being built to the blueprint specifications. The vendor also has a check fixture to randomly verify his

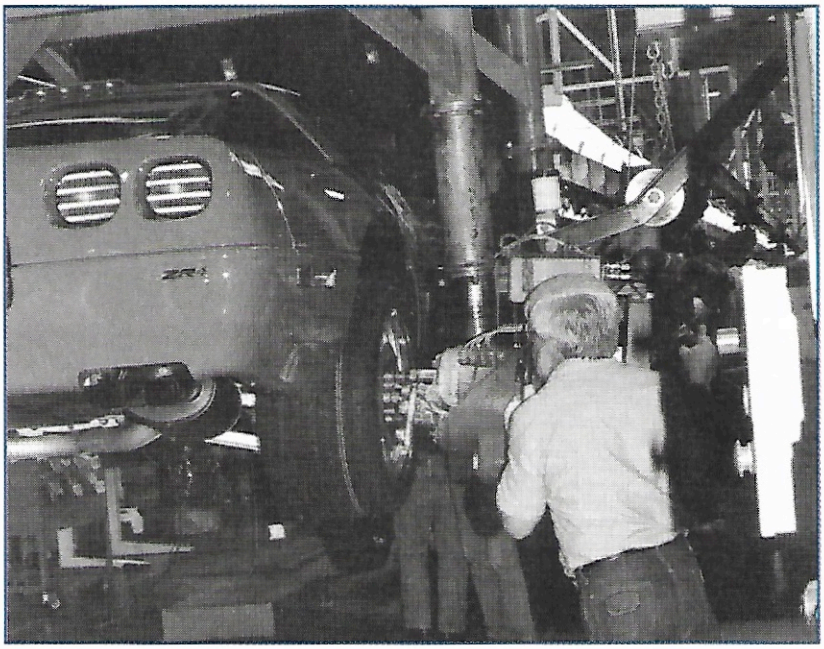


MARRIAGE

As the completed bodies move slowly down from the second floor on an overhead line, they converge with the chassis trucks, which approach from the left. The body/chassis marriage is the most fascinating operation in the assembly of an automobile, as the chassis slowly creeps beneath the body and the two finally becoming synchronous. As the body hovers over the chassis, it slowly lowers as Lanny Wininger (foreground) and Larry Williams make final preparations for the body drop. Notice the protective cover over the LT5 to protect the finish on the plenum and valve covers as the body is lowered.



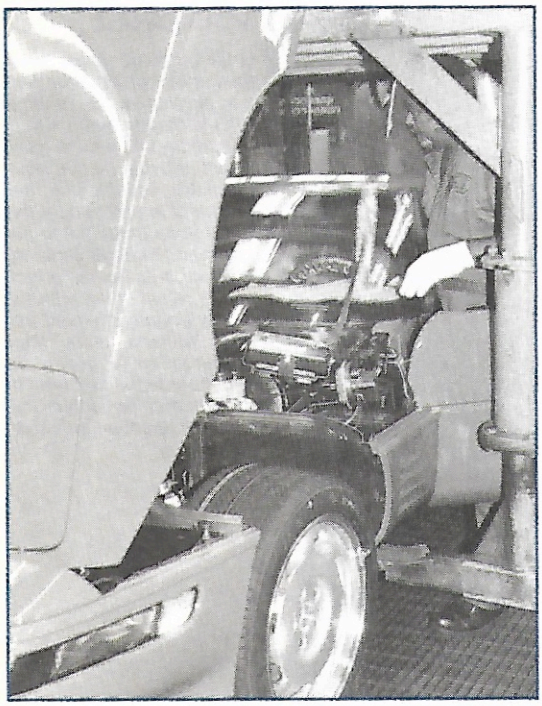
the car moves down the Trim line, the chassis is secured to the body and of the systems are connected or installed, including the ABS, exhaust elds, rear inner fenders, gas line bracketry and the spare tire tub. At ecific locations on the line, a 100 percent bottom end inspection is formed, and a work sheet is checked off, making sure all of the components installed and done to specifications. One step exclusive to convertible dels is the installation of an X-member to the bottom side, done by Mantle sson and William Dunning, to reinforce the body.



Ed Sweeney installs the 315/35ZR17 tires on the rear of the ZR-1. The mounted wheels drop in sequence down a rack to match the application as the car reaches Ed's station. After placing a pressure warning sticker on the wheel, he moves a fixture under the rack and places the tire on. After moving the fixture over to the car, he positions the wheel onto the lugs and hand-starts the lug nuts. Ed than tightens all five lug nuts at once with a single tool. A shield is placed over the face of the wheel to protect it from damage as the lug nuts are tightened. During a normal week of production, he will install over 1,100 tires.

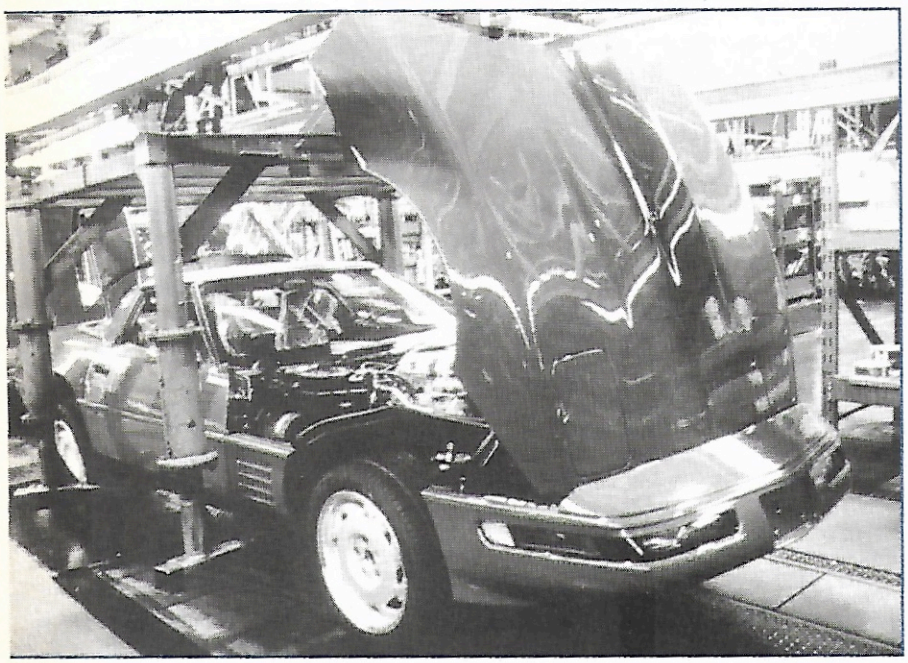
parts are correct before shipment to Bowling Green. If a check fixture is not available for the part, the blueprints are, and the part can be checked against the print. "Each operator is an inspector of his own work," said Ron Boyd, director of Quality and Reliability. "He or she knows how they put that operation together. That's one of the reasons we try to involve the workforce in everything we do, so they're aware of what the demands of the customer are and what the customer is finding fault with."

Quality is important to the workers and to Chevrolet, but there are times when something goes wrong — paint damage, misaligned or inoperative components. When that occurs, quality audit checks capture the error or damage. The affected cars are routed to an area where the problem is corrected and

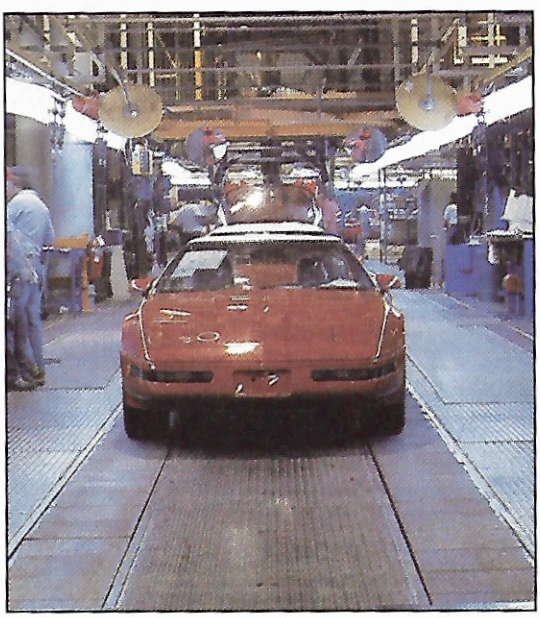


Since some interior components had to be installed in inaccessible areas first, the knee bolsters and seats can now be bolted in. E.C. McKenzie slips the passenger seat into the ZR-1 after installing the seat track.

As the ZR-1 moves down the line, all harnesses are connected, the ECM is installed, all fluids are filled, the idler pulley and serpentine belt are attached and the air conditioning system is sucked down and charged in one operation. The fuel lines are attached to the tank, the fuel pump operation is checked, air is purged from the fuel line, and the ZR-1 is started for the first time. Al Allen, a 23-year employee who moved to the Corvette line at St. Louis in 1974, checks the operation of the brakes, cruise control, wipers and all lamps.



The line makes a left turn and the ZR-1 touches down for the first time. From here to the end of the line, a moving belt in the floor will propel the cars from station to station. When the car hits the ground, the owner's manuals, all labels, decals and stickers are installed, as is the ratchet tool for the removable top. Next, the hood is aligned. Until the body and suspension are loaded with the car's weight, the hood can not be aligned. Twenty-one year veteran Roy Treece fits the hood not by sight, but by feel. Roy "feels the fit," and after 21 years, his fingers tell him far more than his eyes. He also checks the hood latch and release mechanisms for smooth operation and makes any necessary adjustments.



As the ZR-1 moves toward the end of the line, another electrical check is performed and the window sticker is installed. A leak test is conducted using an ultrasonic generator placed in the car and a wand is moved along all windows and door seams. Any sound leaks will be picked up by the wand, indicating a potential water leak. If the reading is high, a repair ticket is written up and the gap will be repaired. To correct minor flaws, three repairmen are stationed at the end of the line. Their responsibility is to repair any defects caught by inspectors on the line and to "finesse-fit"' the convertible tops.

then returned to the "finesse" line, located at the end of the assembly line. "Paperwork travels with the car," said Boyd, "and that's a major part of the communication necessary to build a car as complex as the Corvette, particularly from one area of the plant or one operator to the next. Not only does it tell the operator how to build the product, but also if there's a defect or something that needs further adjustment." Nothing goes out the door with a known defect, and with the extensive quality checks, every attempt is made to ship a Corvette built as well as humanly possible. "We recognize there's a lot of competition in the field or choices the customer has," said Schnoes. "Corvette is America's only true sports car and we think the entire workforce is dedicated to seeing it remains that way."

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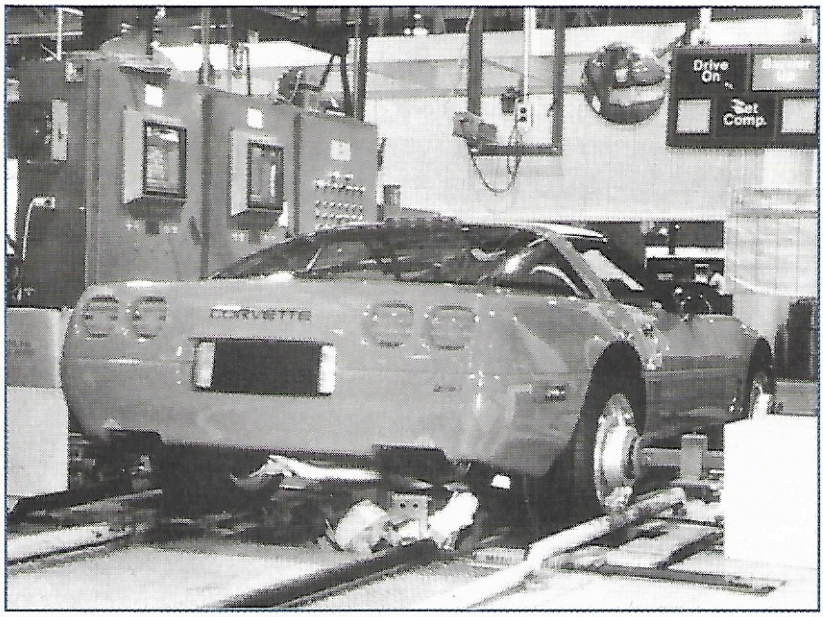

After the final audit is conducted, 21-year employee John Pointer drives the ZR-1 off the line, across a "jounce track" to shake the chassis down and then to the alignment pit, where Larry King and William Douglas stand beneath the ZR-1 and align the front and rear wheels using LED readouts to indicate the proper settings.

From the alignment pit, the car is driven to the DVT (Dynamic Vehicle Test) booth, a computerized check of all vehicle functions. After plugging the test computer into the ALDL plug under the instrument panel, George Ford types in the Corvette's VIN and the computer takes the ZR-1 though its paces. The DVT will test the air conditioning system, transmission up and down shifts, ECM, cruise control and other functions. George follows prompts from the computer on a TV monitor, telling him, for example, when to apply throttle and at what rpm.

Once the ZR-1 passes its DVT test, it's driven over to the one of two water test booths, where a four-minute spray of water drenches the car. The high-pressure spray will turn up any water leaks into the interior during this test.

After the water leakage test, the ZR-1 goes to the "finesse line." Convertible tops receive a protective plastic cover. The finesse line is the last opportunity to inspect the paint finish for flaws under extremely bright lights. If any defects turn up, the paint is gently cut and then repolished to see if the defect is repaired. If the fault can't be repaired here, the car is pulled off the line and taken to an adjacent area for paint repair. If the car passes, it stays on the finesse line and moves through a wash booth. Once washed, paper mats are placed on the floor and the paint is glazed. Floyd Channel, a 24-year GM employee and owner of an 1981 Corvette, places the fuel door emblem on the ZR-1 while up front Danny Bruce installs the hood emblem and the underhood "Built In Bowling Green" plaque. From there, the ZR-1 is sprayed with a protective coating in a small, garage-sized spray building right next to the plant exit.

Building A Legend

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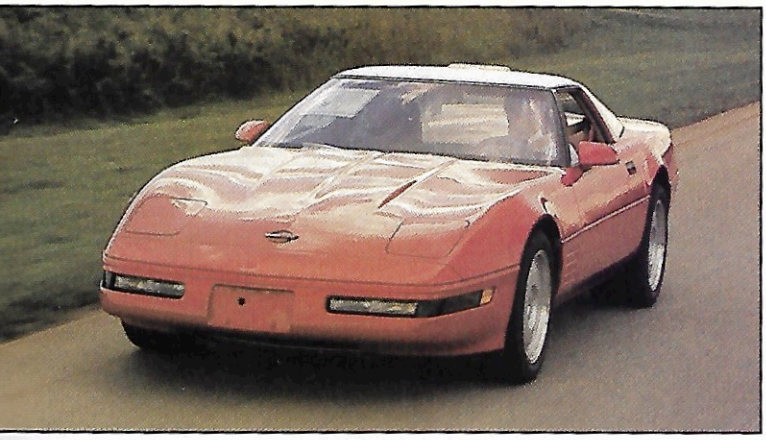
A new program implemented for the 1991 model year was the Drive Audit. The first 776 Corvettes built were driven by employees to evaluate product quality. "The Drive Audit," said Boyd, "allowed us to get immediate feedback by looking at cars the way a customer would when he first takes delivery, tries everything out and drives the car a few miles. We immediately fed that information back into the build process, so we could improve the car and contain any known problems back further in the system and get the quality levels up the first time."

The continued improvements in quality control are best illustrated in the testing procedures for the ZR-1. "We road tested every 1990 ZR-1," said Ed O'Keefe, Corvette Product Improvement Engineer. "But since the '90 ZR-1s tested so well, and we've been able to keep improving the car, we're only going to test the 1991 ZR-1s at random."

Since it all began in 1953, the Corvette has remained America's only true sports car and the pride of General Motors. The noble legacy of five generations of Corvette isn't lost on the people who build the car today. "Our workforce is proud to be building a car that has the heritage this vehicle has," said Schnoes. "It's their intention that the heritage — the mystique — remains over the years and in the future. We're dedicated to making sure the Corvette built today has just as much mystique in the year 2000 as it has today." **CF**



1G1YZ23J9N5800144 is taken for a test ride by Corvette Improvement Engineer Ed O'Keefe. For 1991, ZR-1s are randomly selected for several laps around the assembly plant perimeter road. Test drivers listen for drivetrain noises, vibrations or interior noise. The problem is noted, repaired and the car is retested to verify it was corrected. After the test drive, 1G1YZ23J9N5800144 was shipped to Shelton Harrison Chevrolet in Millington, Tennessee. If you take delivery of a ZR-1 and find some miles on the odometer, don't blame the dealer. Chances are your ZR-1 was test driven at the plant prior to shipping.