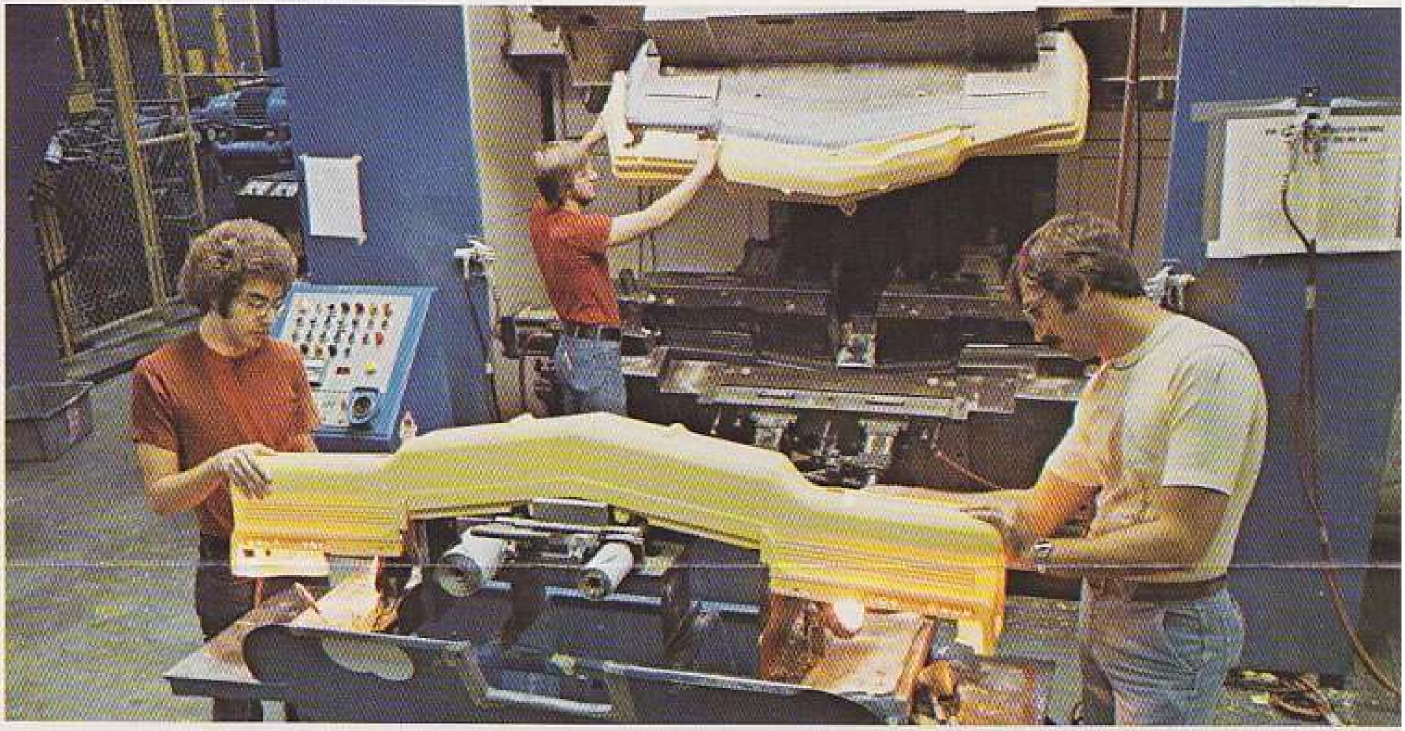
Business - Guide Lamp



MANUFACTURING

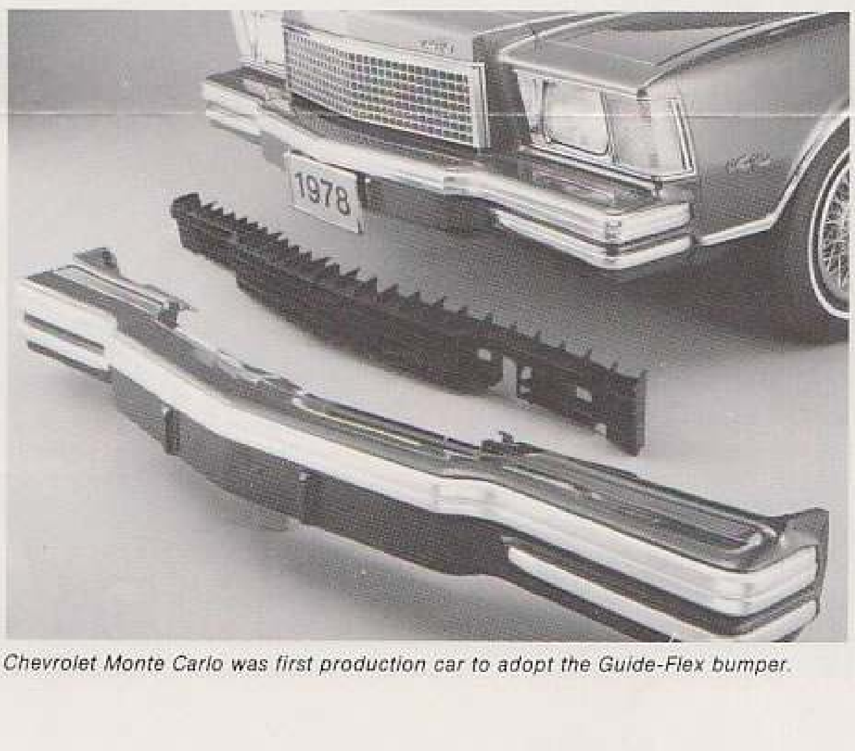
Inside Guide: Building that plastic bumper

GM's Guide Division has swung into high production on its innovative bumper that uses an engineered plastic structure as the shock absorber, saving up to 100 lb per car. Here's the inside story on how they produce and assemble the Guide-Flex bumper.

Certainly plastics are not strangers in bumper applications. Various elastomers have been used in bumperettes, rub strips, filler panels and fascia.

By and large, however, the applications have been modest in design concept; the plastic was used primarily for appearance, limited dent resistance and styling versatility. The real impact resistance was provided by conventional metal components: a steel or aluminum face bar attached to a set of shock absorbers mounted to the car's frame.

As the pressure for better mpg performance mounted, attention inevitably turned to the bumper as a candidate for weight reduction. As in other areas of the car, plastics offered an obvious potential for weight savings. But to deliver this potential, plastics would have to be upgraded from their usual role as a cosmetic element or minor-impact absorber. It would have to become the primary impact absorber, a problem that calls



Chevrolet Monte Carlo was first production car to adopt the Guide-Flex bumper.

Fig 1. Microcellular polyurethane fascia, the protective/decorative outer cover for the Guide-Flex bumper, is molded in 3-min cycle on line of 20 RIM presses. After removal from the tilt-open mold (improves operator access), the transluscent part is inspected for flaws while on the illuminated fixture. The trimmed part is then loaded onto an aluminum fixture on tow line that takes it through a 250F postcure oven.

Fig 2. Postcured fascia, after another QC inspection and washing and priming, moves through paint line where four coats of urethane paint are applied. Thirty-four different colors are available. To change colors, operator merely plugs his spray gun into proper supply line. CRT screen shows how many fascias of each color (or color combination) are needed and when the paint color should be changed.

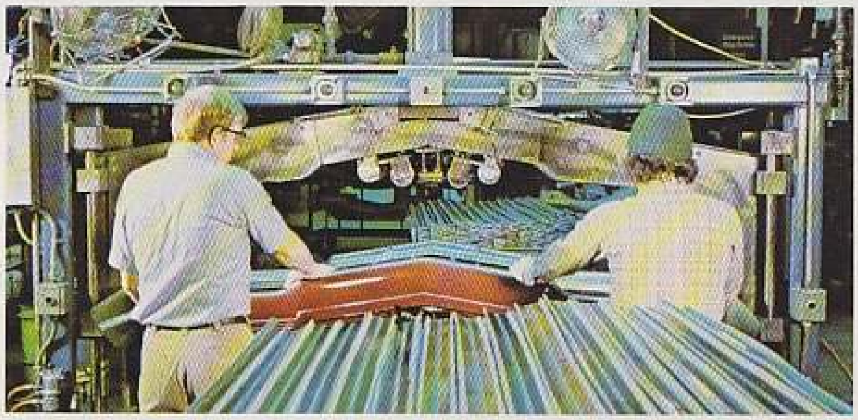
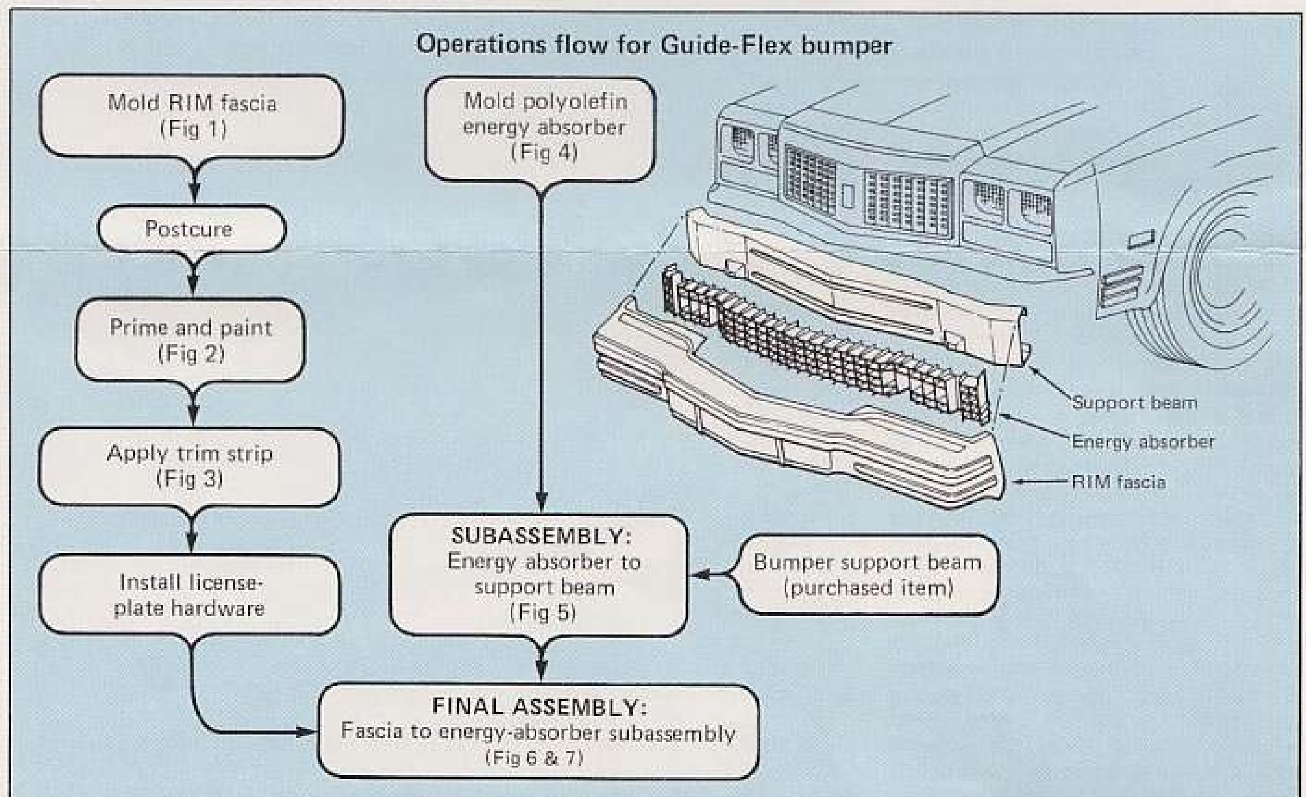


Fig. 3 For the bright touch required for some models, a vinyl trim strip with laminated metallized film is applied to the fascia. The trim is attached to the fascia by means of pressure-sensitive tape. Press in the background applies the force for bonding. Bonding is aided by the residual heat in the fascia, which came from the paint-cure oven a short time previously. Additional heat bled off from the paint-line fixture helps keep the fascia warm for trim attachment.



Engineered polyolefin honeycomb structure replaces 'shock' system.

for unconventional design thinking.

Engineers at the Guide Div. of General Motors, Anderson, Ind., have solved that problem. They sharpened their pencils and found a way to use plastics to build a bumper that weighs significantly less than the conventional steel bumper with shock absorbers, yet meets the NHTSA's collision standards.

The result of this effort is the Guide-Flex bumper, which is now standard on the front and rear of the Chevrolet Monte Carlo and on the rear of the Pontiac Firebird and Chevrolet Camaro.

Relying largely on plastics for its main functional parts, the Guide-Flex bumper saves from 10 to 50 lb over conventional metal bumpers with comparable impact resistance. On the Monte Carlo, for example, it cuts the curb weight by about 100 lb.

Moreover, the bumper meets the NHTSA bumper standard not only for 1979 (no front-end damage from a 5 mph impact), but also the tighter 1980 standard (no damage to the bumper itself from the impact).

Three major parts

The Guide-Flex bumper consists of three major components, two plastic and one metal.

The principal plastic component is the energy absorber. This part, which weighs about 12 lb, duplicates the function of the hydraulic pistons or similar shock-absorbing systems weighing several times as much that are used on conventional bumper systems. The second component is the fascia, the decorative outer covering of the bumper. The third is a metal support bar on which the plastic components are assembled. This steel or aluminum stamping is the rigid backbone of the bumper. Bolted directly to the chassis structure, it protects the car in collisions at speeds over 5 mph.

The energy absorber is injection molded from a polyolefin compound. The fascia is a reaction-injection molded (RIM) polyurethane elastomer.

Polyolefin energy absorber

The polyolefin energy absorber, which resembles a complex honeycomb (or three-dimensional grid), is a one-piece unit that spans the full width of the bumper. Its function is to provide enough "give" to enable the bumper to absorb the collision impact and then recover to its original shape. Though simple in concept, the energy absorber is quite sophisticated in design.

Looked at head-on, the energy absorber resembles a strip of modular honeycomb elements. The geometry of these modules is not uniform across the width of the bumper. It is varied to provide the required impact-energy absorption at all angles of impact and/or to conform to the configuration of the bumper.

To provide the required crush resistance, cell size and cell-wall thickness must be tailored to the mechanical properties of the plastic. Depending on the application, cell-wall thicknesses can range from about 0.060 to 0.180 in. and individual cell dimensions from 3/4 to 1 in. wide. The depth of the cells ranges between 1 1/2 to 4 in. in different modules.

Because of the relatively thin walls and considerable depth of the cells, the molds had to be very carefully designed (details are proprietary) to assure adequate melt flow to fill the mold and reliable ejection of the molded part.

In several designs, the adjacent modules of the energy absorber are separated by "living hinge" strips. These strips provide the flexibility to conform to sharp curvatures along the bumper, particularly at the wrap-around ends.

The energy absorbers are produced on a line of six, fully-automatic 1000-ton molding machines equipped

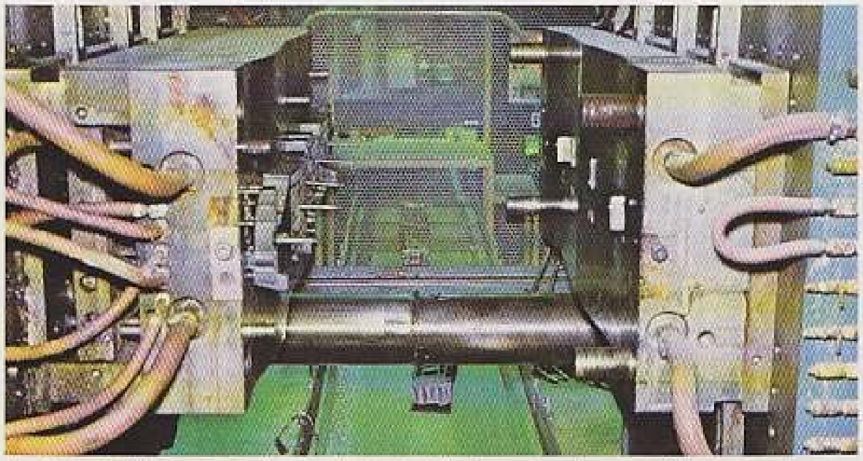


Fig 4. *Polyolefin energy absorber is key to the impact resistance of the bumper. Molded in two-cavity molds on line of 1000-ton presses, these black highly-engineered parts are ejected onto floor-level belt conveyer that carries them to operator who inspects, degates and transfers them to assembly-department conveyor.*

Fig 5. *In first subassembly step, energy absorber is fastened to metal support bar using Pop-type rivets. Support bar may be stamped from steel or aluminum. This subassembly serves the same function as the hydraulic cylinders and mounting brackets of conventional bumper systems weighing about twice as much.*

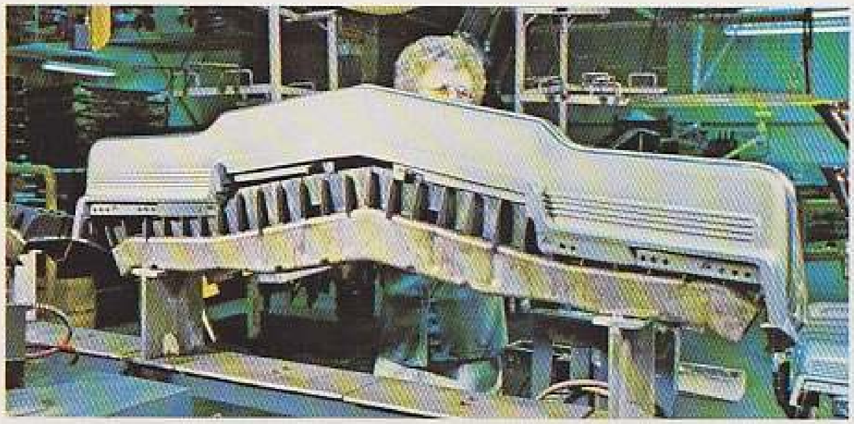


Fig 6. *In final assembly sequence, RIM urethane fascia is lowered onto energy-absorber subassembly for fastening. Before arriving at this point, fascia has had trim strip applied (if used) and has received hardware for attachment of license plate mounting bolts, bulb socket, etc.*

Fig 7. *And finally, at adjacent station, the fascia is permanently attached to the energy-absorber subassembly. Polycarbonate snap-in fasteners (see inset) secure fascia to bottom edge of bumper-support bar. Pop-type fasteners are used to secure the top edge. The Guide-Flex bumper is now completed, ready for shipment.*

with dual-cavity molds. Cycle time ranges from 70 to 90 seconds, depending on the part.

RIM fascia

The second major plastic component of the Guide-Flex bumper is the RIM polyurethane fascia. The part is molded from a 25,000 psi-modulus formulation on a battery of 20 Cincinnati Milacron 75- or 100-ton RIM clamps. Wall thickness varies from 0.120 to 0.150 in. The production cycle is about 3 minutes. Of this, approximately 30 seconds is mold filling and reaction time. The remainder is operator time, for stripping the part and cleaning and spraying the mold with mold release.

The entire molding sequence from mold-close to filling to mold-open is controlled by a programmable controller at each machine. Steel molds, maintained at about 110F by heat exchange lines that remove the exotherm heat, are used.

When the RIM fascia is removed from the mold, it still is in "green" condition ("B" stage of cure) and must be postcured for about 1 1/2 hr at 250F to develop its full mechanical properties and permanent shape.

After trimming and inspection, the newly molded parts are placed on cast aluminum fixtures mounted on carts, which are circulated through the production area by an underfloor tow line. These carts take the fascias through the postcuring oven. The high thermal conductivity of the aluminum fixtures aids heat transfer to the fascia, minimizing their residence time in the oven.

Painting the fascia

After inspection, and repair if needed, the fascias are washed to remove the mold release and any loose flash or dust before the black base coat is applied in the priming booth. Then the primed fascias receive four coats of urethane in the finish-coating booth.

A bumper may be painted with any of one, or a combination of 34 different colors. A CRT terminal, tied into a computerized production scheduling system, informs the spray-booth foreman how many fascia of each color are needed. Based on an automatic-counter input, the CRT also indicates when to change colors.

After the fascia come from the paint-curing oven, they make a few more stops before reaching the final assembly area. Hardware is installed for the license-plate and rear-light mountings. Some also receive a bright trim strip.

Trim application

The bright trim for the fascia is a composite strip. It consists of a metallized foil laminated to an extruded flexible vinyl strip and protected by an extruded clear vinyl top coat. This purchased composite is furnished with a double-faced adhesive tape on its back for attachment to the RIM fascia.

The trim strips are manually positioned on the fascia, then bonded in place using specially designed applicator presses to affix the pressure-sensitive adhesive. After the trim strip is applied, the painted RIM fascia is ready for final bumper assembly.

Final assembly

In the final assembly operation, the three major components are combined to produce the finished bumper. It is done in two steps.

First, the injection-molded energy-absorber honeycomb is fastened to the stamped metal support bar. The fasteners are Pop-type blind rivets spaced along the length of the beam.

As the final assembly step, the fascia with its previously installed hardware is mounted to the energy-absorber subassembly using snap-in plastic fasteners on the bottom of the bumper-support bar and Pop rivets on the top. This completes the bumper, which is now ready for shipment to a body assembly plant.

The simplicity of the bumper's design carries through to its assembly on the car body. The bumper is attached to the car simply by bolting the support bar to the frame. □

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