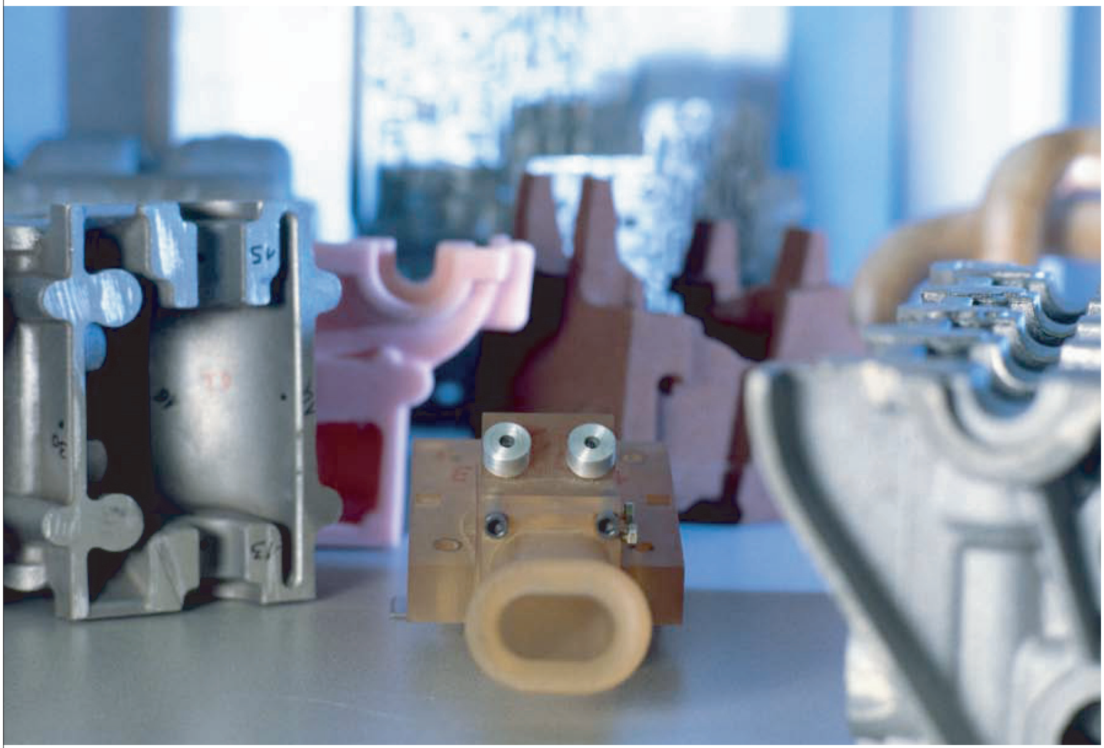
R

RAPID PROTOTYPING

Rapid prototyping is to computer-aided design (CAD) what the conventional printer is to a word processor. **It outputs representative physical parts directly from CAD design files.**



- Safety
- Environment
- Life on board
- Mobility
- **Competitiveness**

BASIC FACTS

Producing a prototype by traditional methods, like sheet metal stamping, metal part die-casting, or plastic injection can take several months. However, determining the tools for manufacturing a car begins a long way upstream from the actual production process and development lead times are growing shorter. Traditional protoyping is thus not always the ideal solution. Even if computer-assisted design (CAD) tools can deliver excellent results, it is important to be sure that no problem is likely to arise in final assembly. The only solution is therefore to produce a physical part from digitized CAD files. Similarly, true judgements can be formed only from actual parts like a dashboards or handles in their real-life environment.

This is where rapid prototyping comes in. Thanks to its “3D printers” it can ensure delivery in two to five days of parts like door trims, and in two weeks of more complex pieces like dashboards, that need finishing and assembly. Each part can then be finally approved and the tools required to make them engineered.

IN SHORT

RAPID PROTOTYPING MAKES USE OF DIGITAL FILES CONTAINING CAD VIRTUAL DESIGN DATA. THEY ENABLE 3D REAL-LIFE PARTS TO BE PRODUCED IN JUST A FEW DAYS, INSTEAD OF THE SEVERAL WEEKS NECESSARY IN TRADITIONAL PROTOTYPING.

HOW DOES IT WORK?

Digital milling and hot plastics are still widely used for rapid prototyping. However an approach that is developing fast is for a machine to use a laser to fabricate a part from a digital CAD file, outputting the data to a 3D printer, which builds an actual, physical part. There are three different fabrication techniques: sintering, stereolithography, and fused deposition modelling. Each method has particularities which make it more less suited to fabricating specific items according to the required mechanical or visual properties.

Sintering involves the fusing, or polymerization, of powder materials, including polymers (plastic). The fusing is carried out by a laser which moves by scanning cross-sections from CAD files, building the part layer by layer. This method is particularly wellsuited to fabricating parts, like dashboard, that are likely to be assembled and disassembled during testing. The mechanical properties of the sintered part – how flexible or stiff it is – are relatively similar to those of the definitive part. It is even possible to make flexible or elastic parts by adding specially treated powder. Radiator hoses, for example, can be fabricated in this way. The powder can contain powdered glass to make it stiffer and more heat-resistant, which can be useful for parts in the vicinity of the engine block. The only drawback of sintering is the roughness of the surface of the fabricated parts. They require considerable manual finishing work before their design can be fully assessed.

Stereolithography involves solidifying a liquid resin contained in a vat by tracing a laser beam on its surface. A part is fabricated layer by layer, with the laser beam tracing shapes from data in CAD files. Stereolithography is the most commonly used prototyping typing technique. It is particularly well adapted to making small items like buttons, handles, and vent grills. Its main drawback is that parts are sensitive to ultraviolet rays. Daylight and sun rays impair their mechanical properties. Gradually parts become brittle and distorted. This downside restricts the use of stereolithograpy for components requiring multiple assembly and disassembly on a prototype.

Fused deposition modelling (FDM) is the only one of these new techniques not to use laser. A nozzle extrudes filaments of hot, melted ABS polymers or polycarbonates. The movements of the nozzle are determined by CAD software. A part takes shape as it is built up from layers of melted plastic that harden immediately. The main advantage of the technique is that it uses the same material as the definitive part, so can be used to validate bonded or thermowelded parts. The downside is that parts are very porous because imperfections form between each pass of the nozzle. What's more ABS polymers are sensitive to heat and are not resistant to high temperatures. FDM should not therefore be used to make parts exposed to high temperatures, like those in the vicinity of the engine block.

RENAULT