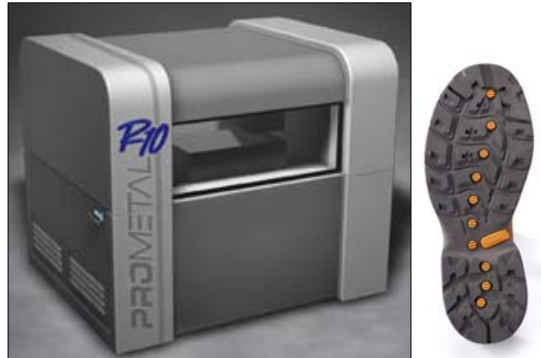


Saving Time with 3-Dimensional Printing

ExOne's Rapid Prototyping Machine Saves Time and Money



The ExOne R10 3DP machine produces tools (molds) and highly detailed prototypes, such as this Timberland boot sole. Instead of hiring professional model makers to turn 2D CAD footwear drawings into 3D prototypes in a week's time at a cost of \$1,200 each, a 3DP printer takes 90 minutes and costs \$35.

The Challenge—In the late 1990s, the U.S. auto industry was replacing steel components with complex cast aluminum engine components to reduce weight and energy consumption. But existing processes required long lead times to design and manufacture the tools (molds), and more than 50 components to allow numerous connections for pellet insertion, steam, and moisture vacuum.

Extrude Hone Corporation formed a joint venture partnership with General Motors Powertrain Group and subcontractor Massachusetts Institute of Technology to develop a new prototyping process called three-dimensional printing (3DP): repeatedly print thin layers of bonding material onto paper-thin layers of powder to build up a part shape from a computer-aided design (CAD) model. Thus they would construct complex metal prototypes and tools directly from the CAD model. The companies received cost-shared funding in 1997 from ATP for the four-year project under a "Motor Vehicle Manufacturing Technology" focused program.

The Outcome—Extrude Hone researchers increased 3DP accuracy and reduced cost by a factor of three to four. Extrude Hone uses 3DP to build metal parts, as well as metal prototypes and tools. The 3DP process

is adaptable to a variety of materials beyond the auto sector, even footwear prototypes.

Extrude Hone spun off its research and development arm, ExOne, in 2005. As of 2006, the company was scaling up 3DP technology to larger, faster machines and scaling down the technology to produce smaller, more precise components. ExOne produces machines for two key processes: direct metal printing and rapid casting. In addition, ExOne provides its services to companies that are too small to purchase the machines (at a cost of up to \$1.5 million).

For direct metal printing, ExOne offers three commercial 3DP machines based on the ATP-funded technology: the original R10 (see figure); the SR-2, built for speed, agility, and flexibility; and the RCT S15, which produces prototype metal parts for testing.

For Rapid Casting, the RCT S15 enables fabrication of molds and cores that are often impossible to create by conventional means. This offers the flexibility to produce complex, finely detailed, patternless castings while reducing production costs and time to market.

Partnering Organization:	ExOne Corporation (formerly Extrude Hone Corporation), Irwin, PA and General Motors (GM) Powertrain Group, Pontiac, MI
Project Duration:	19/19/1997 – 12/18/2002
Project Cost:	\$3.2M ATP cost-share; \$3.2M industry cost-share
Project Brief:	http://jazz.nist.gov/atpcf/prjbriefs/prjbrief.cfm?ProjectNumber=97-02-0055
Project Status Report:	http://statusreports.atp.nist.gov/reports/97-02-0055.htm Research conducted December 2005