

Dimensional Restoration of High-Value, Precision-Gauging Fixtures by Cold Spray

By Julio Villafuerte



A commercial SST cold spray system. (Photo courtesy of CenterLine (Windsor) Ltd.)

Precision gauges and fixtures to dimensionally check automotive components are typically made of heat-sensitive aluminum alloys using a variety of subtractive and/or additive manufacturing techniques — Figs. 1 and 2. Because of the required precision, the machining and finishing costs are often too high and, consequently, any machining mistake can become prohibited. Additionally, recurrent use of the tool leads to unavoidable wear and tear that eventually renders the tool unacceptable for the job even if there could be considerable value remaining.

Aluminum alloys used to fabricate

these components are specially heat treated. These materials are sensitive to any process or procedure such as welding and/or conventional thermal spray, which create a heat-affected zone (HAZ) on the substrate. Not only would the material properties in the HAZ become substandard, but the dimensional accuracy of the tool would be lost due to thermal distortion.

Cold spray technology offers the ability of metal consolidation that can dimensionally restore these tools with minimum or no thermal effects. Therefore, manual and robotic cold spray technology, which is operated at low pressures and low

temperatures, has become a reliable and effective tool for the industry — see lead photo.

Cold spray is a solid-state metal consolidation process that uses a high-speed gas jet to propel metal and other powder particles against a substrate where particles plastically deform and consolidate upon impact. The term “cold spray” refers to the relatively low temperature involved in the process, which is typically much lower than the melting point of the spray material and substrate. With the SST™ cold spray equipment, air can be used as a propellant gas and temperatures will be

low enough not to thermally disturb the substrate material. After low-temperature dimensional restoration of the area, the new consolidated material can be effectively machined back to tolerance using standard machining techniques.

Because adhesion of the metal powder to the substrate and deposited material is achieved in the solid state, the characteristics of cold spray deposits are quite unique, making cold spray suitable for depositing well-bonded, low-porosity, oxide-free coatings. These attributes make cold spray uniquely suitable for depositing a range of temperature-sensitive materials in this application.

Tool issues such as over machining as well as wear and tear can be easily fixed with cold spray technology.

Over Machining

Quite often, there may be irreparable errors in the machining operation that renders the tool useless. In these cases, it is possible to cold spray an equivalent material to dimensionally restore functionality (Fig. 3) and then remachine to proper tolerance.

Wear and Tear

Wear and tear can be easily repaired by cold spray technology by filling in cold spray with the appropriate material (Fig. 4), then machining back to tolerance.

The SST cold spray technology has shown to be cost effective for manufacturers who used the technology

to salvage a number of high-value fixtures that were either wrongly machined or simply worn beyond their useful life.

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Fig. 1 — Subtractive machining of a geometrically complex aluminum-gauging tool for checking automobile polymeric shapes.

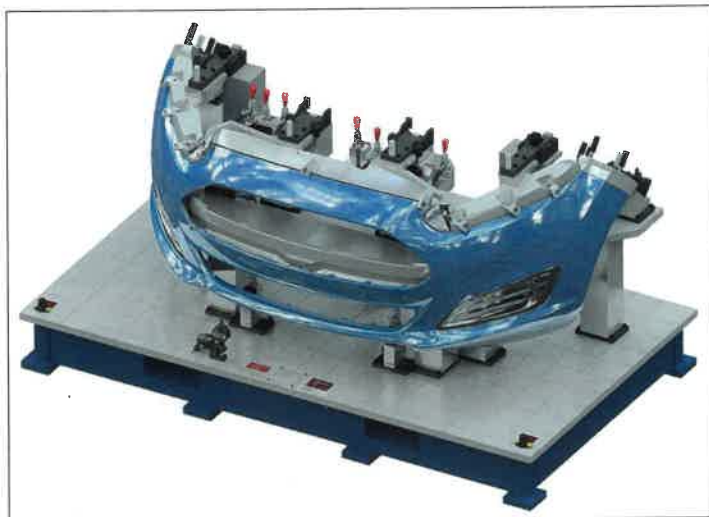


Fig. 2 — Finished check fixture for dimensionally validating a plastic front bumper.

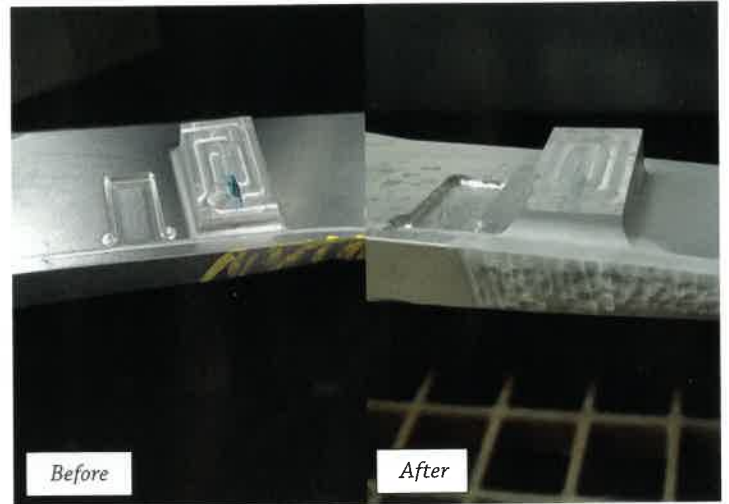


Fig. 3 — Machining errors dimensionally repaired with SST cold spray (before/after).

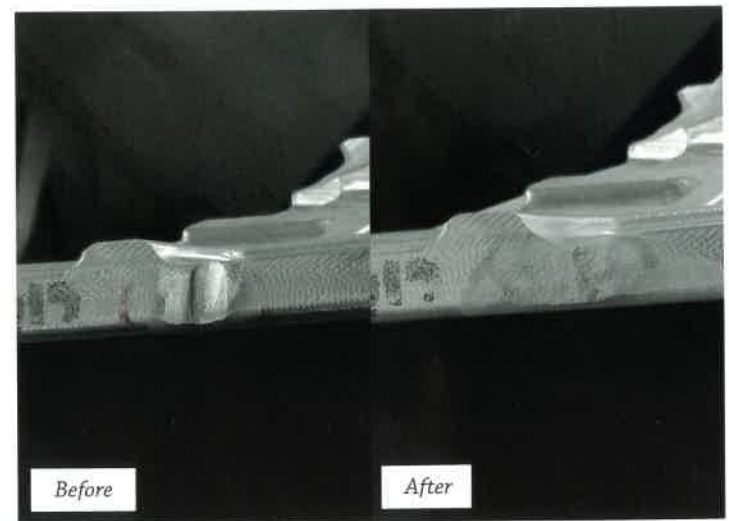


Fig. 4 — Snap-off defect dimensionally repaired with SST cold spray (before/after).