



Figure 1. Lancaster WW II bomber

RESTORATION CHALLENGES

Airworthiness on these and any other historical airplanes is challenging, at best, due to the lack of spare parts and/or effective repair and restoration processes. Corrosion typically takes a toll on the aesthetics and functionality of components, many of which are made of treated materials that cannot tolerate elevated process temperatures. One such component is a ring belonging to the mounting assembly of the rear gun turret (**Figure 2**). Years of corrosion have created through-thickness holes affecting both aesthetics and the integrity of the assembly. These holes are difficult to restore with conventional thermal processes without affecting the integrity of the part.



Figure 2. (a) Rear gun Turret

REASON TO CONSIDER RESTORATION

The Lancaster was a successful British heavy bomber during World War II and emerged as the redesign of the former Avro Manchester aircraft powered by four 1460 HP Rolls-Royce Merlin engines (**Figure 1**). The Lancaster first flew in January 1941 and entered production in early 1942. All of the almost 7,400 Lancasters produced during the war were committed to night-time strategic bombing. For these missions the planes' spacious bomb bays typically carried a mixed load of powerful bombs. Most Lancasters were armed with an assortment of machine gun turrets. After the war, surviving Lancasters served in different non-combat roles including patrol, photoreconnaissance, aerial mapping, flying tanker for aerial re-fueling, and even as a long range trans-Atlantic passenger and postal delivery airliner, till they retired around 1960. Today, there are about 17 planes remaining in historical static displays, mostly in Canada. There are, at least, two Lancasters restored for airworthiness with plans to maintain them airworthy.



Figure 2. (b) and (c) Part of the turret mounting assembly, heavily corroded showing through-thickness corrosion holes.



Figure 3. Commercial SST SERIES P Cold Spray Manual System

OPTION

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. In 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. SST Cold spray technology offers the ability of all metal consolidation for dimensional restoration both manual or robotic application **(Figure 3)**.

THE SOLUTION

The steel ring was submitted cold spray repair. First, surface preparation consisted on cleaning and grit blasting. Then the SST SERIES P machine was utilized to manually fill in all repair areas, including through holes, using the spray parameters depicted in the table 1. In order to successfully fill in through-thickness holes with acceptable adhesion, a qualified cold spray operator used a step process consisting on slow buildup around the edges followed by grinding off to prepare the next buildup. The deposits were gradually bridged to close the hole. By repeating these, the good adhesion deposits were warranted for final post-spray grinding **(Figure 4)**.



Figure 4. Component cold sprayed and grinded

Table 1. Spray Parameters

Machine: SST SERIES P / Manual Gun / 2.0MM Orifice / UltiLife™ nozzle
Spray Powder: SST A0050 (Aluminum – Alumina)
Substrate: Heat treated steel
Gas: Nitrogen
Surface preparation: grit blasting with Grit 80
Gas Temperature: 400 C
Gas Pressure: 180 psi (13 bar)

Practical cold spray coatings.



BENEFITS

Since 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 deposits. These attributes make cold spray uniquely suitable for depositing a range of temperature-sensitive materials in this application.

For more Information: Please contact our technical representatives at <https://www.supersonicspray.com/contact-us/contact-us>

Practical cold spray coatings.

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