Liburdi Powder Metallurgy

Liburdi Powder Metallurgy, LPM™, is a patented high strength process used in the manufacture and repair of blades, vanes and other superalloy turbine components. LPM™ offers superior strength and performance compared to conventional diffusion braze and weld repair methods. The LPM™ powder metallurgy compositions can be formulated from a wide range of alloys depending upon the properties required, including IN738, Mar M247, Rene80, X40, McrAlY's and Chrome Carbide. The LPM™ alloys can be manufactured and applied as either flexible tapes of varying thickness or as a moldable putty for cavities or fillets.

Blade Repairs

LPM™ uses powder alloys of matching composition, where applicable, to provide high strength and fatigue resistance. Repair limits can now be extended to higher stressed areas which were not previously repairable. For the latest advanced engines, the LPM™ process is being used to manufacture blade tips with superior oxidation and wear resistance.

Vane Repairs

Structural areas can now be repaired with LPM™ alloys exceeding the vane material strength and without the distortion caused by welding. LPM™ can also be used to build-up and restore thin airfoil and shroud seal surfaces that have eroded in service. Many vanes experience major cracking in the high stress fillet areas which are not effectively repaired using conventional weld repair. These same parts after repair with higher strength LPM™ are providing reliable service, and often out-perform the new parts without the reinforcing.

LPM™ employs advanced metallurgy to achieve high strength repair joints, in conjunction with reliable mechanical preparation of the surfaces. Damaged areas are first removed by grinding similar to preparation for welding. Then new LPM™ material in putty or tape form is applied to fill the area; the part is then processed through specialized vacuum heat treatments and machined or blended to the final dimensions.

LPM™ Process Steps

1) Component crack and erosion damage before repair.
2) Damaged areas removed by grinding.
3) LPM™ applied to part.
4) Repaired areas after heat treatment, ready for final machining.
Advantages Over Diffusion Braze Repair.
- Damaged material is removed by grinding which is more reliable than chemical cleaning processes to penetrate and remove oxides in cracks prior to brazing. Removal of all oxides and damaged material is assured.
- Relatively large volumes of LPM™ material can be used to reliably fill the prepared areas. Build-ups of .250” (6.4 mm) are achieved in a single application.
- Brazing is limited to fine shallow crack openings and must rely on capillary action to penetrate the full crack depth.
- Build-up of worn surfaces is accomplished with LPM™ applied in flexible tape form. LPM™ tapes produce controlled thickness build-ups to restore eroded airfoils and trailing edges without the use of coupons or inserts.
- LPM™ can be exposed to multiple high temperature heat treatments or repair cycles.
- Very low boron content of LPM™ compared to braze results in excellent hot corrosion resistance and full compatibility with conventional coating systems.

Advantages Over Weld Repair
- Nickel alloy components are repaired with matching LPM™ alloy for strength approaching the original component. Strength far exceeds conventional weld fillers such as IN625.
- Cobalt alloy components can be repaired with matching LPM™ or alternatively with nickel based LPM™ alloy for strength exceeding the original component.
- Able to repair crack sensitive superalloys without the heat affected zone cracks experienced with welding.
- Able to repair structural areas of vane segments without the localized distortion and strain cracks associated with welding.

Service Experience
- LPM™ has been proven reliable in industrial engine service since 1990 and has been qualified on several aero and industrial engines. In comparative rainbow tests in GE, Westinghouse, and Allison engines, the LPM™ repairs outperformed conventional welding and braze repairs and exhibited service lives comparable to or better than the new components.

New Component Manufacture
Engine manufacturers are currently using the LPM™ process to join high strength materials and close cavities in new castings for turbine blades and vanes. Special LPM™ compounds are also being used to apply an oxidation resistant, abrasive tip to the new generation of high pressure turbine blades.

Superior Strength and Metallurgical Structure
The unique LPM™ powder metallurgy process produces a dense deposit with little or no porosity and a metallurgically inter-diffused interface with the substrate alloy. The microstructure is typical of fine grained powder metallurgy alloys and exhibits excellent strength and fatigue properties.

Liburdi Engineering
Liburdi Engineering is a leader in the development of advanced materials processes for the gas turbine industry. New technologies include vision assisted Automated Welding Systems, advanced PVD and CVD Coating Systems, and the LPM™ powder metallurgy process. These developments have been driven by our understanding and years of experience in providing component repairs, metallurgical analysis and component design modifications to the industry.

For further information on the existing and future products, consult our Web Page at:
www.liburdi.com
or contact our main Toronto office.