Laser peening
Component protection

Enhancing the performance of metals and materials

www.metalimprovement.com
Metal Improvement Company (MIC) is a global organization specializing in metal and material surface treatments which enhance the performance and extend the life of critical components, enabling them to achieve their maximum potential.

Established in 1945, MIC has over 65 operating divisions in North America, Europe and Asia with on-site processing worldwide. We offer a quality controlled and cost effective service, working in partnership with our customers to meet their technical and production requirements.

MIC division approvals, where appropriate, include: FAA, AS9100, NADCAP, ISO 9001:2000, ISO 9001:2008 plus other specific OEM, company and industry approvals as required.

Metal Improvement Company is a subsidiary of the Curtiss-Wright Corporation, a diversified global provider of highly engineered products and services in the areas of Motion Control, Flow Control and Metal Treatment.

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Innovators In technology

laser Peening has been used for several years to prolong the fatigue life of critical aerospace components such as turbine engines and aircraft structures, but is now being used to peen form wing skins to achieve the requirements of the new generation of intercontinental aircraft.

Laser peen forming essentially performs the same role as shot peen forming, but because of the greater depth of plastic work, extends the degree of curvatures possible enabling more fuel efficient profiles to be achieved.

Potential applications have also emerged for automotive, power generation, nuclear waste disposal, petroleum drilling, medical implants and recreational sports.

With facilities in the United States and UK, MIc also operates a mobile laser peening unit which enables us to bring this technology directly to our customers on site.

The Process

An output beam, roughly 25 Joules at 18 nanoseconds from a Nd:glass laser is projected onto a work piece to induce a residual compressive stress. The area to be peened can be covered with material to act as an ablative layer and simultaneously as a thermal insulating layer, or peened directly onto the base metal which subsequently may require some form of surface removal of a few microns.

A thin stream of water is made to flow over the surface and the laser light transparently passes through the water, the leading temporal edge of the laser pulse is absorbed on the metal surface or ablative layer. This absorption rapidly ionizes and vaporizes more of the surface material to rapidly form a plasma that is highly absorbing for the rest of the laser pulse.

The plasma rises to approximately 100kBar (1 million PSI) with the water serving to inertially confine the pressure. This rapid rise in pressure effectively creates a shock wave that penetrates into the metal, plastically straining the near surface layer.

The plastic strain results in a residual compressive stress that penetrates to a depth of between 1mm and 8mm depending on the material and the processing conditions. This deep level of compressive stress creates a damage tolerant layer and a barrier to crack initiation and growth, which consequently enhances the fatigue lifetime and provides resistance to stress corrosion cracking and fretting fatigue.

Multiple firings of the laser in a pre-defined surface pattern will impart a layer of residual compressive stress at and below the surface. The process can be tailored to suit the product and potential failure mechanism or enable higher potential loads through weight sensitive designs.

The benefits of an exceptionally deep residual compressive layer are shown above. The S-N curve shows fatigue test results of 6061-T6 aluminum. The testing consisted of unpeened, shot peened and laser peened specimens.
MIC MARKETS INCLUDE:

- Aerospace
- Architectural
- Automotive
- Chemical & food processing
- General & structural engineering
- Marine
- Medical
- Military
- Off-road & earth moving equipment
- Oil, gas & petrochemical
- Power generation
- Railways

MIC SERVICES INCLUDE:

- Controlled shot peening
  induces engineered residual compressive stresses
- Shot peen forming
  creates curvature and corrects distortion
- Laser peening
  induces deeper residual compressive stresses
- Engineered coatings
  improves performance, prevents corrosion and aids lubricity
- C.A.S.E.™ (isotropic finishing)
  removes surface asperities reducing friction
- On-site processing
  provides services on customers’ own premises
- Peentex (architectural finishing)
  creates decorative and aesthetic texturing
- Surface texturing
  applies a textured engineered finish
- Heat treating
  enhances metallurgical properties

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