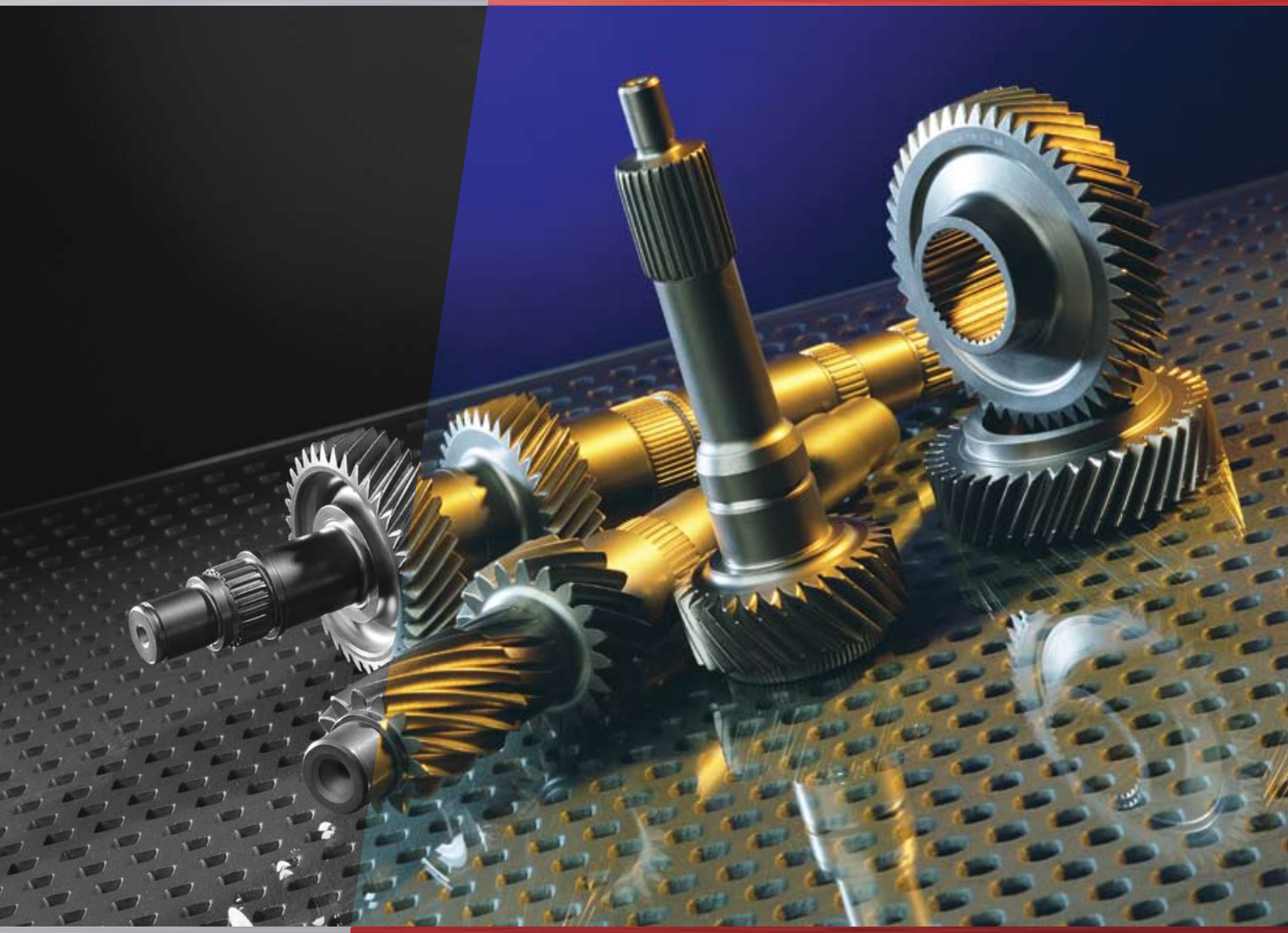
INNOVATORS IN TECHNOLOGY

Metal Improvement Company

Subsidiary of Curtiss-Wright Corporation

Controlled shot peening

Preventing failures



Enhancing the performance of metals and materials

www.metalimprovement.co.uk

CURTISS WRIGHT

Controlled shot peening - preventing failures

Metal Improvement Company (MIC) is a global organisation specialising in metal and material surface treatments which enhance performance and extend the life of critical components, enabling component designs to achieve their maximum potential.

Established in 1945, MIC has over 60 operating divisions in Europe, USA, Canada and Asia with on-site processing worldwide. We offer a quality controlled and cost effective service, working in partnership to meet our customer's needs.

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 international provider of highly engineered products and services to the Motion Control, Flow Control and Materials Treatment industries.

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CURTISS WRIGHT

Component failure is often related to residual tensile stress induced during manufacture. Subsequent severe working and/or unexpected conditions can eventually lead to premature failure.

Typical examples of premature failure are:

- Metal fatigue
- Corrosion fatigue
- Stress corrosion cracking
- Intergranular corrosion
- Fretting
- Galling
- Spalling
- Wear

The services MIC offer induce residual compressive stresses and so extend component life in a wide range of applications.

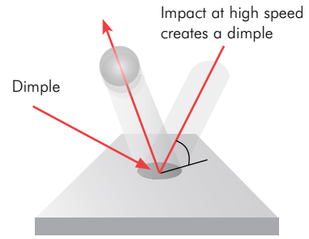
Shot peening is the most cost effective and practical method of inducing surface residual compressive stresses which enhance the performance and extend the life of critical components.

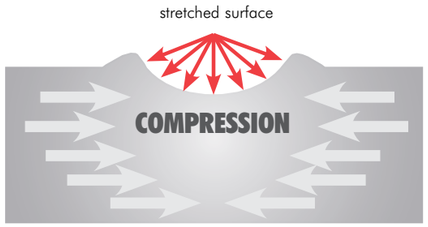
The shot peening process - how it works

Controlled shot peening is the bombardment of a surface with small high quality spherical media called shot in a technically defined and controlled way.

The shot can be steel, stainless steel, glass or ceramic.

Each piece of shot striking the metal acts as a tiny peening hammer imparting a small indentation or dimple into the surface. The action of impinging the surface yields the material in tension, further movement is restrained by the core and a surface residual compressive stress results. The magnitude of the compressive stress is directly related to the yield strength of the base material and is approximately equal to 80% of that value in compression.





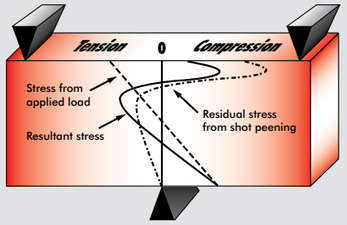
Shot peening process

DESIGN CONSIDERATIONS - COST OF PERFORMANCE CRITERIA

Parameter selection - the choice of shot peening parameters is dependant on a variety of conditions:

- knowledge of the application of the component
- component geometry
- manufacturing method
- mechanical properties of the base material
- strain sensitivity of the base material
- environment
- service conditions, loads and cycles
- cost sensitivity

All the above must be considered when deciding on parameter selection and, equally important, maintained throughout the life of the product in a repeatable and consistent manner.



Shot peening influence on applied stress - algebraic reductions

Depth of compressive layer - this is the depth of the compressive layer resisting crack initiation and propagation. The layer depth can be increased by increasing the peening impact energy, but section thickness has to be considered. A deeper layer is generally desired for crack growth resistance and severe environmental condition.

Surface stress - this magnitude is usually less than the maximum compressive stress, which is subsurface but can be tailored to suit the application.

Controlling the process

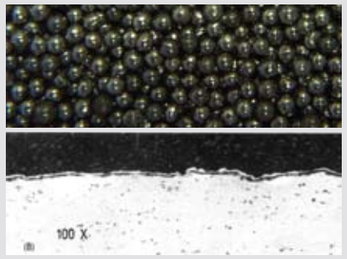
To ensure reliability and repeatability the variable parameters of the shot peening process have to be accurately and repeatedly controlled.

Controlled shot peening is different from most manufacturing processes in that there is no non-destructive method to confirm that it has been performed to the proper specification. Techniques such as x-ray diffraction require the part be sacrificed to generate a full compressive depth profile analysis.

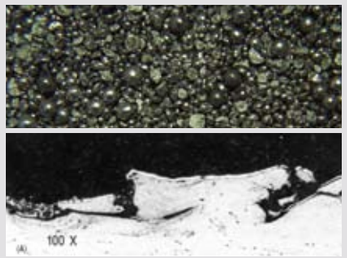
To ensure peening specifications are being met for production batches, the following process controls must be maintained: media intensity, coverage, shot direction and repetition. Equipment should be mechanised to ensure the motion of component to shot flow is consistent - hence the term controlled shot peening.

Media control

Controlling shot shape and size will result in a residual compressively stressed layer on the surface of uniform magnitude and depth:



Poor shot shape and size will result in an irregular residual stress profile, excessive surface disruption and potential stress raisers:



Intensity control

Shot peening intensity is the measure of the energy of the shot stream. It is one of the essential means of ensuring process repeatability. The energy of the shot stream is directly related to the compressive stress that is imparted into a component. Intensity can be increased by using larger media and/or increasing the velocity of the shot stream.

Other variables to consider are the impingement angle and peening media. Intensity is measured using Almen test strips and must be conducted initially during set up and repeated at approved intervals.

Coverage control

Complete coverage of a shot peened surface is crucial in performing high quality shot peening. Coverage is the measure of original surface area that has been obliterated by shot peening dimples. Coverage should never be less than 100% as fatigue and stress corrosion cracks can develop in any non peened area that is not encased in residual compressive stress. Some strain sensitive materials perform better with levels of coverage in excess of 100%.

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
- **Peenflex mouldings**
  protects against processing and handling damage

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