CURTISS-WRIGHT

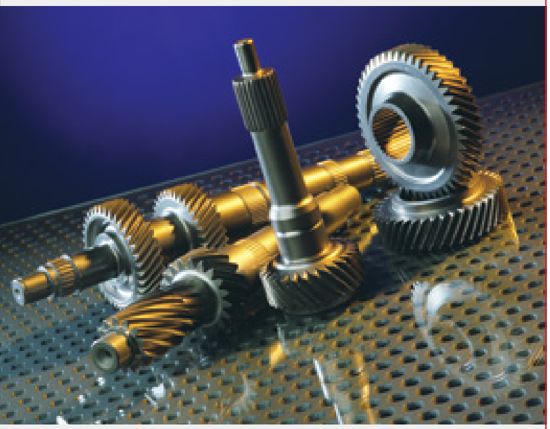
Controlled shot peening

www.cwst.co.uk

COMPANY PROFILE

Curtiss-Wright Surface Technologies (CWST) offers a single source solution and point of contact for all your surface treatments. We can reduce your turnaround times and costs through our network of over 75 worldwide facilities.

Our proven surface treatments meet industry demands for lighter materials, improved performance and life extension in key markets such as Aerospace, Automotive, Energy and Medical. We can prevent premature failures due to fatigue, corrosion, wear, galling and fretting.



Surface Technologies is a Division of Curtiss-Wright (NYSE:CW) a global innovative company that delivers highly engineered, critical function products and services to the commercial, industrial, defense and energy markets. Building on the heritage of Glenn Curtiss and the Wright brothers, Curtiss-Wright has a long tradition of providing reliable solutions through trusted customer relationships.

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Why does controlled shot peening extend part life?

Critical component failure can very often be traced back to residual tensile stresses that are introduced during the manufacturing process. Processes such as welding, laser cutting and electric discharge as well as milling, turning, drilling and grinding can produce residual tensile stresses which will reduce fatigue strength and shorten a component's life.

With the application of controlled shot peening to the surface of a component any residual tensile stresses are converted to compressive stresses which have been proven to prevent typical failure modes such as metal fatigue, corrosion fatigue, stress corrosion cracking, intergranular corrosion, fretting, galling and wear.

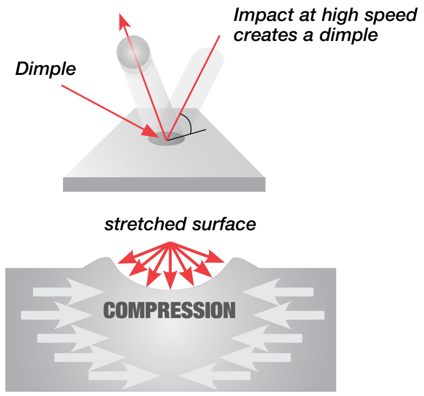
Controlled shot peening has long been associated with engineered surface finishing of metals including steels, stainless steels, aluminium, titanium and copper alloys. It forms an essential part of the manufacturing process used within the engineering industry to improve wear and corrosion resistance and prevent premature fatigue failures.

Shot peening – what is it and how does it work?

Shot peening is a highly cost effective treatment which can be performed on components of any shape and size and can even be done on site, which when combined with the reduced maintenance costs achieved by extended part life, you can clearly see why leading manufacturers specifically include this process in their specifications.

Shot peening is a cold working process that involves creating an indentation on the surface of a component to a technically defined specification using small high quality spherical media called shot.

The surface yields but it is restrained by the substrate, with the result that a residual compressive stress is introduced which makes the surface resistant to crack initiation and propagation. The shot media can be steel, stainless steel, glass or ceramic beads and controlling the size, intensity and coverage will result in a residual compressively stressed layer of uniform magnitude and depth.



Shot peening process

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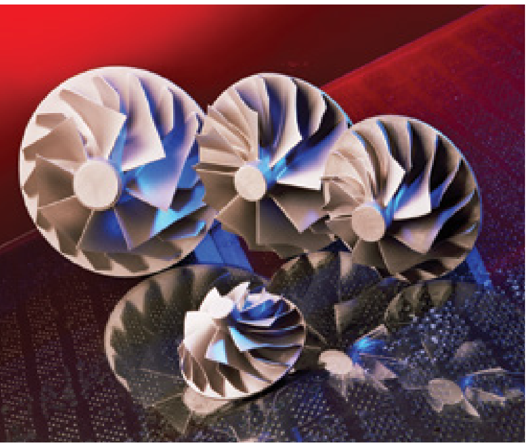


How did the shot peening process begin?

Hammering or cold hammering stresses a material through force beyond its yield strength, so allowing it to be shaped and hardened. The earliest example of this process can be traced back to a gold helmet circa 2700 B.C. The helmet featured the trademark dimpling effect that is induced by hammering an object into shape. The process was widely used to shape and harden armour during the crusades (1100-1400 A.D.).

The process remained relatively unchanged until the industrial revolution when there were many experiments on the manipulation of metals, usually termed as "cold rolling" which essentially replaced cold hammering and through trial and error this brought about improvements in surface hardness and fatigue life.

During the 1920's the benefits of mechanical pre-stressing had become more understood and A C Sampietro, a renowned automotive engineer, was reputed to have said that fillets of crankshafts in European race cars were hand peened to improve fatigue life.

After much research the question of when and how the process of shot peening was formally discovered appears to have been between 1927 and 1929, with the automotive industry taking a further lead by introducing it into their specification for the manufacture of the Cadillac Valve springs in December 1929.

Process specification criteria

To ensure the shot peening process meets all its requirements certain criteria has to be considered and these are:

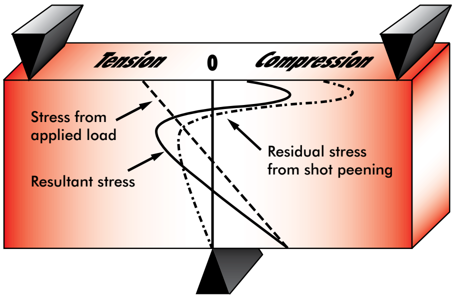
PARAMETER SELECTION

The choice of shot peening parameters is dependent on:

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

DEPTH OF COMPRESSIVE LAYER

This represents the depth of material that is resistant to crack initiation and propagation. This layer is controlled by predetermining the energy of the peening



Shot peening influence on applied stress – algebraic reductions

impact, although the thickness of the section is also a factor. A deeper layer is generally desired for optimum crack growth resistance and protection again severe environmental conditions.

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 accuracy, reliability and repeatability the variable parameters of the shot peening process have to be carefully controlled.

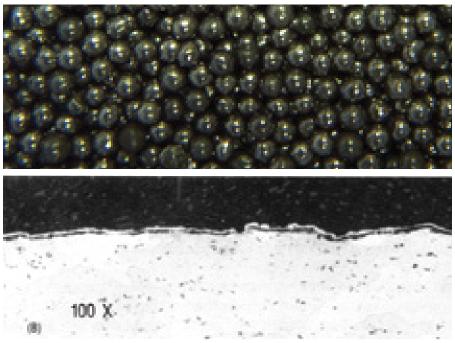
Controlled shot peening is different from most manufacturing processes in that there is no non-destructive method to confirm that it has been performed to the proper specification. Techniques such as x-ray diffraction require the part be sacrificed to generate a full compressive depth profile analysis.

However, to ensure peening specifications are being met for production batches, the following process controls must be maintained: media intensity, coverage, shot direction and repetition.

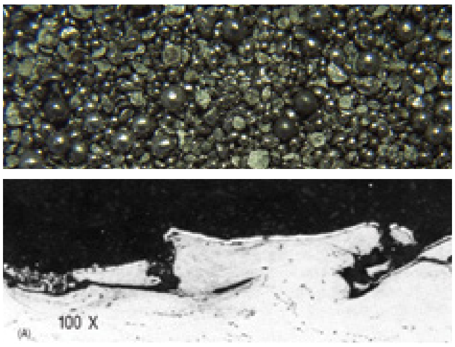
We have developed robotic and specialised mechanical equipment that ensures that the motion of the component to shot flow is consistent – hence the term controlled shot peening.

MEDIA CONTROL

Controlling the shape and size of the shot 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 covered by the shot peening indentations. 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%.

Shot peen forming

The process of controlled shot peening can also used to create a change in the shape of a component, for example to create the aerodynamic contours of aircraft wing skins where within the elastic range of the material gentle curves are formed to consistent tolerances. Parts that have been peen formed have increased resistance to flexural bending fatigue and even if the material is peened on one side only, the process causes both sides to have compressive stresses which has been proven to inhibit stress corrosion cracking and improve fatigue strength.

Correction of distortion

Controlled shot peening can also be used to correct distortion typically caused by manufacturing processes such as casting, rolling, forging and heat treatment which can also dramatically alter the stress pattern of the final machined part making it vulnerable to stress corrosion cracking and fatigue. With the application of controlled shot peening it is possible to stretch the substrate surface of the part to correct the distortion and in the process replace any tensile stresses with beneficial compressive stresses.

C.A.S.E.™ super finishing

This technique is combined with controlled shot peening and is particularly suited to gears and results in a mirror like finish on the component's surface for resistance to crack initiation and propagation, whilst retaining the natural valleys for lubricant retention to reduce operating temperatures and friction and to improve overall life and performance. This process is particularly suited to gears and transmission components and any situation which involves metal to metal contact.

Surface texturing/Peentex

Controlled shot peening can be used to create a range of surface textures from a non-slip textured finish for handgrips on tooling to a mirror like finish for decorative purposes and on various surfaces such as metals, glass and acrylic.

For high traffic areas and internal cladding and railings, surface texturing will diffuse direct light and glare thus disguising fingerprints and mild blemishes. The finish is also non-directional so ideally suited for jointed and welded frames and structures disguising unsightly weld beads giving a more uniform appearance. In addition textured finishing can provide substantial resistance to wear, scratching, written graffiti and stickers as well as making cleaning easier so ideal for architectural applications.

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Why should you choose Curtiss-Wright Surface Technologies (CWST) to deliver your surface treatments:

A worldwide supported network service of over 75 facilities, including on site field crews

We offer a diverse range of quality surface treatments including:

- Controlled Shot Peening
- Shot Peen Forming
- Laser Peening
- Engineered Coatings
- C.A.S.E.™ super finishing
- Surface Texturing
- Material Testing
- Repair and Overhaul

Proud history of experience and innovation dating back to the Wright Brothers and Glen Curtiss who formed the Curtiss-Wright Corporation in 1929

As a single source for all your surface treatments we can improve your turnaround times and save you money

Customer's trust us to improve the performance, strength and life of their components, including the repair and overhaul of worn components

Long experience in protecting components from fatigue, corrosion, wear, galling, fretting and environmental attack in key industries

We maintain all appropriate customer and industry quality approvals including ISO 9001:2008, NADCAP, AS9100 Rev C and ISO 13485

Tailoring our services to meet your needs

The Dublin Spire – a stunning example of our surface texturing technique showing the versatility of controlled shot peening

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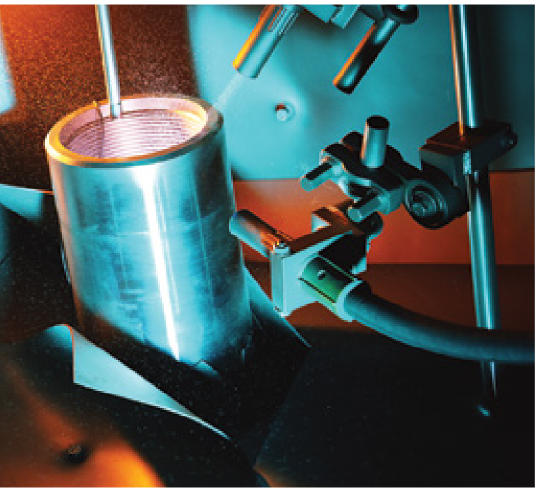

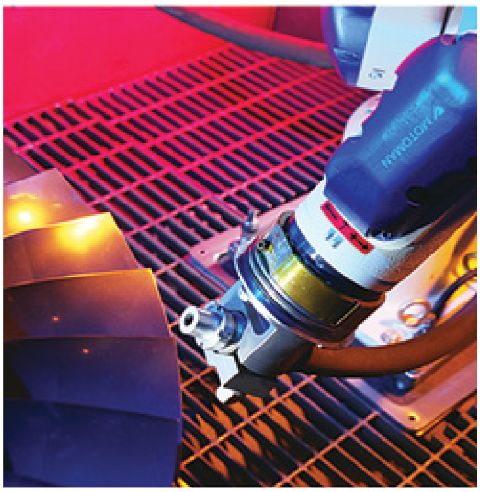

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