Surface finishing techniques to increase the life of subsea components

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Subsea is one of the most hostile environments in which to operate critical equipment with pressures increasing by 10bar for every 100m of depth and plans for ultra-deep oil sites only serve to increase the challenges.

Materials chosen for subsea applications such as mandrels, drill collars, rock bits, ball valves and valve bodies are often chosen for their surface properties and characteristics which can mean using expensive alloys with long lead times and difficult machining attributes. It is however possible to engineer the desired surface requirements using surface modification and finishing technologies. These can be tailored and/or combined to meet the exact demands of your operating environment, reducing manufacturing and maintenance costs and extending component life.

Environmental resistance and protection

For example, Thermal Spray coatings can be used to deposit a film of pure metal, alloy or ceramic oxide onto the surface, making components resistant to wear, corrosion, erosion and chemical attack, as well as increasing thermal insulation and electrical conductivity/insulation.

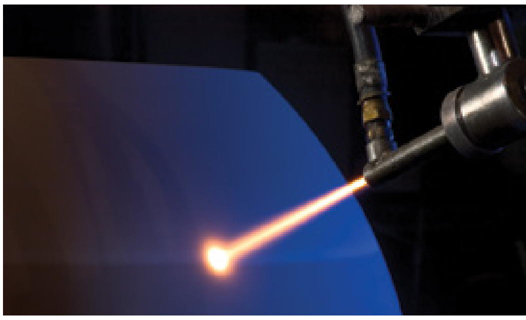
Thermal spray can be applied using a range of processes including high-velocity oxy fuel, plasma, arc wire, flame spray and cold spray. The choice of application process is assessed according to the operating parameters required.

The operation principle is the same for all and involves heating particles, usually to a molten or semi-molten condition and propelling them at high speed onto the component surface, which has been pre-roughened. When the particle hits the roughened surface it flattens and shrinks as it cools, gripping the surface and creating a strong mechanical bond. The coating is then built up in layers to the desired thickness.

Extending fatigue life

Inducing a layer of compressive residual stress into the component surface can significantly increase fatigue life, preventing fatigue cracks which propagate as a result of cyclic stresses that are often far lower than the static design stress considered for the component.

The damage is cumulative and permanent, with failure occurring when cracks propagate to an extent where the remaining



section is unable to withstand the application of a single load.

Harmful tensile residual stresses, often introduced during manufacturing, are effectively added to the operating stresses, accelerating fatigue damage. These stresses can be completely reversed with surface compression techniques.

The most cost-effective and well-proven method of inducing a protective compressive layer is to carry out a controlled shot peening operation. This involves firing spherical media at the component surface at a controlled angle and velocity causing elastic plastic deformation with each indentation. As the substrate material tries to rebound the conflict creates an effective long lasting compressive layer which can be driven deep enough below the surface to sit below pre-existing and post-manufacturing initiation sites such as pits, scratches and notches.

Shot peening can also be combined with thermal spray coatings to provide a protective layer beneath the coating interface, improving both surface characteristics and fatigue resistance.

In addition to improving the performance of new components, thermal spray and shot peening technologies are commonly used in the repair and overhaul of worn and damaged components.

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

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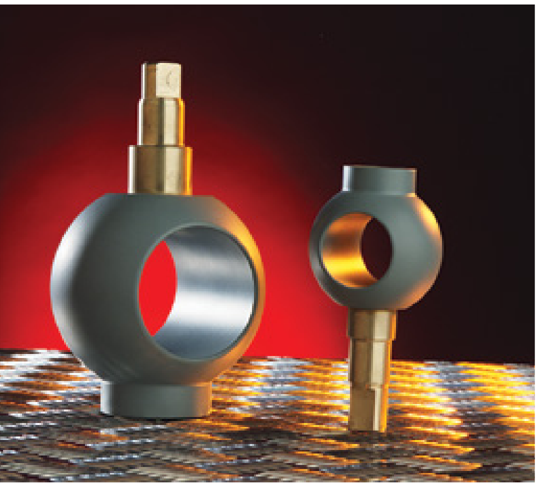

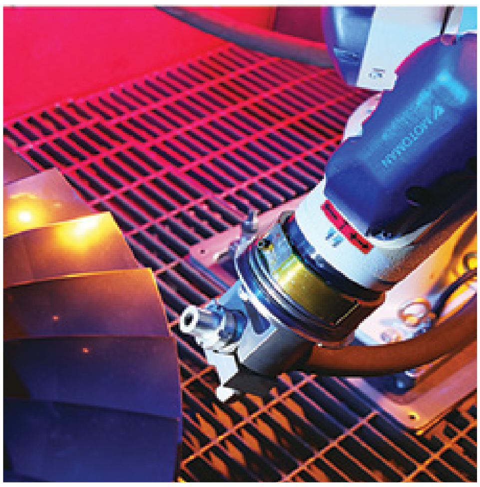

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