Peen forming shapes up and extends life

Europe's first factory specialising in the peen forming of aerospace components—wing panels for the A310 Airbus—and suggests that since the process can also create dramatic increases in the fatigue life of stressed materials, it could be used on a wider scale.

With relatively thin components, such as wing skin panels, compressive stress induced by peening cause the part curvature naturally through plastic flow in the metal. When peening is used to increase fatigue life, the degree of curvature induced in a sample of known is used as a standard measure of intensity of compressive stress induced. It is from this knowledge that the process of peen forming developed.

Saves fuel

The ability to control the degree of curvature is an important asset in skin panel production, because it allows designers to control the shape of the panel, which can significantly affect the aerodynamic efficiency of the aircraft. Peen forming is a process where a part is shot peened to induce compressive stress, which can help to increase the fatigue life of the part and reduce the potential for cracks and failures.

While peen forming cannot be compared with pressing in terms of the degree of deformation that can be obtained, peening can still provide a substantial amount of smoothing. Under controlled conditions, a part can be curved to have an arc height of over its width. Thicknesses of aluminum panels can be formed from 0.05 to 2 in. and up to 1 in for high strength steel alloys.

The company places great emphasis on peening being a controlled process, with two main types of custom-built machinery being used. The panels are mounted on a trolley and pass through a shot peening cabinet, or a cabinet on a rotating table passes over the panel that rests on a stationary table. Shot of closely controlled shape and size is projected at high velocity to the component directly through a series of nozzle wheels. Either way, the severity of peening and the speed of operation are precisely controlled, pre-programmed, and give the required variation in the degree of deformation across and along the panel.

Precise control of shot bombardment means that in addition to being able to vary the curvature, the process can also be used to enhance the surface finish of the part, improving its appearance and potentially increasing its resistance to corrosion.
The A310 Airbus and how its wing panels are formed (centre left).
Improving the endurance limits of ground parts (bottom).

machined flat sheets. The site is owned by the British Steel Corporation, which is joint developer of the industrial park with the Welsh Development Agency. The first 10 recruits are being trained at MIC's New Jersey factory, where the forming of A310 panels has been carried out prior to transfer of the work to this country.

There are two other UK factories, at Derby and Newbury, which specialise in shot peening to improve fatigue life and reduce stress corrosion (for example, where stress around the welded seams of an ammonia tank would otherwise cause cracking to accelerate corrosion). It is for these applications that the peening process is still most widely used, though not as widely as it might be since it can increase the fatigue life of stressed components by as much as 100 per cent.

**Other applications**

It can also be used to restore fatigue resistance following a manufacturing process such as grinding, where residual stresses induced by machining can sometimes approach the ultimate tensile stress of the steel. Peening can also be used beneficially before electroplating to prevent the fine cracks which develop during plating from spreading into the base metal.

The basic effect of peening to improve fatigue life is to create a surface layer in compression to prevent the formation of surface cracks—the primary cause of fatigue failure. Shot peening allows parts such as coiled compression springs, gears or connecting rods to be stressed to much higher levels, alternatively they can be made much lighter to withstand the same amount of stress. Close control of the process to give uniform overall coverage is essential to ensure residual compressive stress is also uniform. It involves using the right combination of shot size, exposure time, choice of air pressure or wheel speed, and so on. Consequently, it's a process best left to the experts.

More information

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