



Engineered Surfaces Improve Race Engine Performance

Valve Springs Experience Longer Life

Background

Valve spring performance degradation and ultimate failure is typically caused by a fatigue phenomenon in which tiny stress cracks nucleate at defect sites on the surface and propagate through the spring wire. This fatigue results in the fracture of the valve spring, and ultimately decreased performance.



To address this performance issue, several surface treatment technologies exist which can be applied. These technologies have recently been put to the test with impressive results in high performance race engine applications.

Various vibratory finishing methods can be employed to modify the surface texture or topography of the spring. These processes decrease the quantity and size of the surface defects, which in turn, decrease the number of fatigue initiation sites. Typical vibratory process equipment consists of a bowl that contains an abrasive media, water and a finishing compound that is circulated at low speeds. The component is immersed in the media for a predetermined amount of time to achieve the desired surface finish. Often a chemical additive is used to accelerate the abrasion of the metal surface, thereby decreasing the required processing time.

Engineered Surfaces Solution

The Timken Company's ES30 engineered surface treatment differs from the above process in two ways: First, a chemical additive is not used nor required for processing; and second, the abrasive media and components are placed in a machine which, through its mechanical action, subjects the surfaces to high mechanical energy. This action not only decreases the quantity and size of the surface defects, but also imparts compressive stresses in the near surface region of the material. These compressive stresses are key to increased performance as they cause any cracks that may begin at remaining defect sites to propagate parallel to the surface of the spring instead of through the body of the wire. Therefore, the main advantage of the Timken ES30 process over conventional finishing methods is the introduction of compressive stresses, which effectively work to reduce valve spring fatigue failure.



Timken ES30 on valve springs



Results

Race teams who use Timken ES30-processed valve springs have reported multiple performance benefits. The increased durability realized delivers spring pressure losses that are significantly less than standard spring sets. On average, teams return home after race day with 10 pounds more spring pressure. Additionally, the increased valve train stability realized allows teams to generate additional horsepower by getting more radical with the valve train. It is estimated that the increased durability and valve train adjustments generate an additional 10 to 15 horsepower, a tremendous advantage on race day.

Timken can help you incorporate surface engineering into your system design or modify a component to eliminate an existing problem. In addition to Timken ES30, the following table outlines the current family of surface engineering technologies available.

Surface Engineering Technologies

ES10/20	Topographical modification process: provides some wear and friction reduction in poor lubrication.
ES30	Topographical modification process: provides some wear and friction reduction in poor lubrication, and increases fatigue life.
ES100	Hard coating with very low friction: provides superior scuffing and fretting protection to sliding contacts.
ES200	Moderately hard coating with low friction: provides scuffing and fretting protection to sliding contacts, and fatigue-life enhancement to rolling contacts.
ES300	Hard coating with moderate friction: provides limited scuffing protection, abrasion resistance and superior fatigue-life enhancement to rolling contacts.
ES500	Hard coating: provides resistance to adhesive shaft wear and tribochemical wear from sliding contact with elastomeric seals (such as Viton, PTFE, etc.) while enhancing seal life.

For more information on Engineered Surfaces, contact your local Timken sales representative or www.timken.com/engineeredsurfaces.

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