Crankshaft evolution

A LOOK AT HOW A NEW GENERATION OF HARDENING PROCESSES IS HELPING ENGINES MEET EVEN THE TOUGHEST SPECIFICATIONS

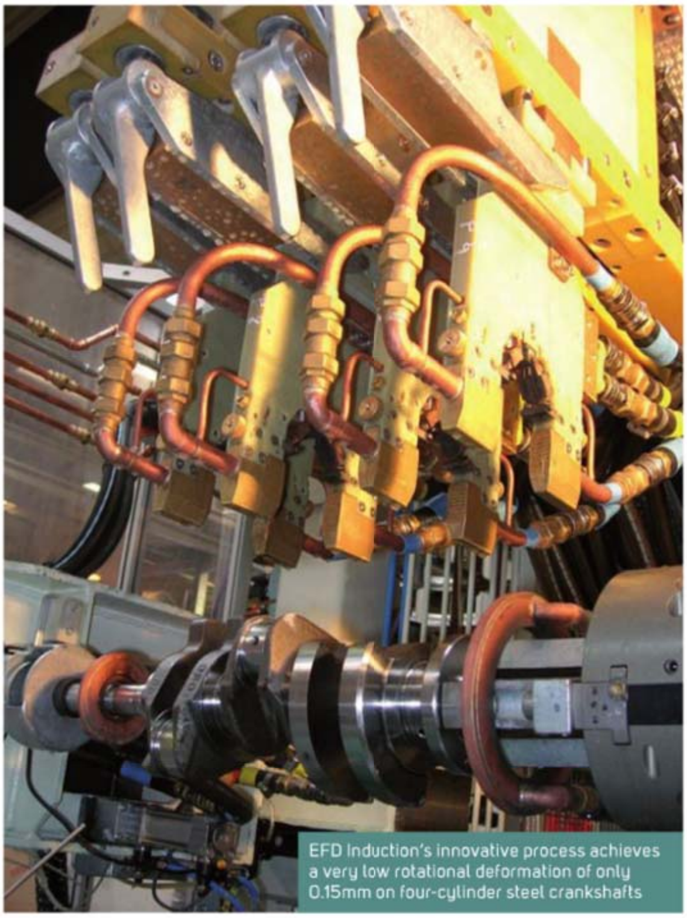
When it comes to crankshafts, engine component makers are caught between the proverbial rock and a hard place. On one hand, car, truck and ship makers are relentless in their pursuit of lower costs. On the other, performance requirements are becoming ever more stringent. Today's crankshafts must be strong and stiff enough to withstand the extreme loads generated by modern engines, yet at the same time, customers are keen to reduce crankshaft weight, size and vibration – all this must occur without sacrificing resistance to wear and fatigue. So how can component makers best meet the dual demands of lower costs and higher performance specifications?

One cost-efficient way to escape such a dilemma is by exploiting the benefits of new-generation induction hardening systems. Such modern systems incorporate technical features that minimize distortion and maximize throughput and process quality. For example, systems are available that dynamically monitor and adjust the power in accordance with the crankshaft's angle of rotation during the heating process. This facilitates fillet induction hardening – a cost-effective alternative to mechanical fillet hardening that destroys tooling and holders. Dynamic power variation also ensures precise heating patterns, minimizing the risk of heat seepage into adjacent or less thick areas. A process developed by EFD Induction achieves a low rotational deformation of only 0.15mm on four-cylinder steel crankshafts. New-generation induction systems also employ innovative inductor-assembly designs and materials that help minimize distortion. These advances ensure optimal contact pressure of the coil guides on the rotating crank that are not enough to cause significant marring or distortion, but sufficient to achieve accurate and dynamic coupling between the bearing and the inductor assembly.

Another way modern induction systems reduce crankshaft-hardening costs is their use of low-weight inductor assemblies. Heavy inductor assemblies are susceptible to wear, leading to short coil working lives. By choosing systems with lighter inductor assemblies, made from composite materials, manufacturers can extend coil lifetimes. For example, new-generation EFD Induction coils, currently used by a leading European OEM, deliver in excess of 70,000 heatings when hardening car crankshafts, and more than 30,000 heatings for truck and off-highway crankshafts.

Major cost savings are also possible by selecting the correct tempering process. Traditional furnace tempering is still widely used, but is extremely time-consuming. Induction-based tempering is integrated into modern induction hardening systems, using two methods. The first, inductive tempering, uses a second low-power heating phase following the initial heat and quench stage. The second, known as auto-tempering, uses residual heat to temper heat-affected zones.

Both methods have their advantages. With inductive tempering it is possible to maintain complete control of the tempering temperature, regardless of the quality and temperature of the quench medium. Auto-tempering has a shorter cycle time (because it dispenses with one heating phase), and works on all hardening profiles.



EFD Induction's innovative process achieves a very low rotational deformation of only 0.15mm on four-cylinder steel crankshafts

Both methods are made possible by advanced real-time monitoring (RTM) software. New-generation induction systems incorporate RTM tools to monitor the hardening and tempering processes, and to provide crucial quality control data on each crankshaft hardened.

The productivity of induction-hardening solutions depends to a great extent on a reliable, energy-efficient power supply. Those used in EFD Induction systems, for instance, employ rugged IGBT transistors, and deliver a power efficiency of more than 92%. Operational flexibility is assured by a broad frequency range of 0.5 – 150kHz, and PLC/CNC-based remote control capabilities. The smart and rigorously tested human-machine interface further aids overall operator productivity and minimizes the risk of human error.

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