PLACING HIGHER DEMANDS ON SPINDLE DESIGN

The move toward high production means increased speeds, increased power and extended service life

By Mauro Merlo, spindle technical director, SKF

There is a continued push to improve productivity in the sector through higher speeds, improved power densities, greater flexibility and machine tools capable of multi-purpose operation.

Modern machine tools are flexible manufacturing centers capable of performing a range of programmed tasks. A key component in all machine tools, spindles are used to carry out a range of cutting operations on, for example cast metal products. These products usually then require finishing through processes such as turning, cutting, drilling, counter-sinking, tapping, reaming, grinding and milling to achieve their final shape and specification. This is no secret to industries such as automotive and aerospace.

Spindles represent a key part of any machine tool. They determine the quality of the final product produced and the overall productivity and efficiency of the machine tool itself.

A spindle is, in principle, a motor driven shaft that both positions and transmits power to a tool or holds a workpiece. Spindles can operate at speeds of 20,000 rpm or more and have a direct impact on efficiency, accuracy and overall productivity.

A new spindle range, launched by SKF in 2003, is comprehensive and includes belt driven, motor driven and combined solutions. Application areas encompass woodworking, metal grinding, turning plus aerospace applications that put demands on high power and extreme speed.

Standard spindles are supplied as belt driven or motorized and are available as cartridge or block units. This standard range includes high-frequency grinding spindles designed for applications that require high operating speeds at relatively low loads. Motorized spindles are offered for high-performance applications such as milling/turning where high production levels call for high speeds, increased power and extended service life.

Design Trends

Specific trends in spindle design indicate that there are three predominant types of spindle configuration tailored to different application needs.

1) For low cost machine tools or those with high torque, belt driven spindle units are favored. Belt driven spindle units are found in machining centers, heavy-duty machine tools and lathes where cost issues are crucial.

2) For general-purpose applications that demand flexibility and automatic spindle change, spindle units coupled to motors are the norm. Coupled motor designs respond to customer requirements for high productivity, where there is limited space for the spindle, high flexibility in case of service and improved dynamic behavior.

This spindle design is being applied to new machine tool concepts and existing standard machine tools with asynchronous motors, automatic spindle change, high torque and high speed.

3) For medium and high performance machine tools, high-speed and high-power systems, the motorized spindle unit is, generally, the preferred design option. Motorized spindle units that incorporate asynchronous or synchronous motor technology will push spindle speeds by 2006 to more than 20,000 rpm and up to 40,000 rpm and even more. This design is responding to customer demands for higher productivity and better workpiece quality. Applications for these units include machining centers, milling machine tools for aerospace use, grinding machine tools, pick-up lathes and high performance lathes.

Monitoring and diagnostics are becoming especially important because of the ever-increasing extension of warranty periods. There is a need to continuously control the operations in machine tools in order to reduce unscheduled downtimes and meet safety requirements in the machines.

For more information, visit www.skf.com.■

Web Reply #504