Typically, machining accuracy varies significantly due to ambient temperatures around the machine, heat generated by the machine, and heat generated during machining. Thermo-Friendly Concept automatically compensates for temperature changes, so high accuracy can be achieved without interventions from the CNC machine tool operator. Thus, machine accuracy is increased while decreasing costs and maximizing profitability for manufacturers.

EXECUTIVE SUMMARY

In a world where manufacturers must deliver perfection (or near perfection) for every part produced, the process for managing thermal deformation has historically been highly imperfect. CNC machines must be warmed up, which wastes time, energy and money. As production is underway, heat generation is unavoidable and is typically managed by making manual adjustments for temperature changes. These adjustments produce variations in CNC machine accuracy over long continuous runs, providing ample opportunity for quality variation and bad parts.

Thermo-Friendly Concept (one of Okuma’s Intelligent Technologies) combines control technology with machine design to both minimize the amount of heat generated and deal with heat that cannot be eliminated. This is possible given Okuma’s 30-year history of testing and analyzing actual machine data to create thermal maps. From this, designs for machine castings and spindles have been optimized for thermal deflection, and CNC control technology (Okuma’s Thermal Active Stabilizer – TAS) has been developed to manage spindle temperatures and machine thermal characteristics.

Thermo-Friendly Concept (TFC) is an excellent example of Okuma’s ability to leverage the mechatronics approach to design, blending mechanical engineering and electronic control development to assure harmonious communications between the machine and control – thus maximizing profitability for manufacturers.
THERMO-FRIENDLY CONCEPT (TFC) INCREASES CNC MACHINE ACCURACY

Typically, machining accuracy varies significantly due to ambient temperatures around the machine, heat generated by the machine, and heat generated during machining. Thermo-Friendly Concept operates in unique fashion to ensure predictable machine growth and automatically compensate for temperature changes, so high accuracy can be achieved without interventions from the CNC machine tool operator. Thus Okuma has created accurately controlled “manageable deformation.”

TFC FUNDAMENTALS OF OPERATION

1. High-precision thermal deformation estimates are generated,
2. Based on these estimates... High-precision deformation compensation controls are implemented.

THE BENEFITS OF TFC

- No need for the CNC machine warm-up operation
- Eliminates manual adjustments by the operator to compensate for temperature changes
- Saves time – improves productivity
- Saves money – reduced energy usage and labor (time) costs
- Enables the machine to cut submicron-precise surfaces
- Enables durable, high-precision manufacturing

THE COMPONENTS OF TFC WORK IN TANDEM

CNC Machines Designed for Temperature Balance

The way the CNC machine is designed sets the stage for temperature balance and manageable deformation.

Okuma’s machine construction is simplified – built with symmetry and with alignment of spindle and axis planes to ensure predictable and parallel direction of growth. CNC Machine designs also isolate peripheral heat sources such as electrical cabinets and hydraulic and coolant systems from the machine casting. And special thermal machine covers are employed to keep hot chips off of the casting eliminating unpredictable and uncontrollable “hot spots”.

TAS-S (Thermal Active Stabilizer-Spindle) CNC Control Technology

Spindle temperature sensors are located top and bottom to provide real-time feedback to the OSP control. Spindle rotation, spindle speed changes, and spindle stoppage are all monitored. Based on this feedback, the CNC control automatically compensates for thermal deformation – without operator intervention.

TAS-C (Thermal Active Stabilizer-Casting) CNC Control Technology

Casting temperature sensors are incorporated using the exact number needed for the particular CNC machine. These sensors deliver real-time temperature feedback data from the casting to the control. Based on this feedback, the CNC control predicts and automatically compensates for thermal deformation in machine construction when both casting and ambient temperatures change. All without operator intervention.
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OKUMA THERMO-FRIENDLY CONCEPT

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OKUMA’S MECHATRONICS APPROACH: THE FOUNDATION FOR THERMO-FRIENDLY CONCEPT

The foundation for Thermo-Friendly Concept lies in Okuma's longstanding commitment to the mechatronics approach to CNC machine design. This full-circle methodology involves a blend of mechanical engineering and electronic control development, thus assuring optimum communication between the machine and the CNC control.

This commitment to mechatronics led to the establishment of a thermal testing room in 1987, and accumulation of thermal data for over 30 years. Only actual CNC machine test data has been used. Through this time over 200 volumes of data have been analyzed to enable the creation of thermal maps. The data and mapping provide the framework for developing the CNC machine casting design, the spindle designs, and the TAS compensation software utilized in the Okuma CNC control (OSP).

MAXIMIZING PROFITABILITY

Thermo-Friendly Concept delivers enhanced machine tool cutting performance, increased machine accuracy, and reduction in costs. The result is maximized profitability for manufacturers.

FOR MORE INFORMATION ABOUT THERMO-FRIENDLY CONCEPT AND THE PRODUCTS ON WHICH IT IS AVAILABLE — CHECK WITH YOUR LOCAL OKUMA DISTRIBUTOR OR VISIT THE OKUMA WEBSITE AT WWW.OKUMA.COM