



Take off with complete  
solutions on board:  
SINUMERIK for Aerospace

**SINUMERIK**

Answers for industry.

**SIEMENS**



# Siemens: your partner for the entire supply chain

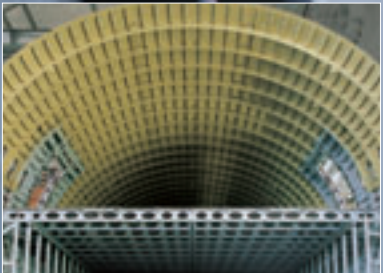
Component manufacturing




Composites



Assembly





## Ready for take-off: faster with SINUMERIK, the trendsetter in CNC technology

Countless processes are completed in the building of an aircraft. As an aircraft manufacturer, parts supplier or machine builder, one of the most important processes is in your hands. The more precise your process, the smoother your manufacturing, the faster the time between first design drawing and realization, and the higher the level of stability and quality that can be achieved. Our answer to the continually increasing demands of the modern aircraft: SINUMERIK®. SINUMERIK is an innovative CNC technology that guarantees increased safety during production, increased productivity thanks to faster production, shorter machine setup and downtime, and an optimized production flow. New uniform and creative machine concepts and integrated CAD/CAM/CNC process chain also allow for further technological advancements.



### High-tech production

These demands have a wide range of effects on the production of your structural components. They are no longer assembled from several parts, but are milled from a single piece of material. This reduces assembly time, greatly increases the strength, and reduces the weight of the component.

Today, stock removal rates exceeding 90% are typical for structural components. Cost-efficiency and precision require the use of high-speed milling machines: high-performance cutting in simultaneous five-axis machining.

### Processing new, innovative materials

The processing of new, innovative materials such as CFRP (carbon-fiber reinforced plastic) makes new demands on CNC processing and all CNC equipment. With SINUMERIK, you are extremely well equipped! CFRP has firmly established itself in state-of-the-art aircraft construction. This lightweight material is particularly tough, corrosion-resistant, and permits significant weight savings – up to 30% compared to aluminum.

### Our solution package is uniquely comprehensive

- Support for innovative machine concepts
- High-end CNC solutions with tailored functionality
- Optimization of the CAD/CAM process chain
- Components for verification and simulation concepts
- Virtual component production
- Comprehensive services from Siemens and established partners

### Established expertise in all relevant technologies

- Five-axis simultaneous machining
- Turning and milling
- Titanium machining
- Grinding
- Waterjet cutting
- Laser cutting, grinding and drilling
- Tape-laying
- Riveting
- Robotics
- Assembly



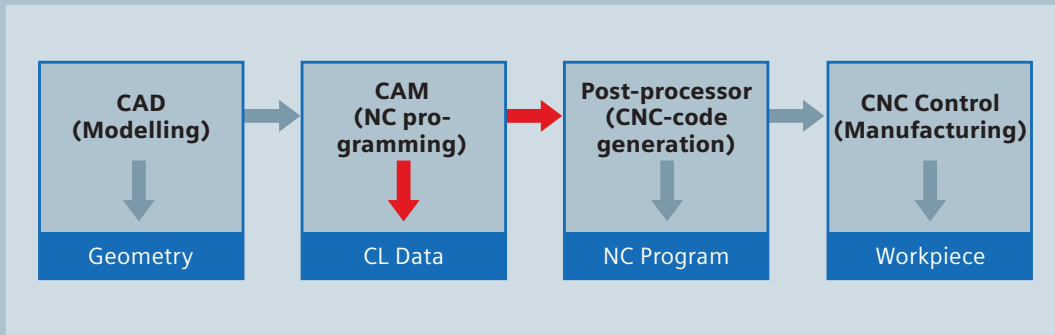
### Tailored services

In addition to proven products, we offer a comprehensive spectrum of services and support. Our cooperation with machine manufacturers, CAD/CAM suppliers, post-processor verification and tool-process monitoring systems ensures module compatibility. This provides quicker and safer programming of your first workpiece. In addition, we support simulating the surface quality of your components and their machining times prior to actual machining and, where necessary, in optimization.

### Get on board with Siemens

Leading international manufacturers of aircraft, engines, and their suppliers use Siemens components in their high-tech production: the SINUMERIK® 840D sl digital CNC controller – in combination with the SINAMICS® S120 drive, 1FN series linear motors, 1FT7 servomotors and SIMATIC® S7 PLC controllers.

# Start faster



**In the aircraft industry, process chain management from conception to completion is crucial. We offer innovative and tailored solutions for the complete production process, beyond any other CNC manufacturer.**

## **Well thought-out from start to finish**

As a leading CNC manufacturer, we know how important the integration of CAM systems is in the optimization of the process chain. Consequently, we maintain strategic partnerships with the leading CAD/CAM suppliers to the aircraft industry. Thanks to this cooperation, interfaces are optimally aligned with each other, and you are able to take advantage of integrated, aligned process steps. Working with Siemens PL (formerly Unigraphics), we offer customer-specific system development, system integration, as well as comprehensive system and process management.

## **Value-added simulation**

Early detection of programming errors, determining machining times, improved workpiece surface quality, increased machine productivity – these are some of the many requirements of machine builders and end-users. With Virtual Production and Virtual NC Kernel (VNCK), Siemens has the innovative solutions to meet these requirements and increase the productivity and performance of your machines. Simulation techniques can



hardly be left out in the planning and design phases for new machines. Here Siemens can offer machine builders the greatest benefit: Mechatronic Support in the form of shortened machine development times, or Machine Simulator, which is able to test and optimize the interaction between machine and automation.

#### **Accurate machining simulation thanks to Virtual NCK**

Programs were previously simulated using control models developed by the CAM manufacturer. However, these methods quickly reach their limits, particularly in the five-axis machining found in aircraft component production. Only with precise data can CAM system users accurately evaluate their NC part programs for executability, collision, workpiece geometry and machine motion behavior. For this reason, Siemens has released the heart of the SINUMERIK 840D control system, namely its mathematical basis, as a virtual NC Kernel (Virtual NCK). This gives the CNC programmer an exact representation of the situation in the machine; the simulation model mirrors reality. The advantages – freedom from collisions,

reduced setup time, increased process reliability, exact knowledge of machining time, optimization of machine utilization, and verified workpiece quality.

#### **Five-axis volumetric compensation**

The SINUMERIK 840D is the first and only control unit in the world that also integrates special algorithms to compensate for all geometrical residual errors on three- and five-axis machines, such as

- Positioning errors
- Straightness errors in vertical direction
- Straightness errors in horizontal direction
- Roll, Pitch, Yaw (RPY)
- Squareness errors of the linear axes
- Geometric errors of rotary axes.

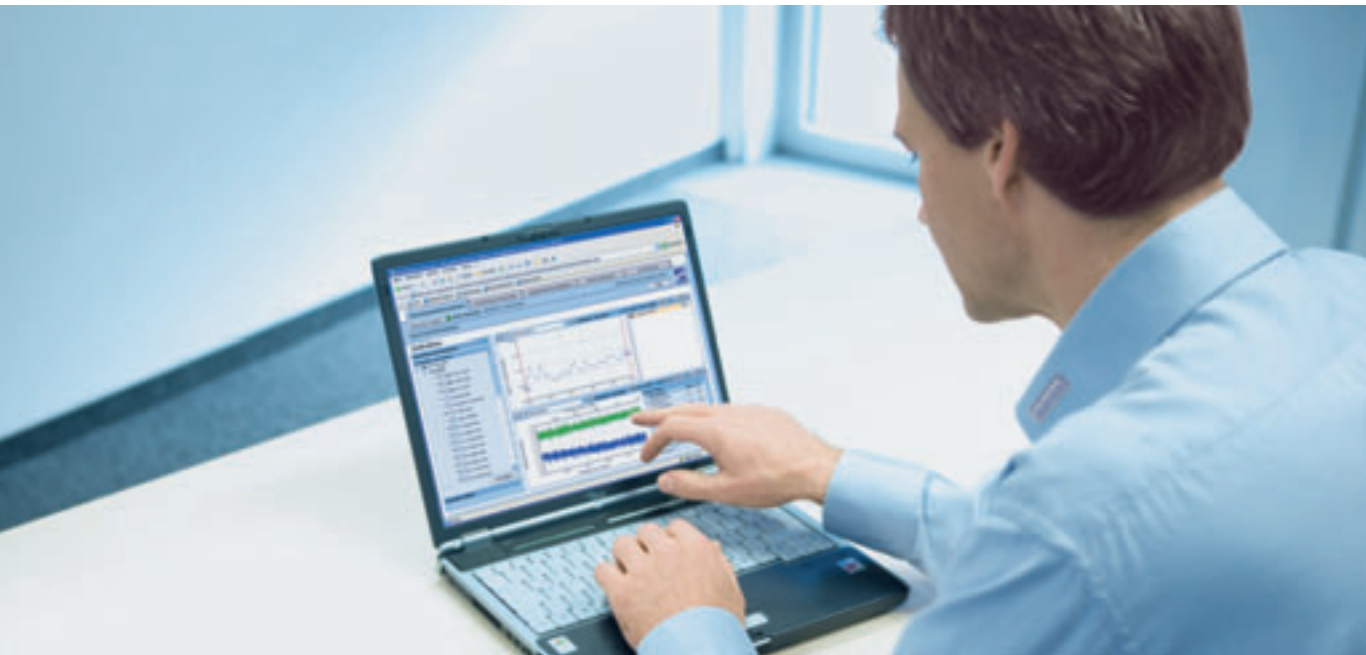
These errors lead to a tool tip position error and in case of five-axis kinematics, to a displacement of the tool orientation. Until now, they could only be reduced by means of mechanical measures at disproportionately high cost. Only with VCS (Volumetric Compensation System) is it possible to efficiently achieve tolerances

less than 50 µm, a requirement in larger machining centers.

#### **Spline conversion in real time**

For traditional CNCs, precise component surfaces in the CAD/CAM system must be approximated using linear blocks. This produces large volumes of data and roughly machined surfaces. COMPCAD spline conversion is the interpolation procedure used by the SINUMERIK 840D. The COMPCAD spline compressor ensures smooth tool paths, allowing you to machine your structural parts and engine components faster and more precisely.

# Increased productivity in your production – with service modules for machine lifecycle



Everywhere, where machines are built and used, the highest possible performance and efficiency is a priority. Siemens not only supplies CNC equipment via SINUMERIK, the integrated automation platform, but also provides solutions and services for machine tool optimization with SINUMERIK Manufacturing Excellence.

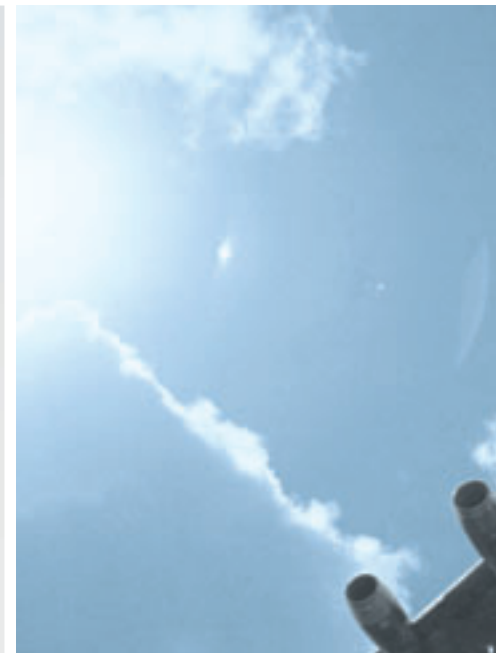
## We're there for you throughout the entire lifecycle

Siemens accompanies machines throughout their entire lifecycle – from the first idea and conception, through operation, all the way through retrofitting – because innovative services for machines can offer enormous potential for optimizing the lifecycle costs. The potential savings lie not only with the price for purchasing new machines and installations, but also for the development, engineering and operation costs.

## Manufacturing IT – for producing according to plan

Behind Manufacturing IT stands the familiar MCIS software suite. It supports the integration of the machines into the IT production environment and offers comprehensive consulting for IT and data security.

# Become a high flier



**Siemens is available to you around the world.**

**We hold our technology workshops on a regular basis at various locations around the globe. We would also be happy to conduct a one-day workshop at your location. Also, ask your local Siemens Aerospace Account Manager for the Airline Application Manual and our Reference Manual, each containing very useful information about aerospace technologies and solutions.**

Regardless of how advanced a technology is, the advantages can only be fully utilized when the user has complete control. Siemens supports you in achieving this. As part of our technology workshops, we provide you with everything you need to know about CNC-controlled production. This gives you a clear competitive advantage. During our technology workshops, we present the most important areas of aerospace CNC technology. This includes Virtual Production, as well as Mechatronic Support, and the simulation systems. You will become familiar with tailored post-processor solutions, five-axis simultaneous machining with SINUMERIK 840D, the Motion Control Information System, and our Condition Monitoring.



## SINUMERIK Manufacturing Excellence – Your advantages at a glance

### For the machine manufacturer:

- Shortened machine development time
- Cost-optimized machine development
- Improved machine service
- Reduce warranty costs
- Machine with optimum dynamics
- Create potential for new services

### For the machine operator:

- Reduction of part costs
- Process optimization
- Increased productivity and machine availability
- Optimized surface quality



## Condition Monitoring determines cost-effectiveness – safely and reliably

Investment decisions are increasingly dependent on the machine lifecycle costs. Aside from consumption-oriented variables, cost drivers in production are mostly due to non-productive periods. Condition-based maintenance can minimize these periods. ePS Network Services offer comprehensive functions to evaluate the machine's state. Using an automated test process, machine status is determined cyclically, and information on the actual loading of the machine is displayed. Knowledge of the state of individual components is the first step to increasing productivity. ePS Network Services are available for machine tool and production machines for various industries. Machine manufacturers and maintenance companies or service providers can increase the system availability and raise productivity to a new level.

## Productivity Improvement – finding and using hidden potential

For the first time, Productivity Improvement can be used to analyze processes on the entire machine without having to interrupt your production. In this way, hidden productivity potential can be found and developed. With Productivity Improvement, Siemens offers a comprehensive approach to reduce machine tool cycle time at the end-user. If un-used potential is discovered using Productivity Improvement, it can be appropriately developed in production at a suitable time.

## Virtual Production

With Virtual Production, it is possible to simulate and analyze CNC programs without interrupting production. The goal is to recognize and develop hidden potential in the CAD/CAM/CNC chain. Large structures, engine components particularly, offer enormous potential for saving processing time. Virtual Production is offered for NC machines equipped with Siemens numerical control and drive technology.

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## Get more information

Everything about SINUMERIK CNC can be found online:

**[www.siemens.com/motioncontrol/aerospace](http://www.siemens.com/motioncontrol/aerospace)**

**[www.siemens.com/sinumerik](http://www.siemens.com/sinumerik)**

Everything about our service portfolio,

SINUMERIK Manufacturing Excellence, can also be found online:

**[www.siemens.com/sinumerik/manufacturing-excellence](http://www.siemens.com/sinumerik/manufacturing-excellence)**

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