

NX Mach Series Machining Solutions

Improving productivity in NC programming and machining

fact sheet

www.ugs.com

► Summary

NX, the digital product development system from UGS, offers several prepackaged Mach Series solutions for NC machining. Available in a range of capability levels, these solutions accelerate programming and improve productivity for a variety of typical manufacturing challenges, from basic machining to complex, multiple-axis and multi-function machining. The packages include complete capabilities for geometry import, NC toolpath creation, verification, postprocessing and shop documentation, along with productivity tools needed to streamline the overall machining process..

The NX Mach Series machining solutions include:

- *NX Mach 1 Machining Foundation*, an entry-level NC programming solution for planar milling and turning
- *NX Mach 2 Machining*, a complete programming package for turning and 3-axis milling, including high-speed machining and synchronization of multiple turrets and spindles in multi-function machines.
- *NX Mach 2 Advanced Machining*, a complete solution for turning and 3- to 5-axis rough and finish milling, supporting multi-function machines.
- *NX Mach 3 Machining*, a full-featured CAD/CAM solution, including solid and surface design and drafting with turning and 3-axis milling, supporting high-speed machining and machines with multiple spindles and turrets.
- *NX Mach 3 Advanced Machining*, a CAD/CAM solution, for turning and 3- to 5-axis milling, supporting high-speed machining and machines with multiple spindles and turrets
- *NX Mach 4 Manufacturing*, a comprehensive solution with the full range of CAD and advanced machining capabilities, plus molded part validation and mold design tools.

Which Mach Series Solution is the best choice?

NX Mach 1 Machining is the entry-level solution, with capabilities building through Mach 4 Manufacturing. Full design capabilities are included in the Mach 3 and 4 Machining Solutions. The Mach 2 and 3 Advanced Machining Solutions include five-axis machining.

Basic turning and 2D milling. If your NC programming requirements include only basic turning and 2D milling, NX Mach 1 Machining Foundation will meet your needs.

CAD capability. If you require full CAD design tools with machining, the NX Mach 3 Machining solutions will most likely meet your needs. If you require CAM capabilities without CAD, an NX Mach 2 Machining solution is probably the best fit.

Five-axis machining. If you need to program simultaneous 5-axis milling, the Mach 2 Advanced Machining or Mach 3 Advanced Machining will meet your requirements.

Mold design. If you design injection molds, the NX Mach 4 Manufacturing solution combines powerful CAD and CAM with molded part validation and the advanced mold design tools of NX Mold Wizard.



NX Mach Series Machining Solutions

See descriptions that follow for further details

	NX Mach 1 Machining Foundation	NX Mach 2 Machining	NX Mach 2 Advanced Machining	NX Mach 3 Machining	NX Mach 3 Advanced Machining	NX Mach 4 Manufacturing
Product Number	NX11400	NX12400	NX12410	NX13410	NX13420	NX14400
Geometry import	•	•	•	•	•	•
NC programming						
Basic machining and toolpath editing	•	•	•	•	•	•
Resource library access	•	•	•	•	•	•
Fixed axis milling						
Planar milling	•	•	•	•	•	•
Core and cavity milling	•	•	•	•	•	•
Fixed axis surface milling		•	•	•	•	•
Facet machining		•	•	•	•	•
Flow cut milling		•	•	•	•	•
NURBS path generation		•	•	•	•	•
5-axis machining						
Sequential milling			•		•	•
Variable axis milling/profiling			•		•	•
Multifunction machine synchronization		•	•	•	•	•
Turning	•	•	•	•	•	•
Wire EDM		•	•	•	•	•
Feature automation		•	•	•	•	•
Machining simulation						
Toolpath verification	•	•	•	•	•	•
Machining simulation		•	•	•	•	•
Postprocessing						
Post builder	•	•	•	•	•	•
Advanced kinematics		•	•	•	•	•
Shop documentation	•	•	•	•	•	•
Product and process management						
Managed Development Environment (MDE)	•	•	•	•	•	•
Extended MDE option		•	•	•	•	•
Design tools						
Product design tools				•	•	•
Mold design tools						•

NX Mach Series Machining Solutions capabilities

NX Mach Series Machining Solutions provide all the tools you need to create, refine and optimize NC toolpaths. From geometry import to toolpath creation, simulation and postprocessing, these solutions deliver comprehensive NC programming capability in a fully integrated system.

Geometry import

All of the NX Mach Series Machining solutions include data exchange tools for importing CAD part geometry from a broad range of sources. NX machining works directly with NX geometric models, and is associatively interoperable with models created with I-deas or Solid Edge. NX translates data from several standard exchange and neutral formats, including IGES, STEP 203 and 214, DXF and DWG. Programmers using any of the Mach Series Machining solutions can also select parts from NX assembly models for machining.

NC toolpath creation and programming

General NC programming tools

All NX Mach Series Machining solutions include tools for creating and editing NC programs. The base capability enables programmers to edit cutter location source files, to reorder tool paths within the cutter location files and to program point-to-point, drive curve machining and drilling. In addition, programmers can graphically display NX toolpaths, and upon selection of a graphical element, can edit the graphical component or its corresponding textual representation (GOTO statements).

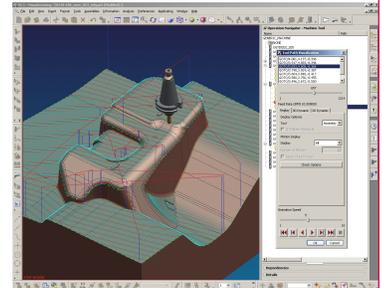
In addition, the NX Machining solutions can readily interface with optional resource libraries of cutters, feeds and speeds and machine tool information. The interface enables programmers to search, review and retrieve resource information through NX query dialogs.

Fixed-axis milling

Planar milling – All NX Mach Series Machining solutions support planar milling operations including multiple-pass profiling and follow pocketing, and include three linear motion area clearance routines. The software automatically creates toolpaths for pre-drilling holes and machining around multiple islands.

Core and cavity milling – All NX Mach Series Machining solutions create toolpaths for fixed-axis core and cavity milling. The toolpaths remove volumes of material in planar layers that are perpendicular to the fixed tool axis. This type of machining operation is most commonly used to rough out material from cores and cavities in preparation for finishing. Multiple cutter trajectory options are available, as well as control for high speed machining. Initial stock material and in-process material can be used to define machining regions, thereby avoiding unnecessary cutter moves.

Fixed-axis surface milling – enables 3-axis machining of surfaces and solids. NX includes a broad selection of drive methods including boundary, radial cut, spiral cut and user-defined. Boundary drive methods offer cut patterns that include concentric and radial patterns. The software features controls for upward and downward cutting and helical engages, and geometry creation to identify uncut or cleanup areas.



Fixed-axis core and cavity milling in NX Mach Series Machining Solutions creates toolpaths that remove material in planar layers perpendicular to the fixed tool axis.

Facet machining – creates toolpaths for machining faceted models such as STL (rapid prototyping format) or Parasolid faceted bodies. This capability can be used in reverse engineering from scanned models.

Flow cut milling – generates fixed contour toolpaths along concave corners and valleys formed by part surfaces. NX automatically determines the direction and order of the flow cuts using rules based on machining best practices. The resulting toolpath is optimized to maintain tool contact with the part and minimize non-cutting moves. Manual assembly is available for the cases where human intervention can improve the results.

NURBS path generation – provides a machine control dialog with an option for output of non-uniform rational B-spline (NURBS) toolpath, the application code for the generation of the toolpath, and the necessary enhancements to postprocess the new format. The format is supported by machine controllers that have NURBS interpolation option.

Five-axis machining

Sequential milling

NX includes toolpath creation for machining a series of edge-to-edge surfaces (sheets or faces) in succession. This sequential milling capability is used to finish surfaces once the area has been roughed out with planar or cavity milling. The software creates toolpaths that carefully follow surface contours using three-, four- or five-axis tool movements while exercising a high degree of control over each tool move.

Variable axis milling and profiling – NX supports both fixed and multi-axis milling functions on any NX part surfaces. Programmers can specify full 3- to 5-axis contouring motion, tool orientation and quality of surface finish. Tool paths may be controlled by surface parameters, by projecting tool paths onto the surface and by arbitrary curves or points.

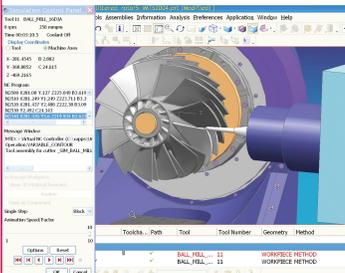
NX creates toolpaths for profile contour milling operations that semi-finish and finish walls. The software defines the tool axis so that the cutter removes material with its side only. For example, upon selection of a cavity floor, the software will create toolpaths for all the walls surrounding the floor in that region. If multiple floors are selected in a single operation, then all the surrounding walls will be machined.

Advanced multi-function machine support (synchronization)

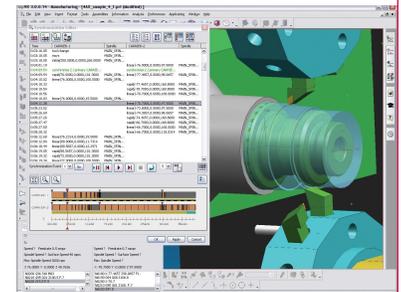
NX supports programming of multiple-function machine tools with a synchronization manager that enables programmers to arrange multiple program “channels” in parallel. The intuitive user interface works like video editing. Multiple program channels can then be easily synchronized and visualized, immediately verifying the simultaneous motion. Timeline presentation emphasizes the program’s efficiency by showing the active tools and tracking the total cycle time.

Turning

All Mach Series Machining solutions include advanced functions for programming in-process linked lathe roughing, finishing and groove operations. The turning capability also addresses programming of mill/turn machines.



NC programming for five-axis machining is included in the Mach 2 and 3 Advanced Machining Solutions and in NX Mach 4 Manufacturing.



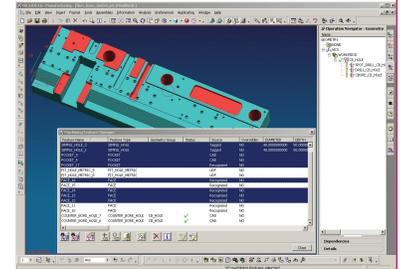
Advanced multi-function machine tools are supported by a synchronization manager that helps arrange multiple program channels in parallel.

Wire EDM

NX Mach 2 through Mach 4 Machining solutions create toolpaths for wire electrical discharge machining of parts in 2- through 4-axis mode. The software works with parts defined in wireframe or solid geometry. It supports a range of wire EDM operations including multi-pass profiling, wire reversing and area removal.

Feature-based machining

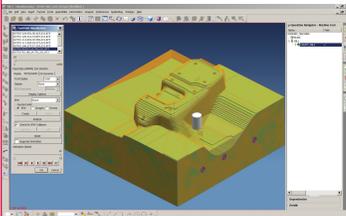
NX automates toolpath creation for machining holes, pockets and faces with feature-based machining. This advanced capability automatically recognizes features in NX design models, including user-defined features and geometry items with machining feature attributes. The software applies templates with pre-defined processes for each feature type and rules for adjusting the process for specific geometry and material conditions. According to the rules, multiple operations are provided for machining the features, including tool selection and parameter settings. An optimization procedure consolidates tool selections and optimizes tool motions across the feature sets.



NX automates toolpath creation for machining holes, pockets, and faces with feature-based machining.

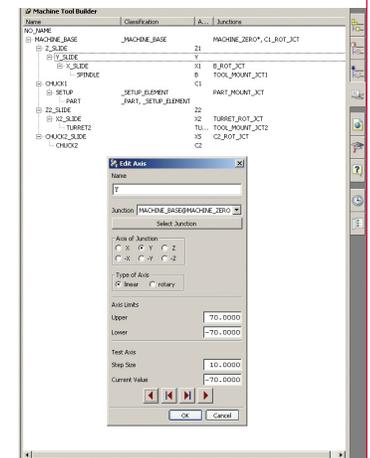
Machining simulation and toolpath verification

Toolpath verification – All Mach Series Machining solutions provide visualization capabilities that display, animate and verify NX toolpaths for milling and turning. The visualization enables shaded display and storage of the in-process workpiece and standard display of the toolpath and holder with gouge detection. The software animates the material removal process and provides analysis tools for remaining material and undercutting.



Toolpath verification in NX Mach Series Machining Solutions includes dynamic display of material removal.

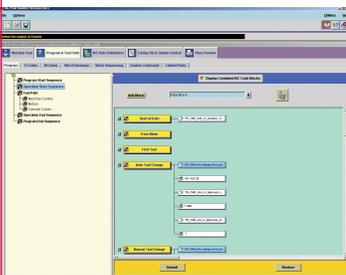
Machining simulation – NX Mach 2, Mach 3 and Mach 4 Machining packages include an out-of-the-box capability for machine simulation and collision detection using a set of pre-defined generic machine tools. In addition, a machine tool builder enables companies to create and simulate customized machine tool/controller combinations. The software simulates toolpaths and machine tool G and M code programs. Custom machines can be stored and retrieved in optional UGS library tools.



NX machine tool simulation includes a machine tool builder that enables companies to create and simulate customized machine tool/controller combinations.

Postprocessing

Post builder. All Mach Series Machining Solutions include an interactive postprocessor generator that creates NC postprocessing programs used to produce machine-specific output from NX toolpaths. Standard milling, drilling and turning machines are supported. The postprocessor development tools include Windows-like structures with drag-and-drop options for defining the postprocessor parameters. In addition, the output can be manually modified by users with programming experience to extend the postprocessing features. Postprocessors can be executed to convert NX toolpaths to machine-ready programs.



All Mach Series Machining Solutions include an interactive post builder that creates NC postprocessing programs used to produce machine-specific output from NX toolpaths.

An *advanced kinematics* library is included in all the Mach Series Machining solutions except Mach 1 Machining Foundation. The advanced kinematics are required for postprocessing advanced machine tools with non-orthogonal heads.

Shop Documentation

All NX Mach Series Machining Solutions include tools for creating NC program documentation for use on the shop floor. The output can be configured to produce ASCII files, HTML (viewable from a web browser), and other formats.

Product, process and program management

Managed development environment – The managed development environment (MDE), powered by UGS' Teamcenter technology, is a foundation product data management system integrated with all NX solutions. It provides a variety of capabilities for vaulting, sharing and securing product data across distributed organizations that can be deployed to meet the challenges of today and scaled to meet those of tomorrow. An integral component of NX solutions, the MDE organizes and protects all part data (including models, drawings, images, technical documents and other related information). With comprehensive search tools, the MDE saves time locating product data and helps coordinate the work of design team members.

Designers can also take advantage of where used/referenced tracking and impact analysis. Additional solutions for managing manufacturing data are available with Teamcenter Manufacturing.

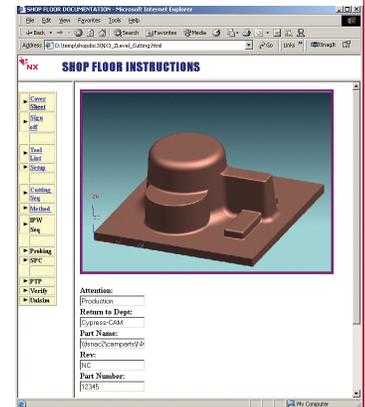
Extended MDE option – The extended MDE option expands the product and process management capabilities. With the extended MDE option, companies can add engineering change management, configuration management and process management, combining these as a platform for repeatable digital validation. By extending the environment beyond typical CAD data management solutions, whether that data is from I-deas NX Series, NX, Solid Edge, CAM and CAE systems or other CAx products, the MDE supports workflow and change management. These capabilities coupled with configuration management provide a platform for realistic and sustainable portfolio management.

Design tools

NX Mach 3 and Mach 4 Machining solutions include a full suite of design tools to deliver comprehensive CAD/CAM capability in a single software package. The design tools include:

Solid/feature-based modeling – This general modeling capability supports the creation of 2D and 3D wireframe models, swept and revolved bodies, Boolean operations and basic associative editing. Feature-based modeling supports the creation and associative editing of standard design features such as holes, slots and pockets. It lets users hollow out solid models and create thin walled objects. A feature can be located relative to any other feature or object and can be instanced to establish associative sets of features.

DesignLogic – Enables users to add design intent or knowledge on the fly in the form of formulas and expressions. For example, a designer may wish to constrain a design dimension so that it is determined by a formula or mathematical expression. Design Logic is implemented so that right-clicking design



NX creates NC program documentation for use on the shop floor. The output can be configured to produce ASCII files, HTML (viewable from a web browser), and other formats.

elements allows entry of the formula or expression that controls it. Users can create features that add intelligent checking to a product's definition. The check feature is similar to other NX features. However, the check feature helps a designer to ensure a product's compliance to corporate standards throughout all phases of the design process through generating reusable rules and formulas. The tools come in the form of checks for mass, distance, size and expression. Check features display in the Part Navigator as standard features.

User-Defined Features (UDFs) – Provide an interactive means to capture and store families of parts for easy retrieval and editing. They let users take an existing associative solid model, created using standard NX modeling tools and establish relationships between parameters, define feature variables, set default values and decide the general form the feature will take when started. Existing UDFs reside in a library that can be accessed by anyone using the Features Modeling application.

Assembly design – This capability supports “top-down” and “bottom-up” assembly modeling. It provides for rapid navigation of the assembly hierarchy and allows direct access to the design model of any component or sub-assembly. It supports the “design in context” approach where changes can be made to a design model of any component while working in the context of the assembly.

NX includes tools for building and manipulating assembly structures. The use of inter-part relationships, such as mating conditions and basic WAVE links, enables the creation of parametric assemblies which capture and preserve the designer intent whenever changes are made.

Assemblies can be easily navigated using the assembly navigator in conjunction with intelligent component searching capabilities. NX assemblies also includes support for modeling and switching between different states of flexible assemblies and parts.

Freeform modeling – Complex-shape modeling tools support the creation of complex surface and solid models. Freeform modeling capabilities include:

- Create solids from sheets
- Basic sweeping along curves
- Proportionally developed shapes using 1, 2 and 3 rail methods
- Lofting – ruled, curve mesh, lofted shapes using standard conic methods; and meshes of points and curves
- Special surface creation – surface extension and n-sided, bounded plane, offset
- Surface manipulation tools: surface extension and surface normal control
- Body-based trimming
- Surface trimming using curves
- Complex filleting, blends, bridges and transition surfaces
- Surface creation from external point, poles and point cloud data
- General-purpose design and manufacturing sweeps and flanges,
- Direct point and pole manipulation
- Boundary, degree and stiffness controls
- Analytical and visual surface quality evaluation

Sheet metal design – A solids-based application that is focused on design for manufacturing of sheet metal parts. Users can create sheet metal component models using feature-based design tools for tabs, flanges and other typical features. They can define forming tables and bend sequence tables, and reform the solid model taking into account material deformation properties. The sheet metal tools generate accurate flat pattern data for downstream applications from solids, sheets and wireframe geometry.

Drafting – Includes tools to automate and streamline engineering drawing production. Drawings are associative to models, so model changes automatically update and are reflected in related drawings. Drafting capabilities include detailing, dimensioning, symbols, sheet layout and placement of standard orthographic and auxiliary views, automatic view creation from the 3D model, hidden line processing. Templates that include drawing borders and view layout can be dragged and dropped on models to automate much of the tedium. Drafting tools automatically comply with the drawing standard selected by the user – ANSI, ISO, JIS, DIN.

Validation – NX validates product designs with a quality assurance checking utility that evaluates parts, assemblies and drawings to check that files are compliant to corporate standards and best practices, models are parametrically correct, model quality problems do not occur (for example, mismatched edges, tiny gaps in faces and non-manifold conditions) and assemblies are complete.

Collaboration – The collaboration functions in the NX Mach design solutions, powered by Teamcenter, enable customers to share designs, hold working design conference sessions and conduct design reviews. For ad hoc design reviews, the Mach Series solutions create packaged files of lightweight design models and related documents that can be distributed via email and viewed outside the NX environment with the free XpresReview viewer.

Web publishing – NX enables users to publish design data to the web with an HTML publisher for creating detailed documentation for component parts or assemblies based on information in NX part files. Web publishing uses template files that contain both HTML and special NX embedded commands. These commands extract information from a design file and write it to an HTML file that can be read universally.

Rapid prototyping – NX can automatically output/export model data in faceted STL format used with rapid prototyping technologies, such as stereolithography and fused deposition. This capability reduces turnaround time regardless of the specific rapid prototyping technology employed.

Rendering – Provides users with rendering tools to communicate designs clearly and to create accurate images that can be used throughout the design and manufacturing processes. Users can accurately visualize designs to reduce costs and shorten design cycles, and to specify real-world materials that will be used when their products are manufactured.

Custom program execution – Enables users of all NX Mach Series Design solutions to run custom programs that were developed with the NX Open software development tools or the Knowledge Fusion knowledge-based engineering package.

Mold design tools

NX Mach 4 Manufacturing includes high-performance design tools for injection mold making:

Mold design – NX mold design combines industry knowledge and best practices with process automation in a state-of-the-art solution that streamlines the entire mold development process. From part design to tool layout, tool design and tool validation, NX mold design excels at even the most challenging mold designs, providing advanced functionality, step-by-step guidance and associativity with part designs to ensure quality molds and quick response to design changes.

Molded part validation – With molded part validation, designers can check the moldability of parts, even if they know virtually nothing about mold design. NX analyzes parts and automatically provides designers with information about draft angles, undercut areas, sharp corners, small radiuses, etc. It provides designers with an easy visual check of core and cavity sides that doesn't require any special analysis or knowledge of mold design.

Product and process management

Managed Development Environment – The Managed Development Environment (MDE), powered by UGS's Teamcenter technology, is a foundation product data management system integrated with all NX solutions. It provides basic vaulting, file check-in/check-out and is an integral component of NX solutions. MDE organizes and protects all product data (models, drawings, associated documents), saves time searching for product data and helps coordinate work of design team members.

Extended Managed Development Environment – Mach 2 through Mach 4 Machining solutions offer an option for Extended Managed Development Environment (MDE). With the extended MDE, companies can expand product and process management capabilities as needed to include engineering change management, process management and repeatable digital validation.

► **Contact**
UGS

Americas 800 498 5351
Europe 44 1276 705170
Asia-Pacific 852 2230 3333

www.ugs.com

