# numcut

TOTAL SOLUTION FOR WATER JET CUTTING PLASMA CUTTING LASER CUTTING



www.num.com

### **NUM Solutions and Systems** Established Worldwide

## Outstanding solutions in machine automation have one thing in common: They are always the product of outstanding performance, exceptional technologies and a high degree of creativity!

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And NUM has earned its exceptional reputation in the machinery and tools industry exactly with that. We develop customized automation solutions that ensure a high degree of added value both to the machine manufacturer and the user. With our expertise that we have developed over decades, we put our motto "NUM automation solutions provide machine builders with a competitive advantage" into practice.NUM had already developed the first CNC controller in 1961, i.e. 10 years before CNC- or NC control systems found a wide acceptance among users. With the launch in 1964, NUM was one of the first CNC providers in the world. Since then, we have maintained our position as a technology leader in this segment and are eager to expand it further. Today's systems, with their flexibility and our expertise, enable us to automate the most varied machinery. Our long, successful track record supports this finding in an impressive manner. We will continue to develop the readiness and flexibility of our systems in this direction and make the necessary investments in R&D as well as in our staff.

As an international company headquartered in Switzerland, we have sales, application development and service locations all over the world (see back cover) from which we operate worldwide. Our research and development departments are located in Switzerland, Italy and France. Our main production facility is located in Italy.

It is our clearly defined vision that we keep the development and manufacture of the core products in the CNC system, including the drives and motors, under our control. This enables us to adjust the important flexibility and readiness of the systems to new market requirements even in the short-term.

The ready and flexible NUM automation systems combined with our locally available engineering expertise and the machine manufacturer as a competent partner, results in a uniquely flexible and powerful team.

### **Customized Projects**

NUM supports you with your projects in the same way as it is ideal for your business and infrastructure. The goal of our cooperation, however, always remains the same: To find the most efficient solution for your project together with you.



### Project facilitation PRODESIGN

#### Efficient consulting for optimal application solutions

This model is ideal for companies with their own development teams and automation specialists. As an external partner, we provide our entire know-how in the field of CNC automation and take on an advisory role.

### Project cooperation CODESIGN

#### Merging knowledge - potentiating results

Your development team will be combined with our team of specialists. Together we will realize the automation of your machine with clearly defined responsibilities. This form of cooperation has proven to be extremely efficient in many projects.

### Total solutions ALLDESIGN

#### Delegating responsibility – controlling result

We assume the entire project management in the sense of a general contractor and are fully responsible for the successful implementation. Starting with the development of the requirements specification, over the development and commissioning, up to support and service.

## **NUM Solutions and Systems** Intelligent and Creative

# We have developed countless customer- and application-specific solutions for different industries and thus mapped out practical solutions for professional requirements. Based on this, our engineers have created groundbreaking total solutions for demanding applications.

All of our solutions are based on a wide range of perfectly matched proprietary products such as CNC, drive amplifiers and motors. The partnership with our customers in the evaluation, project and installation phase is further maintained by our training, support and other services even after commissioning. We attach importance to ensuring that our customers are served by our professionals with specific knowledge.



### numroto

**NUMROTO** – successful trendsetter in high-precision tool grinding for many years

### numspecial

**NUMspecial** – creative and practical solutions for your specific applications

### numcut

NUMcut - a complete solution for advanced cutting machines

### numgear

**NUMgear** – intelligent total solutions for new machines or as a retrofit in the field of gear machining

### numtransfer

**NUMtransfer** – economical and flexible for all lot sizes for transfer, rotary transfer and multi-spindle machines

## numhsc

**NUMhsc** – excellent quality at the highest speeds on machines with 5 or more axes

## numgrind

**NUMgrind** – grinding and dressing cycles, with intuitive shop floor entry screens and 3D visual validation

### nummill

**NUMmill** – flexible solution with a graphical interface for extensive milling cycles, including full 3D simulation

### numwood

**NUMwood** - long tradition with powerful complete solutions in woodworking

## numretrofit

**NUMretrofit** – rational extension of the service life of your machine by years

## NUMcut – Perfection in Cut Quality and Speed

NUMcut on NUM's current control system Flexium<sup>+</sup> is a modular, open and flexible system for cutting contours using water jet, plasma or laser. Each of these technologies has its specific features in the application, which are supported by NUMcut.

#### **NUMcut Total Solutions**

The innovative total solution for material machining using water jet, plasma or laser is characterized by a large range of functions. In combination with the CNC suitable for the application, the drive amplifiers and motors of NUM, NUMcut provides impressive results.

Functions like automatic distance control for cutting heads or coordinate transformations of non-cartesian cutting heads and their error correction contribute to achieve a perfect cut quality at high machining speeds even in 3D applications. Stored technology tables guarantee constant cutting quality and help to increase the productivity and to optimize the process security. It is also possible to create CNC programs in the teach-in process. Particularly in the production of 3D parts in prototype construction, this is a very common procedure.

The openness and flexibility of the system allows 3D machines to realize special head-corrections. Thus, the accuracy of 3D machines can increase extremely.

The continuity in the development of the system, which will still be working on site even after many years, ensure high value retention. Training specifically tailored to the application requirement, expert customer service and remote diagnostics complete the qualities of NUMcut.

#### **NUMcut Cutting Head**

The NUMcut cutting head for plasma torches converts the movement of two linear actuators into a horizontal 360° rotary movement. The angle of inclination can be up to 47°. The cutting head is an easy way to upgrade a 2D machine to a true 3D solution. Cutting head and parallel kinematics together weigh just 36.2kg. With unlimited allowable rotational movements, cables and hoses cannot become twisted and damaged.







### NUMcut – Sets the Standard in Water Jet, Plasma and Laser Cutting

# NUMcut was developed to satisfy the exceptional demands in water jet, laser and plasma cutting. For many years therefore successful companies with extraordinary requirements in this area have been relying on solutions from NUM.

A variety of materials can be advantageously machined with the water jet. Here, machines with 5 or more principal axes can be implemented for the 3D machining. Special functions are used to improve the cutting quality and cutting accuracy.

In plasma cutting, one aims at, among other things, a burrfree cut. Absence of wave formation and a smooth surface as much as possible are two other criteria. Special control functions help in achieving these goals. These include one, which allows rectangular cut edges using inclination of the plasma torch.

NUM normally offers no machine parts or assemblies. One exception is the 3D cutting head specially developed for plasma cutting. This can be integrated into an existing machine concept.

Several parameters are to be complied with in a narrow window for a perfect laser cutting. NUMcut contains the necessary functions, such as the control of the laser power due to the cutting speed and the stored technology parameters. Using "Frog Jump", the laser head is moved as rapidly as possible between the contour end and the new contour. An upward evasive movement is included in the function. This ensures that there is no collision with inclined cut out parts.



NUMcut also contains special functions, which are necessary for the 3D machining and the cutting of hollow profiles.

The option of re-entry into the CNC program using Flexium 3D offers an indispensable comfort. For this, the path of the CNC program is displayed on the screen of the controller. The re-entry point is defined using the mouse. The CNC program then starts from this point.



With respect to the technology and therefore also the requirements, there are different requirements in water jet, plasma and laser cutting, but there are also similarities. For all technologies, NUM offers solutions that are oriented to the respective requirements and the practice. A few, selected functions are presented in more detail in the following.

#### Re-entry after aborting the cutting procedure

A simple re-entry after aborting the cutting procedure (break; interruption; disruption) on the contour is made possible by Flexium 3D. The machine operator has the option to re-enter at the corresponding point in case of a break in the cutting procedure. Apart from the speed and ease of use, the workpiece can thus be "rescued" in a simple manner.

#### **Correction of the Jet Form (Nozzle Inclination)**

For various reasons, the cutting head might have to stand diagonally opposite the workpiece, for example, in order to correct the jet conicity. When moving the axes, this inclination should be taken into consideration. NUMcut has a function that recalculates the angles and repositions the nozzle continuously and in real time.

#### **Height Control**

For all cutting technologies, the constant distance between the cutting head and the workpiece surface is a prerequisite for a good cut. For uneven workpieces, this distance must be tracked. NUMcut provides a height control in the CNC, which meets various requirements. It includes continuous tracking of the distance, as it is required in laser and plasma applications, as well as optionally sequential tracking for water jet cutting machines. The height control can analyze a variety of measurement systems.

#### Fly Cut

The Flexium<sup>+</sup> control provides the ability to execute path-synchronous IO commands without stopping machine movement. For example, the switching action (e.g. laser on/off) can be controlled down to microsecond accuracy, taking into account system-related delay times and ensuring that the laser is toggled at exactly the right position. As a result, the cutting head moves at a high speed with no change in momentum over the entire sheet, cutting parts by accurately switching the laser on and off 'on the fly' with pinpoint accuracy. This considerably reduces the time required, especially for the production of perforated grids and most simple shapes like squares, triangles, and hexagons.

#### **Head Transformations / Correction**

For 3D machining, two rotary are added to the 3 linear axes (X, Y, Z). For various reasons, however, these are often not implemented in cutting processes using two classic rotary axes. A good example of this is our plasma cutting head (NUMcut head). It consists of two linear axes. Rotating movements are performed using parallel kinematics. So that the parts programming can still be done with classical rotational axes, the CNC converts the programmed traversing movements into the movements of linear axes. Due to the openness of the system, any transformations can be realized. Correction functions are especially important in 3D-cutting, which are able to compensate for mechanical errors. For this, NUMcut offers various solutions that are adjusted to the respective application case; this way, the accuracy can be massively increased.



### Intelligent Algorithms for Highest Efficiency

#### **Laser Power Control**

NUMcut contains an electronics module, which converts control commands from the parts program into control signals for the laser power. This is useful both during insertion and during cutting. During insertion, it is about the quickness, thus the nozzles and the lens are protected. During cutting, the laser power must be adjusted to the machine dynamics depending on the material thickness and contour.

#### **Technology Tables**

All relevant setting values (parameters) such as the material thickness, material quality, cutting speed, laser power, cutting gas type and pressure are stored in the technology table, which constitutes the centerpiece of the cutting parameters. Depending on the requirement, these are activated via the parts program and used in the NUMcut functions.

#### "Frog Jump"

Using the function "Frog Jump", the laser head will move as quickly as possible between the contour end and the new contour start. For this, an upward evasive movement is included in the function. This ensures that there is no collision of the laser head with cut out parts. These might have been placed in an incline on the support plate and obstruct the travel movement. This function is retrieved in the parts program.

#### Adjustment of the Feed Rate

With water jet cutting, the cut lags on the bottom side compared to the inlet side for technological reasons. Now if the feed rate of the cutting head is not decelerated gently or accelerated thereafter in front of a corner, the material is not cut through over the entire cross-section. The cut part thus



remains connected to the residual material. Using a NUMcut function, the cutting speed is adjusted in such a way that this effect is absent.

#### **Other Functions / Specialties**

Of course, there are other functions necessary for the various machining methods.

However, a particular advantage of NUMcut is also the open Flexium<sup>+</sup> system itself. Special functions customized to specific application cases can be implemented efficiently. This applies to all areas of the system from the real-time kernel to the HMI (Human Machine Interface). These extensions can be programmed by NUM or by the machine manufacturer himself and can be integrated into the overall system through a special encryption method as copy-proof.



### Flexium+ CNC-System Flexibility, Productivity and Safety

#### Flexium+ Extreme Scalability



Up to 32 axes/spindles per NCK and more than 200 per CNC system

The control system is characterized by an extremely high scalability. It allows the perfect adaptation to the respective application solution. Thus, in a simple way, systems from 1 to over 200 CNC axes can be realized. The Flexium<sup>+</sup> system has a secure PLC in addition to the normal PLC, which communicates via FSoE (Fail Safe over EtherCAT) with the secure inputs and outputs as well as with the NUMDrive X drive control systems. The system covers all necessary safety functions in a simple manner. The programming of the safety logic is carried out with the same software tool as the rest of the PLC. This same tool is also used for the entire system parameterization and commissioning of the machine. The NUMDrive X drive solution is the result of more than 20 years of experience in the development of fully digital drive systems. It is available in different versions with different performance data. The wide range of drive amplifiers is available in single and dual axis versions and also in different performance levels (processing power). This allows a technical and financially optimum adaptation to every application. These modules are designed for rated currents of a few up to 200 amps. Another strength of the drive amplifier is its compactness and high energy efficiency.

### **NUM Motors** Perfect for all Applications

## Excellent volume/performance ratio and great dynamics, so that our motors can satisfy almost all applications.

NUM has more than 50 years of experience developing servo and spindle motors. We pioneered the development and production of AC brushless servo motors, as well as synchronous spindle motors with flux weakening.

The comprehensive **servo-motor** series of NUM offer an excellent volume/output ratio, as well as first-class dynamic properties optimized for the machine tool industry. They, with perfect concentric run-out, satsify even at very low speeds. The so-called "single cable" motors offer the advantage that the complete measuring system cable is eliminated. This simplifies the wiring of the machine significantly and thus saves money.

The **asynchronous motors** of the AMS series offer excellent quiet running at low speed, quick and accurate positioning and are ideally suited as a C-axis and for spindle indexing.

The TMX series **torque motors** have an extremely low cogging torque as well as a very high S1 torque density. They are ideal for applications that require very smooth and precise motion, especially at low speeds. Typical applications are direct drive rotary tables or workhead axes of machine tools. The TMX motors are complemented by an extensive range of torque motors from our partner company Schaeffler Industrial Drives (IDAM), who's customers include many well-known European machine builders.

Key data of the motor series:

- Servo-motors from 0.318 to 160 Nm (IP65, IP67)
- Rated speeds of the servo-motors up to 8000 rpm
- Spindle motors up to 55 kW
- Special kit motors
- Liquid-cooled spindle motors
- Liquid-cooled servo motors
- · Asynchronous and synchronous motor spindles (motor spindle)
- "Single cable" motors
- Custom motors







SCHAEFFLER

### **NUM Services** Worldwide at your Service

# The decision for NUM is also the decision for a customer service that will support you long after the initial investment as on the first day – even after 20 years and on–site. Our specialists can ensure an extended life for your good (but old) machinery with NUM retrofits.

#### Worldwide support by experts

For professional analysis and trainings, a perfect infrastructure is available to our experts in all centers of excellence. So that we can assist you quickly and efficiently around the world, we also rely on the advantages of the most modern communication technologies, e.g. for remote maintenance via Internet. Of course, we will be happy to offer advice on site in your company.



#### Comprehensive training offer

We orient our training to your indivual needs – whether its operator training, maintenance, repair and service training, PLC programming, or adjustment of servo drives.

NUM provides a training offer matched to the customer needs:

- CNC operation
- CNC programming
- PLC programming
- Commissioning and servicing
- · Preparation of custom surfaces
- Customized customer training

#### Technically always up to date

Our team of specialists will actively inform you on the latest hardware- and software developments and provide you with useful technical information.

#### **Repair- and spare parts service**

If an error unexpectedly occurs in your CNC system in spite of proper maintenance, you can trust that this will be fixed by dedicated service employees of our global network.



#### **Customer service**

For you and your markets, we have a worldwide service organization. The International customer service provides telephone consultation, deployment on site, even for many years old installations. With a retrofit from NUM, the operating time of an excellent machine can be extended by many years.

Our customer service is available and responsive to help even with cutting edge products and custom developments. We carry local inventory and have your materials and components in stock ready to meet your requirements for quality and delivery times.

## Complete CNC Solutions Worldwide





#### NUM systems and solutions are used worldwide.

Our global network of sales and service locations guarantees professional service from the beginning of a project to its execution and for the complete life cycle of the machine.

NUM has service centers around the world. Visit our website for the current list of locations.

Follow us on our social media channels for the latest information on NUM CNC Applications.



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