

Tool Management System

NUM's tool management software is designed to track tool data and to ensure that at any moment the location and characteristics of each tool are perfectly known and can be managed by their respective application.

One of the benefits for end users of NUM's tool management system is easy and reliable access to tool life and tool change management, independent of whether the processing tool is in magazine, changer or spindle. Clear dialogs help the operator to add new tools, find existing tools and get free pocket places and data defined by tool and Duplo number. The system also includes various logical HMI list pages for spindle and magazine view, as well as tool view and tool data tables, allowing operators to visualize the complete contents of tool data and the current status.

The OEM/machine builder simply uses the NUM Flexium Tools software to extend the project scope to the database server. Comprehensive API functions allow the implementation of all necessary tool operations, along with a number of special functions in the NCK firmware. So NUM's new system helps the OEM to save significant operating and development costs.

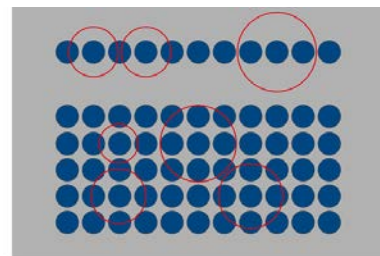
The software meets various mandatory requirements:

- Tool life and tool change management
- Equivalence criteria
- Management of stepped tools (multiple cutting edges)
- Data transfer via network and database
- Tool measurement
- Organization of an unlimited number of magazines

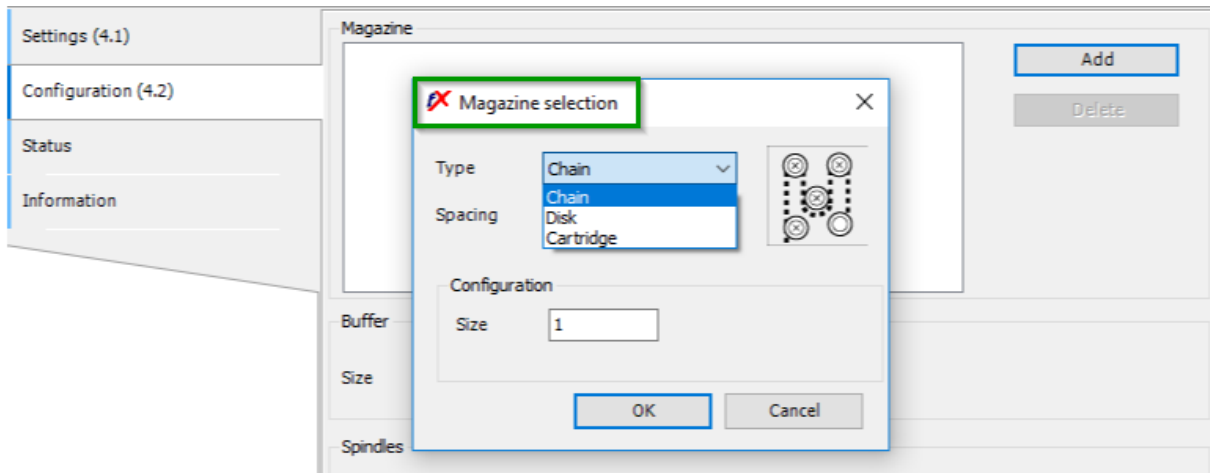
This advanced database-driven tool management software simplifies control of the diversified tool types, e.g. cutters and dressers with different tool sizes (small, medium and large) in magazines. The red circles characterize the required space for pockets inside a typical magazine.

Sizes are:

- Small: the tool uses 1 pocket place
- Medium: The tool uses 1 ½ pocket places in all directions
- Big: The tool uses 2 pocket places in all directions



The configuration of the magazine type and pocket places is done inside the PLC configuration in Flexium Tools.

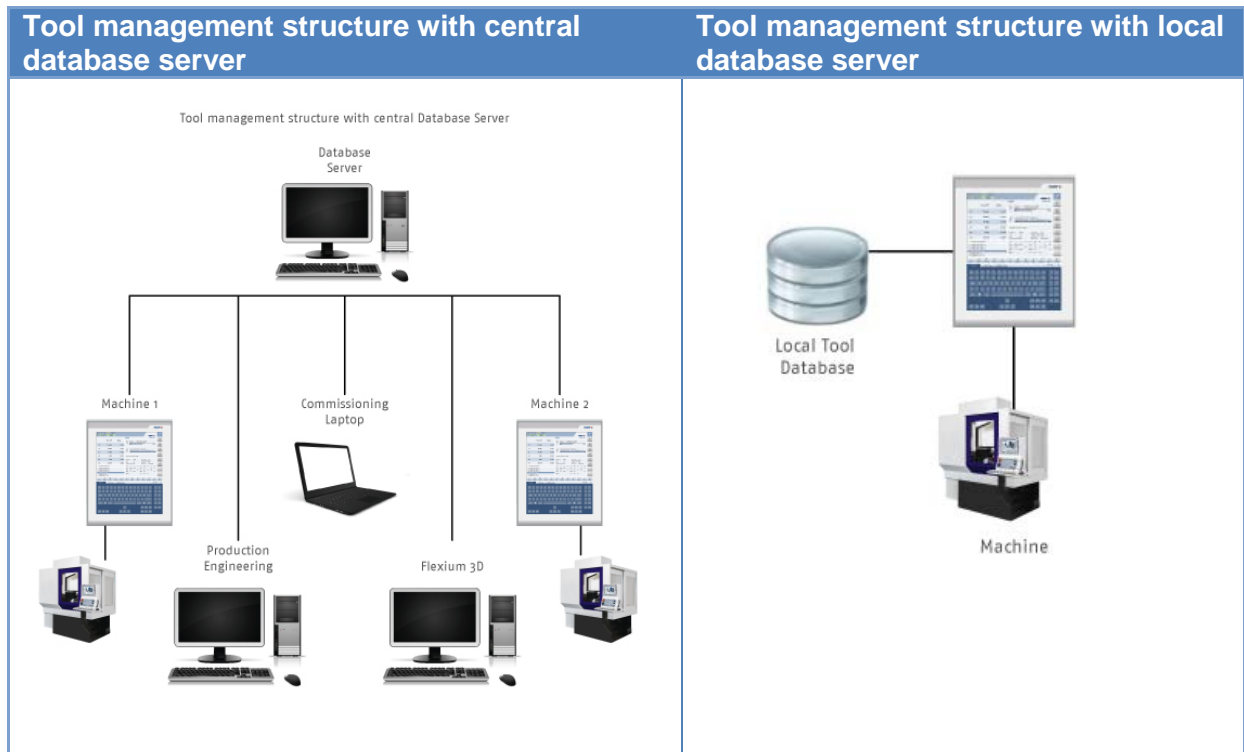


Three different tool magazine types are supported:

- Chain type
- Disc type
- Cartridge / Rack-style or Pickup

NUM has released this software package for the Flexium⁺ CNC platform starting from revision 4.1.10.00.

The machine tool management database can be installed on a server platform somewhere in the production plant, with the complete set of tools needed for production, supporting multiple machines with dedicated tool magazines. Alternatively, the tool management database can be used autonomously on a single CNC machine, as an extension of the Flexium⁺ HMI software.



The tool management software includes PLC libraries as well as special CNC functions and HMI pages. This software accommodates a very large number of different tools in different sizes, e.g. for turning, milling and drilling. Duplo tools with identical cutting properties are also supported, as well as different types of tool magazines, such as disc, chain or shelf or pickup magazines. Additional tool properties such as maximum speed and maximum feed rate are also managed like maximum speed and maximum feed rate (see 'Extended' tool table column below) and tool life can be monitored over time after wear or after a number of machining operations. When approaching defined limit values, appropriate preventive warnings are generated automatically, the tool is blocked and the next Duplo tool is selected automatically.

The software offers a particularly comprehensive extension set for the tool properties. In addition to standard data such as the name, type and quantity

of cuts – up to 18 cutting edges of stepped tools can be specified – extensions for numerous other factors are also available, such as magazine size, tool life management, technical features such as maximum speed and feed rate, as well as status and warning displays.

As tool characteristics, a distinction is made between following items:

Base	Extended
Name	Dimensions
Type	Status
Equivalence (duplo)	Warnings
Number of cuts	Max speed
Size in magazine	Max feed
Type of life management	Operation
	Tool holder
	etc.

General features of tool management:

- The tool management software handles all the spindles, buffers and pockets of the machines.
- The number of tools is only limited by the memory available for the database.
- Up to 18 correctors per tool are supported
- Easy and comfortable functions for tool handling (Fetch/Retrieve/Find/Insert/Return/Update etc.)

Extract of PLC library function:

- FindTool (number)
Return the location of the tool
- LoadToolFromMagazineToBuffer (buffer, location)
Update the tool location (extraction from magazine)
- LoadToolFromBufferToSpindle (spindle, buffer number)
Update the tool NCK data and location (swap with the spindle)
- LoadToolMagazine (tool number, Duplo number)
For inserting tools with Id tag – read the tag and transfer to DB
- UnloadToolFromMagazine (tool number, Duplo number)
For removing a tool from a magazine

NCK functions for tool management:

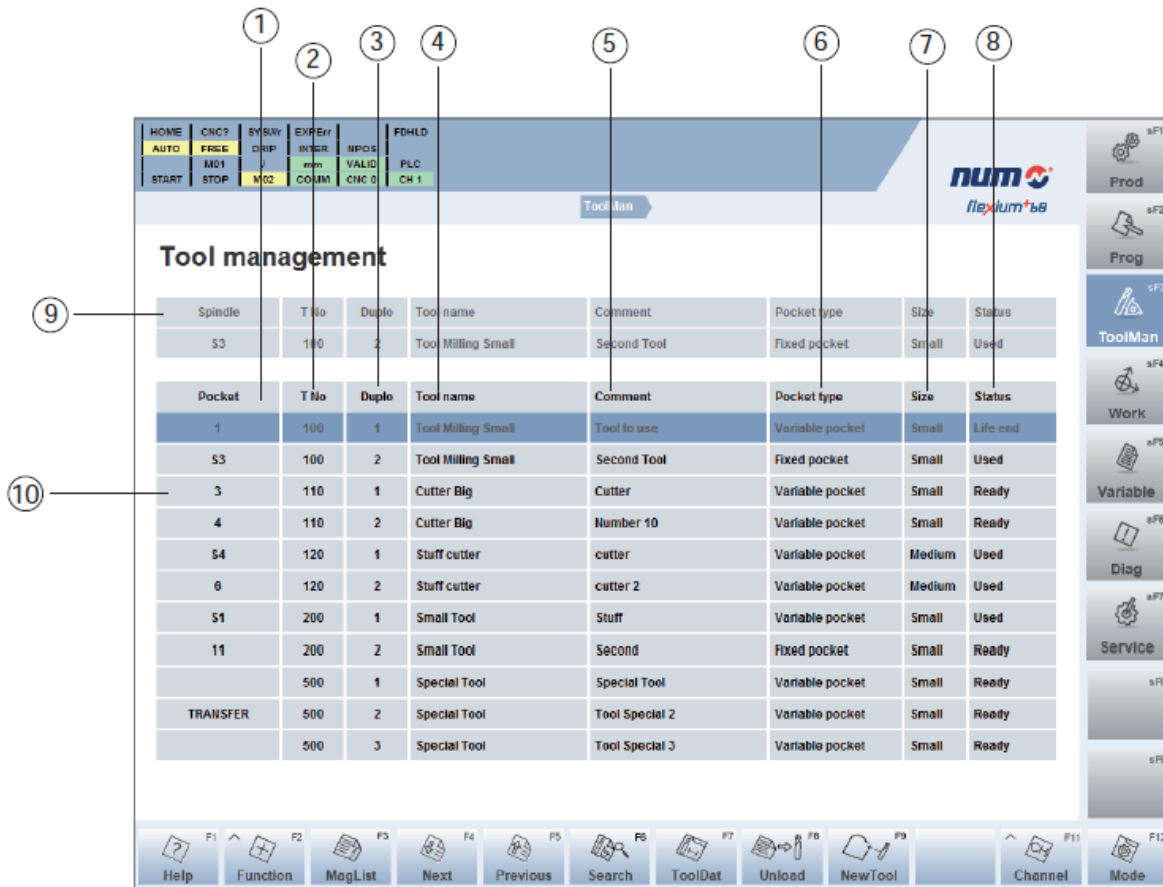
- NCK tool table extension
- Tool life monitoring
- Maximal tool speed monitoring
- Tool life warning and tool life error in the exchange zone
- Automatic assignment of the D number to the spindle
- Load tool characteristics from tool database to NCK tool table
- Save Tool characteristics from NCK to tool database
- New E-parameters ranges to access the new fields in the tool table

Operator Views of the tool management:

With different HMI views, the operator is always informed about the status of used tools in spindles, buffers or tool changer and the magazines, pockets or places.

Tool view:

This page displays the tool view itself with relevant characteristics.



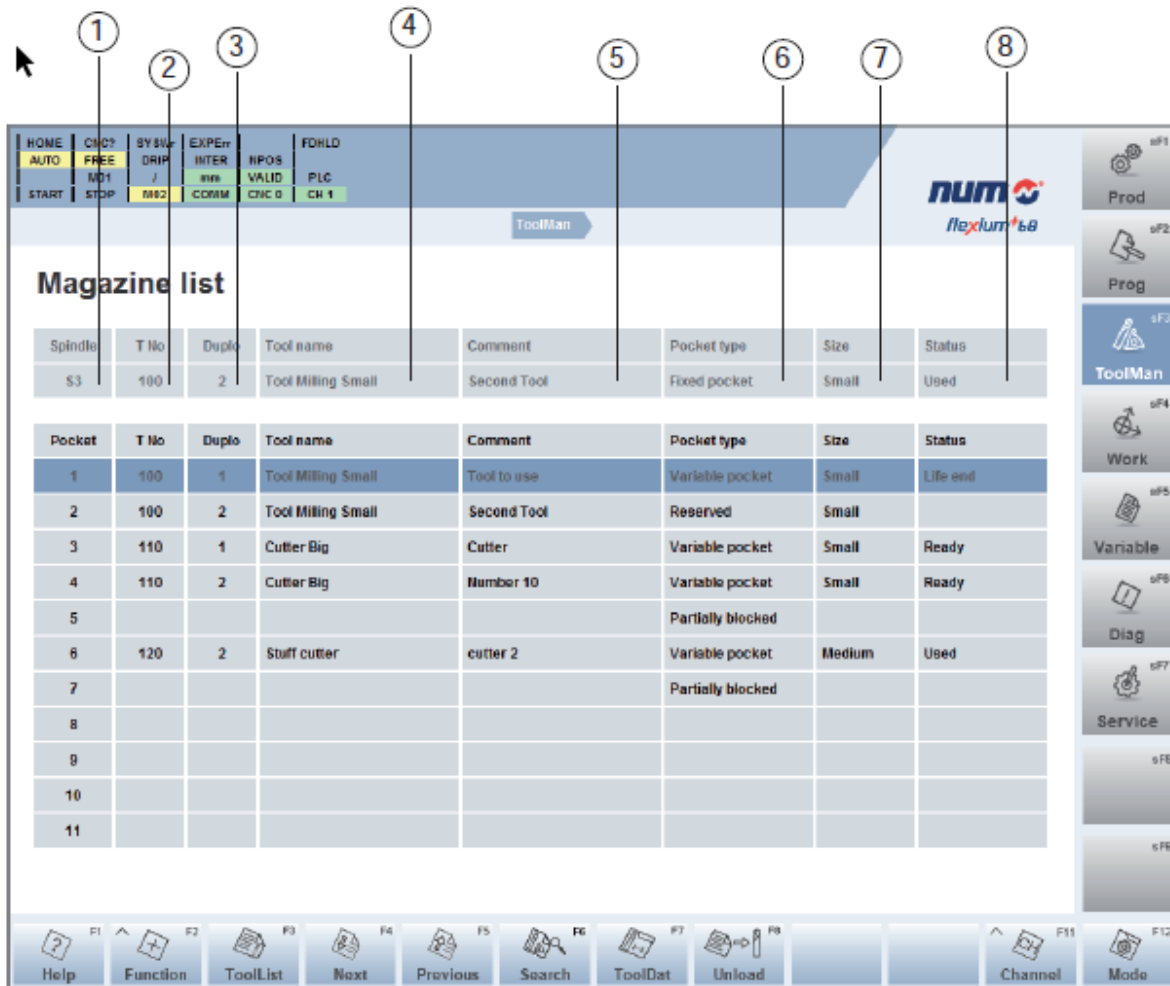
Spindle	T No	Duplo	Tool name	Comment	Pocket type	Size	Status
53	100	2	Tool Milling Small	Second Tool	Fixed pocket	Small	Used

Pocket	T No	Duplo	Tool name	Comment	Pocket type	Size	Status
1	100	1	Tool Milling Small	Tool to use	Variable pocket	Small	Life end
53	100	2	Tool Milling Small	Second Tool	Fixed pocket	Small	Used
3	110	1	Cutter Big	Cutter	Variable pocket	Small	Ready
4	110	2	Cutter Big	Number 10	Variable pocket	Small	Ready
54	120	1	Stuff cutter	cutter	Variable pocket	Medium	Used
6	120	2	Stuff cutter	cutter 2	Variable pocket	Medium	Used
51	200	1	Small Tool	Stuff	Variable pocket	Small	Used
11	200	2	Small Tool	Second	Fixed pocket	Small	Ready
	500	1	Special Tool	Special Tool	Variable pocket	Small	Ready
TRANSFER	500	2	Special Tool	Tool Special 2	Variable pocket	Small	Ready
	500	3	Special Tool	Tool Special 3	Variable pocket	Small	Ready

1	Pocket: - Information, where the tool is loaded - Number: pocket place in the magazine - Sxx: spindle - Buxx: buffer - Name: The tool is loaded on another machine, name of the machine
2	T number of the tool
3	Duplo number of the tool
4	The name of the tool. All tools with the same T number have the same name
5	A comment about the tool
6	Pocket type Variable : the tool is managed in variable positions Fixed: The tool is managed in fixed position
7	Size: - Small: the tool uses 1 pocket place - Medium: The tool uses 1 ½ pocket places in all directions - Big: The tool uses 2 pocket places in all directions
8	Tools status: new, in use, warning, in error, broken, ...
9	Display of the active spindle
10	Display of all tools in the database

Magazine view:

This page displays all tools loaded in the machine in the magazine view.



Spindle	T No	Duplo	Tool name	Comment	Pocket type	Size	Status
S3	100	2	Tool Milling Small	Second Tool	Fixed pocket	Small	Used

Pocket	T No	Duplo	Tool name	Comment	Pocket type	Size	Status
1	100	1	Tool Milling Small	Tool to use	Variable pocket	Small	Life end
2	100	2	Tool Milling Small	Second Tool	Reserved	Small	
3	110	1	Cutter Big	Cutter	Variable pocket	Small	Ready
4	110	2	Cutter Big	Number 10	Variable pocket	Small	Ready
5					Partially blocked		
6	120	2	Stuff cutter	cutter 2	Variable pocket	Medium	Used
7					Partially blocked		
8							
9							
10							
11							

1	Pocket: (see Tool view)
2	T number of the tool
3	Duplo number of the tool
4	The name of the tool. All tools with the same T number have the same name
5	A comment about the tool
6	Pocket type: - Variable pocket: The tool has a variable pocket place - Fixed pocket: The tool has a fixed pocket place - Partial blocked: A tool with the size medium uses this place. - Blocked: a tool with the size big uses this place
7	Size: (see Tool view)
8	Status - Ready: The tool has never been used - Used: The tool has been used already - Life warning: The tool is in life warning status - Life end: The tool is in life end status - Blocked: The tool is broken

Tool data view:

This page allows the tool parameter to be displayed, controlled and edited.



Pocket	T No	Duplo	Tool name	Comment	Pocket type						
6	120	2	Stuff cutter	cutler 2	Variable pocket						
D1	L	100.000	R	10.000 @	10.000 dL	0.000 dR	0.000 H				
	LT	Time	LW	10.000	LE	12.000	LV	08.000	MS	0	MF
D2	L	11.000	R	15.000 @	111.000 dL	0.000 dR	0.000 H				
	LT	Nr. of parts	LW	9	LE	10	LV	11	MS	0	MF
D3	L	444.000	R	13.000 @	11.000 dL	0.000 dR	0.000 H				
	LT	Nr. of parts	LW	9	LE	19	LV	10	MS	0	MF
D4	L	548.000	R	42.000 @	40.000 dL	0.000 dR	0.000 H				
	LT	Dyn L	LW	0.800	LE	5.000			MS	0	MF
D6	L	444.000	R	44.000 @	444.000 dL	0.000 dR	0.000 H				
	LT	Dyn R	LW	1.200	LE	22.000			MS	0	MF

1	Cut in error LV > LE The life value is displayed in red
2	Cut in warning LV > LW and LV < LE The life value is displayed in orange

Description of the special tool manager parameter

LT	Time: machining time of the tool
LW	Limit life warning
LE	Limit life error
LV	Count of the current life value
MS	Max spindle speed
MF	Max feed

Werner Heimpel, NUM product manager for HMI and software tools: "Manufacturers operating multiple CNC machine tools are often forced to spend significant resources on tool management. NUM's new system helps them save considerable operating costs in the long run."