SYNTEC TECHNOLOGY CO.,LTD.

Tool Function.

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- T-code Specification Manual For Lathe
- Tool Auto Retract Function user manual
- Tool Retraction Function
- Tool Management Function
- Tool Life Management (New Version)

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1 T-code Specification Manual For Lathe

车床T码巨集规格说明手冊

1.1 Intro

Different from the tool changing action of milling machines, which often relate to the tool magazine type, most tool changing action of lathe machines only do the simple X and Z axis movements. Therefore, the lathe controller has the standard T code macro (T0000) available to the user.

The specifications of the standard T code macro will be introduced below.

1.2 Operating Specifications

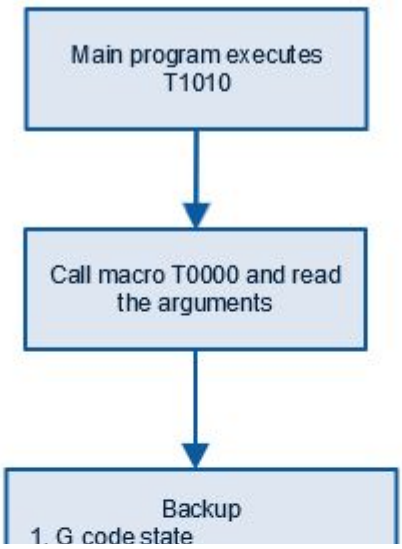
The system will execute the tool changing action automatically after users called the T code macro with 4 digits, e.g. T0101.

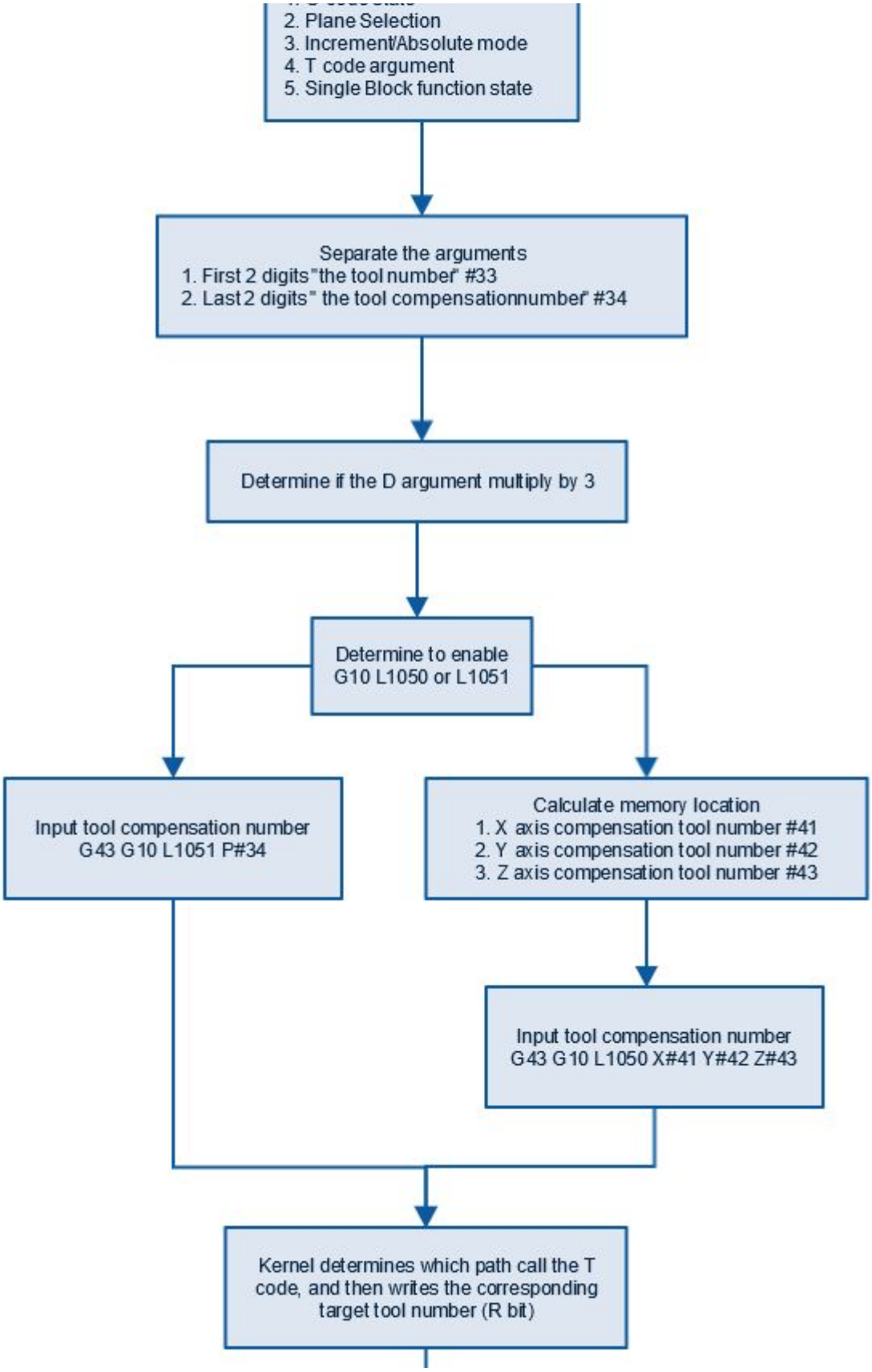
The first 2 digits show the tool number and the other 2 digits behind show the tool compensation number, the tool length and tool wear are using the same set of compensation value.

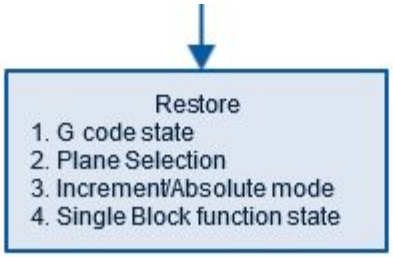
PS: Syntec controllers do not provide the 6 digits T code, which can specify the tool number, tool length and tool wear respectively.

1.3 Execution Process

- Backup system state
- Separate the arguments of the tool number and the tool compensation number
- Determine to enable tool compensation with G10 L1050 or G10 L1051
- Change the tool number shown on the controller screen (HMI)
- Restore system state




2. Plane Selection
3. Increment/Absolute mode
4. T code argument
5. Single Block function state
Separate the arguments
1. First 2 digits "the tool number" #33
2. Last 2 digits " the tool compensationnumber" #34
Determine if the D argument multiply by 3
Determine to enable G10 L1050 or L1051
Input tool compensation number G43 G10 L1051 P#34
Calculate memory location
1. X axis compensation tool number #41
2. Y axis compensation tool number #42
3. Z axis compensation tool number #43
Input tool compensation number G43 G10 L1050 X#41 Y#42 Z#43
Kernel determines which path call the T code, and then writes the corresponding target tool number (R bit)



1.4 Technical Specifications

1.4.1 Multi-Axis Tool Length Compensation Function

- This function can be enabled with Pr3816
- No matter the setting value of Pr3816, "Pr3816 = 2" is fixed in T code macro for multi-axis tool length compensation.
- Before 10.116.34 (not included), the T code macro can only execute the tool length compensation with G10 L1050.
    - This command is able to assign the tool length and tool wear compensation value of each axis
        - For example, G10 L1050 X1 Z2 means X and Z axis are using the compensation value of tool table number 1 and 2 respectively, please refer to the next section for tool table number definitions.
    - G10 L1050 only supports the compensation value set to the first 6 axes.
- After 10.116.34 (included), the T code macro executes the tool length compensation with G10 L1051 in default.
    - G10 L1051 assigns the tool compensation number with P argument and compensates with setting the value of each axis in the corresponding path.
        - For example, G10 L1051 P1 means compensating with the setting value of each axis in tool number 1.
        - Following the example above, suppose the T code is executed in the 1st path, and only X, Z, A axis are belonging to the 1st path, then only the compensation value of X, Z, A axis will be used.
    - G10 L1051 only supports the compensation value set to the first 12 axes.
    - For customized T0000 macro, even the software is updated to the latest version, it still requires to modify the command to G10 L1051 to support 12 axis compensation.
- Both G10 L1050 and G10 L1051 needs to apply with G43 to enable the compensation function.

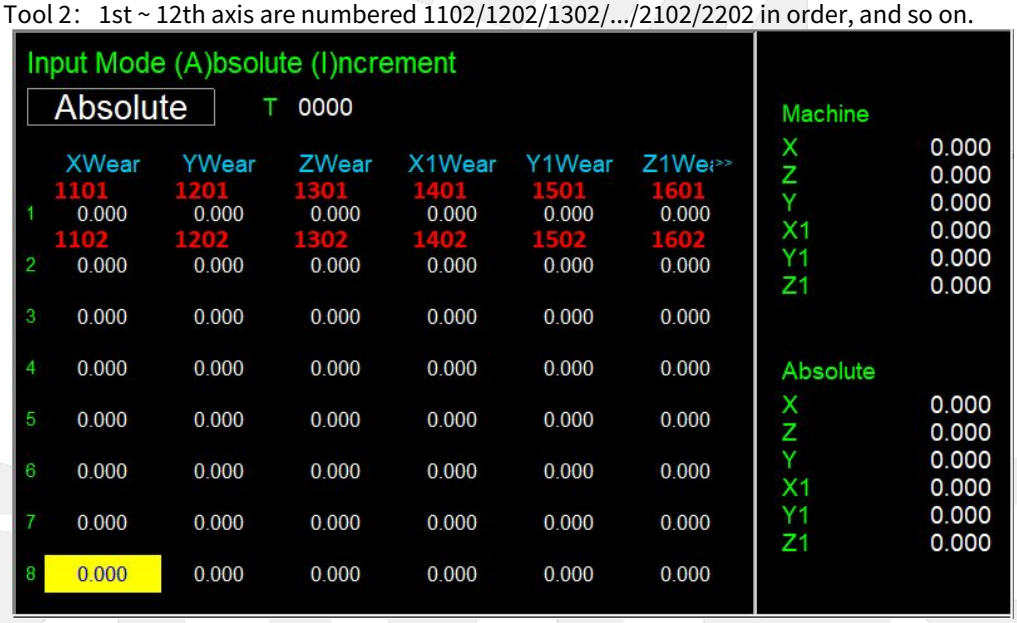
1.4.2 Tool Table Number Explanation

- Only G10 L1050 requires the tool table number.
- Before 10.116.34 (not included), only supports the 6 axes compensation, the numbering regulation is as shown below:
    - Tool number 1: 1st ~ 3rd axis are numbered 1/2/3 in order; 4th ~ 6th axis are numbered 401/402/403 in order.

- Tool number 2: 1st ~ 3rd axis are numbered 4/5/6 in order; 4th ~ 6th axis are numbered 404/404/406 in order, and so on.



- After 10.116.34 (included), it's expanded to support 12 axis compensation, the numbering regulation is as shown below:
  - Tool 1: 1st ~ 12th axis are numbered 1101/1201/1301/.../2101/2201 in order.
  - Tool 2: 1st ~ 12th axis are numbered 1102/1202/1302/.../2102/2202 in order, and so on.





1.5 Example

Assume there are X, Y, Z, A, B, C total 6 axes on the lathe machine, the three programs below have the same function

- G10 L1051 P1
- G10 L1050 X1 Y2 Z3 A401 B402 C403
- G10 L1050 X1101 Y1201 Z1301 A1401 B1501 C1601

1.6 Remarks

1. **For # variables corresponded to each tool table number, please refer to Macro Variable.**

1.7 Q&A

1. **Why T code arguments require to be 4 digits?**
   The workpiece will be deformed while cutting due to the forces between the tool and the workpiece. The part nears to gripper has smaller deformation and the cutting amount will be closer to the expectation. On the contrary, the part far from gripper has larger deformation and the cutting amount will be less than the expectation. Therefore, even it's the same tool, it might need two different compensation values with setting the last 2 digits.
2. **Why T code only compensates axis named X/Y/Z, but able to compensate axis in multi-path named X2/Z2?**
   Because the controller takes the axis which name is the simplest in the path as the compensation target, such as the X, Y, and Z axis. For example, when X/X1 and Z1/Z2 are in the same path, only X axis and Z1 axis will be compensated when executing the T code.
3. **How many tool compensation axes does the lathe controller support? Any limitations?**
   a. Before 10.116.34 (not included), only supports tool compensation of the first 6 axes. Therefore, when setting axial parameters, please set the axis requiring tool compensation in the first 6 axes.

b. After 10.116.34 (included), the controller provides the tool compensation of the first 12 axes.
c. Only the linear axis will be shown on the tool table and are able to apply the tool compensation function.

4. **Why is tool length setting after the 4th axis invalid?**
   a. Before 10.116.34 (not included), the standard T code macro use G10 L1050 and compensates for 3 axes only in default. Therefore, if you need to compensate for more than 3 axes, please make a customized T code macro.
   b. After 10.116.34 (included), the problem is solved since G10 L1051 is applied, but it still needs to check if the previous customized T0000 exists in the Macro or NCFiles folders.
   c. For customization, please refer to the steps below:
      i. Download the installation package of the corresponding software version, then find DiskC\OpenCNC\Res**LatMacro.res** and unzip to find T0000.
      ii. Open T0000 with editing software and find the line G43 G10 L1050 X#41 Y#42 Z#43...
      iii. Add the following contents before line program metioned in step ii. (Assume the name of the 4th axis is X1)

```
#40 := AXID(X1);
IF( #40 > 3 ) THEN
#44 := (#34-1)*3 + 400 + #40 - 3;
ELSEIF ( #40 > 0 ) THEN
#44 := (#34-1)*3 + #40;
ELSE
#44 := #0;
END_IF;
```

      iv. Add **X1=**#44 behind Z#43 mentioned in step ii.
      v. Save the file and import T0000 to the controller.

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2 Tool Auto Retract Function user manual

中文版 Chinese Version : 断电回退功能应用手册

- Foreword
- User restrictions
- Action specifications
- Parameter Setting
- Alarm Description

2.1 Foreword

SYNTEC package system (SYNTEC Controller + SYNTEC drive) supports Tool Auto Retract Function.

If an unexpected power failure occurs, the drives will move the specified axis for a specified distance, and the Controller will also pop out a corresponding alarm to record the abnormal condition.

2.2 User restrictions

2.2.1 Software version

Controller version	Drive version
10.118.12Q and after 10.118.22A and after	2.12.8 and after

2.2.2 Hardware selection

As long as the drive matches the Controller software version, the system supports the Tool Auto Retract Function, but the retract effect will depend on the current load of the specified axis and the drive's capacitance.

Multi-axis servo drive	Part Number
SMH-25/25-75-M	SMD-338-2575
SMH-35/35-100-M	SMD-338-35100
SMH-25/25/35-75-XL	SMD-34B-2550
SMH-35/35/35-100-XL	SMD-348-3575
SMH-50/50/50-150-XL	SMD-34B-50150

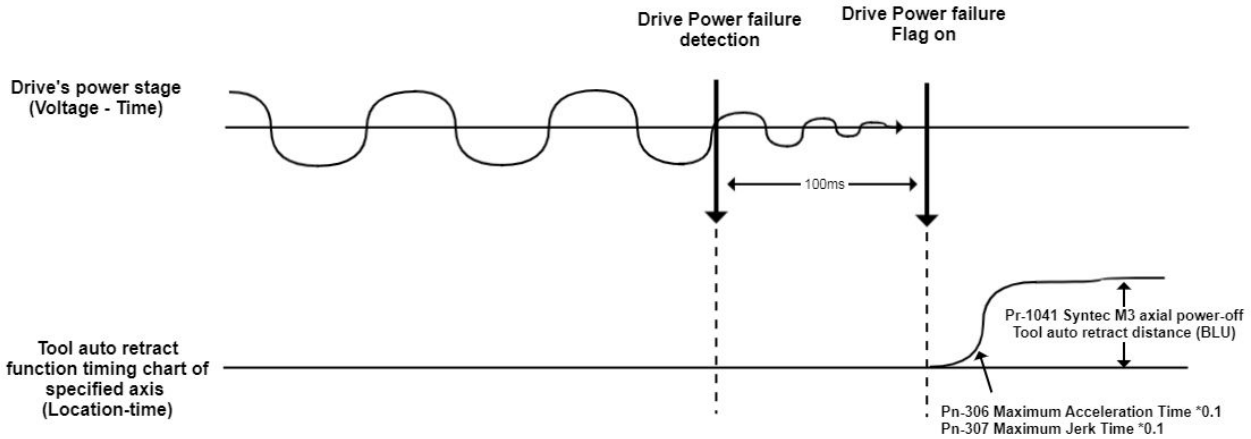
2.2.3 **Wiring instructions**

When using this function, the brake power supply of the Z axis must be independent, and independent power supply is required for the following reasons :

1. When the power of the whole machine is cut off, the power supply including the switchboard will also be cut off.
   At this time, if the Z-axis brake and the external device share the same power supply,
   The capacitor voltage in the power supply will soon be consumed by many external devices.
   After the consumption is exhausted, The Z-axis brake will be locked immediately, which will cause the power failure to retract.
2. It is necessary to separate the power supply of the Z-axis brake dedicated power supply from the power supply of other external devices to ensure that the capacitor of the power supply can support the back-off time of about 1 second when the power is off, so that this function can be executed smoothly
3. Current recommended specifications: A power supply above 100W can maintain a stable power supply until the power-off rollback is completed.

2.3 **Action specifications**

1. Tool Auto Retract Function usage scenario : Machine is ready / in busy→ Power-off of the whole machine (Controller + drive) → **Tool Auto Retract Function** is activated.
2. Local variable # 1509 can dynamically turn off the Tool Auto Retract Function. When the value of the corresponding bit is 1,
   the corresponding axis will not perform Tool Auto Retract . For example, there is no Tool Auto Retract during tapping.
3. The Amax (maximum acceleration) and Jmax (maximum jerk) of the Tool Auto Retract Function will be based on the drive parameters Pn306 and Pn307,
   which will be 10 times more rapid.



2.4 Parameter Setting

2.4.1 Controller Parameter

No	Descriptions	Range	Unit	Default	Effective
1041~1060	*Syntec M3 axial power-off Tool auto retract distance (BLU)	[-1000~1000]	BLU	0	restart

- If parameter is not 0, when an abnormal drive power off (not an "Not Rdy" state), the axial retract will be performed, and the +/- signs represent the retract direction.
- If the power is turned off at "Not Rdy" state, retract will not happen.
- Axis will be stopped before performing retract .
- Only Syntec M3 drives support this function, and the firmware version must be 2.10, 1, 2.11.0 or above.
- If this function is enabled on an unsupported drive, MOT-65 alarm will be triggered but will not enter "Not Rdy" state.
- The power-off retract speed profile is defined by 0.1 times of M3 drive parameter Pn-306 Max Acceleration and Pn-307 Max Jerk.

2.4.2 Local Variable

Number	Description	Rule	Type
#1509	Axial forbidden Tool Auto Retract Function • bit0: Save • bit1: Setting 1, No.1 Axis forbidden , Setting 0, No.1 Axis allowed • bit2: Setting 1, No.2 Axis forbidden , Setting 0, No.2 Axis allowed • ... • bit18: Setting 1, No.18 Axis forbidden , Setting 0, No.18 Axis allowed • bit19~31: save	R/W	Long

Drive Parameter

> **Note**
>
> **To speed up the drive deceleration planning command, the following drive parameters must be set.**

【Pn-306】Maximum Acceleration Time　【Pn-307】Maximum Jerk Time

Parameter No.	Description	Default	Unit	Range	Effective
Pn-306	Maximum Acceleration Time	2000	ms	[0~ 60000]	Immediate

Driver version：

	Version	Description
1	OpenDrive 5.2.1, OpenDrive 3.0.43, OpenDrive 5.0.12	In Speed Control Mode, When host alarm occurred and forced stops, use Pn-306 or Pn-D48 to stop the motor.
2	Pending	In Spindle Posing Mode, When host alarm occurred and forced stops, use Pn-306 or Pn-D48 to stop the motor.

Sets the time limit for achieving maximum speed from rest.

【Pn-306】Maximum Acceleration Time 【Pn-307】Maximum Jerk Time

Parameter No.	Description	Default	Unit	Range	Effective
Pn-307	Maximum Jerk Time	50	ms	[0~ 60000]	Immediate

Parameter function:

This parameter’s definition varies slightly when applied to different system types. If applying to a linear axis, signified by setting Pn-700 Motor Type as 1 (linear motor) or setting Pn-335 Mechanical Couple Type as 1 (ball screw type), this parameter’s value represents the time limit for accelerating to 1 G from rest. For all other cases, this parameter represents the time limit for accelerating to 1000 rpm from rest.

Note

The following drive parameters do not need to be set in drives, they will be automatically brought in after setting Pr1041 ~ by the Controller.

【Pn-804】Enable Power Off Pull-up Function 【Pn-805】Weight Direction 【Pn-806】Pull-up Distance

Parameter No.	Description	Default	Unit	Range	Effective
Pn-804	Enable Power Off Pull-up Function	0	-	[0~1]	Immediate

Driver version:

	Version	Description
1	OpenDrive 2.12.5, OpenDrive 2.13.0, OpenDrive 2.14.0	Remove this parameter from the controller "Serial Parameter Screen" .

Parameter function:

Specifies whether to enable the Power Off Pull-up function. Setting this parameter as 0 disables the function.

The pull-up distance and direction are determined according to Pn-806 Pull-up Distance, and the pull-up direction is the sign of Pn-806 Pull-up Distance.

The pull-up trajectory is determined according to 0.1 times the two parameters Pn-306 Maximum Acceleration Time and Pn-307 Maximum Jerk Time.

【Pn-804】Enable Power Off Pull-up Function 【Pn-805】Weight Direction 【Pn-806】Pull-up Distance

Parameter No.	Description	Default	Unit	Range	Effective
Pn-805	Weight Direction	0	-	[-1~1]	Immediate

Driver version:

	Version	Description
1	OpenDrive 2.12.5, OpenDrive 2.13.0, OpenDrive 2.14.0	Remove this parameter from the controller "Serial Parameter Screen" .

Parameter function:

Determines the weight direction. If this parameter is set as 1, the weight direction corresponds to the motor's positive rotation; if set as -1, the weight direction corresponds to the motor's negative rotation.

【Pn-804】Enable Power Off Pull-up Function 【Pn-805】Weight Direction 【Pn-806】Pull-up Distance

Parameter No.	Description	Default	Unit	Range	Effective
Pn-806	Pull-up Distance	0	pulse	[-999999999~999999999]	Immediate

Driver version:

	Version	Description
1	OpenDrive 2.12.5, OpenDrive 2.13.0, OpenDrive 2.14.0	Remove this parameter from the controller "Serial Parameter Screen" .

Parameter function:

This parameter will be setup by controller depends on Pr1041~Pr1060 Syntec M3 Axes Pull-Up Distance(BLU), the sign of Pn806 represent the pull-up direction.

⚠Attention:

- Because of Pn-806 can be setup by controller, the value will be converted to Electronic Gear Ratio scale, and the direction will be decide by Host Command Polarity.
- If real pull-up distance or direction is not match Pn806, please check driver parameter 【Pn-020】Host Command Polarity、【Pn-20E】 Electronic Gear Ratio (Numerator)、【Pn-210】Electronic Gear Ratio (Denominator)

$$RealPullupDistanceDirection(pulse) = (HostCommandPolaritySetup) * Pn806 * \frac{Pn20E}{Pn210}$$

Example:

If Pn806=2000 pulse, Electronic Gear Ratio=2:1 (Pn20E=2， Pn210=1), Host Command Polarity change direction(Pn020=1)

The real pull-up distance will be 2000*(2/1)=4000 pulse. The real pull-up direction is controller's "positive" direction, and driver's "negative" direction.

2.5 Alarm Description

Alarm ID	MOT-065	Alarm Title	Axis driver doesn't support power-off retract
Description	Driver doesn't support power-off retract function.		
Possible Cause	Driver doesn't support power-off retract function. When Pr1041~ Pr1060 setting is not 0 and this alarm will be issued.		
Solution	1. Only Syntec Bus M3 Driver supports power-off retract function. 2. Confirm Syntec Serial Bus M3 Driver's firmware version. Support firmware versions are 2.10.1, 2.11.0 and above version.		

Alarm ID	OP-071	Alarm title	【Driver power off, and perform power off retract】
Description	Pr1041~Pr1060 Syntec M3 axial power-off Tool auto retract distance (BLU) is set, when driver's power is cut off and perform retract action.		
Possible Cause	1. power blackout. 2. Main power supply is shut down. 3. RST power supply is cut off.		
Solution	Confirm RST power supply of driver.		

Alarm ID	OP-072	Alarm title	【System has performed power-off retract】
Description	System has performed power-off retract.		
Possible Cause	Detect Syntec M3 driver power-off abnormally. 1. Parameter Pr1041~Pr1060 has setting retract value. 2. Syntec M3 driver supports power-off retract function.		
Solution	After confirm power supply, reboot controller and driver.		

Examples

2.5.1 Example 1

Q: If the X-axis of the machine needs to enable the Tool Auto Retract Function, how to set it?

A: Please follow the steps below to set

步驟	圖片	說明
1		設定 Pr1043(第三軸)：新代M3軸向斷電回退距離=1000 um（假設螺桿 pitch=10mm） Set Pr1043 (third axis): Syntec M3 axial power-off Tool auto retract distance (BLU) = 1000 um (assuming screw pitch = 10mm)

步驟	圖片	說明
2		★ If the acceleration / deceleration of the retraction needs to be more rapid, set the drive parameters 【Pn-306】 Maximum Acceleration Time 【Pn-307】 Maximum Jerk Time
3		★When setting the Controller's parameters, the relevant drive's parameters will be set automatically by the Controller(no parameters need to be set in this step) Meaning of drive parameters: Assume that the motor resolution is 4194304 pulse, so the Pull-up distance set by the Controller is equivalent to 4194304/10 = 419430 pulse 1. 【Pn-804】 Enable Power Off Pull-up Function = 1 2. 【Pn-806】 Pull-up Distance = 419430
4	☐ (斷電前) ☐ (斷電後)	ⓘ Function enable checking In order to check if the feature is successfully enabled After manually setting the parameters of Pr1041 ~ Pr1060 series Turn off the power of the specified axis drive. If the controller displays OP-071 alarm, it means the setting is successful. Note : In the case of separate power supply for the front and power stages, the power of the power stage will be automatically cut off during an emergency stop, and an OP-071 alarm will pop up. The controller automatically clears the OP-071 alarm after the emergency stop pulled when the power stage power supplied.

Note :

Depending on the current reduction ratio, screw pitch, and motor load, the Tool Auto Retract Function may not be able to achieve 100% of the parameter set value.

2.5.2 **Example 2**

Q: If I do not want the Z axis to perform Tool Auto Retract Function when tapping, how to use it?

A: You can use # 1509 to turn off the Z-axis Tool Auto Retract Function before tapping through the custom G84 method.

The following scenario assumes that the Z axis is the third axis

Macro示範

```
% @ MACRO
# 30: = # 1509;
# 33: = AXID (Z);
# 34: = ROUND (POW (2, # 33)); // Please be sure to add ROUND () to an integer, otherwise the value returned by POW () is a floating point number, which will cause the next line to skip syntax errors
# 1509: = # 1509 OR # 34; // on Bit3 Disable Tool Auto Retract Function
...
# 1509: = # 30; // Reply does not prohibit Tool Auto Retract Function
M99;
```

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3 Tool Retraction Function

3.1 Purpose

While machining, if it is suspended due to special reasons, manually move the tool to a suitable position through "Manual Pulse Generator" (MPG). After the problem is eliminated, the system will follow MPG returning path and return the tool to the pause position "reversely". This function is very suitable for small machine where there are potential fixture interference.

3.2 Trigger Condition

This function can be started by triggering C21 during automatic machining.

If G10.6 is declared at the beginning of the program, after triggering C21, the system will select one of the XYZ axes for tool retraction according to the setting. The relevant command is explained as follows.

3.2.1 Command:

G10.6 X_ [F_] //Retract along the specified axis
G10.6 R_ [F_] //Count the retracting distance along the tool vector

G10.6: Enable the tool retraction function

X (or Y or Z): The program coordinates when the tool is retracted can only specify one axis at a time. Currently, only X/Y/Z three axes are supported. The increment or absolute type depends on G90 and G91.

R: Specify the retraction distance, which must be greater than 0. If R value is less than or equal to 0, the MAR-454 alarm will pop out.

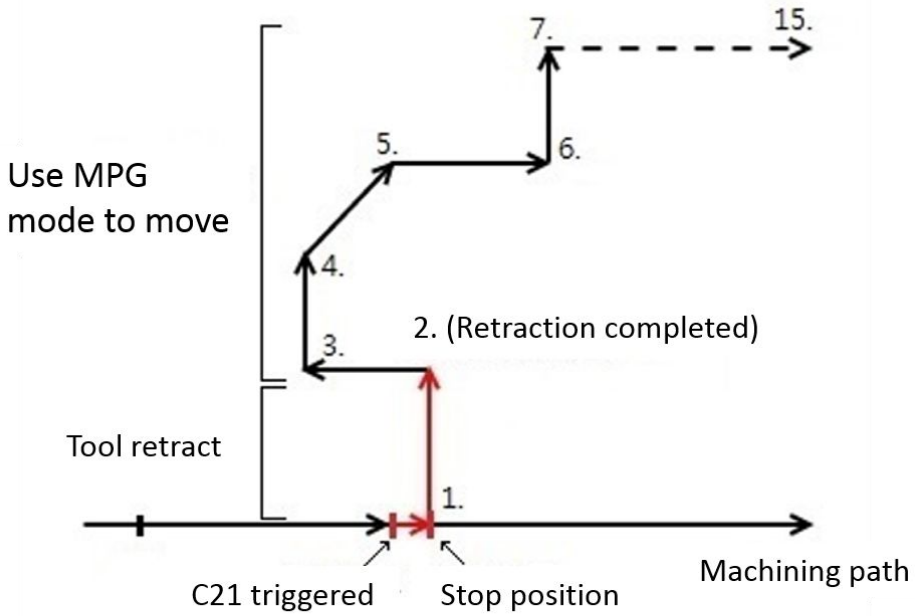
F: Tool feed speed. Tool retraction speed and tool repositioning speed are determined by the tool feed speed F. Execute retraction, tool return and tool repositioning at the same specified speed.

1. When the retraction speed (F parameter) is not specified, the speed is determined by parameter Pr3854.
2. The speed of tool return and tool repositioning is determined by parameter Pr3855.

3.3 Instruction

1. The tool retraction function is divided into four processes: tool retract => move tool by using "Manual Pulse Generator" => tool return => tool repositioning
2. Trigger C21 during automatic machining to enable the tool retraction function, and the system decelerates and stops at position 1 (before stopping, the system is still on machining mode)
3. The system will retract the tool according to the specified axis and feed rate, stop at position 2, and enter the pause state (if G10.6 is not enabled then this step will be skipped)
4. User uses MPG mode to move the tool as required, one axis at a time. The system records at most 15 points in sequence. It will reach the 15th point and then return in order.
   (Note: During the process of tool return and tool repositioning, if feedhold is triggered and the tool is manually moved, the trajectory of subsequent movement in MPG mode can still be recorded. The amount of points to be recorded is 15 minus the nonreturn points. For example, from the 15th point to the 5th point, if

pause state (Feedhold) is triggered, it can still record 10 points after manually moving)



5. After the problem is eliminated, switch back to automatic mode and press to start the program
6. The system starts to execute tool returning, and the tool returns to position 2 along all the points recorded in the original path (at most 15 points)
7. After the tool return is completed (position 2), the system repositions the tool back to position 1, and directly continues machining along the original path.

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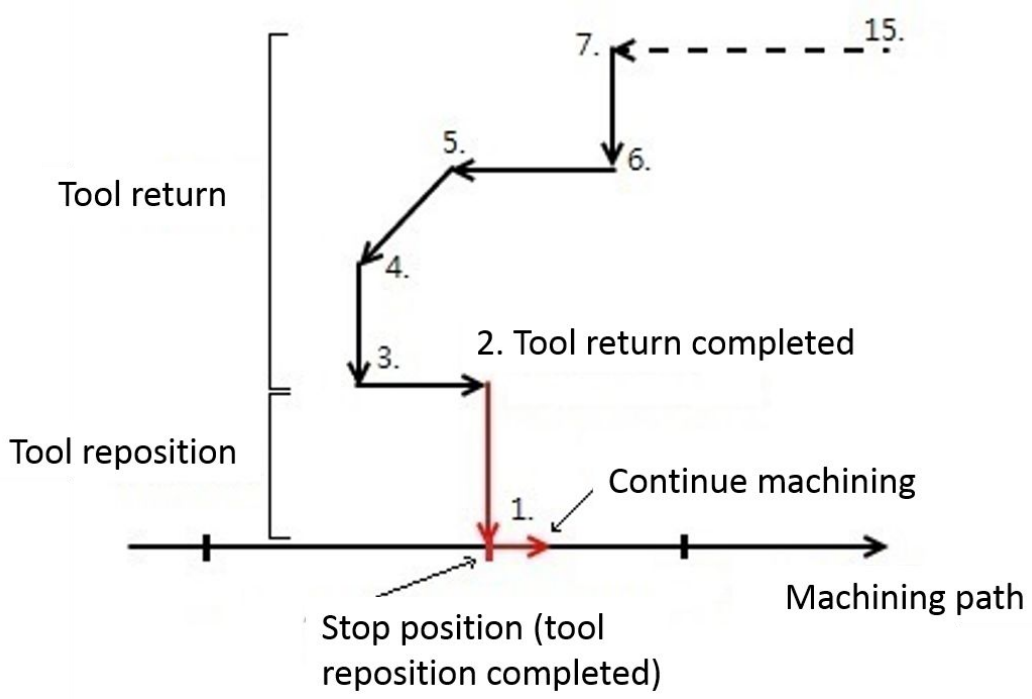


3.4 **Note**

Supported version description:

1. Valid version starts at 10.116.16.
2. Add the following two parameters for version starts at 10.118.27.
    a. Pr3854 sets different retraction speeds (default value is 1000mm/min).
    b. Pr3855 sets the tool return and repositioning speed (the default value is 1000mm/min).

3.4.1 Restrictions

1. For safety reasons, only moving tools by using "MPG mode" is supported.
2. When the customized feedhold position retract (Pr3852=1) is enabled, this function is invalid.
3. Repeated triggering C21 is invalid during the process.
4. G10.6 can only specify any axis of X, Y, Z; if R value or axis is not specified, the alarm MAR-452 will pop out.
5. Freehold is not allowed when the tool is retracted; it's allowed when the tool is returned or repositioned, actions will be continued after restarting.
6. Reset is invalid while retracting, only ESTOP can be done. (Note: If Reset is triggered while retracting, it will perform after the retraction is completed, the retracting path will be cleared and the tool retraction mode will be released); press Reset during tool return and tool repositioning, the retracting path will be cleared and the tool retraction mode will be released.
7. Description of speed planning for tool retraction function:
    a. When the specified axis is retracted, the retracting speed is planned according to the motion plan.
    b. When retracting along the tool vector, each axis will decelerate to 0 and then be positioned after the tool is retracted in order.

8. If the G10.6 command is repeated in the NC program, the tool retraction function will be executed with the last specified axial position or tool vector distance when C21 ON is triggered.
9. The function of retracting along the tool vector does not support G12.1, robot, two-dimensional or parallel mechanism transformation.
10. Do not switch tool in the MPG mode (that is, changing tool length is not supported), so as to avoid the danger of interfering the machine during the tool return or repositioning.
11. If the tool retraction command (G10.6) has specified the tool retracting speed, then command G01 must specify the feed rate, otherwise the machining will be executed at the feed rate of G10.6.
12. The process of retracting, returning and repositioning supports MPG simulation.
13. Do not support virtual axis applications.

3.4.2 Restriction of Five-axis function

1. If this function is triggered when the five-axis function is turned on, the handwheel Rotate Tool Center Point (RTCP) activation is not supported when MPG mode is to be turned on after the tool is retracted. That is, R518 and R519 need to be set to 0, if it is not 0, the OP-57 alarm will be triggered after the tool retraction is completed.
2. Use G10.6 X_ to specify retraction along axis position. If in tilted working plane machining (G68.2/G68.3) mode or RTCP (G43.4/G43.5) mode, the COR-148 alarm will pop out if C21 ON is triggered.
   Use G10.6 R_ to specify retraction along tool vector. If it's **not** in tilted working plane machining (G68.2/ G68.3) mode or RTCP (G43.4/G43.5) mode, the COR-148 alarm will pop out if C21 ON is triggered.
3. When using tool vector retraction in tilted working plane machining, user must issue the tool alignment command G53.1 or G53.6 after G68.2, otherwise the tool retraction direction will be wrong.
4. The system will use the current five-axis multi-kinematic chain (G10L5000P_Q_) to pull out the tool.

3.5 Alarms

Type	No.	Description
MAR	452	Tool retraction function only supports X/Y/Z one axis retraction or retract along tool vector.
MAR	454	Tool retraction function only supports retraction distance R greater than 0.

Alarm ID	COR-148	Alarm Title	The use of tool retract function error
Description	When using the tool retract function, a given improper argument results in the function cannot be executed.		
Possible Cause	1. In the Tilted working plane machining (G68.2/G68.3) or RTCP (G43.4/G43.5) mode, the C21 ON is triggered to execute the assigned axial position retraction. 2. In the non-Tilted working plane machining (G68.2/G68.3) or non- RTCP (G43.4/G43.5) mode, the C21 ON is triggered to execute the assigned retraction along the tool vector.		

Alarm ID	COR-148	Alarm Title	The use of tool retract function error
Solution	1. In the slopping plane machining (G68.2/G68.3) or RTCP (G43.4/G43.5) mode, apply G10.6 R_ to assign the tool retraction function. 2. In the non-slopping plane machining (G68.2/G68.3) or non- RTCP (G43.4/G43.5) mode, apply G10.6 X_ to assign the tool retraction function.		

Alarm ID	OP-057	Alarm title	【Tool retraction function, hand wheel shift only supports R518, R519 set to 0】
Description	When using G10.6 tool retraction function, R518, R519 must be set as 0, then user can use MPG to move.		
Possible Cause	R518, R519 is not 0.		
Solution	Set R518, R519 to 0.		

3.6 Machining Example

%@MACRO

G0 X0. Y0. Z0.;

G10.6 Z50. F1000;//Turn on the tool retraction function, set the retract position Z50., the retract speed and the tool return and repositioning speed to 1000mm/min

G01 X30.;

X50.;

M30;

G43.4 H1

G10.6 R30. F1000 //Turn on the tool retraction function, set the retraction along the tool vector to 30mm, the retraction speed and the tool return and repositioning speed to 1000mm/min

...

M30

G68.2 // Obtain the characteristic coordinate system using the outer product method according to the tool direction

G53.1 // Tool alignment

G10.6 R30. F1000 //Turn on the tool retraction function, set the retraction along the tool vector to 30mm, the retraction speed and the tool return and repositioning speed to 1000mm/min

...

G69

M30

%@MACRO

G0 X0. Y0. Z0.;

G10.6 Z50.;//Turn on the tool retraction function, set the retract position Z50. Pr3854 determines the retraction speed, Pr3855 determines the tool return and repositioning speed

G01 X30.;

X50.;

M30;

3.7 Interface Description

3.7.1 Parameters

No	Descriptions	Range	Unit	Default	Effective
3852	*Enable customized feedhold point retract	[0~1]	-	0	Reboot
3854	G10.6 Tool Retraction speed	[1 ~999999999]	mm/min	1000	Press Reset
3855	G10.6 Tool Retraction and repositioning speed	[1 ~999999999]	mm/min	1000	Press Reset

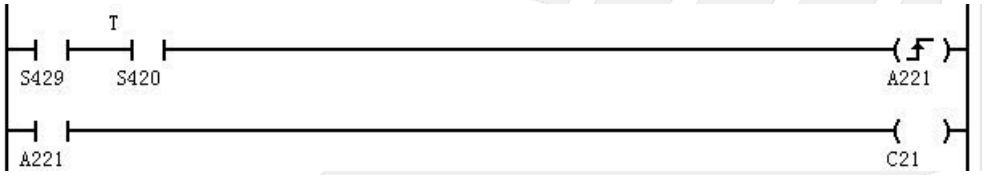
Note: This function is invalid when the customized feedhold point retract is enabled (Pr3852 is set to 1).

3.7.2 **PLC Interface**

No	Title	Descriptions
C21	Tool Withdraw	When this function is triggered, the system will automatically pause (Feedhold). After the machine stops, the tool will retract according to the tool retraction position set by G10.6 and feedrate override.

No	Title	Descriptions
S21	During Tool Withdraw	After entering the tool retraction function and leaving the original machining path, this FLAG will be ON; until the tool returns to and repositions the original machining program path, and this FLAG will be OFF.

3.8 **PLC Example**



In this example, C21 is triggered by Ctrl+T. When the program executes the G10.6 command and specifies the retract axis (program axis) and feed rate, press Ctrl+T during automatic machining or feedhold or single block stop to trigger the C21 tool retraction function.

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4 Tool Management Function

4.1 **Summary**

This project is to realize the F brand tool management function through Syntec's latest technology.

4.2 **Operation**

4.2.1 Purpose

Using Syntec's tool management function, users can input tool status and in conjunction with tool change instructions and processing, it will automatically time and judge whether the tool can be used, effectively providing on-site operators with a simple and clear tool management system.

4.2.2 Instruction

Tool status can be controlled in the tool management system. During machining, it will automatically determine whether the tool can be used and calculate the machining time.

1. **Human machine path**
    a. Activation conditions:
    Enable the tool management function Pr3228=1 (0: Disable, 1: Enable)
    b. Path
        i. Arm system
        8 keys: F3 Offset/Setting=>F7 Tool Life Manag.
        5 keys: F3 Offset/Setting=>F10=>F2 Tool Life Manag.
        ii. X86 system
        8 keys: F4 Execute=>F5 Tool Setting=>F6 Tool Manag.
        5 keys: F4 Execute=>F5 Tool Setting=>F10 (enable when Pr3228=1)=>F1 Tool Manag.
    c. Tool management page
    The string in the green prompt in the lower left corner will change with the selected block and show

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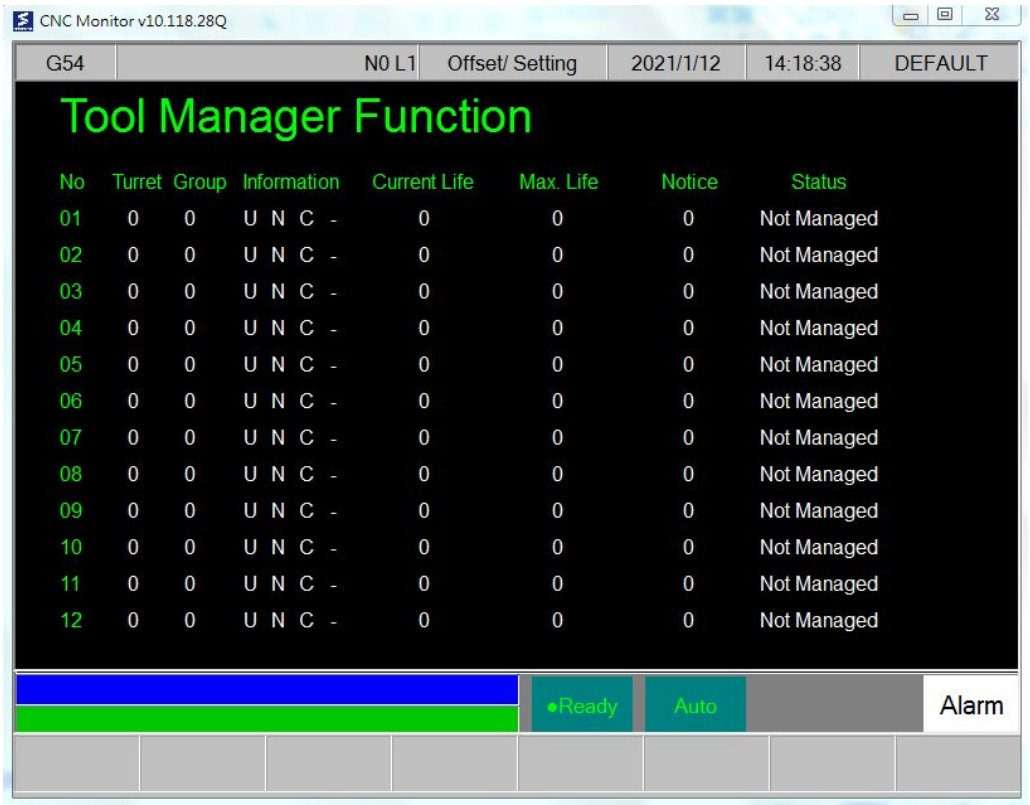
instructions.



2. **Human machine interface description**
   a. Operation screen:

number (Tool number)	MG (Tool magazine)	GROUP (Tool group)	T-INFO (Information)				T-COUNT (Current life)	MAX-LIFE (Maximum life)	NOTICE-L (Service life notice)	L-STATE (Tool status)
1	1	0	U	N	C	-	0	0	0	NO-Managed
2	2	0	U	N	C	-	0	0	0	NO-Managed

3	3	0	U	N	C	-	0	0	0	NO-Managed
4	4	0	U	N	C	-	0	0	0	NO-Managed
5	5	0	U	N	T	-	0	0	0	NO-Managed
6	6	0	U	N	T	-	0	0	0	NO-Managed
7	7	0	U	N	C	-	0	0	0	NO-Managed
8	8	0	U	N	C	-	0	0	0	NO-Managed
9	9	0	U	N	C	-	0	0	0	NO-Managed
10	10	0	U	N	C	-	0	0	0	NO-Managed
11	11	0	U	N	C	-	0	0	0	NO-Managed
12	12	0	U	N	C	-	0	0	0	NO-Managed

b. Operating screen description:

Item	**Content**
NO. (Tool number)	List all tool numbers (0~96)
MG (Tool magazine)	Display the tool pot position of the current tool number (0~96)

GROUP (Tool group)	Set tool groups (0~96) to distinguish tool types, and set "0" to cancel the group. Example: Assuming that tool 1~3 are group tools (the group values of tool 1~3 are all set to 1), if user calls tool 2, but its life has ended and cannot be used, the system will search the same group from tool number 1 again. If there's no available group tool, the system will pop up the alarm "101. Tool life has ended, please change the tool".

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T-INFO (Tool information)

Tool number information field, which displays the inputting tool information.
From left to right, the definition of each column is as follows:
==========

Data Status	(L) Lock	(U) Unlock
Tool Type	(B) Big Radius Tool	(N) Normal Tool
Life Count	(T) Use Time	(C) Use Count
Tool Manage	(R) Calculation Enabled	(-) Calculation Disabled

==========

- Data status (default U):
  (L) Lock; (U) Unlock
  Set the current tool to be Lock or Unlock.
  If the state is Lock, then the tool cannot be used.
- Tool Type (default N):
  (B) Big Radius Tool; (N) Normal Tool
  Determine the tool type to see whether the neighboring tool can be placed.
- Life Count (default C):
  *(T) Use time (hour, minute, second):
  Use Time is to calculate the accumulated time of tool used on spindle during machining (single spindle supported only), under cutting command (G01, G02, G03, G33), spindle rotation and axial non-stationary status, the minimum calculation unit is seconds;
  (C) Use Count (times):
  Use Count calculation means that during machining (in AUTO or MDI mode), the calculated value will be increased by one when the T code tool change command is executed. For example, in the program, when T1 is executed, the count of the first tool will be increased by one.
- Tool Manage (default -):

  (R) Calculation Enabled:
  When the value is calculation-enabled, the system will automatically calculate the time or number of times;
  (-) Calculation Disabled:

	Due to special reasons, you need to temporarily stop counting (such as dry running test), you can switch to the numerical invalid mode
T-COUNT (Current life)	Current life of the tool, displaying the time or number of used times. The format is displayed according to the Life Count.
MAX-LIFE (Maximum life)	Set the maximum service life of the tool
NOTICE-L(Service life notice)	When the available using times or life of the tool is less than this value, the tool status will be changed to End Announce.
L-STATE (Tool state)	The current status of each tool is

(0)NO-Managed	Usable, but the life is not managed, not calculated
**(1)Not use	Usable, Current Life=0
(2)Usable	Usable, Current Life>=0
(3)End Announce	Usable, Max.-Current Life<Notice
(4)Life End	Unusable, Max.-Current Life=0
(5)Damage	Unusable, tool needs to be replaced

i. Tool status(2)~(4) will be automatically updated according to the current life, and the rest need to be changed manually. For example: (5) The tool is damaged and the status needs to be input by the user. After the input, the tool cannot be used.
ii. (0)For NO-Managed mode, any tool life prompt will be ignored, but the tool can still be used for machining. User needs to evaluate carefully before using.
iii. When the tool status changes to (3) End Announce, the prompt "Tool life is about to end" will pop up during machining to remind the user that the tool life is about to end. (This prompt needs to be added by developers)
iv. When the tool changes to (4) Life End (5) Damage, the alarm "10001. Tool life has ended, please replace the tool" during machining.

*The Life Count function of CE system only exists in the version after 10.116.0W/10H, previous version can only got number of used times.
**If the tool status input is (1) Not Use, the current system BUG will display Not Use forever, so it is recommended that (2) can be used for initial use in the short term.

3. **Process**
    a. Set the tool information and tool life on the Tool Manager page.
    b. After the machine is ready (or after the last machining is completed), it will automatically check whether the tool life is over. If it is (4) Life End or (5) Damage, an alarm will be triggered, "Tool life has ended, please replace the tool"
    c. When machining starts, Current Life of the tool will be counted according to the machining time or times. If the cumulative count is (4) Life End, an alarm will be triggered after the end of this machining, "Tool life has ended, please replace the tool"
    d. In case of tool change or re-machining, the cumulative tool count will be automatically updated to the new tool number. Repeat 2~3 actions.

4.2.3 Restriction

1. It is prohibited to update tool management settings while machining.
2. While any of the tool's life comes to an end, the alarm will pop up and machining can't be continued.
3. Tool Life needs to be input by the user and confirmed after the tool is changed.
4. Operating time of the life count will update data according to the refresh time or conditions, and it will refresh every ten seconds; the data will also be refreshed when an emergency stop, reset or M30 is executed.
5. When a tool status shows "Life End", the alarm "10001. Tool life has ended, please replace the tool" will pop up until the above condition is lifted.
6. M30 must be added to the end of the machining program.

4.2.4 Alarm

Alarm or reminder (ID+content)	**Reason**	**Approach**
10001. Tool life has ended, please replace the tool	Tool life has ended, tool status shows (4)Life End or (5)Damage	1. Replace tool 2. Re-enter the current life

4.2.5 Tool Magazine Application

There are different tool magazine systems for automatic tool change. The following contents explains the difference in timing when changing tools in different systems, and provides timing operating basis for operators when changing tools.

1. Tool magazine that tool search and tool change are carried out together
    a. Tool magazine example
    Milling: Linear type, tapping type, drum type
    Lathe: gang type, oil pressure turret
    b. Tool change command example
    T01→Change to the 1st tool
    T05→Change to the 5th tool
    c. When the tool change is commanded, determining the required tool and the tool changing will be executed simultaneously, that is, the searched tool is the one that the tool magazine stops at. While changing the tool, the system will determine whether the current commanded tool number can be

used. If it cannot be used and there is no group tool to replace, a prompt or alarm notification will pop out; if it is available or a group tool can be used, timing will be completed and update simultaneously after the tool change is done.

2. Tool magazine that tool search and tool change are carried out separately
    a. Tool magazine example
    Milling: Tapping type
    b. Tool change command example
    T01→The tool magazine searches the 1st tool
    M06→Tool magazine ready position changes tool with the spindle
    T05 M06(or M06 T05)→The tool magazine searches the 5th tool, and when it reaches ready position, exchanging with the tool on the spindle
    c. Tool search and tool change commands can be input separately or together. For example, Txx is a tool search command. M6 is a tool change command, Txx M6 (M6 Txx is the same action) is a continuous tool search and tool change command.
    When searching for a tool, it will determine whether the tool can be used. If it cannot be used and there is no group tool, a prompt or alarm will pop out; if there is a tool that can be used (including group tools), the tool magazine will first be rotated to the ready position and won't time the action. After the above actions, if the tool change continues, the current tool number data will be updated and the timing will update simultaneously when the tool change is completed.

4.3 Specifications

4.3.1 Interface Description

Structure

Through the Syntec tool manager function page, the tool management function can be achieved with Macro and PLC. Macro is used for tool confirmation and variable transmission while tool change;

PLC is used for tool life timing and alarm reminding. With the above functions, the tool management system is completed. The following figure shows the interface structure diagram during developing.

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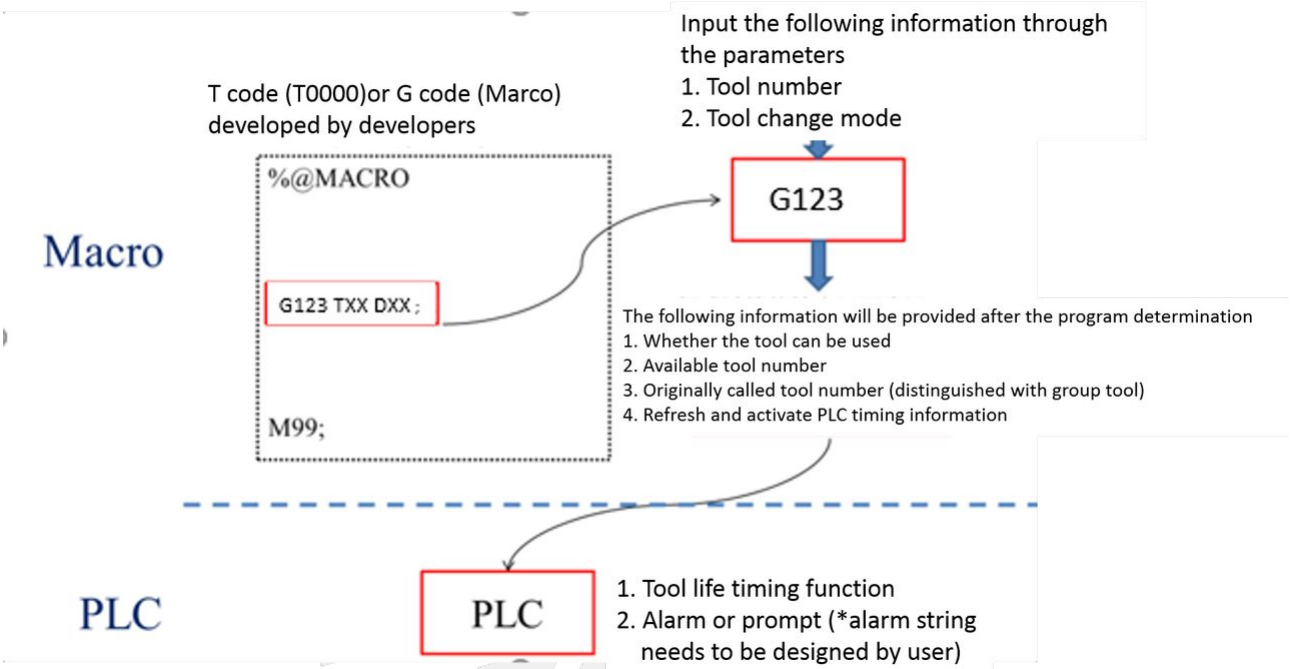


Timing Interface Description and Instruction

Tool life management function is developed on the machine with auto Tools Change function. Tool change is executed according to the T0000 Macro program.

Developers can add G code Macro function commands in the tool change T code program to execute tool confirmation and variable transmission during changing.

1. **G123 Command**
   G123 T_ D_
   Input parameter definition

Input	**Parameter**	**Variable Description**
Tool number input info	T(#20)	Input the required tool number, the program will automatically determine and output the available tool number
Tool change mode(0~2)	D(#7)	D=0, the mode is to execute tool search and tool change together D=1, the mode is for tool search D=2, the mode is for tool change

   Output parameter definition

Output	**Parameter**	**Variable Description**

Tool determination	@120001	0: Unusable, an alarm will pop out to indicate the tool status 1: Usable 2: Usable, but remind will show when the tool life is closed to an end
Tool number used	@120002	The last tool number that can be used after tool management
Originally called tool number	@120003	Originally inputted tool number (variables that group tool will use)

2. **G123 Interface Restriction and Protection**

Restriction	**Protection/Troubleshooting**
The input value of D parameter must be between 0~2	If the input value is wrong, the message "G123 D parameter input value is incorrect" will pop up, and the program ends →Correct the D parameter to avoid input errors
The input value of the T parameter must match the number of tools in the tool magazine	If the input is wrong, G123 may search the wrong tool →Developers need to make protection restrictions in Macro tool change by themselves
If the life of the searched tool ends and the D parameter is not 2, an alarm will be triggered	"Alarm 10001. Tool life has ended, please replace the tool" pops up, and the program ends →Change tool to reset tool life, or avoid using life-ended tool

3. **G123 MACRO Instruction(For detailed flow chart, please refer to chapter "M code Macro Technical Specifications→Program Process")**
   a. Input the selected tool change tool number and mode according to the T and D parameters.
   b. Determine the tool change mode,
      D=0 or 1, continue to the next step;
      D=2, skip to the 6th step.
   c. T parameter is for input tool number, determine whether it is available according to the tool status and whether it is locked
      (If not, it will search for a group knife).
   d. Find the available tool number (if it is a group tool, the selected tool number will be overwritten).
      If there is no available tool number, the program will end and output 120003.
   e. Determine whether D=1,
      =1, output 120002;
      ≠1, continue to the next step.
      (*@120001 may equal to 2, developer can choose whether to prompt that the tool life will end soon)
   f. Determine the timing mode and whether the value is valid. If the value is invalid, the system will output 120002 and no other actions will be taken;
      If it is valid and is counting times, output 120002 and the life of the current tool number plus one;

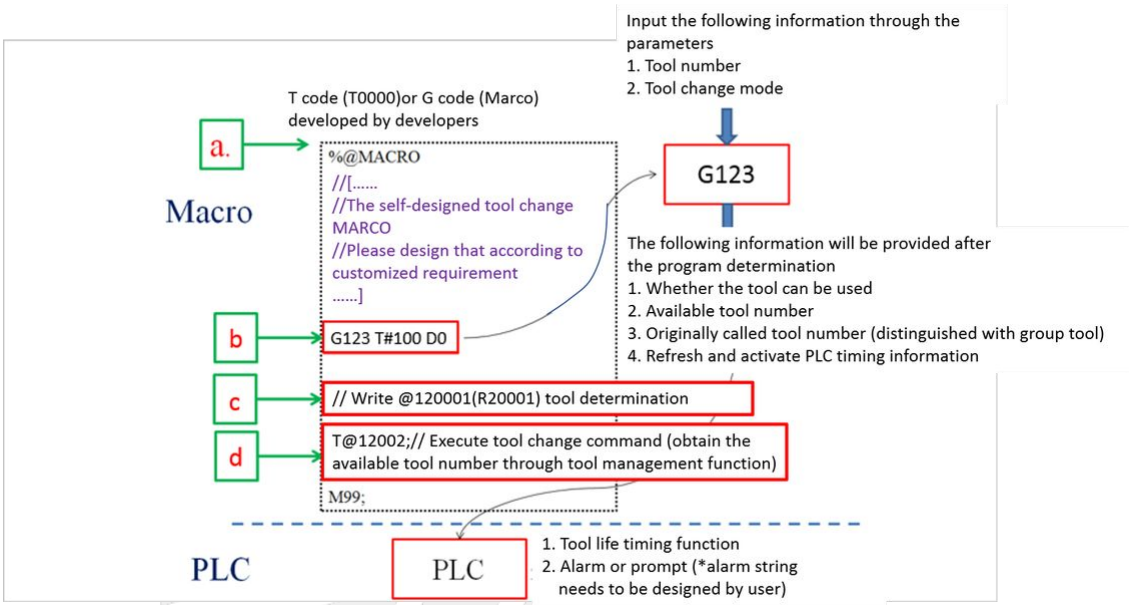
If it is valid and is timing, output 120002 and activate Life Count (@120000=1);
(*@120001 may equal to 2, developer can choose whether to prompt that the tool life will end soon)

4. **G123 Examples(PLC can refer to the chapter "PLC Technical Specifications", copy and add it to the PLC development file)**
   I.Tool magazine that tool search and tool change are carried out together (For example: milling tapping type ATC or lathe oil pressure turret)
   Add a line of M code to call the tool magazine management function in the T code program for tool change, G123 Txx D0. Calculated by Macro, the output variables @120001~@120002 will be provided to the back-end determination, and the PLC timing function will start to refresh the tool number and timing. Users can develop and use the above application by themselves.
   Examples:
   a. Developers first develop a tool change MACRO (T0000) according to their customized needs
   b. If the tool number command, which is for lathe or special use, is with a four-code structure (for example, T0102, the first two codes 01 are the tool change numbers, the last two codes 02 are the tool compensation numbers). The first two codes are results from MACRO calculation and be exported to #100 (#100 is used in this example, users can modify it by themselves).
   c. Write the tool life management function in the T0000 Macro program, G123 T#100 D0 (In this example, the T parameter imports #100, which can be modified by users; the D parameter imports 0 because the tool search and tool change are executed together)
   d. After the last step (G123 is calculated), first write a statement of @120001 to determine whether the tool can be used
      Developers write the statement based on the following table

@120001=0	The tool is unusable, and an alarm needs to be popped out to explain the tool status (the original called tool number is @120003)
@120001=1	The tool is usable (available tool number is @120002)
@120001=2	The tool is usable, but it should remind that the tool life is close to an end (the available tool number is @120002)

      i. G123 will output value of 0~2 in @120001, providing a program to determine whether the tool can be used
      ii. When @120001=2, it means that the tool life is close to an end. Developer can determine whether this condition needs to trigger the prompt string (the string content needs to be designed by the developer)
      iii. For example, @120001=0, the tool life has ended, and the program needs to trigger the alarm and stop the work (for example: when @120001=0, Macro alarm "101" is triggered, and the alarm string "Tool life has ended, please replace the tool")
   e. Following the above determination and obtain @120001=1 or 2, which is used as the tool change command, T@120002

f. End of tool change program



II.Tool magazine that tool search and tool change are carried out separately (For example: milling tapping type ATC)

Examples

a. Tool search
Add a line of G code to call the tool magazine management function in the T code (or G code) program for tool search, G123 Txx D1. Calculated by Macro, the output variables @120001~@120002 will be provided to the back-end determination. Users can develop and use the above application by themselves.
Examples:
   i. Write the tool life management function in T0000 Macro program→G123 Txx D1
   ii. @120001 will output a value of 0~2 and provide a program to determine whether the tool is usable

@120001=0	The tool is unusable, and an alarm needs to be popped out to explain the tool status (the original called tool number is @120003)
@120001=1	The tool is usable (available tool number is @120002)
@120001=2	The tool is usable, but it should remind that the tool life is close to an end(the available tool number is @120002)

   iii. Choose whether to trigger a prompt when @120001=2 (string content needs to be designed by the developer)
   (When @120001=0, Macro alarm "101" will be triggered, please add the string "Tool life has ended, please replace the tool")
   iv. If @120001=0, the program will end and exit
   v. If @120001=1~2, execute tool change command→T@120002
   vi. Tool search, program ends

b. Tool change
Add a line of M code to call the tool magazine management function in the T code (or M code)

program for tool change, G123 Txx D2. Calculated by Macro, PLC timing function will start to refresh the tool number and timing.
Examples:

i. Insert the tool life management function in the T0000 Macro program → G123 Txx D2
ii. The program will automatically notify the PLC timing function (no need to write additionally)
iii. Tool change, program ends

Developing Conditions

1. The tool change command must use T0000 Macro (or G code Macro).
2. The tool magazine and tool group functions only provide human machine interface input and variable storage in the management function. Developers need to edit T0000 Macro to determine whether to use the program judgement.
3. Need to write a G code Macro as the main call-subprogram for tool management inspection.
4. The data status in the tool number information is checked through the M code Macro proposed in no.3. It provides a variable check. Developers need to edit T0000 Macro to determine whether to use the program judgement.
5. The Tool Type in the tool number information only provides human machine interface input and variable storage in the management function. Developers need to edit T0000 Macro to determine whether to use the program judgement.
6. There are two counting methods for Life Count in the tool number information, counting operating times and * timing. It can be done by using T0000 Macro plus PLC. The details are explained in the technical specifications.
   Counting operating times is when the tool change instruction is executed (or when the tool is used by the automatic tool change mechanism), the counting value will be increased by one, and the planning condition will do the same when T code calls;
   Timing is the accumulated time value that the tool being used on the spindle (single spindle supported only) during machining and under the interpolation command (G code). The minimum calculation unit is seconds. The planning conditions will be tied up with G01, G02, G03 and G33 cutting commands, spindle rotation and axial non-stationary state.
7. The tool management in the tool number information is developed in the PLC to control whether the timing function is valid. The details are explained in the technical specifications.
   *The timing function of CE system Life Count is only supported after 10.116.0W/10H. The previous version can only be used for the counting times.

Tool management function Variables

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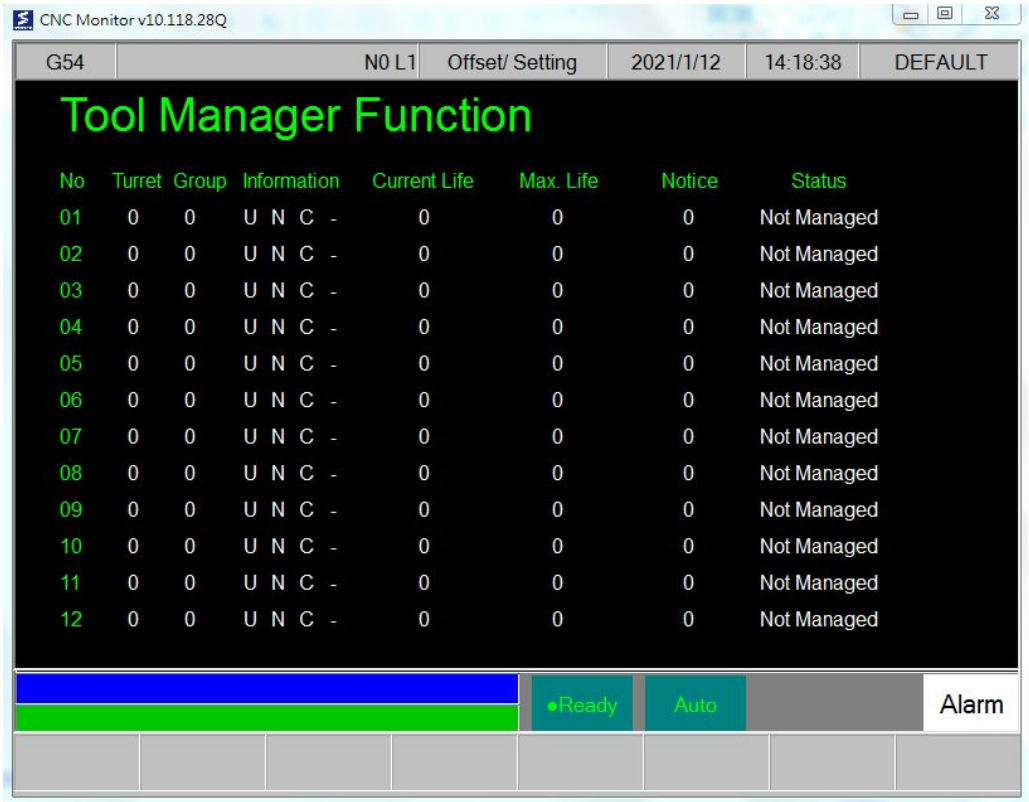


Item	**Specifications**
number (Tool number)	Display range: 0~96
MG (Tool magazine)	Input range: 0~96 Input format: Integer Input to: R(2100+tool number*10)
GROUP (Tool group)	Input range: 0~96 Input format: Integer Input to: R(2101+tool number*10)

<table>
<tr><td>T-INFO (Tool information)</td><td>Input range: No
Input format: String
Input to: BIT of R(2102+tool number*10), please refer to the table below
<table><tr><td>Data Status</td><td>(L)Lock
R(2102+tool number*10).1=1</td><td>(U)Unlock
R(2102+tool number*10).1=0</td></tr><tr><td>Tool Type</td><td>(B)Big Radius Tool
R(2102+tool number*10).2=1</td><td>(N)Normal Tool
R(2102+tool number*10).2=0</td></tr><tr><td>Life Count</td><td>(T)Use Time
R(2102+tool number*10).3=1</td><td>(C)Use Count
R(2102+tool number*10).3=0</td></tr><tr><td>Tool Manage</td><td>(R)Calculation Enabled
R(2102+tool number*10).4=1</td><td>(-) Calculation Disabled
R(2102+tool number*10).4=0</td></tr></table>From left to right, the valid inputs are LU/BN/TC/R-
If it is not a valid input, the original value will be kept</td></tr>
<tr><td>T-COUNT (Current life)</td><td>Input range: No
Input format: Integer
Input to: R(2103+tool number*10)
The displayed format will be different from (life count) of (tool number information). For example:
R(2102+tool number*10).3=0, when R(2103+tool number*10)=100, it will display 100
R(2102+tool number*10).3=1, when R(2103+tool number*10)=100, it will display 00:01:40</td></tr>
<tr><td>MAX-LIFE (Maximum life)</td><td>Input range: No
Input format: Integer
Input to: R(2104+tool number*10)
The displayed format will be different from (life count) of (tool number information). For example:
R(2102+tool number*10).3=0, when R(2104+tool number*10)=100, it will display 100
R(2102+tool number*10).3=1, when R(2104+tool number*10)=100, it will display 00:01:40</td></tr>
</table>

<table>
<tr><td>NOTICE-L(Service life notice)</td><td>Input range: No
Input format: Integer
Input to: R(2105+tool number*10)
The displayed format will be different from (life count) of (tool number information). For example:
R(2102+tool number*10).3=0, when R(2105+tool number*10)=100, it will display 100
R(2102+tool number*10).3=1, when R(2105+tool number*10)=100, it will display 00:01:40</td></tr>
<tr><td>L-STATE (Tool state)</td><td>Input range: No
Input format: Integer
Input to: R(2106+tool number*10)
The valid input is 0.1.2.3.4.5
If the input is not valid, it'll be viewed as "input 0"<table><tr><td>(0) NO-Managed</td><td></td></tr><tr><td>(1) Not use</td><td>(2) Usable</td></tr><tr><td>(3) End Announce</td><td>(4) Life End</td></tr><tr><td>(5) Damage</td><td></td></tr></table>After inputting, the status won't remain the same forever. When the status is (2) Usable or (3) End Announce or (4) Life End, the status will change according to the following rules.
When the current tool life ≦ ("MAX LIFE"-"NOTICE-L"), the display status: (2) Usable.
When the current tool life<(MAX-LIFE), and ("MAX LIFE"-"NOTICE-L"), the display status: (3) End Announce
When the current tool life≧(MAX-LIFE), the display status: (4) Life End</td></tr>
</table>

4.3.2 Technical Specification Realization

M code Macro technical specifications

Develop an M code Macro as the M code check function of the tool management function. The following example uses M0123 as the function number and file name. This Macro includes tool confirmation and call variable transmission. Through the input variables, tool determination and confirmation are performed, and then the output variables are provided for back-end applications. The following is a detailed description of the I/O interface.

I/O interface (Parameter)

Input	Parameter	Parameter description	Usage	Note

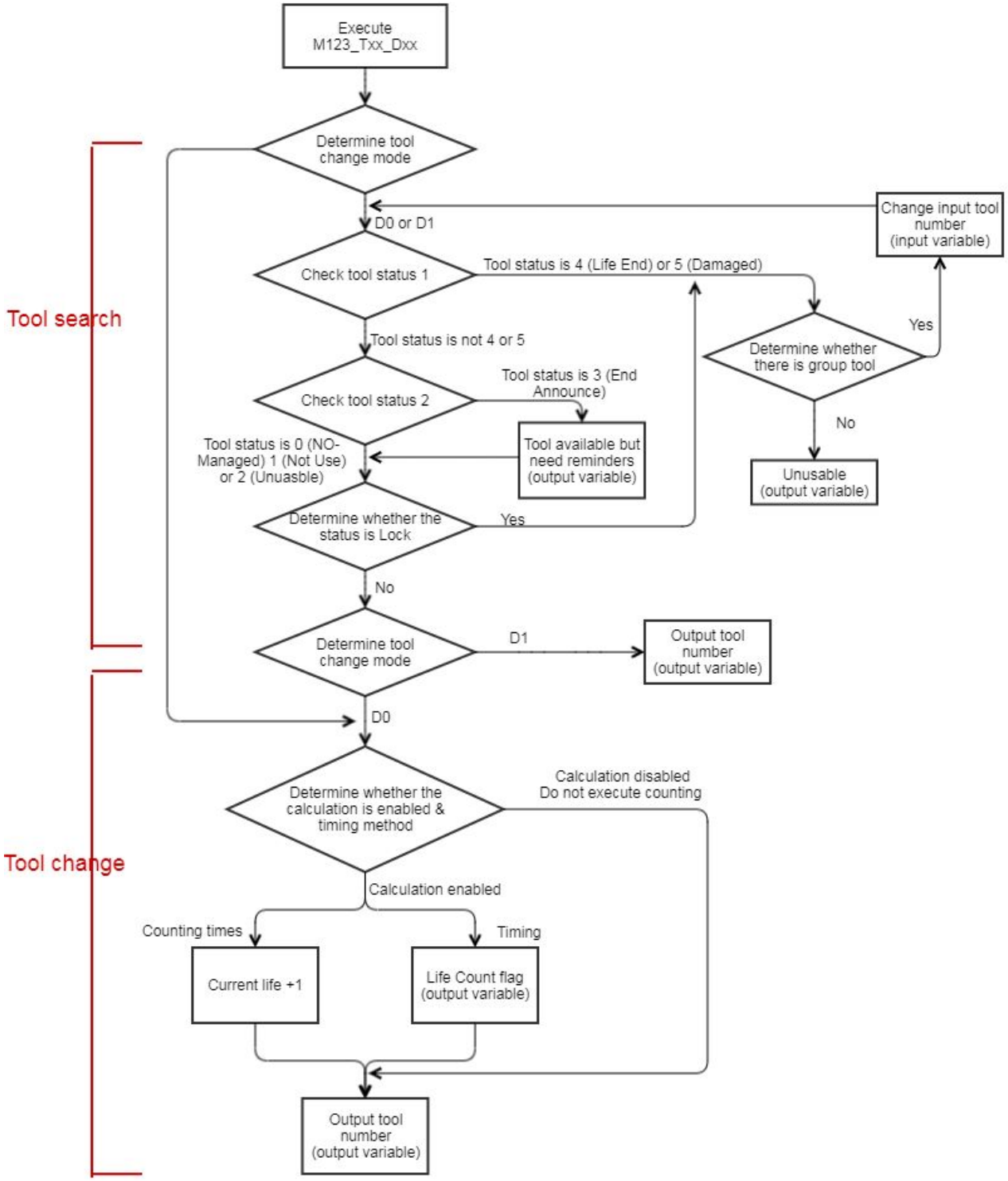
Tool number (T)	#20	Tool number input value	Macro plus T parameter	For example: G123 T1D1
Tool change mode (D)	#13	The mode used when changing the tool D0 (default): The mode that tool search and tool change are carried out together D1: Tool change mode is tool search D2: Tool change mode is tool change	Macro plus D parameter	For example: G123 T1 D1

Input	**Parameter**	**Parameter description**	**Usage**	**Note**
Tool determination	@120001 (R20001)	Determine whether the tool can be used, or it's usable but needs to be prompted 0: Unusable, an alarm will pop out to indicate the tool status 1: Usable 2: Usable, but reminds that the tool life is about to end	The output value is for the tool change Macro to determine whether to use the tool, or pop up an alarm or prompt	
Tool number used	@120002 (R20002)	The last tool no. that can be used after tool management	The output value is used for tool change Macro and PLC	
Originally called tool number	@120003 (R20003)	Originally inputted tool no. (variables that group tool will use) If a group tool is used, but the tool still cannot be used, the originally called tool number value needs to be output and provided to the alarm string for determination.	The output value is used for tool change Macro	For example: T1 and T2 are group tools. If both tools are unusable, after the user executes T1, the user will be notified that the unusable tool is still T1

Life count (timing) flag	@120000 (R20000)	Life Count (timing) flag 0: Disabled 1: Enabled	Provide for PLC	Enable flag for timing, no need for counting used times

Program process

SYNTEC



Macro Program

```
%@MACRO
//Tool number (T) #20
//Tool change mode (D) #7
//D0 (default): The mode that tool search and tool change are carried out together
//D1: Tool change mode is tool search
//D2: Tool change mode is tool change

//Tool determination #301
//0: Unusable, an alarm will pop out to indicate the tool status
//1: Usable
//2: Usable, but reminds that the tool life is about to end
//Originally called tool number #302
//Used tool number #303
//Group value of the originally called tool number #304

//R20000 //Enable the Life Count flag(PLC)
//R20001 //Output_tool determination #301
//R20002 //Output_usable tool number #303
//R20003 //Output_originally called tool number #302

//Parameters used in Macro program============================
//#201 Tool status temporary storage
//#202 The tool number of the first (last) search of the group tool
//#203 Variables for group tool search (for loops)
//#204 Variables for group tool search (group value temporary storage)
//#205 Tool number information temporary storag//R(2102+tool number*10)
//#206 Temporary storage of the locked tool number information//0: unlock; 1: lock, unusable
//#207 Temporary storage of the timing tool number information//0: counting operating times; 1: timing(S)
//#208 Temporary storage of the tool management of tool number information (whether the timing is valid)//0:
invalid; 1: valid
//=============================================

//Initialize==========================================
//#20 := 1;
//#7 := 1;
#202 := 1;//Clear the search tool number of group tool, the initial value is 1
#302 := #20;//Record the originally called tool number
#304 := @[102101+#20*10];//Write the tool number group value of the original call

IF(#7<0) OR (#7>2) THEN //Check the tool change mode, the user must enter in the correct range
MSG("M123 D parameter input value is incorrect");
G04 X1.;
M30;

ELSEIF(#7=#0) THEN //If not, default to 0
#7:=0;

END_IF;
//=============================================


IF( #7 = 2 ) THEN //Determine the tool change mode for the first time //If D=2, skip to the tool change determining
```

```
process
GOTO 20;
END_IF;

//Tool search=============================================
N11;
//D=0 or 1
//Tool status R(2106+Tool number*10)
//(0)NO-Managed(1)Not use(2)Usable(3)End Announce(4)Life End(5)Damage

#201 := @[102106+#20*10]; //The tool status of the tool selected by the user
#205 := @[102102+#20*10];//#205 Tool number information temporary storage//R(2102+tool number*10)
#205 := #205 / 2;
#206 := #205 MOD 2; //#206 Temporary storage of the lock tool number information//0: unlock 1: lock, unusable

IF (#201=4) OR (#201=5) THEN //check tool status_1
GOTO 10;//4 Life End or 5 Damage, looking for group tool
ELSEIF (#201<0) OR (#201>5) THEN
MSG("The tool status input value is incorrect");
G04 X1.;
M30;

ELSEIF #201 = 3 THEN
#301 := 2;//Output tool determination//2: Usable, but should be reminded that the tool life is about to end//0:
Unusable, an alarm pops out to explain the tool status//1: Usable

#303 := #20;//Available tool number #303
IF (#206=1) THEN //Check if the status is lock, if lock, search for group tool
GOTO 10;//Search for group tool
END_IF;

ELSE //0~2
#301 := 1;//Output tool determination//1: Usable
#303 := #20;//Available tool number #303
IF (#206=1) THEN //Check if the status is lock, if lock, search for group tool
GOTO 10;//Search for group tool
END_IF;
END_IF;
//=========================================================

GOTO 12;//Didn't enter the group tool determination, skip
//Group tool determination=================================
N10;
//Tool group_R(2101+tool number*10)
//#202 The tool number of the first (last) search of the group tool
//#203 Variables for group tool search (for loops)
//#204 Variables for group tool search (group value temporary storage)
//#302 Originally called tool number
//#304 Original tool group value
FOR #203 := #202 TO 96 BY 1.0 DO
#204 := @[102101+#203*10];//Temporarily store the searched tool group value in the group
#202 := #203 + 1;//Every time the searched tool number needs to be updated, it may be used in the second
search
```

```
IF #203=#302 THEN //If the original tool is searched, nothing will be done
;
ELSEIF (#203<>#302) AND (#304 <> 0) AND (#204=#304) THEN //Others, enter determination (not the original tool)
#20 := #203;//Update tool number input
GOTO 11;//Continue to the original tool check condition_1

ELSEIF (#203=96) THEN //Others, it can't be searched
#301=0;//Output tool determination//0: Unusable, an alarm will pop up and describe tool status
#303 := #302;//Available tool number#303(Here refer to the unusable tool number)
GOTO 30;
END_IF;
END_FOR;
//================================================
N12;

IF( #7 = 1 ) THEN //Second determination of tool change mode //If D=1 output the tool number and jump out of the program
//#301=1;//Output tool determination//1: Usable
//#303 := #20;//Available tool number #303
GOTO 30;
END_IF;

//Tool change================================================
N20;
//#207 Temporary storage of the timing tool number information//0:Counting operating times 1: Timing(S)
//#208 Temporary storage of the tool management of tool number information (whether the timing is valid)//0: Calculation disabled; 1: Calculation enabled
#205 := @[102102+#20*10];//#205 Temporary storage of the tool number information//R(2102+tool number*10)
#205 := #205 / 2;
#205 := #205 / 2;
#205 := #205 / 2;
#207 := #205 MOD 2; //#207 Temporary storage of the timing tool number information//0:Counting operating times 1: Timing(S)
#205 := #205 / 2;
#208 := #205 MOD 2; //#208 Temporary storage of the tool management of tool number information (whether the timing is valid)//0: Calculation disabled; 1: Calculation enabled

//Determine whether the calculation is enabled & timing method
IF(#208 = 0) THEN //Calculation disabled
#303 := #20;//If the calculation is disabled, output the used tool number //Available tool number #303

ELSEIF (#208 = 1) AND (#207 = 0) THEN //Calculation enabled, counting times//Current life R(2103+tool number*10)
#303 := #20;//Available tool number#303
@[102103+#303*10] := @[102103+#303*10] + 1; //counting times+1

ELSEIF (#208 = 1) AND (#207 = 1) THEN //Calculation enabled, counting times
#303 := #20;//Available tool number#303
//R20000 //Enable the Life Count flag(PLC)
@120002 := #303;//Update the timing tool number of PLC
@120000 := 1;//Enable the Life Count flag
END_IF;
//================================================
```

```
N30;
//Alarm and prompt=========================================
IF(#301 = 0) AND (#7 <> 2) THEN //0:Unusable, an alarm will pop out to explain the tool status
ALARM(101); // Alarm 101. Tool life has ended, please replace the tool
M30;
END_IF;

//=================================================

//输出=============================================
@120001 := #301; //Tool determination #301
@120002 := #303; //Available tool number #303
@120003 := #302; //Original tool number #302
//=================================================
M99;
```

PLC Technical Specifications

Purpose

The purpose of developing PLC is to cooperate with G code Macro to complete tool Life Count function and ※ alarm notification. 'When the user executes command M123, the human machine input value and tool life status will be determined. After the determination, M123 Macro will notify PLC to turn on the timing function, update the tool number and accumulate the operating time.

※Alarm notification: When any tool status becomes Life End, R3100 will become 1, and user can use it as an alarm reminder. The description is omitted below.

Program Description

PLC is to cooperate with the M code Macro flag (R20000=1) to turn on and perform the timing function. The Timer element is added, so it needs a fixed interval (10s) before accumulating the value while timing.

A462 Initialize Tool Management

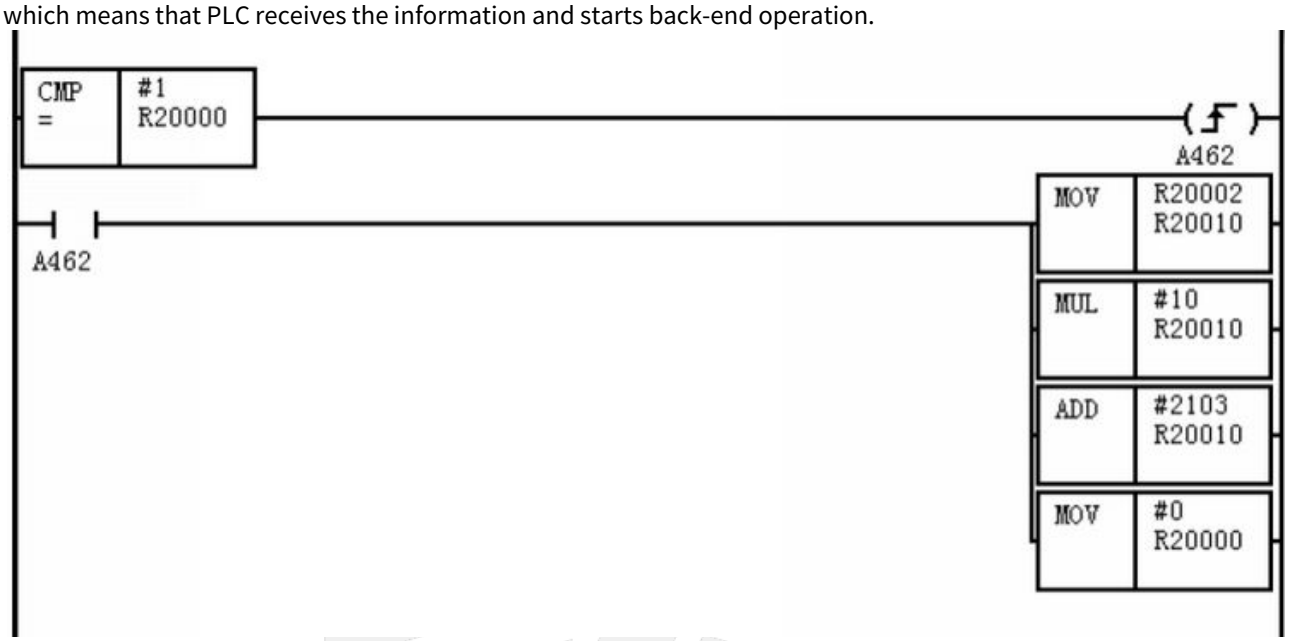
Purpose:

After G123 Macro is executed, if the tool calculation is enabled and the life is timed, R20000 and R20002 will be output to the PLC as the Life Count (timer) enabling flag and the currently timed tool number data. After knowing the tool number data, PLC will give the R value address of the tool number current life timer, R(2103+tool number*10).

Operation:

According to the Life Count (timing) flag (R20000) provided in the G code Macro (G123), when the flag is 1, execute the A462 to move the currently used tool number value. After calculation, obtain that the timing R value is stored in R20010, which is used as indirect addressing hereafter. Then specify R20000 to 0 and disable the flag function,

which means that PLC receives the information and starts back-end operation.



A463 Switch for enabling timing

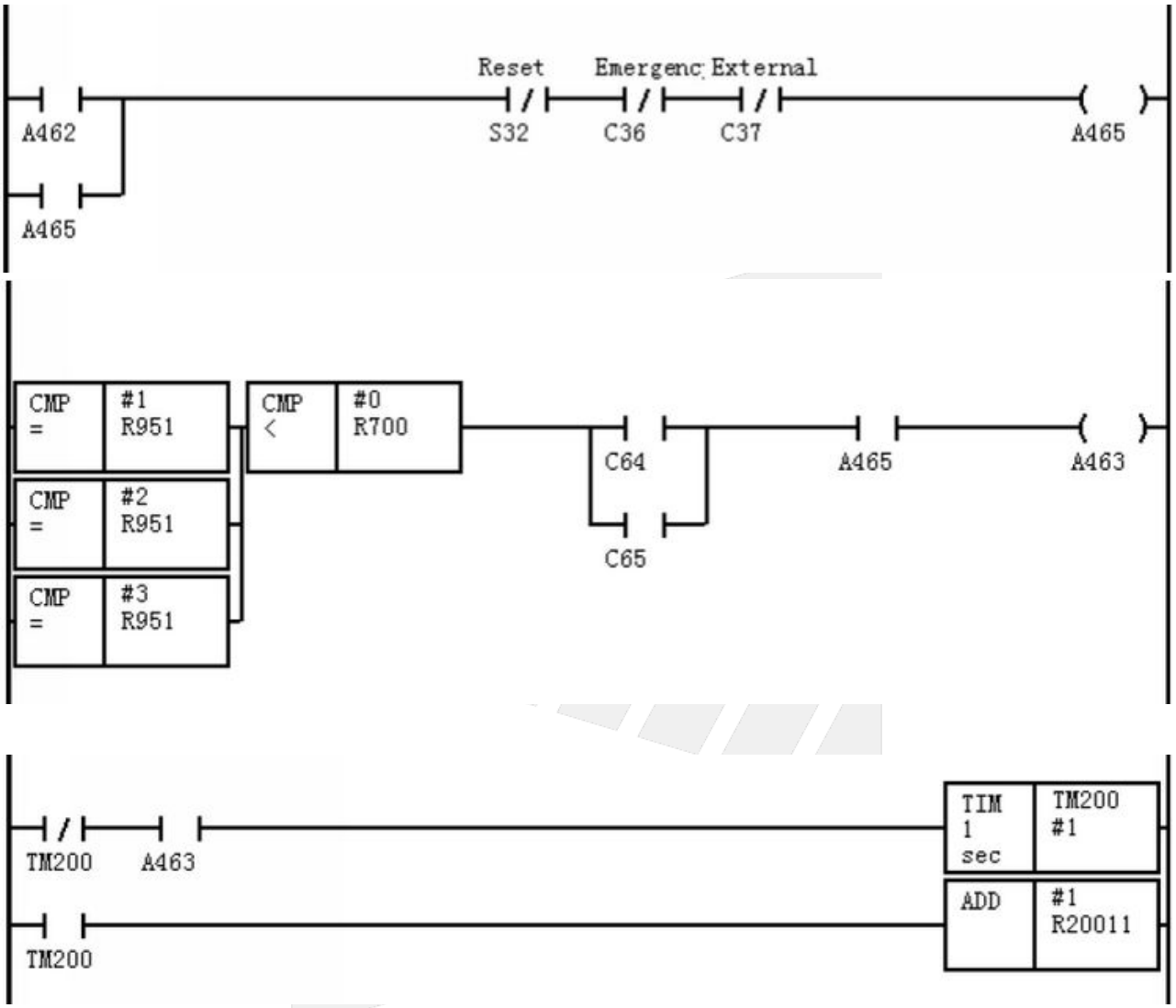
Purpose:

When A462 is triggered, PLC will start timing, and simultaneously detect whether the machine is in the G01~03 interpolation mode, the resultant speed is not zero and the spindle is in counterclockwise or clockwise rotation. When the above conditions are met, the timing switch will be enabled.

Operation:

When A462 is notified to give a readout, it'll trigger A465 to enable PLC timing flag. The timing conditions are enabling PLC timing flag, G01~03 interpolation mode, resultant speed is not zero and the spindle is in counterclockwise or clockwise rotation. When the above conditions are met, the timing switch will be enabled. Timer200 is used in the calculation and the unit is second(s). The result will be accumulated and stored into R20011. When Reset or Emergency Stop is triggered, the timing switch will be disabled, and will not be enabled until the next time when A462 is notified to give a readout.

SYNTEC



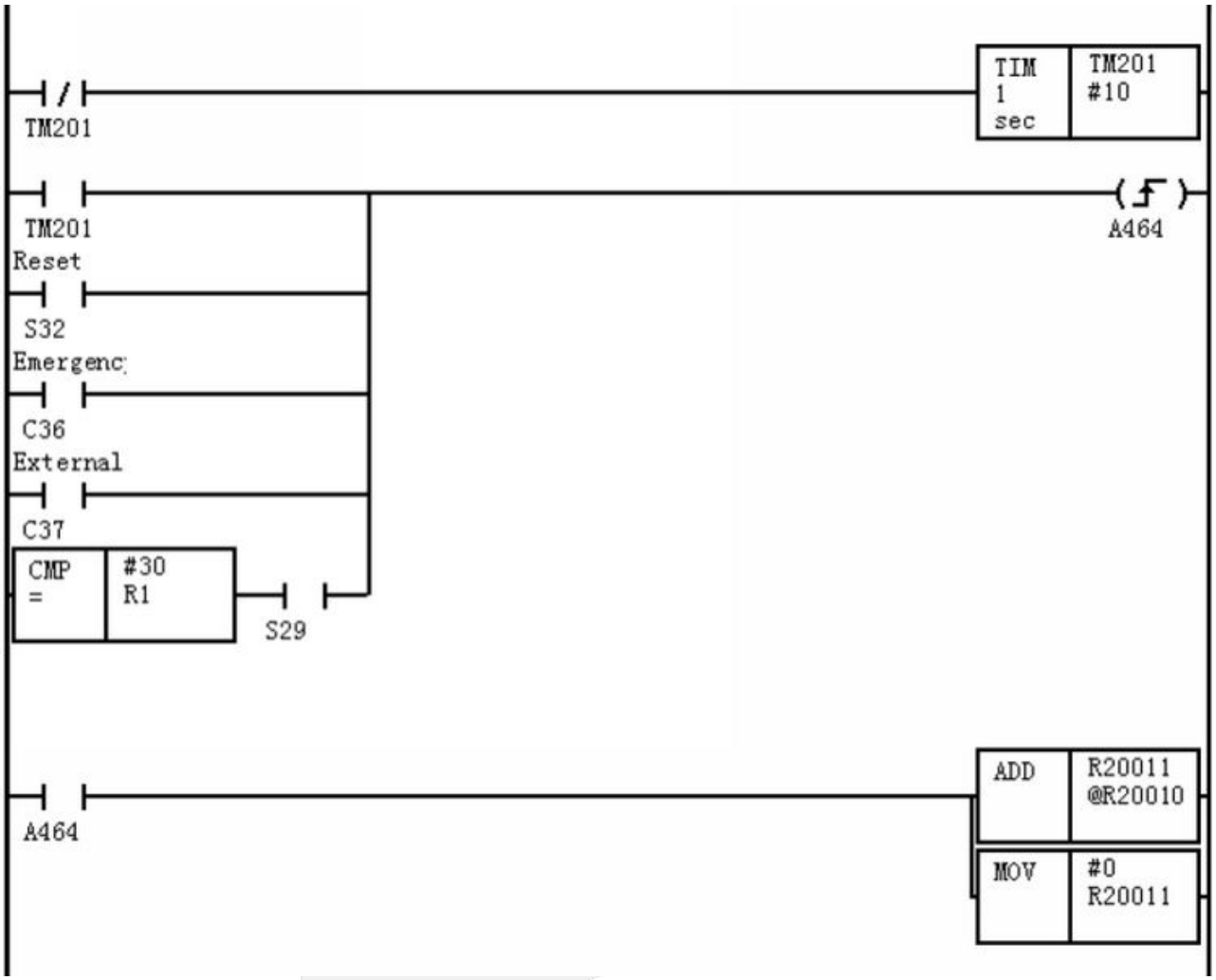
A464 Update Accumulated Time

Purpose:

When timing is executed, the cumulative refresh time (10s) is designed in PLC. When the refresh time is reached, the timing switch will be enabled, and then the cumulative value is added to the R value of the specified tool life (using indirect addressing to specify the R value).

Operation:

The timing function uses R20011 as temporary storage to avoid excessive reading and writing (fram) of the permanent temporary storage R value, so set the switch A464 using Timer201 to store R20011 value to the R value indirect address obtained by A461 or A462. This value will be accumulated to the temporary storage space of operating tool and to activate the accumulated time switch. When the emergency stop, Reset or M30 action is executed, the accumulated time switch will also be executed.



4.4 Note

4.4.1 Variable

A bit

A462	initialize tool management
A463	Enable timing switch
A464	Refresh cumulative time

A465	Temporarily store the status when PLC is notified to give the readout

R bit

R1	M code readout
R700	Actual value of resultant feed rate
R951	Current interpolation mode of the first coordinate program, the possible value is 0/1/2/3/4/33/34/35
R20000	Life Count flag
R20001	Tool status 0: Unusable, an alarm will pop out to indicate the tool status 1: Usable 2: Usable, but reminds that the tool life is about to end
R20002	Available tool number (Life Count tool number)
R20003	Originally called tool number
R20010	Indirect addressing of the timing stored R value
R20011	Temporarily store the accumulated time of PLC

Timer

TM200	Life Count of used tool
TM201	Used life refresh time (default 10s, can be changed according to requirements)

SYNTEC

5 Tool Life Management (New Version)

5.1 Abstract

Tool plays a very critical role during machining. A broken tool not only unable to machine normally, but also cause damage to the workpiece, machine or other tools. The tool life management function can help users to monitor the tools status with intuition. According to the times that the tool be used or the cutting time that the tool takes, it can predict whether the tool is still usable or about to break and needs to be replaced in advance.

In the old version of tool life management, PLC and MACRO have a large part needed to be developed and high barriers to entry. Therefore, we developed a new version of tool life management which greatly reduces the entry difficulty.

Functions provided by the new version of tool life management:

1. Tool used times (T-code) or tool cutting time are counted as tool life.
2. Early warning of the tool life ending, reminding the user that the tool life is about to end, let the user to pay attention to the tool condition.
3. Spare tool automatic exchange (spare tool function), when the tool life has ended, it will automatically find the usable tool in the same group according to the group setting, and replace the old tool with it.
4. According to different controller models, there are different interfaces and applications (read the tool life management manual of each model for details).

Lathe Milling High-Speed Spindle Milling

5.2 Contents

- Contents
- Notice
- Operation Specification Descriptions
- Operation Guide
- Alarm Descriptions
- T-code Customization
- Contents
- Notice
- Operation Specification Descriptions
- Operation Guide
- Alarm Descriptions
- Contents
- Notice
- Operation Specification Descriptions
- Operation Guide
- Alarm Descriptions

Version Update Descriptions

Controller version : 10.118.46B, 10.118.48M, 10.118.52G and subsquent testing-version, developing-version.

- Add the page "End of tool life".

- Add a pop-up alert mechanism at the end of tool life management.
- Add the function of lettering count for high-speed spindle milling model.
- Fix the boot error when the number of z axis is less than 4 for high-speed spindle milling model.
- Fix the tool ID display error after resetting to default settings for high-speed spindle milling model.

Controller version : 10.118.56N, 10.118.60H, 10.118.66B, 10.118.67 and subsquent testing-version, developing-version.

- Add "Group function switch", enabling the turn-off of tool group function.
- Add "When group funtion switch is off, tool compensation can be defined customizedly".

Controller version : 10.118.56N, 10.118.60H, 10.118.66B, 10.118.68 and subsquent testing-version, developing-version.

- The tool compensation function is supported in lathe system.
- Add "When group function switch is off, the column of tool group will be hidden".

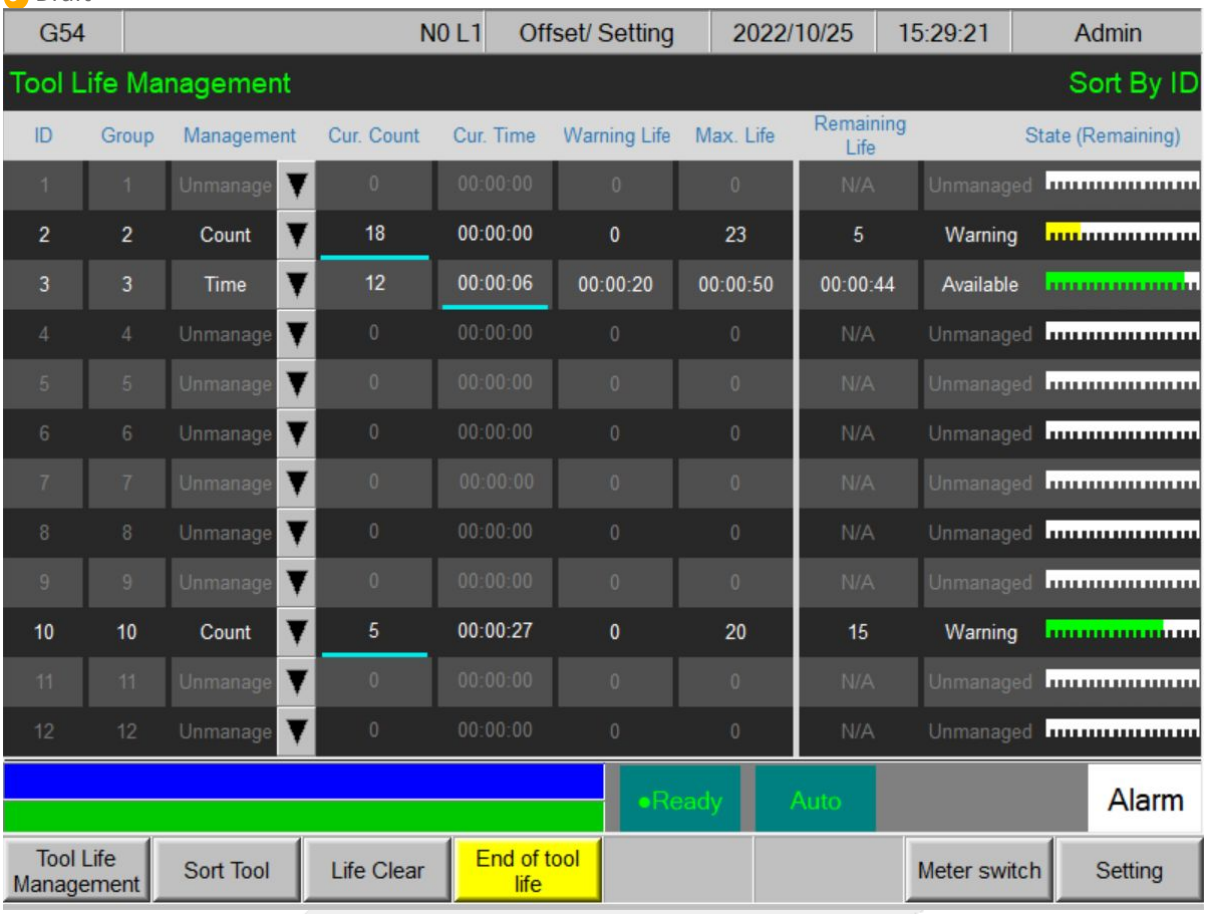
5.3 Notice

- Fuction turn on method:
  a. Set Pr3228 to 1.
  b. Set Pr4601 to 1.
  c. Reboot the controller.
- Please ensure R2100~R3100 are not customized, otherwise, tool life management can't work normally.
- The system backup(SB) will backup this software function and related settings. System recovery will also overwrite the tool information and related settings on the original page.
- After the version 10.118.52E, 10.118.56, tool life end alarm is supported to pop up at the end of maching, therefore, M30 or M99 must be added at the end of maching program.
- Support software version : after 10.118.28Q (inclusive).
- Support life counting function of single-axis group and double-axis group, but currently unsupport three-axis group or four-axis group.
- After turning on this function (Pr3228=1 & Pr4601=1), determine whether tool group function should be turnned on at setting page.
  - Group function switch is defaulted to "on" : When calling a tool, the tool compensation number will be forced to be the same as the tool number. The purpose is when the tool life ends, it can call the spare tool by following the logic of two digits of T codes.
  - Group function switch is "off" : When calling a tool, the tool compensation number can be defined customizedly. When the tool life ends, it will not call the spare tool.
  - If there are other requirements (such as turret machine), you can customize the T-code (T0000) by yourself. For details, please refer to the description of the "T-code Customization" chapter.
- R2101 needs to be zero, basically only other models may have non-zero conditions.
- Function entry:
  a. 10+8 key: (right row) offset/setting → F7 tool life management.
  b. key 8: F3 offset/setting → F7 tool life management.
  c. key 5: F3 offset/setting → F10 → F2 tool life management.

5.4 Operation Specification Descriptions

F1 - Tool Life Management

Draft



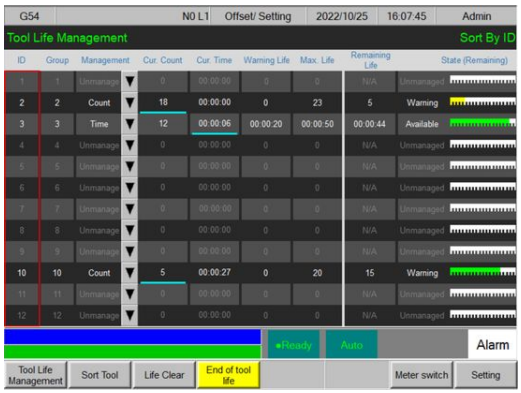
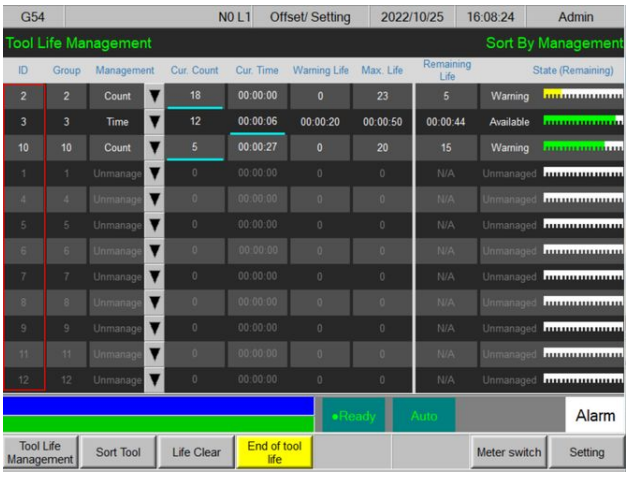
1. **ID**: Supports up to 96 tools.
2. **Group** (spare tool): When the T code is executed, if the life of the original tool has been ended, it will automatically search for the spare tool in the tool magazine. If there is one, it will be automatically replaced with an usable spare tool. Otherwise, the "Xth tool life has ended" alarm will be displayed.
   Note: Before using this function, the spare tool must be set and input into the corresponding tool compensation table.
   Example
   Ex: Originally call T01, but after the life of T01 end, the spare tool T03 will be automatically searched, and the tool compensation number is also 03, which is equivalent to calling T0303. Therefore, the correspond tool of T03 must be added to the column 03 in the tool table.
3. **Management**: Can be set to "unmanaged", "times count" and "time count" three statuses.
   a. Set to "Unmanaged", the related parameters of this tool can't be set, and the font color of the entire tool list will turn to gray. The system will ignore the life judgment of this tool and output directly.
   b. Set "times count", the current counting times will be regarded as the current life, the current times counting field of the tool will have a small blue mark for the user to quickly distinguish.
   c. Set "time count", the current counting time will be regarded as the current life, the current time counting field of the tool will have a small blue mark for the user to quickly distinguish.

   d. Set "distance count", the current counting distance will be regarded as the current life, the current distance counting field of the tool will have a small blue mark for the user to quickly distinguish.
4. **Cur. Count**: The times that the tool has been used so far. Every time T code is executed, the current times count of the tool called by the T code will be +1 (if its status is unmanaged, the times count won't change).
5. **Cur. Time**: The time that the tool has been used so far. After the tool is called by T code, the timing will start when the following conditions are met.
   Timing Conditions
   - Tool management is times count or time count.
   - G code status is G01, G02 or G03.
   - C36, C37, S32 are all Off.
   - The actual value of the feedrate command of the axis group>0.
6. **Cur. Distance**: The distance that the tool has machined so far. Display in meter to the third decimal place. The machining distance calculation method is briefly described as follows.
   Notice
   a. The time for maching a single line segment is recommended to be greater than 2.5 seconds, otherwise calculation errors are likely to occur.
   b. Currently only single-axis group is supported.
7. **Warning Life**: When the current life of tool is greater than this value, and less than the maximum life, the prompt window of "Txx tool life is about to end" will pop up, and the machining will not be affected (won't stop).
8. **Max. Life**: When the tool current life is greater than this value, the machine will execute the command according to the tool life end alarm.
9. **State**: Display the current status of tool, and its display conditions are as follows:
   a. unmanaged : choose unmanaged in tool management option.
   b. available : cuurent life smaller than maximum life.
   c. warning : cuurent life greater than warning life and cuurent life smaller than maximum life.
   d. broken : cuurent life greater than maximum life.
10. **Meter Switch** : Provides a visual diagram showing the remaining amount or used amount of the tool life, which can be switched by personal preference. The definition of the colors are as follows:
    a. remaining amount
       i. 100%~51% : green
       ii. 50% ~ 11% : yellow
       iii. 10% ~ 1% : red
       iv. 0%: red (whole bar)
    b. usage amount
       i. 0% ~ 49% : green
       ii. 50% ~ 89% : yellow
       iii. 90% ~ 100% : red

F2 - Sort Tool

Draft

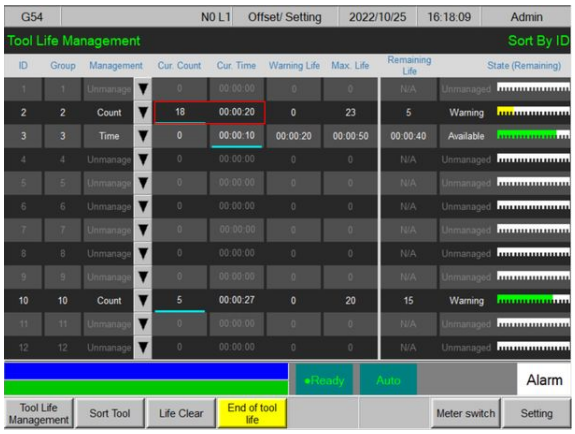
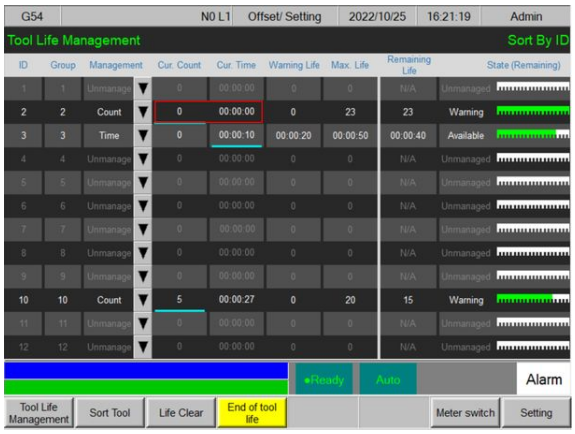
SYNTEC

Sort By ID	Sort By Management
	

1. After pressing F2 Sort Tool, it will switch to "sort by management", and the sorting method is:
    a. Sort By Management (choose time count or times count in the tool management page), the tool numbers are sorted from small to large, starting from the first page.
    b. Sort By ID, the tool numbers are successively sorted from small to large.
2. Press F2 again to switch to "sort by ID".
3. When the "All Tool Management Function Switch" is activated, the sort tool function is unavailable.

F3 - Life Reset

Draft

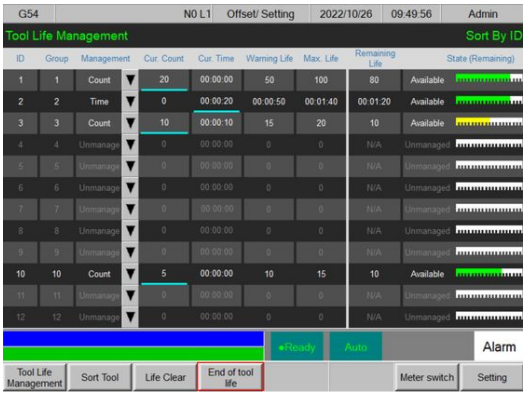
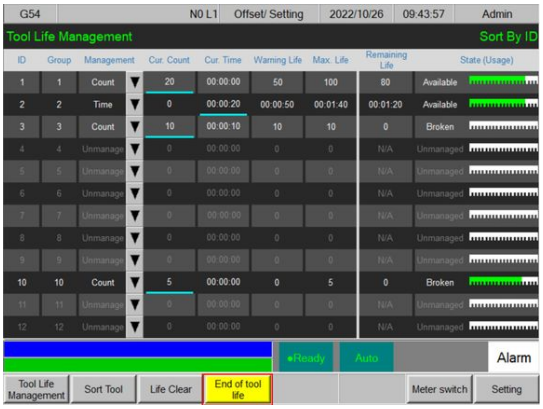
Before Pressing "Life Reset"	After Pressing "Life Reset"
	

Reset the "current count", "current time" and "current distance" values of the tool in the row where the yellow cursor is on.

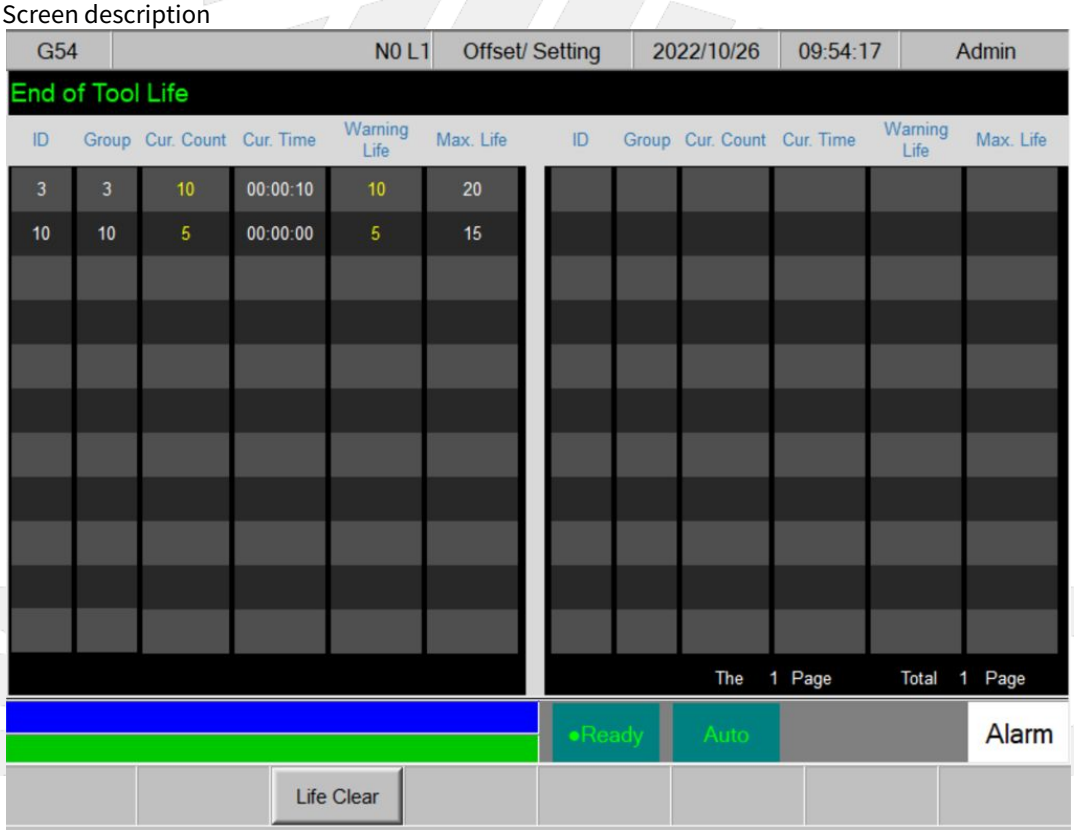
F4 - End of Tool Life

Draft

1. Function description: All the tools with warning life and ended life will be displayed on this page.
2. If there is a tool with warning life or ended life, this fenu display will turn yellow.

No tool with warning life or ended life	Any tool with warning life or ended life
	

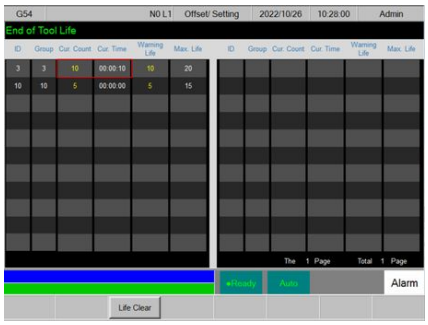
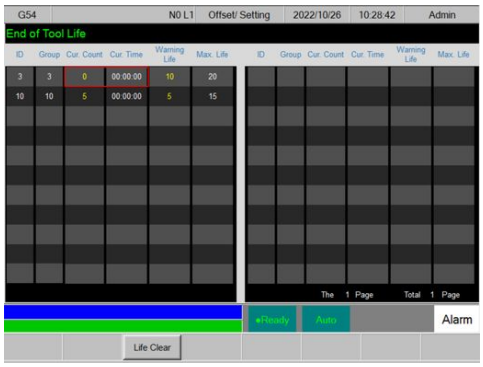
3. Screen description



a. **ID** : Display tool number with warning life or ended life.
b. **Group** (high-speed spindle milling: z axis) :
    i. Display the group which current tool number belongs to.
    ii. Edit is not available.

c. **Cur. Count** :
   i. Contents and usages are similar to current count in F1 - Tool Life Management.
   ii. If the tool status is "warning life", the font color will be yellow; if the tool status is "ended life", the font color will be red.
d. **Cur. TIme/Cur. Distance** :
   i. Contents and usages are similar to current time/curent distance in F1 - Tool Life Management.
   ii. If the tool status is "warning life", the font color will be yellow; if the tool status is "ended life", the font color will be red.
e. **Warning Life** :
   i. Contents and usages are similar to warning life in F1 - Tool Life Management.
   ii. If the tool status is "warning life", the font color will be yellow.
f. **Max. Life** :
   i. Contents and usages are similar to max life in F1 - Tool Life Management.
   ii. If the tool status is "ended life", the font color will be red.
g. **Current Number of Page** :
   i. The lower right corner displays the current number of page.
h. **Total Number of Pages** :
   i. The lower reght corner displays the number of total pages.

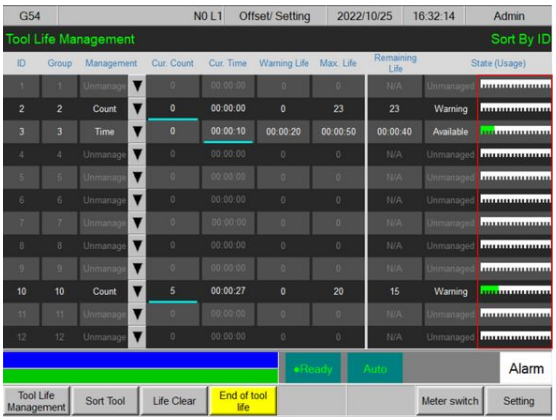
4. Fenu button description
   - **F3 - Life Clear**
     - Reset the current time, current count and current distance of the tool where the cursor is located to zero.

Before life clear	After life clear
	

   - **Keyboard "PageUp"**
     i. Go to previous page.
   - **Keyboard "PageDown"**
     i. Go to next page.
   - **ESC**
     i. Go to "Tool Life Management" page.

F7 - Meter Switch

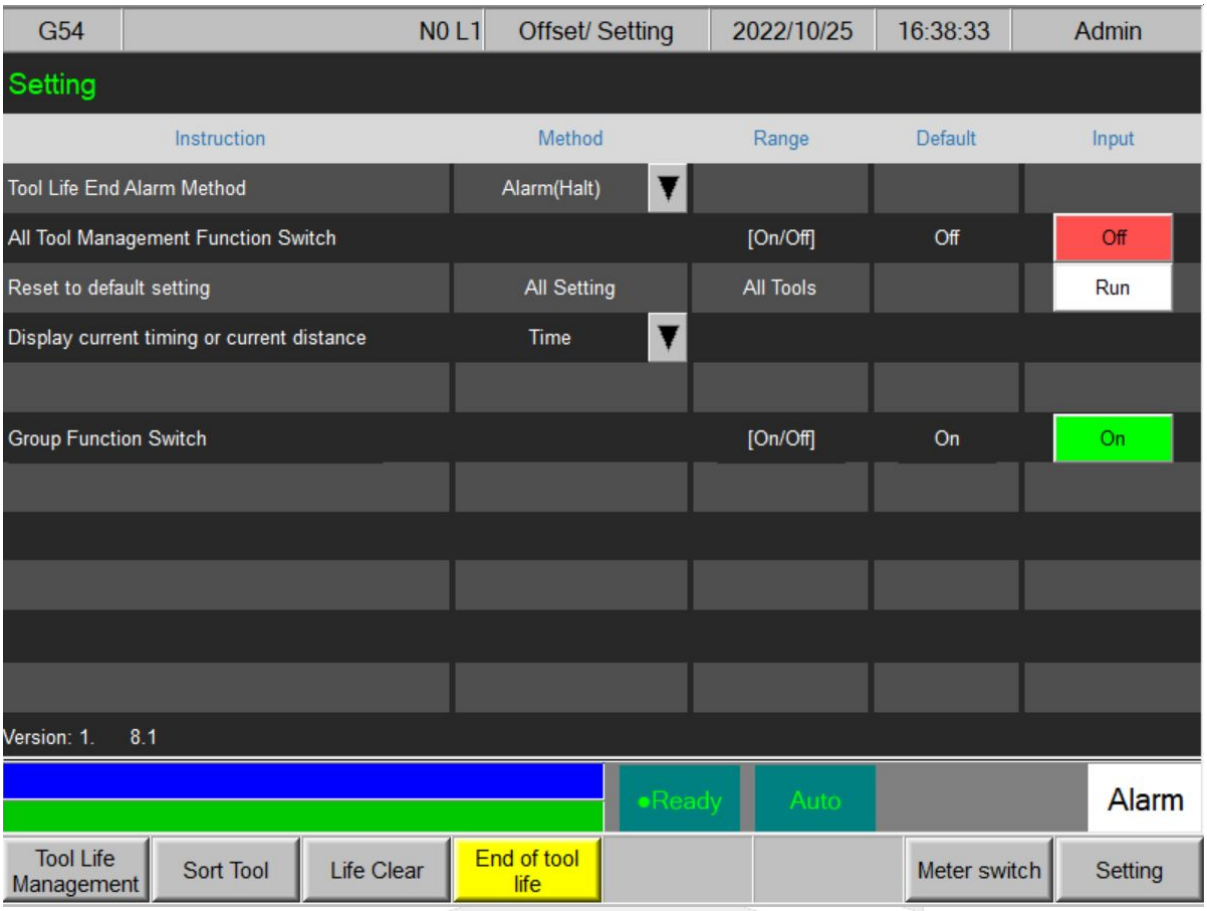
Draft

Remaining amount	Usage amount
	

Switch the display method of the tool life meter between "remaining amount" and "usage amount".

F8 - Setting

Draft

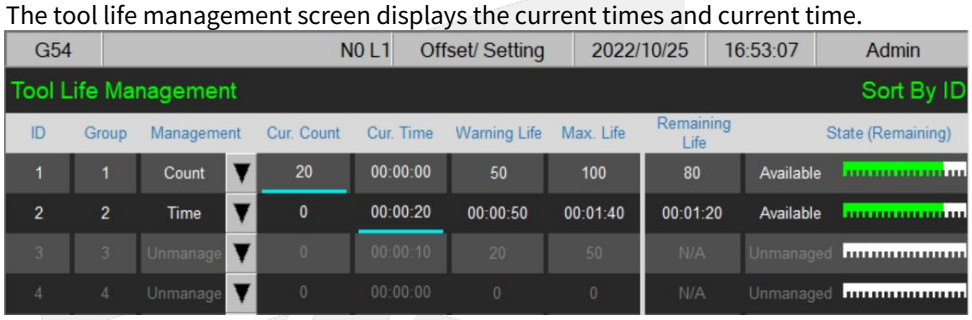


1. Tool life end alarm method : divided into three types:
    a. Alarm (Halt) : The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will trigger the alarm and stop.
    b. M00 : The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will pop up a message at the end of the program and execute M00 (program pause).
    c. Remind only, NON-STOP : When the current life of the called tool has exceeded the maximum life and there is no spare tool available, the system will only pop up a message and continue machining.

2. All tool management function switch : when "On" is pressed, all tools will be switched to unmanaged, and the tool management column cannot be operated. Press it again to cancel it, and restore to the state before it is turned on.
    a. When the all tool management function switch is on, the tool number 1~96 in tool life management cannot be operated.
    b. When the all tool management function switch is on, the sort tool function is unable to use.
3. Reset to default setting: All tool data will be restored to their default values, please refer to the table below for the initial values:

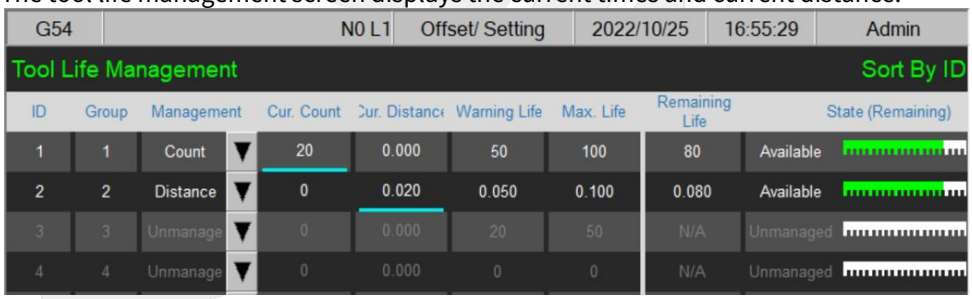
Tool number	Group	Tool Management	Current Times	Current Time	Remaining Life	Maximum Life
1~96	same as tool number	unmanagement	0	0	0	0

4. Display current timing or current distance
    a. Choose "current time"
        i. The tool life management screen displays the current times and current time.



        ii. "Current distance" can't be choosed as tool management method.

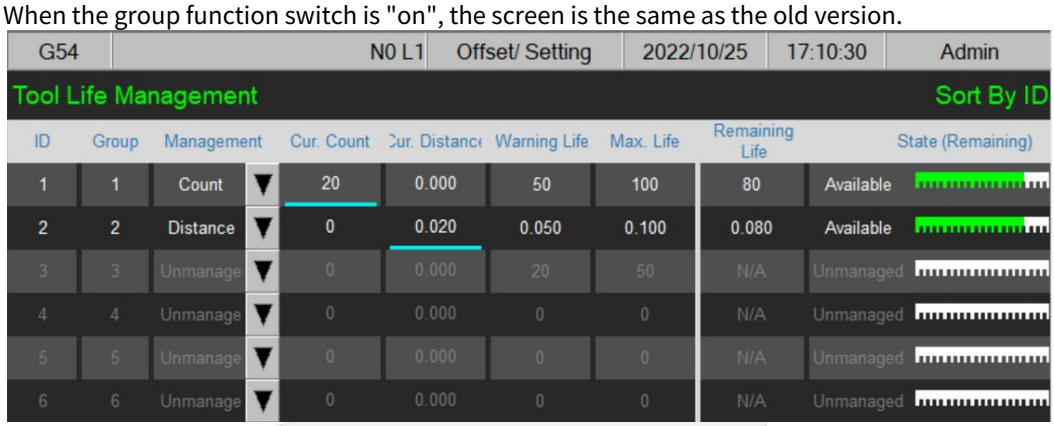
    b. Choose "current distance"
        i. The tool life management screen displays the current times and current distance.



        ii. "Current time" can't be choosed as tool management method.

    c. Notice
        i. It does not matter whether the current time or current distance is selected. The current times, current time and current distance of the tool will all be counted at the same time. (This setting option only affects the screen display and tool management options)
        ii. In the dipole mode, the front stage and the back stage must be manually set and consistent.
5. Group function switch
    a. Default is "on".

b. When the group function switch is "on", the screen is the same as the old version.



i. The tool group function is supported.
ii. The tool compensation always equal to the tool number, which can't be defined customizedly.

c. When the group function switch is "off", the column of group will be hidden.



i. The tool group function will be ineffective compeletely, no matter it was set or not before.
ii. The customized tool compensation is available. If T000 customization is needed, it is necessary to modify T000 according to **T-Code Customization**. If T000 customization is not needed, the new version of T000 is updated in standard installation package.
iii. The setting value will be restored after switched to "on" again.

d. Example

Example

Suppose T1 and T2 belong to the same tool group.

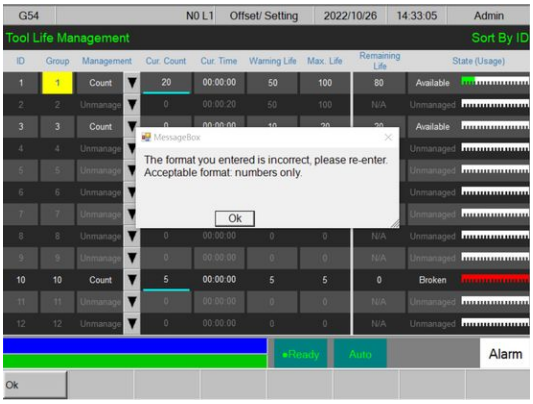
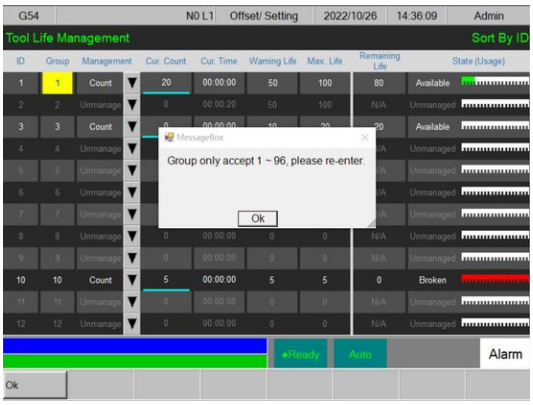
T code in NC program	**Group function switch**	
	On	**Off**

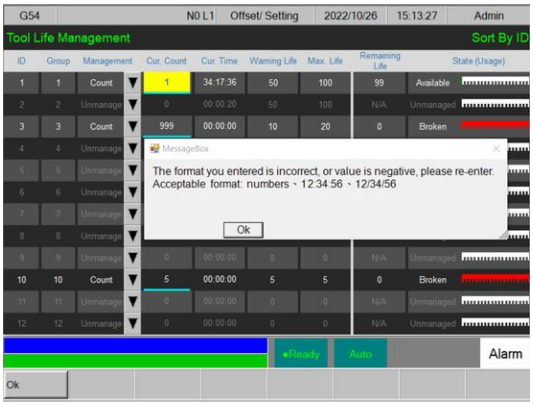
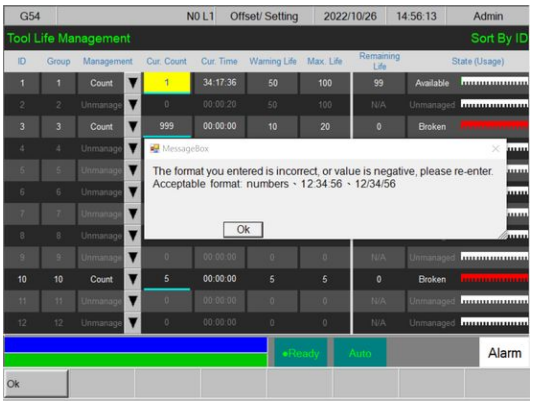
	The tool life of original tool number is not ended	Switch to spare tool	The tool life of original tool number is not ended	Switch to spare tool
T01	T0101	T0202	T0101	N/A
T0101	T0101	T0202	T0101	N/A
T0103	T0101	T0202	T0103	N/A

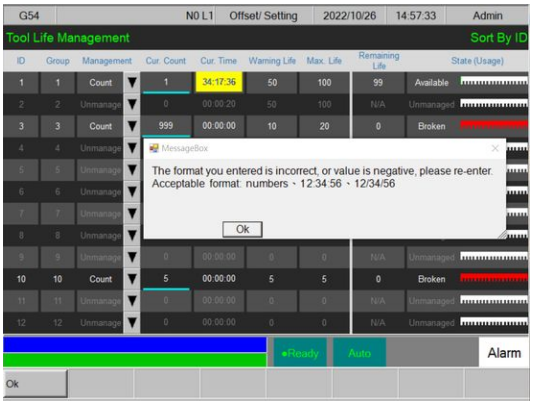
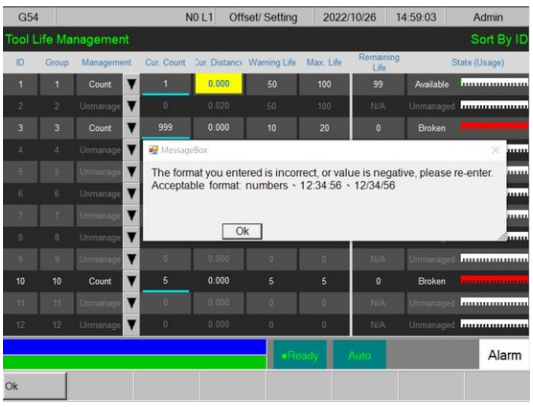
5.5 Operation Guide

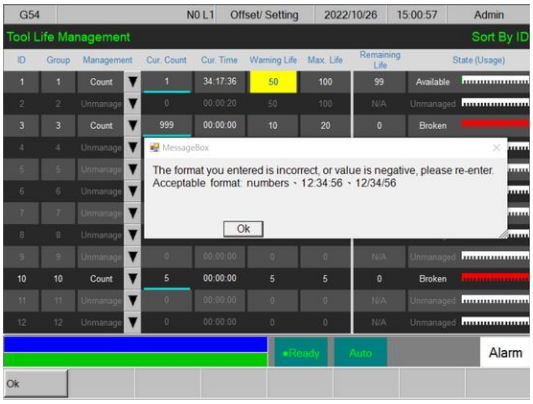
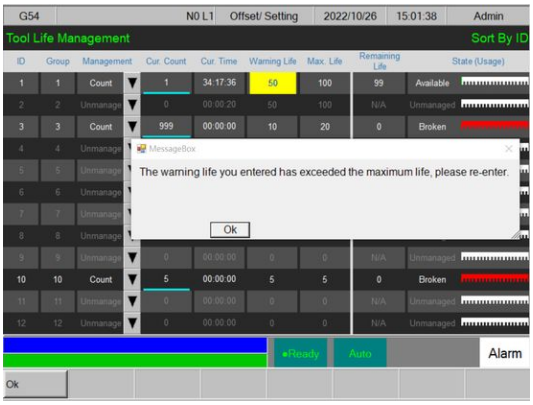
- When the user enters an value which is out of specification, the controller will prompt to inform the user, ask user to check the entered value.
  Detailed Descriptions

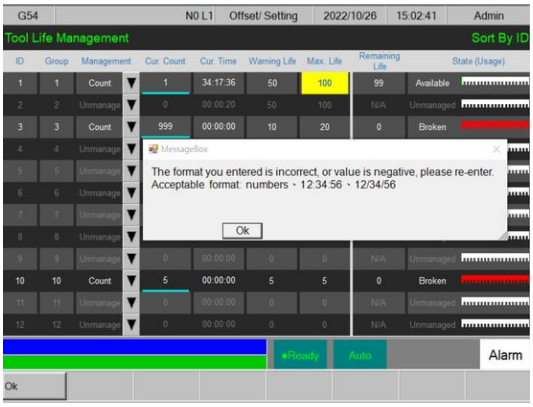
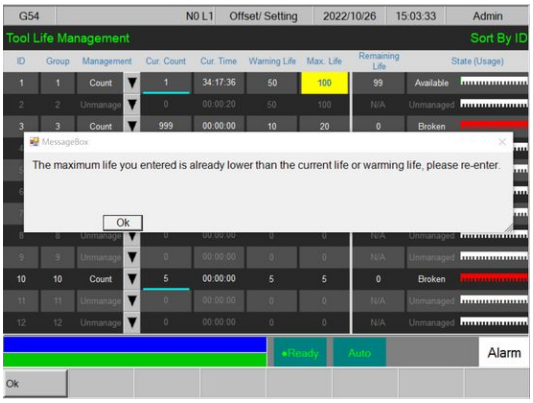
SYNTEC

input object	reasonable range	condition of pop-up reminder	reminder content	note
group	1~96	negative numbers, non-number characters	The format you entered is incorrect, please re-enter. Acceptable format: numbers only. **Figure** 	high-speed spindle milling machine unsupport the setting of tool group.
		group>96 or group<1	Group only accept 1~96, please re-enter. **Figure** 	high-speed spindle milling machine unsupport the setting of tool group.

input object	reasonable range	condition of pop-up reminder	reminder content	note
life input object	0~1000000000	input>1000000000	The format you entered is incorrect, or value is negative, please re-enter. Acceptable format: numbers、12:34:56、12/34/56 **Figure** 	
current count	0~1000000000	Negative numbers, non-number characters, but excluding "/" and ":"	The format you entered is incorrect, or value is negative, please re-enter. Acceptable format: numbers、12:34:56、12/34/56 **Figure** 	If you enter a floating point number, it will be taken the decimal point to the third place, and the value will be automatically multiplied by 1000. For example: 10. → 10000

input object	reasonable range	condition of pop-up reminder	reminder content	note
current time	0~1000000000	Negative numbers, non-number characters, but excluding "/" and ":"	The format you entered is incorrect, or value is negative, please re-enter. Acceptable format: numbers、12:34:56、12/34/56 **Figure** 	If you enter a floating point number, it will be taken the decimal point to the third place, and the value will be automatically multiplied by 1000. For example: 10. → 10000
current distance	0.000~1000000.000	Negative numbers, non-number characters.	The format you entered is incorrect, or value is negative, please re-enter. Acceptable format: numbers、12:34:56、12/34/56 **Figure** 	

input object	reasonable range	condition of pop-up reminder	reminder content	note
warning life	0~maximum life	Negative numbers, non-number characters, but excluding "/" and ":"	The format you entered is incorrect, or value is negative, please re-enter. Acceptable format: numbers、12:34:56、12/34/56 **Figure** 	
		remaining life>=maximum	The warning life you entered has exceeded the maximum life, please re-enter. **Figure** 	

input object	reasonable range	condition of pop-up reminder	reminder content	note
Maximum life	>current life	Negative numbers, non-number characters, but excluding "/" and ":"	The format you entered is incorrect, or value is negative, please re-enter. Acceptable format: numbers、12:34:56、12/34/56 **Figure** 	
		maximum life< current life	The maximum life you entered is already lower than current life or warning life, please re-enter. **Figure** 	
		maximum life< remaining life		

- Input current count, current time, current distance, remaining life, if the number include decimal point, the input result will be x1000.

5.6 Alarm Descriptions

Alarm ID	**MSG-397**	**Alarm Title**	**[Tool Management Function:Txx Tool Life is about to run out]**
description	The "current life" of the used tool is greater than or equal to the set value of "remaining life".		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		
others	1. When the tool life reaches the remaining life value during machining, the message will not be shown until next time the tool been change. 2. If the input tool remaining life is unreasonable (Ex: remaining life>maximum life), it will switch back to the last set value. 3. There will be no prompts for the same profile in the subsequent, the prompts will only be shown when next ime you press "Cycle Start".		

Alarm ID	**MSG-398**	**Alarm Title**	**[Tool Management Function: The Input Value of Tool Status is Incorrect]**
description	The tool status setting is not 0~5, (0) unmanaged, (1) unused, (2) usable, (3) about to end, (4) life end, (5) tool break.		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		
others	In old version, "tool status" can be set (0 or 5), but the new version of tool life management does not provide the function of setting the "tool status", so basically there will be no such alarm, but the alarm mechanism has been remained.		

Alarm ID	**MSG-399**	**Alarm Title**	**[Tool Management Function: Tool searching process error, please inform the developer]**
description	In the process of tool searching, an exception (not 0~5) occurs when determining the "tool status".		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		

Alarm ID	MSG-400	Alarm Title	[Tool Management Function: Incorrect input value of argument D Incorrect]
description	Set tool change mode(argument D), directly set to "0" in current.		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		

Alarm ID	MACRO-7xx	Alarm Title	[Txx Tool Life Has Reached to the End]
description	The tool life has ended, and the spare tool cannot be found in the tool magazine. The "xx" displayed in MACRO-7xx and Txx is the life-ended tool number.		
clear method	1. Change the tool or add a spare tool in the tool magazine and press Reset to clear this alarm, otherwise this alarm will appear again in the next tool change. 2. Check whether the customer has met the alarm interval required of tool life management.		
others	1. When the tool life reaches the pre-warning value during processing, it will not alarm, and will not alarm until the next tool change. 2. If the input value of tool remaining life is unreasonable (Ex: remaining life<maximum life), it will switch back to the last set value. 3. When the "current life" is greater than or equal to the "maximum life", the "Xth tool life ended" message prompt will be shown, and the machine will be in a "pause" state. Press Reset to clear the alarm.		

5.7 T-code Customization

1. Customers do not have customized T code MACRO: Use the standard T0000 function provided by the system without any modification. But make sure that the customers do not use the same program variables and MACRO Alarm ID interval. The T0000 file can be directly imported.
   Use the interval of program variables
   - T0000 MACRO:
     #50。
   - ToolManagement MACRO:
     #300~#310。
     #200~#220。
   - MACRO Alarm ID:
     ID300~ID400。
2. The customer has a customized T code MACRO: It needs to be modified, and the modification content is as follows:
   a. Add the following sample codes in the appropriate places of the customized T code MACRO. The best place is after the Txxxx four-code commands are separated, the program variables cannot

conflict with the ones used by original customer, and need to be modified according to the situation.

Modification 1

```
// #39 controls the display of R102, R525, R535, ..., (2 digits or 4
digits)
// If the new version of tool life management is used, #39 will
determine the final display method based on the 2 digits or 4 digits
entered by user
// If the new version of tool life management is not used, the original
value #1036 will be used, and the subsequent operations will be the
same as the original T code
#39 := #1036;

//=================================================================
//Call Tool Management Function
#50 := PARAM(3228);//Open Tool Management Function Parameter
#51 := PARAM(3209);
#52 := PARAM(4601);// Enable New Tool Life Management, when value == 1
IF(#50=1 AND #52=1) THEN
    CASE #51 OF
        0:
            M98 P"ToolManagement_common";
        1:
            M98 P"ToolManagement_cht";
        119:
            M98 P"ToolManagement_chs";
        ELSE
            M98 P"ToolManagement_common";
    END_CASE;

    // Used tool number (#33)、tool compensation (#34) are likely to be
changed by tool management
    // Current specification: Two-digits tool number always equals to
four-digits tool number
    // For four-digits tool number, if group function switch is "on",
the tool compensation number is forced to equalize the tool number; if
group function switch is "off", the tool compensation
    // number can be defined customizedly

    IF( #1036 >= 100 ) THEN
        #39 := 100 * #33 + #34;
    ELSE
        #39 := #33;
        #34 := #33;
    END_IF;
END_IF
//=================================================================
```

Modification 2

```
// !!!!!!! Notice !!!!!!!
// #1036 is tool compensation + tool number(4 digits) or tool number(2
digits) called by user in the machining program
// If there is a need for customized tool compensation logic, it is
recommended to change the #1036 below to the customized tool
compensation + tool number (4 digits) or tool number (2 digits)
// !!!!!!!!!!!!!!!!!!!!!!

IF( #38 = 1 AND #1010 = 71 ) THEN
CASE #37 OF
1:
#39 := #1036 / 100.;
2:
#39 := #1036 / 1000.;
3:
#39 := #1036 / 10000.;
END_CASE;
ELSEIF( #38 = 1 AND #1010 = 70 ) THEN
CASE #37 OF
1:
#39 := #1036 / 1000.;
2:
#39 := #1036 / 10000.;
3:
#39 := #1036 / 100000.;
END_CASE
ELSE
#39 = #1036;
END_IF;
```

Add tool life management interval to the current system standard T code

```
% @MACRO

#30 := #1000;
#31 := #1002;
#32 := #1004;

#35 := #1036;
#36 := #1502;

#37 := PARAM(17);
#38 := PARAM(3241);

#1502 := #36 OR 1;


IF( #1036 > 9999 ) THEN
 ALARM(6);
END_IF;
```

SYNTEC

```
IF( #1036 >= 100 ) THEN
 #33 := #1036 / 100;
 #34 := #1036 MOD 100;
ELSE
 #33 := #1036;
 #34 := #1036;
END_IF;

// #39 controls the display of R102, R525, R535, ..., (2 digits or 4 digits)
// If the new version of tool life management is used, #39 will determine the final display method based on the 2 digits or 4 digits entered by user
// If the new version of tool life management is not used, the original value #1036 will be used, and the subsequent operations will be the same as the original T code
#39 := #1036;

//================================================================
//Call Tool Management Function
#50 := PARAM(3228);//Open Tool Management Function Parameter
#51 := PARAM(3209);
#52 := PARAM(4601);// Enable New Tool Life Management, when value == 1
IF(#50=1 AND #52=1) THEN
 CASE #51 OF
  0:
   M98 P"ToolManagement_common";
  1:
   M98 P"ToolManagement_cht";
  119:
   M98 P"ToolManagement_chs";
  ELSE
   M98 P"ToolManagement_common";
 END_CASE;

 // The tool number used may have been changed (spare tool function)
 // Current specifications (must): When the user enters the four-digit T codes, the first two codes are defined as #33, and the last two codes are also defined as #33. If the tool management status is "unmanaged", the tool number will not be equal to the tool compensation number ( #33 != #34)
 // Reason: If the spare tool is changed, it is difficult to determine the current tool compensation
 IF( #1036 >= 100 ) THEN
  #39 := #33 + 100 * #33;
 ELSE
  #39 := #33;
 END_IF;
END_IF
//================================================================

IF( #1065 = 0 ) THEN
 #44 := #34 * 3;
ELSE
 #44 := #34;
END_IF;
```

```
IF( #34 = 0 ) THEN
 G49 G10 L1050 X0 Y0 Z0 D0;
ELSEIF( #1061 = 1 ) THEN
 G43 G10 L1051 P#34 D#44;
ELSE
   #40 := AXID(X);
 IF( #40 > 3 ) THEN
  #41 := (#34-1)*3 + 400 + #40 - 3;
 ELSEIF ( #40 > 0 ) THEN
  #41 := (#34-1)*3 + #40;
 ELSE
  #41 := #0;
 ENDIF;

   #40 := AXID(Y);
 IF( #40 > 3 ) THEN
  #42 := (#34-1)*3 + 400 + #40 - 3;
 ELSEIF ( #40 > 0 ) THEN
  #42 := (#34-1)*3 + #40;
 ELSE
  #42 := #0;
 ENDIF;

   #40 := AXID(Z);
 IF( #40 > 3 ) THEN
  #43 := (#34-1)*3 + 400 + #40 - 3;
 ELSEIF ( #40 > 0 ) THEN
  #43 := (#34-1)*3 + #40;
 ELSE
  #43 := #0;
 ENDIF;
 G43 G10 L1050 X#41 Y#42 Z#43 D#44;
END_IF;

IF( #38 = 1 AND #1010 = 71 ) THEN
 CASE #37 OF
  1:
 #39 := #39 / 100.;
  2:
 #39 := #39 / 1000.;
  3:
 #39 := #39 / 10000.;
 END_CASE;
ELSEIF( #38 = 1 AND #1010 = 70 ) THEN
 CASE #37 OF
  1:
 #39 := #39 / 1000.;
  2:
 #39 := #39 / 10000.;
  3:
 #39 := #39 / 100000.;
 END_CASE
ELSE
```

```
 #39 = #39;
END_IF;

CASE #1508 OF
    1:
 G90 G10 L1000 P102 R#39;
 G90 G10 L1000 P525 R#39;
    2:
 G90 G10 L1000 P535 R#39;
    3:
 G90 G10 L1000 P545 R#39;
    4:
 G90 G10 L1000 P555 R#39;
END_CASE;
T#33;
#1502 := #36;
G#30 G#31 G#32;
M99;
```

Lathe | Milling | High-Speed Spindle Milling

5.8 Contents

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V1.5.3 Version Update Descriptions

- Add the option of set page of tool life management: "display current time or current distance"
- Add the way of tool life management: "distance count"
- Add tool life column: "current distance" in meter
- Add decimal point input method
- Modify the maximum input value of current count, current column, remaining time, maximum life, changing from 100000 to 1000000000.
- Improve operation function.

5.9 Notice

- Fuction turn on method:
  - Pr3228=0: Turn off tool life management function.
  - Pr3228=1 and Pr4601=1: Turn on the "new version" of tool life management function.
  - Pr3228=1 and Pr4601=0: Turn on the "old version" of tool life management function.
- Before use the function, please pay attention to whether there is a customized tool life management installed, and whether R2100~R3100 are used to avoid conflicts.
- The status of "machining" prohibits the modification of the parameters on the tool life management page.
- The system backup(SB) will backup this software function and related settings. System recovery will also overwrite the tool information and related settings on the original page.
- Before using the version 10.118.28Q of controller, it is necessary to avoid installing the new version of the tool life management function in the form of installation package, otherwise the plugin conflict alarm will be triggerd. If this alarm is triggered or the tool life management has been installed in the form of installation package, you can enter SA remove PrdMMIRes\ToolLifeManagement first.
- Only supports single-axis group life counting function, currently unsupport two-axis group, three-axis group or four-axis group.
- Milling machine tool life management "spare tool" is only supported in the following software versions:
  - Shipping version: 10.118.42S (inclusive) and above
  - R&D version: 10.118.45 (inclusive) and above
- Support model: 21MA-E、22MA、210MA-E、210MA-E5、210MB-E、210MB-E5、220MA、220MA-5、220MB、220MB-5
- Support software version: after 10.118.28S (inclusive)
- Function entry:
  a. 10+8 key: (right row) offset/setting → F2 tool settings→ F8 tool life management.
  b. key 8: F3 offset/setting → F2 tool settings→ F8 tool life management.
  c. key 5: F3 offset/setting → F2 tool settings → F5 tool life management.

5.10 Operation Specification Descriptions

F1 -- Tool Life Management

Draft



1. Tool number: Support up to 24 tools.
2. Spare tool: Since there is no spare tool application for high-speed spindle milling, no setting is required.
    a. Set "Unmanaged", unable to set the parameters related to this tool, and the color of the whole tool data will turn in gray, and the system will ignore the life count of this tool and output directly.
    b. Set "Count Times", the current counted times will be regarded as the current life, and the current count field of the tool will have a small blue mark for users to quickly check.
    c. Set "Count Time", the current counted times will be regarded as the current life, and the current count field of the tool will have a small blue mark for users to quickly check.
3. Current time count: The time that the tool has been used so far. After the tool is called by T code, the timing will start when the following conditions are met.
4. Remaining life: When the current life of tool is greater than this value, and less than the maximum life, the prompt window of "Txx tool life is about to end" will pop up, and the machining will not be affected (won't stop).
5. Maximum life: When the tool current life is greater than this value, the machine will execute the command according to the tool life end alarm.
6. Tool status: Display the current status of tool, and its display conditions are as follows:
    a. unmanaged: choose unmanaged in tool management option
    b. usable: current life smaller than maximum life
    c. about to end: current life bigger than remaining life and current life smaller than maximum life

d. life end: current life bigger than maximum life

7. Monitor: Provides a visual diagram showing the remaining amount or used amount of the tool life, which can be switched by personal preference. The definition of the colors are as follows:
   a. remaining amount
      i. 100%~51% : green
      ii. 50% ~ 11% : yellow
      iii. 10% ~ 1% : red
      iv. 0%: red (whole bar)
   b. used amount
      i. 0% ~ 49% : green
      ii. 50% ~ 89% : yellow
      iii. 90% ~ 100% : red

F2 -- Tool Arrangement

Draft

tool number in ascending order	managed tool in ascending order
	

The default sorting method for tools is ascending (from smallest to largest).

After pressing F2 Tool Sorting, it will switch to sorting by managed tool, and the sorting method is:

1. Ascending order sorted by managed (tool management select count time or count times) tool number from the first page.
2. The unmanaged tool number also be sorted in ascending order.

When pressed again, it will switch to ascending order by tool number.

F3 -- Life Reset

Draft

Before pressing "Life Reset"	After pressing "Life Reset"
	

Reset the "current count" and "current time" values of the tool in the column where the yellow cursor is on.

F6 -- Z-Axis Switch

Draft

Z1 axis	Z2 axis	Z3 axis	Z4 axis
			

1. Loop switch the tool state of each Z-axis through Fenu (Z1=>Z2=>Z3=>Z4=>Z1)
2. Initially, 4 Z-axis settings are available, but only when Z5 and Z6 are set can be switched by Fenu.
3. Support up to 6 Z-axis for life management.

F7 -- Avaliable / Used Amount Switch

Draft

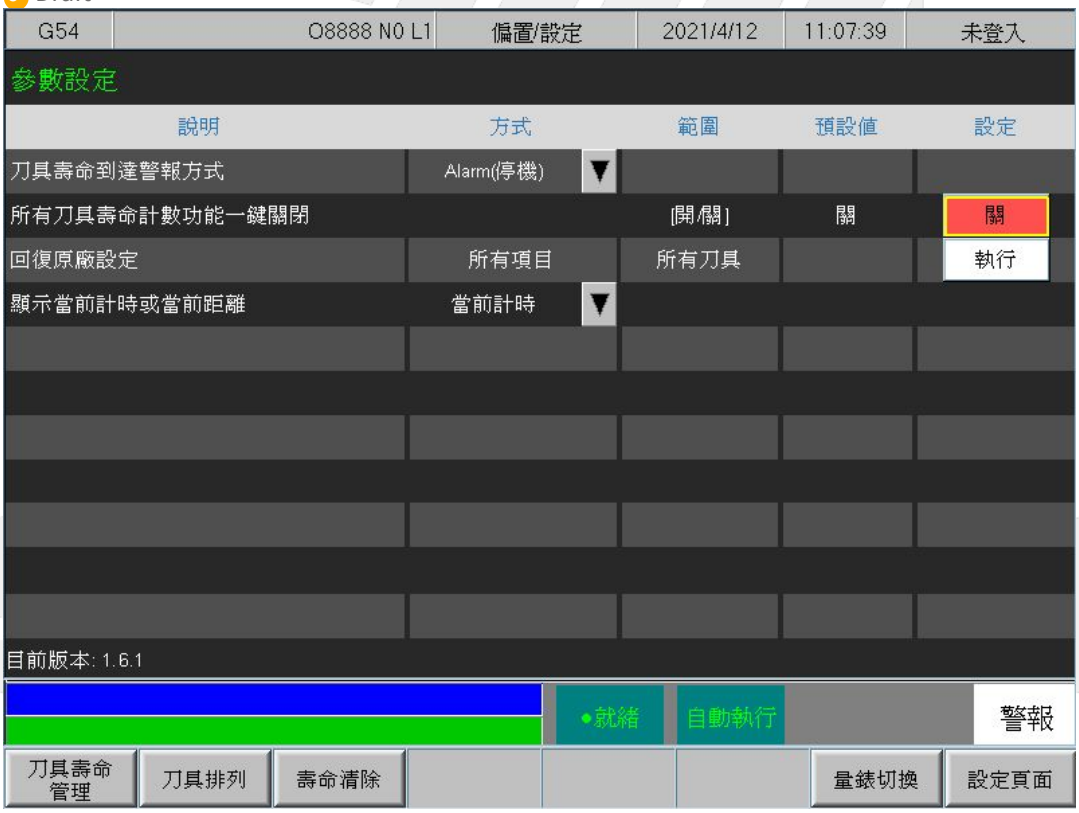
SYNTEC

Remaining amount	Used amount
	

Switch the display item of the tool life monitor between "remaining amount" and "used amount".

F8 -- Setting Page

Draft



1. Tool life ending alarm: divided into three types:

a. Alarm: The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will trigger the alarm and stop.
b. M00 pause: The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will pop up a message and pause the M00 program execution.
c. Showing without stop: When the current life of the called tool has exceeded the maximum life and there is no spare tool available, the system will only pop up a message and continue machining.

2. Turn off all tool life counting functions with one key: when pressing "On", all tools will be switched to unmanaged, and the tool management column cannot be operated. Make sure this function is off before system power off to avoid the tool management data lost.
3. Display current time or current distance
   a. Choose "current time"
      i. The tool life management screen displays the current times and current time.



      ii. "Current distance" can't be chosen as tool management method.

   b. Choose "current distance"
      i. The tool life management screen displays the current times and current distance.



      ii. "Current time" can't be chosen as tool management method.

   c. Notice
      i. Before switching to current time, please make sure that all tools didn't select distance counting. If there is, the tool will be restored to the initial settings.
      ii. Before switching to the current distance, please make sure that all tools didn't select timing. If there is, the tool will be restored to the initial settings.
      iii. It does not matter whether the current time or current distance is selected. The current times, current time and current distance of the tool will all be counted at the same time.(This setting option only affects the screen display and tool management options)
4. Reset to original setting: All the tool data will reset to default value, for the default value, please refer to the following table:

tool number	group	tool management	current times	current time	remaining life	maximum life
1~24	same as tool number	unmanaged	0	0	0	0

5.11 Application Specification

According to the type of milling machine, it can be divided into "machining center" ,"engraving machine" and "tapping machine"

Machining Center | Engraving & tapping machine

1. Modification file: M06 (example file: M0006)
2. Modification method:
   a. The last T code output by the tool life management is #33, which means that the T code argument in M06 should be changed to #33
   b. Before M06 executes the tool magazine rotation, add the following commands.

Execute tool life management in M06

```
//=====================Call Tool Management
Function=======================
#50 := PARAM(3228);
#51 := PARAM(3209);
#52 := PARAM(4601);
#33 := #20;                 //Record the T argument to #33 for
ToolManagement use
IF(#50=1 AND #52=1) THEN
CASE #51 OF
0:
M98 P"ToolManagement_common";
1:
M98 P"ToolManagement_cht";
119:
M98 P"ToolManagement_chs";
ELSE
M98 P"ToolManagement_common";
END_CASE;
END_IF
```

   c. The overall modification will become the following:
   M06 overall modification(the modified parts are in red)

```
%@MACRO
//=========================================================================
//#20  T argument
//M0019  Spindle Orientation
//M0050  Unclamp spindle tool
//#26023 Z AXIS 2nd reference point
//#1004  G90/G91 mode
//@501  MAG tools
//@502  Spindle tools
//@470  T code executing
//@101  record G90/G91 status
//@102     REMEMBER the station of coolpump on or off
//#6001    cool pump station(ON OR OFF)
WAIT();
//=========================Wait for previous T code finish
execution=======================
WHILE (@470<>1) DO
   SLEEP();
END_WHILE;
//======================M06When there is a big tool, it is forbidden to execute M06
alone=====================
IF ((#20=#0) AND (@488>0)) THEN
  ALARM(10002);
  M99;

END_IF;
//====================Call Tool Management Function=====================
#50 := PARAM(3228);
#51 := PARAM(3209);
#52 := PARAM(4601);
#33 := #20;                              //Record the T argument to #33 for ToolManagement
use
IF(#50=1 AND #52=1) THEN
 CASE #51 OF
 0:
  M98 P"ToolManagement_common";
 1:
  M98 P"ToolManagement_cht";
 119:
  M98 P"ToolManagement_chs";
 ELSE
  M98 P"ToolManagement_common";
 END_CASE;
END_IF
//============================Execute 帶刀
====================================
IF (#20<>#0)THEN
 IF ((#20 > (@489+1)) OR  (0>=#20) OR(#20=@502))THEN
   M99;
 ELSE
   T#33;
 END_IF;
```

```
END_IF;
WHILE (@470<>1) DO  //Wait T code to fininsh execution
  SLEEP();
END_WHILE;
```

3. Notice:
    a. For the general custom of machining center, tool arm changes tool will be implemented to M06, and tool magazine rotation will be implemented to PLC
    b. Continues with a, Pr3215 must be set to 0, otherwise the T argument (#20) will unable be read.
4. Spare tool function

Spare tool custom method

a. Only support the following versions:
    i. Shipping version: 10.118.42S (inclusive) and above
    ii. R&D version: 10.118.45 (inclusive) and above
b. To support the spare tool function, you need to make the following modifications:
    i. Login G43 Marco(Pr3701~Pr3710 *G code Macro call registry)(EX: Pr3701 = 8)
    ii. Import G0043 into MACRO. The function of this customization is that if the spare tool is called by tool life management, the tool length called by G43 can also be converted accordingly.

G43 customization

```
%@MACRO
IF @653 <> 0 THEN
#11:= @653;
END_IF
G43 H#11; // @653 is from M06, if the spare tool function is enabled in tool life management, the tool compensation must also be modified accordingly
M99;
```

    iii. Make the following corrections to M06 (M0006_with spare tool function)

Execute tool life management & spare tool in M06

```
//=====================Call Tool Management Function=======================
#50 := PARAM(3228);
#51 := PARAM(3209);
#52 := PARAM(4601);
#33 := #20;                                  //Record T argument to #33 for ToolManagement to use
IF(#50=1 AND #52=1) THEN
CASE #51 OF
0:
M98 P"ToolManagement_common";
```

```
1:
M98 P"ToolManagement_cht";
119:
M98 P"ToolManagement_chs";
ELSE
M98 P"ToolManagement_common";
END_CASE;
END_IF
@653:=#33;              //Record the tool number after tool
life management calculation (may include spare tools)
```

Machining Center | Engraving & tapping machine

1. Modify file T0000(Example file: T0000)
2. Modification method:
   a. The T code output by the tool life management at the end is #33, which means that the T code argument inside T0000 should be changed to #33
   b. Before T0000 executes the tool magazine rotation, add the following commands

Execute tool life management in T0000

```
//======================Call Tool Management
Function=======================
#50 := PARAM(3228);
#51 := PARAM(3209);
#52 := PARAM(4601);
#33 := #1036;                        //Record T argument to #33 for
ToolManagement to use
IF(#50=1 AND #52=1) THEN
CASE #51 OF
0:
M98 P"ToolManagement_common";
1:
M98 P"ToolManagement_cht";
119:
M98 P"ToolManagement_chs";
ELSE
M98 P"ToolManagement_common";
END_CASE;
END_IF
```

   c. The overall modification will become:

T0000 overall modification(the changed parts are marked in red)

```
%@MACRO
WAIT();
IF ( @502 = #1036 OR 0 = #1036 OR @489 < #1036 ) THEN
M99;
```

```
END_IF;
                        //Above determine if it is the same number tool, tool number 0 or
greater than the total tools, then end and return.
M05;                    //Spindle stop
M22;                    //Software protection
M09;
WAIT();
@452:=1;                //Start to change tool and flag
@103:=#1004;            //Save those currently in state G91 or G90
@104:=#1036;            //Backup target tool number
@105:=#1008;            //Backup feed unit setup G94/95
G94;
M20;                    //Spindle orientation and doesn't wait
G90 G53 G00  Z0;        //Z-axis moves the machine zero point
M19;                    //Spindle second orientation
G90 G53 G00  Z@481;     //Z-axis moves to tool change point
G90 G53 G00 Z@482;      //Z axis moves to previous row deceleration point
G91 G01 Z@483 F@487;    //Move at the set speed
G90 G00 G53 Z@484;      //Z-axis move to safe point_Pr3404
WAIT();                 //Stop look-ahead block

//====================Call Tool Management Function=====================
#50 := PARAM(3228);
#51 := PARAM(3209);
#52 := PARAM(4601);
#33 := #1036;           //Record T argument to #33 for ToolManagement to use
IF(#50=1 AND #52=1) THEN
 CASE #51 OF
  0:
   M98 P"ToolManagement_common";
  1:
   M98 P"ToolManagement_cht";
  119:
   M98 P"ToolManagement_chs";
  ELSE
   M98 P"ToolManagement_common";
 END_CASE;
END_IF
//=======================Start changing
tool===================================
T#33 ;
```

3. Spare tool function

Spare tool custom method

a. Only support the following versions:
   i. Shipping version: 10.118.42S (inclusive) and above
   ii. R&D version: 10.118.45 (inclusive) and above
b. If required spare tool function, the following modification need be done:
   i. Login G43 Marco(Pr3701~Pr3710 *G code Macro call registry)(EX: Pr3701 = 8)

ii. Import G0043 into MACRO. The function of this customization is that if the spare tool is called by tool life management, the tool length called by G43 can also be converted accordingly.

G43 customization

```
%@MACRO
IF @653 <> 0 THEN
#11:= @653;
END_IF
G43 H#11; // @653 is from M06, if the spare tool function is
enabled in tool life management, the tool compensation must
also be modified accordingly
M99;
```

c. Make the following corrections to T0000(T0000_add spare tool function)

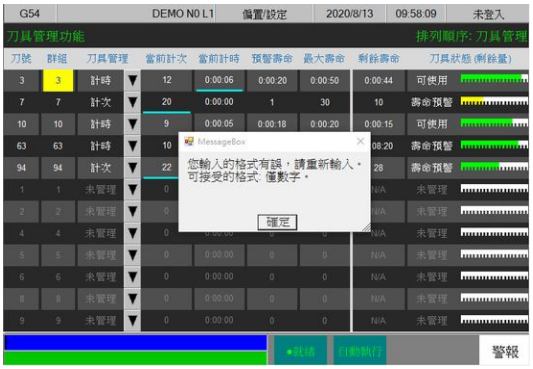
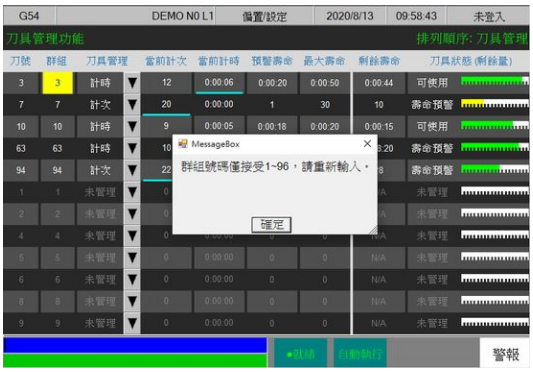
Execute tool life management & spare tool in T0000

```
//======================Call Tool Management
Function=======================
#50 := PARAM(3228);
#51 := PARAM(3209);
#52 := PARAM(4601);
#33 := #1036;                          //Record T argument to #33
for ToolManagement to use
IF(#50=1 AND #52=1) THEN
CASE #51 OF
0:
M98 P"ToolManagement_common";
1:
M98 P"ToolManagement_cht";
119:
M98 P"ToolManagement_chs";
ELSE
M98 P"ToolManagement_common";
END_CASE;
END_IF
@653:=#33;                        //Record the tool number after
tool life management calculation (may include spare tools)
```

5.12 Operation Guide

- When the user enters an value which is out of specification, the controller will prompt to inform the user, ask user to check the input value.

Detailed Descriptions

input object	reasonable range	condition of pop-up reminder	reminder content	note
group	1~96	negative numbers, non-number characters	Input format error, please enter the value again. Acceptable format: only positive number. **Figure** 	high-speed spindle milling machine unsupport the setting of tool group.
		group>96 or group<1	The group number only accept 1~96, please enter the value again. **Figure** 	high-speed spindle milling machine unsupport the setting of tool group.

input object	reasonable range	condition of pop-up reminder	reminder content	note
life input object	0~1000000000	input>1000000000	Please enter a reasonable value. times: 0~1000000000 time: 0:00:00~277777:46:40 distance: 0.000~1000000.000 **Figure** 	

input object	reasonable range	condition of pop-up reminder	reminder content	note
current count	0~1000000000	Negative numbers, non-number characters, but excluding "/" and ":"	Input format error, please enter the value again. Acceptable format: positive number, 12:34:56, 12/34/56. **Figure** 	If you enter a floating point number, it will be taken the decimal point to the third place, and the value will be automatically multiplied by 1000. For example: 10. → 10000
current time	0~1000000000	Negative numbers, non-number characters, but excluding "/" and ":"	Input format error, please enter the value again. Acceptable format: positive number, 12:34:56, 12/34/56. **Figure** 	If you enter a floating point number, it will be taken the decimal point to the third place, and the value will be automatically multiplied by 1000. For example: 10. → 10000

input object	reasonable range	condition of pop-up reminder	reminder content	note
current distance	0.000~1000000.000	Negative numbers, non-number characters.	Input format error, please enter the value again. **Figure** 	
remaining life	0~maxium life	Negative numbers, non-number characters, but excluding "/" and ":"	Input format error, please enter the value again. Acceptable format: positive number, 12:34:56, 12/34/56. **Figure** 	

input object	reasonable range	condition of pop-up reminder	reminder content	note
		remaining life>=maximum	The value exceed the maximum life, please enter the value again. **Figure** 	
Maximum life	>current life	Negative numbers, non-number characters, but excluding "/" and ":"	Input format error (or be nagetive value), please enter again. Acceptable format: positive number, 12:34:56, 12/34/56. **Figure** 	

input object	reasonable range	condition of pop-up reminder	reminder content	note
		maximum life< current life	The maximum life be entered has lower than current life or remaining life, please enter again. **Figure** 	
		maximum life< remaining life		

- Input current count, current time, current distance, remaining life, if the number include decimal point, the input result will be x1000.

5.13 Alarm Descriptions

Alarm ID	MSG-397	Alarm Title	[Tool Management Function:Txx Tool Life is about to run out]
description	The "current life" of the used tool is greater than or equal to the set value of "remaining life".		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		

Alarm ID	**MSG-397**	**Alarm Title**	**[Tool Management Function:Txx Tool Life is about to run out]**
others	1. When the tool life reaches the remaining life value during machining, the message will not be shown until next time the tool been change. 2. If the input tool remaining life is unreasonable (Ex: remaining life>maximum life), it will switch back to the last set value. 3. There will be no prompts for the same profile in the subsequent, the prompts will only be shown when next ime you press "Cycle Start".		

Alarm ID	**MSG-398**	**Alarm Title**	**[Tool Management Function: The Input Value of Tool Status is Incorrect]**
description	The tool status setting is not 0~5, (0) unmanaged, (1) unused, (2) usable, (3) about to end, (4) life end, (5) tool break.		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		
others	In old version, "tool status" can be set (0 or 5), but the new version of tool life management does not provide the function of setting the "tool status", so basically there will be no such alarm, but the alarm mechanism has been remained.		

Alarm ID	**MSG-399**	**Alarm Title**	**[Tool Management Function: Tool searching process error, please inform the developer]**
description	In the process of tool searching, an exception (not 0~5) occurs when determining the "tool status".		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		

Alarm ID	**MSG-400**	**Alarm Title**	**[Tool Management Function: Incorrect input value of argument D Incorrect]**
description	Set tool change mode(argument D), directly set to "0" in current.		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		

Alarm ID	MACRO-3xx	Alarm Title	[Txx Tool Life Has Reached to the End]
description	The tool life has ended, and the spare tool cannot be found in the tool magazine. The "xx" displayed in MACRO-3xx and Txx is the life-ended tool number.		
clear method	1. Change the tool or add a spare tool in the tool magazine and press Reset to clear this alarm, otherwise this alarm will appear again in the next tool change. 2. Check whether the customer has met the alarm interval required of tool life management.		
others	1. When the tool life reaches the pre-warning value during processing, it will not alarm, and will not alarm until the next tool change. 2. If the input value of tool remaining life is unreasonable (Ex: remaining life<maximum life), it will switch back to the last set value. 3. When the "current life" is greater than or equal to the "maximum life", the "Xth tool life ended" message prompt will be shown, and the machine will be in a "pause" state. Press Reset to clear the alarm.		

Lathe Milling High-Speed Spindle Milling

5.14 Contents

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V1.5.3 Version Update Descriptions

- Add the option of set page of tool life management: "display current time or current distance"
- Add the way of tool life management: "distance count"

- Add tool life column: "current distance" in meter
- Add decimal point input method
- Modify the maximum input value of current count, current column, remaining time, maximum life, changing from 100000 to 1000000000.
- Improve operation function.
- Add tool life management new function "Tool Life End", showing the tools which current state is "about to end" or "end".

5.15 Notice

- Function turn on method:
  - Pr3228=0: Turn off tool life management function.
  - Pr3228=1 and Pr4601=1: Turn on the "new version" of tool life management function.
  - Pr3228=1 and Pr4601=0: Turn on the "old version" of tool life management function.
- Before use the function, please pay attention to whether there is a customized tool life management installed, and whether R2100~R3100 are used to avoid conflicts.
- The status of "machining" prohibits the modification of the parameters on the tool life management page.
- The system backup(SB) will backup this software function and related settings. System recovery will also overwrite the tool information and related settings on the original page.
- Before using the version 10.118.28Q of controller, it is necessary to avoid installing the new version of the tool life management function in the form of installation package, otherwise the plugin conflict alarm will be triggerd. If this alarm is triggered or the tool life management has been installed in the form of installation package, you can enter SA remove PrdMMIRes\ToolLifeManagement first.
- Support model: 6GA-E、21GA-E
- This function provide after 118.42W
- Supports double-axis group life counting function, currently unsupport three-axis group or four-axis group.
- Function entry:
  a. 10+8 key: (right row) offset/setting → F2 tool settings→ F8 tool life management.
  b. key 8: F3 offset/setting → F2 tool settings→ F8 tool life management.
  c. key 5: F3 offset/setting → F2 tool settings → F5 tool life management

5.16 Operation Specification Descriptions

F1 -- Tool Life Management

Draft

SYNTEC



1. Tool number: Support up to 24 tools.
2. Spare tool: Since there is no spare tool application for high-speed spindle milling, no setting is required.
    a. Set "Unmanaged", unable to set the parameters related to this tool, and the color of the whole tool data will turn in gray, and the system will ignore the life count of this tool and output directly.
    b. Set "Count Times", the current counted times will be regarded as the current life, and the current count field of the tool will have a small blue mark for users to quickly check.
    c. Set "Count Time", the current counted times will be regarded as the current life, and the current count field of the tool will have a small blue mark for users to quickly check.
3. Current time count: The time that the tool has been used so far. After the tool is called by T code, the timing will start when the following conditions are met.
4. Remaining life: When the current life of tool is greater than this value, and less than the maximum life, the prompt window of "Txx tool life is about to end" will pop up, and the machining will not be affected (won't stop).
5. Maximum life: When the tool current life is greater than this value, the machine will execute the command according to the tool life end alarm.
6. Tool status: Display the current status of tool, and its display conditions are as follows:
    a. unmanaged: choose unmanaged in tool management option
    b. usable: current life smaller than maximum life
    c. about to end: current life bigger than remaining life and current life smaller than maximum life

d. life end: current life bigger than maximum life

7. Monitor: Provides a visual diagram showing the remaining amount or used amount of the tool life, which can be switched by personal preference. The definition of the colors are as follows:
   a. remaining amount
      i. 100%~51% : green
      ii. 50% ~ 11% : yellow
      iii. 10% ~ 1% : red
      iv. 0%: red (whole bar)
   b. used amount
      i. 0% ~ 49% : green
      ii. 50% ~ 89% : yellow
      iii. 90% ~ 100% : red

F2 -- Tool Arrangement

Draft

tool number in ascending order	managed tool in ascending order
	

The default sorting method for tools is ascending (from smallest to largest).

After pressing F2 Tool Sorting, it will switch to sorting by managed tool, and the sorting method is:

1. Ascending order sorted by managed (tool management select count time or count times) tool number from the first page.
2. The unmanaged tool number also be sorted in ascending order.

When pressed again, it will switch to ascending order by tool number.

F3 -- Life Reset

Draft

Before pressing "Life Reset"	After pressing "Life Reset"
	

Reset the "current count" and "current time" values of the tool in the column where the yellow cursor is on.

F6 -- Z-Axis Switch

Draft

Z1 axis	Z2 axis	Z3 axis	Z4 axis
			

1. Loop switch the tool state of each Z-axis through Fenu (Z1=>Z2=>Z3=>Z4=>Z1)
2. Initially, 4 Z-axis settings are available, but only when Z5 and Z6 are set can be switched by Fenu.
3. Support up to 6 Z-axis for life management.

F7 -- Avaliable / Used Amount Switch

Draft

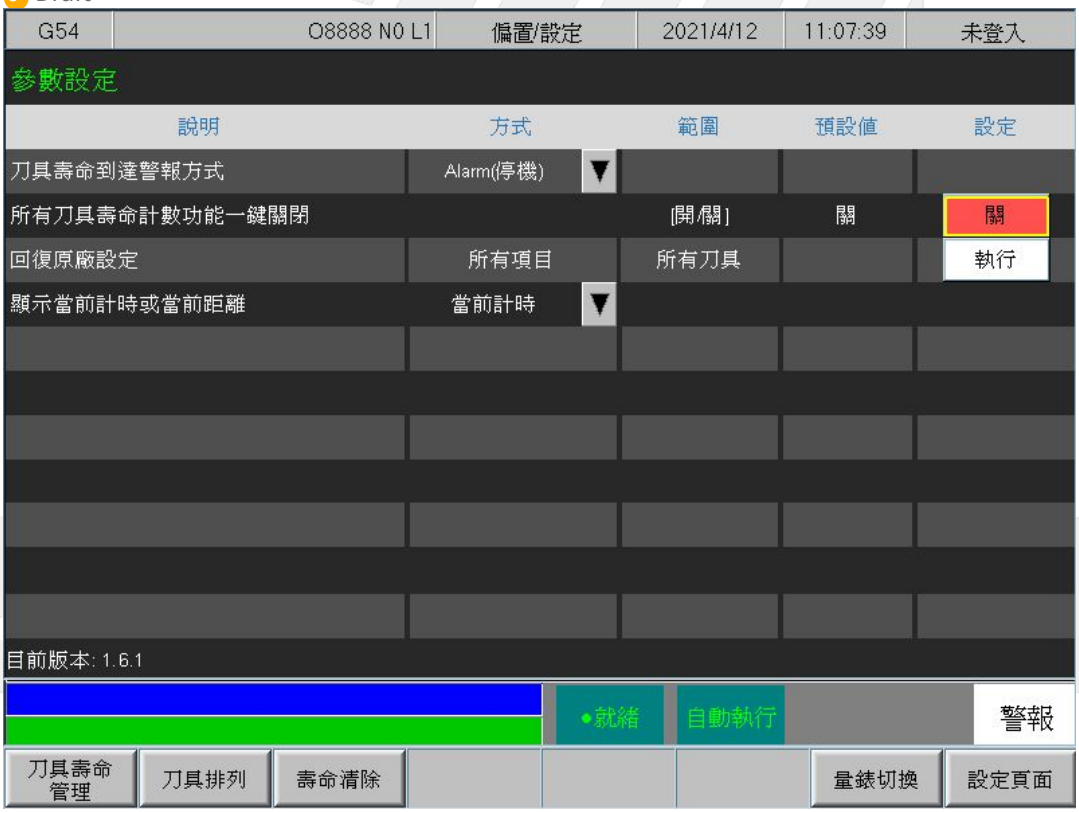
SYNTEC

Remaining amount	Used amount
	

Switch the display item of the tool life monitor between "remaining amount" and "used amount".

F8 -- Setting Page

Draft



1. Tool life ending alarm: divided into three types:

a. Alarm: The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will trigger the alarm and stop.
b. M00 pause: The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will pop up a message and pause the M00 program execution.
c. Showing without stop: When the current life of the called tool has exceeded the maximum life and there is no spare tool available, the system will only pop up a message and continue machining.

2. Turn off all tool life counting functions with one key: when pressing "On", all tools will be switched to unmanaged, and the tool management column cannot be operated. Make sure this function is off before system power off to avoid the tool management data lost.
3. Display current time or current distance
   a. Choose "current time"
      i. The tool life management screen displays the current times and current time.



      ii. "Current distance" can't be chosen as tool management method.

   b. Choose "current distance"
      i. The tool life management screen displays the current times and current distance.



      ii. "Current time" can't be chosen as tool management method.

   c. Notice
      i. Before switching to current time, please make sure that all tools didn't select distance counting. If there is, the tool will be restored to the initial settings.
      ii. Before switching to the current distance, please make sure that all tools didn't select timing. If there is, the tool will be restored to the initial settings.
      iii. It does not matter whether the current time or current distance is selected. The current times, current time and current distance of the tool will all be counted at the same time.(This setting option only affects the screen display and tool management options)
4. Reset to original setting: All the tool data will reset to default value, for the default value, please refer to the following table:

tool number	group	tool management	current times	current time	remaining life	maximum life
1~24	same as tool number	unmanaged	0	0	0	0

5.17 Application Specification

1. The customer has had a customized T code MACRO: It needs to be modified, and the modification content is as follows:
   a. The tool life is calculated based on the tool number filled in R525, so for T code Macro, R525 is required and R102 cannot be used. (Note: The value of R525 must be filled in with G10L1000, and make sure the value be filled in the G90 state)
   b. For customized text settings, the modification of Marco is required. (available after controller version 118.42W, 118.48H): Only the code in line 5 is added to provide the operator to set the starting value of R value for Z-axis machining state, e.g. #53 = 7001, the R value of Z1 axis machining state is R7001; the R value of Z2 axis machining state is R7002 and so on.
   c. Add the following sample code to the appropriate places of the customized T code MACRO. The program variables used cannot conflict with those used by the original customer and need to be modified according to the situation.

Modification 1

```
//=====================Call Tool Management
Function=======================
#50 := PARAM(3228);
#51 := PARAM(3209);
#52 := PARAM(4601);
@102101 := 525;
IF(#50=1 AND #52=1) THEN
CASE #51 OF
0:
M98 P"ToolManagement_Glass_common";
1:
M98 P"ToolManagement_Glass_cht";
119:
M98 P"ToolManagement_Glass_chs";
ELSE
M98 P"ToolManagement_Glass_common";
END_CASE;
END_IF
```

5.18 Operation Guide

- When the user enters an value which is out of specification, the controller will prompt to inform the user, ask user to check the entered value.
  Detailed Descriptions

input object	reasonable range	condition of pop-up reminder	reminder content	note
group	1~96	negative numbers, non-number characters	Input format error, please enter the value again. Acceptable format: only positive number. **Figure** 	high-speed spindle milling machine unsupport the setting of tool group.

SYNTEC

input object	reasonable range	condition of pop-up reminder	reminder content	note
		group>96 or group<1	The group number only accept 1~96, please enter the value again. **Figure** 	high-speed spindle milling machine unsupport the setting of tool group.
life input object	0~1000000000	input>1000000000	Please enter a reasonable value. times: 0~1000000000 time: 0:00:00~277777:46:40 distance: 0.000~1000000.000 **Figure** 	

input object	reasonable range	condition of pop-up reminder	reminder content	note
current count	0~1000000000	Negative numbers, non-number characters, but excluding "/" and ":"	Input format error, please enter the value again. Acceptable format: positive number, 12:34:56, 12/34/56. **Figure** 	If you enter a floating point number, it will be taken the decimal point to the third place, and the value will be automatically multiplied by 1000. For example: 10. → 10000
current time	0~1000000000	Negative numbers, non-number characters, but excluding "/" and ":"	Input format error, please enter the value again. Acceptable format: positive number, 12:34:56, 12/34/56. **Figure** 	If you enter a floating point number, it will be taken the decimal point to the third place, and the value will be automatically multiplied by 1000. For example: 10. → 10000

input object	reasonable range	condition of pop-up reminder	reminder content	note
current distance	0.000~1000000.000	Negative numbers, non-number characters.	Input format error, please enter the value again. **Figure** 	
remaining life	0~maxium life	Negative numbers, non-number characters, but excluding "/" and ":"	Input format error, please enter the value again. Acceptable format: positive number, 12:34:56, 12/34/56. **Figure** 	

input object	reasonable range	condition of pop-up reminder	reminder content	note
		remaining life>=maximum	The value exceed the maximum life, please enter the value again. **Figure** 	
maximum life	>current life	Negative numbers, non-number characters, but excluding "/" and ":"	Input format error (or be nagetive value), please enter again. Acceptable format: positive number, 12:34:56, 12/34/56. **Figure** 	

input object	reasonable range	condition of pop-up reminder	reminder content	note
		maximum life< current life	The maximum life be entered has lower than current life or remaining life, please enter again. **Figure** 	
		maximum life< remaining life		

- Input current count, current time, current distance, remaining life, if the number include decimal point, the input result will be x1000.

5.19 Alarm Descriptions

Alarm ID	MSG-397	Alarm Title	[Tool Management Function: Txx Tool Life is about to run out]
description	The "current life" of the used tool is greater than or equal to the set value of "remaining life".		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		

Alarm ID	**MSG-397**	**Alarm Title**	**[Tool Management Function: Txx Tool Life is about to run out]**
others	1. When the tool life reaches the remaining life value during machining, the message will not be shown until next time the tool been change. 2. If the input tool remaining life is unreasonable (Ex: remaining life>maximum life), it will switch back to the last set value. 3. There will be no prompts for the same profile in the subsequent, the prompts will only be shown when next time you press "Cycle Start".		

Alarm ID	**MSG-398**	**Alarm Title**	**[Tool Management Function: The Input Value of Tool Status is Incorrect]**
description	The tool status setting is not 0~5, (0) unmanaged, (1) unused, (2) usable, (3) about to end, (4) life end, (5) tool break.		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		
others	In old version, "tool status" can be set (0 or 5), but the new version of tool life management does not provide the function of setting the "tool status", so basically there will be no such alarm, but the alarm mechanism has been remained.		

Alarm ID	**MSG-399**	**Alarm Title**	**[Tool Management Function: Tool searching process error, please inform the developer]**
description	In the process of tool searching, an exception (not 0~5) occurs when determining the "tool status".		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		

Alarm ID	**MSG-400**	**Alarm Title**	**[Tool Management Function: Incorrect input value of argument D Incorrect]**
description	Set tool change mode(argument D), directly set to "0" in current.		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		

Alarm ID	MACRO-5xx	Alarm Title	[Txx Tool Life Has Reached to the End]
description	The tool life has ended. MACRO-501~524 corresponds to Z1-T1~T24 life end; MACRO-525~548 corresponds to Z2-T1~T24 life end; and so on.		
clear method	1. Change the tool or add a spare tool in the tool magazine and press Reset to clear this alarm, otherwise this alarm will appear again in the next tool change. 2. Check whether the customer has met the alarm interval required of tool life management.		
others	1. When the tool life reaches the pre-warning value during processing, it will not alarm, and will not alarm until the next tool change. 2. If the input value of tool remaining life is unreasonable (Ex: remaining life<maximum life), it will switch back to the last set value. 3. When the "current life" is greater than or equal to the "maximum life", the "Xth tool life ended" message prompt will be shown, and the machine will be in a "pause" state. Press Reset to clear the alarm.		

5.20 High-Speed Spindle Milling Tool Life Management

5.20.1 Contents

- Contents
- Notice
- Operation Specification Descriptions
- Application Specification
- Operation Guide
- Alarm Descriptions

V1.5.3 Version Update Descriptions

- Add the option of set page of tool life management: "display current time or current distance"
- Add the way of tool life management: "distance count"
- Add tool life column: "current distance" in meter
- Add decimal point input method
- Modify the maximum input value of current count, current column, remaining time, maximum life, changing from 100000 to 1000000000.
- Improve operation function.
- Add tool life management new function "Tool Life End", showing the tools which current state is "about to end" or "end".

5.20.2 Notice

- Function turn on method：
  - Pr3228=0： Turn off tool life management function.
  - Pr3228=1 and Pr4601=1： Turn on the "new version" of tool life management function.
  - Pr3228=1 and Pr4601=0： Turn on the "old version" of tool life management function.
- Before use the function, please pay attention to whether there is a customized tool life management installed, and whether R2100~R3100 are used to avoid conflicts.
- The status of "machining" prohibits the modification of the parameters on the tool life management page.
- The system backup(SB) will backup this software function and related settings. System recovery will also overwrite the tool information and related settings on the original page.
- Before using the version 10.118.28Q of controller, it is necessary to avoid installing the new version of the tool life management function in the form of installation package, otherwise the plugin conflict alarm will be triggerd. If this alarm is triggered or the tool life management has been installed in the form of installation package, you can enter SA remove PrdMMIRes\ToolLifeManagement first.
- Support model: 6GA-E、21GA-E
- This function provide after 118.42W
- Supports double-axis group life counting function, currently unsupport three-axis group or four-axis group.
- Function entry：
  a. 10+8 key: (right row) offset/setting → F2 tool settings→ F8 tool life management.
  b. key 8: F3 offset/setting → F2 tool settings→ F8 tool life management.
  c. key 5: F3 offset/setting → F2 tool settings → F5 tool life management

5.20.3 Operation Specification Descriptions

F1 -- Tool Life Management

Draft

SYNTEC



1. Tool number: Support up to 24 tools.
2. Spare tool: Since there is no spare tool application for high-speed spindle milling, no setting is required.
    a. Set "Unmanaged", unable to set the parameters related to this tool, and the color of the whole tool data will turn in gray, and the system will ignore the life count of this tool and output directly.
    b. Set "Count Times", the current counted times will be regarded as the current life, and the current count field of the tool will have a small blue mark for users to quickly check.
    c. Set "Count Time", the current counted times will be regarded as the current life, and the current count field of the tool will have a small blue mark for users to quickly check.
3. Current time count: The time that the tool has been used so far. After the tool is called by T code, the timing will start when the following conditions are met.
4. Remaining life: When the current life of tool is greater than this value, and less than the maximum life, the prompt window of "Txx tool life is about to end" will pop up, and the machining will not be affected (won't stop).
5. Maximum life: When the tool current life is greater than this value, the machine will execute the command according to the tool life end alarm.
6. Tool status: Display the current status of tool, and its display conditions are as follows:
    a. unmanaged: choose unmanaged in tool management option
    b. usable: current life smaller than maximum life
    c. about to end: current life bigger than remaining life and current life smaller than maximum life
    d. life end: current life bigger than maximum life
7. Monitor: Provides a visual diagram showing the remaining amount or used amount of the tool life, which can be switched by personal preference. The definition of the colors are as follows:
    a. remaining amount

i. 100%~51% : green
ii. 50% ~ 11% : yellow
iii. 10% ~ 1% : red
iv. 0%: red (whole bar)

b. used amount
i. 0% ~ 49% : green
ii. 50% ~ 89% : yellow
iii. 90% ~ 100% : red

F2 -- Tool Arrangement

Draft

tool number in ascending order	managed tool in ascending order
	

The default sorting method for tools is ascending (from smallest to largest).

After pressing F2 Tool Sorting, it will switch to sorting by managed tool, and the sorting method is:

1. Ascending order sorted by managed (tool management select count time or count times) tool number from the first page.
2. The unmanaged tool number also be sorted in ascending order.

When pressed again, it will switch to ascending order by tool number.

F3 -- Life Reset

Draft

Before pressing "Life Reset"	After pressing "Life Reset"
	

Reset the "current count" and "current time" values of the tool in the column where the yellow cursor is on.

F6 -- Z-Axis Switch

Draft

Z1 axis	Z2 axis	Z3 axis	Z4 axis
			

1. Loop switch the tool state of each Z-axis through Fenu (Z1=>Z2=>Z3=>Z4=>Z1)
2. Initially, 4 Z-axis settings are available, but only when Z5 and Z6 are set can be switched by Fenu.
3. Support up to 6 Z-axis for life management.

F7 -- Avaliable / Used Amount Switch

Draft

Remaining amount	Used amount
	

Switch the display item of the tool life monitor between "remaining amount" and "used amount".

F8 -- Setting Page

Draft



1. Tool life ending alarm: divided into three types:

a. Alarm: The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will trigger the alarm and stop.
b. M00 pause: The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will pop up a message and pause the M00 program execution.
c. Showing without stop: When the current life of the called tool has exceeded the maximum life and there is no spare tool available, the system will only pop up a message and continue machining.

2. Turn off all tool life counting functions with one key: when pressing "On", all tools will be switched to unmanaged, and the tool management column cannot be operated. Make sure this function is off before system power off to avoid the tool management data lost.
3. Display current time or current distance
   a. Choose "current time"
      i. The tool life management screen displays the current times and current time.



      ii. "Current distance" can't be chosen as tool management method.

   b. Choose "current distance"
      i. The tool life management screen displays the current times and current distance.



      ii. "Current time" can't be chosen as tool management method.

   c. Notice
      i. Before switching to current time, please make sure that all tools didn't select distance counting. If there is, the tool will be restored to the initial settings.
      ii. Before switching to the current distance, please make sure that all tools didn't select timing. If there is, the tool will be restored to the initial settings.
      iii. It does not matter whether the current time or current distance is selected. The current times, current time and current distance of the tool will all be counted at the same time. (This setting option only affects the screen display and tool management options)
4. Reset to original setting: All the tool data will reset to default value, for the default value, please refer to the following table:

tool number	group	tool management	current times	current time	remaining life	maximum life
1~24	same as tool number	unmanaged	0	0	0	0

5.20.4 Application Specification

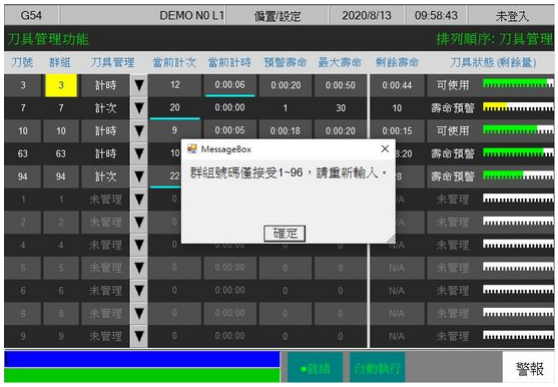
1. The customer has had a customized T code MACRO: It needs to be modified, and the modification content is as follows:
   a. The tool life is calculated based on the tool number filled in R525, so for T code Macro, R525 is required and R102 cannot be used. (Note: The value of R525 must be filled in with G10L1000, and make sure the value be filled in the G90 state)
   b. For customized text settings, the modification of Marco is required. (available after controller version 118.42W, 118.48H): Only the code in line 5 is added to provide the operator to set the starting value of R value for Z-axis machining state, e.g. #53 = 7001, the R value of Z1 axis machining state is R7001; the R value of Z2 axis machining state is R7002 and so on.
   c. Add the following sample code to the appropriate places of the customized T code MACRO. The program variables used cannot conflict with those used by the original customer and need to be modified according to the situation.

Modification 1

```
//=====================Call Tool Management Function=======================
#50 := PARAM(3228);
#51 := PARAM(3209);
#52 := PARAM(4601);
@102101 := 525;
IF(#50=1 AND #52=1) THEN
CASE #51 OF
0:
M98 P"ToolManagement_Glass_common";
1:
M98 P"ToolManagement_Glass_cht";
119:
M98 P"ToolManagement_Glass_chs";
ELSE
M98 P"ToolManagement_Glass_common";
END_CASE;
END_IF
```

5.20.5 Operation Guide

- When the user enters an value which is out of specification, the controller will prompt to inform the user, ask user to check the entered value.
  Detailed Descriptions

input object	reasonable range	condition of pop-up reminder	reminder content	note
group	1~96	negative numbers, non-number characters	Input format error, please enter the value again. Acceptable format: only positive number. **Figure** 	high-speed spindle milling machine unsupport the setting of tool group.
		group>96 or group<1	The group number only accept 1~96, please enter the value again. **Figure** 	high-speed spindle milling machine unsupport the setting of tool group.

input object	reasonable range	condition of pop-up reminder	reminder content	note
life input object	0~1000000000	input>1000000000	Please enter a reasonable value. times: 0~1000000000 time: 0:00:00~277777:46:40 distance: 0.000~1000000.000 **Figure** 	

input object	reasonable range	condition of pop-up reminder	reminder content	note
current count	0~1000000000	Negative numbers, non-number characters, but excluding "/" and ":"	Input format error, please enter the value again. Acceptable format: positive number, 12:34:56, 12/34/56. **Figure** 	If you enter a floating point number, it will be taken the decimal point to the third place, and the value will be automatically multiplied by 1000. For example: 10. → 10000
current time	0~1000000000	Negative numbers, non-number characters, but excluding "/" and ":"	Input format error, please enter the value again. Acceptable format: positive number, 12:34:56, 12/34/56. **Figure** 	If you enter a floating point number, it will be taken the decimal point to the third place, and the value will be automatically multiplied by 1000. For example: 10. → 10000

input object	reasonable range	condition of pop-up reminder	reminder content	note
current distance	0.000~1000000.000	Negative numbers, non-number characters.	Input format error, please enter the value again. **Figure** 	
remaining life	0~maxium life	Negative numbers, non-number characters, but excluding "/" and ":"	Input format error, please enter the value again. Acceptable format: positive number, 12:34:56, 12/34/56. **Figure** 	

input object	reasonable range	condition of pop-up reminder	reminder content	note
		remaining life>=maximum	The value exceed the maximum life, please enter the value again. **Figure** 	
maximum life	>current life	Negative numbers, non-number characters, but excluding "/" and ":"	Input format error (or be nagetive value), please enter again. Acceptable format: positive number, 12:34:56, 12/34/56. **Figure** 	

input object	reasonable range	condition of pop-up reminder	reminder content	note
		maximum life< current life	The maximum life be entered has lower than current life or remaining life, please enter again. **Figure** 	
		maximum life<remaining life		

- Input current count, current time, current distance, remaining life, if the number include decimal point, the input result will be x1000.

5.20.6 Alarm Descriptions

Alarm ID	MSG-397	Alarm Title	[Tool Management Function: Txx Tool Life is about to run out]
description	The "current life" of the used tool is greater than or equal to the set value of "remaining life".		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		
others	1. When the tool life reaches the remaining life value during machining, the message will not be shown until next time the tool been change. 2. If the input tool remaining life is unreasonable (Ex: remaining life>maximum life), it will switch back to the last set value. 3. There will be no prompts for the same profile in the subsequent, the prompts will only be shown when next time you press "Cycle Start".		

Alarm ID	MSG-398	Alarm Title	[Tool Management Function: The Input Value of Tool Status is Incorrect]
description	The tool status setting is not 0~5, (0) unmanaged, (1) unused, (2) usable, (3) about to end, (4) life end, (5) tool break.		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		
others	In old version, "tool status" can be set (0 or 5), but the new version of tool life management does not provide the function of setting the "tool status", so basically there will be no such alarm, but the alarm mechanism has been remained.		

Alarm ID	MSG-399	Alarm Title	[Tool Management Function: Tool searching process error, please inform the developer]
description	In the process of tool searching, an exception (not 0~5) occurs when determining the "tool status".		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		

Alarm ID	MSG-400	Alarm Title	[Tool Management Function: Incorrect input value of argument D Incorrect]
description	Set tool change mode(argument D), directly set to "0" in current.		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		

Alarm ID	MACRO-5xx	Alarm Title	[Txx Tool Life Has Reached to the End]
description	The tool life has ended. MACRO-501~524 corresponds to Z1-T1~T24 life end; MACRO-525~548 corresponds to Z2-T1~T24 life end; and so on.		
clear method	1. Change the tool or add a spare tool in the tool magazine and press Reset to clear this alarm, otherwise this alarm will appear again in the next tool change. 2. Check whether the customer has met the alarm interval required of tool life management.		

Alarm ID	MACRO-5xx	Alarm Title	[Txx Tool Life Has Reached to the End]
others	1. When the tool life reaches the pre-warning value during processing, it will not alarm, and will not alarm until the next tool change. 2. If the input value of tool remaining life is unreasonable (Ex: remaining life<maximum life), it will switch back to the last set value. 3. When the "current life" is greater than or equal to the "maximum life", the "Xth tool life ended" message prompt will be shown, and the machine will be in a "pause" state. Press Reset to clear the alarm.		

5.21 Lathe Tool Life Management

5.21.1 Contents

- Contents
- Notice
- Operation Specification Descriptions
- Operation Guide
- Alarm Descriptions
- T-code Customization

Version Update Descriptions

Controller version : 10.118.46B, 10.118.48M, 10.118.52G and subsquent testing-version, developing-version.

- Add the page "End of tool life".
- Add a pop-up alert mechanism at the end of tool life management.
- Add the function of lettering count for high-speed spindle milling model.
- Fix the boot error when the number of z axis is less than 4 for high-speed spindle milling model.
- Fix the tool ID display error after resetting to default settings for high-speed spindle milling model.

Controller version : 10.118.56N, 10.118.60H, 10.118.66B, 10.118.67 and subsquent testing-version, developing-version.

- Add "Group function switch", enabling the turn-off of tool group function.
- Add "When group funtion switch is off, tool compensation can be defined customizedly".

Controller version : 10.118.56N, 10.118.60H, 10.118.66B, 10.118.68 and subsquent testing-version, developing-version.

- The tool compensation function is supported in lathe system.
- Add "When group function switch is off, the column of tool group will be hidden".

5.21.2 Notice

- Fuction turn on method:
  a. Set Pr3228 to 1.
  b. Set Pr4601 to 1.

c. Reboot the controller.

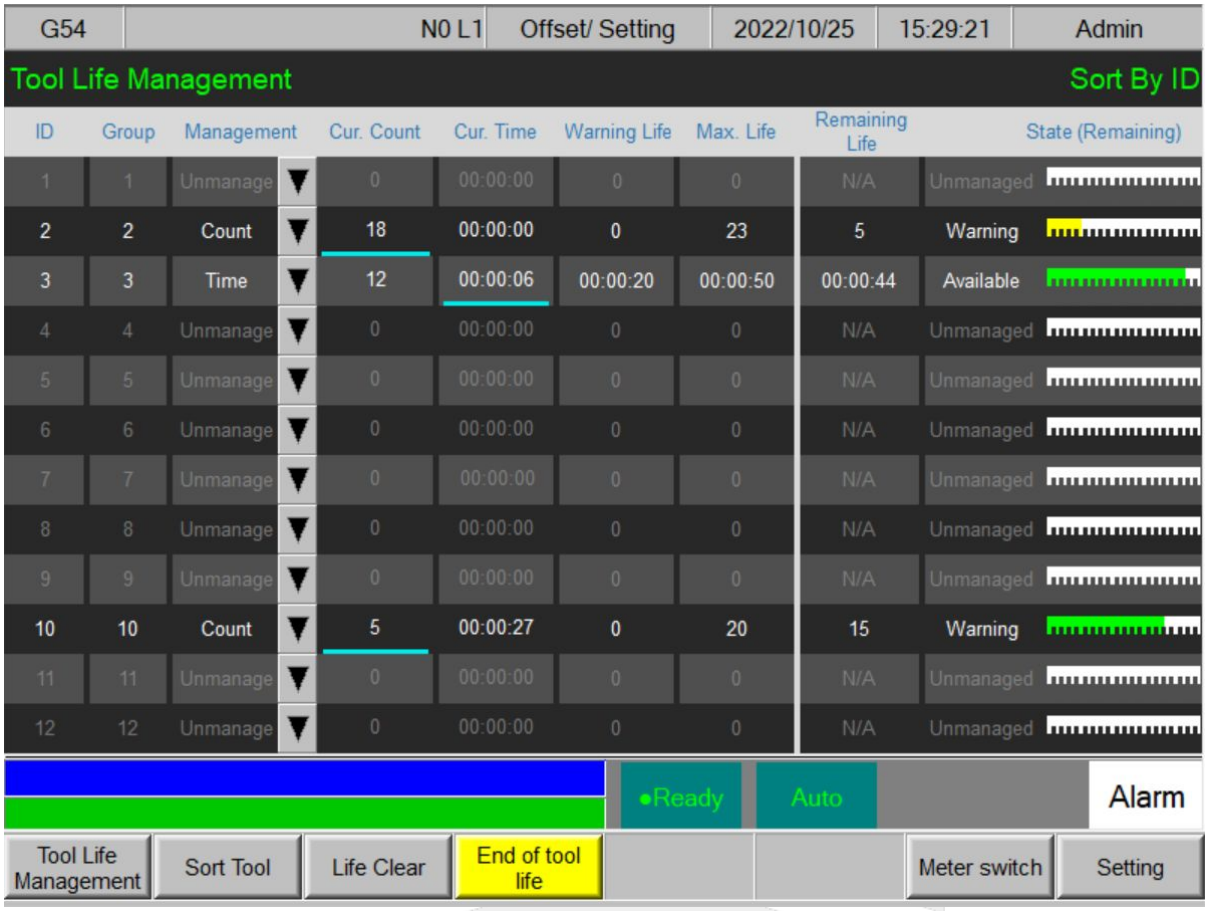
- Please ensure R2100~R3100 are not customized, otherwise, tool life management can't work normally.
- The system backup(SB) will backup this software function and related settings. System recovery will also overwrite the tool information and related settings on the original page.
- After the version 10.118.52E, 10.118.56, tool life end alarm is supported to pop up at the end of maching, therefore, M30 or M99 must be added at the end of maching program.
- Support software version : after 10.118.28Q (inclusive).
- Support life counting function of single-axis group and double-axis group, but currently unsupport three-axis group or four-axis group.
- After turning on this function (Pr3228=1 & Pr4601=1), determine whether tool group function should be turnned on at setting page.
  - Group function switch is defaulted to "on" : When calling a tool, the tool compensation number will be forced to be the same as the tool number. The purpose is when the tool life ends, it can call the spare tool by following the logic of two digits of T codes.
  - Group function switch is "off" : When calling a tool, the tool compensation number can be defined customizedly. When the tool life ends, it will not call the spare tool.
  - If there are other requirements (such as turret machine), you can customize the T-code (T0000) by yourself. For details, please refer to the description of the "T-code Customization" chapter.
- R2101 needs to be zero, basically only other models may have non-zero conditions.
- Function entry:
  a. 10+8 key: (right row) offset/setting → F7 tool life management.
  b. key 8: F3 offset/setting → F7 tool life management.
  c. key 5: F3 offset/setting → F10 → F2 tool life management.

5.21.3 Operation Specification Descriptions

F1 - Tool Life Management

Draft

SYNTEC



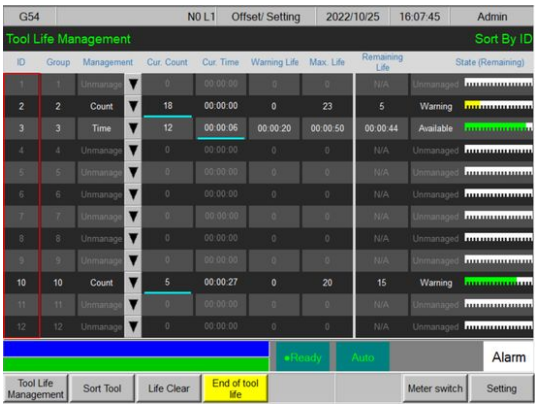
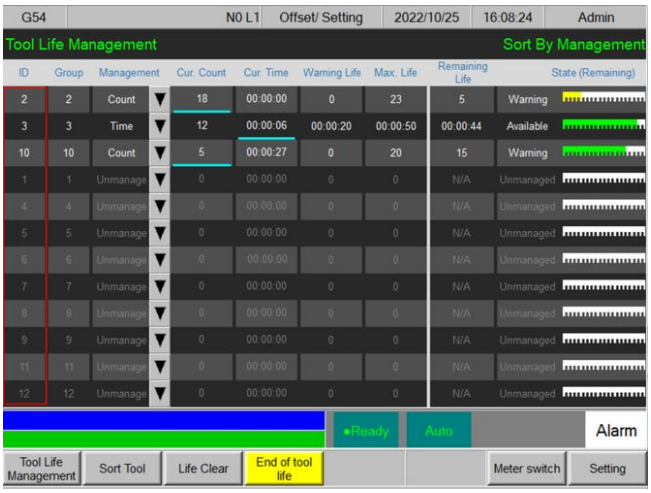
1. **ID**: Supports up to 96 tools.
2. **Group** (spare tool): When the T code is executed, if the life of the original tool has been ended, it will automatically search for the spare tool in the tool magazine. If there is one, it will be automatically replaced with an usable spare tool. Otherwise, the "Xth tool life has ended" alarm will be displayed.
   Note: Before using this function, the spare tool must be set and input into the corresponding tool compensation table.
   Example
   Ex: Originally call T01, but after the life of T01 end, the spare tool T03 will be automatically searched, and the tool compensation number is also 03, which is equivalent to calling T0303. Therefore, the correspond tool of T03 must be added to the column 03 in the tool table.
3. **Management**: Can be set to "unmanaged", "times count" and "time count" three statuses.
   a. Set to "Unmanaged", the related parameters of this tool can't be set, and the font color of the entire tool list will turn to gray. The system will ignore the life judgment of this tool and output directly.
   b. Set "times count", the current counting times will be regarded as the current life, the current times counting field of the tool will have a small blue mark for the user to quickly distinguish.
   c. Set "time count", the current counting time will be regarded as the current life, the current time counting field of the tool will have a small blue mark for the user to quickly distinguish.
   d. Set "distance count", the current counting distance will be regarded as the current life, the current distance counting field of the tool will have a small blue mark for the user to quickly distinguish.

4. **Cur. Count**: The times that the tool has been used so far. Every time T code is executed, the current times count of the tool called by the T code will be +1 (if its status is unmanaged, the times count won't change).
5. **Cur. Time**: The time that the tool has been used so far. After the tool is called by T code, the timing will start when the following conditions are met.
   Timing Conditions
   - Tool management is times count or time count.
   - G code status is G01, G02 or G03.
   - C36, C37, S32 are all Off.
   - The actual value of the feedrate command of the axis group>0.
6. **Cur. Distance**: The distance that the tool has machined so far. Display in meter to the third decimal place. The machining distance calculation method is briefly described as follows.
   Notice
   a. The time for maching a single line segment is recommended to be greater than 2.5 seconds, otherwise calculation errors are likely to occur.
   b. Currently only single-axis group is supported.
7. **Warning Life**: When the current life of tool is greater than this value, and less than the maximum life, the prompt window of "Txx tool life is about to end" will pop up, and the machining will not be affected (won't stop).
8. **Max. Life**: When the tool current life is greater than this value, the machine will execute the command according to the tool life end alarm.
9. **State**: Display the current status of tool, and its display conditions are as follows:
   a. unmanaged : choose unmanaged in tool management option.
   b. available : cuurent life smaller than maximum life.
   c. warning : cuurent life greater than warning life and cuurent life smaller than maximum life.
   d. broken : cuurent life greater than maximum life.
10. **Meter Switch** : Provides a visual diagram showing the remaining amount or used amount of the tool life, which can be switched by personal preference. The definition of the colors are as follows:
    a. remaining amount
       i. 100%~51% : green
       ii. 50% ~ 11% : yellow
       iii. 10% ~ 1% : red
       iv. 0%: red (whole bar)
    b. usage amount
       i. 0% ~ 49% : green
       ii. 50% ~ 89% : yellow
       iii. 90% ~ 100% : red

F2 - Sort Tool

Draft

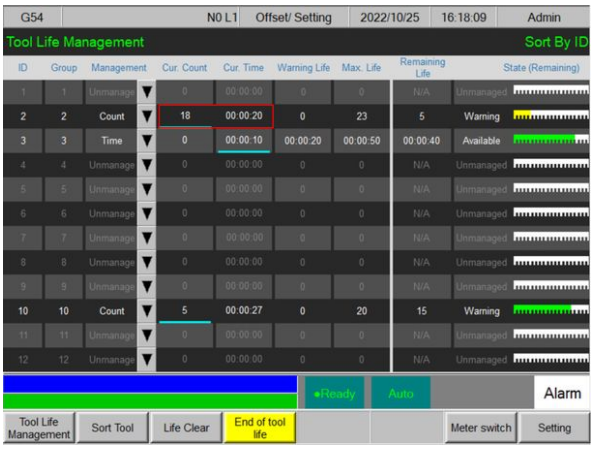
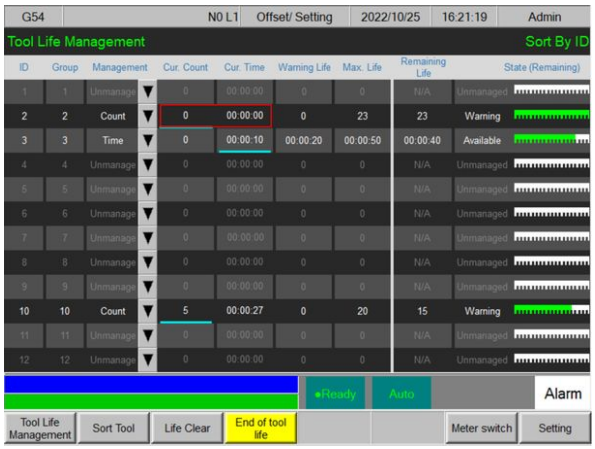
SYNTEC

Sort By ID	Sort By Management
	

1. After pressing F2 Sort Tool, it will switch to "sort by management", and the sorting method is:
    a. Sort By Management (choose time count or times count in the tool management page), the tool numbers are sorted from small to large, starting from the first page.
    b. Sort By ID, the tool numbers are successively sorted from small to large.
2. Press F2 again to switch to "sort by ID".
3. When the "All Tool Management Function Switch" is activated, the sort tool function is unavailable.

F3 - Life Reset

Draft

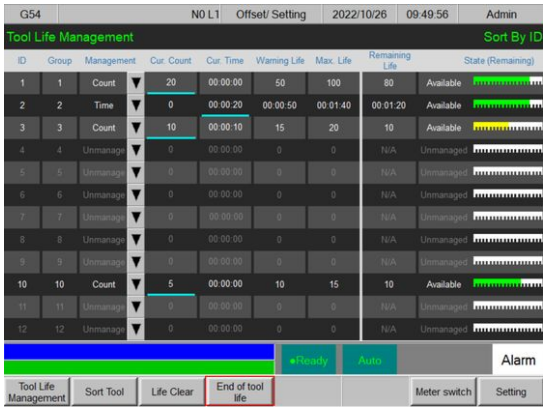
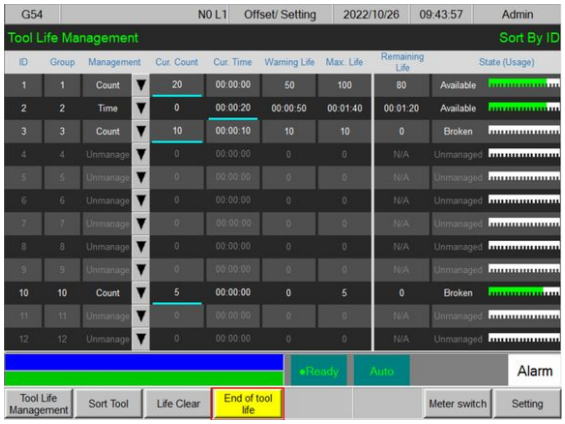
Before Pressing "Life Reset"	After Pressing "Life Reset"
	

Reset the "current count", "current time" and "current distance" values of the tool in the row where the yellow cursor is on.

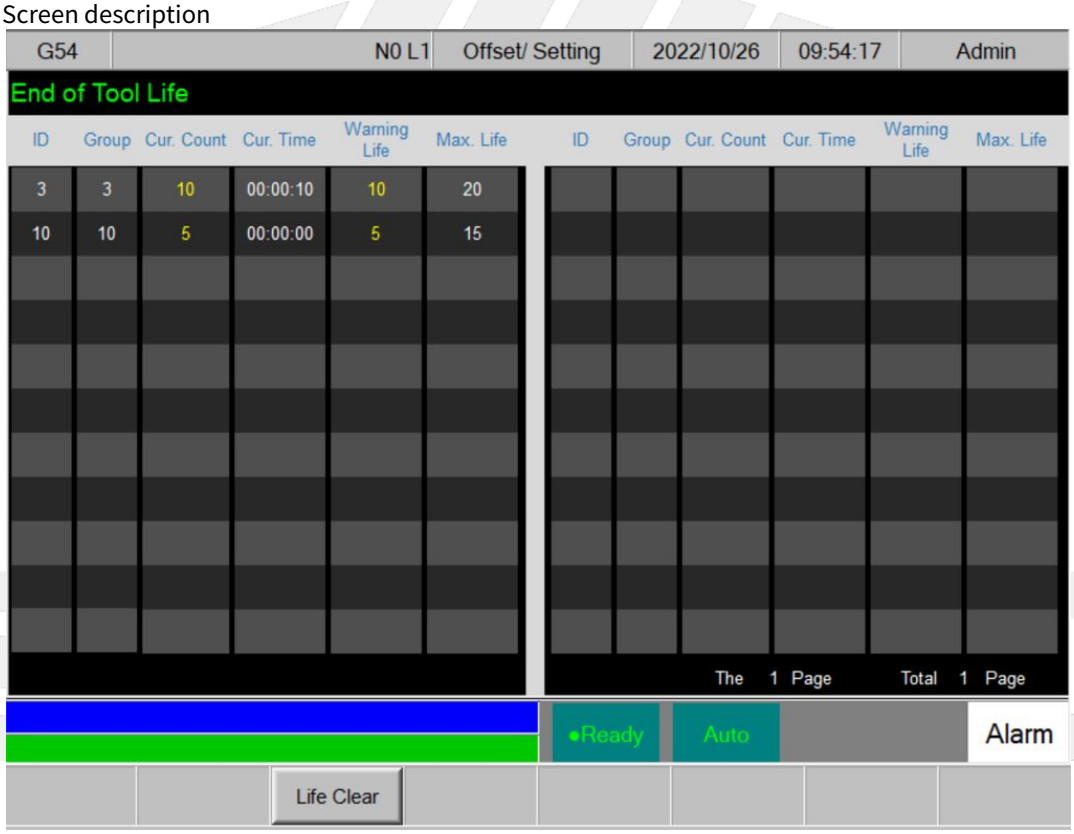
F4 - End of Tool Life

Draft

1. Function description: All the tools with warning life and ended life will be displayed on this page.
2. If there is a tool with warning life or ended life, this fenu display will turn yellow.

No tool with warning life or ended life	Any tool with warning life or ended life
	

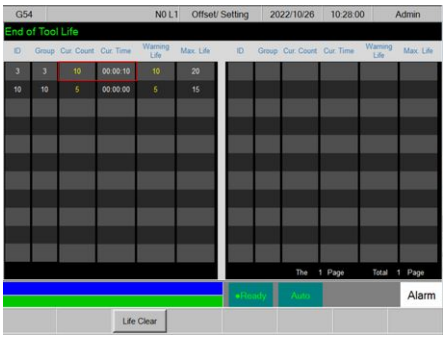
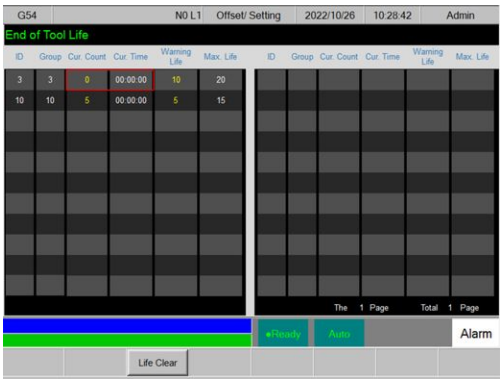
3. Screen description



a. **ID** : Display tool number with warning life or ended life.
b. **Group** (high-speed spindle milling: z axis) :
    i. Display the group which current tool number belongs to.
    ii. Edit is not available.

c. **Cur. Count** :
   i. Contents and usages are similar to current count in F1 - Tool Life Management.
   ii. If the tool status is "warning life", the font color will be yellow; if the tool status is "ended life", the font color will be red.
d. **Cur. TIme/Cur. Distance** :
   i. Contents and usages are similar to current time/curent distance in F1 - Tool Life Management.
   ii. If the tool status is "warning life", the font color will be yellow; if the tool status is "ended life", the font color will be red.
e. **Warning Life** :
   i. Contents and usages are similar to warning life in F1 - Tool Life Management.
   ii. If the tool status is "warning life", the font color will be yellow.
f. **Max. Life** :
   i. Contents and usages are similar to max life in F1 - Tool Life Management.
   ii. If the tool status is "ended life", the font color will be red.
g. **Current Number of Page** :
   i. The lower right corner displays the current number of page.
h. **Total Number of Pages** :
   i. The lower reght corner displays the number of total pages.

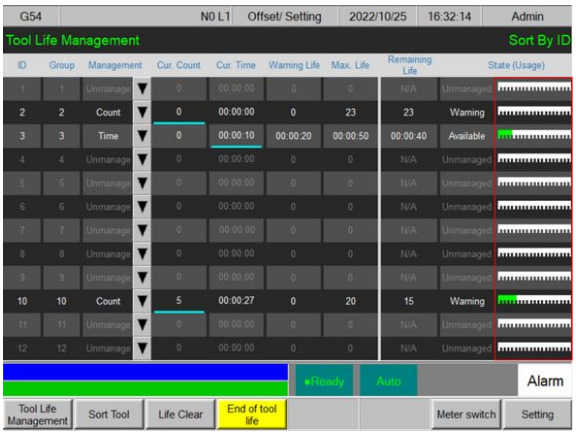
4. Fenu button description
   - **F3 - Life Clear**
     - Reset the current time, current count and current distance of the tool where the cursor is located to zero.

Before life clear	After life clear
	

   - **Keyboard "PageUp"**
     i. Go to previous page.
   - **Keyboard "PageDown"**
     i. Go to next page.
   - **ESC**
     i. Go to "Tool Life Management" page.

F7 - Meter Switch

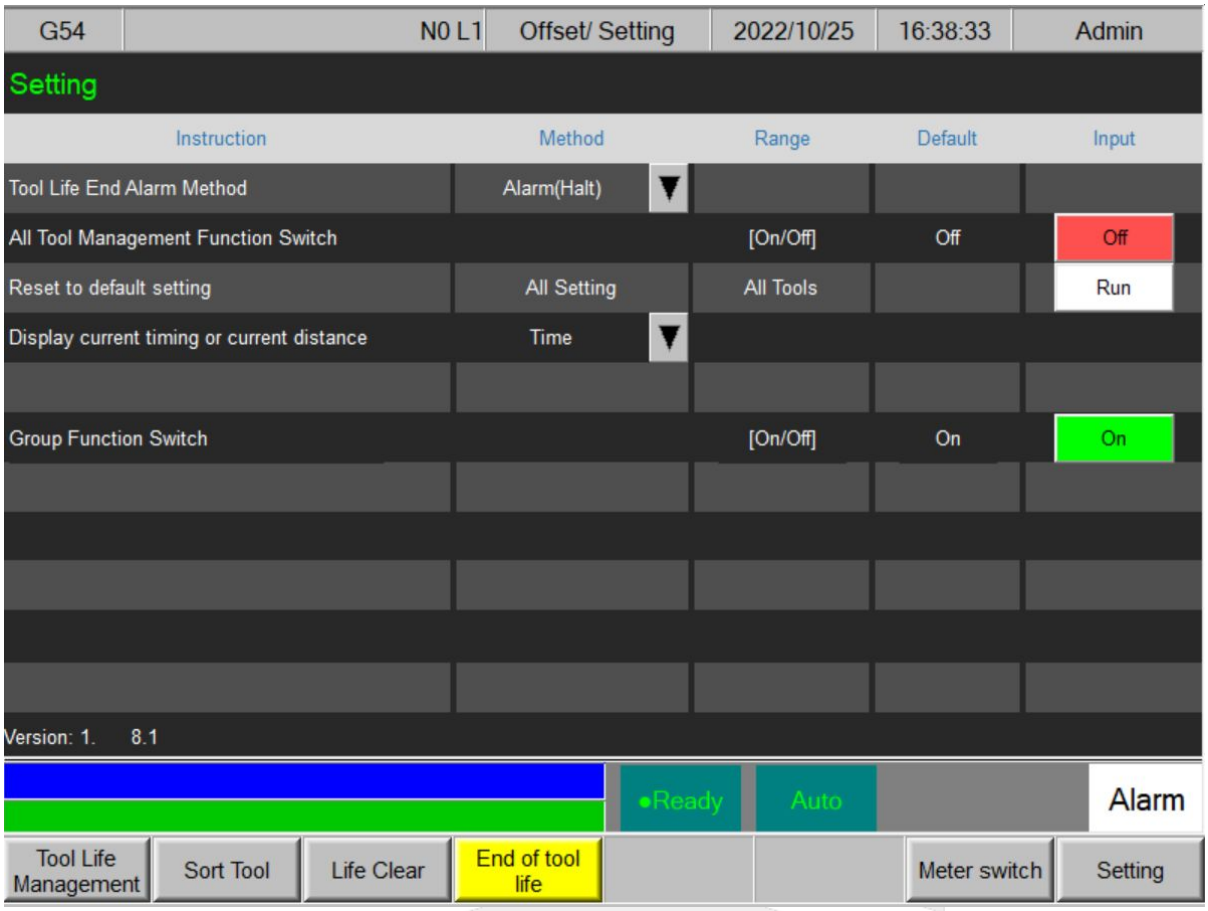
Draft

Remaining amount	Usage amount
	

Switch the display method of the tool life meter between "remaining amount" and "usage amount".

F8 - Setting

Draft

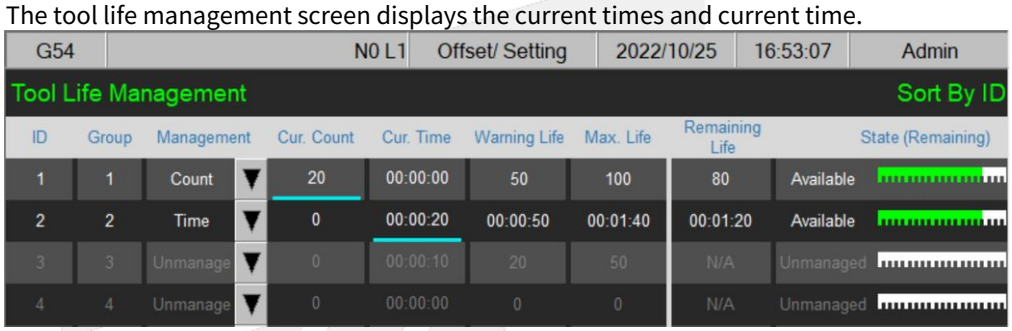


1. Tool life end alarm method : divided into three types:
    a. Alarm (Halt) : The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will trigger the alarm and stop.
    b. M00 : The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will pop up a message at the end of the program and execute M00 (program pause).
    c. Remind only, NON-STOP : When the current life of the called tool has exceeded the maximum life and there is no spare tool available, the system will only pop up a message and continue machining.

2. All tool management function switch : when "On" is pressed, all tools will be switched to unmanaged, and the tool management column cannot be operated. Press it again to cancel it, and restore to the state before it is turned on.
    a. When the all tool management function switch is on, the tool number 1~96 in tool life management cannot be operated.
    b. When the all tool management function switch is on, the sort tool function is unable to use.
3. Reset to default setting: All tool data will be restored to their default values, please refer to the table below for the initial values:

Tool number	Group	Tool Management	Current Times	Current Time	Remaining Life	Maximum Life
1~96	same as tool number	unmanagement	0	0	0	0

4. Display current timing or current distance
    a. Choose "current time"
        i. The tool life management screen displays the current times and current time.



        ii. "Current distance" can't be choosed as tool management method.

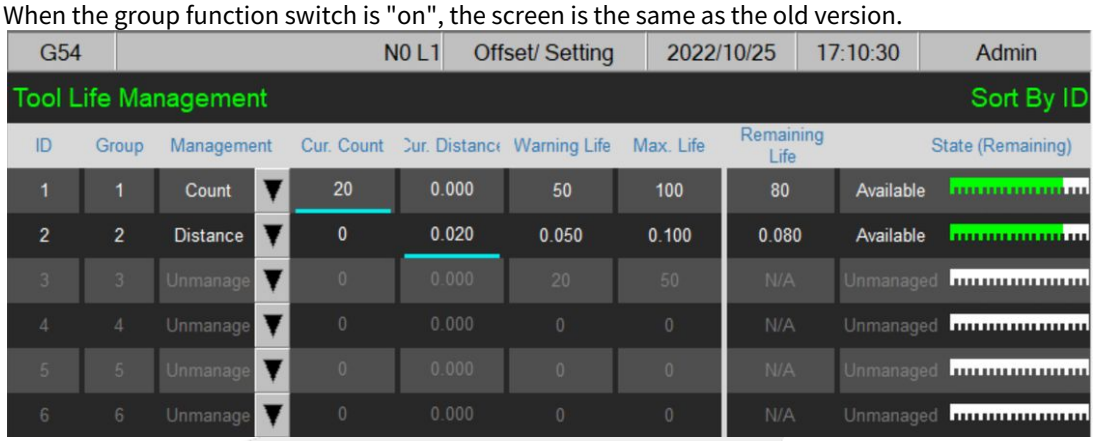
    b. Choose "current distance"
        i. The tool life management screen displays the current times and current distance.



        ii. "Current time" can't be choosed as tool management method.

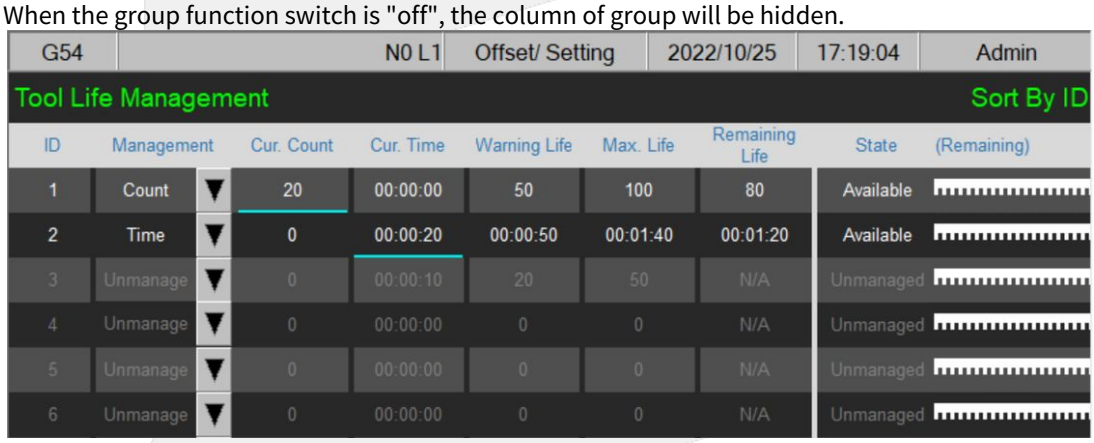
    c. Notice
        i. It does not matter whether the current time or current distance is selected. The current times, current time and current distance of the tool will all be counted at the same time. (This setting option only affects the screen display and tool management options)
        ii. In the dipole mode, the front stage and the back stage must be manually set and consistent.
5. Group function switch
    a. Default is "on".

b. When the group function switch is "on", the screen is the same as the old version.



i. The tool group function is supported.
ii. The tool compensation always equal to the tool number, which can't be defined customizedly.

c. When the group function switch is "off", the column of group will be hidden.



i. The tool group function will be ineffective compeletely, no matter it was set or not before.
ii. The customized tool compensation is available. If T000 customization is needed, it is necessary to modify T000 according to **T-Code Customization**. If T000 customization is not needed, the new version of T000 is updated in standard installation package.
iii. The setting value will be restored after switched to "on" again.

d. Example

Example

Suppose T1 and T2 belong to the same tool group.

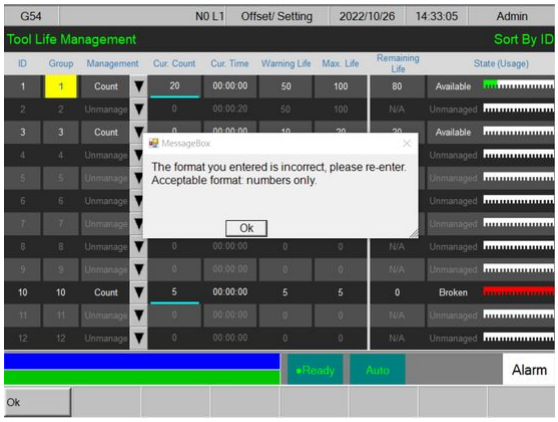
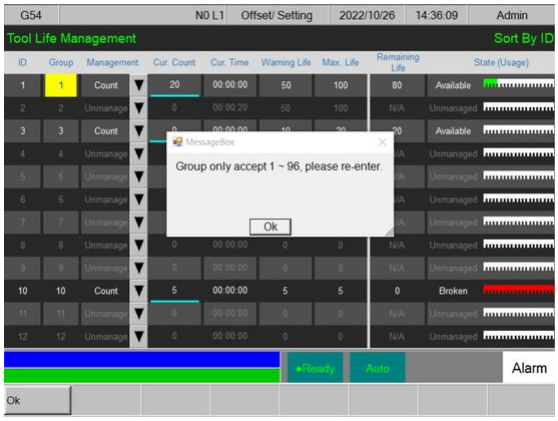
T code in NC program	**Group function switch**	
	On	**Off**

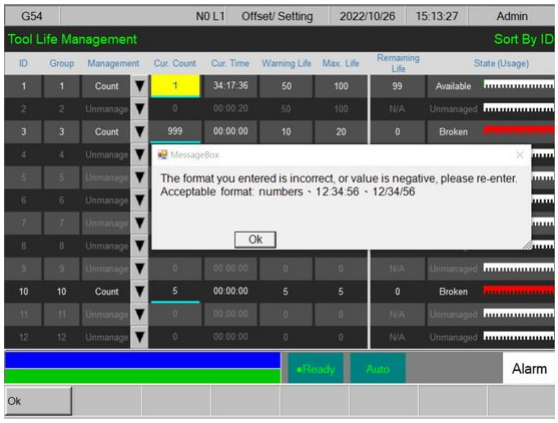
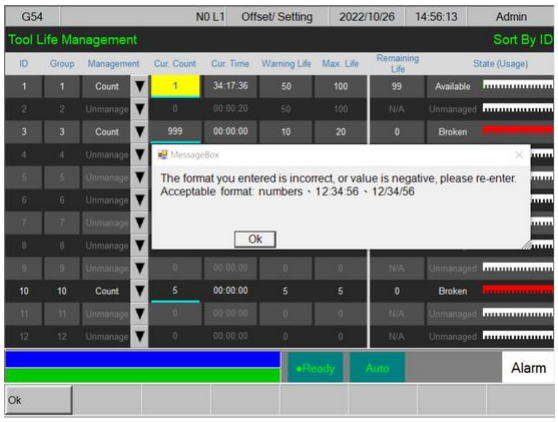
	The tool life of original tool number is not ended	Switch to spare tool	The tool life of original tool number is not ended	Switch to spare tool
T01	T0101	T0202	T0101	N/A
T0101	T0101	T0202	T0101	N/A
T0103	T0101	T0202	T0103	N/A

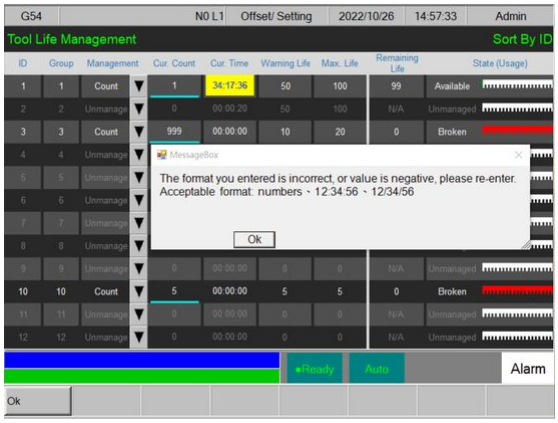
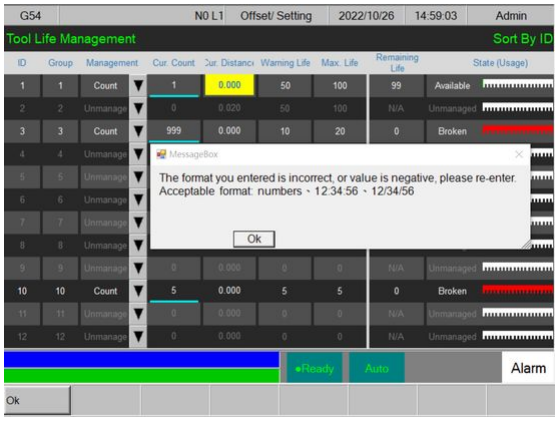
5.21.4 Operation Guide

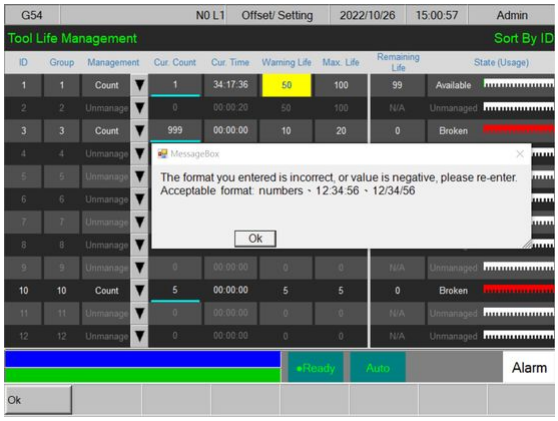
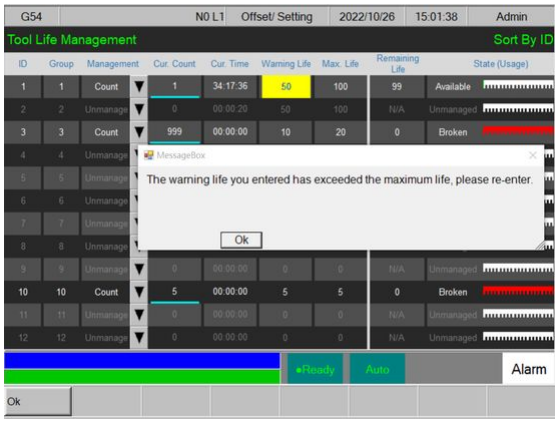
- When the user enters an value which is out of specification, the controller will prompt to inform the user, ask user to check the entered value.
  Detailed Descriptions

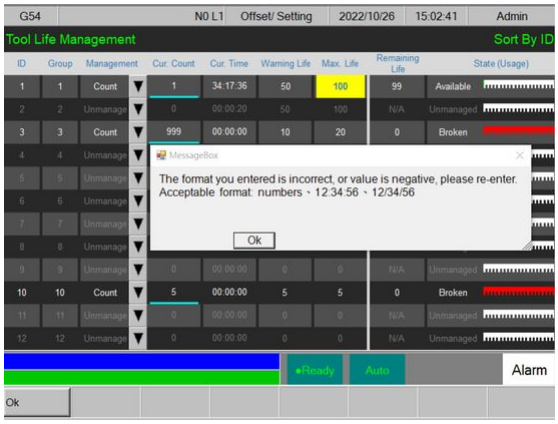
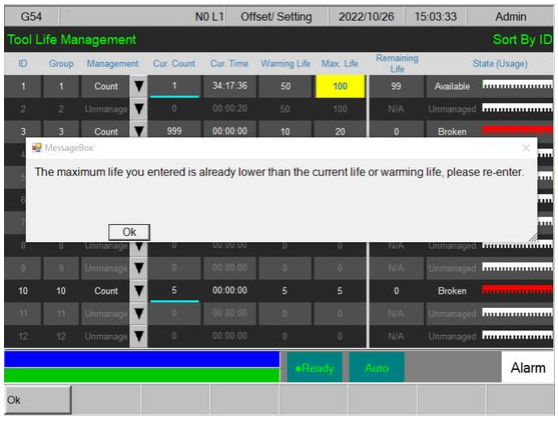
SYNTEC

input object	reasonable range	condition of pop-up reminder	reminder content	note
group	1~96	negative numbers, non-number characters	The format you entered is incorrect, please re-enter. Acceptable format: numbers only. **Figure** 	high-speed spindle milling machine unsupport the setting of tool group.
		group>96 or group<1	Group only accept 1~96, please re-enter. **Figure** 	high-speed spindle milling machine unsupport the setting of tool group.

input object	reasonable range	condition of pop-up reminder	reminder content	note
life input object	0~1000000000	input>100000000	The format you entered is incorrect, or value is negative, please re-enter. Acceptable format: numbers、12:34:56、12/34/56 **Figure** 	
current count	0~1000000000	Negative numbers, non-number characters, but excluding "/" and ":"	The format you entered is incorrect, or value is negative, please re-enter. Acceptable format: numbers、12:34:56、12/34/56 **Figure** 	If you enter a floating point number, it will be taken the decimal point to the third place, and the value will be automatically multiplied by 1000. For example: 10. → 10000

input object	reasonable range	condition of pop-up reminder	reminder content	note
current time	0~1000000000	Negative numbers, non-number characters, but excluding "/" and ":"	The format you entered is incorrect, or value is negative, please re-enter. Acceptable format: numbers、12:34:56、12/34/56 **Figure** 	If you enter a floating point number, it will be taken the decimal point to the third place, and the value will be automatically multiplied by 1000. For example: 10. → 10000
current distance	0.000~1000000.000	Negative numbers, non-number characters.	The format you entered is incorrect, or value is negative, please re-enter. Acceptable format: numbers、12:34:56、12/34/56 **Figure** 	

input object	reasonable range	condition of pop-up reminder	reminder content	note
warning life	0~maxium life	Negative numbers, non-number characters, but excluding "/" and ":"	The format you entered is incorrect, or value is negative, please re-enter. Acceptable format: numbers、12:34:56、12/34/56 **Figure** 	
		remaining life>=maximum	The warning life you entered has exceeded the maximum life, please re-enter. **Figure** 	

input object	reasonable range	condition of pop-up reminder	reminder content	note
Maximum life	>current life	Negative numbers, non-number characters, but excluding "/" and ":"	The format you entered is incorrect, or value is negative, please re-enter. Acceptable format: numbers、12:34:56、12/34/56 **Figure** 	
		maximum life<current life	The maximum life you entered is already lower than current life or warning life, please re-enter. **Figure** 	
		maximum life<remaining life		

- Input current count, current time, current distance, remaining life, if the number include decimal point, the input result will be x1000.

5.21.5 Alarm Descriptions

Alarm ID	**MSG-397**	**Alarm Title**	**[Tool Management Function:Txx Tool Life is about to run out]**
description	The "current life" of the used tool is greater than or equal to the set value of "remaining life".		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		
others	1. When the tool life reaches the remaining life value during machining, the message will not be shown until next time the tool been change. 2. If the input tool remaining life is unreasonable (Ex: remaining life>maximum life), it will switch back to the last set value. 3. There will be no prompts for the same profile in the subsequent, the prompts will only be shown when next ime you press "Cycle Start".		
Alarm ID	**MSG-398**	**Alarm Title**	**[Tool Management Function: The Input Value of Tool Status is Incorrect]**
description	The tool status setting is not 0~5, (0) unmanaged, (1) unused, (2) usable, (3) about to end, (4) life end, (5) tool break.		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		
others	In old version, "tool status" can be set (0 or 5), but the new version of tool life management does not provide the function of setting the "tool status", so basically there will be no such alarm, but the alarm mechanism has been remained.		
Alarm ID	**MSG-399**	**Alarm Title**	**[Tool Management Function: Tool searching process error, please inform the developer]**
description	In the process of tool searching, an exception (not 0~5) occurs when determining the "tool status".		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		

Alarm ID	MSG-400	Alarm Title	[Tool Management Function: Incorrect input value of argument D Incorrect]
description	Set tool change mode(argument D), directly set to "0" in current.		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		

Alarm ID	MACRO-7xx	Alarm Title	[Txx Tool Life Has Reached to the End]
description	The tool life has ended, and the spare tool cannot be found in the tool magazine. The "xx" displayed in MACRO-7xx and Txx is the life-ended tool number.		
clear method	1. Change the tool or add a spare tool in the tool magazine and press Reset to clear this alarm, otherwise this alarm will appear again in the next tool change. 2. Check whether the customer has met the alarm interval required of tool life management.		
others	1. When the tool life reaches the pre-warning value during processing, it will not alarm, and will not alarm until the next tool change. 2. If the input value of tool remaining life is unreasonable (Ex: remaining life<maximum life), it will switch back to the last set value. 3. When the "current life" is greater than or equal to the "maximum life", the "Xth tool life ended" message prompt will be shown, and the machine will be in a "pause" state. Press Reset to clear the alarm.		

5.21.6 T-code Customization

1. Customers do not have customized T code MACRO: Use the standard T0000 function provided by the system without any modification. But make sure that the customers do not use the same program variables and MACRO Alarm ID interval. The T0000 file can be directly imported.
   Use the interval of program variables
   - T0000 MACRO:
     #50。
   - ToolManagement MACRO:
     #300~#310。
     #200~#220。
   - MACRO Alarm ID:
     ID300~ID400。
2. The customer has a customized T code MACRO: It needs to be modified, and the modification content is as follows:
   a. Add the following sample codes in the appropriate places of the customized T code MACRO. The best place is after the Txxxx four-code commands are separated, the program variables cannot conflict with the ones used by original customer, and need to be modified according to the situation.

Modification 1

```
// #39 controls the display of R102, R525, R535, ..., (2 digits or 4
digits)
// If the new version of tool life management is used, #39 will determine
the final display method based on the 2 digits or 4 digits entered by user
// If the new version of tool life management is not used, the original
value #1036 will be used, and the subsequent operations will be the same
as the original T code
#39 := #1036;

//=====================================================================
//Call Tool Management Function
#50 := PARAM(3228);//Open Tool Management Function Parameter
#51 := PARAM(3209);
#52 := PARAM(4601);// Enable New Tool Life Management, when value == 1
IF(#50=1 AND #52=1) THEN
    CASE #51 OF
        0:
            M98 P"ToolManagement_common";
        1:
            M98 P"ToolManagement_cht";
        119:
            M98 P"ToolManagement_chs";
        ELSE
            M98 P"ToolManagement_common";
    END_CASE;

    // Used tool number (#33)、tool compensation (#34) are likely to be
changed by tool management
    // Current specification: Two-digits tool number always equals to
four-digits tool number
    // For four-digits tool number, if group function switch is "on", the
tool compensation number is forced to equalize the tool number; if group
function switch is "off", the tool compensation
    // number can be defined customizedly

    IF( #1036 >= 100 ) THEN
        #39 := 100 * #33 + #34;
    ELSE
        #39 := #33;
        #34 := #33;
    END_IF;
END_IF
//=====================================================================
```

Modification 2

```
// !!!!!!! Notice !!!!!!!
// #1036 is tool compensation + tool number(4 digits) or tool number(2
digits) called by user in the machining program
// If there is a need for customized tool compensation logic, it is
recommended to change the #1036 below to the customized tool compensation
+ tool number (4 digits) or tool number (2 digits)
// !!!!!!!!!!!!!!!!!!!!!!

IF( #38 = 1 AND #1010 = 71 ) THEN
CASE #37 OF
1:
#39 := #1036 / 100.;
2:
#39 := #1036 / 1000.;
3:
#39 := #1036 / 10000.;
END_CASE;
ELSEIF( #38 = 1 AND #1010 = 70 ) THEN
CASE #37 OF
1:
#39 := #1036 / 1000.;
2:
#39 := #1036 / 10000.;
3:
#39 := #1036 / 100000.;
END_CASE
ELSE
#39 = #1036;
END_IF;
```

Add tool life management interval to the current system standard T code

```
% @MACRO

#30 := #1000;
#31 := #1002;
#32 := #1004;

#35 := #1036;
#36 := #1502;

#37 := PARAM(17);
#38 := PARAM(3241);

#1502 := #36 OR 1;


IF( #1036 > 9999 ) THEN
 ALARM(6);
END_IF;
```

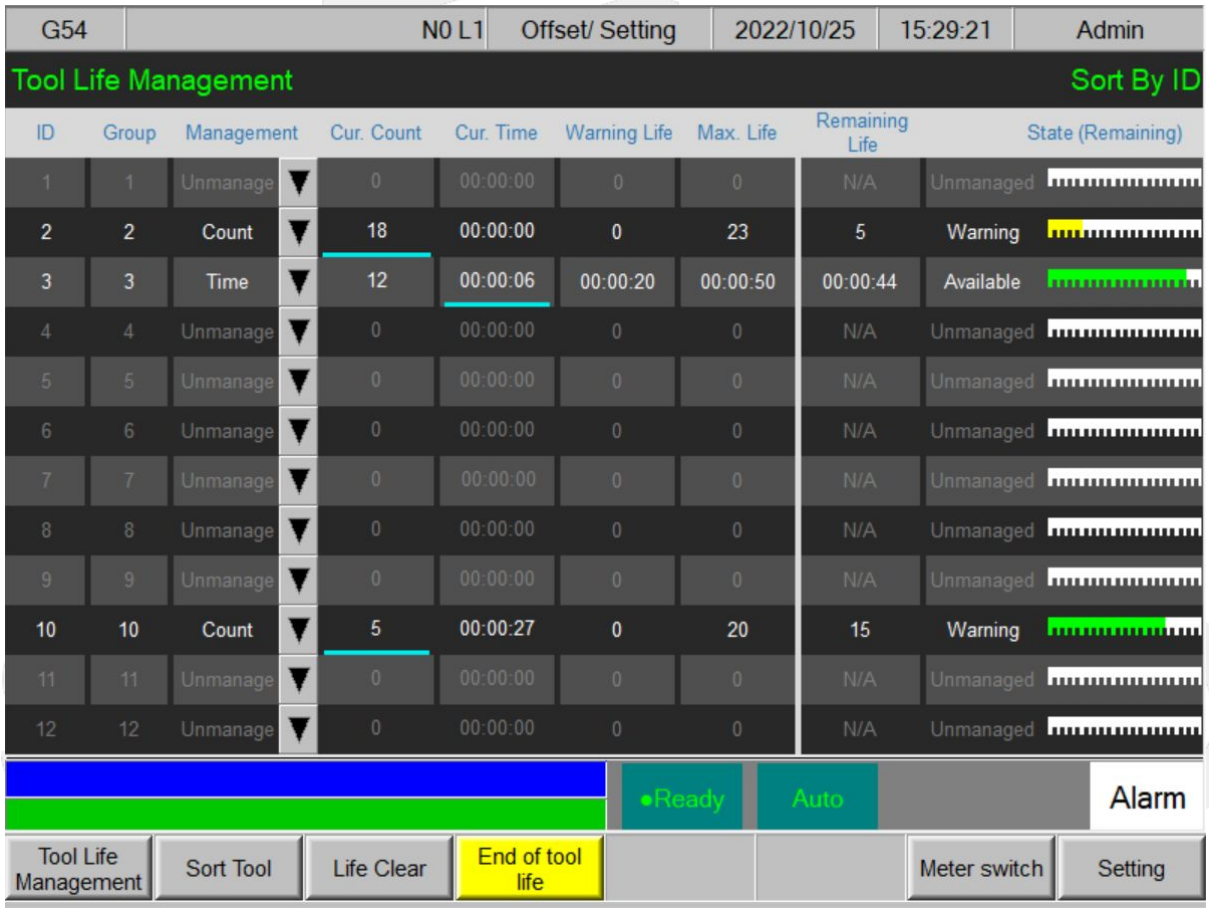
SYNTEC

```
IF( #1036 >= 100 ) THEN
 #33 := #1036 / 100;
 #34 := #1036 MOD 100;
ELSE
 #33 := #1036;
 #34 := #1036;
END_IF;

// #39 controls the display of R102, R525, R535, ..., (2 digits or 4 digits)
// If the new version of tool life management is used, #39 will determine the final display method based on the 2 digits or 4 digits entered by user
// If the new version of tool life management is not used, the original value #1036 will be used, and the subsequent operations will be the same as the original T code
#39 := #1036;

//================================================================
//Call Tool Management Function
#50 := PARAM(3228);//Open Tool Management Function Parameter
#51 := PARAM(3209);
#52 := PARAM(4601);// Enable New Tool Life Management, when value == 1
IF(#50=1 AND #52=1) THEN
 CASE #51 OF
  0:
   M98 P"ToolManagement_common";
  1:
   M98 P"ToolManagement_cht";
  119:
   M98 P"ToolManagement_chs";
  ELSE
   M98 P"ToolManagement_common";
 END_CASE;

 // The tool number used may have been changed (spare tool function)
 // Current specifications (must): When the user enters the four-digit T codes, the first two codes are defined as #33, and the last two codes are also defined as #33. If the tool management status is "unmanaged", the tool number will not be equal to the tool compensation number ( #33 != #34)
 // Reason: If the spare tool is changed, it is difficult to determine the current tool compensation
 IF( #1036 >= 100 ) THEN
  #39 := #33 + 100 * #33;
 ELSE
  #39 := #33;
 END_IF;
END_IF
//================================================================

IF( #1065 = 0 ) THEN
 #44 := #34 * 3;
ELSE
 #44 := #34;
END_IF;

IF( #34 = 0 ) THEN
 G49 G10 L1050 X0 Y0 Z0 D0;
ELSEIF( #1061 = 1 ) THEN
 G43 G10 L1051 P#34 D#44;
```

```
ELSE
   #40 := AXID(X);
 IF( #40 > 3 ) THEN
  #41 := (#34-1)*3 + 400 + #40 - 3;
 ELSEIF ( #40 > 0 ) THEN
  #41 := (#34-1)*3 + #40;
 ELSE
  #41 := #0;
 ENDIF;

   #40 := AXID(Y);
 IF( #40 > 3 ) THEN
  #42 := (#34-1)*3 + 400 + #40 - 3;
 ELSEIF ( #40 > 0 ) THEN
  #42 := (#34-1)*3 + #40;
 ELSE
  #42 := #0;
 ENDIF;

   #40 := AXID(Z);
 IF( #40 > 3 ) THEN
  #43 := (#34-1)*3 + 400 + #40 - 3;
 ELSEIF ( #40 > 0 ) THEN
  #43 := (#34-1)*3 + #40;
 ELSE
  #43 := #0;
 ENDIF;
 G43 G10 L1050 X#41 Y#42 Z#43 D#44;
END_IF;

IF( #38 = 1 AND #1010 = 71 ) THEN
 CASE #37 OF
  1:
 #39 := #39 / 100.;
  2:
 #39 := #39 / 1000.;
  3:
 #39 := #39 / 10000.;
 END_CASE;
ELSEIF( #38 = 1 AND #1010 = 70 ) THEN
 CASE #37 OF
  1:
 #39 := #39 / 1000.;
  2:
 #39 := #39 / 10000.;
  3:
 #39 := #39 / 100000.;
 END_CASE
ELSE
 #39 = #39;
END_IF;


CASE #1508 OF
      1:
```

```
G90 G10 L1000 P102 R#39;
G90 G10 L1000 P525 R#39;
    2:
G90 G10 L1000 P535 R#39;
    3:
G90 G10 L1000 P545 R#39;
    4:
G90 G10 L1000 P555 R#39;
END_CASE;
T#33;
#1502 := #36;
G#30 G#31 G#32;
M99;
```

5.21.7 F1 - Tool Life Management



1. **ID**: Supports up to 96 tools.
2. **Group** (spare tool): When the T code is executed, if the life of the original tool has been ended, it will automatically search for the spare tool in the tool magazine. If there is one, it will be automatically replaced

with an usable spare tool. Otherwise, the "Xth tool life has ended" alarm will be displayed. Note: Before using this function, the spare tool must be set and input into the corresponding tool compensation table.

Example

Ex: Originally call T01, but after the life of T01 end, the spare tool T03 will be automatically searched, and the tool compensation number is also 03, which is equivalent to calling T0303. Therefore, the correspond tool of T03 must be added to the column 03 in the tool table.

3. **Management**: Can be set to "unmanaged", "times count" and "time count" three statuses.
   a. Set to "Unmanaged", the related parameters of this tool can't be set, and the font color of the entire tool list will turn to gray. The system will ignore the life judgment of this tool and output directly.
   b. Set "times count", the current counting times will be regarded as the current life, the current times counting field of the tool will have a small blue mark for the user to quickly distinguish.
   c. Set "time count", the current counting time will be regarded as the current life, the current time counting field of the tool will have a small blue mark for the user to quickly distinguish.
   d. Set "distance count", the current counting distance will be regarded as the current life, the current distance counting field of the tool will have a small blue mark for the user to quickly distinguish.
4. **Cur. Count**: The times that the tool has been used so far. Every time T code is executed, the current times count of the tool called by the T code will be +1 (if its status is unmanaged, the times count won't change).
5. **Cur. Time**: The time that the tool has been used so far. After the tool is called by T code, the timing will start when the following conditions are met.

   Timing Conditions

   - Tool management is times count or time count.
   - G code status is G01, G02 or G03.
   - C36, C37, S32 are all Off.
   - The actual value of the feedrate command of the axis group>0.

6. **Cur. Distance**: The distance that the tool has machined so far. Display in meter to the third decimal place. The machining distance calculation method is briefly described as follows.

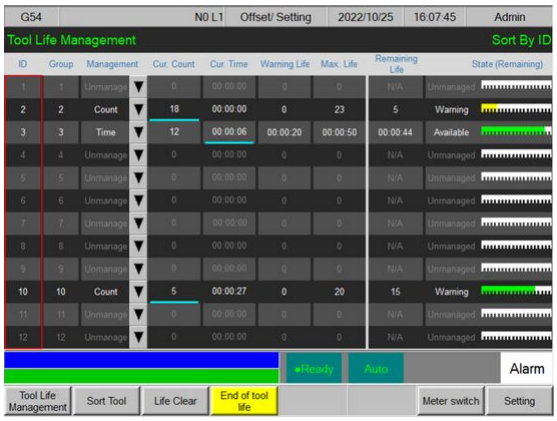
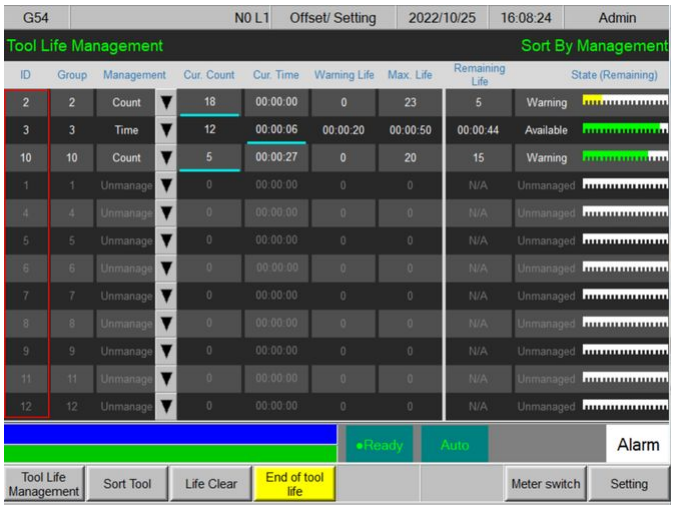
   Notice

   a. The time for maching a single line segment is recommended to be greater than 2.5 seconds, otherwise calculation errors are likely to occur.
   b. Currently only single-axis group is supported.

7. **Warning Life**: When the current life of tool is greater than this value, and less than the maximum life, the prompt window of "Txx tool life is about to end" will pop up, and the machining will not be affected (won't stop).
8. **Max. Life**: When the tool current life is greater than this value, the machine will execute the command according to the tool life end alarm.
9. **State**: Display the current status of tool, and its display conditions are as follows:
   a. unmanaged : choose unmanaged in tool management option.
   b. available : cuurent life smaller than maximum life.
   c. warning : cuurent life greater than warning life and cuurent life smaller than maximum life.
   d. broken : cuurent life greater than maximum life.
10. **Meter Switch** : Provides a visual diagram showing the remaining amount or used amount of the tool life, which can be switched by personal preference. The definition of the colors are as follows:
    a. remaining amount
       i. 100%~51% : green
       ii. 50% ~ 11% : yellow
       iii. 10% ~ 1% : red
       iv. 0%: red (whole bar)
    b. usage amount
       i. 0% ~ 49% : green

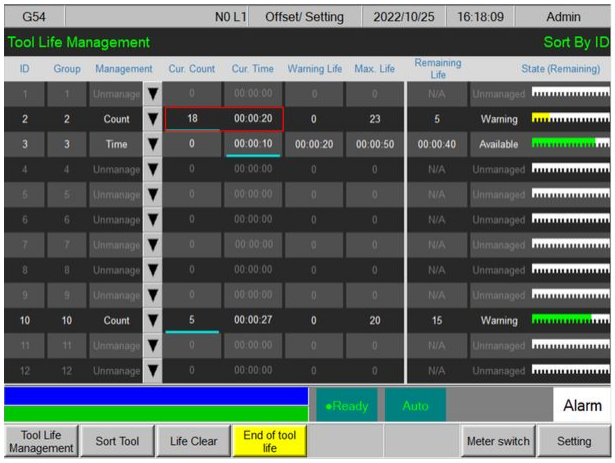
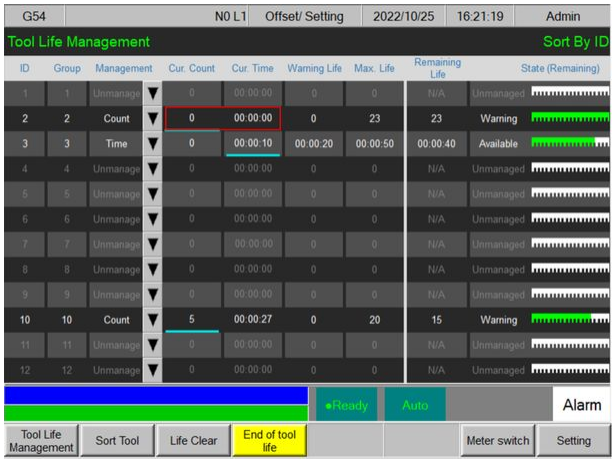
ii. 50% ~ 89% : yellow
iii. 90% ~ 100% : red

5.21.8 F2 - Sort Tool

Sort By ID	Sort By Management
	

1. After pressing F2 Sort Tool, it will switch to "sort by management", and the sorting method is:
   a. Sort By Management (choose time count or times count in the tool management page), the tool numbers are sorted from small to large, starting from the first page.
   b. Sort By ID, the tool numbers are successively sorted from small to large.
2. Press F2 again to switch to "sort by ID".
3. When the "All Tool Management Function Switch" is activated, the sort tool function is unavailable.

5.21.9 F3 - Life Reset

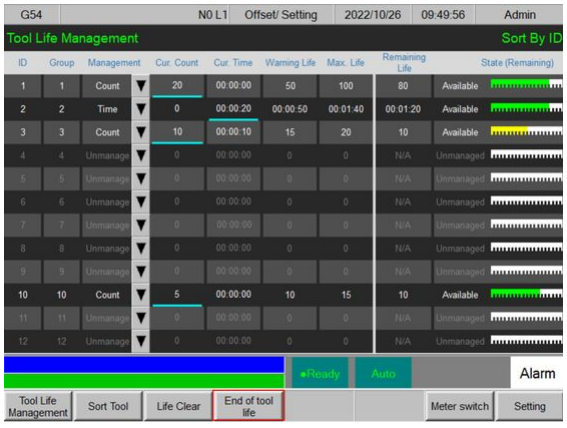
Before Pressing "Life Reset"	After Pressing "Life Reset"
	

Reset the "current count", "current time" and "current distance" values of the tool in the row where the yellow cursor is on.

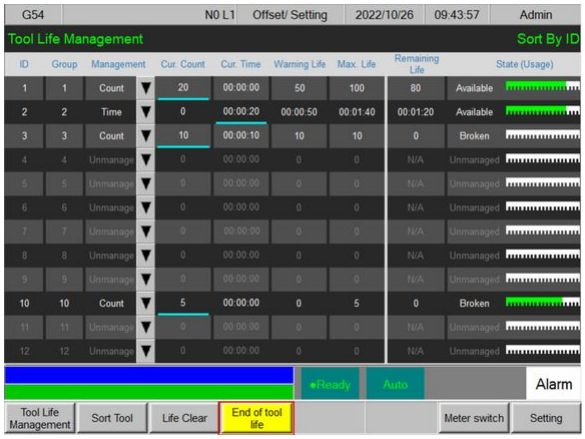
5.21.10 F4 - End of Tool Life

1. Function description: All the tools with warning life and ended life will be displayed on this page.
2. If there is a tool with warning life or ended life, this fenu display will turn yellow.

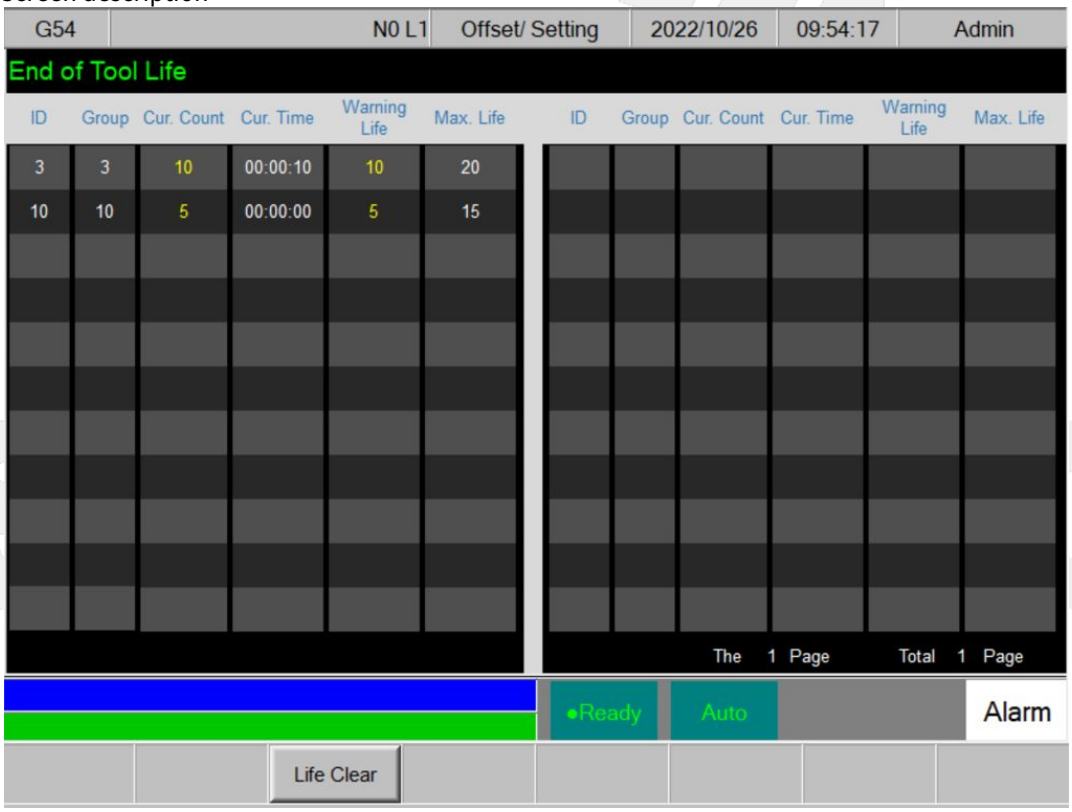
No tool with warning life or ended life



Any tool with warning life or ended life



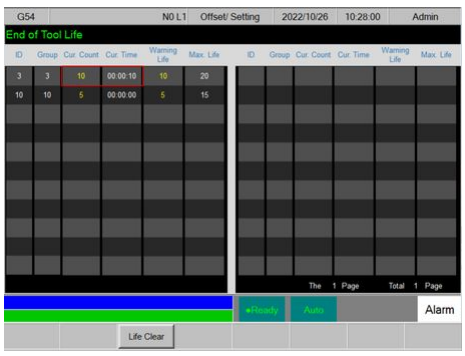
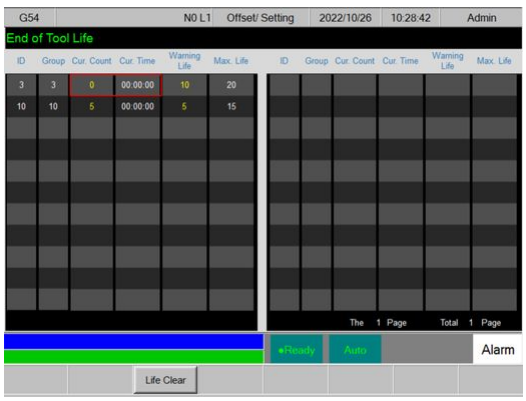
3. Screen description



a. **ID** : Display tool number with warning life or ended life.

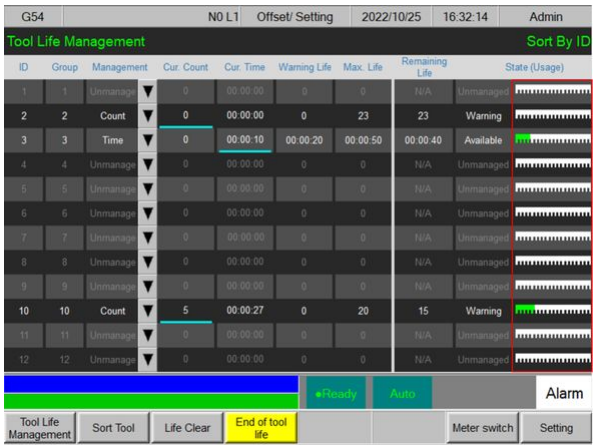
b. **Group** (high-speed spindle milling: z axis) :
   i. Display the group which current tool number belongs to.
   ii. Edit is not available.
c. **Cur. Count** :
   i. Contents and usages are similar to current count in F1 - Tool Life Management.
   ii. If the tool status is "warning life", the font color will be yellow; if the tool status is "ended life", the font color will be red.
d. **Cur. TIme/Cur. Distance** :
   i. Contents and usages are similar to current time/curent distance in F1 - Tool Life Management.
   ii. If the tool status is "warning life", the font color will be yellow; if the tool status is "ended life", the font color will be red.
e. **Warning Life** :
   i. Contents and usages are similar to warning life in F1 - Tool Life Management.
   ii. If the tool status is "warning life", the font color will be yellow.
f. **Max. Life** :
   i. Contents and usages are similar to max life in F1 - Tool Life Management.
   ii. If the tool status is "ended life", the font color will be red.
g. **Current Number of Page** :
   i. The lower right corner displays the current number of page.
h. **Total Number of Pages** :
   i. The lower reght corner displays the number of total pages.

4. Fenu button description
   - **F3 - Life Clear**
     - Reset the current time, current count and current distance of the tool where the cursor is located to zero.

Before life clear	After life clear
	

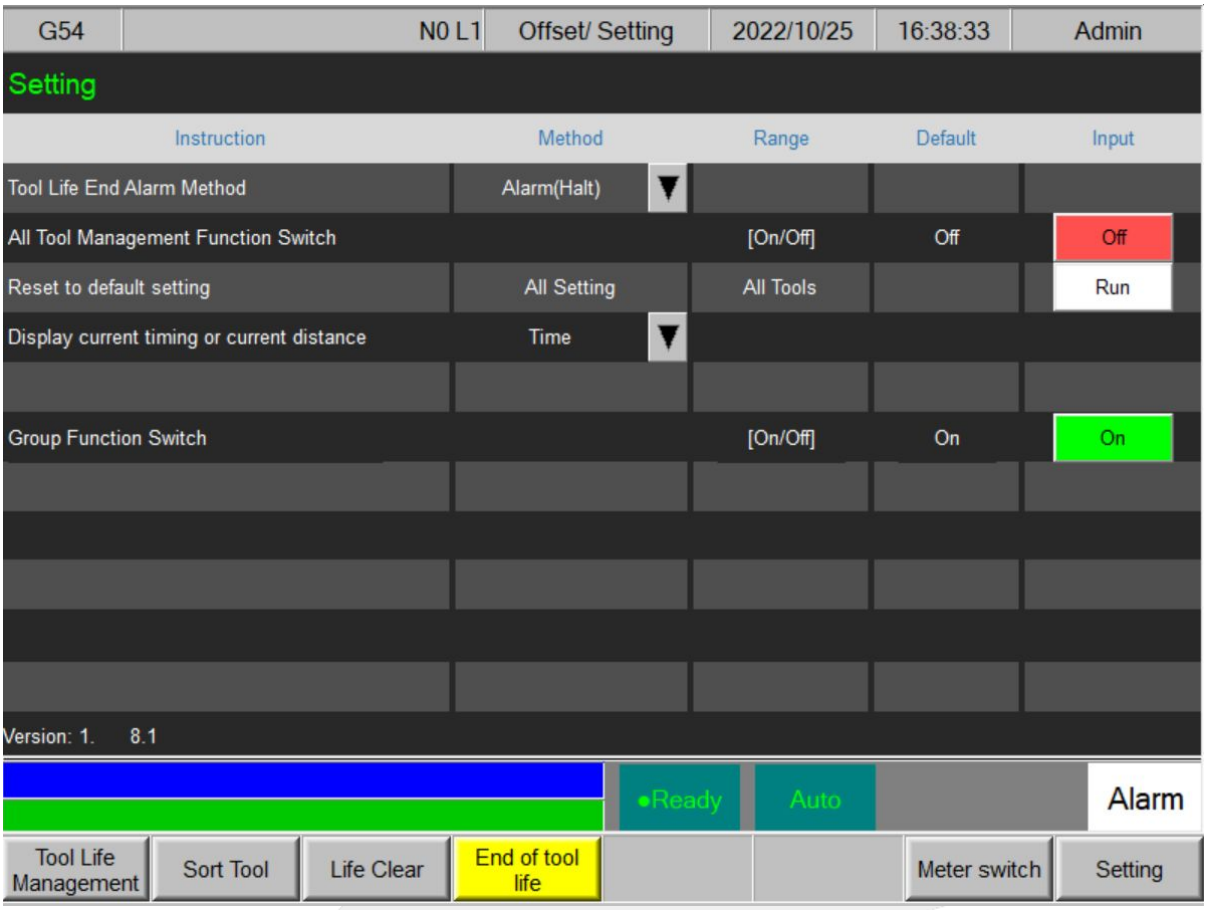
   - **Keyboard "PageUp"**
     i. Go to previous page.
   - **Keyboard "PageDown"**
     i. Go to next page.
   - **ESC**
     i. Go to "Tool Life Management" page.

5.21.11 F7 - Meter Switch

Remaining amount	Usage amount
	

Switch the display method of the tool life meter between "remaining amount" and "usage amount".

5.21.12 F8 - Setting

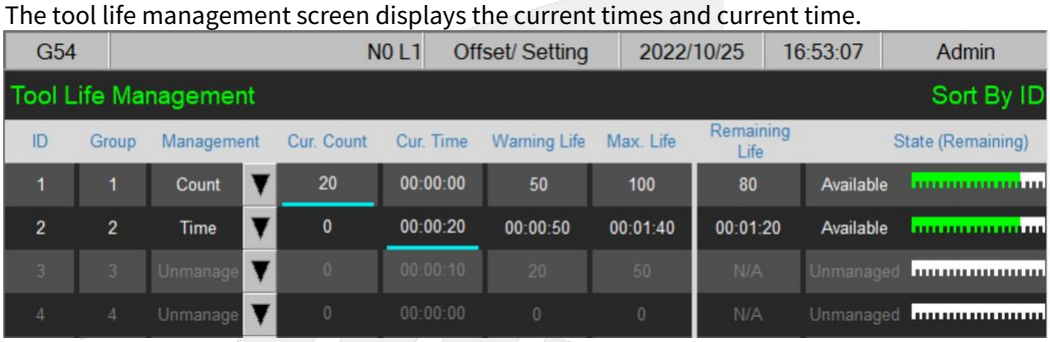


1. Tool life end alarm method : divided into three types:
    a. Alarm (Halt) : The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will trigger the alarm and stop.
    b. M00 : The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will pop up a message at the end of the program and execute M00 (program pause).
    c. Remind only, NON-STOP : When the current life of the called tool has exceeded the maximum life and there is no spare tool available, the system will only pop up a message and continue machining.

2. All tool management function switch : when "On" is pressed, all tools will be switched to unmanaged, and the tool management column cannot be operated. Press it again to cancel it, and restore to the state before it is turned on.
    a. When the all tool management function switch is on, the tool number 1~96 in tool life management cannot be operated.
    b. When the all tool management function switch is on, the sort tool function is unable to use.
3. Reset to default setting: All tool data will be restored to their default values, please refer to the table below for the initial values:

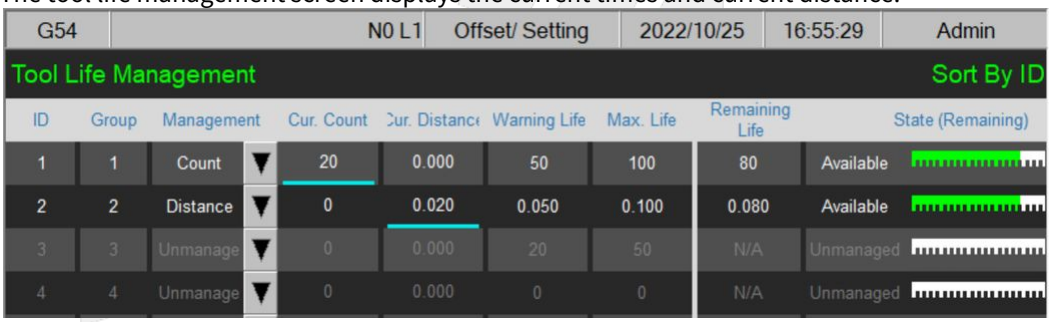
Tool number	Group	Tool Management	Current Times	Current Time	Remaining Life	Maximum Life
1~96	same as tool number	unmanagement	0	0	0	0

4. Display current timing or current distance
   a. Choose "current time"
      i. The tool life management screen displays the current times and current time.



      ii. "Current distance" can't be choosed as tool management method.

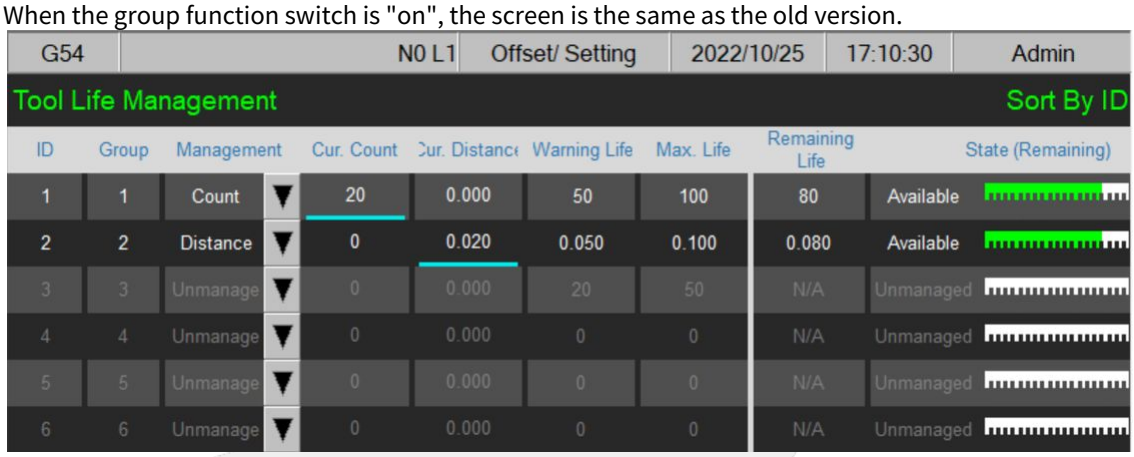
   b. Choose "current distance"
      i. The tool life management screen displays the current times and current distance.



      ii. "Current time" can't be choosed as tool management method.

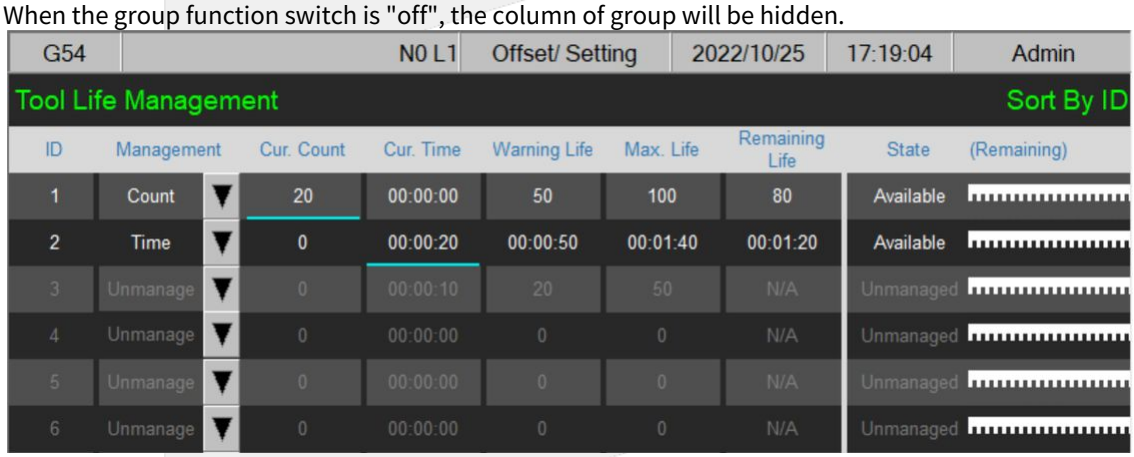
   c. Notice
      i. It does not matter whether the current time or current distance is selected. The current times, current time and current distance of the tool will all be counted at the same time. (This setting option only affects the screen display and tool management options)
      ii. In the dipole mode, the front stage and the back stage must be manually set and consistent.
5. Group function switch
   a. Default is "on".

b. When the group function switch is "on", the screen is the same as the old version.



i. The tool group function is supported.
ii. The tool compensation always equal to the tool number, which can't be defined customizedly.

c. When the group function switch is "off", the column of group will be hidden.



i. The tool group function will be ineffective compeletely, no matter it was set or not before.
ii. The customized tool compensation is available. If T000 customization is needed, it is necessary to modify T000 according to **T-Code Customization**. If T000 customization is not needed, the new version of T000 is updated in standard installation package.
iii. The setting value will be restored after switched to "on" again.

d. Example

Example

Suppose T1 and T2 belong to the same tool group.

T code in NC program	**Group function switch**			
	On		**Off**	
	The tool life of original tool number is not ended	**Switch to spare tool**	**The tool life of original tool number is not ended**	**Switch to spare tool**

T01	T0101	T0202	T0101	N/A
T0101	T0101	T0202	T0101	N/A
T0103	T0101	T0202	T0103	N/A

5.22 Milling Tool Life Management

5.22.1 Contents

- Contents
- Notice
- Operation Specification Descriptions
- Application Specification
- Operation Guide
- Alarm Descriptions

V1.5.3 Version Update Descriptions

- Add the option of set page of tool life management: "display current time or current distance"
- Add the way of tool life management: "distance count"
- Add tool life column: "current distance" in meter
- Add decimal point input method
- Modify the maximum input value of current count, current column, remaining time, maximum life, changing from 100000 to 1000000000.
- Improve operation function.

5.22.2 Notice

- Fuction turn on method:
  - Pr3228=0: Turn off tool life management function.
  - Pr3228=1 and Pr4601=1: Turn on the "new version" of tool life management function.
  - Pr3228=1 and Pr4601=0: Turn on the "old version" of tool life management function.
- Before use the function, please pay attention to whether there is a customized tool life management installed, and whether R2100~R3100 are used to avoid conflicts.
- The status of "machining" prohibits the modification of the parameters on the tool life management page.
- The system backup(SB) will backup this software function and related settings. System recovery will also overwrite the tool information and related settings on the original page.
- Before using the version 10.118.28Q of controller, it is necessary to avoid installing the new version of the tool life management function in the form of installation package, otherwise the plugin conflict alarm will be triggerd. If this alarm is triggered or the tool life management has been installed in the form of installation package, you can enter SA remove PrdMMIRes\ToolLifeManagement first.
- Only supports single-axis group life counting function, currently unsupport two-axis group, three-axis group or four-axis group.
- Milling machine tool life management "spare tool" is only supported in the following software versions:
  - Shipping version: 10.118.42S (inclusive) and above
  - R&D version: 10.118.45 (inclusive) and above

- Support model: 21MA-E、22MA、210MA-E、210MA-E5、210MB-E、210MB-E5、220MA、220MA-5、220MB、220MB-5
- Support software version: after 10.118.28S (inclusive)
- Function entry:
    a. 10+8 key: (right row) offset/setting → F2 tool settings→ F8 tool life management.
    b. key 8: F3 offset/setting → F2 tool settings→ F8 tool life management.
    c. key 5: F3 offset/setting → F2 tool settings → F5 tool life management.

5.22.3 Operation Specification Descriptions

F1 -- Tool Life Management



1. Tool number: Support up to 24 tools.
2. Spare tool: Since there is no spare tool application for high-speed spindle milling, no setting is required.
    a. Set "Unmanaged", unable to set the parameters related to this tool, and the color of the whole tool data will turn in gray, and the system will ignore the life count of this tool and output directly.
    b. Set "Count Times", the current counted times will be regarded as the current life, and the current count field of the tool will have a small blue mark for users to quickly check.
    c. Set "Count Time", the current counted times will be regarded as the current life, and the current count field of the tool will have a small blue mark for users to quickly check.

3. Current time count: The time that the tool has been used so far. After the tool is called by T code, the timing will start when the following conditions are met.
4. Remaining life: When the current life of tool is greater than this value, and less than the maximum life, the prompt window of "Txx tool life is about to end" will pop up, and the machining will not be affected (won't stop).
5. Maximum life: When the tool current life is greater than this value, the machine will execute the command according to the tool life end alarm.
6. Tool status: Display the current status of tool, and its display conditions are as follows:
    a. unmanaged: choose unmanaged in tool management option
    b. usable: current life smaller than maximum life
    c. about to end: current life bigger than remaining life and current life smaller than maximum life
    d. life end: current life bigger than maximum life
7. Monitor: Provides a visual diagram showing the remaining amount or used amount of the tool life, which can be switched by personal preference. The definition of the colors are as follows:
    a. remaining amount
        i. 100%~51% : green
        ii. 50% ~ 11% : yellow
        iii. 10% ~ 1% : red
        iv. 0%: red (whole bar)
    b. used amount
        i. 0% ~ 49% : green
        ii. 50% ~ 89% : yellow
        iii. 90% ~ 100% : red

F2 -- Tool Arrangement

Draft

tool number in ascending order	managed tool in ascending order
	

The default sorting method for tools is ascending (from smallest to largest).

After pressing F2 Tool Sorting, it will switch to sorting by managed tool, and the sorting method is:

1. Ascending order sorted by managed (tool management select count time or count times) tool number from the first page.
2. The unmanaged tool number also be sorted in ascending order.

When pressed again, it will switch to ascending order by tool number.

F3 -- Life Reset

Draft

Before pressing "Life Reset"	After pressing "Life Reset"
	

Reset the "current count" and "current time" values of the tool in the column where the yellow cursor is on.

F6 -- Z-Axis Switch

Draft

Z1 axis	Z2 axis	Z3 axis	Z4 axis
			

1. Loop switch the tool state of each Z-axis through Fenu (Z1=>Z2=>Z3=>Z4=>Z1)
2. Initially, 4 Z-axis settings are available, but only when Z5 and Z6 are set can be switched by Fenu.
3. Support up to 6 Z-axis for life management.

F7 -- Avaliable / Used Amount Switch

Draft

Remaining amount	Used amount
	

Switch the display item of the tool life monitor between "remaining amount" and "used amount".

F8 -- Setting Page

Draft



1. Tool life ending alarm: divided into three types:

a. Alarm: The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will trigger the alarm and stop.
b. M00 pause: The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will pop up a message and pause the M00 program execution.
c. Showing without stop: When the current life of the called tool has exceeded the maximum life and there is no spare tool available, the system will only pop up a message and continue machining.

2. Turn off all tool life counting functions with one key: when pressing "On", all tools will be switched to unmanaged, and the tool management column cannot be operated. Make sure this function is off before system power off to avoid the tool management data lost.
3. Display current time or current distance
   a. Choose "current time"
      i. The tool life management screen displays the current times and current time.



      ii. "Current distance" can't be chosen as tool management method.

   b. Choose "current distance"
      i. The tool life management screen displays the current times and current distance.



      ii. "Current time" can't be chosen as tool management method.

   c. Notice
      i. Before switching to current time, please make sure that all tools didn't select distance counting. If there is, the tool will be restored to the initial settings.
      ii. Before switching to the current distance, please make sure that all tools didn't select timing. If there is, the tool will be restored to the initial settings.
      iii. It does not matter whether the current time or current distance is selected. The current times, current time and current distance of the tool will all be counted at the same time. (This setting option only affects the screen display and tool management options)
4. Reset to original setting: All the tool data will reset to default value, for the default value, please refer to the following table:

tool number	group	tool management	current times	current time	remaining life	maximum life
1~24	same as tool number	unmanaged	0	0	0	0

5.22.4 Application Specification

According to the type of milling machine, it can be divided into "machining center" ,"engraving machine" and "tapping machine"

Machining Center | Engraving & tapping machine

1. Modification file: M06 (example file: M0006)
2. Modification method:
   a. The last T code output by the tool life management is #33, which means that the T code argument in M06 should be changed to #33
   b. Before M06 executes the tool magazine rotation, add the following commands.

Execute tool life management in M06

```
//=====================Call Tool Management
Function======================
#50 := PARAM(3228);
#51 := PARAM(3209);
#52 := PARAM(4601);
#33 := #20;                 //Record the T argument to #33 for
ToolManagement use
IF(#50=1 AND #52=1) THEN
CASE #51 OF
0:
M98 P"ToolManagement_common";
1:
M98 P"ToolManagement_cht";
119:
M98 P"ToolManagement_chs";
ELSE
M98 P"ToolManagement_common";
END_CASE;
END_IF
```

   c. The overall modification will become the following:
   M06 overall modification(the modified parts are in red)

```
%@MACRO
//=========================================================================
//#20  T argument
//M0019  Spindle Orientation
//M0050  Unclamp spindle tool
//#26023 Z AXIS 2nd reference point
//#1004  G90/G91 mode
//@501  MAG tools
//@502  Spindle tools
//@470  T code executing
//@101  record G90/G91 status
//@102     REMEMBER the station of coolpump on or off
//#6001    cool pump station(ON OR OFF)
WAIT();
//==========================Wait for previous T code finish
execution=======================
WHILE (@470<>1) DO
   SLEEP();
END_WHILE;
//======================M06When there is a big tool, it is forbidden to execute M06
alone=====================
IF ((#20=#0) AND (@488>0)) THEN
  ALARM(10002);
  M99;

END_IF;
//====================Call Tool Management Function=====================
#50 := PARAM(3228);
#51 := PARAM(3209);
#52 := PARAM(4601);
#33 := #20;                              //Record the T argument to #33 for ToolManagement use
IF(#50=1 AND #52=1) THEN
 CASE #51 OF
 0:
  M98 P"ToolManagement_common";
 1:
  M98 P"ToolManagement_cht";
 119:
  M98 P"ToolManagement_chs";
 ELSE
  M98 P"ToolManagement_common";
 END_CASE;
END_IF
//============================Execute 带刀=================================
IF (#20<>#0)THEN
 IF ((#20 > (@489+1)) OR  (0>=#20) OR(#20=@502))THEN
   M99;
 ELSE
   T#33;
 END_IF;
END_IF;
WHILE (@470<>1) DO   //Wait T code to fininsh execution
```

```
    SLEEP();
END_WHILE;
```

3. Notice:
    a. For the general custom of machining center, tool arm changes tool will be implemented to M06, and tool magazine rotation will be implemented to PLC
    b. Continues with a, Pr3215 must be set to 0, otherwise the T argument (#20) will unable be read.
4. Spare tool function
   Spare tool custom method
    a. Only support the following versions:
        i. Shipping version: 10.118.42S (inclusive) and above
        ii. R&D version: 10.118.45 (inclusive) and above
    b. To support the spare tool function, you need to make the following modifications:
        i. Login G43 Marco(Pr3701~Pr3710 *G code Macro call registry)(EX: Pr3701 = 8)
        ii. Import G0043 into MACRO. The function of this customization is that if the spare tool is called by tool life management, the tool length called by G43 can also be converted accordingly.

G43 customization

```
%@MACRO
IF @653 <> 0 THEN
#11:= @653;
END_IF
G43 H#11; // @653 is from M06, if the spare tool function is
enabled in tool life management, the tool compensation must
also be modified accordingly
M99;
```

        iii. Make the following corrections to M06 (M0006_with spare tool function)

Execute tool life management & spare tool in M06

```
//=====================Call Tool Management
Function=====================
#50 := PARAM(3228);
#51 := PARAM(3209);
#52 := PARAM(4601);
#33 := #20;                                    //Record T argument
to #33 for ToolManagement to use
IF(#50=1 AND #52=1) THEN
CASE #51 OF
0:
M98 P"ToolManagement_common";
1:
M98 P"ToolManagement_cht";
119:
```

```
M98 P"ToolManagement_chs";
ELSE
M98 P"ToolManagement_common";
END_CASE;
END_IF
@653:=#33;              //Record the tool number after tool
life management calculation (may include spare tools)
```

Machining Center | Engraving & tapping machine

1. Modify file T0000(Example file: T0000)
2. Modification method:
   a. The T code output by the tool life management at the end is #33, which means that the T code argument inside T0000 should be changed to #33
   b. Before T0000 executes the tool magazine rotation, add the following commands

Execute tool life management in T0000

```
//=====================Call Tool Management
Function=======================
#50 := PARAM(3228);
#51 := PARAM(3209);
#52 := PARAM(4601);
#33 := #1036;                        //Record T argument to #33 for
ToolManagement to use
IF(#50=1 AND #52=1) THEN
CASE #51 OF
0:
M98 P"ToolManagement_common";
1:
M98 P"ToolManagement_cht";
119:
M98 P"ToolManagement_chs";
ELSE
M98 P"ToolManagement_common";
END_CASE;
END_IF
```

   c. The overall modification will become:
   T0000 overall modification(the changed parts are marked in red)

```
%@MACRO
WAIT();
IF ( @502 = #1036 OR 0 = #1036 OR @489 < #1036 ) THEN
M99;
END_IF;
                        //Above determine if it is the same number tool, tool number 0 or
greater than the total tools, then end and return.
```

```
M05;                    //Spindle stop
M22;                    //Software protection
M09;
WAIT();
@452:=1;                //Start to change tool and flag
@103:=#1004;            //Save those currently in state G91 or G90
@104:=#1036;            //Backup target tool number
@105:=#1008;            //Backup feed unit setup G94/95
G94;
M20;                    //Spindle orientation and doesn't wait
G90 G53 G00  Z0;        //Z-axis moves the machine zero point
M19;                    //Spindle second orientation
G90 G53 G00  Z@481;     //Z-axis moves to tool change point
G90 G53 G00 Z@482;      //Z axis moves to previous row deceleration point
G91 G01 Z@483 F@487;    //Move at the set speed
G90 G00 G53 Z@484;      //Z-axis move to safe point_Pr3404
WAIT();                 //Stop look-ahead block

//====================Call Tool Management Function=====================
#50 := PARAM(3228);
#51 := PARAM(3209);
#52 := PARAM(4601);
#33 := #1036;           //Record T argument to #33 for ToolManagement to use
IF(#50=1 AND #52=1) THEN
 CASE #51 OF
  0:
   M98 P"ToolManagement_common";
  1:
   M98 P"ToolManagement_cht";
  119:
   M98 P"ToolManagement_chs";
  ELSE
   M98 P"ToolManagement_common";
 END_CASE;
END_IF
//=======================Start changing
tool==================================
T#33 ;
```

3. Spare tool function

   Spare tool custom method

   a. Only support the following versions:
      i. Shipping version: 10.118.42S (inclusive) and above
      ii. R&D version: 10.118.45 (inclusive) and above
   b. If required spare tool function, the following modification need be done:
      i. Login G43 Marco(Pr3701~Pr3710 *G code Macro call registry)(EX: Pr3701 = 8)
      ii. Import G0043 into MACRO. The function of this customization is that if the spare tool is called by tool life management, the tool length called by G43 can also be converted accordingly.

G43 customization

```
%@MACRO
IF @653 <> 0 THEN
#11:= @653;
END_IF
G43 H#11; // @653 is from M06, if the spare tool function is
enabled in tool life management, the tool compensation must
also be modified accordingly
M99;
```

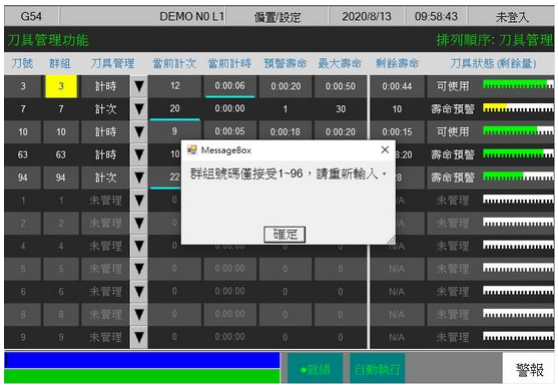
c. Make the following corrections to T0000(T0000_add spare tool function)

Execute tool life management & spare tool in T0000

```
//=====================Call Tool Management
Function=======================
#50 := PARAM(3228);
#51 := PARAM(3209);
#52 := PARAM(4601);
#33 := #1036;                          //Record T argument to #33 for
ToolManagement to use
IF(#50=1 AND #52=1) THEN
CASE #51 OF
0:
M98 P"ToolManagement_common";
1:
M98 P"ToolManagement_cht";
119:
M98 P"ToolManagement_chs";
ELSE
M98 P"ToolManagement_common";
END_CASE;
END_IF
@653:=#33;                         //Record the tool number after tool
life management calculation (may include spare tools)
```

5.22.5 Operation Guide

- When the user enters an value which is out of specification, the controller will prompt to inform the user, ask user to check the input value.
  Detailed Descriptions

input object	reasonable range	condition of pop-up reminder	reminder content	note
group	1~96	negative numbers, non-number characters	Input format error, please enter the value again. Acceptable format: only positive number. **Figure** 	high-speed spindle milling machine unsupport the setting of tool group.
		group>96 or group<1	The group number only accept 1~96, please enter the value again. **Figure** 	high-speed spindle milling machine unsupport the setting of tool group.

input object	reasonable range	condition of pop-up reminder	reminder content	note
life input object	0~1000000000	input>1000000000	Please enter a reasonable value. times: 0~1000000000 time: 0:00:00~277777:46:40 distance: 0.000~1000000.000 **Figure** 	

input object	reasonable range	condition of pop-up reminder	reminder content	note
current count	0~1000000000	Negative numbers, non-number characters, but excluding "/" and ":"	Input format error, please enter the value again. Acceptable format: positive number, 12:34:56, 12/34/56. **Figure** 	If you enter a floating point number, it will be taken the decimal point to the third place, and the value will be automatically multiplied by 1000. For example: 10. → 10000
current time	0~1000000000	Negative numbers, non-number characters, but excluding "/" and ":"	Input format error, please enter the value again. Acceptable format: positive number, 12:34:56, 12/34/56. **Figure** 	If you enter a floating point number, it will be taken the decimal point to the third place, and the value will be automatically multiplied by 1000. For example: 10. → 10000

input object	reasonable range	condition of pop-up reminder	reminder content	note
current distance	0.000~1000000.000	Negative numbers, non-number characters.	Input format error, please enter the value again. **Figure** 	
remaining life	0~maxium life	Negative numbers, non-number characters, but excluding "/" and ":"	Input format error, please enter the value again. Acceptable format: positive number, 12:34:56, 12/34/56. **Figure** 	

input object	reasonable range	condition of pop-up reminder	reminder content	note
		remaining life>=maximum	The value exceed the maximum life, please enter the value again. **Figure** 	
Maximum life	>current life	Negative numbers, non-number characters, but excluding "/" and ":"	Input format error (or be nagetive value), please enter again. Acceptable format: positive number, 12:34:56, 12/34/56. **Figure** 	

input object	reasonable range	condition of pop-up reminder	reminder content	note
		maximum life< current life	The maximum life be entered has lower than current life or remaining life, please enter again. **Figure** 	
		maximum life<remaining life		

- Input current count, current time, current distance, remaining life, if the number include decimal point, the input result will be x1000.

5.22.6 Alarm Descriptions

Alarm ID	MSG-397	Alarm Title	[Tool Management Function:Txx Tool Life is about to run out]
description	The "current life" of the used tool is greater than or equal to the set value of "remaining life".		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		
others	1. When the tool life reaches the remaining life value during machining, the message will not be shown until next time the tool been change. 2. If the input tool remaining life is unreasonable (Ex: remaining life>maximum life), it will switch back to the last set value. 3. There will be no prompts for the same profile in the subsequent, the prompts will only be shown when next ime you press "Cycle Start".		

Alarm ID	MSG-398	Alarm Title	[Tool Management Function: The Input Value of Tool Status is Incorrect]
description	The tool status setting is not 0~5, (0) unmanaged, (1) unused, (2) usable, (3) about to end, (4) life end, (5) tool break.		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		
others	In old version, "tool status" can be set (0 or 5), but the new version of tool life management does not provide the function of setting the "tool status", so basically there will be no such alarm, but the alarm mechanism has been remained.		

Alarm ID	MSG-399	Alarm Title	[Tool Management Function: Tool searching process error, please inform the developer]
description	In the process of tool searching, an exception (not 0~5) occurs when determining the "tool status".		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		

Alarm ID	MSG-400	Alarm Title	[Tool Management Function: Incorrect input value of argument D Incorrect]
description	Set tool change mode(argument D), directly set to "0" in current.		
clear method	1. Press ESC or wait a second. 2. Check whether the customer has met the variable range required for tool life management.		

Alarm ID	MACRO-3xx	Alarm Title	[Txx Tool Life Has Reached to the End]
description	The tool life has ended, and the spare tool cannot be found in the tool magazine. The "xx" displayed in MACRO-3xx and Txx is the life-ended tool number.		
clear method	1. Change the tool or add a spare tool in the tool magazine and press Reset to clear this alarm, otherwise this alarm will appear again in the next tool change. 2. Check whether the customer has met the alarm interval required of tool life management.		

Alarm ID	MACRO-3xx	Alarm Title	[Txx Tool Life Has Reached to the End]
others	1. When the tool life reaches the pre-warning value during processing, it will not alarm, and will not alarm until the next tool change. 2. If the input value of tool remaining life is unreasonable (Ex: remaining life<maximum life), it will switch back to the last set value. 3. When the "current life" is greater than or equal to the "maximum life", the "Xth tool life ended" message prompt will be shown, and the machine will be in a "pause" state. Press Reset to clear the alarm.		

5.22.7 Operation Specification Descriptions

F1 -- Tool Life Management

Draft



1. Tool number: Support up to 24 tools.
2. Spare tool: Since there is no spare tool application for high-speed spindle milling, no setting is required.
    a. Set "Unmanaged", unable to set the parameters related to this tool, and the color of the whole tool data will turn in gray, and the system will ignore the life count of this tool and output directly.

   b. Set "Count Times", the current counted times will be regarded as the current life, and the current count field of the tool will have a small blue mark for users to quickly check.
   c. Set "Count Time", the current counted times will be regarded as the current life, and the current count field of the tool will have a small blue mark for users to quickly check.
3. Current time count: The time that the tool has been used so far. After the tool is called by T code, the timing will start when the following conditions are met.
4. Remaining life: When the current life of tool is greater than this value, and less than the maximum life, the prompt window of "Txx tool life is about to end" will pop up, and the machining will not be affected (won't stop).
5. Maximum life: When the tool current life is greater than this value, the machine will execute the command according to the tool life end alarm.
6. Tool status: Display the current status of tool, and its display conditions are as follows:
   a. unmanaged: choose unmanaged in tool management option
   b. usable: current life smaller than maximum life
   c. about to end: current life bigger than remaining life and current life smaller than maximum life
   d. life end: current life bigger than maximum life
7. Monitor: Provides a visual diagram showing the remaining amount or used amount of the tool life, which can be switched by personal preference. The definition of the colors are as follows:
   a. remaining amount
      i. 100%~51% : green
      ii. 50% ~ 11% : yellow
      iii. 10% ~ 1% : red
      iv. 0%: red (whole bar)
   b. used amount
      i. 0% ~ 49% : green
      ii. 50% ~ 89% : yellow
      iii. 90% ~ 100% : red

F2 -- Tool Arrangement

Draft

tool number in ascending order	managed tool in ascending order
	

The default sorting method for tools is ascending (from smallest to largest).

After pressing F2 Tool Sorting, it will switch to sorting by managed tool, and the sorting method is:

1. Ascending order sorted by managed (tool management select count time or count times) tool number from the first page.
2. The unmanaged tool number also be sorted in ascending order.

When pressed again, it will switch to ascending order by tool number.

F3 -- Life Reset

Draft

Before pressing "Life Reset"	After pressing "Life Reset"
	

Reset the "current count" and "current time" values of the tool in the column where the yellow cursor is on.

F6 -- Z-Axis Switch

Draft

Z1 axis	Z2 axis	Z3 axis	Z4 axis
			

1. Loop switch the tool state of each Z-axis through Fenu (Z1=>Z2=>Z3=>Z4=>Z1)
2. Initially, 4 Z-axis settings are available, but only when Z5 and Z6 are set can be switched by Fenu.
3. Support up to 6 Z-axis for life management.

F7 -- Avaliable / Used Amount Switch

Draft

Remaining amount	Used amount
	

Switch the display item of the tool life monitor between "remaining amount" and "used amount".

F8 -- Setting Page

Draft



1. Tool life ending alarm: divided into three types:

a. Alarm: The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will trigger the alarm and stop.
b. M00 pause: The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will pop up a message and pause the M00 program execution.
c. Showing without stop: When the current life of the called tool has exceeded the maximum life and there is no spare tool available, the system will only pop up a message and continue machining.

2. Turn off all tool life counting functions with one key: when pressing "On", all tools will be switched to unmanaged, and the tool management column cannot be operated. Make sure this function is off before system power off to avoid the tool management data lost.
3. Display current time or current distance
   a. Choose "current time"
      i. The tool life management screen displays the current times and current time.



      ii. "Current distance" can't be chosen as tool management method.

   b. Choose "current distance"
      i. The tool life management screen displays the current times and current distance.



      ii. "Current time" can't be chosen as tool management method.

   c. Notice
      i. Before switching to current time, please make sure that all tools didn't select distance counting. If there is, the tool will be restored to the initial settings.
      ii. Before switching to the current distance, please make sure that all tools didn't select timing. If there is, the tool will be restored to the initial settings.
      iii. It does not matter whether the current time or current distance is selected. The current times, current time and current distance of the tool will all be counted at the same time. (This setting option only affects the screen display and tool management options)
4. Reset to original setting: All the tool data will reset to default value, for the default value, please refer to the following table:

tool number	group	tool management	current times	current time	remaining life	maximum life
1~24	same as tool number	unmanaged	0	0	0	0

F1 -- Tool Life Management



1. Tool number: Support up to 24 tools.
2. Spare tool: Since there is no spare tool application for high-speed spindle milling, no setting is required.
    a. Set "Unmanaged", unable to set the parameters related to this tool, and the color of the whole tool data will turn in gray, and the system will ignore the life count of this tool and output directly.
    b. Set "Count Times", the current counted times will be regarded as the current life, and the current count field of the tool will have a small blue mark for users to quickly check.
    c. Set "Count Time", the current counted times will be regarded as the current life, and the current count field of the tool will have a small blue mark for users to quickly check.
3. Current time count: The time that the tool has been used so far. After the tool is called by T code, the timing will start when the following conditions are met.

4. Remaining life: When the current life of tool is greater than this value, and less than the maximum life, the prompt window of "Txx tool life is about to end" will pop up, and the machining will not be affected (won't stop).
5. Maximum life: When the tool current life is greater than this value, the machine will execute the command according to the tool life end alarm.
6. Tool status: Display the current status of tool, and its display conditions are as follows:
    a. unmanaged: choose unmanaged in tool management option
    b. usable: current life smaller than maximum life
    c. about to end: current life bigger than remaining life and current life smaller than maximum life
    d. life end: current life bigger than maximum life
7. Monitor: Provides a visual diagram showing the remaining amount or used amount of the tool life, which can be switched by personal preference. The definition of the colors are as follows:
    a. remaining amount
        i. 100%~51% : green
        ii. 50% ~ 11% : yellow
        iii. 10% ~ 1% : red
        iv. 0%: red (whole bar)
    b. used amount
        i. 0% ~ 49% : green
        ii. 50% ~ 89% : yellow
        iii. 90% ~ 100% : red

F2 -- Tool Arrangement

tool number in ascending order	**managed tool in ascending order**
	

The default sorting method for tools is ascending (from smallest to largest).

After pressing F2 Tool Sorting, it will switch to sorting by managed tool, and the sorting method is:

1. Ascending order sorted by managed (tool management select count time or count times) tool number from the first page.
2. The unmanaged tool number also be sorted in ascending order.

When pressed again, it will switch to ascending order by tool number.

F3 -- Life Reset

Before pressing "Life Reset"	After pressing "Life Reset"
	

Reset the "current count" and "current time" values of the tool in the column where the yellow cursor is on.

F6 -- Z-Axis Switch

Z1 axis	Z2 axis	Z3 axis	Z4 axis
			

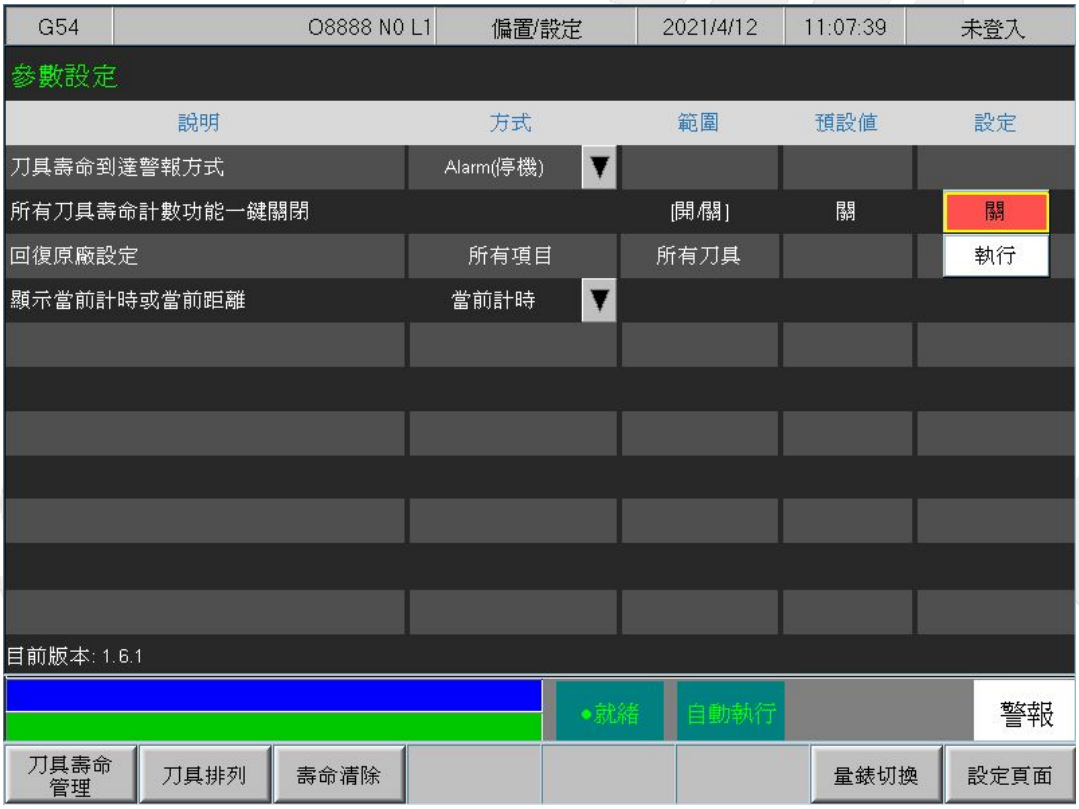
1. Loop switch the tool state of each Z-axis through Fenu (Z1=>Z2=>Z3=>Z4=>Z1)
2. Initially, 4 Z-axis settings are available, but only when Z5 and Z6 are set can be switched by Fenu.
3. Support up to 6 Z-axis for life management.

F7 -- Avaliable / Used Amount Switch

Remaining amount	Used amount
	

Switch the display item of the tool life monitor between "remaining amount" and "used amount".

F8 -- Setting Page



1. Tool life ending alarm: divided into three types:

a. Alarm: The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will trigger the alarm and stop.
b. M00 pause: The current life of the called tool has exceeded the maximum life, and there is no spare tool available, the system will pop up a message and pause the M00 program execution.
c. Showing without stop: When the current life of the called tool has exceeded the maximum life and there is no spare tool available, the system will only pop up a message and continue machining.

2. Turn off all tool life counting functions with one key: when pressing "On", all tools will be switched to unmanaged, and the tool management column cannot be operated. Make sure this function is off before system power off to avoid the tool management data lost.
3. Display current time or current distance
   a. Choose "current time"
      i. The tool life management screen displays the current times and current time.



      ii. "Current distance" can't be chosen as tool management method.

   b. Choose "current distance"
      i. The tool life management screen displays the current times and current distance.



      ii. "Current time" can't be chosen as tool management method.

   c. Notice
      i. Before switching to current time, please make sure that all tools didn't select distance counting. If there is, the tool will be restored to the initial settings.
      ii. Before switching to the current distance, please make sure that all tools didn't select timing. If there is, the tool will be restored to the initial settings.
      iii. It does not matter whether the current time or current distance is selected. The current times, current time and current distance of the tool will all be counted at the same time.(This setting option only affects the screen display and tool management options)
4. Reset to original setting: All the tool data will reset to default value, for the default value, please refer to the following table:

tool number	group	tool management	current times	current time	remaining life	maximum life
1~24	same as tool number	unmanaged	0	0	0	0

SYNTEC