

TB123 (Rev4) - Rigid Tapping Setup

Overview

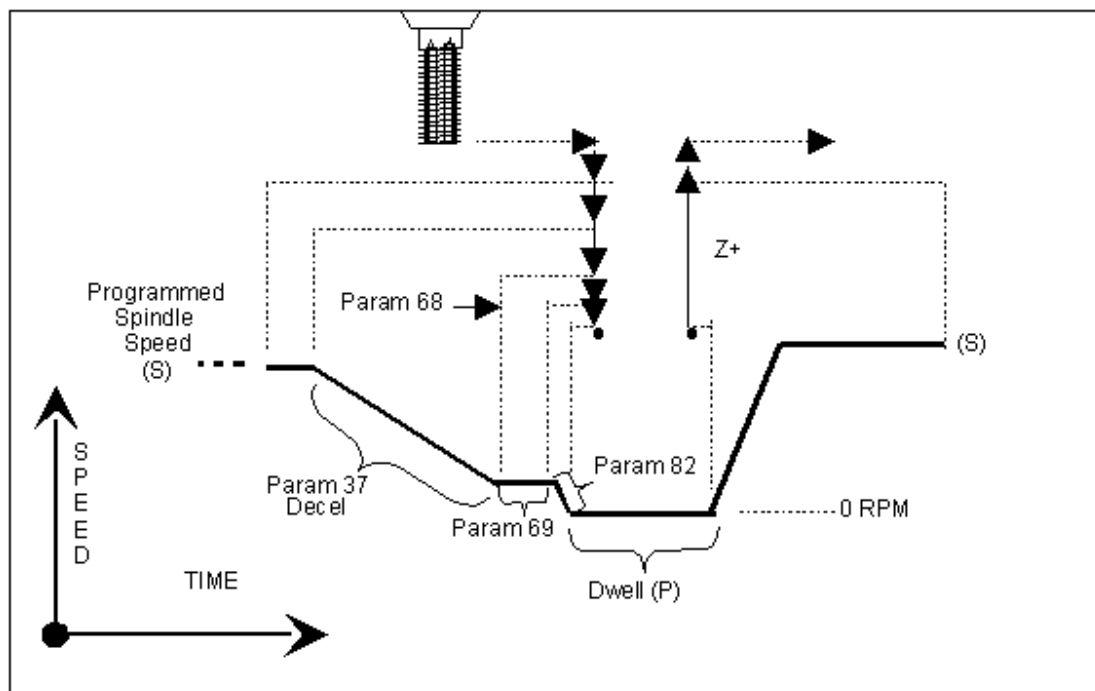
This document describes the theory of rigid tapping parameters, to control accuracy of depth of cut and quality of threads in various working materials.

There is no set specification on over-travel or under-travel associated with rigid tapping. Therefore rigid tapping must be considered an "art" of machining. Centroid makes no warranty or guarantee regarding rigid tapping depth of over-travel.

If rigid tapping results are not satisfactory, the user should consider purchasing an inexpensive and very forgiving floating tap attachment or use the very versatile thread milling technique, both are supported by Centroid.

Since Rigid Tapping requires the feedback from a spindle encoder, the spindle encoder can also be used to display the actual spindle speed rather than the commanded spindle speed. On the main screen in the upper right corner directly underneath the feedrate, is the spindle speed display. If the value of parameter 78 is set to 1, the displayed spindle speed will be the speed seen from the spindle encoder input. From the main screen press **F1 (Setup)** ->**F3 (Config)** ->default password is 137->**F3 (Params)**.

Graphic representation of parameter controls



Rigid Tapping Parameters

Parameter	Value	Function
34	4,096	Spindle Encoder Counts/Revolution – Tells the software the encoder counts per revolution of the spindle encoder. Typically, the spindle encoders that have been used in the past are 1024 line or ppr encoders which produce an encoder count of 4096. If the encoder counts up when the spindle turns CW then the value should be positive. If the encoder counts up when the spindle turns CCW then the value should be negative.
35	5	Spindle Encoder Input or Spindle Axis (CNC11) – In CNC7 and CNC10, this is designated as the encoder input that the spindle encoder is installed on. In CNC11, this is designated as the spindle axis number. The encoder mapping parameters, 308-315, tells the software which encoder input the spindle encoder is installed on. Please see charts below.
36	Bitwise value	Bit 0: 0-Disable rigid tapping, 1-Enable rigid tapping Bit 1: 0-Wait for index pulse during rigid tapping, 2-Do not wait for index pulse Bit 2: 0-Do not allow spindle override, 4-Allow spindle override <i>Example:</i> A value of 3 will enable rigid tapping (bit 0 = 1) and during execution will not wait for the index pulse to start (bit 1 = 2) and the spindle override will not change the spindle speed (bit 2 = 0). Note: Please check your operator's manual for a detailed description of this parameter. There may be additional bits that are dependent on the software version which are described in the operator's manual.
37	3.0	Spindle Deceleration Time - This value is used for setting the spindle deceleration rate from the programmed spindle speed (S) down to the spindle speed of Parameter 68. Check the value of your inverter setting and enter it. (i.e. if the inverter is set to 3 seconds deceleration, enter 3).
68	400 RPM	Minimum Rigid Tapping Spindle Speed (RPM) - This parameter is the speed that the spindle slows down to from the programmed spindle speed towards the end of the tapping cycle. The lower the value, the more accurately the Z axis will land on target but at the expense of possibly stalling the motor which in turn will cause Z to stop short. If this value is too large, the off-target error increases.
69	1.25 sec	Duration for Minimum Spindle Speed Mode (Seconds) - This is a buffer time value to allow the spindle time to decelerate to the spindle speed defined by parameter 68. If the number is too small, overshoot may occur. If it's too large, the user waits longer for the hole to be tapped at the slow speed specified by parameter 68.
74	4	Spindle M function to be run at the bottom of the hole for G84 tapping. Spindle M function to be run at the top of the hole to for G74 counter tapping.
78	Bitwise value	Bit 0: 0-Displayed speed is commanded speed, 1-Displayed speed is actual speed from spindle encoder Bit 1: 0-Does not prorate feedrate, 2-Prorates programmed feedrate proportional to spindle speed if speed is lower than threshold percent set by parameter 149 Bit 2: 0-Does not wait for spindle to get up to speed, 4-Waits for the spindle speed to get up to speed threshold set by parameter 149 before continuing on with the next line in the program
84	3	Spindle M function to be run at the bottom of the hole for G74 tapping. Spindle M function to be run at the top of the hole to for G84 counter tapping.
82	720 (2 revs)	Spindle Drift Adjustment (degrees of rotation, i.e. 360 = 1 full rotation, 90 = 1/4 rotation) - This value is the number of turns that the spindle makes to coast to a stop when it is shut off at the speed specified by parameter 68. This value is proportional to

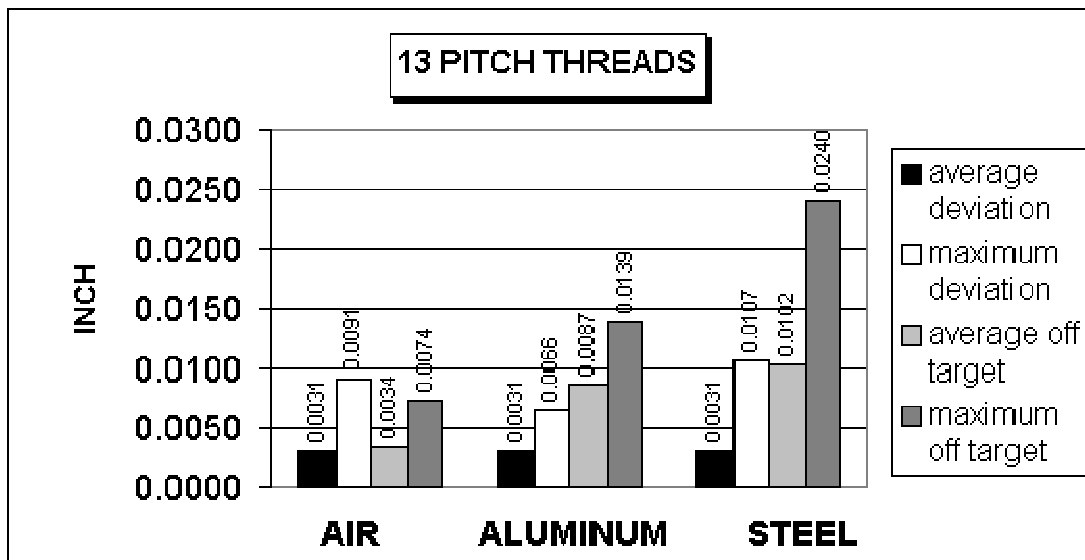
		the distance above the Z target at which the spindle motor must be shut off in order for Z to land on target. (Remember that Z is slaved to the spindle speed during rigid tapping.)
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Spindle Encoder Input Chart

CPU7/CPU9		CPU10(B)			
Encoder Input	P35	DC		AC	
3	2	Encoder Input	P35	Encoder Input	P35
4	3	5	4	SD3	6
5	4			SD1	21
SD3 drive 6	5				

ALLIN1DC/MPU11			OAK		
Encoder Input	P35	Encoder Mapping Parameter	Encoder Input	P35	Encoder Mapping Parameter
3	3	P310 = 3	5	5	P312 = 5
4	4	P311 = 4			
5	5	P312 = 5			
6	6	P313 = 6	6	6	P313 = 6

Graphic Representation of Test Results for Precision



The above chart shows test results of rigid tapping, utilizing version 7.14 software. The tool used in the testing was a 1/2-13 spiral fluted tap with TiN coating. Coolant used was water base soluble oil. Hole size was 0.4218". Tapping depth was 0.800". Also note that the parameters were adjusted to cut air and not changed for aluminum or cold rolled steel for these tests. It can be seen, as the material changes, so does the off target values. This is due in part to the amount of torque required from the spindle to cut the various types of material. For testing purposes, the parameter settings for the above results were as follows.

Parameter 36 = 1, Parameter 37 = 3, Parameter 68 = 100, Parameter 69 = 1.25, Parameter 82 = 108

Summary

Rigid tapping parameters will vary from machine to machine. Not all machines are built the same (i.e. Spindle hp, inverter type, rigidity, etc.) and tooling will play a role in performance as well. It was found, through our testing, that if we changed one physical parameter, (i.e. using a tapping oil instead of water-based coolant), it improved the off target values by 1.5%. This is due to the fact that less friction is present when using special cutting oil therefore requiring less hp by the spindle to drive the tap. In most cases, rigid tapping depths should be able to be held within +/- 0.008" or less by adjusting parameter 82 for specific cases.

Troubleshooting

Symptoms	Possible Problem	Solution/Troubleshoot
Rigid tapping was working and now when running jobs the message "Option not available, line xx" appears.	Demo mode ran out and permanent unlocks not entered.	From the main screen press F7 (Utility) ->F8 (Options) . Verify Tapping Cycles and Rigid Tapping are on.
When running a G74 or G84 rigid tap cycle, the control stops above the hole to be tapped with a message in the status window "moving" and DOES NOT continue.	<ol style="list-style-type: none"> 1. No spindle encoder feedback. 2. No spindle encoder index pulse. 3. On CPU10 s/n 384 and lower, the 6th axis index pulse on the CPU does not work. (For SD1 only systems) 	<ol style="list-style-type: none"> 1. Verify parameter 35 is set correctly. 2. Turn the spindle by hand. Check for encoder movement in PID menu shown in figure 1. If there isn't any movement, check the spindle encoder, the cable, and the connections. Figure 2 shows the DB9 pin out for the encoder. 3. Verify the system sees the index pulse from the spindle encoder. <ol style="list-style-type: none"> a. On a DC system, turn the spindle by hand and look for the asterisk, *, next to the axis label that is designated for the spindle as shown in figure 1. b. On an AC system, set the bit of parameter 36 to ignore the index pulse as described above. Change the value of parameter 35 to 20 and install the spindle encoder onto the 5th encoder input on the CPU10 (B). Turn the spindle by hand and look for the asterisk, *, next to the axis label that is designated for the spindle as shown in figure 1. 4. If the asterisk is not seen from step 3, then check the spindle encoder, the cable, and the connections. Figure 2 shows the DB9 pin out for the encoder.
When running a G74 or G84 rigid tap cycle, you get a "410: Z axis (3)	1. Spindle encoder turning opposite direction of spindle	<ol style="list-style-type: none"> 1. Change the sign on the value of parameter 34 as described above. 2. Try tapping at a reduced spindle speed.

position error".	motor. 2. Spindle speed too high for tapping. 3. Wrong number of spindle encoder counts.	3. See figure 1 below to verify encoder counts for the spindle encoder is set correctly. When the spindle is turned 1 revolution, the number of counts should change by the value that's in parameter 34 .
Tapping does not make it to the bottom of the hole. Not deep enough.	1. Not programmed deep enough. 2. Spindle is turning off too soon.	1. Check Intercon or G code program for depth. 2. Parameter 68, 69, and/or 82 may need adjusted as described above.
Breaking taps in blind holes or tapping too deep.	1. Programmed too deep. 2. Spindle is turning off too late. 3. Spindle speed is too high.	1. Check Intercon or G code program for depth. 2. Parameter 68, 69, and/or 82 may need adjusted as described above. 3. Slow down spindle speed.

From the main screen, press **F1 (Setup)** -> **F3 (Config)** -> enter "PASSWORD"->**F4 (PID)** to see the PID menu below.

Figure 1: Encoder Input

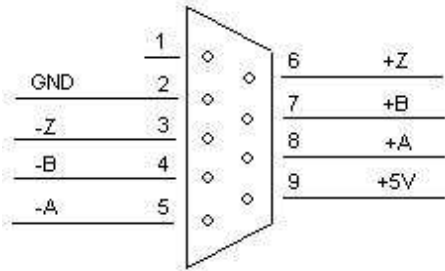
The screenshot displays the following information:

- WCS #1 (G54) Current Position (Inches):** X: -0.1308, Y: -0.2010, Z: +0.2468
- Job Name:** 04-4001A.cnc
- Tool:** T1 H---
- Feedrate:** 100%
- Spindle:** 0 A
- Status:** Stopped, 406 Emergency stop detected. Press CYCLE START to start job.
- Configuration Table:**

Axis	Limit	Kg	Kv1	Ka	Accel.	Max Rate
X	2000	0	0	0	0.500	300.0
Y	2000	0	1	39	0.050	330.0
Z	2000	0	2	38	0.050	300.0
N	1.000	0.00391	5.000	32000	0	0
N	0.000	0.00000	0.000	0	0	0
- PID Data Table:**

Axis	Error	Sum	Delta	PID Out	Abs Pos	Line	PID Collected
X*	0	0	0	OFF	-5233	1	
Y	0	0	0	OFF	-8041	2	
Z	0	0	2	OFF	9871	3	
N	0	0	0	OFF	-16	4	
N*	0	0	0	OFF	23710	5	
- Callouts:**
 - One callout points to the 'Delta' column in the PID table, stating: "Move axis or spindle to see the encoder index pulse, indicated by an '*'. Should be seen once per motor revolution."
 - Another callout points to the 'Line' column in the PID table, stating: "Check for axis or spindle encoder movement here if using encoder inputs 1-5. The 6th axis encoder input can be checked under <F8> Drive."
- Buttons:** PID (F1), Prog. (F2), Collect (F3), Tune (F5), Drag (F6), Drive (F8), Plot (F9).

Figure 2: Spindle Encoder Pin Out



Document History

Rev4 Modified on 2015-04-23 by #270
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