

# Effective multiple clamping Principle and application with SINUMERIK Operate

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## Effective multiple clamping for milling



### 1 Multiple clamping

- 1.1 Multiple clamping fundamentals
- 1.2 Using multiple clamping
- 1.3 Multiple clamping with SINUMERIK Operate

2 Practical example on a Mazak VTC 530C with SINUMERIK 828D

### 3 Summary

### **1** Fundamentals of multiple clamping

Ineffective utilization of the machining space with one clamping in the machine.





### **1** Fundamentals of multiple clamping

Linear arrangement of several vices in the machine space results in better utilization of that space.





### **1** Fundamentals of multiple clamping

The advantage of multiple clamping devices in the machining space is lost as the number of tool changes is multiplied.







Manual programming to optimize the machining sequence is complex to implement in G code.

### **Conventional machining** of components without optimizing the tool change



### **Optimized machining** (arrangement and fewer tool changes)

	Component #1	Component #2	Component #3	
1st tool change	Drilling	Drilling	Drilling	3 components x 3 tools
2nd tool change	Chamfering	Chamfering	Chamfering	=
3rd tool change	Threading	Threading	Threading	3 tool changes



Outside a CAD/CAM environment, optimizing the tool change is complex.

93 N0710 G0 Z100.

94 N0720 S1326 M3 M99 M8



1 ; \*\*\* Programm SINUMERIK 3x Milling 2 N0010 G17 G90 G64 G54 4 N0020 ; T01 DRILL D8.5 VHM 5 N0030 T01 6 N0040 M6 7 N0050 MSG ("DRILL D8.5 VHM") 8 N0060 MSG ("SM-DRILL") 10 N0070 MSG ("SM-DRILL ESP.AUFM.: R0. L0. ") 12 ; \*\*\* VORSCHUB PARAMETER \*\*\* 13 N0080 R62=524 ; Z-VORSCHUB 14 F=R62 15 N0090 G0 X-35, Y35, 16 N0100 G0 Z100. 17 N0110 S5243 M3 M99 M8 18 N0120 G0 X-35. Y35. 19 N0130 G0 Z100. 20 N0140 MCALL CYCLE81 (100.,0,2.,,32.554) 21 N0150 X-35. Y35. F=R62 22 N0160 X35. Y35. 23 N0170 X35. Y-35. 24 N0180 X-35. Y-35. 25 N0190 MCALL 26 N0200 G0 Z2 28 NO210 MSG ("SM-DRILL ESP.AUFM.: R0. L0. ") 30 ; \*\*\* VORSCHUB PARAMETER \*\*\* 31 N0220 R62=524 ; Z-VORSCHUB 32 F=R62 33 N0230 G0 X115. Y35. 34 N0240 G0 Z100. 35 N0250 S5243 M3 M99 M8 36 N0260 G0 X115. Y35. 37 N0270 G0 Z100. 38 N0280 MCALL CYCLE81 (100.,0,2.,,32.554) 39 N0290 X115. Y35. F=R62 40 N0300 X185. Y35. 41 N0310 X185. Y-35. 42 N0320 X115. Y-35. 43 N0330 MCALL 44 N0340 G0 Z2. 46 N0350 MSG ("SM-DRILL ESP.AUFM.: R0. L0. ") 

48 ; \*\*\* VORSCHUB PARAMETER \*\*\* 49 N0360 R62=524 ; Z-VORSCHUB 50 F=R62 51 N0370 G0 X265, Y35, 52 N0380 G0 Z100. 53 N0390 S5243 M3 M99 M8 54 N0400 G0 X265. Y35. 55 N0410 G0 Z100. 56 N0420 MCALL CYCLE81 (100.,0,2.,,32.554) 57 N0430 X265. Y35. F=R62 58 N0440 X335, Y35, 59 N0450 X335. Y-35. 60 N0460 X265. Y-35. 61 N0470 MCALL 62 N0480 G0 Z2. 63 N0490 ; T01 CENTERDRILL D12 HSS 64 N0500 T01 65 N0510 M6 66 N0520 MSG ("CENTERDRILL D12 HSS") 67 N0530 MSG ("SM-CENTERDRILL") 69 N0540 MSG ("SM-CENTERDRILL ESP.AUFM.: R0. L0. ") 71 ; \*\*\* VORSCHUB PARAMETER \*\*\* 72 N0550 R62=159 ; Z-VORSCHUE 73 F=R62 74 N0560 G0 X-35. Y35. 75 N0570 G0 Z100. 76 N0580 S1326 M3 M99 M8 77 N0590 G0 X-35. Y35. 78 N0600 G0 Z100. 79 N0610 MCALL CYCLE81 (100.,0,2.,,5.75) 80 N0620 X-35. Y35. F=R62 81 N0630 X35. Y35. 82 N0640 X35. Y-35. 83 N0650 X-35, Y-35, 84 N0660 MCALL 85 N0670 G0 Z2. 87 N0680 MSG ("SM-CENTERDRILL ESI 89 ; \*\*\* VORSCHUB PARAMETER \*\*\* 90 N0690 R62=159 ; Z-VORSCHUB 91 F=R62 92 N0700 G0 X115. Y35.

94 N0720 S1326 M3 M99 M8 95 N0730 G0 X115, Y35, 96 N0740 G0 Z100. 97 N0750 MCALL CYCLE81 (100.,0,2.,,5.75) 98 N0760 X115. Y35. F=R62 99 N0770 X185, Y35, 100 N0780 X185. Y-35. 101 N0790 X115. Y-35. 102 N0800 MCALL 103 N0810 G0 Z2. 105 NO820 MSG ("SM-CENTERDRILL ESP.AUFM.: R0. L0. ") 107 ; \*\*\* VORSCHUB PARAMETER \*\*\* 108 N0830 R62=159 ; Z-VORSCHUB 109 F=R62 110 N0840 G0 X265, Y35, 111 N0850 G0 Z100. 112 N0860 S1326 M3 M99 M8 113 N0870 G0 X265. Y35. 114 N0880 G0 Z100. 115 N0890 MCALL CYCLE81 (100.,0,2.,,5.75) 116 N0900 X265. Y35. F=R62 117 N0910 X335. Y35. 118 N0920 X335. Y-35. 119 N0930 X265. Y-35. 120 N0940 MCALL 121 N0950 G0 Z2 122 N0960 ; T03 M10 123 N0970 T03 124 N0980 M6 125 N0990 T01 : WZ-VORWAHL 126 N1000 MSG ("M10") 127 N1010 MSG ("SM-THREAD M10") 

Complex, for quick change directly at the control system inflexible, G-code output

The "Multiple clamping" function is available under ShopMill.







Automatic optimization and fewer tool changes facilitates effective machining and more components in the machine space.

### **1** Multiple clamping with SINUMERIK Operate

ShopMill facilitates user-friendly multiplication of machining programs with high process reliability.



ŀ	1C/L	jks/multi_clamping/mc_lin_:	3TIM_MC_3X/MC3 1	Select
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	þ	Clamping	1 G54	Decild
	\$	Face milling $\nabla$	T=ALU_D63 F=0.25/t U=450m X0=-52.5 Y0=-52.5	Build
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±		POCKET_DOWN_F		
+		POCKET_RIGHT_F		Find
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÷	E	POCKET_LEFT_F		Mark
	ē,	Clamping	1 G54	TIAIK
	勴	Settings	Block centered G17 SC2 RP100 Down-cut	
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	e	Clamping	2 G55	
	鼠	Settings	Block centered G17 SC2 RP100 Down-cut	
	Ø	Circular pocket $\nabla \nabla \nabla$	T=ALU_D12_R1.5 F=0.05/t U=550m X0=0 Y0=0	Paste
	e.	Clamping	3 G56	
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	ę	Clamping	1 G54	
		Settings	Block centered G17 SC2 RP100 Down-cut	E
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	•	Edit Z Drilling Z Milling	Cont. Vari- mill. Vari- ous Simu-	Ex− ecute

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The "Multiple clamping" function is selected in the Program Manager and then in the menu extension. The number of clamping operations and the work offset are defined there.

## 1 Multiple clamping with SINUMERIK Operate

The multiple clamping function is in the Program Manager with subsequent menu extension.



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The arrangement of multiple clamping operations depends on the batch size to be machined.

Linear arrangement of several clamping operations

Flat clamping systems, own clamping systems or several vises

Longitudinal multiple clamping systems

Clamping arrangements with rotating axis are suitable for large batch quantities

Reversible clamping device (vertical milling machines, the rotary axis/axes has/have to be prepared)

Stacked plates (horizontal milling machines, the rotary axis/axes has/have to be prepared)









## 1 Multiple clamping with SINUMERIK Operate

The CUST\_CLAMP defines the switch condition for the rotary axis when using rotating/reversible clamping devices.

- A 4th axis (= rotary axis) is required when using reversible/rotating clamping devices.
- CUST\_CLAMP defines the switch condition of the rotary axis
- Generates an executable, multiple clamping program from single workpiece programs.
- Only clocking the rotary axis to bring the workpiece into the correct machining position; no swiveling with CYCLE 800!
- Changes require intervention in the PLC.

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### Multiple clamping with SINUMERIK Operate CUST\_CLAMP.spf\*



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; PARAMETER:¶ ;¶ ;_NPV : Number of the 1st vork offset¶ ; 0 = G500¶ ; 1 = G54¶	Mark Copu	; G00 A = DC(270)¶ ; ENDIF ¶ ¶ _NV=_NPV+_ACT ; calculate the number of the actual work offse t¶ ; ¶		
;¶ ; _PREV : Number of the previous clamping positio ; _ACT : Number of the actual clamping position ; _NEXT : Number of the next clamping position (-	SIEMENS  SINUMERIK OPERATE    ( NC/CMA.DIR/CUST_CLAMP.SPF	N10 G[8]=_NV ; here is no calculation allowed¶ ;		
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Unrestricted © Siemens AG 2019	G00 RA1 = DC(0)¶ ENDIF¶ ¶ ;G556 G557¶ IF ((_ACT==3) OR (_ACT==4)) ¶ MSG("AUFSPANNUNG "<<_ACT)¶ G00 RA1 = DC(180)¶ ENDIF ¶ ¶ ;G558 G559¶ IF ((_ACT==5) OR (_ACT==6)) ¶ Edit	Copy Paste Cut Cut Cut		

## 1 Multiple clamping with SINUMERIK Operate

In one clamping situation, identical or different parts can be machined.



### Different programs Same programs 30G ₩ 306 啗 啗 i 05/06/19 1:19 PM í SIEMENS SIEMENS Select Select Date Length Name Type Length Time Name Date Time Type program program DIR 03/29/19 7:07:28 AM 🗄 🗀 Part programs DIR 03/29/19 7:07:28 AM 🖶 🗀 Part programs 🖶 🗀 Subprograms 🗄 🗀 Subprograms DIR 03/29/19 7:07:19 AM DIR 03/29/19 7:07:19 AM 🖻 🖻 Workpieces DIR 🖮 🗁 Workpieces DIR 05/06/19 1:15:06 PM 05/06/19 1:15:06 PM 🖶 🗀 FORMENBAU WPD WPD 03/29/19 7:07:29 AM 03/29/19 7:07:29 AM 5 PM 5 PM CHAN1 Multiple clamping Multiple clamping PM 🗄 🖻 M PM 🗄 🦰 M 🖹 No. WO No. WO Name PM B Name PM 3 PM 6 PM $\left( \rightarrow \right)$ 1 G54 MC\_3TIM\_LIN\_MC\_3X.MPF [→] 1 G54 MC\_3TIM\_LIN\_MC\_3X.MPF 🗄 🧰 TEST 48 AM 🖮 🧰 TEST 48 AM 2 G55 NC/Workpieces/TEST.WPD/TEST.MPF 2 G55 MC\_3TIM\_LIN\_MC\_3X.MPF 3 G56 NC Extend/TOBIAS.WPD/SALESTRAIN\_MAZAK/FORMPL 3 G56 MC\_3TIM\_LIN\_MC\_3X.MPF Delete Delete entru entru Delete Delete all all × X Cancel Cancel $\checkmark$ $\checkmark$ NC/Workpieces/MULTI CLAMPING.WPD/MC\_LIN\_3TIM\_MC\_3X.WP NC/Workpieces/MULTI\_CLAMPING.WPD/MC\_LIN\_3TIM\_MC\_3X.WP Free: 6.4 MB Free: 6.4 MB OK OK

### **2** Practical example at a Mazak VTC 530C with SINUMERIK 828D







The following must be taken into consideration from the user's perspective:

- Only in ShopMill: no G-code programming
- No marks/repetitions, work offsets or coordinate transformations in the program
- The "Starting point" parameter must not be set to "manual" in the stock removal cycle (contour milling, pocket).

Advantages for the user:

- Fewer tool changes reduces idle times → Maximized machining times
- Effective use of the available clamping area on the machine table
- Reduced programming work
- User-friendly, multiplication of machining programs with high process reliability
- Multiple clamping is also possible under CAD/CAM

## Maximum productivity with the greatest flexibility.

### **Produced by**





### **Digital Experience and Application Center Erlangen**

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