



Multi-tip tools in Pro/NC

Beat Fretz

Multi-tip Tools: Since Pro/ENGINEER Wildfire 2.0

For current tools

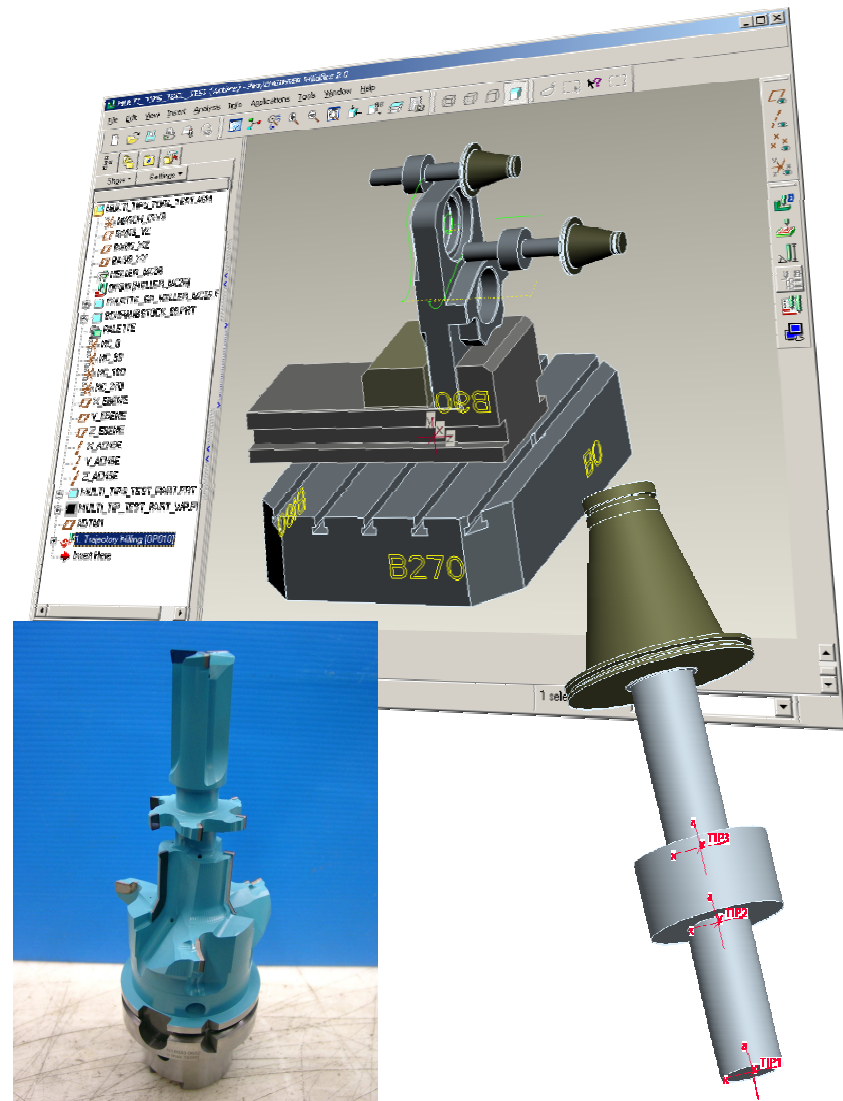
- Multiple Controlpoints (Length Offsets)
- Replacement of OSETNO_VAL and Z_GAUGE_Offset
- For all milling sequences

New Tool Type : Multi-tip

- Only for drilling (incl. Custom Cycle), and 2- / 3-axis trajectory
- Since WF 3.0 for manual sequence
- Defined by
 - Tip #, z-offset, diameter and angle

CL Data Output

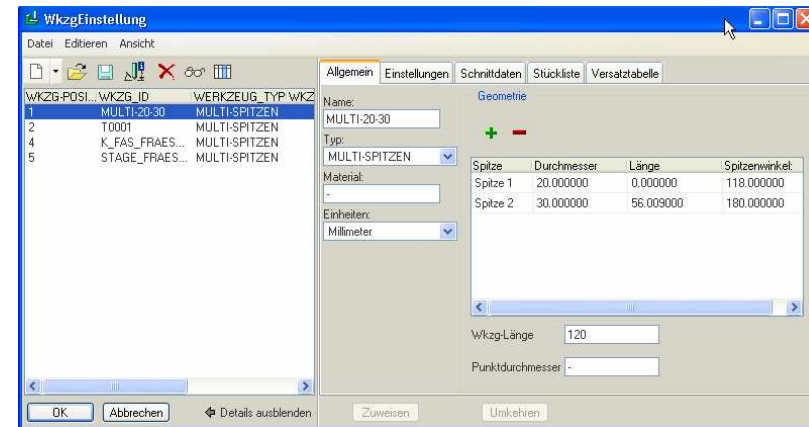
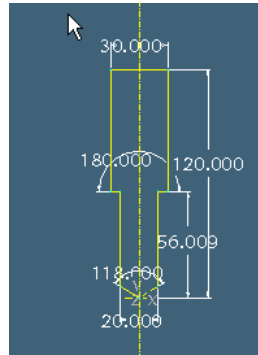
- CL coordinates in regard of tip point
- LOADTL/tool number, OSETNO, offset number
- PPRINT with additional tool information



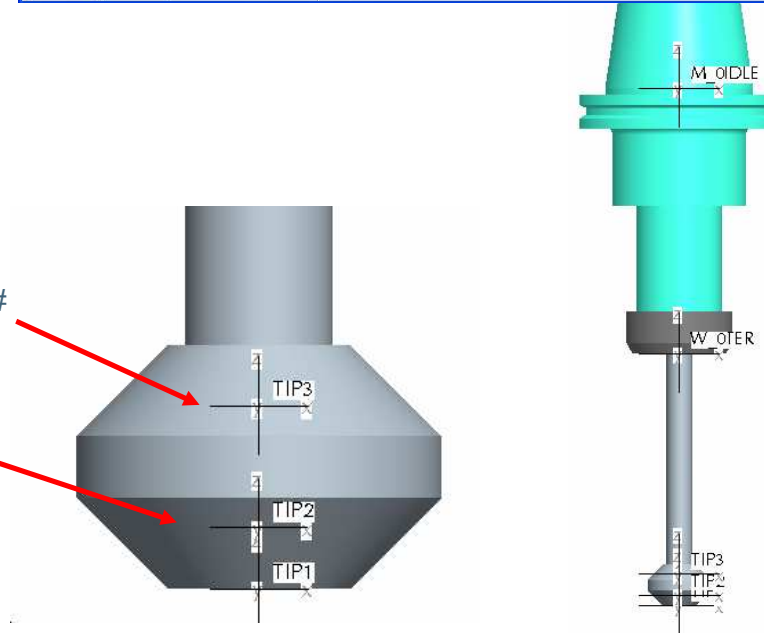
Multi-tip tools

Tool definition

- Parameter tool
 - Simple and fast to define
 - Not suitable for all geometrical forms



- 3D model (recommended)
 - Better collision detection
 - Not limitation on geometry
 - Higher tip # can have smaller diameter than lower tip #
 - Tip point can reside anywhere on a cutting edge

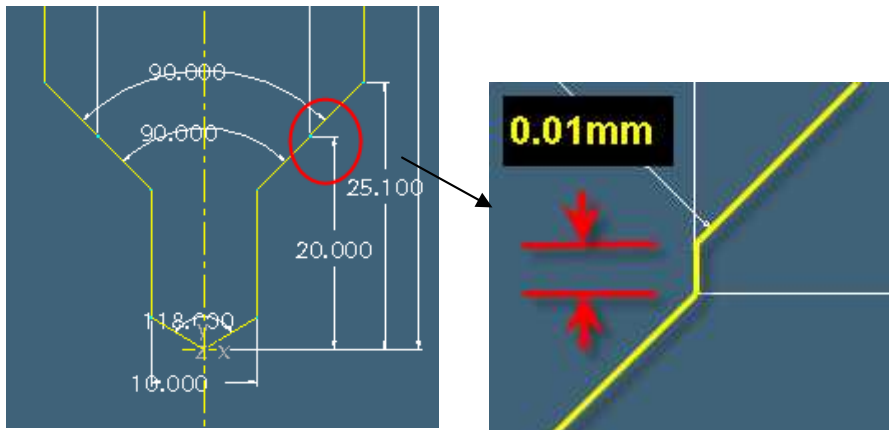


Multi-tip tools

Parameter tool

- Cannot be used for all forms !
 - Tip in the middle of a cutting edge
 - Tool cannot be viewed because, the edge length is 0 mm
 - Depending on accuracy (e.g. 0.01mm), the tool can be viewed, but
 - Careful: Such tools can often not be displayed in shaded mode during simulation
- **Better use 3D tool instead !!**

Spitze	Durchmesser	Länge	Spitzenwinkel:
Spitze 1	10.000000	0.000000	118.000000
Spitze 2	20.000000	20.000000	90.000000
Spitze 3	30.000000	25.000000	90.000000



Spitze	Durchmesser	Länge	Spitzenwinkel:
Spitze 1	10.000000	0.000000	118.000000
Spitze 2	20.000000	20.000000	90.000000
Spitze 3	30.000000	25.010000	90.000000

Multi-tip tools

Setup

- Config.pro (up to Wildfire 2.0) „allow_multiple_tool_tips yes“
- PPRINTS

– Div. Tool informations

TOOL_NAME	Ja
TOOL_TYPE	Ja
TOOL_POSITION_NUMBER	Ja
TOOL_COMMENTS	Ja
TOOL_PARAMETERS	Ja
TOOL_OFFSET_NUMBER	Ja

- „TIP_CONTROL_POINT YES“

TIP_CONTROL_POINT	Ja
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– TOOLINFO START

– TOOLINFO_END

- LOADTL ,5 / OSETNO ,1 / \$\$-> stufe 1
- Tool # / Offset # / Comment per tip

```

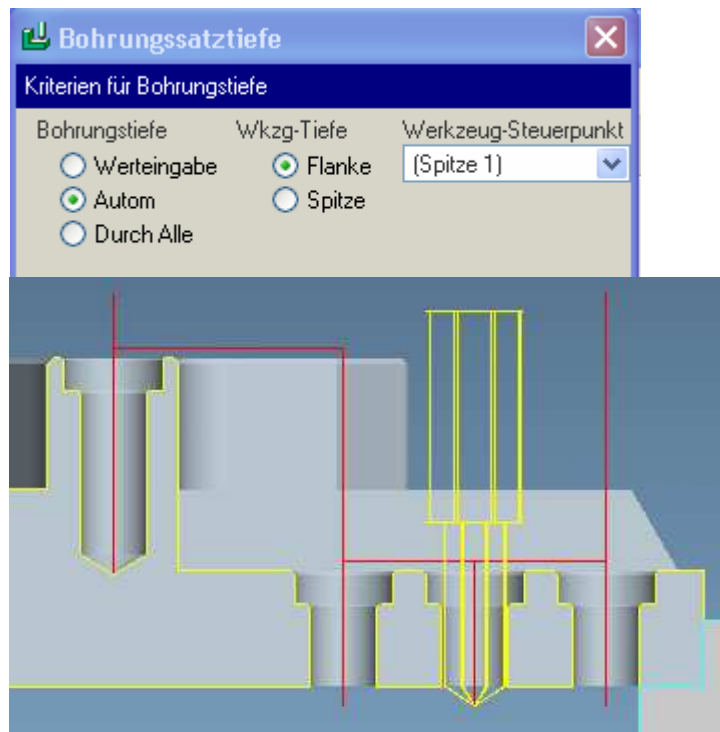
0  $$*   Pro/CLfile Version Wildfire 3.0 - M040
1  $$-> MFGNO / MULTI
2  PARTNO / MULTI
3  $$-> FEATNO / 534
4  MACHIN / UNCX01,1
5  $$-> CUTCOM_GEOMETRY_TYPE / OUTPUT_ON_CENTER
6  UNITS / MM
7  PPRINT / TOOL NAME : STAGE_FRAESER_1
8  PPRINT / TOOL_TYPE : MULTI_TIP
9  PPRINT / TOOL POSITION NUMBER : 5
10 PPRINT /      TOOL COMMENTS
11 PPRINT / STUFENWERKZEUG
12 PPRINT / TOOL_OFFSET NUMBER : 1
13 $$ TOOL_INFO_START
14 PPRINT / TOOL TIP CONTROL POINT : 1
15 PPRINT / TOOL LENGTH OFFSET : 0.000000
16 PPRINT / TOOL DIAMETER : 35.000000
17 PPRINT / TOOL COMMENT : stufe1
18 $$ TOOL_INFO_END
19 LOADTL / 5, OSETNO, 1 $$-> stufe1
20 $$-> CSYS / 1.0000000000, 0.0000000000, 0.0000000000, 0.0000000000, $
21      0.0000000000, 1.0000000000, 0.0000000000, 0.0000000000, $
22      0.0000000000, 0.0000000000, 1.0000000000, 0.0000000000
23 SPINDL / RPM, 500.000000, CLW
24 COOLNT / ON
  
```

Multi-tip tools – Standard Drilling

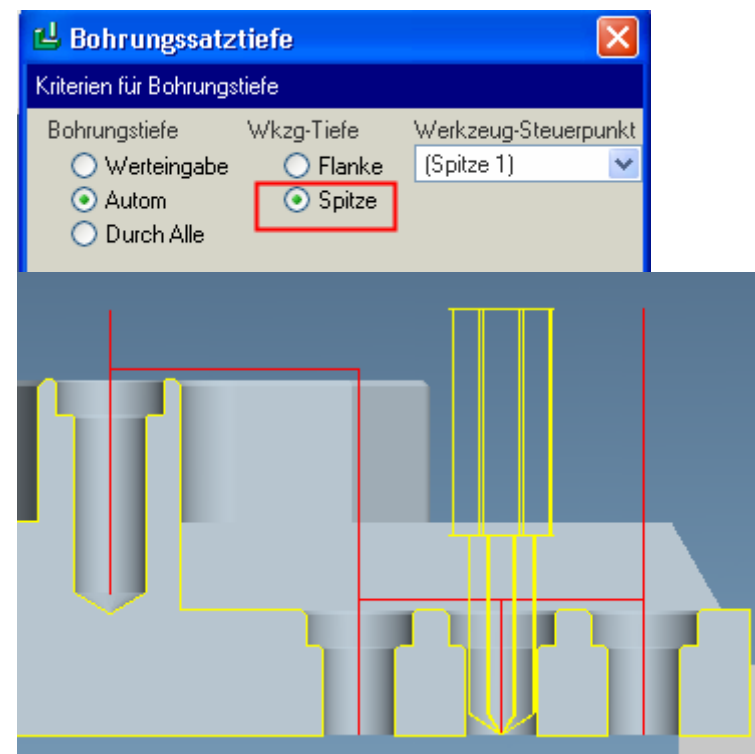
Standard drilling using Tip 1

- Selection of Tip number and tool depth reference

Tool depth = Shoulder
 Tool Tip Point = Tip 1



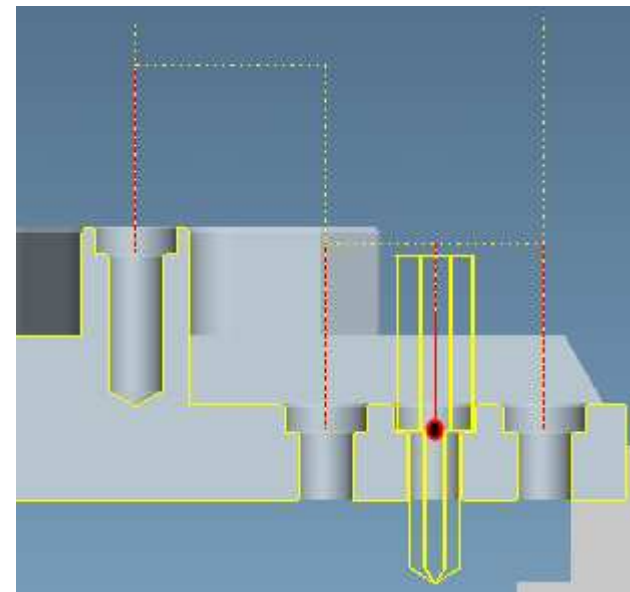
Tool depth = Tip
 Tool Tip Point = Tip 1



Multi-tip tools – Standard Drilling

Standard drilling using Tip 2

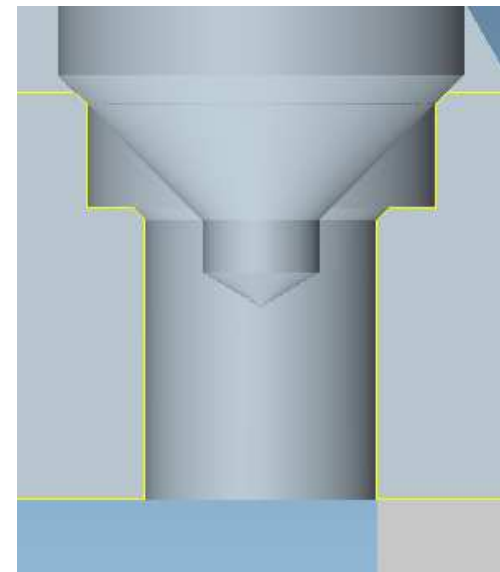
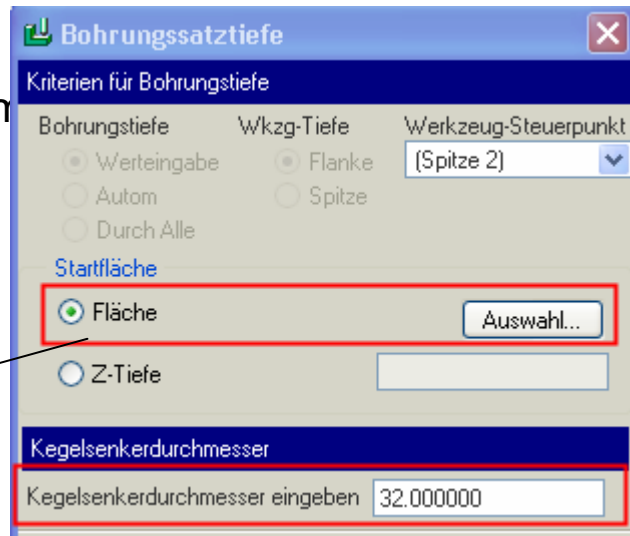
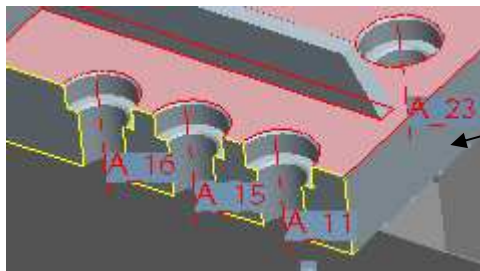
- Selection of Tip number and tool depth reference
- Automatic Hole depth recognition
- Clearance automatically in regard of lowest tool tip point



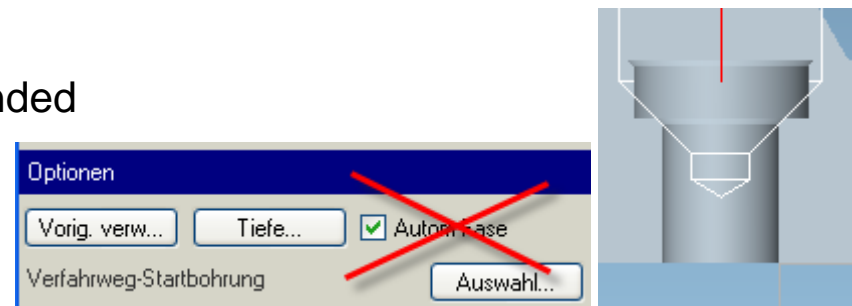
Multi-tip tools – Countersink

Countersink

- Selection of tip to be used
- Selection of start surface
- Definition of countersink diameter



- Note: Use of „Auto Chamfer“ is not recommended
 - Can lead to unpredicted results

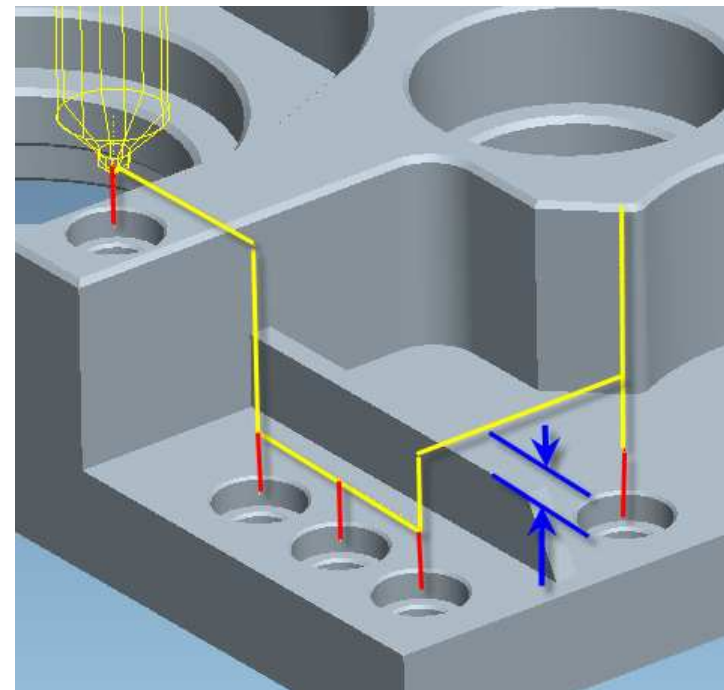


Multi-tip tools – Countersink

Collision detection

- Reference part selected as check surface
- Results in shortest collision free tool path
- Collision detection in regard of lowest tip point, eventhough the current tool path uses only Tip 2 for machining

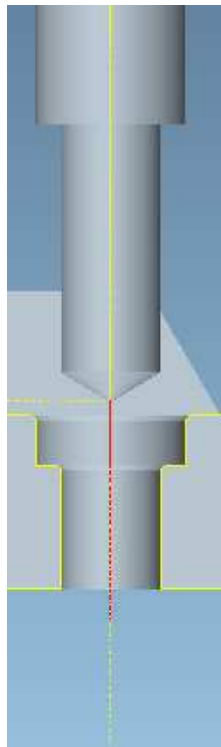
Countersink with Tip 2



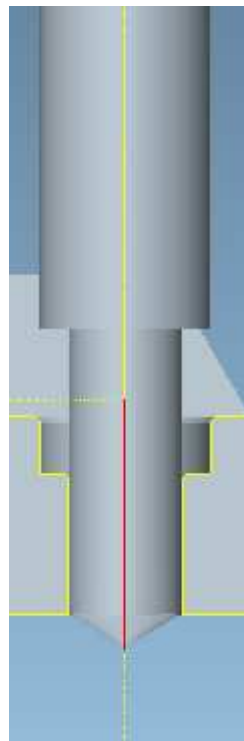
Multi-tip tools – Custom Cycle

Custom Cycle

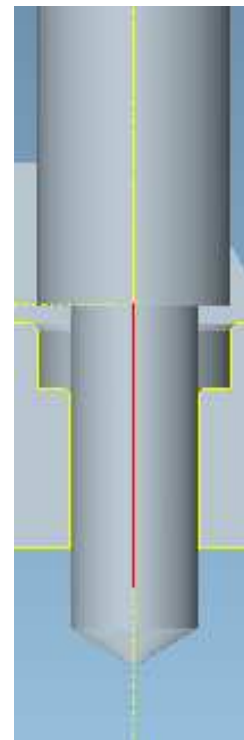
- Drilling (Tip1, S1, F1) und 180 degrees sinking (Tip2, S2, F2)



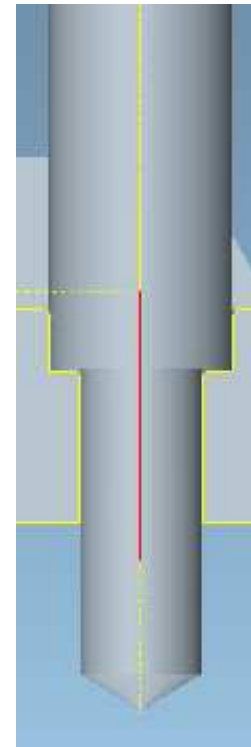
Tip1
S= S1
F=Rapid



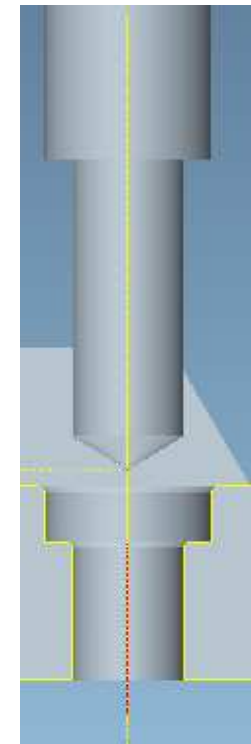
Tip1
S= S1
F=Feed1



Tip2
S= S2
F=Rapid



Tip2
S= S2
F=Feed2



Tip1
S= S1
F=Rapid

Multi-tip tools – Custom Cycle

Definition of cycle

- Selection of references
- Definition of variables
- Selection of Tip #

Zyklus anpassen

Datei Editieren

Zyklusname: multi_20_30

Zyklustyp: multi_20_30

Zyklus-Eingabeaufforderungen

Name	Typ	Beschreibung
start surface	Referenz	start surface
end surface	Referenz	end surface
spindle_2	Variabel	
feed_2	Variabel	
end_surface_tip2	Referenz	
depth	Ausdruck	$depth = + start\ surface - end\ surface + \text{ÜBERLAUF}$
depth_tip2	Ausdruck	$depth_tip2 = + start\ surface - end_surface_tip2$
spindle_1	Ausdruck	$spindle_1 = + SPINDEL_DREHZAHL$

Zyklusbewegung

Baum	Vertikale Ref.	Vertikaler Versatz	Wert
multi_20_30			
GOTO CPNT0	-	↑ start surface SICHERHEITSABST...	
GOTO CPNT1	-	↓ end surface ÜBERLAUF	
VORSCHUB_RATE			CUT
SPITZEN_STEURPUNKT			1
SPINDEL_DREHZAHL			spindle_1
GOTO CPNT2	-	CPNT0	
SPINDEL_DREHZAHL			spindle_2
VORSCHUB_RATE			FREE
SPITZEN_STEURPUNKT			2
GOTO CPNT3	-	end_surface_tip2	
SPINDEL_DREHZAHL			spindle_2
VORSCHUB_RATE			feed_2
SPITZEN_STEURPUNKT			2
GOTO CPNT4	-	CPNT0	
VORSCHUB_RATE			FREE
SPITZEN_STEURPUNKT			1

Multi-tip tools – trajectory milling

Trajectory

- One automatic_cut per machining geometry
- Optimised connections
 - Goto Point
 - Tangent etc..

Autom Schnitt

- Autom Schnitt
- Skizze folgen
- Pkt anfahren
- Inkr anfahren
- Ziel anfahren
- Eintauchen
- Rückzug
- Tang anfahren
- Tang wegfahren
- Senkr anfahren
- Senkr wegfahren
- Kreisförmig anfahren
- Kreisförmig wegfahren
- Spiralförmig anfahren
- Spiralförmig wegfahren
- CL-Befehl

Anpassen

Aktuelle Wkzg-Bewegung(en)

<Beginn des WkzgWegs>

- 1: Autom Schnitt
- 2: Pkt anfahren
- 3: Folgeschnitt
- 4: Pkt anfahren
- 5: Autom Schnitt
- 6: Tang anfahren
- 7: Folgeschnitt
- 8: Autom Schnitt
- 9: Tang anfahren
- 10: Folgeschnitt

<Ende des WkzgWegs>

- Different parameter setting per cut

5. LEIT_GR_BOHR... Wkzgsteuerungs-ka... Wkzgsteuerungs-ka... Wkzgsteuerungs-kante ID 544				
VORSCHUB	200	(200)	100	100
SCHNITT_VORSCHUB				

- Selection of Tip # per cut (TIP_CONTROL_POINT)

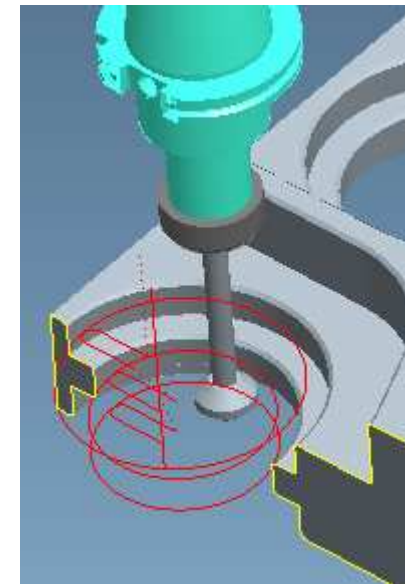
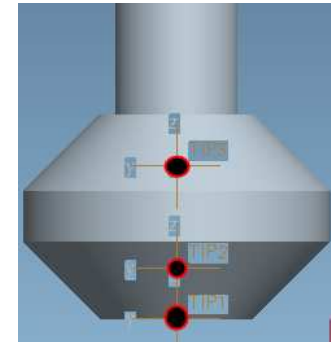
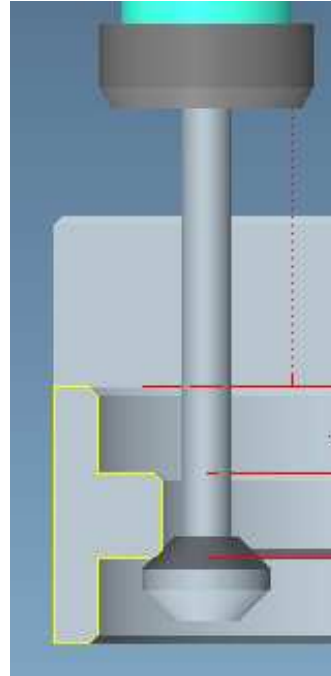
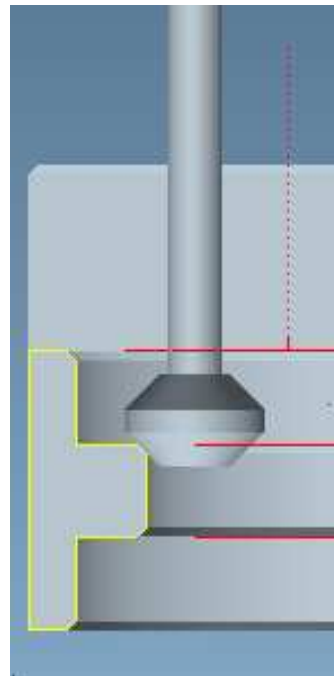
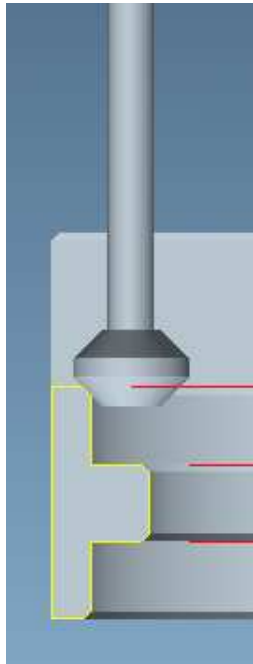
SPITZEN_STEURPUNKT	(1)	(1)	2	3
WKZGWCHSEL_SPTZ_NR	(URSPRÜNGLICH)			

- Selection of Tip for last move (TLCHG_TIP_NUMBER = CURRENT or INITIAL)

Multi-tip tools – trajectory milling

Trajectory

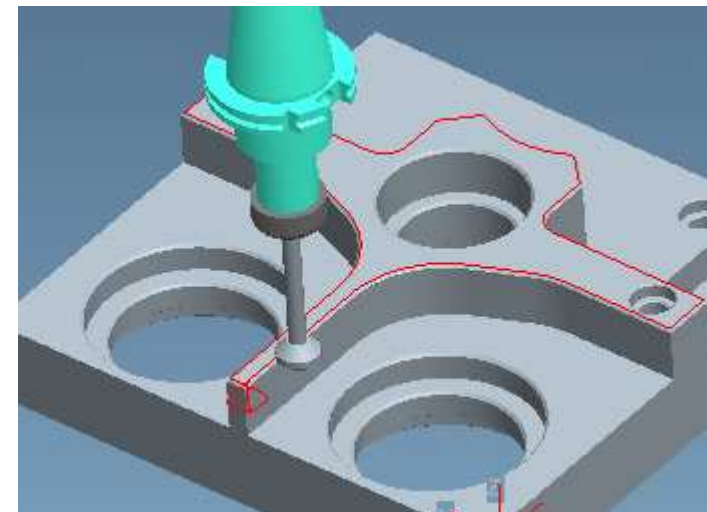
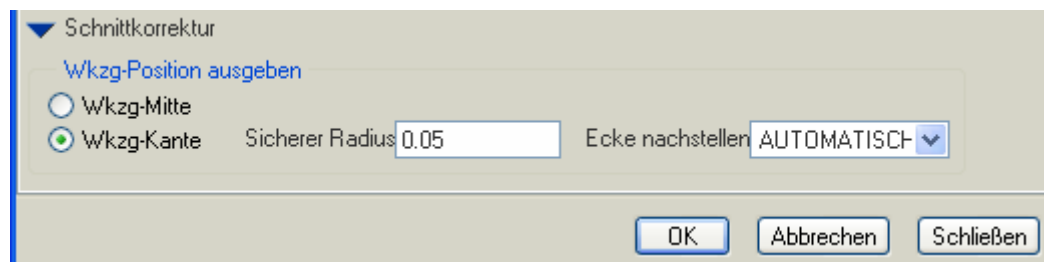
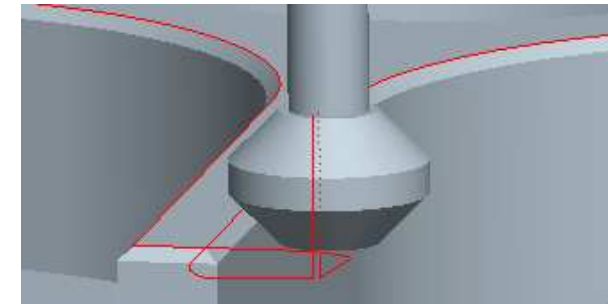
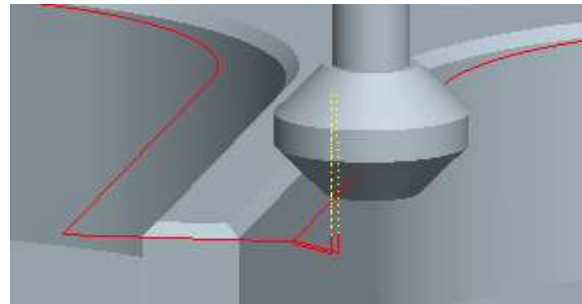
- Create chamfer with a multi-tip tool



Multi-tip tools – trajectory milling

Trajectory

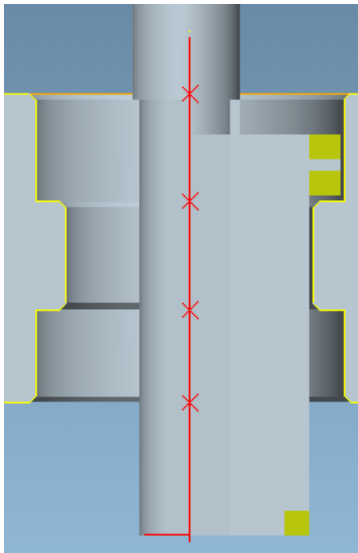
- Cutter Compensation
 - Tool-Center
 - Tool-Edge



Multi-tip tools – trajectory milling

Single Step Programming

- GOTO Point
- GO_DELTA
- Selection of Tip #
- Cut feed
- SPINDLE_SPEED or SPINDLE_ORIENT



Pkt anfahren

Wkzgbewegungs-Parameter festlegen:

Spitze# [Spitze 1]

Vorschub... FEDRAT / 100.000, MMPM

Spindel... SPINDL / RPM, 300.000, CLW

Kühlmittel... COOLNT / OFF

Ziel-Anfahrpunkt: Punkt festlegen... Versatzwerte: Versatz festlegen...

Achsen festlegen, entlang derer sich Werkzeug bewegt:

Simultan X-Achse Y-Achse Z-Achse

Z zuerst

Z zuletzt

OK Vorschau Abbrechen

Wkzgbewegungs-Parameter festlegen:

Spitze# [Spitze 1]

Vorschub... (Spitze 1)
Spitze 1

Spindel... Spitze 2
Spitze 3

Vorschubparameter

Vorschubgeschw 45.000

Vorschubeinheiten MMPM

Spindelparameter

Spindeldrehzahl [300]

Spindelsteuerung **KONST_ORIENT**

Spindeldrehrichtung (UHRZEIGERSINN)

Max Spindel-U/min [-]

Bereichszahl [0]

Spindelbereich (KEIN_BEREICH)

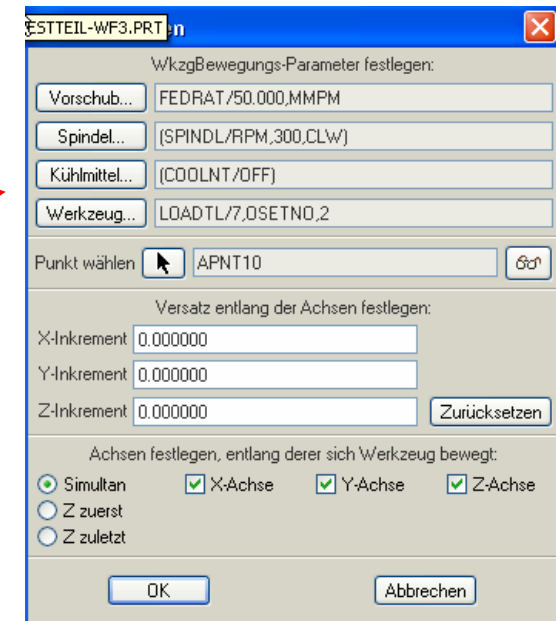
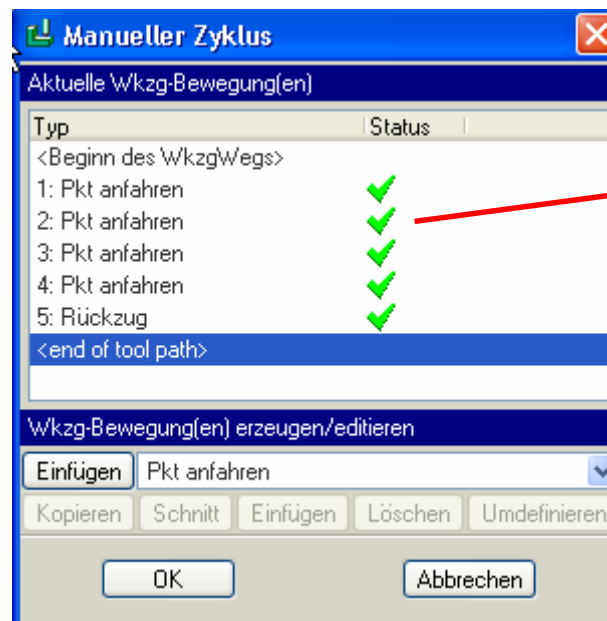
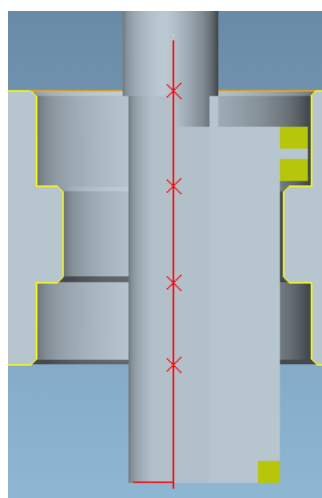
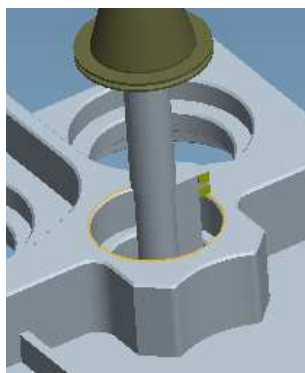
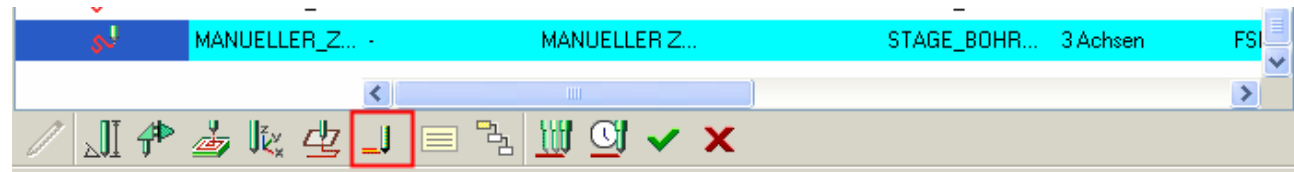
Orient Winkel **0.000000**

Knickabstand -

Multi-tip tools – manual cycle

Single Step programming directly in process manager

- GOTO Point
- GO_DELTA
- Selection of Tip #
- Cut feed
- SPINDLE_SPEED or SPINDLE_ORIENT





Multi-tip Tools in Pro/NC Erfahrungen bei ZF Friedrichshafen

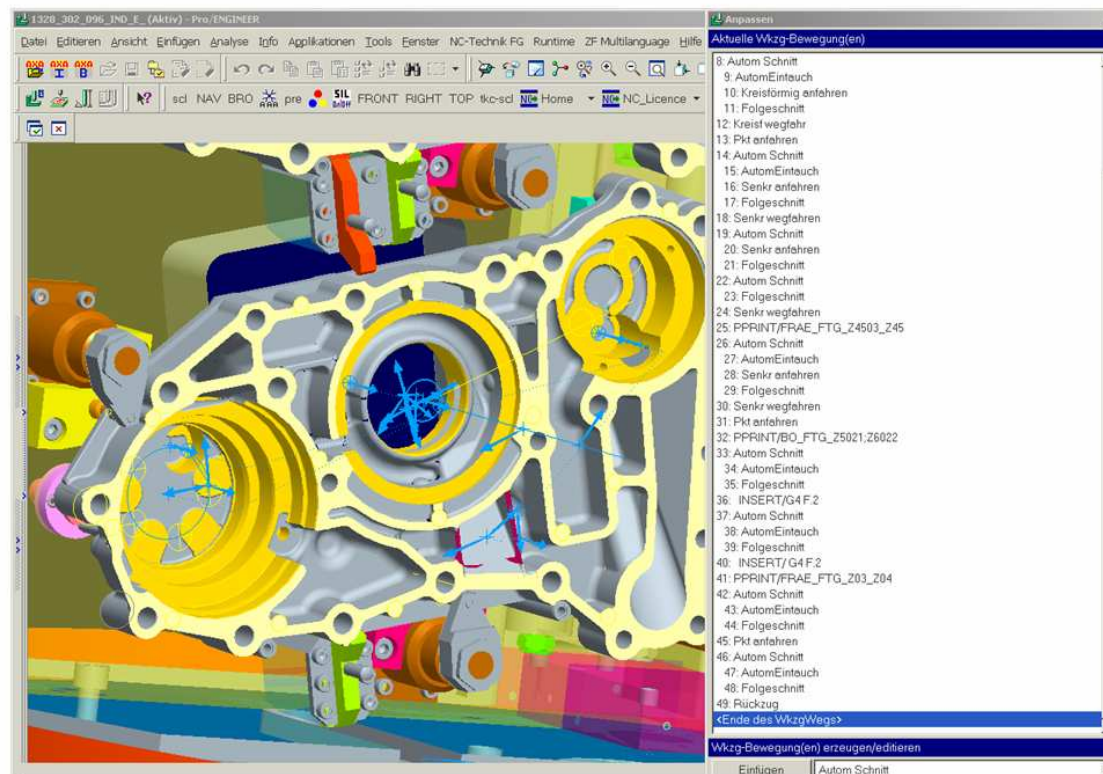
Winfried Geßler

Multispitzenwerkzeuge: Erfahrungen bei ZF Friedrichshafen



Stage Tool: Definition of the tool path

The whole tool path of a stage tool can be defined in a single NC-sequence. In the following example the tool path for 3 different tool tips will be defined by 10 automated steps.



IEF-N Geßler 5

Visit at PTC July 2006

Copy right ZF

Multispitzenwerkzeug: Erfahrungen bei ZF Friedrichshafen



Stage Tool: the benefit for the Pro/NC user and ZF

The benefit:

- Simple and stable programming and simulation of the tool paths.
- Time optimized NC paths for serial production can be created because of the definition of the complete tool path by a single NC sequence.
- For each automated cut the needed tip of the tool can be chosen.
- The connection between the single working steps can be controlled by the function „Goto Point“ in an optimal manner.
- Very good process stability by saving all tool dependent data in the tool and not distributed over tool and NC sequence parameter.

