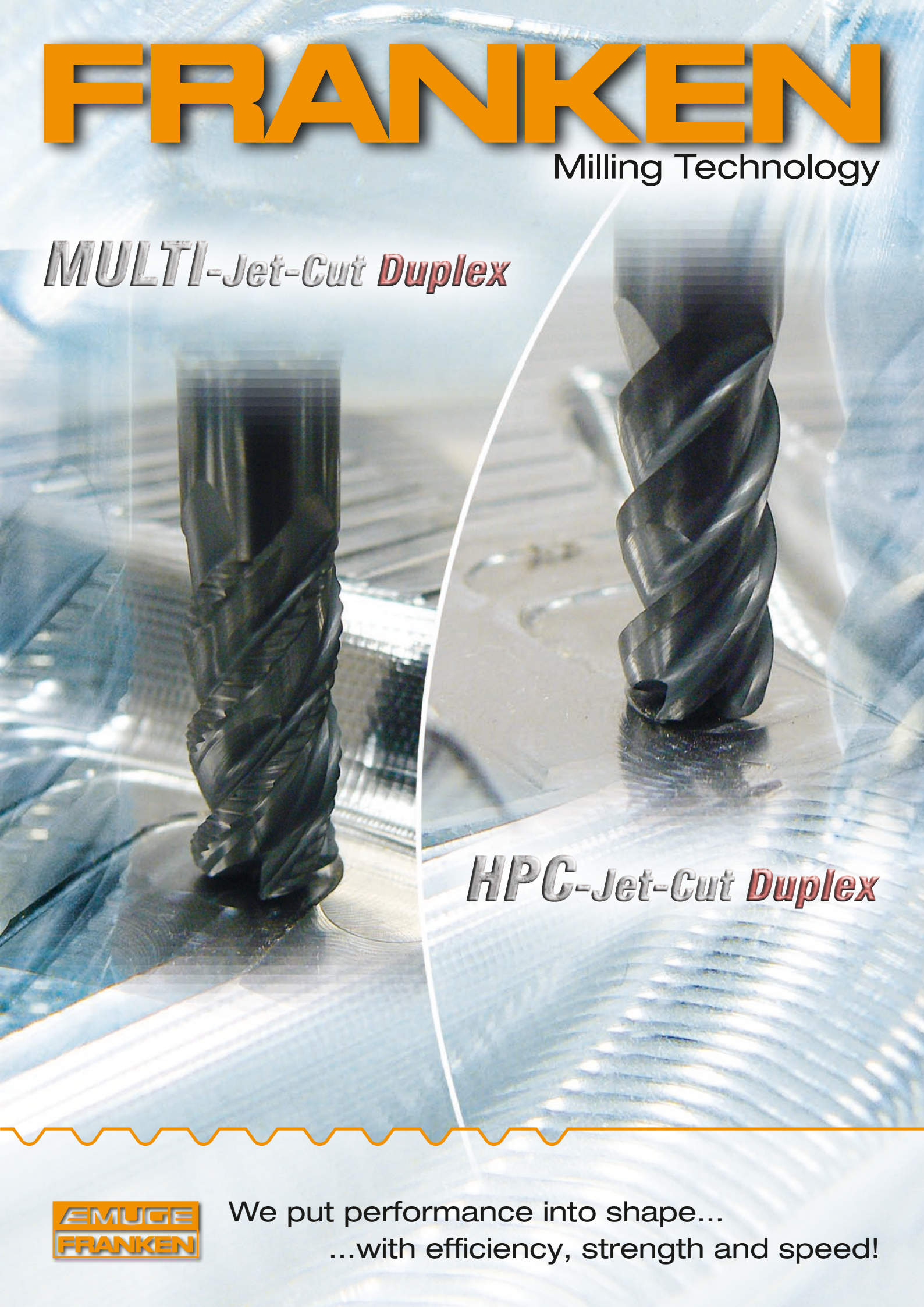
FRANKEN

Milling Technology

MULTI-Jet-Cut Duplex



HPC-Jet-Cut Duplex

EMUGE FRANKEN

We put performance into shape...
...with efficiency, strength and speed!

MULTI-Jet-Cut line — Patent no.: 103 25 600

MULTI-Jet-Cut Duplex

With the **Duplex** tools, FRANKEN is treading new paths in milling. The term **Duplex** comes from Latin and means as much as “double” or “two-fold.” With the FRANKEN **Duplex** tools, both meanings apply. They make it possible to do pocket and slot milling (2D) as well as complex 3D operations like copy and high-feed milling with **only one tool. The Duplex series will reduce the number of tool places in your workshop!** In the face area, the **Duplex** cutter has a ground double-radius geometry **(Duplex geometry)** which permits highest feeds with appropriate axial depth-of-cut values. The name **Duplex** thus refers not only to the variety of possible applications but also to the new, patented cutting geometry.

Advantages

- High flexibility due to two constructional lengths
- Low machining forces due to roughing serration
- No tendency to vibrate due to variable irregular spacing
- Perfect chip transport due to S-geometry on the tool face
- Internal coolant-lubricant supply (IKZ) as standard
- Maximum application flexibility by combining two tools in one
- Reduction of tool places and tool changes in your machine

What is the right application for the MULTI-Jet-Cut Duplex?

The special feature of the **MULTI-Jet-Cut Duplex** is the newly developed high-feed geometry on the cutting face. This special geometry permits extremely high feed-per-tooth values with adjusted depth of cut. The circumference cutting edge with the highly successful **MULTI-Jet-Cut** roughing serration makes extremely high machining volumes possible in milling. The coolant-lubricant supply integrated into the cutters as standard improves chip transport in a dramatic way. This helps to considerably improve tool life as well as process safety with high feed values. We recommend this tool for the machining of materials with a hardness of up to approx. 48 HRC.
For the machining of even harder materials up to 66 HRC, we recommend our tool type **HPC-Jet-Cut Duplex** (see pages 4-5).

Application cases for the MULTI-Jet-Cut Duplex

- Pocket milling jobs of any kind where there are no requirements as to surface quality
- 2D roughing applications, slots, pockets with normal NC cycles
- Relief milling jobs of any kind
- 3D roughing applications, high-feed milling, line-by-line and copy milling to finishing allowance
- Helical drill milling, drill milling

Application example 1:

3D roughing job:	3D contour, length 160 mm x width 160 mm x height 30 mm
Material:	Cold work steel 1.2312 (1000 N/mm²) – cooling with internal air supply and cold-air nozzle [1)]
Tool:	***MULTI-Jet-Cut Duplex*** dia. 10 mm (art. no. 2614AZ.010)
Cutting data:	v_c 250 m/min – f_z 0.38 mm – a_p 0.7 mm – a_e 6 mm

Application example 2:

2D roughing job:	Pocket milling, length 60 mm x width 60 mm x depth 22 mm
Material:	Tool steel 1.1730 (800 N/mm²) – cooling with internal air supply and cold-air nozzle [1)]
Tool:	***MULTI-Jet-Cut Duplex*** dia. 10 mm (art. no. 2614AZ.010)
Cutting data:	v_c 180 m/min – f_z 0.06 mm – a_p 11 mm – a_e 6 bis 10 mm

Application example 3:

2D roughing job:	Slot milling, length 160 mm x width 10 mm x depth 15 mm
Material:	Cold work steel 1.2085 (1100 N/mm²) – cooling with internal air supply and cold-air nozzle [1)]
Tool:	***MULTI-Jet-Cut Duplex*** dia. 10 mm (art. no. 2614AZ.010)
Cutting data:	v_c 120 m/min – f_z 0.05 mm – a_p 15 mm – a_e 10 mm

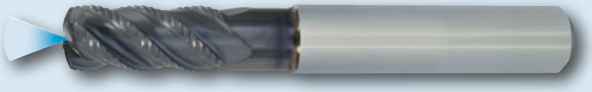
Additional technical information:

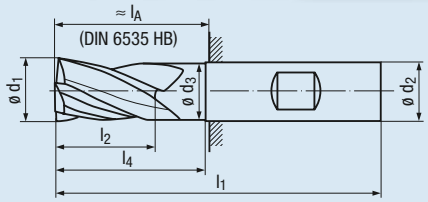
- Always provide tool holders with good concentricity and high holding force
- Before clamping the tool, clean all clamping surfaces completely from grease and oil
- Ramping angle 3-15°, feed speed (v_f) 100% - 50%, adjust to individual ramping angle
- Down-milling will lead to better tool life

[1)] Cold-air nozzle, see page 6

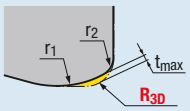
For videos about the application examples, see our homepage **www.emuge-franken.de**, under **Media/Downloads**

End mills MULTI-Jet-Cut Duplex – short design — DIN 6527 L





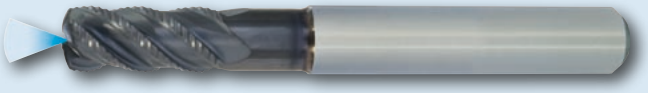
ø d_1 h11	l_2	l_1	l_4	l_A	ø d_2 h6	ø d_3	t_{max}	R_{3D}	r_1 / r_2	Z	Shank acc. DIN 6535 HA Article no.	Shank acc. DIN 6535 HB Article no.
6	13	57	20	21	6	5.8	0.2	0.8	2.9 / 0.6	4	**2614AZ.006**	**2615AZ.006**
8	19	63	25	27	8	7.7	0.3	1.0	3.9 / 0.8	4	**2614AZ.008**	**2615AZ.008**
10	22	72	30	32	10	9.5	0.4	1.2	4.9 / 1.0	4	**2614AZ.010**	**2615AZ.010**
12	26	83	35	38	12	11.5	0.4	1.6	5.9 / 1.2	4	**2614AZ.012**	**2615AZ.012**
16	32	92	40	44	16	15.5	0.5	2.2	7.8 / 1.6	4	**2614AZ.016**	**2615AZ.016**

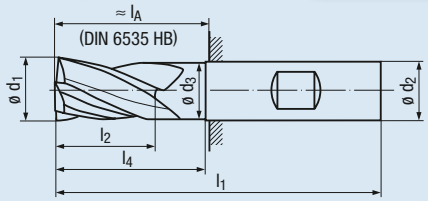


t_{max} = Maximum residual material produced by radius deviation from R_{3D}
R_{3D} = Radius to be programmed in the CAM
r_1 = Face radius
r_2 = Tangential radius between face radius and circumference cutting edge

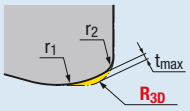
	HPC and roughing applications				HSC and high-feed machining					
	v_c [m/min]	f_z [mm]	a_p max. [mm]	a_e max. [mm]	v_c [m/min]	f_z max. [mm]	a_p max. [mm]	a_e [mm]	Cooling	Lubrication
1										
1.1	160 - 180	0.0065 x d_1	1.5 x d_1	1 x d_1	240 - 260	0.04 x d_1	0.06 x d_1	0.6 x d_1	Cold air / Pressurized air	Emulsion / MQL
1.2	140 - 160	0.0055 x d_1	1.5 x d_1	1 x d_1	220 - 240	0.04 x d_1	0.06 x d_1	0.6 x d_1	Cold air / Pressurized air	Emulsion / MQL
1.3	120 - 140	0.005 x d_1	1 x d_1	1 x d_1	200 - 220	0.03 x d_1	0.05 x d_1	0.6 x d_1	Cold air / Pressurized air	—
1.4	100 - 120	0.004 x d_1	1 x d_1	1 x d_1	180 - 200	0.03 x d_1	0.04 x d_1	0.6 x d_1	Cold air / Pressurized air	—
1.5	80 - 100	0.004 x d_1	1 x d_1	1 x d_1	160 - 180	0.02 x d_1	0.035 x d_1	0.6 x d_1	Cold air / Pressurized air	—
1.6	50 - 80	0.003 x d_1	1 x d_1	1 x d_1	120 - 160	0.015 x d_1	0.03 x d_1	0.6 x d_1	Cold air	—
2										
2.1 - 2.2	100 - 160	0.005 x d_1	1.5 x d_1	1 x d_1	180 - 200	0.05 x d_1	0.07 x d_1	0.6 x d_1	Cold air / Pressurized air	—
2.3 - 2.4	80 - 120	0.004 x d_1	1 x d_1	1 x d_1	160 - 180	0.04 x d_1	0.07 x d_1	0.6 x d_1	Cold air / Pressurized air	—
3										
3.2 - 3.3	140 - 160	0.005 x d_1	1 x d_1	1 x d_1	180 - 200	0.04 x d_1	0.07 x d_1	0.6 x d_1	—	Emulsion / MQL
3.4 - 3.5	120 - 140	0.005 x d_1	1 x d_1	1 x d_1	160 - 180	0.04 x d_1	0.06 x d_1	0.6 x d_1	—	Emulsion / MQL
8										
8.1	140 - 160	0.006 x d_1	1.5 x d_1	1 x d_1	200 - 220	0.05 x d_1	0.07 x d_1	0.6 x d_1	—	Emulsion / MQL
9										
9.2	60 - 100	0.004 x d_1	1 x d_1	1 x d_1	100 - 140	0.035 x d_1	0.07 x d_1	0.6 x d_1	—	Emulsion / MQL

End mills MULTI-Jet-Cut Duplex – long design — Internal standard





ø d_1 h11	l_2	l_1	l_4	l_A	ø d_2 h6	ø d_3	t_{max}	R_{3D}	r_1 / r_2	Z	Shank acc. DIN 6535 HA Article no.	Shank acc. DIN 6535 HB Article no.
8	19	68	30	32	8	7.7	0.3	1.0	3.9 / 0.8	4	**2616AZ.008**	**2617AZ.008**
10	22	80	35	40	10	9.5	0.4	1.2	4.9 / 1.0	4	**2616AZ.010**	**2617AZ.010**
12	26	93	45	47	12	11.5	0.4	1.6	5.9 / 1.2	4	**2616AZ.012**	**2617AZ.012**
16	32	108	55	60	16	15.5	0.5	2.2	7.8 / 1.6	4	**2616AZ.016**	**2617AZ.016**



t_{max} = Maximum residual material produced by radius deviation from R_{3D}
R_{3D} = Radius to be programmed in the CAM
r_1 = Face radius
r_2 = Tangential radius between face radius and circumference cutting edge

	HPC and roughing applications				HSC and high-feed machining					
	v_c [m/min]	f_z [mm]	a_p max. [mm]	a_e max. [mm]	v_c [m/min]	f_z max. [mm]	a_p max. [mm]	a_e [mm]	Cooling	Lubrication
1										
1.1	140 - 160	0.0055 x d_1	1 x d_1	1 x d_1	240 - 260	0.04 x d_1	0.05 x d_1	0.6 x d_1	Cold air / Pressurized air	Emulsion / MQL
1.2	120 - 140	0.0055 x d_1	1 x d_1	1 x d_1	220 - 240	0.04 x d_1	0.05 x d_1	0.6 x d_1	Cold air / Pressurized air	Emulsion / MQL
1.3	120 - 140	0.005 x d_1	1 x d_1	1 x d_1	200 - 220	0.03 x d_1	0.04 x d_1	0.6 x d_1	Cold air / Pressurized air	—
1.4	100 - 120	0.004 x d_1	1 x d_1	1 x d_1	180 - 200	0.03 x d_1	0.035 x d_1	0.6 x d_1	Cold air / Pressurized air	—
1.5	80 - 100	0.004 x d_1	1 x d_1	1 x d_1	160 - 180	0.02 x d_1	0.03 x d_1	0.6 x d_1	Cold air / Pressurized air	—
1.6	50 - 80	0.003 x d_1	1 x d_1	0.5 x d_1	120 - 160	0.015 x d_1	0.025 x d_1	0.6 x d_1	Cold air	—
2										
2.1 - 2.2	100 - 160	0.005 x d_1	1 x d_1	1 x d_1	180 - 200	0.05 x d_1	0.06 x d_1	0.6 x d_1	Cold air / Pressurized air	—
2.3 - 2.4	80 - 120	0.004 x d_1	1 x d_1	1 x d_1	160 - 180	0.04 x d_1	0.06 x d_1	0.6 x d_1	Cold air / Pressurized air	—
3										
3.2 - 3.3	140 - 160	0.005 x d_1	1 x d_1	1 x d_1	180 - 200	0.04 x d_1	0.06 x d_1	0.6 x d_1	—	Emulsion / MQL
3.4 - 3.5	120 - 140	0.005 x d_1	1 x d_1	1 x d_1	160 - 180	0.04 x d_1	0.06 x d_1	0.6 x d_1	—	Emulsion / MQL
8										
8.1	140 - 160	0.006 x d_1	1.5 x d_1	1 x d_1	200 - 220	0.05 x d_1	0.07 x d_1	0.6 x d_1	—	Emulsion / MQL
9										
9.2	60 - 100	0.004 x d_1	1 x d_1	1 x d_1	100 - 140	0.035 x d_1	0.06 x d_1	0.6 x d_1	—	Emulsion / MQL

HPC-Jet-Cut line — Patent no.: 103 25 600

HPC-Jet-Cut Duplex

The **HPC-Jet-Cut Duplex** is designed for the machining of hard materials. The extremely wear-resistant carbide substrate in connection with the newly developed cutting geometry and, of course, a high-heat-resistant coating, make it at last possible to work out machining strategies with just one tool instead of the two tools needed until now as a minimum. Any kind of 2D operation, like pocket and slot milling, or 3D operations like line-by-line milling, copy milling and high-feed roughing of contours can now be done with one tool only, due to the redevelopment of our patented cutting geometry. The **HPC-Jet-Cut Duplex** permits the machining of soft and hardened steels with a hardness of up to 66 HRC, cast materials, brass and similar materials.

Advantages

- High flexibility due to two constructional lengths
- Stable cutting geometry due to radial relief
- No tendency to vibrate due to variable irregular spacing
- Perfect chip transport due to S-geometry on the tool face
- Internal coolant-lubricant supply (IKZ) as standard
- Maximum application flexibility by combining two tools in one
- Reduction of tool places and tool changes in your machine

What is the right application for the HPC-Jet-Cut Duplex?

In tool making and in the mold-and-die industry, this tool can be used for roughing and finishing applications in 3D components, as well as for pocket and slot milling in any kind of mold construction. The design of the face geometry permits the machining of all short-chipping materials without any problem. The coolant-lubricant supply integrated into the tools improves chip transport dramatically. Tool life and process safety with high feeds can be extended considerably. We recommend this tool for the machining of materials with a hardness from 35 HRC to approximately 66 HRC.
For the machining of softer materials, like construction steel etc., we recommend our tool type **MULTI-Jet-Cut Duplex** (see pages 2-3).

Application cases for the HPC-Jet-Cut Duplex

- Pocket milling jobs of any kind where there are no requirements as to surface quality
- 2D roughing applications, slots, pockets with normal NC cycles
- Relief milling jobs of any kind
- 3D roughing applications, high-feed milling, line-by-line and copy milling to finishing allowance
- Helical drill milling, drill milling

Application example 1:

2D roughing job:	Contour milling, length 160 mm x width 5 mm x height 15 mm
Material:	Cold work steel 1.2312 (hardened to 53 HRC) – cooling with internal air supply and cold-air nozzle [1)]
Tool:	***HPC-Jet-Cut Duplex*** dia. 10 mm (art. no. 2610AZ.010)
Cutting data:	v_c 80 m/min – f_z 0.03 mm – a_p 15 mm – a_e 5 mm

Application example 2:

2D roughing job:	Pocket milling, length 60 mm x width 60 mm x depth 15 mm
Material:	Cold work steel 1.2379 (hardened to 56 HRC) – cooling with internal air supply and cold-air nozzle [1)]
Tool:	***HPC-Jet-Cut Duplex*** dia. 10 mm (art. no. 2610AZ.010)
Cutting data HSC:	v_c 120 m/min – f_z 0.20 mm – a_p 0.4 mm – a_e 6 mm **(machining time approx. 10 minutes)**
Cutting data HPC:	v_c 80 m/min – f_z 0.03 mm – a_p 7.5 mm – a_e 5 mm **(machining time approx. 6 minutes)**

Application example 3:

2D roughing job:	Circular slot milling, length 30 mm x width 20 mm x depth 15 mm
Material:	Cold work steel 1.2379 (hardened to 60 HRC) – cooling with internal air supply and cold-air nozzle [1)]
Tool:	***HPC-Jet-Cut Duplex*** dia. 10 mm (art. no. 2610AZ.010)
Cutting data:	v_c 100 m/min – f_z 0.06 mm – a_p 15 mm – a_e 1 mm

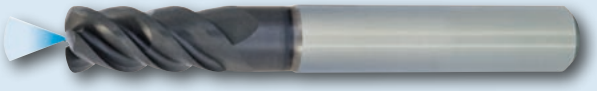
Additional technical information:

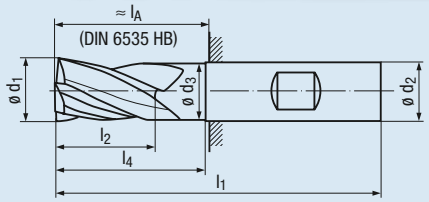
- Always provide tool holders with good concentricity and high holding force
- Before clamping the tool, clean all clamping surfaces completely from grease and oil
- Ramping angle in long-chipping materials 3-5°, reduce feed speed (v_f) by approx. 50%
- Down-milling will lead to better tool life

[1)] Cold-air nozzle, see page 6

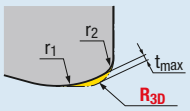
For videos about the application examples, see our homepage **www.emuge-franken.de**, under **Media/Downloads**

End mills HPC-Jet-Cut Duplex – short design — DIN 6527 L





ø d_1 -0.04	l_2	l_1	l_4	l_A	ø d_2 h5	ø d_3	t_{max}	R_{3D}	r_1 / r_2	Z	Shank acc. DIN 6535 HA Article no.	Shank acc. DIN 6535 HB Article no.
6	13	57	20	21	6	5.8	0.2	0.8	2.9 / 0.6	4	**2610AZ.006**	**2611AZ.006**
8	19	63	25	27	8	7.7	0.3	1.0	3.9 / 0.8	4	**2610AZ.008**	**2611AZ.008**
10	22	72	30	32	10	9.5	0.4	1.2	4.9 / 1.0	4	**2610AZ.010**	**2611AZ.010**
12	26	83	35	38	12	11.5	0.4	1.6	5.9 / 1.2	4	**2610AZ.012**	**2611AZ.012**
16	32	92	40	44	16	15.5	0.5	2.2	7.8 / 1.6	4	**2610AZ.016**	**2611AZ.016**



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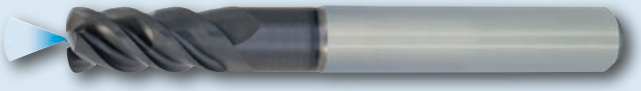
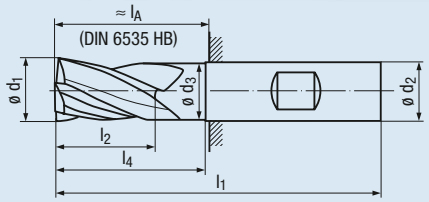
R_{3D} = Radius to be programmed in the CAM
r_1 = Face radius
r_2 = Tangential radius between face radius and circumference cutting edge

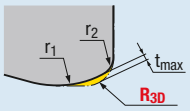
	HPC and roughing applications				HSC and high-feed machining					
	v_c [m/min]	f_z [mm]	a_p max. [mm]	a_e max. [mm]	v_c [m/min]	f_z max. [mm]	a_p max. [mm]	a_e [mm]	Cooling	Lubrication
1										
1.1	180 - 200	0.005 x d_1	1.5 x d_1	1 x d_1	280 - 300	0.04 x d_1	0.06 x d_1	0.6 x d_1	Cold air / Pressurized air	Emulsion / MQL
1.2	160 - 180	0.005 x d_1	1.5 x d_1	1 x d_1	260 - 280	0.03 x d_1	0.05 x d_1	0.6 x d_1	Cold air / Pressurized air	Emulsion / MQL
1.3	140 - 160	0.004 x d_1	1 x d_1	1 x d_1	240 - 260	0.025 x d_1	0.04 x d_1	0.6 x d_1	Cold air / Pressurized air	—
1.4	120 - 140	0.004 x d_1	1 x d_1	1 x d_1	220 - 240	0.025 x d_1	0.04 x d_1	0.6 x d_1	Cold air / Pressurized air	—
1.5	100 - 120	0.003 x d_1	1 x d_1	1 x d_1	180 - 200	0.02 x d_1	0.035 x d_1	0.6 x d_1	Cold air / Pressurized air	—
1.6	80 - 100	0.003 x d_1	1.5 x d_1	0.5 x d_1	120 - 160	0.015 x d_1	0.03 x d_1	0.6 x d_1	Cold air	—
1.7	60 - 80	0.0025 x d_1	1 x d_1	0.3 x d_1	100 - 120	0.01 x d_1	0.025 x d_1	0.6 x d_1	Cold air	—
1.8	40 - 60	0.0025 x d_1	1.5 x d_1	0.1 x d_1	80 - 100	0.01 x d_1	0.02 x d_1	0.6 x d_1	Cold air	—
1.9	20 - 40	0.002 x d_1	1.5 x d_1	0.05 x d_1	60 - 80	0.007 x d_1	0.015 x d_1	0.6 x d_1	Cold air	—
2										
2.1 - 2.2	100 - 160	0.005 x d_1	1.5 x d_1	1 x d_1	180 - 200	0.05 x d_1	0.07 x d_1	0.6 x d_1	Cold air / Pressurized air	—
2.3 - 2.4	80 - 120	0.004 x d_1	1 x d_1	1 x d_1	160 - 180	0.04 x d_1	0.07 x d_1	0.6 x d_1	Cold air / Pressurized air	—
3										
3.2 - 3.3	140 - 160	0.005 x d_1	1 x d_1	1 x d_1	180 - 200	0.04 x d_1	0.07 x d_1	0.6 x d_1	—	Emulsion / MQL
3.4 - 3.5	120 - 140	0.005 x d_1	1 x d_1	1 x d_1	160 - 180	0.04 x d_1	0.06 x d_1	0.6 x d_1	—	Emulsion / MQL
8										
8.1	140 - 160	0.006 x d_1	1.5 x d_1	1 x d_1	200 - 220	0.05 x d_1	0.07 x d_1	0.6 x d_1	—	Emulsion / MQL
9										
9.2	60 - 100	0.004 x d_1	1 x d_1	1 x d_1	100 - 140	0.035 x d_1	0.07 x d_1	0.6 x d_1	—	Emulsion / MQL

End mills HPC-Jet-Cut Duplex – long design — Internal standard





ø d_1 -0.04	l_2	l_1	l_4	l_A	ø d_2 h5	ø d_3	t_{max}	R_{3D}	r_1 / r_2	Z	Shank acc. DIN 6535 HA Article no.	Shank acc. DIN 6535 HB Article no.
8	19	68	30	32	8	7.7	0.3	1.0	3.9 / 0.8	4	**2612AZ.008**	**2613AZ.008**
10	22	80	35	40	10	9.5	0.4	1.2	4.9 / 1.0	4	**2612AZ.010**	**2613AZ.010**
12	26	93	45	47	12	11.5	0.4	1.6	5.9 / 1.2	4	**2612AZ.012**	**2613AZ.012**
16	32	108	55	60	16	15.5	0.5	2.2	7.8 / 1.6	4	**2612AZ.016**	**2613AZ.016**



t_{max} = Maximum residual material produced by radius deviation from R_{3D}
R_{3D} = Radius to be programmed in the CAM
r_1 = Face radius
r_2 = Tangential radius between face radius and circumference cutting edge

	HPC and roughing applications				HSC and high-feed machining					
	v_c [m/min]	f_z [mm]	a_p max. [mm]	a_e max. [mm]	v_c [m/min]	f_z max. [mm]	a_p max. [mm]	a_e [mm]	Cooling	Lubrication
1										
1.1	140 - 160	0.004 x d_1	1.5 x d_1	1 x d_1	280 - 300	0.04 x d_1	0.06 x d_1	0.6 x d_1	Cold air / Pressurized air	Emulsion / MQL
1.2	140 - 160	0.004 x d_1	1.5 x d_1	1 x d_1	260 - 280	0.03 x d_1	0.05 x d_1	0.6 x d_1	Cold air / Pressurized air	Emulsion / MQL
1.3	120 - 140	0.0035 x d_1	1 x d_1	1 x d_1	240 - 260	0.025 x d_1	0.04 x d_1	0.6 x d_1	Cold air / Pressurized air	—
1.4	100 - 120	0.003 x d_1	1 x d_1	1 x d_1	220 - 240	0.025 x d_1	0.04 x d_1	0.6 x d_1	Cold air / Pressurized air	—
1.5	80 - 100	0.003 x d_1	1 x d_1	0.7 x d_1	180 - 200	0.02 x d_1	0.035 x d_1	0.6 x d_1	Cold air / Pressurized air	—
1.6	80 - 100	0.0025 x d_1	1.5 x d_1	0.35 x d_1	120 - 160	0.015 x d_1	0.03 x d_1	0.6 x d_1	Cold air	—
1.7	60 - 80	0.0025 x d_1	1 x d_1	0.2 x d_1	100 - 120	0.01 x d_1	0.02 x d_1	0.6 x d_1	Cold air	—
1.8	40 - 60	0.002 x d_1	1.5 x d_1	0.05 x d_1	80 - 100	0.01 x d_1	0.015 x d_1	0.6 x d_1	Cold air	—
1.9	40 - 60	0.002 x d_1	1.5 x d_1	0.05 x d_1	60 - 80	0.007 x d_1	0.015 x d_1	0.6 x d_1	Cold air	—
2										
2.1 - 2.2	100 - 160	0.005 x d_1	1.5 x d_1	1 x d_1	180 - 200	0.05 x d_1	0.06 x d_1	0.6 x d_1	Cold air / Pressurized air	—
2.3 - 2.4	80 - 120	0.004 x d_1	1 x d_1	1 x d_1	160 - 180	0.04 x d_1	0.06 x d_1	0.6 x d_1	Cold air / Pressurized air	—
3										
3.2 - 3.3	140 - 160	0.005 x d_1	1 x d_1	1 x d_1	180 - 200	0.04 x d_1	0.06 x d_1	0.6 x d_1	—	Emulsion / MQL
3.4 - 3.5	120 - 140	0.005 x d_1	1 x d_1	1 x d_1	160 - 180	0.04 x d_1	0.06 x d_1	0.6 x d_1	—	Emulsion / MQL
8										
8.1	140 - 160	0.006 x d_1	1.5 x d_1	1 x d_1	200 - 220	0.05 x d_1	0.07 x d_1	0.6 x d_1	—	Emulsion / MQL
9										
9.2	60 - 100	0.004 x d_1	1 x d_1	1 x d_1	100 - 140	0.035 x d_1	0.06 x d_1	0.6 x d_1	—	Emulsion / MQL

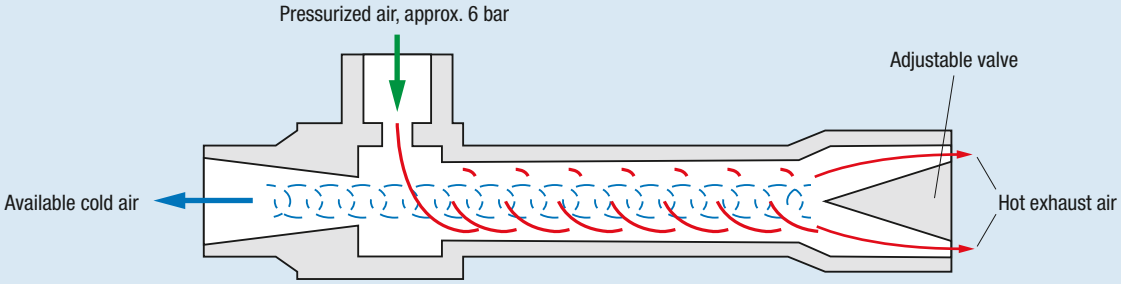
Cold-air nozzle – Increasing efficiency

Principle of the cold-air nozzle

The application of cooled air can help to reduce temperatures in the cutting area, which in turn permits higher cutting speeds and longer tool life.
This type of cooling is necessary to bring out all the advantages of modern coatings, because the cutting edge can no longer be damaged by thermal shock. In addition, the cold-air nozzle will help to remove the tiny chips which are produced in copy milling even from deep recesses or cavities.
The function of the cold-air nozzle is based on the principle of the vortex tube, in which two opposed, rotating air streams are generated (without using any moving components).
The internal air stream exits from one end, in the form of useable cold air with a temperature down to -40 °C.
The only thing that is needed is a normal pressurized air connection.

	Article no.
Cold-air nozzle	**6910.15**

Delivery:
- Length (without hose) 225 mm, weight: 0.7 kg
- With flexible hose (length approx. 300 mm) for cold air
- Muffler (SN14) for hot exhaust air
- Ball-valve with fitting (1/4") for inlet hose (6 mm) with quick-change attachment (7.2 mm)



Temperature, measured on the effective exit of the vortex tube (not the end of the nozzle!)

Pressure of incoming air bar	Temperature of usable air in °C, with a cold air percentage of 25%	50%	75%
3	-31	-22	- 6
4	-35	-35	- 8
5	-39	-28	-10
6	-42	-31	-11
7	-46	-34	-13

Air consumption, with an incoming air temperature of 21 °C

Input pressure bar	Air consumption	Capacity
6,9	7.08 l/s ≙ 25.5 m^3/h	226 kcal/h ≙ 263 W

Accessories for cold-air nozzle

Spare hose

Length	Article no.
≈ 300 mm	**6910.20**
≈ 400 mm	**6910.22**
≈ 500 mm	**6910.21**

Fixture complete

Weight	Article no.
0.4 kg	**6910.25**

Magnetic shoe

Diameter	Article no.
80 mm	**6910.26**

Socket

Height	Article no.
≈ 75 mm	**6910.27**

Description of material groups

Material group	Material type	Tensile strength range	Material examples		
1	**Steel materials**				
1.1	Cold-extrusion steels, Magnetic soft iron	≤ 400 N/mm²	Q-St37-3 R-Fe80	1.0123 1.1014	
1.2	Free-cutting steels, General construction steels	≤ 600 N/mm²	9SMnPb28 St37-2	1.0718 1.0037	500-700 N/mm² 340-470 N/mm²
1.3	Free-cutting steels, Construction steels, Alloyed steels, Steel castings	≤ 850 N/mm²	St70-2 GS-25CrMo4	1.0070 1.7218	700-900 N/mm² 650-950 N/mm²
1.4	Cementation steels, Heat-treatable steels, Nitriding steels, Cold work steels	≤ 1100 N/mm²	16MnCr5 Ck45 100Cr6	1.7131 1.1191 1.3505	500-700 N/mm² 600-800 N/mm² 700-900 N/mm²
1.5	Heat-treatable steels, Nitriding steels, Hot work steels, Hardened steels up to 44 HRC Cold work steels	≤ 1400 N/mm²	42CrMo4V X30WCrV5-3 X38CrMoV5-3 X155CrVMo12-1	1.7225 1.2567 1.2367 1.2379	1200-1400 N/mm² 1100 N/mm² 900-1100 N/mm² 900-1100 N/mm²
1.6	Hardened steels > 44 - 55 HRC		55NiCrMoV6	1.2713	47-52 HRC
1.7	Hardened steels > 55 - 60 HRC		45WCrV7	1.2542	56-57 HRC
1.8	Hardened steels > 60 - 63 HRC		X155CrVMo12-1	1.2379	60-63 HRC
1.9	Hardened steels > 63 - 66 HRC		X210CrW12	1.2436	63-64 HRC
1.10	Corrosion-proof steels, Acid-proof steels, Heat-resistant steels	≤ 850 N/mm²	X10NiCrAlTi32-20 [INCOLOY800] X12CrNiTi18-9 X6CrNiMoTi17-12-2	1.4876 1.4878 1.4571	610-850 N/mm² 500-700 N/mm² 500-730 N/mm²
1.11	Corrosion-/Acid-proof steels, Heat-resistant steels	≤ 1100 N/mm²	X45SiCr4	1.4704	900-1100 N/mm²
1.12	Corrosion-/Acid-proof steels, Heat-resistant steels	≤ 1400 N/mm²	X5NiCrTi26-15	1.4980	1200 N/mm²
1.13	Special steel materials	≤ 1400 N/mm²	FerroTiC Hardox500		800-900 N/mm² 1300-1400 N/mm²
2	**Cast materials**				
2.1	Cast iron		GG 20 GG 30	0.6020 0.6030	120-220 HB 220-270 HB
2.2	Cast iron with nodular graphite		GGG 40 GGG 70	0.7040 0.7070	400 N/mm² 700-1050 N/mm²
2.3	Cast iron with vermicular graphite		GGV (80% Perlit) GGV (100% Perlit)		220 HB 230 HB
2.4	Malleable cast iron		GTW 40 GTS 65	0.8040 0.8165	360-420 N/mm² 580-650 N/mm²
2.5	Hard castings up to 400 HB				- 400 HB
3	**Copper, Copper alloys, Bronze, Brass**				
3.1	Pure copper and low alloyed copper	≤ 500 N/mm²	E-Cu	2.0060	250-350 N/mm²
3.2	Copper-zinc alloys (brass, long-chipping)		CuZn40 [Ms60] CuZn37 [Ms63]	2.0360 2.0321	340-490 N/mm² 310-550 N/mm²
3.3	Copper-zinc alloys (brass, short-chipping)		CuZn39Pb2 [Ms58]	2.0380	380-500 N/mm²
3.4	Copper-aluminium alloys (alubronze, long-chipping) Copper-tin alloys (bronze, long-chipping)		CuAl10Ni	2.0966	500-800 N/mm²
3.5	Copper-tin alloys (bronze, short-chipping)		GCuSn5ZnPb [Rg5] GCuSn7ZnPb [Rg7]	2.1096 2.1090	150-300 N/mm² 150-300 N/mm²
3.6	Special copper alloys, up to Q 18		Ampco16		630 N/mm²
3.7	Special copper alloys over Q 18		Ampco20		600 N/mm²
4	**Nickel/Cobalt alloys**				
4.1	Nickel/Cobalt alloys heat-resistant	≤ 850 N/mm²	NiCu30Fe [MONEL400]	2.4360	420-610 N/mm²
4.2	Nickel/Cobalt alloys high-heat resistant	850 - 1400 N/mm²	NiCr19NbMo [INCONEL718]	2.4668	850-1190 N/mm²
4.3	Nickel/Cobalt alloys high-heat resistent	> 1400 N/mm²	Haynes 25 (L605)		1550-2000 N/mm²
5	**Aluminium alloys**				
5.1	Aluminium wrought alloys		Al 99,5 [F13] AlCuMg1 [F39]	3.0255 3.1325	100-250 N/mm² 300-500 N/mm²
5.2	Aluminium cast alloys Si ≤ 5%		G-AlMg3	3.3541	130-190 N/mm²
5.3	Aluminium cast alloys 5% < Si ≤ 12 %		GD-AlSi9Cu3 GD-AlSi12	3.2163 3.2582	240-310 N/mm² 220-300 N/mm²
5.4	Aluminium cast alloys 12 % < Si ≤ 17%		G-AlSi17Cu4		180-250 N/mm²
6	**Magnesium alloys**				
6.1	Magnesium wrought alloys		MgAl6	3.5662	300-500 N/mm²
6.2	Magnesium cast alloys		GMgAl9Zn1	3.5912	300-500 N/mm²
7	**Titanium, Titanium alloys**				
7.1	Pure titanium, Titanium alloys	≤ 900 N/mm²	Ti3 [Ti99.4] TiAl6V4	3.7055 3.7164	700 N/mm² 700-900 N/mm²
7.2	Titanium alloys	900 - 1250 N/mm²	TiAl4Mo4Sn2	3.7185	900-1250 N/mm²
8	**Synthetics**				
8.1	Duroplastics (short-chipping)		BAKELIT		110 N/mm²
8.2	Thermoplastics (long-chipping)		HOSTALEN		80 N/mm²
8.3	Fibre-reinforced synthetics		CFK / GFK / AFK		800-1500 N/mm²
9	**Materials for special applications**				
9.1	Graphite		C-8000		60 N/mm²
9.2	Tungsten-copper alloys		W-Cu 80/20		230-250 HV

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