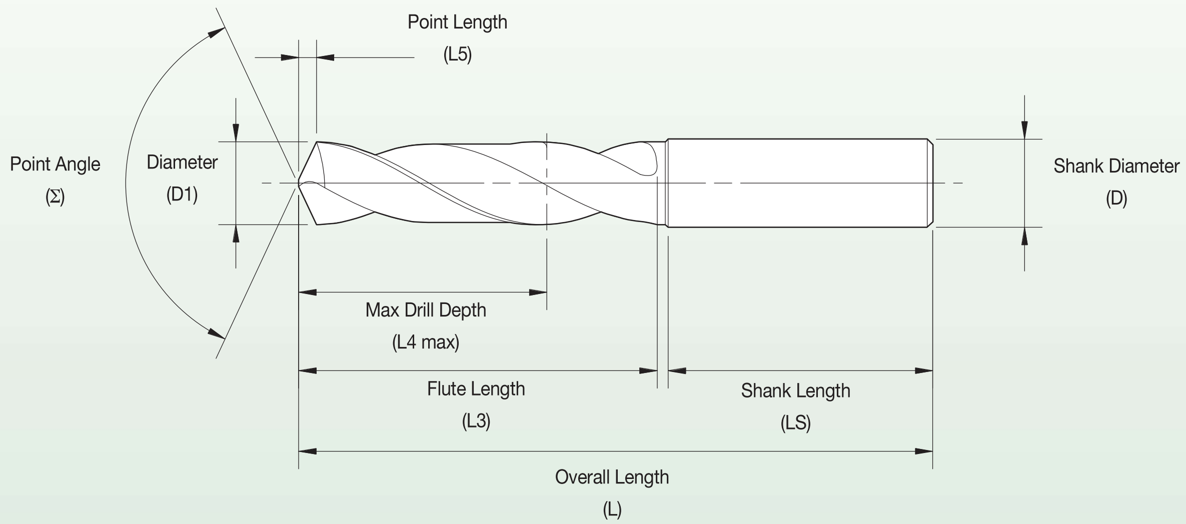
2017 Master Catalog

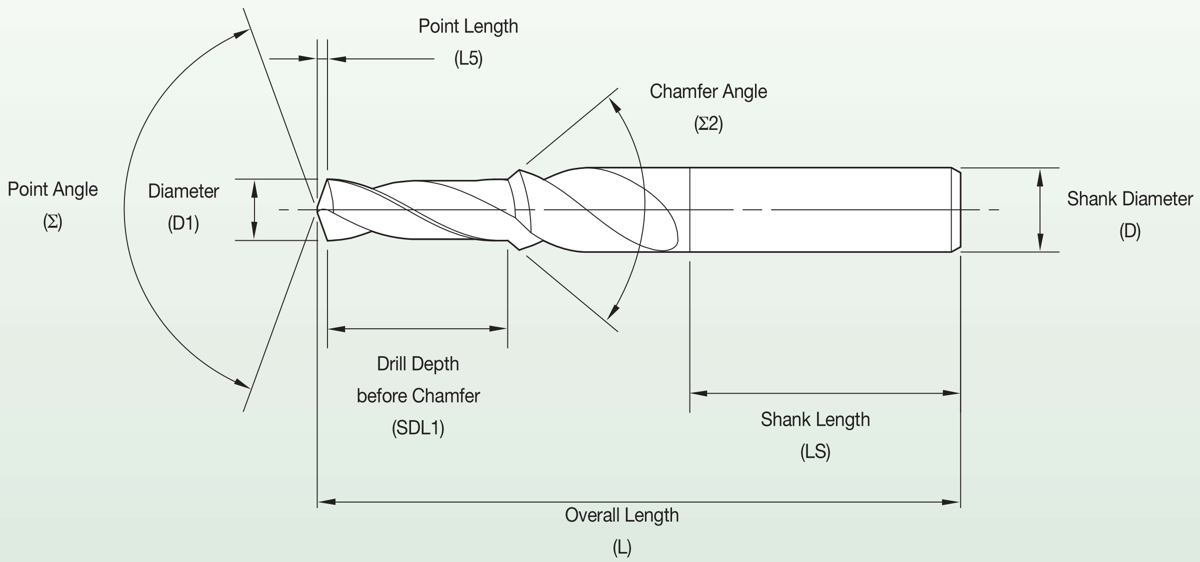
WIDIA™

The Anatomy of a Drill

Use this diagram when describing features of a solid carbide drill.

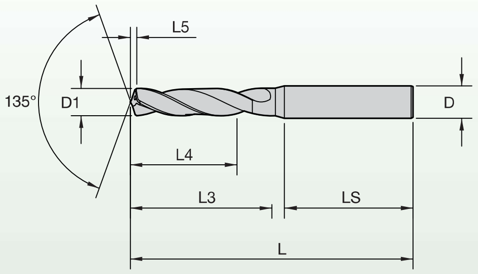


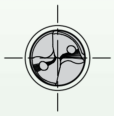
Use this diagram when describing features of a solid carbide step drill.

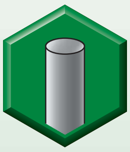


Shank Designs to DIN 6535

Form HE,
2° angle
Design F







Form HA,
straight
design A

Dimensions for WIDIA™ High-Performance Solid Carbide Drills

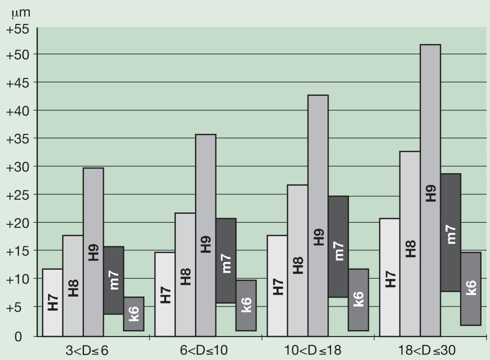
inch Ø		DIN 6535		SHORT* ~3 x D			LONG* ~5 x D			EXTRA LONG** ~8 x D		
D1 min	D1 max	D	LS	L	L3	L4 max	L	L3	L4 max	L	L3	L4 max
.0394	.0551	.1575	1.10	2.28	.28	.20	2.28	.35	.24	2.28	.47	.39
.0552	.0748	.1575	1.10	2.28	.35	.24	2.28	.47	.35	2.28	.71	.59
.0748	.0906	.1575	1.10	2.28	.51	.35	2.28	.71	.55	2.60	1.02	.87
.0906	.1177	.1575	1.10	2.28	.67	.47	2.28	.87	.67	2.60	1.18	.98
.1181	.1476	.2362	1.42	2.44	.79	.55	2.60	1.10	.91	3.07	1.57	1.30
.1477	.1870	.2362	1.42	2.60	.94	.67	2.91	1.42	1.14	3.43	1.93	1.61
.1870	.2362	.2362	1.42	2.60	1.10	.79	3.23	1.73	1.38	3.70	2.20	1.89
.2363	.2756	.3150	1.42	3.11	1.34	.94	3.58	2.09	1.69	4.13	2.64	2.24
.2756	.3150	.3150	1.42	3.11	1.61	1.14	3.58	2.09	1.69	4.33	2.83	2.40
.3150	.3937	.3937	1.57	3.50	1.85	1.38	4.06	2.40	1.93	4.80	3.15	2.68
.3937	.4724	.4724	1.77	4.02	2.17	1.57	4.65	2.80	2.20	5.55	3.70	3.11
.4725	.5512	.5512	1.77	4.21	2.36	1.69	4.88	3.03	2.36	6.10	4.25	3.58
.5512	.6299	.6299	1.89	4.53	2.56	1.77	5.24	3.27	2.48	6.73	4.76	3.98
.6300	.7087	.7087	1.89	4.84	2.87	2.01	5.63	3.66	2.80	7.28	5.32	4.45
.7087	.7874	.7874	1.97	5.16	3.11	2.17	6.02	3.98	3.03	7.87	5.83	4.88
.7874	.8661	.7874	1.97	5.55	3.39	2.36	6.57	4.41	3.35	8.54	6.38	5.35
.8662	.9843	.9843	2.20	6.02	3.74	2.56	7.24	4.96	3.86	9.37	7.09	5.91

** D1<20mm to DIN 6537K*
D1>20mm to factory standard
*** To factory standard*

Tolerances of Drills and Holes

High-performance solid carbide drills with tolerances of m7 create holes with tolerances of H9. H8 can be achieved in very good conditions. The drill should be used for holes in H8, and in favorable conditions, H7 can be achieved. Solid carbide drills with H7 create holes in K9–11. Other drilling tolerances require special solid carbide drill versions.

Tolerances of diameter D1 on:
Spiral Flute
TDG Drill

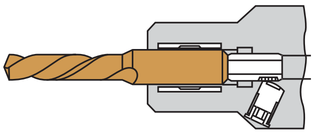


Toolholding Systems

As with any drilling system, components of the entire system contribute to the quality of the machined hole, not just the drill itself.
For maximum efficiency and accuracy, the following toolholding systems are your best choices:

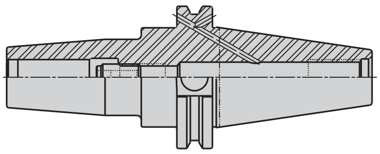
First Choice

Hydraulic chucks



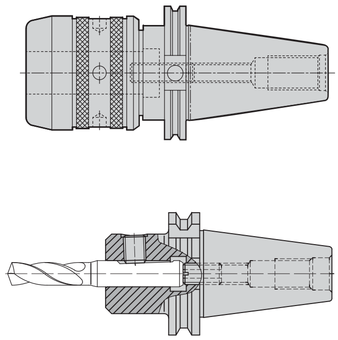
Second Choice

Shrink Fit

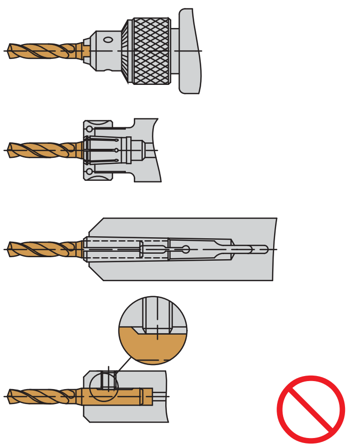


Third Choice

High-performance milling chucks
with reduction sleeves



Not Recommended

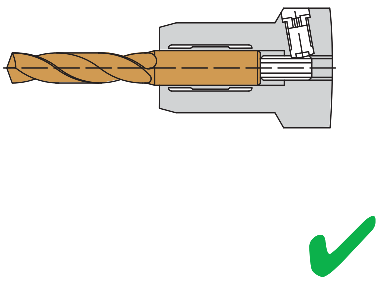


Clamping Chuck

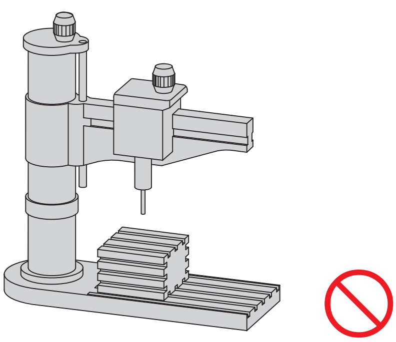
Use of all-purpose drilling chuck collets, clamping sleeves, and Weldon® clamping chucks should be avoided because they do not absorb cutting forces reliably and provide insufficient precision of concentricity.

Highly Recommended

Hydraulic chucks ensure a secure torque transmission with excellent concentricity.



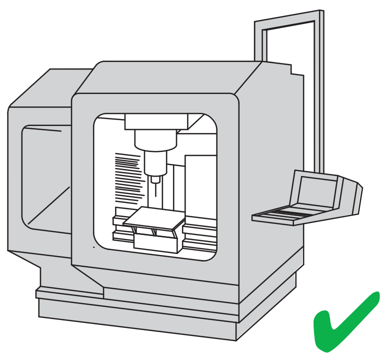
Not Recommended



Machine

Solid carbide drills have a much higher rigidity than conventional high-speed steel drills. This enables the machining of close-tolerance holes with a position accuracy of ±.001". However, it also means that drills require rigid machine tools with good spindles.

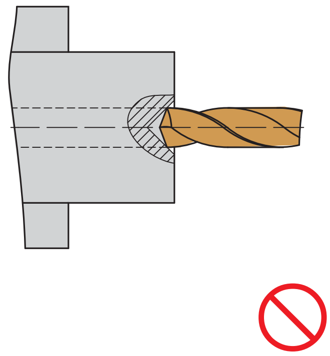
Rigid Machine Tool Recommended



(continued)

(continued)

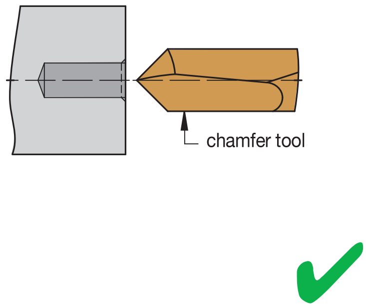
Wrong



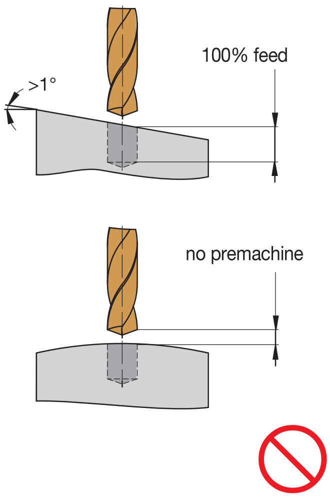
Drilling and Chamfering

Drill into the solid first, then chamfer.

Correct



Wrong



Drilling on Inclined or Rounded Surfaces

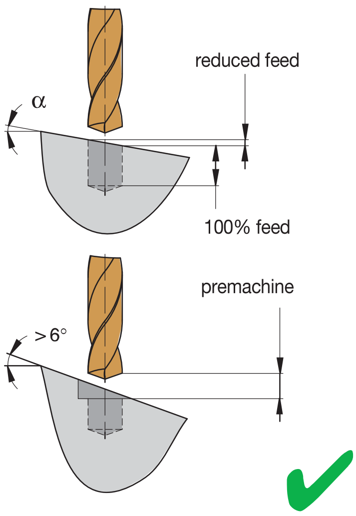
When drilling on inclined or curved surfaces, use a lower feed than the standard value. The reduction of feed required is dependent on the inclination angle of the workpiece surface and the drill type (see table).

reduced feed (% of standard value)

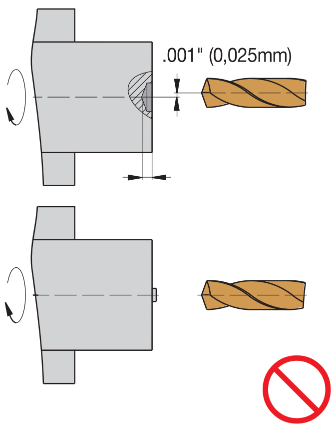
inclination α	3 x D	5 x D Long	<5 x D
1°	100%	80%	premachine
2°	80–50%	80–50%	premachine
3°	65%	50%	premachine
4°	50%	premachine	premachine
6°	30%	premachine	premachine

Premachining is usually done with an end mill operation.

Correct



Wrong



Drilling on Turning Machines

When drilling on turning machines, the drill must be on center. The tolerance range of the center position should not exceed ±.001". On bar-turning lathes, do not drill into center stub or bur. Cut-off tools must be mounted precisely to eliminate center stub or bur. Do not drill into pre-existing holes.

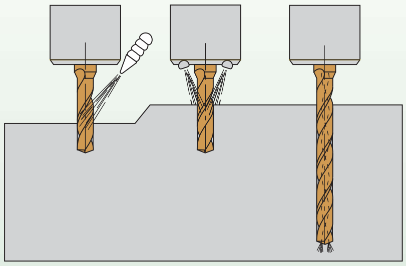
Hole Depths Greater than 3 x D

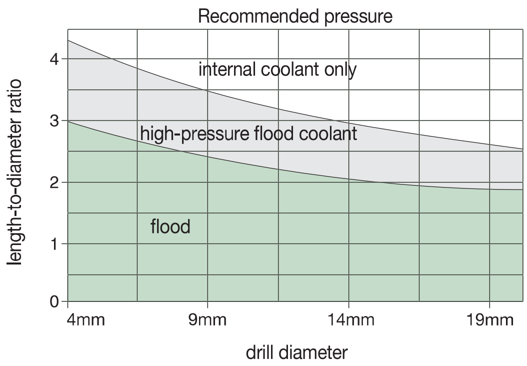
Hole depths that are deeper than three times the drill diameter may require a speed reduction. A 15% lower speed is suggested.

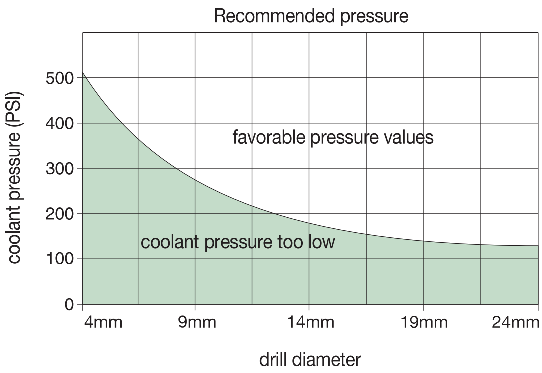
Coolant

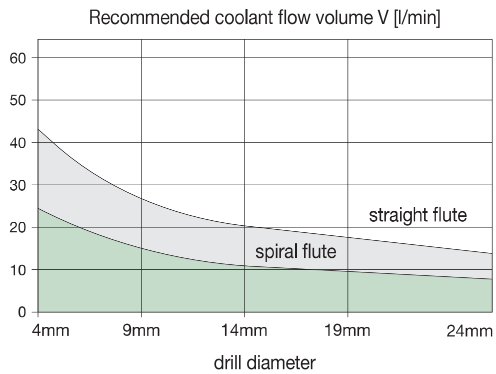
- To optimize their performance, drills must be adequately cooled. With the proper coolant flow, better tool life and higher maximum effective cutting speeds can be achieved.
- If not properly cooled, the drill will heat up rapidly. This causes the drill diameter to expand, which in turn may cause the drill to seize inside the hole.
- Solid carbide drills with internal coolant channels require deeper drilling depths to be effective. The higher the coolant pressure, the better the drilling results. Drill life and hole quality improve with ample coolant flow.
- When using drills without internal coolant flow, try to get at least one coolant jet as parallel to the drill as possible.
- For short-hole applications, drills without internal coolant may often provide better tool life. The tool is more solid, and it does not suffer from thermal shock at the cutting edge.
- It is important to use high coolant concentration to provide lubricity, which will aid in tool life, chip evacuation, and finer surface finishes.
- High-pressure coolant, either through the tool or through a line adjacent and parallel to the tool, should always be considered for increased tool life and production.
- Do not use multi-coolant lines. Use one line with 100% of the flow capacity to evacuate the chips from the hole.

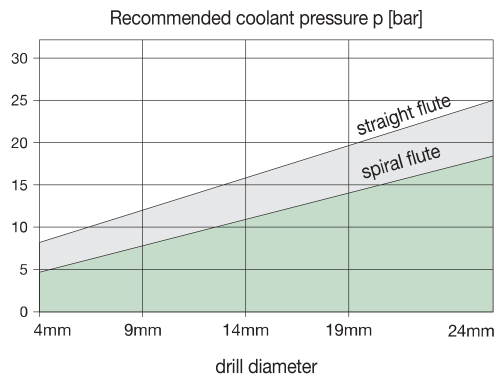
Coolant requirement for carbide drills





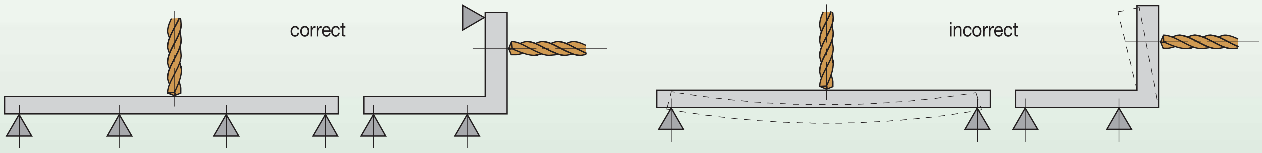




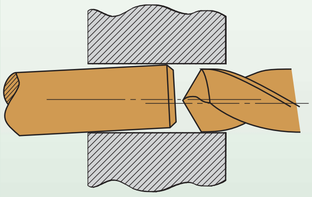
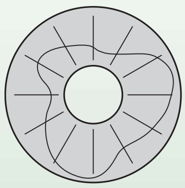
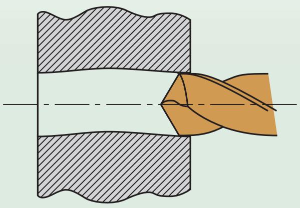


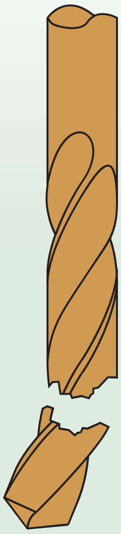
Workpiece Rigidity

Because solid carbide drills have much higher penetration rates, it is important that the workpiece has adequate support.



problem	source	solution
heavy wear on the cutting corners 	**insufficient coolant**	• Check cooling lubricant. In the case of internal coolant supply, increase coolant pressure. In the case of external coolant supply, adjust positioning of coolant jet. Cool from both sides.
	workpiece movement	• Stabilize workpiece chucking and check stability of machine tool.
	wrong drill	• Check drill type, drilling depth, cooling system, and workpiece material.
	cutting conditions	• Reduce cutting speed; increase feed.
splintering on the chisel edge 	**clamping chuck**	• Check clamping accuracy. Use hydraulic clamping chuck or high-precision chucking system.
	cutting conditions	• Decrease feed; increase speed.
built-up edge 	**insufficient coolant**	• Check cooling lubricant. In the case of internal coolant supply, increase coolant pressure. In the case of external coolant supply, adjust positioning of coolant jet. Cool from both sides.
	cutting conditions	• Increase speed 20–30%.
splintering on the cutting edges 	**clamping chuck**	• Check clamping accuracy and torque transmission. Use hydraulic clamping chuck or high-precision chucking system.
	cutting conditions caused by built-up edge	• Check cutting values, and possibly increase cutting speed.
		• Examine regularly for built-up edge.
thermal checking/comb cracking 	**cutting conditions**	• Adapt coolant and cutting conditions to reduce thermal shock.

problem	source	solution
hole too big 	**cutting conditions**	• Check cutting values, increase cutting speed, or reduce feed.
	clamping chuck	• Check clamping accuracy and torque transmission. Use hydraulic clamping chuck or high-precision chucking system.
	wrong drill	• Check drill diameter. Please note that drills are ground to a positive tolerance. Check concentric running.
hole too small 	**insufficient coolant**	• Check cooling lubricant. In the case of internal coolant supply, increase coolant pressure. In the case of external coolant supply, adjust positioning of coolant jet. Cool from both sides.
	cutting conditions	• Decrease feed; increase speed.
	wrong drill	• Check cutting-edge diameter.
hole not cylindrical 	**clamping chuck**	• Check clamping accuracy and torque transmission. Use hydraulic clamping chuck or high-precision chucking system.
	workpiece movement	• Stabilize workpiece chucking and check stability of machine tool.
	wrong drill	• Check drill type and drilling depth. Use longer drills.
	cutting conditions	• Reduce feed at entry.

problem	source	solution
drill breakage 	clamping chuck	• Check clamping accuracy and torque transmission. Use hydraulic clamping chuck or high-precision chucking system.
	workpiece movement	• Stabilize workpiece chucking and check stability of machine tool.
	wrong drill	• Check drill type, drilling depth, cooling system, and workpiece material.
	insufficient coolant	• Check cooling lubricant. In the case of internal coolant supply, increase coolant pressure. In the case of external coolant supply, adjust positioning of coolant jet. Cool from both sides.
	cutting conditions	• Check cutting values, and possibly reduce feed.
	clamping chuck	• Check torque transmission. Use hydraulic clamping chuck or high-precision chucking system.
splintering on the cutting corners 	workpiece movement	• Stabilize workpiece chucking and check stability of machine tool.
	wrong drill	• Check drill type, drilling depth, cooling system, and workpiece material. Possibly use longer drill.
	insufficient coolant	• Check cooling lubricant. In the case of internal coolant supply, increase coolant pressure. In the case of external coolant supply, adjust positioning of coolant jet. Cool from both sides.
	cutting conditions	• Check cutting values, and possibly reduce feed.