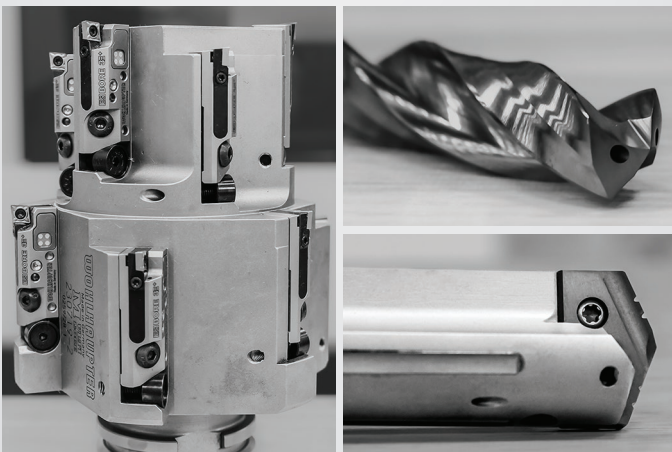
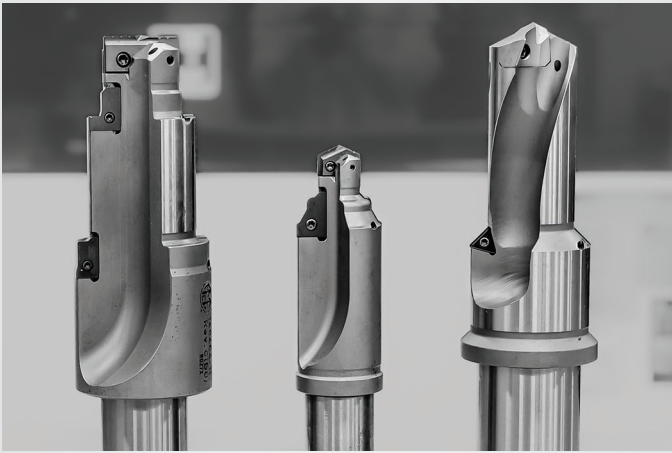


SPECIAL TOOLING CATALOG



**ALLIED MACHINE
& ENGINEERING**

www.alliedmachine.com

It's so much easier when you make **BETTER CHIPS**

Allied Machine specializes in developing innovative solutions designed to **pulverize** material. Our tools achieve the chip formation and chip evacuation you need to increase your production.



Allied Machine &
Engineering is registered
to ISO 9001:2015 by DQS



Wohlhaupter GmbH is
registered to ISO
9001:2015 by QUACERT



Allied Machine &
Engineering Co. Europe
Ltd. is registered to
ISO 9001:2015 by bsi.



Our Commitment to **YOU**



Manufacturing is the DNA of success everywhere in the world. When you're manufacturing, you're building, creating, and developing something that physically didn't exist before.

At Allied Machine, our core purpose is to provide practical and dependable solutions to improve your manufacturing processes. We know you face challenges and difficulties every day, so we're here to simplify your holmaking processes and improve your production.

However, many factors must be incorporated to truly improve production.

Some of those factors include increasing penetration rates while also improving chip formation and evacuation, reducing scrap rates by producing better parts, reducing setup times, and increasing tool life to get the most from your investment.

Not only does our tooling achieve these results, but our customer service is also an extension of our tooling advantages. Our Application Engineers and Field Sales Engineers are available to assist with any problems you encounter. Don't hesitate to put their skills and knowledge to the test. They won't disappoint.

This is our commitment to manufacturing, and it's our promise to you.



ALLIED MACHINE
& ENGINEERING



ALLIED MACHINE & ENGINEERING



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WOHLHAUPTER®

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India



LEADING HOLEMAKING SOLUTIONS WORLDWIDE

Allied Machine & Engineering is a worldwide leader in holemaking and finishing solutions. We are committed to providing practical and dependable solutions to our customers through innovative designs and superior customer and technical support.

We continue to expand our product offering in order to provide new and different solutions. With Field Sales Engineers located around the world, we position ourselves to provide technical support on site, right at your spindle.

Your safety and the safety of others is very important. This catalog contains important safety messages. Always read and follow all safety precautions.



This triangle is a safety hazard symbol. It alerts you to potential safety hazards that can cause tool failure and serious injury. When you see this symbol in the catalog, look for a related safety message that may be near this triangle or referred to in the nearby text.

There are safety signal words also used in the catalog. Safety messages follow these words:

⚠ WARNING means that failure to follow the precautions in this message could result in tool failure and serious injury.

NOTICE means that failure to follow the precautions in this message could result in damage to the tool or machine but not result in personal injury.

NOTE and **IMPORTANT** are also used. These are important that you read and follow but are not safety-related.

Visit www.alliedmachine.com for the most up-to-date information and procedures.

Patent Information

Allied Machine & Engineering patent information can be found at www.alliedmachine.com/patents

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SECTION

X10-SUP

Superion® Solid Carbide and PCD Tools

Superion[®] Solid Carbide and PCD Tools



Out of the Box Solutions

Superion became a subsidiary of Allied Machine and Engineering in 2016. We share a common mission to provide product excellence, expert technical support, and innovative holemaking solutions to our metal-cutting partners. We have strengthened these roots while growing to serve the unique cutting tool needs of new industries such as aerospace, defense, equipment testing, material processing, and more.

With significant investment in technology, Superion has opened the door for our team to manufacture new solutions including several carbide and PCD configurations. We focus on providing solutions that reduce our customers' costs, increase throughput and assist in developing processes that allow for consistent and repeatable performance.

- ▶ Material-specific coatings / geometries.
- ▶ Reduce setup times.
- ▶ Decrease cost per hole.

Applicable Industries

-  Aerospace
-  Agriculture
-  Automotive
-  Defense
-  General Production
-  Heavy Equipment
-  Hydraulics
-  Marine
-  Medical
-  Oil and Gas
-  Renewable Energy/ Energy
-  Tool, Mold, and Die

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Visit www.alliedmachine.com for the most up-to-date information and procedures.	



Superion Capabilities

WHAT IS SUPERION?

Superion capabilities provide cutting-edge solutions in both solid carbide and PCD tooling.

X10

WHY SHOULD YOU USE SUPERION?

- State-of-the-art manufacturing automation allows for high repeatability and consistency, regardless of the quantity you need.
- Superion provides application-specific solutions tailored to meet your toughest demands.
- Superion tooling excels in difficult and unique material applications.
- Our goal is to provide you a quality solution to exceed your need on a schedule that satisfies.

WHEN SHOULD YOU USE SUPERION?

- When finish is critical and dimensions are tight, Superion will deliver a tool to maintain your tolerances.
- When your tooling budget requires regrinds and the ability to remanufacture, Superion tackles your needs.
- If you're dealing with CFRP or other unique materials, Superion tooling is the right solution.



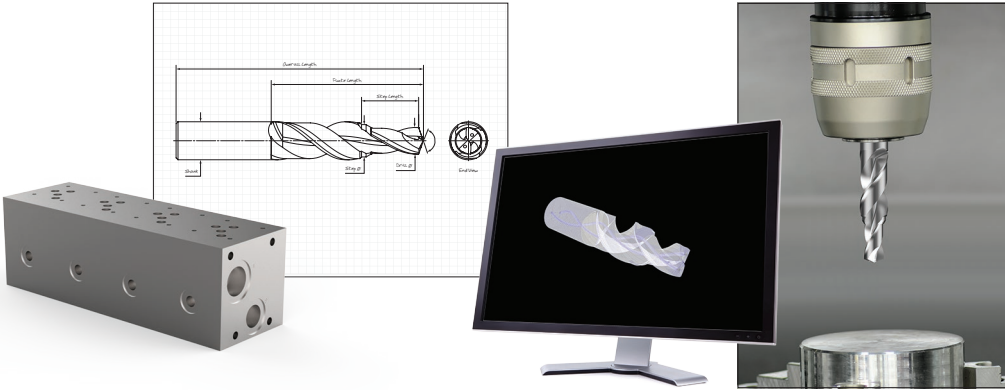


Tough Applications Solved

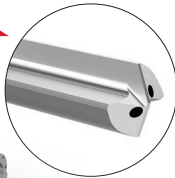
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FROM CONCEPT TO REALITY

Allied's team of engineers is ready to assist you with your application. We'll gather all the information we need about your application and turn your concept into reality. Give us a call today to collaborate with you. We'll listen to your needs, formulate a concept, develop the model, and build the solution.



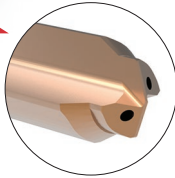
AEROSPACE / Landing Gear Components



DRILL BURNISH TOOLS

Reduce cycle time, increase throughput, and increase profitability by combining roughing and finishing operations using our burnishing geometry for applications in which surface finish and hole tolerance are critical.

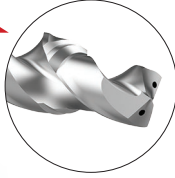
AUTOMOTIVE / Crankshafts



COMBINATION TOOLS

Combine multiple steps and various profile features to improve throughput. Combination tools reduce cost per hole and increase profit potential.

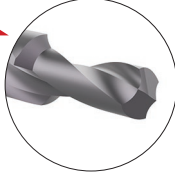
HEAVY EQUIPMENT / Manifolds



SOLID CARBIDE TOOLS WITH COOLANT

Solid carbide solutions optimize the manufacturing of manifolds. Most port specs call for at least 3 steps, and combining these features can reduce costs and increase throughput.

AUTOMOTIVE / Transmission Components



SOLID CARBIDE STEP TOOLS

You can rely on Superior's state-of-the-art manufacturing facility, built specifically to satisfy the customer's need whether it's 10 drills or 1,000 drills. Superior will provide consistent and effective solutions to your production needs.



Case Study

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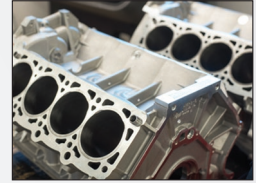
If you need to hold a tight tolerance, we have the solution.

When an application requires you to hold a tight tolerance, it quickly eliminates many tooling options because those options aren't capable of holding the strict tolerance. Our customer was using a solid carbide drill to machine cylinder heads for the automotive industry. The cylinder blocks were made from A356 aluminum.

When the end user raised concerns over the hole tolerance created by our customer's previous tooling, our customer changed the required tolerance from ± 0.013 mm (0.0005") to ± 0.009 mm (0.0003"). However, the previous tooling couldn't achieve the new tolerance requirements.

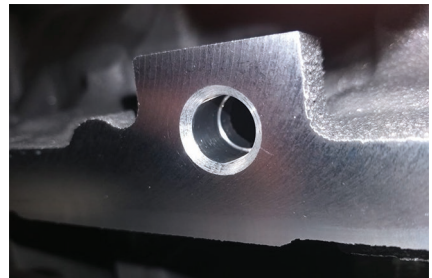
The customer tested the **Superion Solid Carbide Step Burnishing Drill** in this application. The Superion drill did exactly what the customer needed and successfully held the new tolerance of ± 0.009 mm (0.0003"). It also held the new tolerance with a 1.66 CPK, which was higher than the previous tool's CPK even at the initial ± 0.013 mm (0.0005") tolerance.

Don't tolerate tolerance issues. *Call us to help you find the right tool for the job.*



		Measure	Superion® Step Burnishing Drill
Product:	Superion® Step Burnishing Drill	RPM	3490
Objectives:	Achieve required tolerance	Speed	160.1 m/min (528 SFM)
Industry:	Automotive	Feed	0.29 mm/rev (0.0115 IPR)
Part:	Cylinder head	Penetration Rate	1100 mm/min (43 IPM)
Material:	A356 aluminum	Cycle Time	4 sec
Hole Ø:	14.70 mm (0.579")	Tool Life	3000 parts
Hole Depth:	30.00 mm (1.181")	Tolerance	± 0.009 mm (± 0.0003 ")

- Superion
Superion Step Burnishing Drill



The Step Burnishing Drill provided:

- ✓ Required tolerance
- ✓ Increased CPK

Case Study: CS0503

Case Study

Old adage, modern innovation: the right tool for the job.

Reduce costs and eliminate headaches by calling us to help solve your challenges. If your current process doesn't seem to be providing the results you want, you might be using the wrong tooling. Our customer was using a diamond-coated end mill to machine guide pads on frac pocket plugs used in down-hole oil drilling. The guide pads were made from fiberglass and glass wound filament material, which is very abrasive and shortens the life of cutting tools.

When the diamond coating wore off the end mill, the carbide substrate was exposed directly to the abrasive material, and the tool would quickly fail. The customer needed an optimized tool to extend tool life in this abrasive material and to solidify the repeatability of the process.

The customer tested the **Superion® PCD Flat Bottom Drill** in this application. The PCD substrate is more wear-resistant in the fiberglass material and provided more even wear of the tool throughout the process. Much to the customer's delight, the Superion drill ran at a higher penetration rate, which shortened cycle time. Most importantly, the Superion drill increased the customer's tool life from 7,500 holes to 50,000 holes (a 567% increase).

A costly application became effective and worry-free by finding the right tooling. The Superion drill didn't just increase the customer's tool life; it provided a repeatable, reliable process so the customer could "set it and forget it."

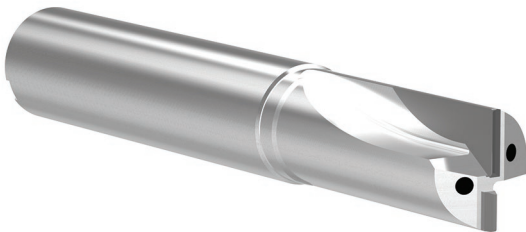
Don't tolerate unnecessary hassle and stress in your production. *Call us to help you find the right tool for the job.*



X10

Product: Superion® PCD Flat Bottom Drill Objectives: Increase tool life Industry: Oil & gas/petrochemical Part: Frac pocket plug guide pads Material: Fiberglass and glass wound filament Hole Ø: 9.652 mm (0.380") Hole Depth: 6.985 mm (0.275")	Measure	Diamond Coated End Mill	Superion® PCD Flat Bottom Drill
	RPM	4500	7500
	Speed	136.55 m/min (448 SFM)	227.381 m/min (746 SFM)
	Feed Rate	0.203 mm/rev (0.008 IPR)	0.203 mm/rev (0.008 IPR)
	Penetration Rate	914.4 mm/min (36 IPM)	1524 mm/min (60 IPM)
	Cycle Time	0.46 sec	0.28 sec
	Tool Life	7,500 holes	50,000 holes

▸ Superion
PCD solid carbide flat bottom drill



The PCD substrate for wear resistance in abrasive materials provided:

- ✓ Increased tool life
- ✓ Increased penetration rate
- ✓ Repeatable/reliable machining process

Case Study: CS0502



Superion Geometries

There's a Geometry for That

Allied Machine knows there isn't a one-size-fits-all solution when it comes to holemaking. To better accommodate the countless holes our customers drill, we offer multiple options in material-specific geometries and material-specific coatings.

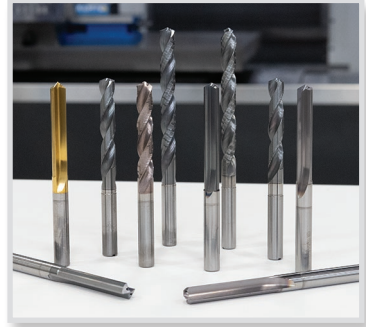
Superion geometries feature a unique edge prep tailored to specific material groups to optimize tool life and edge strength. Some geometries also offer solutions for rough and finish burnishing.

If you're unsure which geometry would be best for your application, give our Application Engineers a call. They're standing by, ready to help.

 **1.330.343.4283 ext: 7611**

 **1.800.321.5537 (toll free United States and Canada)**

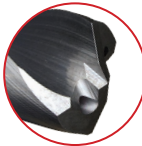
 **appeng@alliedmachine.com**



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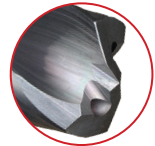
HPM

- Linear cutting edge aids in corner strength and improves chip formation in softer materials.
- Free cutting primary and secondary clearance.
- Ideal for drilling softer carbon, alloy and tool steel materials.
- AM420 coating for enhanced heat thresholds and tool life.
- TiCN coating for use in aluminum bronze.



HPM2M

- HPM geometry with a double margin.
- Recommended for improved hole tolerance and hole finish.
- Recommended for interrupted cuts and drill depths greater than 8xD.
- Double margins are optimized with a unique web for full engagement of all four margins at entry, leading to better stability.
- AM420 coating for enhanced heat thresholds and tool life.



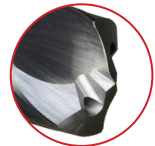
HPS

- Radius cutting edge for improved chip formation.
- Cam ground clearance for added point strength and stability.
- Reduced bell mouth for longer drill depths.
- OD flute edge prep for added corner strength.
- Ideal for drilling harder steels, high-temp alloys, and stainless.
- AM420 coating for enhanced heat thresholds and tool life in steels.
- AM460 coating provides industry leading tool life in stainless and HRSA materials with our highest heat threshold coating available.



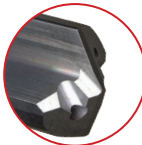
HPS2M

- HPS geometry with a double margin.
- Recommended for improved hole tolerance and hole finish.
- Recommended for interrupted cuts and drill depths greater than 8xD.
- Double margins are optimized with a unique web for full engagement of all four margins at entry, leading to better stability.
- Ideal for drilling gray/white and SG/nodular cast iron.
- AM420 coating for enhanced heat thresholds and tool life in steels.
- AM440 coating for reduced flank wear in cast irons.
- AM460 coating provides industry leading tool life in stainless and HRSA materials with our highest heat threshold coating available.



HP106

- Optimized core, point, and web features for increased strength.
- Utilizes a single margin design with straight flutes.
- Ideal for drilling hardened steels and wear plates.
- AM420 coating for enhanced heat thresholds and tool life.



HPF

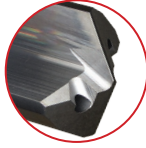
- Unique open geometry for high penetration rates specifically tailored for aluminum.
- Double margins are optimized with a unique web for full engagement of all four margins at entry, leading to better stability.
- Reduced helix angle for increased chip evacuation.
- Enhanced surface finish on tool to improve chip flow and reduce built-up edge.
- High lubricity TiCN coating for use in cast/wrought aluminum.



Superion Geometries

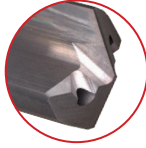
CIB (cast iron burnishing drill)

- Unique point, web, and cutting edge designed to significantly improve hole finish and hole tolerance.
- Double margins designed for enhanced stability.
- Minimized back taper to enhance straightness.
- Ideal pre-drill when using carbide taps.
- Straight flute design ideal for use on lathes.
- Enhanced surface finish on tool to improve chip flow and reduce built-up edge.
- AM440 coating for reduced flank wear in cast irons.



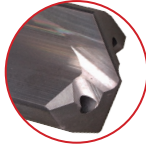
CAB (cast aluminum burnishing drill)

- Unique point, web, and cutting edge designed to significantly improve hole finish and hole tolerance.
- Straight flute design ideal for use on lathes.
- Double margins designed for enhanced stability.
- Minimized back taper to enhance straightness.
- Enhanced surface finish on tool to improve chip flow and reduce built-up edge.
- TiCN coating to enhance lubricity when drilling in aluminum.



WAB (wrought aluminum burnishing drill)

- Unique point, web, and cutting edge designed to significantly improve hole finish and hole tolerance.
- Straight flute design ideal for use on lathes.
- Double margins designed for enhanced stability.
- Minimized back taper to enhance straightness.
- Geometry enhancements for drilling wrought aluminum.
- Enhanced surface finish on tool to improve chip flow and reduce built-up edge.
- TiCN coating to enhance lubricity when drilling in aluminum.



BCB (brass copper burnishing drill)

- Straight flute design ideal for use on lathes.
- Double margins designed for enhanced stability.
- Minimized back taper to enhance straightness.
- Geometry enhancements for drilling brass and copper.
- Enhanced surface finish on tool to improve chip flow and reduce built-up edge.
- TiN coating.



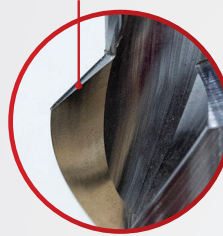
FEATURES THAT WORK STEP DRILL DUB OFF

We have the solution when you have:

- Difficulties with chip formation on step tools.
- Chips wrapping around the tool even with peck cycles.
- To use multiple diameter drills.

Superion solid carbide step drills *now* include dub off.

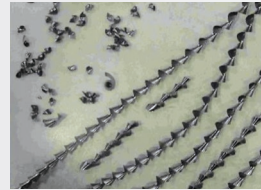
without dub off



with dub off



Hardened 4150



without dub off

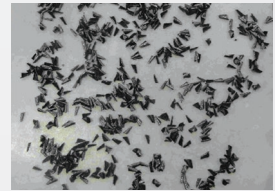


with dub off

Ductile Iron



without dub off



with dub off

Soft 1018



without dub off



with dub off

X10

**Recommended Drilling Data | Metric (mm)****SUPERION SOLID CARBIDE****X10**

ISO	Material	Hardness (BHN)	General Application Geometry	Special Geometry*	Coating	Speed (m/min)	Feed Rate (mm/rev) by Diameter	
							3.00 - 4.00	4.00 - 5.00
P	Free-Machining Steel 1118, 1215, 12L14, etc.	100-150	HPM	● HPM2M	AM420	152	0.15	0.18
		150-200	HPM	● HPM2M	AM420	145	0.13	0.17
		200-250	HPS	▲ HPS2M	AM420	137	0.10	0.15
	Low-Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85-125	HPM	● HPM2M	AM420	139	0.15	0.18
		125-175	HPM	● HPM2M	AM420	134	0.15	0.17
		175-225	HPM	● HPM2M	AM420	130	0.13	0.15
		225-275	HPS	▲ HPS2M	AM420	125	0.11	0.15
	Medium-Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125-175	HPM	● HPM2M	AM420	134	0.14	0.15
		175-225	HPM	● HPM2M	AM420	131	0.13	0.14
		225-275	HPS	▲ HPS2M	AM420	122	0.11	0.13
		275-325	HPS	▲ HPS2M	AM420	114	0.10	0.13
	Alloy Steel 4140, 5140, 8640, etc.	125-175	HPM	● HPM2M	AM420	123	0.14	0.15
		175-225	HPM	● HPM2M	AM420	116	0.13	0.14
		225-275	HPS	▲ HPS2M	AM420	111	0.10	0.13
		275-325	HPS	▲ HPS2M	AM420	104	0.10	0.13
		325-375	HP106	—	AM420	99	0.09	0.11
	High-Strength Alloy 4340, 4330V, 300M, etc.	225-300	HPS	▲ HPS2M	AM420	104	0.10	0.13
		300-350	HPS	▲ HPS2M	AM420	98	0.10	0.13
		350-400	HP106	—	AM420	76	0.09	0.10
	Structural Steel A36, A285, A516, etc.	100-150	HPS	▲ HPS2M	AM420	137	0.14	0.17
		150-250	HPS	▲ HPS2M	AM420	130	0.11	0.14
		250-350	HPS	▲ HPS2M	AM420	119	0.10	0.13
	Tool Steel H-13, H-21, A-4, S-3, etc.	150-200	HPM	● HPM2M	AM420	82	0.11	0.11
		200-250	HPS	▲ HPS2M	AM420	76	0.10	0.10
M	Stainless Steel 400 Series 416, 420, etc.	185-275	HPS	▲ HPS2M	AM460	76	0.10	0.11
		275-350	HPS	▲ HPS2M	AM460	59	0.09	0.10
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.	135-185	HPS	▲ HPS2M	AM460	61	0.09	0.10
		185-275	HPS	▲ HPS2M	AM460	53	0.08	0.09
	Super Duplex Stainless Steel	135-185	HPS	▲ HPS2M	AM460	46	0.09	0.10
		185-275	HPS	▲ HPS2M	AM460	41	0.08	0.09

NOTE: The speeds and feeds listed above are for solid carbide tooling only. These are not recommendations for any polycrystalline diamond tools.

***Special Geometry**

- Use HPM2M for greater drill depths over 8xD. HPM2M is used for any interruptions and produces a better hole tolerance and finish in comparison to HPM.
- ▲ Use HPS2M for greater drill depths over 8xD. HPS2M is used for any interruptions and produces a better hole tolerance and finish in comparison to HPS.

Parameter Reductions for Length to Diameter Relationships

6xD	0.90 reduction for speed and feed adjustment
9xD	0.80 reduction for speed and feed adjustment
12xD	0.70 reduction for speed and feed adjustment
15xD - 20xD	0.60 reduction for speed and feed adjustment

Flood Coolant Applications

Recommend if diameter to depth is less than or equal to three times the diameter. Reduce speed by 20%, and if needed, drop feed by 10% to maintain optimal chip formation.

Parameter Recommendations for Step Drills

- Feed rate is based off the pilot diameter.
- Speed rate is based off the largest step diameter.

IMPORTANT: The speeds and feeds listed above are a general starting point for all applications. Refer to the Coolant Recommendation charts for coolant requirements to run at the recommended speeds and feeds. Factory technical assistance is also available through our Application Engineering team.

⚠ WARNING Refer to Speed and Feed charts for recommended adjustments to speeds and feeds. Refer to page **X10: 18** for Deep Hole Drilling Guidelines in this section of the catalog. Visit www.alliedmachine.com/DeepHoleGuidelines for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering department: appeng@alliedmachine.com.

**Recommended Drilling Data | Metric (mm)****SUPERION SOLID CARBIDE**

Feed Rate (mm/rev) by Diameter								
5.00 - 6.00	6.00 - 7.00	7.00 - 8.00	8.00 - 10.00	10.00 - 12.00	12.00 - 14.00	14.00 - 16.00	16.00 - 18.00	18.00 - 20.00
0.20	0.23	0.25	0.30	0.33	0.38	0.43	0.46	0.51
0.19	0.22	0.24	0.28	0.30	0.36	0.41	0.43	0.48
0.18	0.20	0.23	0.25	0.28	0.33	0.38	0.41	0.46
0.20	0.23	0.25	0.30	0.34	0.37	0.42	0.44	0.50
0.19	0.22	0.24	0.29	0.33	0.36	0.41	0.43	0.48
0.18	0.20	0.23	0.28	0.32	0.34	0.38	0.41	0.46
0.18	0.20	0.23	0.25	0.30	0.33	0.38	0.41	0.46
0.18	0.19	0.23	0.28	0.30	0.33	0.37	0.41	0.44
0.15	0.18	0.22	0.27	0.29	0.32	0.36	0.39	0.43
0.15	0.18	0.22	0.27	0.28	0.32	0.34	0.37	0.42
0.14	0.17	0.20	0.25	0.28	0.30	0.33	0.36	0.41
0.17	0.19	0.22	0.27	0.29	0.33	0.37	0.41	0.43
0.15	0.18	0.20	0.25	0.28	0.32	0.36	0.39	0.42
0.15	0.17	0.20	0.24	0.27	0.30	0.34	0.37	0.39
0.14	0.15	0.19	0.23	0.25	0.29	0.33	0.36	0.38
0.13	0.14	0.18	0.23	0.25	0.28	0.32	0.34	0.37
0.15	0.17	0.20	0.24	0.27	0.30	0.34	0.37	0.39
0.14	0.15	0.19	0.23	0.25	0.29	0.33	0.36	0.38
0.11	0.14	0.17	0.20	0.22	0.25	0.28	0.30	0.33
0.18	0.20	0.24	0.30	0.33	0.36	0.39	0.41	0.47
0.15	0.18	0.20	0.27	0.30	0.30	0.34	0.36	0.41
0.14	0.17	0.19	0.24	0.27	0.29	0.32	0.34	0.38
0.13	0.15	0.18	0.24	0.25	0.28	0.32	0.33	0.38
0.11	0.14	0.17	0.22	0.23	0.25	0.29	0.30	0.36
0.14	0.17	0.19	0.23	0.24	0.25	0.28	0.28	0.30
0.11	0.14	0.17	0.20	0.22	0.24	0.25	0.25	0.28
0.11	0.13	0.15	0.18	0.19	0.20	0.23	0.24	0.27
0.10	0.10	0.13	0.15	0.17	0.18	0.20	0.20	0.23
0.11	0.13	0.15	0.18	0.18	0.19	0.19	0.20	0.22
0.10	0.10	0.11	0.14	0.14	0.17	0.17	0.18	0.18

NOTE: The speeds and feeds listed above are for solid carbide tooling only. These are not recommendations for any polycrystalline diamond tools.

X10



Recommended Drilling Data | Metric (mm)

SUPERION SOLID CARBIDE

X10

ISO	Material	Hardness (BHN)	General Application Geometry	Special Geometry*	Coating	Speed (m/min)	Feed Rate (mm/rev) by Diameter	
							3.00 - 4.00	4.00 - 5.00
K	SG / Nodular Cast Iron	120-150	HPS2M	◆ CIB	AM440	152	0.20	0.22
		150-200	HPS2M	◆ CIB	AM440	148	0.18	0.19
		200-220	HPS2M	◆ CIB	AM440	143	0.15	0.18
		220-260	HPS2M	◆ CIB	AM440	139	0.15	0.18
		260-320	HPS2M	◆ CIB	AM440	127	0.13	0.17
	Grey / White Iron	120-150	HPS2M	◆ CIB	AM440	166	0.23	0.24
		150-200	HPS2M	◆ CIB	AM440	162	0.20	0.22
		200-220	HPS2M	◆ CIB	AM440	157	0.18	0.20
		220-260	HPS2M	◆ CIB	AM440	145	0.18	0.20
		260-320	HPS2M	◆ CIB	AM440	137	0.15	0.19
N	Cast Aluminum	30	HPF	○ CAB	TiCN	290	0.19	0.22
		180	HPF	○ CAB	TiCN	230	0.17	0.19
	Wrought Aluminum	30	HPF	△ WAB	TiCN	335	0.19	0.22
		180	HPF	△ WAB	TiCN	290	0.17	0.19
	Aluminum Bronze	100-200	HPM	—	TiCN	113	0.10	0.13
		200-250	HPM	—	TiCN	95	0.09	0.11
S	Brass	100	BCB	—	TiN	229	0.13	0.15
	Copper	60	BCB	—	TiN	155	0.05	0.06
	High-Temp Alloy Hastelloy® B, Inconel® 600, etc.	140-220	HPS	—	AM460	34	0.08	0.08
		220-310	HPS	—	AM460	30	0.05	0.05
	Titanium Alloy	140-220	HPS	—	AM460	46	0.06	0.08
		220-310	HPS	—	AM460	37	0.05	0.06
H	Aerospace Alloy S82	185-275	HPS	—	AM460	49	0.08	0.08
		275-350	HPS	—	AM460	40	0.05	0.05
	Wear Plate Hardox®, AR400, T-1, etc.	400	HP106	—	AM420	52	0.05	0.05
		500	HP106	—	AM420	43	0.05	0.05
		600	HP106	—	AM420	30	0.05	0.05
	Hardened Steel	300-400	HP106	—	AM420	52	0.05	0.05
		400-500	HP106	—	AM420	43	0.05	0.05

NOTE: The speeds and feeds listed above are for solid carbide tooling only. These are not recommendations for any polycrystalline diamond tools.

***Special Geometry**

◆ CIB (Cast Iron Burnish): Unique point, web, and cutting edge designed to significantly improve hole finish and tolerance.

NOTE: Reduce speed and feed parameters above from 40% - 50% reduction.

○ CAB (Cast Aluminum Burnish): Unique point, web, and cutting edge designed to significantly improve hole finish and tolerance

NOTE: Reduce speed and feed parameters above from 40% - 50% reduction.

△ WAB (Wrought Aluminum Burnish): Unique point, web, and cutting edge designed to significantly improve hole finish and tolerance.

NOTE: Reduce speed and feed parameters above from 40% - 50% reduction.

Parameter Reductions for Length to Diameter Relationships

6xD	0.90 reduction for speed and feed adjustment
9xD	0.80 reduction for speed and feed adjustment
12xD	0.70 reduction for speed and feed adjustment
15xD - 20xD	0.60 reduction for speed and feed adjustment

Flood Coolant Applications

Recommend if diameter to depth is less than or equal to three times the diameter. Reduce speed by 20%, and if needed, drop feed by 10% to maintain optimal chip formation.

Parameter Recommendations for Step Drills

- Feed rate is based off the pilot diameter.
- Speed rate is based off the largest step diameter.

IMPORTANT: The speeds and feeds listed above are a general starting point for all applications. Refer to the Coolant Recommendation charts for coolant requirements to run at the recommended speeds and feeds. Factory technical assistance is also available through our Application Engineering team.

⚠ WARNING Refer to Speed and Feed charts for recommended adjustments to speeds and feeds. Refer to page **X10: 18** for Deep Hole Drilling Guidelines in this section of the catalog. Visit www.alliedmachine.com/DeepHoleGuidelines for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering department: appeng@alliedmachine.com.

**Recommended Drilling Data | Metric (mm)****SUPERION SOLID CARBIDE**

Feed Rate (mm/rev) by Diameter								
5.00 - 6.00	6.00 - 7.00	7.00 - 8.00	8.00 - 10.00	10.00 - 12.00	12.00 - 14.00	14.00 - 16.00	16.00 - 18.00	18.00 - 20.00
0.23	0.28	0.30	0.36	0.39	0.43	0.47	0.52	0.56
0.22	0.25	0.29	0.33	0.36	0.39	0.42	0.47	0.53
0.20	0.23	0.28	0.30	0.33	0.36	0.38	0.43	0.47
0.20	0.23	0.28	0.30	0.33	0.36	0.38	0.43	0.47
0.19	0.22	0.25	0.29	0.32	0.34	0.37	0.39	0.43
0.25	0.30	0.33	0.39	0.42	0.47	0.51	0.56	0.61
0.24	0.28	0.32	0.37	0.39	0.42	0.44	0.50	0.56
0.23	0.25	0.30	0.33	0.36	0.38	0.41	0.46	0.51
0.23	0.25	0.30	0.33	0.36	0.38	0.41	0.46	0.51
0.22	0.24	0.29	0.32	0.34	0.37	0.39	0.42	0.48
0.23	0.25	0.32	0.37	0.41	0.46	0.50	0.51	0.56
0.22	0.23	0.29	0.34	0.39	0.43	0.47	0.48	0.53
0.24	0.28	0.32	0.37	0.43	0.47	0.51	0.53	0.58
0.22	0.25	0.29	0.34	0.39	0.44	0.48	0.51	0.56
0.15	0.18	0.20	0.23	0.25	0.30	0.33	0.36	0.38
0.13	0.15	0.17	0.18	0.20	0.25	0.28	0.30	0.36
0.18	0.23	0.25	0.29	0.32	0.36	0.41	0.43	0.46
0.08	0.08	0.08	0.10	0.10	0.10	0.13	0.15	0.18
0.09	0.10	0.11	0.14	0.15	0.17	0.18	0.19	0.22
0.08	0.09	0.09	0.11	0.13	0.15	0.17	0.17	0.19
0.09	0.10	0.11	0.15	0.15	0.18	0.19	0.20	0.23
0.08	0.09	0.10	0.13	0.14	0.15	0.18	0.18	0.20
0.09	0.10	0.10	0.11	0.14	0.15	0.17	0.18	0.20
0.08	0.09	0.09	0.10	0.11	0.14	0.15	0.15	0.18
0.05	0.08	0.08	0.10	0.13	0.14	0.18	0.20	0.23
0.05	0.08	0.08	0.10	0.10	0.11	0.15	0.18	0.20
0.05	0.08	0.08	0.10	0.10	0.11	0.15	0.18	0.20
0.05	0.08	0.08	0.10	0.13	0.14	0.18	0.20	0.23
0.05	0.08	0.08	0.10	0.10	0.11	0.15	0.18	0.20

NOTE: The speeds and feeds listed above are for solid carbide tooling only. These are not recommendations for any polycrystalline diamond tools.

X10



Recommended Drilling Data | Imperial (in)

SUPERION SOLID CARBIDE

X10

ISO	Material	Hardness (BHN)	General Application Geometry	Special Geometry*	Coating	Speed (SFM)	Feed Rate (IPR) by Diameter	
							0.118 - 0.157	0.157 - 0.197
P	Free-Machining Steel 1118, 1215, 12L14, etc.	100 - 150	HPM	● HPM2M	AM420	500	0.0060	0.0070
		150 - 200	HPM	● HPM2M	AM420	475	0.0050	0.0065
		200 - 250	HPS	▲ HPS2M	AM420	450	0.0040	0.0060
	Low-Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 125	HPM	● HPM2M	AM420	455	0.0060	0.0070
		125 - 175	HPM	● HPM2M	AM420	440	0.0060	0.0065
		175 - 225	HPM	● HPM2M	AM420	425	0.0050	0.0060
		225 - 275	HPS	▲ HPS2M	AM420	410	0.0045	0.0060
	Medium-Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 175	HPM	● HPM2M	AM420	440	0.0055	0.0060
		175 - 225	HPM	● HPM2M	AM420	430	0.0050	0.0055
		225 - 275	HPS	▲ HPS2M	AM420	400	0.0045	0.0050
		275 - 325	HPS	▲ HPS2M	AM420	375	0.0040	0.0050
	Alloy Steel 4140, 5140, 8640, etc.	125-175	HPM	● HPM2M	AM420	405	0.0055	0.0060
		175-225	HPM	● HPM2M	AM420	380	0.0050	0.0055
		225-275	HPS	▲ HPS2M	AM420	365	0.0040	0.0050
		275-325	HPS	▲ HPS2M	AM420	340	0.0040	0.0050
		325-375	HP106	—	AM420	325	0.0035	0.0045
	High-Strength Alloy 4340, 4330V, 300M, etc.	225 - 300	HPS	▲ HPS2M	AM420	340	0.0040	0.0050
		300 - 350	HPS	▲ HPS2M	AM420	320	0.0040	0.0050
		350 - 400	HP106	—	AM420	250	0.0035	0.0040
	Structural Steel A36, A285, A516, etc.	100 - 150	HPS	▲ HPS2M	AM420	450	0.0055	0.0065
		150 - 250	HPS	▲ HPS2M	AM420	425	0.0045	0.0055
		250 - 350	HPS	▲ HPS2M	AM420	390	0.0040	0.0050
	Tool Steel H-13, H-21, A-4, S-3, etc.	150 - 200	HPM	● HPM2M	AM420	270	0.0045	0.0045
		200 - 250	HPS	▲ HPS2M	AM420	250	0.0040	0.0040
M	Stainless Steel 400 Series 416, 420, etc.	185-275	HPS	▲ HPS2M	AM460	250	0.0040	0.0045
		275-350	HPS	▲ HPS2M	AM460	195	0.0035	0.0040
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.	135-185	HPS	▲ HPS2M	AM460	200	0.0035	0.0040
		185-275	HPS	▲ HPS2M	AM460	175	0.0030	0.0035
	Super Duplex Stainless Steel	135-185	HPS	▲ HPS2M	AM460	150	0.0035	0.0040
		185-275	HPS	▲ HPS2M	AM460	135	0.0030	0.0035

NOTE: The speeds and feeds listed above are for solid carbide tooling only. These are not recommendations for any polycrystalline diamond tools.

***Special Geometry**

- Use HPM2M for greater drill depths over 8xD. HPM2M is used for any interruptions and produces a better hole tolerance and finish in comparison to HPM.
- ▲ Use HPS2M for greater drill depths over 8xD. HPS2M is used for any interruptions and produces a better hole tolerance and finish in comparison to HPS.

Parameter Reductions for Length to Diameter Relationships

6xD	0.90 reduction for speed and feed adjustment
9xD	0.80 reduction for speed and feed adjustment
12xD	0.70 reduction for speed and feed adjustment
15xD - 20xD	0.60 reduction for speed and feed adjustment

Flood Coolant Applications

Recommend if diameter to depth is less than or equal to three times the diameter. Reduce speed by 20%, and if needed, drop feed by 10% to maintain optimal chip formation.

Parameter Recommendations for Step Drills

- Feed rate is based off the pilot diameter.
- Speed rate is based off the largest step diameter.

IMPORTANT: The speeds and feeds listed above are a general starting point for all applications. Refer to the Coolant Recommendation charts for coolant requirements to run at the recommended speeds and feeds. Factory technical assistance is also available through our Application Engineering team.

WARNING Refer to Speed and Feed charts for recommended adjustments to speeds and feeds. Refer to page **X10: 18** for Deep Hole Drilling Guidelines in this section of the catalog. Visit www.alliedmachine.com/DeepHoleGuidelines for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering department: appeng@alliedmachine.com.



Recommended Drilling Data | Imperial (in)

SUPERION SOLID CARBIDE

Feed Rate (IPR) by Diameter								
0.197 - 0.236	0.236 - 0.276	0.276 - 0.315	0.315 - 0.394	0.394 - 0.472	0.472 - 0.551	0.551 - 0.630	0.630 - 0.709	0.709 - 0.787
0.0080	0.0090	0.0100	0.0120	0.0130	0.0150	0.0170	0.0180	0.0200
0.0075	0.0085	0.0095	0.0110	0.0120	0.0140	0.0160	0.0170	0.0190
0.0070	0.0080	0.0090	0.0100	0.0110	0.0130	0.0150	0.0160	0.0180
0.0080	0.0090	0.0100	0.0120	0.0135	0.0145	0.0165	0.0175	0.0195
0.0075	0.0085	0.0095	0.0115	0.0130	0.0140	0.0160	0.0170	0.0190
0.0070	0.0080	0.0090	0.0110	0.0125	0.0135	0.0150	0.0160	0.0180
0.0070	0.0080	0.0090	0.0100	0.0120	0.0130	0.0150	0.0160	0.0180
0.0070	0.0075	0.0090	0.0110	0.0120	0.0130	0.0145	0.0160	0.0175
0.0060	0.0070	0.0085	0.0105	0.0115	0.0125	0.0140	0.0155	0.0170
0.0060	0.0070	0.0085	0.0105	0.0110	0.0125	0.0135	0.0145	0.0165
0.0055	0.0065	0.0080	0.0100	0.0110	0.0120	0.0130	0.0140	0.0160
0.0065	0.0075	0.0085	0.0105	0.0115	0.0130	0.0145	0.0160	0.0170
0.0060	0.0070	0.0080	0.0100	0.0110	0.0125	0.0140	0.0155	0.0165
0.0060	0.0065	0.0080	0.0095	0.0105	0.0120	0.0135	0.0145	0.0155
0.0055	0.0060	0.0075	0.0090	0.0100	0.0115	0.0130	0.0140	0.0150
0.0050	0.0055	0.0070	0.0090	0.0100	0.0110	0.0125	0.0135	0.0145
0.0060	0.0065	0.0080	0.0095	0.0105	0.0120	0.0135	0.0145	0.0155
0.0055	0.0060	0.0075	0.0090	0.0100	0.0115	0.0130	0.0140	0.0150
0.0045	0.0055	0.0065	0.0080	0.0085	0.0100	0.0110	0.0120	0.0130
0.0070	0.0080	0.0095	0.0120	0.0130	0.0140	0.0155	0.0160	0.0185
0.0060	0.0070	0.0080	0.0110	0.0120	0.0120	0.0135	0.0140	0.0160
0.0055	0.0065	0.0075	0.0095	0.0105	0.0115	0.0125	0.0135	0.0150
0.0050	0.0060	0.0070	0.0095	0.0100	0.0110	0.0125	0.0130	0.0150
0.0045	0.0055	0.0065	0.0085	0.0090	0.0100	0.0115	0.0120	0.0140
0.0055	0.0065	0.0075	0.0090	0.0095	0.0100	0.0110	0.0110	0.0120
0.0045	0.0055	0.0065	0.0080	0.0085	0.0095	0.0100	0.0100	0.0110
0.0045	0.0050	0.0060	0.0070	0.0075	0.0080	0.0090	0.0095	0.0105
0.0040	0.0040	0.0050	0.0060	0.0065	0.0070	0.0080	0.0080	0.0090
0.0045	0.0050	0.0060	0.0070	0.0070	0.0075	0.0075	0.0080	0.0085
0.0040	0.0040	0.0045	0.0055	0.0055	0.0065	0.0065	0.0070	0.0070

NOTE: The speeds and feeds listed above are for solid carbide tooling only. These are not recommendations for any polycrystalline diamond tools.



Recommended Drilling Data | Imperial (in)

SUPERION SOLID CARBIDE

X10

ISO	Material	Hardness (BHN)	General Application Geometry	Special Geometry*	Coating	Speed (SFM)	Feed Rate (IPR) by Diameter	
							0.118 - 0.157	0.157 - 0.197
K	SG / Nodular Cast Iron	120-150	HPS2M	◆ CIB	AM440	500	0.0080	0.0085
		150-200	HPS2M	◆ CIB	AM440	485	0.0070	0.0075
		200-220	HPS2M	◆ CIB	AM440	470	0.0060	0.0070
		220-260	HPS2M	◆ CIB	AM440	455	0.0060	0.0070
		260-320	HPS2M	◆ CIB	AM440	415	0.0050	0.0065
	Grey / White Iron	120-150	HPS2M	◆ CIB	AM440	545	0.0090	0.0095
		150-200	HPS2M	◆ CIB	AM440	530	0.0080	0.0085
		200-220	HPS2M	◆ CIB	AM440	515	0.0070	0.0080
		220-260	HPS2M	◆ CIB	AM440	475	0.0070	0.0080
		260-320	HPS2M	◆ CIB	AM440	450	0.0060	0.0075
N	Cast Aluminum	30	HPF	○ CAB	TiCN	950	0.0075	0.0085
		180	HPF	○ CAB	TiCN	755	0.0065	0.0075
	Wrought Aluminum	30	HPF	△ WAB	TiCN	1100	0.0075	0.0085
		180	HPF	△ WAB	TiCN	950	0.0065	0.0075
	Aluminum Bronze	100-200	HPM	—	TiCN	370	0.0040	0.0050
		200-250	HPM	—	TiCN	310	0.0035	0.0045
S	Brass	100	BCB	—	TiN	750	0.0050	0.0060
	Copper	60	BCB	—	TiN	510	0.0020	0.0025
	High-Temp Alloy Hastelloy® B, Inconel® 600, etc.	140-220	HPS	—	AM460	110	0.0030	0.0030
		220-310	HPS	—	AM460	100	0.0020	0.0020
	Titanium Alloy	140-220	HPS	—	AM460	150	0.0025	0.0030
		220-310	HPS	—	AM460	120	0.0020	0.0025
H	Aerospace Alloy S82	185-275	HPS	—	AM460	160	0.0030	0.0030
		275-350	HPS	—	AM460	130	0.0020	0.0020
	Wear Plate Hardox®, AR400, T-1, etc.	400	HP106	—	AM420	170	0.0020	0.0020
		500	HP106	—	AM420	140	0.0020	0.0020
		600	HP106	—	AM420	100	0.0020	0.0020
	Hardened Steel	300-400	HP106	—	AM420	170	0.0020	0.0020
		400-500	HP106	—	AM420	140	0.0020	0.0020

NOTE: The speeds and feeds listed above are for solid carbide tooling only. These are not recommendations for any polycrystalline diamond tools.

*Special Geometry

◆ CIB (Cast Iron Burnish): Unique point, web, and cutting edge designed to significantly improve hole finish and tolerance.

NOTE: Reduce speed and feed parameters above from 40% - 50% reduction.

○ CAB (Cast Aluminum Burnish): Unique point, web, and cutting edge designed to significantly improve hole finish and tolerance

NOTE: Reduce speed and feed parameters above from 40% - 50% reduction.

△ WAB (Wrought Aluminum Burnish): Unique point, web, and cutting edge designed to significantly improve hole finish and tolerance.

NOTE: Reduce speed and feed parameters above from 40% - 50% reduction.

Parameter Reductions for Length to Diameter Relationships

6xD	0.90 reduction for speed and feed adjustment
▲ 9xD	0.80 reduction for speed and feed adjustment
▲ 12xD	0.70 reduction for speed and feed adjustment
▲ 15xD - 20xD	0.60 reduction for speed and feed adjustment

Flood Coolant Applications

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▲ WARNING

Refer to Speed and Feed charts for recommended adjustments to speeds and feeds. Refer to page X10: 18 for Deep Hole Drilling Guidelines in this section of the catalog. Visit www.alliedmachine.com/DeepHoleGuidelines for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering department: appeng@alliedmachine.com.

**Recommended Drilling Data | Imperial (in)****SUPERION SOLID CARBIDE**

Feed Rate (IPR) by Diameter								
0.197 - 0.236	0.236 - 0.276	0.276 - 0.315	0.315 - 0.394	0.394 - 0.472	0.472 - 0.551	0.551 - 0.630	0.630 - 0.709	0.709 - 0.787
0.0090	0.0110	0.0120	0.0140	0.0155	0.0170	0.0190	0.0205	0.0220
0.0085	0.0100	0.0115	0.0130	0.0140	0.0155	0.0165	0.0185	0.0210
0.0080	0.0090	0.0110	0.0120	0.0130	0.0140	0.0150	0.0170	0.0190
0.0080	0.0090	0.0110	0.0120	0.0130	0.0140	0.0150	0.0170	0.0190
0.0075	0.0085	0.0100	0.0115	0.0125	0.0135	0.0145	0.0155	0.0170
0.0100	0.0120	0.0130	0.0155	0.0165	0.0185	0.0200	0.0220	0.0240
0.0095	0.0110	0.0125	0.0145	0.0155	0.0165	0.0175	0.0195	0.0220
0.0090	0.0100	0.0120	0.0130	0.0140	0.0150	0.0160	0.0180	0.0200
0.0090	0.0100	0.0120	0.0130	0.0140	0.0150	0.0160	0.0180	0.0200
0.0085	0.0095	0.0115	0.0125	0.0135	0.0145	0.0155	0.0165	0.0190
0.0090	0.0100	0.0125	0.0145	0.0160	0.0180	0.0195	0.0200	0.0220
0.0085	0.0090	0.0115	0.0135	0.0155	0.0170	0.0185	0.0190	0.0210
0.0095	0.0110	0.0125	0.0145	0.0170	0.0185	0.0200	0.0210	0.0230
0.0085	0.0100	0.0115	0.0135	0.0155	0.0175	0.0190	0.0200	0.0220
0.0060	0.0070	0.0080	0.0090	0.0100	0.0120	0.0130	0.0140	0.0150
0.0050	0.0060	0.0065	0.0070	0.0080	0.0100	0.0110	0.0120	0.0140
0.0070	0.0090	0.0100	0.0115	0.0125	0.0140	0.0160	0.0170	0.0180
0.0030	0.0030	0.0030	0.0040	0.0040	0.0040	0.0050	0.0060	0.0070
0.0035	0.0040	0.0045	0.0055	0.0060	0.0065	0.0070	0.0075	0.0085
0.0030	0.0035	0.0035	0.0045	0.0050	0.0060	0.0065	0.0065	0.0075
0.0035	0.0040	0.0045	0.0060	0.0060	0.0070	0.0075	0.0080	0.0090
0.0030	0.0035	0.0040	0.0050	0.0055	0.0060	0.0070	0.0070	0.0080
0.0035	0.0040	0.0040	0.0045	0.0055	0.0060	0.0065	0.0070	0.0080
0.0030	0.0035	0.0035	0.0040	0.0045	0.0055	0.0060	0.0060	0.0070
0.0020	0.0030	0.0030	0.0040	0.0050	0.0055	0.0070	0.0080	0.0090
0.0020	0.0030	0.0030	0.0040	0.0040	0.0045	0.0060	0.0070	0.0080
0.0020	0.0030	0.0030	0.0040	0.0040	0.0045	0.0060	0.0070	0.0080
0.0020	0.0030	0.0030	0.0040	0.0050	0.0055	0.0070	0.0080	0.0090
0.0020	0.0030	0.0030	0.0040	0.0040	0.0045	0.0060	0.0070	0.0080

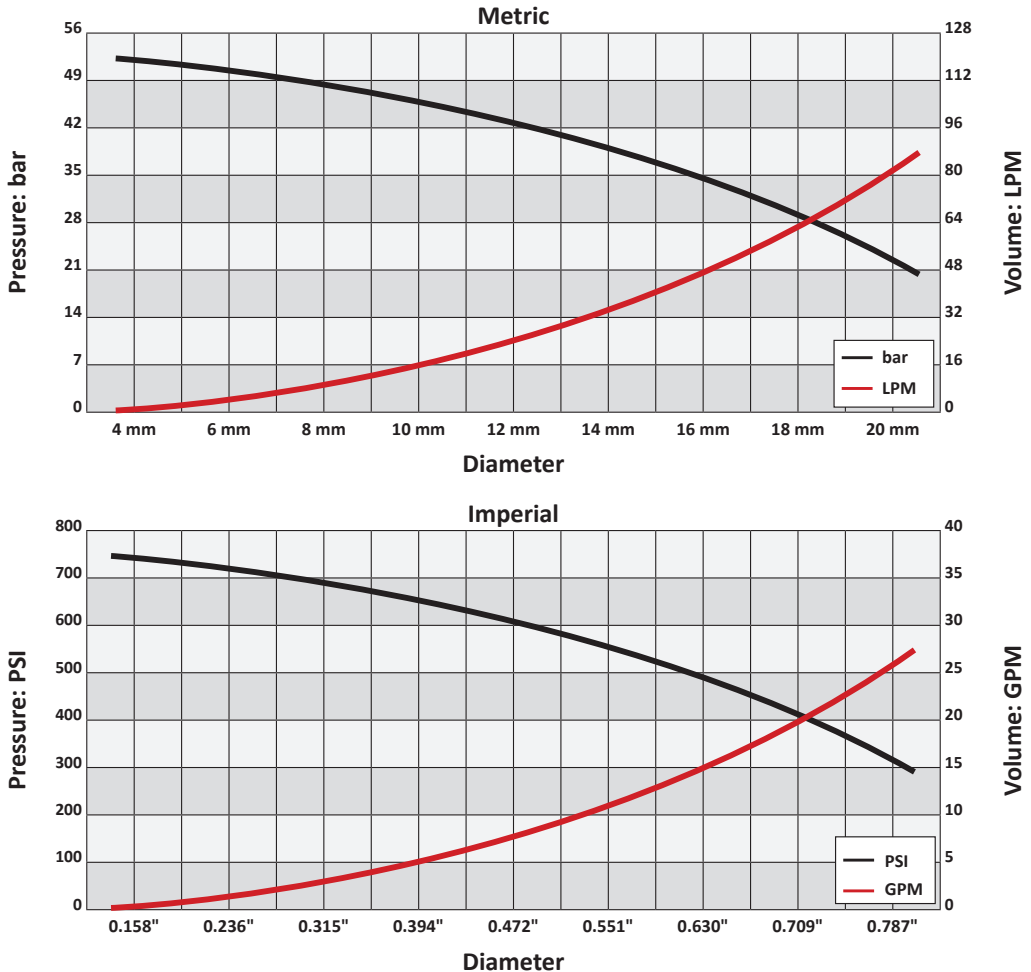
NOTE: The speeds and feeds listed above are for solid carbide tooling only. These are not recommendations for any polycrystalline diamond tools.

X10



Coolant Recommendations

X10



NOTE: The coolant recommendations listed above are for solid carbide tooling only. These are not recommendations for any polycrystalline diamond tools.

Coolant Adjustment

Drill Length	Pressure and Flow Multiplier
Up to 6xD	See above chart
>6 - 9xD	1.2
>9 - 12xD	1.4
>12 - 15xD	1.6
>15 - 20xD	2

Coolant Recommendation Example | Metric

If the recommended coolant pressure and flow is 42 bar and 32 LPM for a 3xD tool, the adjusted pressure and flow for a 9xD tool would be:

$$42 \times 1.2 = 50.4 \text{ bar}$$

$$32 \times 1.2 = 38.4 \text{ LPM}$$

Coolant Recommendation Example | Imperial

If the recommended coolant pressure and flow is 600 PSI and 12 GPM for a 3xD tool, the adjusted pressure and flow for a 9xD tool would be:

$$600 \times 1.2 = 720 \text{ PSI}$$

$$12 \times 1.2 = 14.4 \text{ GPM}$$

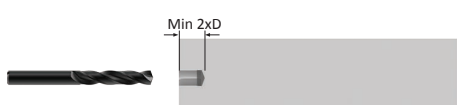
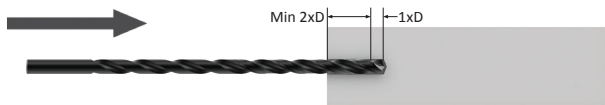
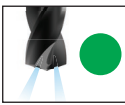
NOTES:

- Coolant must have proper additives to prevent excessive foaming during drilling cycle.
- Positive displacement coolant pump is recommended to maintain coolant flow at recommended values.
- The coolant filter must be less than 5µm. Fine filtration is necessary to prevent blockage of the smaller coolant holes.

WARNING Refer to Speed and Feed charts for recommended adjustments to speeds and feeds. Refer to page X10: 18 for Deep Hole Drilling Guidelines in this section of the catalog. Visit www.alliedmachine.com/DeepHoleGuidelines for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering department: appeng@alliedmachine.com.

Deep Hole Drilling Guidelines

X10

1. Pilot Hole 100% RPM 100% mm/rev (IPR)	Establish the pilot hole using the same diameter short drill to a depth of 2xD minimum. Utilize a pilot drill with the same or larger included point angle.  Coolant ON 
2. Feed-in  50 RPM max 300 mm/min (12 IPM)	Feed the longer drill within 1.5 mm (1/16") short of the established pilot hole bottom at a maximum of 50 RPM and 300 mm/min (12 IPM) feed rate.  Coolant OFF 
3. Deep Hole Transition Drilling 50% RPM 75% mm/rev (IPR)	Drill additional 1xD past the bottom of the pilot hole at 50% reduction of recommended speed and 25% reduction of recommended feed. Minimum of one second dwell is required to meet full speed before feeding.  Coolant ON 
4. Deep Hole Drilling - Blind 100% RPM 100% mm/rev (IPR)	Drill to full depth at recommended speed and feed for longer drill according to Allied speed and feed charts. No peck cycle recommended.  Coolant ON 
5. Deep Hole Drilling - at Breakout 50% RPM 75% mm/rev (IPR)	For through holes only: Reduce speed by 50% and feed by 25% prior to breakout. Do not break out more than 3 mm (1/8") past the full diameter of the drill.  Coolant ON 
6. Drill Retract  50 RPM max	Reduce speed to a maximum of 50 RPM before retracting from the hole.  Coolant OFF 

⚠ WARNING Tool failure can cause serious injury. To prevent:

- When using drills greater than 9xD without support bushing, use a short Superion drill to establish an initial hole that is a minimum of 2 diameters deep.
- Do not rotate drills more than 50 RPM unless it is engaged with the workpiece or fixture.

Visit www.alliedmachine.com/DeepHoleGuidelines for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering department: appeng@alliedmachine.com.



Troubleshooting Guide

X10

Problem	Condition	Shorten Flute Length	Increase		Decrease		Increase		Use Through Tool Coolant ^B	Change Point Angle	Align / Repair Spindle
			Feed Rate ^A	Speed ^G	Feed Rate ^A	Speed ^G	Coolant Pressure	Coolant Flow			
Decrease Tool Life	Lack of drill rigidity	○									
	Improper cutting parameters		●		●	●					
	Excessive margin wear					●	○	○	○		●
	Cutting edge chipping				●						●
	Chattering/vibration	○	●			○					●
	Built-up edge ^D					●	○	○	●		
	Chipping of point				●	●				○	●
Poor Chip Evacuation ^C	Long chips		●			●	○	○			
	Chip packing				●	●	●	○	●		
	Blue chips				●	●	●	●	●		
Hole Form	Workpiece deflection				●					○	
	Bell mouth	○	●			●				○	
	Oversized hole	○		●	●						●
	Undersized hole		●			●	●	●			
	Hole leadoff	○			●	○				○	●
Performance	Workpiece burning				●	●	●	●	●		
	Tool deflection	○			●	●				○	●
	Harder materials				●	●			●		
	Retract spiral	●			●	●					●
	Exit burr			●	●					○	

●: Primary solution

○: Secondary solution

A: Do not reduce feed rates below threshold of good chip form.**B:** Run coolant through tool when drilling greater than 3xD.**C:** Add peck cycle to help clear chips.**D:** Ensure coolant quality with regular maintenance free of swarf.**G:** Refer to speed and feed chart.

IMPORTANT: Factory technical assistance is available for your specific applications through our Application Engineering department: appeng@alliedmachine.com.



Troubleshooting Guide

Problem	Condition	Different Coating	Different Geom.	Tool Clamping	Work-piece Fixturing	Regrind/Recond.	Check Tool Diameter ^F	Entry Speed & Feed ^F	TIR Verification	Exit Speed & Feed
Decrease Tool Life	Lack of drill rigidity			●	●					
	Improper cutting parameters									
	Excessive margin wear	○		●	●	○				
	Cutting edge chipping		○	●	●	○				
	Chattering/vibration			●	●					
	Built-up edge ^D	○	○							
	Chipping of point		○	●	●	○				
Poor Chip Evacuation ^C	Long chips		○							
	Chip packing		○							
	Blue chips									
Hole Form	Workpiece deflection		○		●					
	Bell mouth			●	●			●		
	Oversized hole			●	●	○			●	
	Undersized hole					●	●		●	
	Hole leadoff		○	●	●	○		●	●	
Performance	Workpiece burning									
	Tool deflection		○	●	●			●	○	
	Harder materials	○	○							
	Retract spiral		○	●					●	●
	Exit burr		○							

●: Primary solution

○: Secondary solution

C: Add peck cycle to help clear chips.**D:** Ensure coolant quality with regular maintenance free of swarf.**E:** Reduce entry speed and feed parameters 20%.**F:** TIR range of 0.000"-0.001" (prefer 0.0000"-0.0005").**Speed and Feed Reduction Table****Interruptions:**

Condition	Reduction Speed	Reduction Feed
Small Cross Hole (C.H)	0.90	0.85
Large Cross Hole(C.H)	0.75	0.70
Incline Angle Entry(I.A)	0.80	0.75
I.A + C.H	0.70	0.65

Coolant Type:

Condition	Reduction Speed	Reduction Feed
Flood**	See Note	See Note
Dry	0.50	0.50
Mist	0.70	0.85

Machine:

Machine Type	Reduction Speed	Reduction Feed
Lathe	0.90	0.85

Depth Ratio:

Condition	Reduction Speed	Reduction Feed
6xD	0.90	0.90
9xD	0.80	0.80
12xD	0.70	0.70
15-20xD	0.60	0.60

Example:

Recommended speed and feed is 365 SFM and 0.010 IPR for a 0.276" - 0.315" diameter drill at 12xD.

$$365 \text{ SFM} \times 0.70 = 255 \text{ SFM} \quad | \quad 0.010 \text{ IPR} \times 0.70 = 0.007 \text{ IPR}$$

**Flood coolant applications: Recommend if diameter to depth is less than or equal to 3xD. Reduce speed by 20%, and if needed, drop feed by 10% to maintain optimal chip formation.

IMPORTANT: Factory technical assistance is available for your specific applications through our Application Engineering department: appeng@alliedmachine.com.

Please email the completed form to:
your local FSE (if applicable) or appeng@alliedmachine.com.

Please include any prints for the part (specify the feature) and/or tool for this project. More information will help ensure proper tooling for this quote.

LOGIN TO DOWNLOAD AND
COMPLETE THIS FORM OFFLINE:
alliedmachine.com/SuperionQuoteForm

Name

FSE (if applicable)

Please fill in the fields below completely for a quote to be processed.

Distributor Information

Company Name:

Contact:

Account Number:

Phone:

Email:

End User Information

Company Name:

Contact:

Industry:

Phone:

Email:

Superion Objective What issue(s) are we solving? (i.e. penetration rate, finish, tool life, hole size, etc.)

Application Information

Hole Diameter:

in/mm

Tolerance:

Material:

(4150/A36/Cast Iron/etc.)

Pre-existing Diameter:

in/mm

Depth of Cut:

in/mm

Hardness:

(BHN/Rc)

Required Finish:

RMS

State:

(Casting/Hot rolled/Forging)

Machine Information

Machine Type:

(Lathe/Screw machine/Machine center/etc.)

Builder:

(Haas, Mori Seiki, etc.)

Model #:

Shank Required:

(Cylindrical/Whistle Notch/Tang/etc.)

Power:

HP/KW

Rigidity:

Orientation:

Tool Rotating:

Thrust:

lbs/N

☐ Excellent

☐ Vertical

☐ Yes

☐ Good

☐ Horizontal

☐ No

Max Spindle Speed:

RPM

☐ Poor

Current Process Is this a new project? Yes___ No___ (If selected no, please fill the box out below)

Current Tooling:

(Manufacturer/Item Number)

Current Tool Life:

Holes

Parts

Inches

Current Speeds and Feeds:

Current Coating/Substrate:

Notes:

This image shows a full page of blank graph paper. The grid consists of thin, light gray horizontal and vertical lines that intersect to form small squares across the entire surface. There are no margins, text, or other markings on the paper.

X10

SECTION

X20-ESP

Special Tooling Solutions

Special Tooling Solutions



Specialty is Our Specialty

When it comes to designing and developing special solutions for customers, Allied Machine is the top choice. Our engineers see applications in ways many others don't, and that ability allows us to win situations that haven't been won before.

If you have a particularly unique or difficult application, give us a call. Most of our tooling can be tweaked as specials, and we can create entirely new concepts if alterations to standard product won't do the trick.

After all, everyone deserves some special attention.

Applicable Industries

-  Aerospace
-  Agriculture
-  Automotive
-  Defense
-  General Production
-  Heavy Equipment
-  Hydraulics
-  Marine
-  Medical
-  Oil and Gas
-  Renewable Energy/ Energy
-  Tool, Mold, and Die

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Your safety and the safety of others is very important. This catalog contains important safety messages. Always read and follow all safety precautions.



This triangle is a safety hazard symbol. It alerts you to potential safety hazards that can cause tool failure and serious injury. When you see this symbol in the catalog, look for a related safety message that may be near this triangle or referred to in the nearby text.

There are safety signal words also used in the catalog. Safety messages follow these words:

 WARNING	means that failure to follow the precautions in this message could result in tool failure and serious injury.
NOTICE	means that failure to follow the precautions in this message could result in damage to the tool or machine but not result in personal injury.
NOTE and IMPORTANT	are also used. These are important that you read and follow but are not safety-related.
Visit www.alliedmachine.com for the most up-to-date information and procedures.	



Special Tooling Solutions

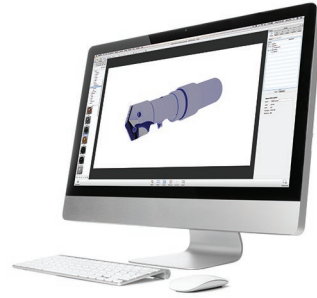
Options

Special Tooling is Our Specialty

We know standard tooling can't be the answer for everyone, and that's why we specialize in developing unique tooling to fit your needs.

Many of our products can be altered as specials. In fact, many of our standard items are results of frequently requested special features. Many times, one special design can end up solving problems for multiple customers across a variety of industries. Our specials capabilities truly set us apart from our competition.

Our Application Engineering team and Field Sales Engineers are trained and highly skilled to develop unique solutions that you won't find anywhere else. If you need special tooling, give us a call. Let us be the ones to tell you it can't be done. But don't expect us to.



X20



Insta-Quote®

Insta-Quote is an online custom tool designer. The program is available 24/7 and guides you through the steps as you create a special tool designed to meet the requirements of your application.

Products Available:

- T-A® Inserts.
- T-A® Holders.
- GEN3SYS® XT Holders.
- ALVAN® Reamers.



See pages X20: 5 - 12.



Engineered Specials

When the requirements of your application fall outside the limitations of Insta-Quote, your special tooling becomes an Engineered Special. These are tool designs that our engineers create and develop specifically for you.

Reasons to Call:

- Many standard products can be specially engineered.
- Allied Machine specials can save you time and increase tool life.
- Our engineers have the skills and knowledge to create designs that meet the challenge.



See pages X20: 13 - 22.



Special Tooling Solutions

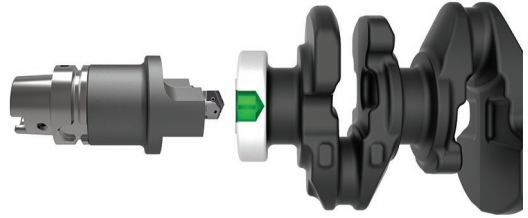
Industry Solutions

Every Industry Needs Some Special Attention

Many specific industry applications can be tricky, and processes can change drastically from one sector to the next. Allied's Field Sales Engineers and Application Engineers work together to develop breakthrough solutions that help customers master processes that before seemed impossible to improve.

You know your parts. You know your materials. You know what works and what doesn't. All you need to do is let us know what you're dealing with, and we'll take it from there. Whether you're machining the wings of an airplane or the engine block in a new car, we'll develop the right design to solve the problem you're facing.

For more industry examples, see Allied Machine's case studies at www.alliedmachine.com/RealLifeResults.



X20



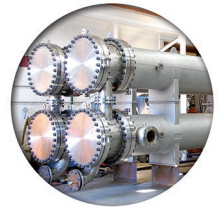
Automotive
Engine Block



Aerospace
Central Fuselage Wing Box

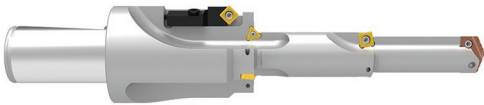


Heavy Machinery
Track Links



Oil and Gas
Heat Exchanger

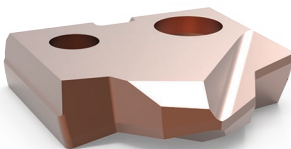
COMPLEX SOLUTIONS



INNOVATIVE SOLUTIONS



LONG SOLUTIONS



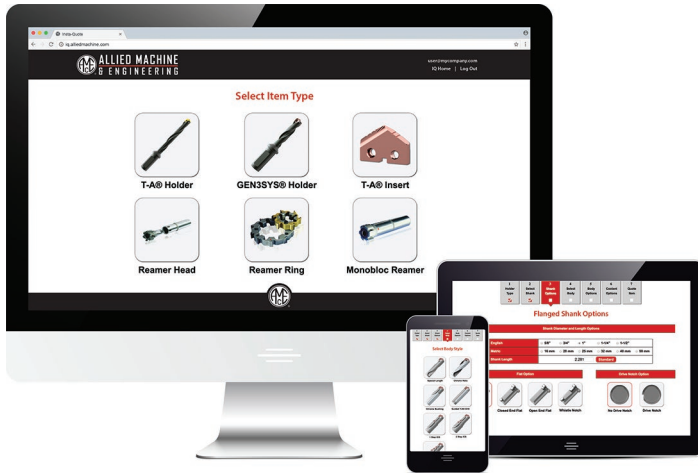
EVERY PROBLEM
HAS A
SOLUTION

**Insta-Quote**

Design Your Custom Tooling

Design your custom tooling and receive a drawing and quote...all within *minutes*.**iq.alliedmachine.com**

X20

**Design Your Own Solutions**

Insta-Quote is an online program that allows you to design and quote your own tooling in a matter of minutes. After you log in, Insta-Quote will guide you through the steps to gather all the necessary information and generate the solution you need. Within the system, you can choose from the following tools to design:

- T-A® Inserts.
- T-A® Holders.
- GEN3SYS® XT Holders.

Along with designing these products as specials, Insta-Quote can also help you create your item number for ALVAN® reamers. Because reamer item numbers do not follow the same method as Allied Machine's standard products, you must build your reamer item numbers. Insta-Quote can do that for you.

- Replaceable Head Style.
- Monobloc Style.
- Cutting Ring Style.



Design anytime from anywhere.

Available online 24/7.



Insta-Quote

User Guide



Where Do I Find Insta-Quote?

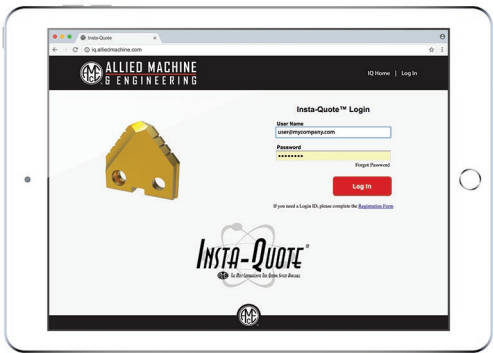
There are two ways to get to the Insta-Quote program. You can visit the Allied Machine homepage (www.alliedmachine.com) and find it under the Online Tools section of the upper navigation.

Or you can simply go to iq.alliedmachine.com to access Insta-Quote directly.



OR iq.alliedmachine.com

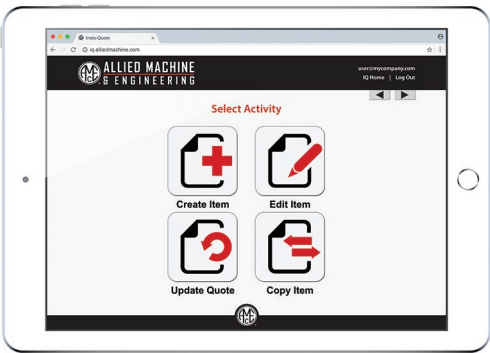
X20



1

Log In

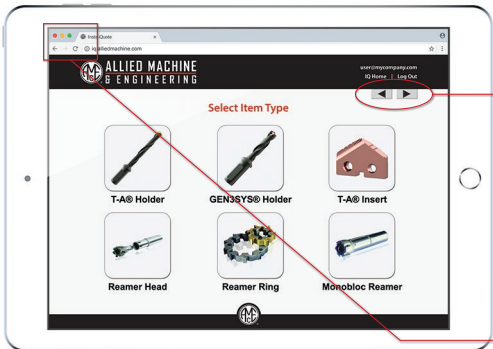
Fill in "User Name" and "Password" and click the login button. If you do not have a login, just click the "Registration Form" option beneath the login button and submit your registration.



2

Select Activity

On this screen, you can choose to create a new tool, edit a previous tool, update your quote, or copy a previous item.



3

Select Tool Type

Choose the type of special tool you would like to create. The options include T-A® inserts, T-A® holders, GEN3SYS® holders, replaceable head reamers, monobloc reamers, and cutting ring reamers.



IMPORTANT:

The right and left arrows will navigate you through each step. **DO NOT** use the web browser's back and forward buttons; doing so may result in loss of progress.



Do not use the web browser's back and forward arrows



Insta-Quote

User Guide

What Is My Item Number?

As soon as you select the type of product you want to design, Insta-Quote automatically generates the item number for your tool. The item number will appear at the top left-hand side of your screen.

170209-547

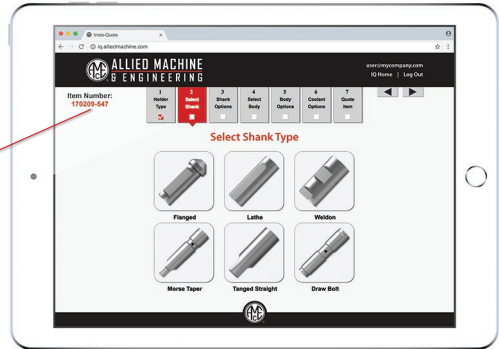
Year Month Day Reference No.

First Part of the Item Number:

This represents the date you began designing your tool (ex. 170209 = February 9, 2017).

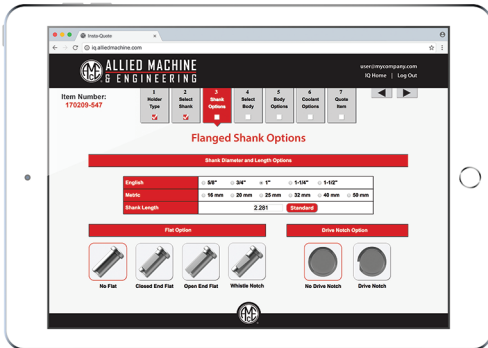
Second Part of the Item Number:

This is the reference number for that specific item. If you begin designing another tool on the same day, the first part of the new item number would be the same, but the reference number would be unique to that new item.

**4**

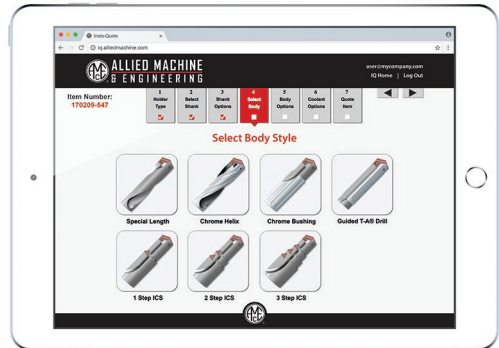
Shank Selection

Select the shank type you require and then click the right arrow button ► to proceed.

**5**

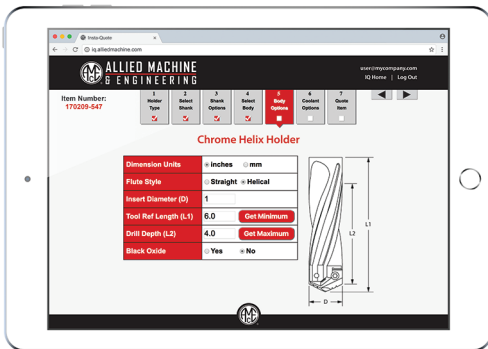
Shank Options

After choosing the shank type, you will be provided with additional shank options (if applicable). Once your selections are made, click the right arrow button ► to proceed.

**6**

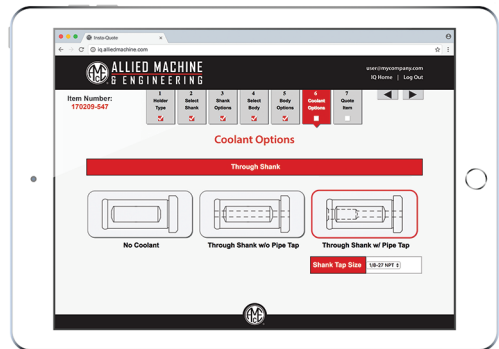
Select Body Style

Choose the holder style you need, and then click the right arrow button ► to proceed.

**7**

Body Options

After choosing the holder style, you will be provided with additional holder options (if applicable). Once your selections are made, click the right arrow button ► to proceed.

**8**

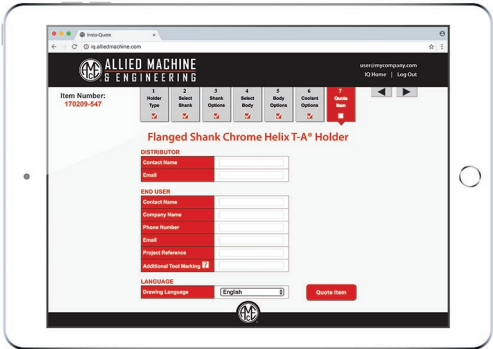
Coolant Options

On this screen you will select your coolant options. When finished, click the right arrow button ► to proceed.

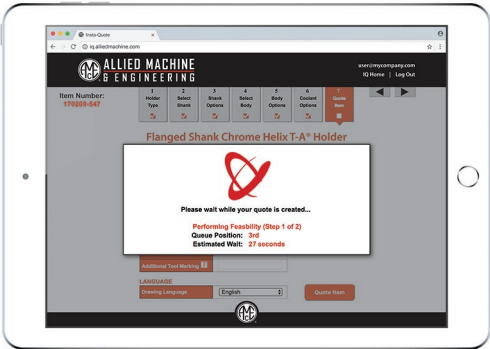


Insta-Quote

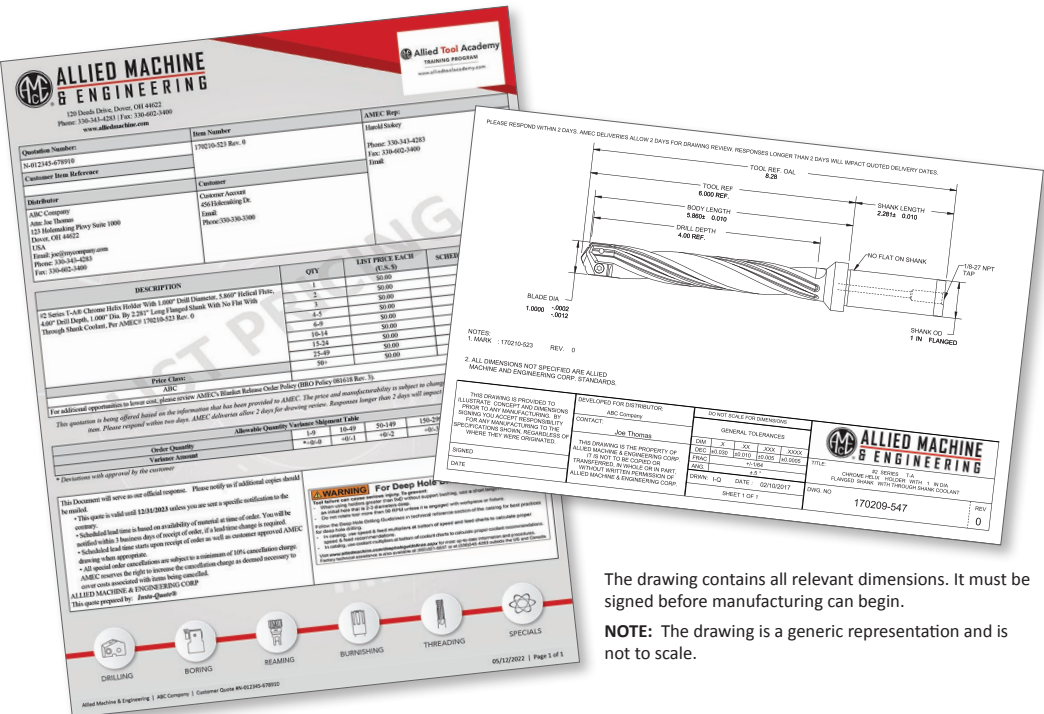
User Guide



9 **Contact Information**
Complete the contact details and select a language for the drawing. Click the "Quote Item" button to proceed.



10 **Quote Your Item**
Once you have selected "Quote Item," a box will appear to let you know the estimated time remaining before your quote and drawing are created (typical wait time is less than 1 minute).
NOTE: Your pop-up blocker must be disabled in order to view the downloaded files.



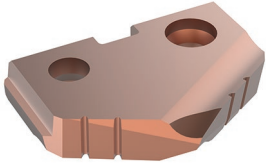
The drawing contains all relevant dimensions. It must be signed before manufacturing can begin.
NOTE: The drawing is a generic representation and is not to scale.



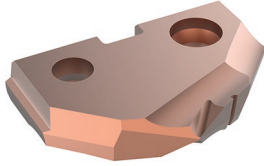
Insta-Quote

T-A® Inserts

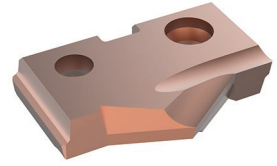
X20



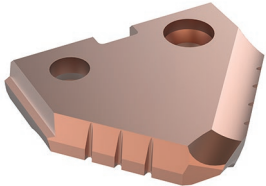
Special Angle



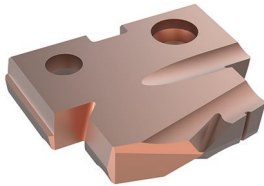
Double Angle



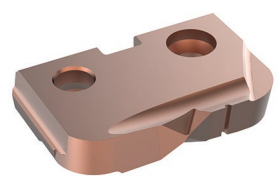
Spur Point



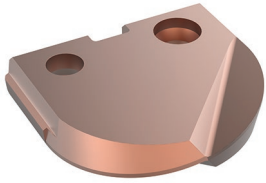
Spot and Chamfer



Step Insert



Flat Bottom



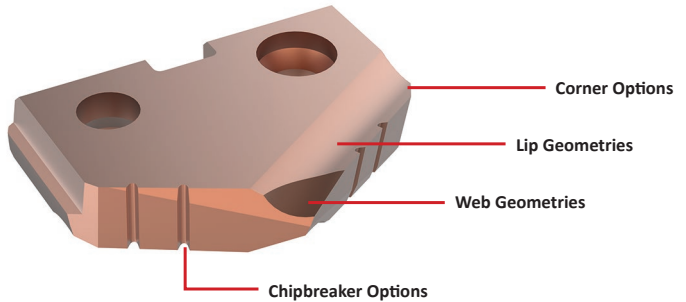
Ball Nose

Insta-Quote®



Additional Features

Insta-Quote provides multiple options to enhance different areas of the insert. If you have questions about which options would most benefit your application, just give us a call. We'll be happy to provide in-depth explanations about how certain options can optimize your results.



Substrate Options
HSS: HSS, Super Cobalt, Premium Cobalt
Carbide: C1, C2, C3, C5

Coating Options			
AM200®	TiN	TiAlN	TiCN

Insta-Quote

T-A® Holders

X20



Chrome Helix



Chrome Bushing



⚠ Guided Holder



One Step ICS



Two Step ICS



Three Step ICS



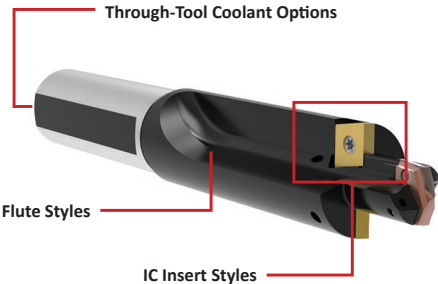
⚠ Special Length

Insta-Quote® 



Additional Features

Insta-Quote provides multiple options to enhance different parts of the holder. If you have questions about which options would most benefit your application, just give us a call. We'll be happy to provide in-depth explanations about how certain options can optimize your results.



⚠ WARNING Refer to Speed and Feed charts for recommended adjustments to speeds and feeds. Refer to page X20: 25 for deep hole drilling guidelines in this section of the catalog. Visit www.alliedmachine.com/DeepHoleGuidelines for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering department: appeng@alliedmachine.com.



Insta-Quote

GEN3SYS® XT Holders

X20



Chrome Helix



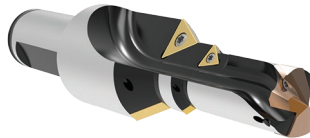
Chrome Bushing



⚠ Special Length



One Step ICS



Two Step ICS

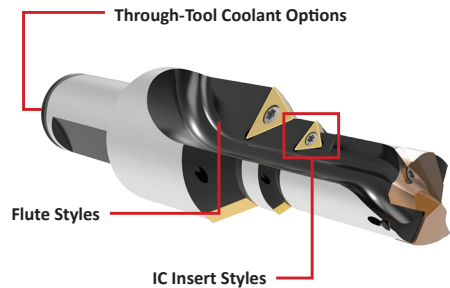
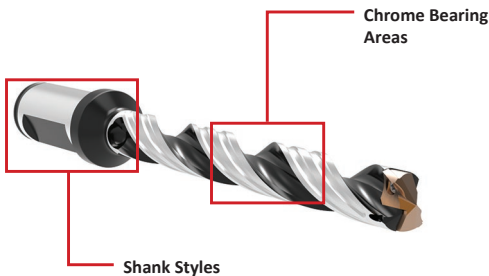


Three Step ICS

Additional Features

Insta-Quote provides multiple options to enhance different parts of the holder. If you have questions about which options would most benefit your application, just give us a call. We'll be happy to provide in-depth explanations about how certain options can optimize your results.

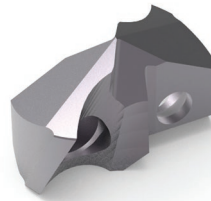
Insta-Quote®



Where are the Inserts?

Though Insta-Quote incorporates special designs for GEN3SYS XT holders, it does not include options for designing special GEN3SYS XT inserts. GEN3SYS XT holders utilize standard GEN3SYS XT inserts, which can be found in Section A20 of the product catalog.

If you need a special insert or would simply like to discuss options for designing one to fit your application, please contact us, and we can create a special design as an engineered special.



Engineered Special
GEN3SYS XT insert designed for
specific aerospace application

⚠ WARNING Refer to Speed and Feed charts for recommended adjustments to speeds and feeds. Refer to page X20: 25 for deep hole drilling guidelines in this section of the catalog. Visit www.alliedmachine.com/DeepHoleGuidelines for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering department: appeng@alliedmachine.com.



Insta-Quote

ALVAN® Reamers by S.C.A.M.I.

Use Insta-Quote to Build Your Part Numbers

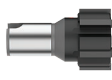
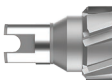
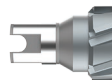
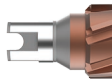
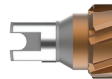
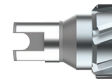
Insta-Quote can help you find or build the ALVAN® reamer item numbers you need along with the price and delivery of the items. It can also give you the recondition item and delivery. Just follow the steps, and Insta-Quote will guide you through the process.

Insta-Quote®



X20

Replaceable Head Style

Diameter/Series Options	Flute Options	Coating Options
Expandable Diameter		
 5000 Series	 Straight	 Uncoated
 7000 Series	 Right-Hand Helical	 TiN
Fixed Diameter	 Left-Hand Helical	 TiCN
 7000 Series		 TiAlN
 9000 Series		 Alcrona
		 Hardcut
		 R coating
		 T coating

Monobloc Style

Flute Options	Coating Options
 Straight	Uncoated 
 Left-Hand Helical	Alcrona 
	TiN 
	Hardcut 
	TiCN 
	R coating 
	TiAlN 
	T coating 

Cutting Ring Style

Flute Options	Coating Options
 Straight	Uncoated 
 Left-Hand Helical	TiN 
	TiCN 
	TiAlN 
	Alcrona 
	Hardcut 
	R coating 
	T coating 



Engineered Specials

Insert Designs

X20

OUR **SOLUTION**

T-A® PCD Drill Insert



- C3 carbide substrate increases tool life.
- PCD tip is specifically designed for carbon reinforced polymer (CFRP) material.
- Notch Point® geometry, special corner clip, and drill point angle help minimize delamination upon exiting the hole.

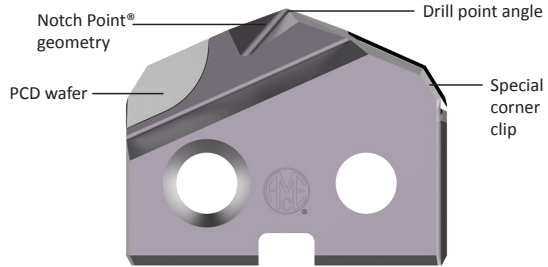
► YOUR **ADVANTAGE**

Take control of carbon fiber reinforced polymer applications. The T-A PCD drill insert can provide the hole quality you need to produce successful quality parts and reduce scrap.

Polycrystalline Diamond Insert

What allows the polycrystalline diamond (PCD) insert to generate such high success in aerospace carbon fiber is the sharp cutting edge that provides clearance cutting and reduces delamination. The PCD wafers improve the wear resistance.

While other tools encounter massive tearing when exiting the hole in carbon fiber, the PCD insert geometry, along with precise OD corner prep and Notch Point® technology, encounters minimal delamination. This produces a near-perfect, tight tolerance and smooth hole.



The Proof is in the Numbers

See the following results from a customer who was experiencing difficulty when drilling CFRP material:

INCREASED tool life by **700%**

Number of Holes Drilled: ONE Competing Insert



10

Number of Holes Drilled: ONE PCD Tipped T-A Insert



10



20



30



40



50



60



70

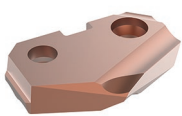


80

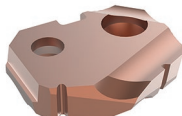
Infinite Solutions

Though Insta-Quote® and i-Form are incredible special tooling systems, some applications require a deeper level of engineering to accomplish the optimal results. No matter what the application may be, Allied Machine engineers have the knowledge, experience, and expertise to design and develop a special product to exceed your expectations.

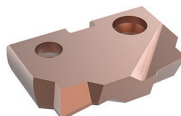
Engineered Specials are not limited to T-A® or GEN3SYS® XT products. In fact, Engineered Specials can be created for most products offered by Allied Machine, including APX™ drill, Opening Drill®, AccuThread® 856, and many other product families.



Back Chamfer
without Chip Breakers



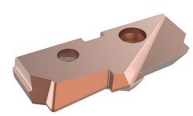
Back Chamfer
with Chip Breakers



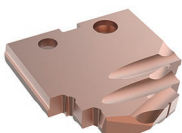
Noncenter Cutting
and Chamfer



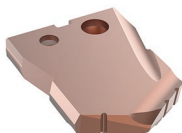
Special Inverted
Coring Geometry



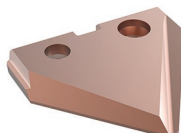
Flat Bottom with Pilot,
Corner Radius, and Chamfer



Multiple Step



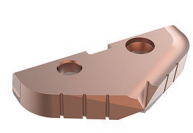
Special Step



Special Point



Special Counterbore
Step



Special Corner Radius



Engineered Specials

GEN3SYS® XT Vacuum Drill



The GEN3SYS XT® vacuum drill allows you to reap the productivity benefits of the GEN3SYS® XT outside of a fixed-position machine tool. The vacuum drill technology attaches to a hose to remove material that flows up through the internal flute of the drill. This versatile ability allows the drilling process to move from location to location, performing operations on large components.

The design of the GEN3SYS® XT insert increases penetration rates, which can lower your production time and decrease operation costs. Available in multiple material-specific geometries, the GEN3SYS® XT has a solution for most applications.

OUR **SOLUTION**

GEN3SYS® XT Vacuum Drill



- Spent coolant and chips are evacuated through an internal flute.
- Guided body diameter to run through a drill bushing.
- Replaceable tip for quick and easy insert change.

► YOUR **ADVANTAGE**

The sealed vacuum system lets you move your drilling operations outside the confines of a machine, allowing you to increase productivity on massive components.

MATERIAL TIPS

Drilling in CFRP (Carbon Fiber Reinforced Polymer)

- These applications are run with the vacuum only (no coolant).
- Can be run with or without a micro peck cycle.

Drilling in Metal

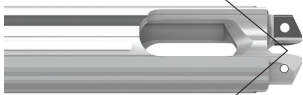
- These applications are run with the vacuum and coolant or mist.
- Recommended to be run with a micro peck cycle.



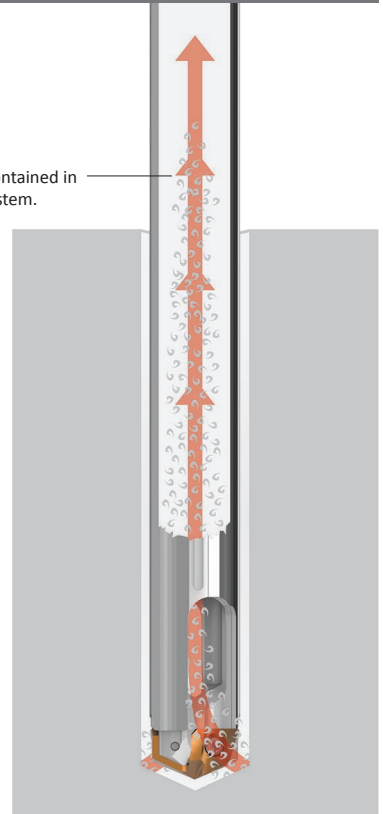
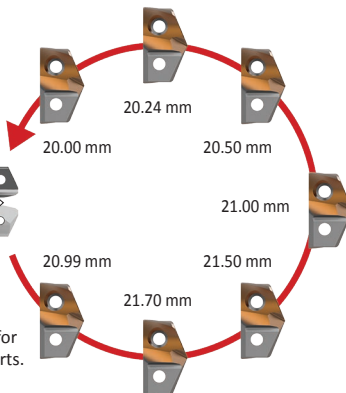
Materials remain contained in a sealed vacuum system.



The same holder can be used for a range of diameters.



The same holder can be used for different material-specific inserts.





Engineered Specials

Guided T-A®

X20



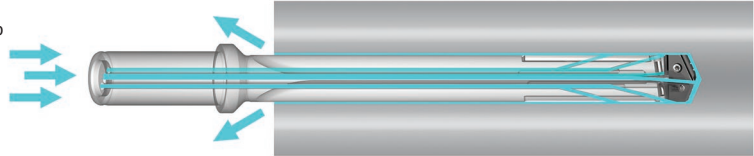
Guided T-A Highlights

- Two adjustable Torx® PLUS screw pins allow for diameter adjustment to reduce TIR.
- Provides improved tool life and hole finish.
- Guided wear pads improve hole straightness.
- Coolant-through design with multiple coolant outlets along the drill holder provides stability in deep hole drilling applications and also improves chip evacuation.

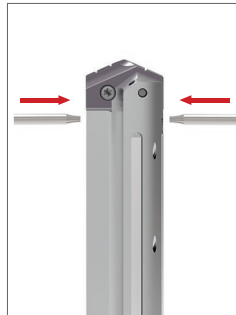
Industry Application
AutomotiveIndustry Application
Aerospace

Triple Coolant Outlets

- Additional coolant outlets help keep the holder straight and precise.
- Longer holders experience and maintain increased stability in deeper holes.



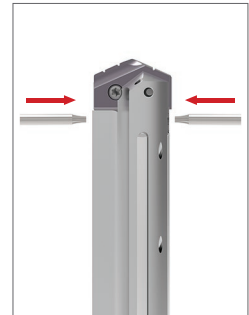
Locate the two adjustable Torx® PLUS screws (one on each side).



Loosen each screw.



Adjust insert position.



Tighten each screw.

The Proof is in the Numbers

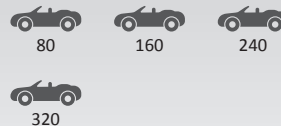
The following results came from a real-life application that utilized the Guided T-A. The customer was experiencing a high scrap rate and needed to find a solution to eliminate the problem.



✓ Our Chips

✗ Their Chips

Number of Holes Drilled: ONE Competing Insert & Holder

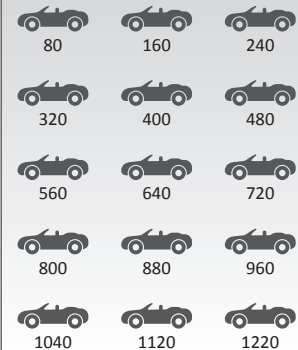


In this application, Allied Machine:

- Eliminated **\$240,000** in scrap per year.
- Optimized the chip formation.
- Enhanced the chip evacuation.
- Provided excellent surface finish.

INCREASED tool life by
280%

Number of Holes Drilled: ONE Allied Machine Special Insert & Holder





Engineered Specials

Success Stories

Real-Life Results

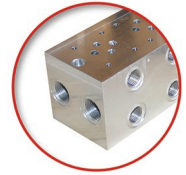
Below are five brief success stories. Each one provides an overview of specific situations when our special tooling achieved top-quality performance for our customers. For more in-depth case studies, go to www.alliedmachine.com/RealLifeResults.



Industry Application Oil & Gas

Special AccuPort 432® Port Contour Cutter Hydraulic Manifolds

- Eliminated multiple tools in the process.
- Eliminated regrinds.
- Improved performance in cross hole applications.



X20



Industry Application Heavy Equipment

Special T-A® Holder & Insert Axle Shafts

- 100% increase in tool life.
- \$7,500 reduction in setup costs.
- Eliminated scrap that was caused by setup issues.



Industry Application Defense

i-Form Drill Barrel Nut

- Eliminated three tools in the process.
- Reduced cycle time by 25%.
- Improved chip formation.



Industry Application Automotive

T-A® Rim Drill Aluminum Wheels

- 50% increase in penetration rates.
- 50% increase in tool life.
- Eliminated regrinds.



Industry Application Aerospace

Special Carbide Clad T-A® Holder with Diamond Coated Insert

Carbon Fiber Landing Arm

- Eliminated delamination of carbon fiber.
- 7x more tool life.
- Special shank threads directly into drill unit for easy tool change.





Engineered Specials

i-Form Custom Indexable Drill / Form Tool System

Any Way You Want It

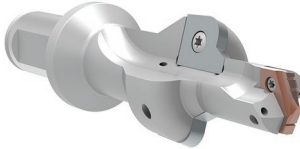
What if you could utilize complex forms that only seem to be available as brazed or solid carbide tools? Allied Machine's i-Form custom indexable drill/form tool system allows for complex designs with a replaceable cutting edge. This will reduce setup times and eliminate regrinds, allowing you to increase your productivity and reduce costs. Don't settle for being good when the possibility of being great is right in front of you.

This is just a small sample of what you can do.

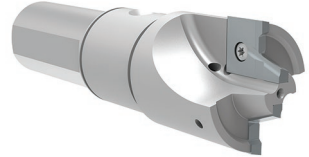
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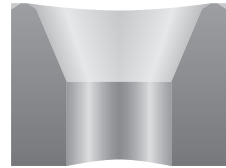
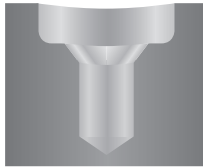
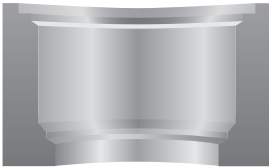
**i-Form Holder
with i-Form Inserts**



**Lug Hole T-A® Drill
with i-Form Inserts**



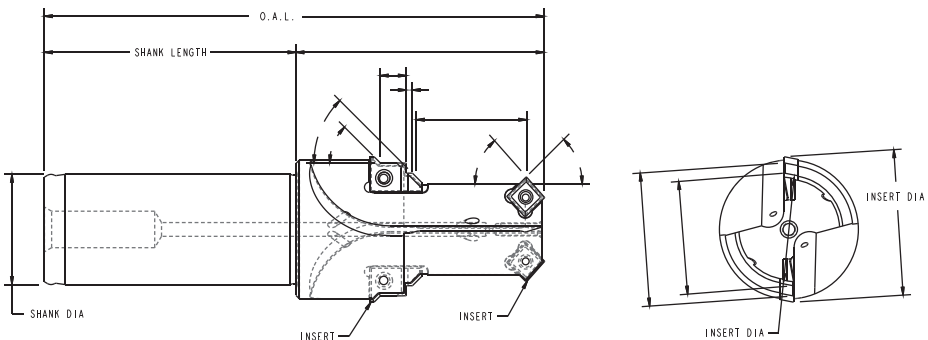
**i-Form Drill for Facing Operations
with ID-OD Chamfer**



Design Complex Forms for ANY Hole Style

i-Form allows you to design complex forms for any style hole with increased productivity. The i-Form product line - both pilot inserts and form inserts - creates custom engineered forms that provide complex designs with replaceable cutting edges and improved consistency, all while outperforming brazed and solid carbide tooling. i-Form tools will increase your productivity, minimize setup times, and eliminate regrind tool float and inconsistency.

- Holders have coolant-through capabilities.
- Holders can utilize standard inserts, Insta-Quote® inserts, and/or special insert designs.

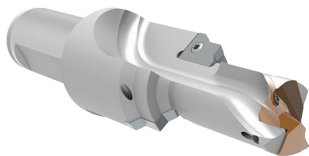




Engineered Specials

i-Form Custom Indexable Drill / Form Tool System

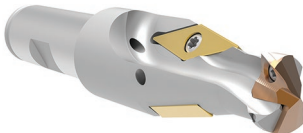
X20



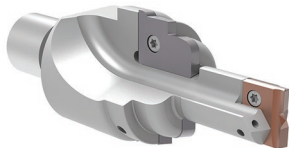
**GEN3SYS® XT Pilot Insert
with i-Form Inserts**



**GEN3SYS® XT Pilot Insert
with i-Form Inserts**



**GEN3SYS® XT Back Chamfer
Insert with ISO Inserts**



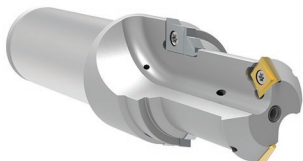
**T-A® Flat Bottom Form Drill
with i-Form Inserts**



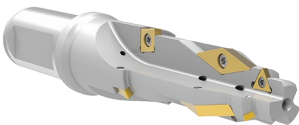
**T-A® ICS Drill
with i-Form Inserts**



**T-A® Pilot Insert
with i-Form Inserts**



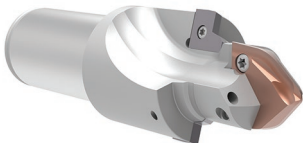
**Square QDSI 34™ Inserts
with i-Form Inserts**



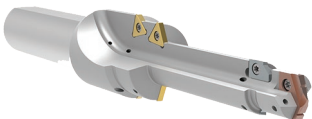
**3-Flute IC Drill
with i-Form Inserts**



**i-Form Holder
with i-Form Inserts**



**AccuPort 432® Drill
with Special T-A® Form Insert**



**T-A® 2-Step IC Drill
with i-Form Inserts**



**Special Core Drill
with i-Form Inserts**



Engineered Specials

T-A® Products

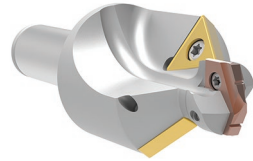
X20



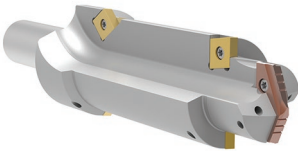
**T-A IC Drill
with Back Chamfer Insert**



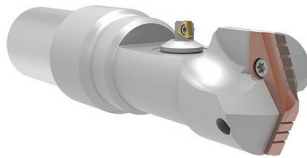
T-A 1-Step Stub Length



T-A IC Drill



T-A 2-Step IC Drill



**T-A Counter Bore Tool
with Micro Adjustable Cartridge**



**T-A Form Drill
with Adjustable Cartridge**



**T-A Multiple Step Drill
with Adjustable Cartridge**



**T-A Large Diameter
Multiple Step IC Drill**



T-A Deburr Drill



**T-A IC Drill
with Customer Defined Shank**



**T-A Deep Hole Drill
with Customer Defined Design**



**T-A Chrome Bearing Drill
with Customer Defined Shank**



**T-A 1-Step IC Drill
with Flat Bottom Insert**



T-A Form Drill

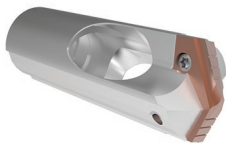


**T-A Drill
with Special Holder and Insert Design**

Engineered Specials

Other Products

X20



Special BT-A Drill
with Internal Thread



Special BT-A Drill



Special BT-A Drill



APX™ Drill
with Carbide Clad Guides



APX™ Drill
with 1-Step Design



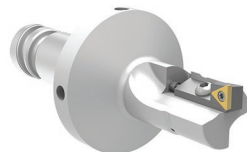
APX™ Drill
with HSK Shank



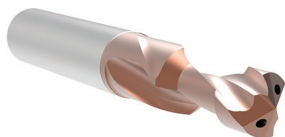
Opening Drill®
with Special Diameter



Special Core Drill
with 2-Step Design



ICS Drill
with Adjustable Cartridge



Superion® Solid Carbide
with AM200® Coating



AccuThread® 856
with Through Coolant



AccuPort 432®
Special Length



ALVAN® Ring Style Reamer
with Special Length



GEN3SYS® XT
with Morse Taper Shank



GEN3SYS® XT
with IC Inserts and Special Body



Engineered Specials

Design Form

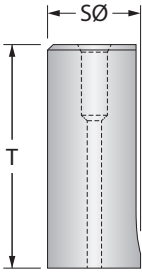
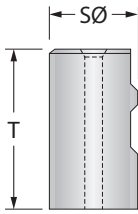
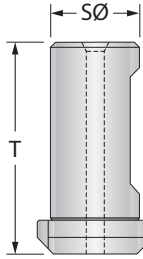
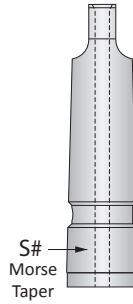
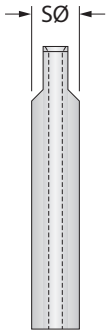
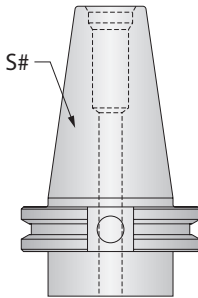
Show Us What You Need

These pages have been included so you can assist us with defining your special tooling requirements.

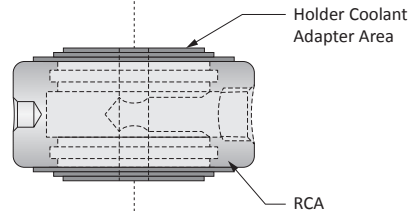
- Select a shank (1 - 6), or define shank 7.
- Indicate if the shank will be used with or without a rotary coolant adapter (RCA).

We ask that you define your hole profile and offer an example of a tool form to help us with the design process. Tools 1 - 5 cover only a small portion of our capabilities, so feel free to use your imagination. Please scan these pages, record your information in the boxes on the next page, and email the information for our quickest response.

X20

**Shank 1: Straight****Shank 2: Weldon****Shank 3: Flanged****Shank 4A:**
Coolant-Through
Tang End**Shank 4B:**
Through-Shank
Coolant**Shank 4C:**
No Coolant**Shank 5: Tang Shank****Shank 6: CAT50****Shank 7: Customer Defined Shank Information**

Shank	SØ	S#	T	RCA
4A (EXAMPLE)	—	4MT	—	YES / NO
				YES / NO
				YES / NO
				YES / NO





Engineered Specials

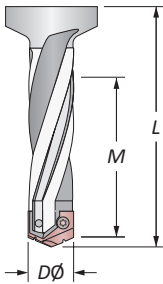
Tool 1

☐ Carbide Clad

☐ Chrome Plate

☐ Helical Flute

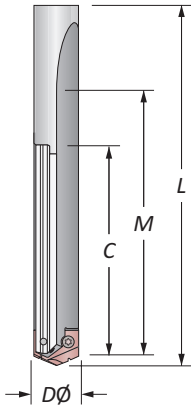
☐ Straight Flute



Tool 2

☐ Helical Pilot

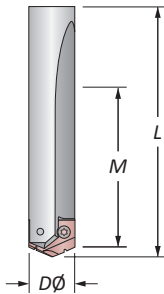
☐ Chrome Pilot



Tool 3

☐ Helical Flute

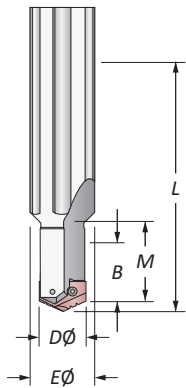
☐ Straight Flute



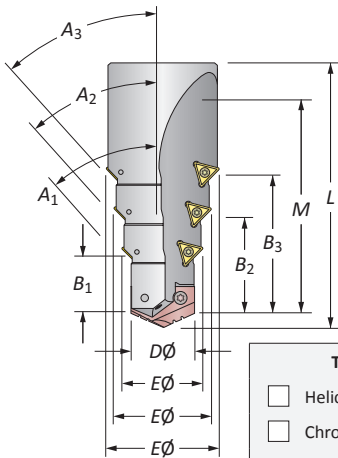
Tool 4

☐ Helical Pilot

☐ Chrome Pilot



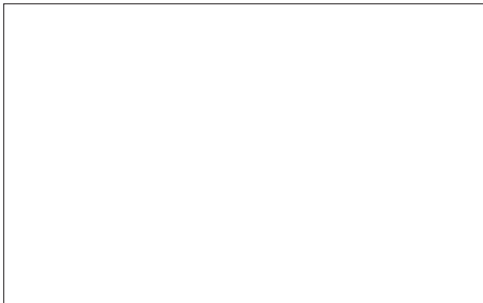
X20



Tool 5

☐ Helical Pilot

☐ Chrome Pilot



Hole Profile

Please email or fax your design to:
Application Engineering Department -
appeng@alliedmachine.com

Item	Tool	A ₁	A ₂	A ₃	B ₁	B ₂	B ₃	C	D Ø	E Ø	F Ø	G	L	M
EXAMPLE	5	30°	-	-	1.00	-	-	0.25	0.620	1.25	-	-	4.50	3.00

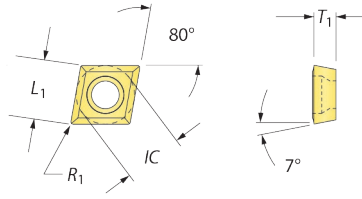
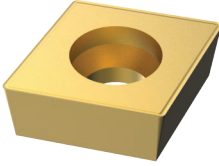
Name:		Company:	
Email:	Phone:	Distributor (if known):	
Customer Signature:		Date:	

Please be sure to include shank and coolant information from the previous page when sending tool designs.

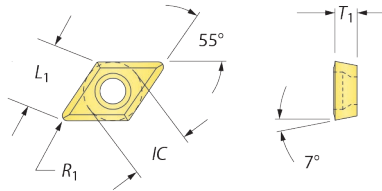
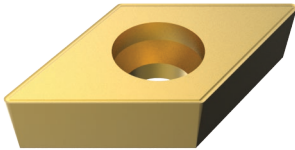
**QDSI 34™ Inserts**

80° Diamond | 55° Diamond

X20

**80° Diamond Inserts**

IC		Metric (mm)			Imperial (in)			Part No.	ANSI Designation	Torx Screw	Torx® Driver
mm	in	L_1	T_1	R_1	L_1	T_1	R_1				
6.35	0.250	6.32	2.39	0.20	0.249	0.094	0.008	CCGT-060202	CCGT 2(1.5)0.5	7256-IP8-1	8IP-8
		6.28	2.39	0.40	0.247	0.094	0.016	CCMT-060204	CCMT 2(1.5)1		
		6.21	2.39	0.79	0.244	0.094	0.031	CCMT-060208	CCMT 2(1.5)2		
		6.21	3.96	0.79	0.244	0.156	0.031	CCGT-06T308	CCGT 2(2.5)2		
9.53	0.375	9.49	3.96	0.20	0.374	0.156	0.008	CCGT-09T302	CCGT 3(2.5)0.5	7359-IP15-1	8IP-15
		9.46	3.96	0.40	0.372	0.156	0.016	CCMT-09T304	CCMT 3(2.5)1		
		9.39	3.96	0.79	0.369	0.156	0.031	CCMT-09T308	CCMT 3(2.5)2		
12.70	0.500	12.63	4.76	0.40	0.497	0.188	0.016	CCMT-120404	CCMT 431	745105-IP20-1	8IP-20
		12.56	4.76	0.79	0.494	0.188	0.031	CCMT-120408	CCMT 432		

NOTE: QDSI 34 inserts are utilized only in special ICS holders. Speeds and feeds for QDSI 34 inserts are determined by drill insert.**55° Diamond Inserts**

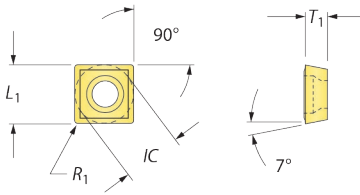
IC		Metric (mm)			Imperial (in)			Part No.	ANSI Designation	Torx Screw	Torx® Driver
mm	in	L_1	T_1	R_1	L_1	T_1	R_1				
6.35	0.250	6.18	2.39	0.008	0.243	0.094	0.008	DCGT-070202	DCGT 2(1.5)0.5	7256-IP8-1	8IP-8
		6.01	2.39	0.016	0.237	0.094	0.016	DCMT-070204	DCMT 2(1.5)1		
		5.67	2.39	0.031	0.223	0.094	0.031	DCMT-070208	DCMT 2(1.5)2		
9.53	0.375	9.19	3.96	0.016	0.362	0.156	0.016	DCMT-11T304	DCMT 3(2.5)1	7359-IP15-1	8IP-15
		8.85	3.96	0.031	0.348	0.156	0.031	DCMT-11T308	DCMT 3(2.5)2		

NOTE: QDSI 34 inserts are utilized only in special ICS holders. Speeds and feeds for QDSI 34 inserts are determined by drill insert.



QDSI 34™ Inserts

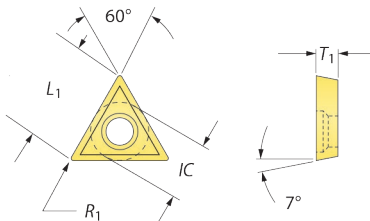
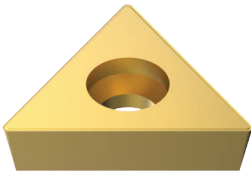
Square | 60° Triangle



Square Inserts

IC		Metric (mm)			Imperial (in)			Part No.	ANSI Designation	Torx Screw	Torx® Driver
mm	in	L ₁	T ₁	R ₁	L ₁	T ₁	R ₁				
9.53	0.375	9.53	3.96	0.40	0.375	0.156	0.016	SCMT-09T304	SCMT 3(2.5)1	7359-IP15-1	8IP-15

NOTE: QDSI 34 inserts are utilized only in special ICS holders. Speeds and feeds for QDSI 34 inserts are determined by drill insert.



80° Diamond Inserts

IC		Metric (mm)			Imperial (in)			Part No.	ANSI Designation	Torx Screw	Torx® Driver
mm	in	L ₁	T ₁	R ₁	L ₁	T ₁	R ₁				
3.97	0.156	6.58	1.98	0.20	0.259	0.078	0.008	TCGT-06T102	TCGT 1.2(1.2)0.5	724-IP6-1	8IP-6
		6.29	1.98	0.40	0.248	0.078	0.016	TCGT-06T104	TCGT 1.2(1.2)1		
		5.71	1.98	0.79	0.225	0.078	0.031	TCGT-06T108	TCGT 1.2(1.2)2		
5.65	0.219	9.33	2.39	0.20	0.367	0.094	0.008	TCGT-090202	TCGT 1.8(1.5)0.5	7225-IP7-1	8IP-7
		9.04	2.39	0.40	0.356	0.094	0.016	TCGT-090204	TCGT 1.8(1.5)1		
		8.46	2.39	0.79	0.333	0.094	0.031	TCGT-090208	TCGT 1.8(1.5)2		
6.35	0.250	10.71	2.39	0.20	0.422	0.094	0.008	TCGT-110202	TCGT 2(1.5)0.5	7256-IP8-1	8IP-8
		10.42	2.39	0.40	0.410	0.094	0.016	TCMT-110204	TCMT 2(1.5)1		
		9.84	2.39	0.79	0.387	0.094	0.031	TCMT-110208	TCMT 2(1.5)2		
9.53	0.375	15.92	3.96	0.40	0.627	0.156	0.016	TCMT-16T304	TCMT 3(2.5)1	7359-IP15-1	8IP-15
		15.34	3.96	0.79	0.604	0.156	0.031	TCMT-16T308	TCMT 3(2.5)2		
12.70	0.500	20.83	4.76	0.79	0.820	0.188	0.031	TCGT-220408	TCGT 432	745105-IP20-1	8IP-20

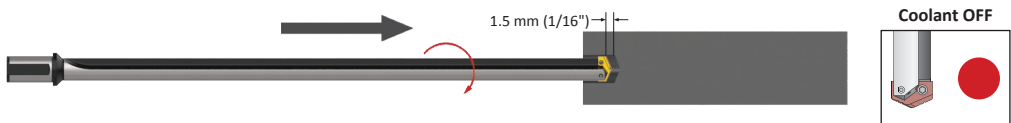
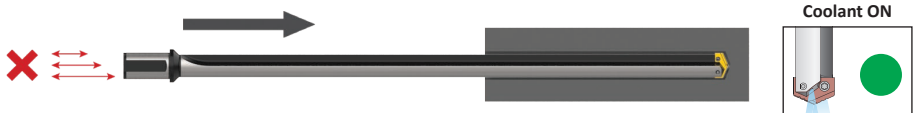
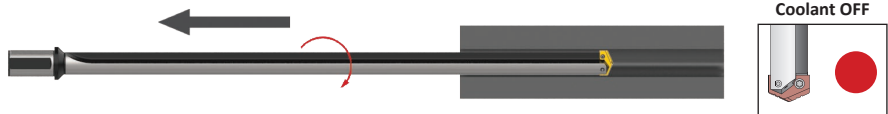
NOTE: QDSI 34 inserts are utilized only in special ICS holders. Speeds and feeds for QDSI 34 inserts are determined by drill insert.



Deep Hole Drilling Guidelines

For Lengths Greater Than 9xD (Standard Plus, Extended, Long, Long Plus, XL, 3XL, and Special Lengths)

X20

1. Pilot Hole 100% RPM 100% mm/rev (IPR)	Establish the pilot hole using the same diameter short drill to a depth of 2xD minimum. Utilize a pilot drill with the same or larger included point angle.	
2. Feed-in 50 RPM max 300 mm/min (12 IPM)	Feed the longer drill within 1.5 mm (1/16") short of the established pilot hole bottom at a maximum of 50 RPM and 300 mm/min (12 IPM) feed rate.	
3. Deep Hole Transition Drilling 50% RPM 75% mm/rev (IPR)	Drill additional 1xD past the bottom of the pilot hole at 50% reduction of recommended speed and 25% reduction of recommended feed. Minimum of one second dwell is required to meet full speed before feeding.	
4. Deep Hole Drilling - Blind 100% RPM 100% mm/rev (IPR)	Drill to full depth at recommended speed and feed for longer drill according to Allied speed and feed charts. No peck cycle recommended.	
5. Deep Hole Drilling - at Breakout 50% RPM 75% mm/rev (IPR)	For through holes only: Reduce speed by 50% and feed by 25% prior to breakout. Do not breakout more than 3 mm (1/8") past the full diameter of the drill.	
6. Drill Retract 50 RPM max	Reduce speed to a maximum of 50 RPM before retracting from the hole.	

WARNING Tool failure can cause serious injury. To prevent:

- When using holders without support bushing, use a short T-A holder to establish an initial hole that is a minimum of 2 diameters deep.
- Do not rotate tool holders more than 50 RPM unless it is engaged with the workpiece or fixture.

Visit www.alliedmachine.com/DeepHoleGuidelines for the most up-to-date information and procedures. Factory technical assistance is available for your specific applications through our Application Engineering department: appeng@alliedmachine.com.

This image shows a full page of blank graph paper. The grid consists of small, equal-sized squares formed by thin, dark gray lines. There are 20 columns and 20 rows of squares, creating a total of 400 square units. The background is white, and the grid covers the entire area of the page without any margins or additional markings.

X20

SECTION

X30-WBS

Wohlhaupter® Boring Specials

Wohlhaupter® Boring Specials



Special Design Tooling

When it comes to special solutions for customers, Wohlhaupter has unique capabilities to effectively design and develop special boring tools. Our special boring tools are designed for specific machines, processes, and materials to help save you time and money.

If you have a particularly unique or difficult application, reach out to our Application Engineering team:
appeng@alliedmachine.com.

Applicable Industries

-  Aerospace
-  Agriculture
-  Automotive
-  Defense
-  General Production
-  Heavy Equipment
-  Hydraulics
-  Marine
-  Medical
-  Oil and Gas
-  Renewable Energy/ Energy
-  Tool, Mold, and Die

Table of Contents

Custom Boring Tools

ES-Bore Fine Boring Lay Down Cartridge	3
EK Groover Lay Down Cartridge	4
Anti-Vibration Multistep Boring Tool	5
OD Turning Padded Line Boring Tool	6
Multistep Boring Tool Line Boring Tool.....	7
DigiBore Special Boring Tools.....	8
Combi-Line Special Boring Tool	9

Your safety and the safety of others is very important. This catalog contains important safety messages. Always read and follow all safety precautions.



This triangle is a safety hazard symbol. It alerts you to potential safety hazards that can cause tool failure and serious injury. When you see this symbol in the catalog, look for a related safety message that may be near this triangle or referred to in the nearby text.

There are safety signal words also used in the catalog. Safety messages follow these words:

 WARNING	means that failure to follow the precautions in this message could result in tool failure and serious injury.
NOTICE	means that failure to follow the precautions in this message could result in damage to the tool or machine but not result in personal injury.
NOTE and IMPORTANT	are also used. These are important that you read and follow but are not safety-related.
Visit www.alliedmachine.com for the most up-to-date information and procedures.	



Custom Boring Tools

ES-Bore Fine Boring Lay Down Cartridge

DIGITAL ES-BORE WITH ADAPTER PLATE



NOTE: ES-Bore digital fine boring cartridges must be used with the new 3E^{TECH+} and adapter plate. The ES-Bore cannot be used with 3E^{TECH}.

NOTE: 3E^{TECH+} adjustment accuracy of 0.001 mm (0.00005") on diameter.

ANALOG ES-BORE



LAY DOWN CARTRIDGES

ES-BORE

- ▶ Mounts to custom designed boring tools.
- ▶ Available with digital 3E^{TECH+} or analog adjustment.
- ▶ Accurate adjustments with easy-to-use settings.
- ▶ Versatility in many different application types over 28.00 mm (1.102") on diameter.



Custom Boring Tools

EK Groover | Lay Down Cartridge



X30

GROOVING TOOLS

EK GROOVER

- ▶ Create complex grooves faster and deeper than ever before.
- ▶ Eliminate chatter in hard-to-reach internal forms.
- ▶ The electronically-controlled insert release can be adapted to most machine tools.
- ▶ Single or double grooving in one operation.

ROUGH BORING TOOLS

LAY DOWN CARTRIDGE

- ▶ Increase the productivity of your roughing tool while protecting your investment.
- ▶ If the tool is ever damaged, simply replace a cartridge and resume making chips.



Custom Boring Tools

Anti-Vibration | Multistep Boring Tool

X30



SPECIAL BORING TOOLS

ANTI-VIBRATION

- ▶ Vibration dampening rings.
- ▶ Optimized tool weight.
- ▶ Used to reduce harmonic vibration in deeper boring applications.



SPECIAL BORING TOOLS

MULTISTEP BORING TOOL

- ▶ Fine adjustment tool for reverse machining.
- ▶ Combined with multidiameter fine adjustable cartridges for finish machining.

Custom Boring Tools

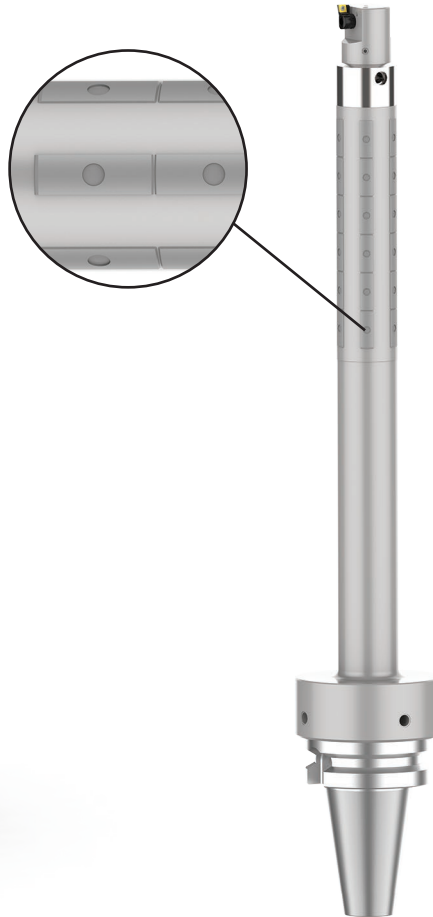
OD Turning | Padded Line Boring Tool



SPECIAL BORING TOOLS

OD TURNING TOOLS

- ▶ Multistep OD turning.
- ▶ Drastically reduce cycle time.
- ▶ Improve surface finish and feature concentricity.



SPECIAL BORING TOOLS

PADDED TOOLING

- ▶ Aids in stable part processing.
- ▶ Expands length-to-diameter capabilities.
- ▶ Improves surface finish.
- ▶ Pads are replaceable to extend tool life.

X30



Custom Boring Tools

Multistep Boring Tool | Line Boring Tool

X30



3E^{TECH+} BORING TOOL

MULTISTEP BORING TOOL

- ▶ Easy diameter adjustments with 3E^{TECH+}.
- ▶ One digital readout module to use on all steps.

3E^{TECH+} BORING TOOL

LINE BORING TOOL

- ▶ One digital readout module used on all steps.
- ▶ Easy diameter adjustment at the machine spindle.

Custom Boring Tools

DigiBore Special Boring Tools



NOTE: Imperial items pictured.
NOTE: Digital adjustment accuracy of
0.0001" or 0.002 mm on diameter.

FINISH BORING TOOLS

DIGIBORE WITH 248 (249)

- ▶ Standard DigiBore head, standard 248 (249) head, and special slide for precise two-step bore.
- ▶ MVS connection.

FINISH BORING TOOLS

DIGIBORE SPECIAL

- ▶ Standard DigiBore boring head with OD turn and OD chamfer insert holder.
- ▶ MVS connection.



Custom Boring Tools

Combi-Line Special Boring Tool



ROUGH, FINISH, and CHAMFER BORING TOOLS

COMBI-LINE

- ▶ Standard Combi-Line tooling with added chamfer cartridge.
- ▶ MVS connection.



Notes

[illegible]

X30

Guaranteed Test / Demo Application Form

Distributor PO #

The following must be filled out completely before your test will be considered.

IMPORTANT: For processing, send purchase order to your Allied Field Sales Engineer (FSE).
Please clearly mark the paperwork as "Test Order."

Distributor Information

Company Name: _____
Contact: _____
Account Number: _____
Phone: _____
Email: _____

End User Information

Company Name: _____
Contact: _____
Industry: _____
Phone: _____
Email: _____

Current Process List all tooling, coatings, substrates, speeds and feeds, tool life, and any problems you are experiencing.

Test Objective List what would make this a successful test (i.e. penetration rate, finish, tool life, hole size, etc.).

Application Information

Hole Diameter: _____ in/mm	Tolerance: _____	Material: _____ (4150, A36, cast iron, etc.)
Preexisting Diameter: _____ in/mm	Depth of Cut: _____ in/mm	Hardness: _____ (BHN, Rc)
Required Finish: _____ RMS	State: _____ (Casting, hot rolled, forging)	

Machine Information

Machine Type: _____ (Lathe, screw machine, machine center, etc.)	Builder: _____ (Haas, Mori Seiki, etc.)	Model #: _____
Shank Required: _____ (CAT50, Morse taper, etc.)	Power: _____ HP/KW	
Rigidity: _____ ☐ Excellent ☐ Good ☐ Poor	Orientation: _____ ☐ Vertical ☐ Horizontal	Tool Rotating: _____ ☐ Yes ☐ No
		Thrust: _____ lbs/N

Coolant Information

Coolant Delivery: _____ (Through tool, flood)	Coolant Pressure: _____ PSI / bar
Coolant Type: _____ (Air mist, oil, synthetic, water soluble, etc.)	Coolant Volume: _____ GPM / LPM

Requested Tooling

QTY	Item Number

QTY	Item Number



**ALLIED MACHINE
& ENGINEERING**

Allied Machine & Engineering
120 Deeds Drive
Dover, OH 44622

Telephone: (330) 343-4283
Toll Free USA & Canada: (800) 321-5537
Email: info@alliedmachine.com



ALLIED MACHINE & ENGINEERING

Warranty Information



Allied Machine & Engineering ("Allied Machine") warrants to original equipment manufacturers, distributors, industrial and commercial users of its products for one year from the original date of sale that each new product manufactured or supplied by Allied Machine shall be free from defects in material and workmanship.

Allied Machine's sole and exclusive obligation under this warranty is limited to, at its option, without additional charge, replacing or repairing this product or issuing a credit. For this warranty to be applied, the product must be returned freight prepaid to the plant designated by an Allied Machine representative and which, upon inspection, is determined by Allied Machine to be defective in material and workmanship.

Complete information as to operating conditions, machine, setup, and the application of cutting fluid should accompany any product returned for inspection. This warranty shall not apply to any Allied Machine products which have been subjected to misuse, abuse, improper operating conditions, improper machine setup or improper application of cutting fluid or which have been repaired or altered if such repair or alteration, in the judgement of Allied Machine, would adversely affect the performance of the product.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Allied Machine shall have no liability or responsibility for any claim, whether in contract, tort or otherwise, for any loss or damage arising out of, connected with, or resulting from the manufacture, sale, delivery or use of any product sold hereunder, in excess of the cost of replacement or repair as provided herein.

Allied Machine shall not be liable in contract or in tort (including, without limitation, negligence, strict liability or otherwise) for economic losses of any kind or for any special, incidental, indirect, consequential, punitive or exemplary damages arising in any way out of the performance of, or failure to perform this agreement.

ALL PRICES, DELIVERIES, DESIGNS, AND MATERIALS ARE SUBJECT TO CHANGE WITHOUT NOTICE.



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