



ALLIED MACHINE & ENGINEERING

Holemaking Solutions for Today's Manufacturing



Boring



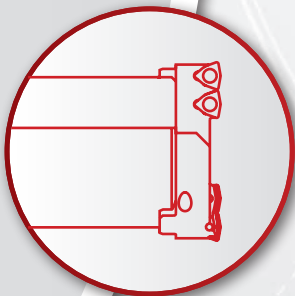
Reaming



Burnishing



Threading



Specials



Opening Drill[®]

► *DRILLING*

Indexable Insert Drilling System

North America

Allied Machine

120 Deeds Drive
Dover, OH 44622
United States

Allied Machine

485 West 3rd Street
Dover, OH 44622
United States

ThreadMills USA™

4185 Crosstowne Ct #B
Evans, GA 30809
United States

Superion™

1285 S Patton St.
Xenia, OH 45385
United States

Europe

Allied Machine Europe

93 Vantage Point
Pensnett Estate
Kingswinford
West Midlands
DY6 7FR, United Kingdom

Wohlhaupter® GmbH

Maybachstrasse 4
Postfach 1264
72636 Frickenhausen
Germany

Asia

Wohlhaupter® India

B-23, 2nd Floor
B Block Community Centre
Janakpuri, New Delhi - 110058
India



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.



ALLIED MACHINE
& ENGINEERING

www.alliedmachine.com



ALLIED MACHINE & ENGINEERING

Holemaking Solutions for Today's Manufacturing

Opening Drill®

The Foundation

Since 1941, Allied Machine & Engineering has provided dependable and practical holemaking solutions to the world. What was once a small job shop in Ohio is now a worldwide leader in cutting tool technology. With three manufacturing facilities in Ohio, one in Georgia, another in Germany, and headquarters in both the United States and Europe, Allied Machine is positioned to bring innovative solutions and technical expertise directly to the customers' hands.



The Beginning

Harold E. Stokey founded Allied Machine & Engineering to aid the war effort, manufacturing taper bearing lock nuts for the production of M1 tanks. Years later, after a sales meeting gone wrong, Stokey possessed a warehouse stocked with spade drill inserts. He set forth into the industry that would become Allied Machine's thriving identity: holemaking.



The T-A®

When Harold's son, William H. Stokey, became the president and CEO, he developed the Throw Away, or T-A, spade drill insert system. The T-A revolutionized the holemaking industry, launching Allied Machine ahead of the competition. Since then, numerous innovations and advancements have been created from the T-A's inspiration.



The Innovation

Since the development of the T-A, Allied Machine has expanded its product offering to support a vast range of customer applications, including large diameter and deep hole drilling, boring, reaming, burnishing, porting, and threading.

The People

Allied Machine understands that high quality products are only one facet of success. Our customer support is crucial to what we do, and that's why we make sure the best engineers and customer service associates are in place to assist our customers around the world.

The Future

With over 75 years of experience, Allied Machine has encountered the challenges of growth and success. By investing in cutting edge technology and the brightest and sharpest minds, our knowledge and capabilities continue to expand and grow every day.



Steve Stokey
Executive Vice President

William H. Stokey
President and CEO

Mike Stokey
Executive Vice President



WOHLHAUPTER®



SUPERION™

CRITERION™

Replaceable Insert Drills

- Reduce costs by decreasing set-up time and utilizing a single holder for the lives of multiple inserts
- Provide flexibility to quickly switch between inserts with different geometries
- Products:
 - GEN3SYS® XT | GEN3SYS® XT Pro
 - Original T-A® | GEN2 T-A®
 - High Performance | Universal



Indexable Insert Drills

- Protect your investment and reduce your inventory with replaceable cartridges that allow the same holder to be used repeatedly
- Indexable inserts increase productivity and tool life while reducing costs
- Products:
 - 4TEX® Drill
 - Revolution Drill®
 - Opening Drill®



Replaceable / Indexable Insert Drills

- Allow for higher spindle speeds and take advantage of the power curve on modern CNC machines
- Achieve maximum penetration rates in deep hole drilling applications
- Holders cover a range of sizes with the replaceable heads determining the cutting diameter
- Products:
 - APX™ Drill



Solid Carbide Drills

- Offer greater strength and stability when drilling tougher materials
- Available in diameters from 3mm - 20mm
- Can be made-to-order specifically for your application (Superion™ quoted specials)
 - ASC 320®
 - Superion™



Structural Steel Solutions



- Deliver outstanding performance and durability in structural steel applications
- Designed to produce optimal results in difficult-to-machine materials
- Available in multiple lengths and diameters
- T-A® style drills have different insert geometry options to improve performance depending on material
- Products:
 - **Original T-A®** | **GEN2 T-A®**
 - **GEN3SYS® XT Pro**

BTA (STS) Machining Solutions

- The internal ejection system flushes chips and debris from the hole with no interference to the cutting process
- Utilizes the advantages of the T-A® drill insert
- Designed to significantly increase penetration rates over brazed heads and traditional gun drills
- Products:
 - **BT-A Drill**



Hydraulic Port Contour Cutters



- Save significant time and money by performing four processes in one step
- Replaceable insert design reduces costs, inventory, and set-up times
- Available in 4 industry specifications:
 - Imperial: SAE J-1926
 - Metric: ISO 6149-1:2006
 - Military: SAE AS5202
 - John Deere: JDS-G173.1
- Products:
 - **AccuPort 432®**



Enhanced Special Drilling Capabilities

- Allied Machine Engineers are available to meet with you to evaluate your application and recommend the best solution for you
- Special drilling solutions can incorporate advanced features such as adjustable diameter locations, multiple steps, additional coolant designs, special lengths and diameters, and more
- Special drills can drastically reduce your cost-per-hole and increase your overall productivity by eliminating multiple processes and increasing tool life



WOHLHAUPTER® High Precision Boring Systems

- Designs available for high volume applications that increase rigidity to improve performance
- Versatile boring heads that are flexible with changing applications while maintaining excellent performance
- Provides high precision with absolute repeatability to ensure every part is held to tolerance
- Offers an industry leading modular shank connection that maintains rigidity and reduces inventory on your boring system
- Available with both digital and analog settings
- Products:
 - Wohlhaupter® Boring Tools



CRITERION® Modular Boring Systems

- The modular capabilities are ideal for use across multiple different projects
- Offers versatile boring heads suitable for all job shops and tooling rooms
- Provides an economical solution for low volume and/or short-term production applications
- Offers both rough and finish boring solutions
- Products:
 - Criterion® Boring Tools

S.C.A.M.I.®

Expandable Reaming Solutions

- Expandable cutting diameters accommodate for wear, which extends tool life
- Replaceable cutting heads and rings reduce waste and improve production time versus solid high speed steel and carbide reamers
- Hold tight tolerances to ensure processes are performed to accurate specifications
- Reduce tooling costs because many items are available for recondition
- Products:
 - ALVAN® Reamers



S.C.A.M.I.®

Roller Burnishing Solutions

- Produce excellent surface finishes
- Provide accurate size control
- Increase surface hardness
- Solutions for both through hole and blind hole applications
- Products:
 - S.C.A.M.I.® Roller Burnishing Tools





Solid Carbide Thread Mills

- Available with coolant through options
- Cover a wide range of thread forms
- Provide optimal solutions for both high production projects and short-run applications
- Products
 - AccuThread™ 856
 - AccuThread™ T3
 - ThreadMills USA™



Replaceable Insert Thread Mills

- 3 insert lengths are available that cover a wide range of thread forms
- Holders can utilize inserts with different pitches and thread forms
- Repeatability is achieved by both the bolt-in style and the pin style locking systems
- Increase tool life by 25 - 50% with Allied Machine's AM210® coating
- Products
 - AccuThread™ 856: Bolt-in Style
 - AccuThread™ 856: Pin Style



SPECIAL CAPABILITIES


When it comes to designing and developing special solutions for customers, Allied Machine is the top choice. If your application requires special tooling, give us a call. Our engineered specials are developed by the brightest engineers in the industry. Most of our standard tooling can be altered as specials, or we can create entirely new concepts for particularly unique applications.

One special tooling solution is Insta-Quote®, the online system that allows you to design your own special tooling 24/7. Receive a quote and drawings within minutes just by following the steps.

And with the addition of Superior™ technology and capabilities, we can customize made-to-order solid carbide tools to achieve optimal results for your applications.

Whatever your application, Allied Machine has the answer.



Insta-Quote® 



 SUPERION™



ToolMD™

Increase the production and success of your applications today.

- Offers direct access to 2D drawings and 3D models
- Assemble and view tool images in your browser
- Download drawings for use in most machining software programs
- Browse products, search item numbers, and save assemblies for future use



toolmd.com

WOHLHAUPTER® Tool-Architect

Find the right Wohlhaupter® solution for your application.

- Configure your complete tool assembly
- Compile an order list to be quoted
- Search and quickly find components using various criteria
- Adjust your language and measurement preferences

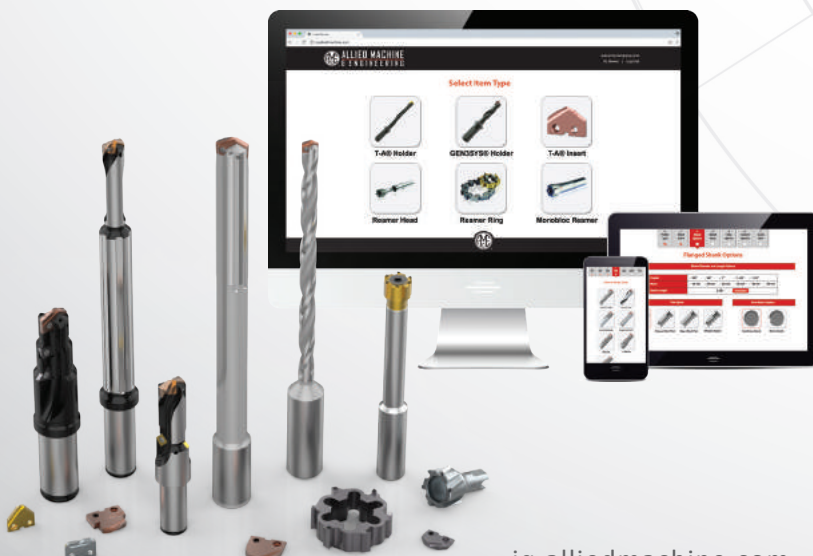


tool-architect.com

Insta-Quote®

Design your custom tooling and receive a drawing and quote...all within minutes.

- Design and quote your own tooling
- Guides you through steps to generate the solution you need
- Features the following products
 - T-A® Inserts
 - T-A® Holders
 - GEN3SYS® XT Holders
 - ALVAN® Reamers



iq.alliedmachine.com

Insta-Code®

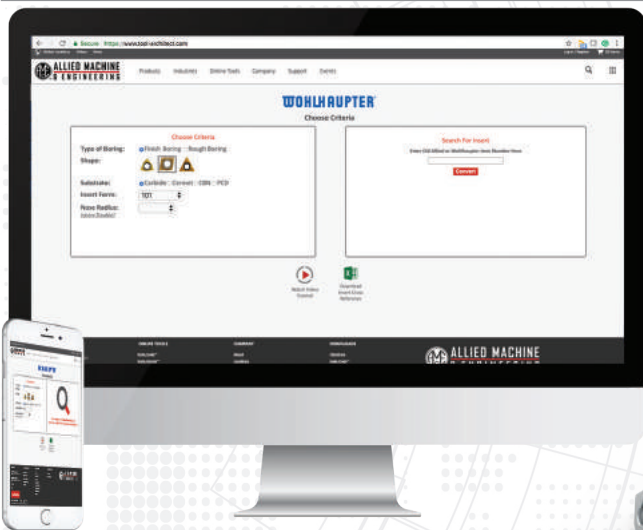
Eliminate the wait. Get your program now.

- Choose the best thread mill for your application
- Create program code for your machine
- Available as a PC download app (that can be used offline)
- Website app available 24/7



Insta-Code also has a
Cycle Time Calculator

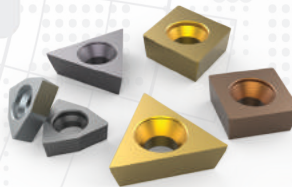
alliedmachine.com/InstaCode



WOHLHAUPTER® Boring Insert Selector

Find the best insert for your application.

- Generate the correct boring insert for your job in just six easy steps
- Choose type, shape, substrate, insert form, nose radius, and material
- Easily order by adding the item to your cart



www.alliedmachine.com/bis

Product Selector

Use the product selector to find the right tool for your application.

- Guides you through steps to generate the right tool for your application
- Learn about your recommended tool and how to maximize its performance

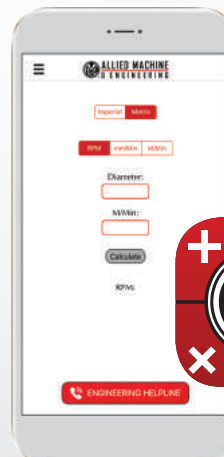


www.alliedmachine.com/productselector

Machinist Tool App

Quickly convert cutting tool parameters for the machine inputs you need.

- Input data to calculate the RPM and speed and feed rates
- Also features the Boring Insert Selector
- Access product literature right at your fingertips



Opening Drill®

Large Diameter Replaceable IC Insert Drilling System

► Diameter Range: 2.000" - 5.620" (50.8mm - 142.8mm)



Need larger holes? No problem.

The Opening Drill is an extremely effective tool designed to enlarge existing holes. It is available in nine different shank styles: Straight, ABS 63, CAT V40, CAT V50, HSK 63A/C, HSK 100A/C, BT 40, BT 50, and DIN50.

In a *single* operation, an existing hole can be opened and large amounts of material can be removed. The insert design reduces chip size and improves evacuation. Also, inventory and cost are reduced by the adjustable diameters.

Excellent chip control	Improves hole quality and surface finish	Provides maximum durability and stability
------------------------	--	---

Applicable Industries



Aerospace



Agriculture



Automotive



Firearms



General Machining



Oil & Gas



Renewable Energy

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

WARNING (shown above) 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.

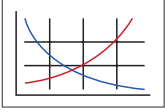
Reference Icons

The following icons will appear throughout the catalog to help you navigate between products.



Setup / Assembly Information

Detailed instructions and information regarding the corresponding part(s)



Recommended Cutting Data

Speed and feed recommendations for optimum and safe drilling

Series	Diameter Range	
	Imperial (inch)	Metric (mm)
OP1	2.00 - 2.50	50.8 - 63.5
OP2	2.50 - 3.00	63.5 - 76.2
OP3	3.00 - 4.12	76.2 - 104.7
OP4	4.12 - 5.62	104.7 - 142.8

Introduction Information

Product Overview 2
 Set-up Instructions 3
 Product Nomenclature. 4 - 5

Drill Shank Style

Straight Imperial 6
 Straight Metric 7
 CAT40 8
 CAT50 9
 BT40. 10
 BT50. 11
 HSK63 12
 HSK100 13
 ABS63 14
 DIN50 15

Recommended Cutting Data

Imperial (inch) 16 - 17
 Metric (mm) 18 - 19

Product Overview

Features

- Can be used as a rotating or stationary tool
- Can be used in rough boring operations
- Available in multiple different shanks (see chart below)
- Smooth cutting action and quiet operations in lathes and mills
- Special lengths, diameters, and shanks are available upon request

Advantages

- Opens an existing hole in a single operation
- Ignores core shifts up to 1/8" (3.175mm) providing straight and true holes without the need for boring
- Allows for large amounts of material removal
- Unique design enables larger holes to be made on low horsepower machines
- Replaceable cartridges protect your investment
- Adjustable diameters reduce inventory and cost

Shank Options



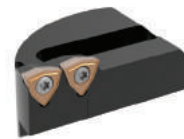
AM300°



AM200°



TiN



2 Inserts
(OP1 - OP3 series)



3 Inserts
(OP4 series)

Insert Application Recommendations

Carbide Grade Options

- | | |
|----------|--|
| C5 (P35) | General purpose carbide grade suitable for most applications.
▶ <i>Common application in steels and stainless steels.</i> |
| C1 (K35) | Toughest carbide grade. Provides the best combination of edge strength and tool life.
▶ <i>Recommended for less rigid applications.</i> |
| C2 (K25) | Higher wear resistant carbide suitable for abrasive material applications.
▶ <i>Recommended for grey, ductile, and nodular irons.</i> |

Additional Geometry Option

- | | |
|----------------|--|
| High Rake (HR) | Provides superior chip control and tool life in long chipping carbon and alloy steels below 200 Bhn. |
|----------------|--|

IC Inserts

- The design allows for excellent chip control and aggressive penetration rates
- The proprietary AM200° and AM300° coatings increase tool life above competitors' premium coatings
- The same inserts are used for both Revolution Drill and Opening Drill products

Set-up Instructions



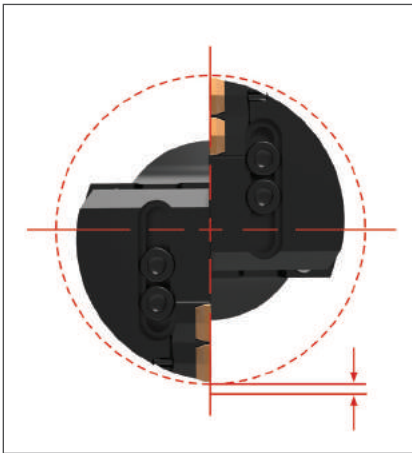
Step 1:
Loosen the mounting screws on both cartridges.



Step 2:
Set one cartridge to the finish diameter by tightening the adjustment screw against the adjustment pin.



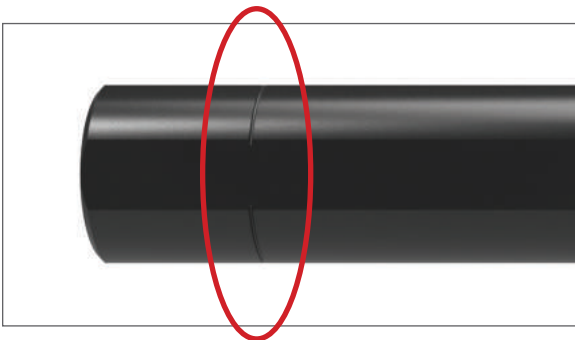
Step 3:
Tighten the mounting screws on the cartridge to 11-14 ft-lbf (15-19 N-m).



Step 4:
Set the opposing cartridge with 0.160" to 0.200" radial offset inward by tightening the adjustment screw against the adjustment pin (optimum situation for each insert to remove equal material).



Step 5:
Tighten the mounting screws on the cartridge to 11-14 ft-lbf (15-19 N-m).



Straight Shanks

- Designed for lathe applications
- Can be cut off for use in end-mill holders
- The score mark (circled to the left) is provided for recommended cut length
- Cut and deburr at the score mark
- This improves rigidity when the body sits against the face of an end-mill holder



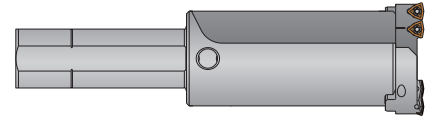
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BORING
C
REAMING
D
BURNISHING
E
THREADING
X
SPECIALS



Product Nomenclature

Opening Drill Holders

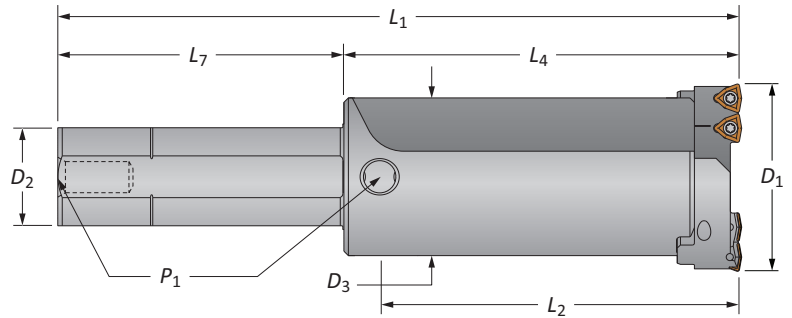
OP1	-	1S	-	SS1.5
1		2		3



1. Series	2. Length	3. Shank Type	
OP1 = 2.00" - 2.50" (50.8mm - 63.5mm) OP2 = 2.50" - 3.00" (63.5mm - 76.2mm) OP3 = 3.00" - 4.12" (76.2mm - 104.7mm) OP4 = 4.12" - 5.62" (104.7mm - 142.8mm)	1S = Short 1L = Long	SS1.5 = 1-1/2 ϕ straight SS2.5 = 2-1/2 ϕ straight 40M = 40mm straight 50M = 50mm straight CV40 = CAT40 CV50 = CAT50	BT40 = BT40 BT50 = BT50 HSK63 = HSK 63A/C HSK100 = HSK 100A/C ABS63 = ABS63 DV50 = DIN50

Reference Key

Symbol	Attribute
D_1	Drill diameter range
D_2	Shank diameter
D_3	Body diameter
L_1	Overall length
L_2	Maximum drill depth
L_4	Holder length
L_7	Shank length
P_1	Rear pipe tap



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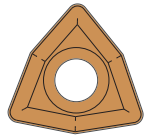
F
THREADING

X
SPECIALS

Product Nomenclature

Opening Drill Inserts

OP	-	05	T3	08	-	1	H	HR
1		2	3	4		5	6	7



1. Compatible with: Opening Drill Revolution Drill	2. IC Type 05 = 5/16"	3. Thickness T3 = 5/32"	4. Radius 08 = 1/32"	5. Carbide Grade Blank = C5 (P35) 1 = C1 (K35) 2 = C2 (K25)
6. Coating P = AM300® H = AM200® T = TiN A = TiAlN N = TiCN U = Uncoated	7. Geometry Blank = General Purpose HR = High Rake			

A

DRILLING

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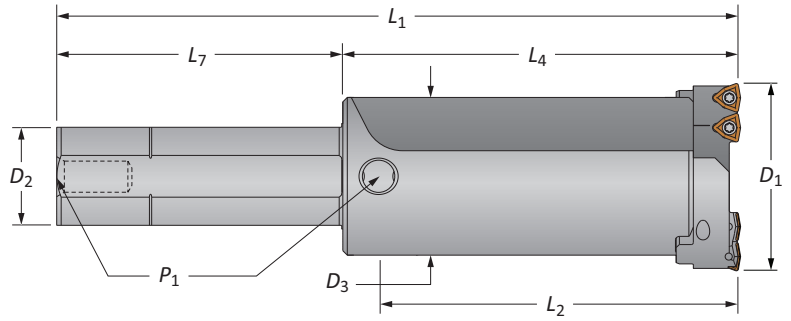
THREADING

X

SPECIALS

Opening Drill Holders

Straight Shank | Imperial | Diameter Range: 2.00" - 5.62" (50.8mm - 142.8mm)



Holder

Length	D ₁ Range	Holder				Shank			Part No.	Cartridges
		D ₃	L ₂	L ₄	L ₁	D ₂	L ₇	P ₁		
Short	2.00 - 2.50	1.840	3-9/32	4-3/64	8-3/64	1-1/2	4	1/4 NPT	OP1-1S-SS1.5	OP1-WC05
Long	2.00 - 2.50	1.840	5-17/32	6-19/64	10-19/64	1-1/2	4	1/4 NPT	OP1-1L-SS1.5	OP1-WC05
Short	2.50 - 3.00	2.220	4-43/64	5-1/2	9-1/2	1-1/2	4	1/4 NPT	OP2-1S-SS1.5	OP2-WC05
Long	2.50 - 3.00	2.220	7-43/64	8-1/2	12-1/2	1-1/2	4	1/4 NPT	OP2-1L-SS1.5	OP2-WC05
Short	3.00 - 4.12	2.806	5-7/64	6	10	1-1/2	4	1/4 NPT	OP3-1S-SS1.5	OP3-WC05
Long	3.00 - 4.12	2.806	9-7/64	10	14	1-1/2	4	1/4 NPT	OP3-1L-SS1.5	OP3-WC05
Short	4.12 - 5.62	3.500	5-1/64	6	10-1/2	2	4-1/2	1/4 NPT	OP4-1S-SS2.0	OP4-WC05
Long	4.12 - 5.62	3.500	10-33/64	11-1/2	16	2	4-1/2	1/4 NPT	OP4-1L-SS2.0	OP4-WC05

*Holder includes cartridges; however, inserts are sold separately.

Cartridges

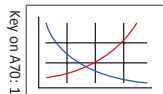
Replacement Cartridges	Qty. Inserts Needed	Mounting Screw	Key Size	Adjusting Screw	Driver
OP1-WC05	2	MS-13M-1	5mm	AS-10T9-1	8T-9
OP2-WC05	2	MS-15M-1	5mm	AS-10T9-1	8T-9
OP3-WC05	2	MS-15M-1	5mm	AS-12T9-1	8T-9
OP4-WC05	3	MS-15M-1	5mm	AS-14T9-1	8T-9

IC Inserts

Carbide Grade	Geometry	Part No.			Insert Screws	Driver
		AM300®	AM200®	TiN		
C5 (P35)	Standard	OP-05T308-P	OP-05T308-H	OP-05T308-T	IS-10-1	8T-9
C1 (K35)	Standard	OP-05T308-1P	OP-05T308-1H	OP-05T308-1T	IS-10-1	8T-9
C2 (K25)	Standard	OP-05T308-2P	OP-05T308-2H	-	IS-10-1	8T-9
C5 (P35)	High Rake	OP-05T308-PHR	OP-05T308-HHR	-	IS-10-1	8T-9

A70: 14 - 17

A70: 2 - 3



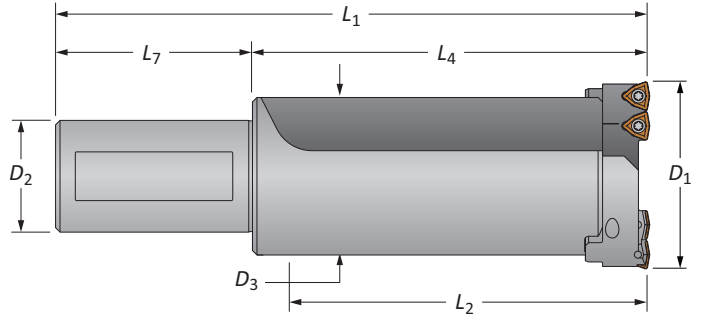
Mounting screws sold in multiples of 4 | Adjusting screws sold in multiples of 4
 IC inserts sold in multiples of 10 | Insert screws sold in multiples of 10

i = Imperial (in)
m = Metric (mm)

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Opening Drill Holders

Straight Shank | Metric | Diameter Range: 2.00" - 5.62" (50.8mm - 142.8mm)



Holder

Length	D ₁ Range	Holder				Shank			Part No.	Cartridges	
		D ₃	L ₂	L ₄	L ₁	D ₂	L ₇	P ₁			
m	Short	50.8 - 63.5	1.840	83.5	102.9	172.9	40	70	-	OP1-1S-40M	OP1-WC05
	Long	50.8 - 63.5	1.840	140.6	160.1	230.1	40	70	-	OP1-1L-40M	OP1-WC05
	Short	63.5 - 76.2	2.220	118.5	139.8	209.8	40	70	-	OP2-1S-40M	OP2-WC05
	Long	63.5 - 76.2	2.220	194.7	216.0	286.0	40	70	-	OP2-1L-40M	OP2-WC05
	Short	76.2 - 104.7	2.806	129.9	152.5	222.5	40	70	-	OP3-1S-40M	OP3-WC05
	Long	76.2 - 104.7	2.806	231.5	254.1	324.1	40	70	-	OP3-1L-40M	OP3-WC05
	Short	104.7 - 142.8	3.500	127.4	152.5	232.5	50	80	-	OP4-1S-50M	OP4-WC05
	Long	104.7 - 142.8	3.500	254.4	292.2	372.2	50	80	-	OP4-1L-50M	OP4-WC05

*Holder includes cartridges; however, inserts are sold separately.

Cartridges

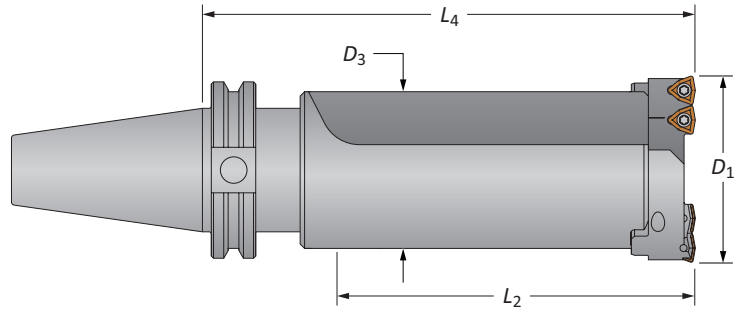
Replacement Cartridges	Qty. Inserts Needed	Mounting Screw	Key Size	Adjusting Screw	Driver
OP1-WC05	2	MS-13M-1	5mm	AS-10T9-1	8T-9
OP2-WC05	2	MS-15M-1	5mm	AS-10T9-1	8T-9
OP3-WC05	2	MS-15M-1	5mm	AS-12T9-1	8T-9
OP4-WC05	3	MS-15M-1	5mm	AS-14T9-1	8T-9

IC Inserts

Carbide Grade	Geometry	Part No.			Insert Screws	Driver
		AM300®	AM200®	TiN		
C5 (P35)	Standard	OP-05T308-P	OP-05T308-H	OP-05T308-T	IS-10-1	8T-9
C1 (K35)	Standard	OP-05T308-1P	OP-05T308-1H	OP-05T308-1T	IS-10-1	8T-9
C2 (K25)	Standard	OP-05T308-2P	OP-05T308-2H	-	IS-10-1	8T-9
C5 (P35)	High Rake	OP-05T308-PHR	OP-05T308-HHR	-	IS-10-1	8T-9

Opening Drill Holders

CAT40 Shank | Diameter Range: 2.00" - 5.62" (50.8mm - 142.8mm)



Holder

Length	D ₁ Range	D ₃	Holder		Part No.	Cartridges
			L ₂	L ₄		
Short	2.00 - 2.50	1.840	3-9/32	5-27/64	OP1-1S-CV40	OP1-WC05
Long	2.00 - 2.50	1.840	5-17/32	7-43/64	OP1-1L-CV40	OP1-WC05
Short	2.50 - 3.00	2.220	4-43/64	6-7/8	OP2-1S-CV40	OP2-WC05
Long	2.50 - 3.00	2.220	7-43/64	9-7/8	OP2-1L-CV40	OP2-WC05
Short	3.00 - 4.12	2.806	5-7/64	7-3/8	OP3-1S-CV40	OP3-WC05
Long	3.00 - 4.12	2.806	9-7/64	11-3/8	OP3-1L-CV40	OP3-WC05
Short	4.12 - 5.62	3.500	5-1/64	7-3/8	OP4-1S-CV40	OP4-WC05

*Holder includes cartridges; however, inserts are sold separately.

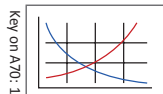
Cartridges

Replacement Cartridges	Qty. Inserts Needed	Mounting Screw	Key Size	Adjusting Screw	Driver
OP1-WC05	2	MS-13M-1	5mm	AS-10T9-1	8T-9
OP2-WC05	2	MS-15M-1	5mm	AS-10T9-1	8T-9
OP3-WC05	2	MS-15M-1	5mm	AS-12T9-1	8T-9
OP4-WC05	3	MS-15M-1	5mm	AS-14T9-1	8T-9

IC Inserts

Carbide Grade	Geometry	Part No.			Insert Screws	Driver
		AM300®	AM200®	TiN		
C5 (P35)	Standard	OP-05T308-P	OP-05T308-H	OP-05T308-T	IS-10-1	8T-9
C1 (K35)	Standard	OP-05T308-1P	OP-05T308-1H	OP-05T308-1T	IS-10-1	8T-9
C2 (K25)	Standard	OP-05T308-2P	OP-05T308-2H	-	IS-10-1	8T-9
C5 (P35)	High Rake	OP-05T308-PHR	OP-05T308-HHR	-	IS-10-1	8T-9

A70: 14 - 17



A70: 2 - 3



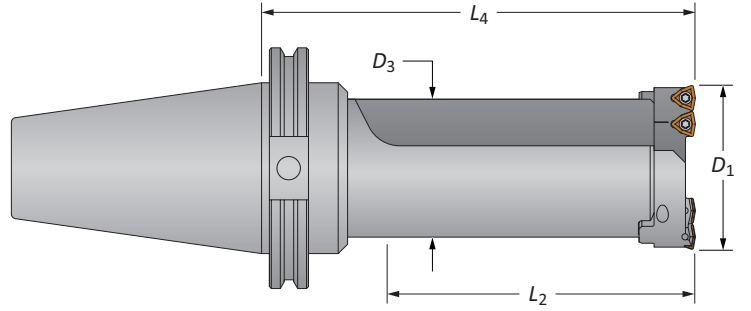
Mounting screws sold in multiples of 4 | Adjusting screws sold in multiples of 4
 IC inserts sold in multiples of 10 | Insert screws sold in multiples of 10

i = Imperial (in)
m = Metric (mm)

A DRILLING
 B BORING
 C REAMING
 D BURNISHING
 E THREADING
 X SPECIALS

Opening Drill Holders

CAT50 Shank | Diameter Range: 2.00" - 5.62" (50.8mm - 142.8mm)



Holders

Length	D ₁ Range	D ₃	Holder		Part No.	Cartridges
			L ₂	L ₄		
Short	2.00 - 2.50	1.840	3-9/32	5-27/64	OP1-1S-CV50	OP1-WC05
			5-17/32	7-43/64	OP1-1L-CV50	OP1-WC05
Long	2.50 - 3.00	2.220	4-43/64	6-7/8	OP2-1S-CV50	OP2-WC05
			7-43/64	9-7/8	OP2-1L-CV50	OP2-WC05
Short	3.00 - 4.12	2.806	5-7/64	7-3/8	OP3-1S-CV50	OP3-WC05
			9-7/64	11-3/8	OP3-1L-CV50	OP3-WC05
Long	4.12 - 5.62	3.500	5-1/64	7-3/8	OP4-1S-CV50	OP4-WC05
			10-33/64	12-7/8	OP4-1L-CV50	OP4-WC05

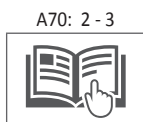
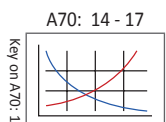
*Holder includes cartridges; however, inserts are sold separately.

Cartridges

Replacement Cartridges	Qty. Inserts Needed	Mounting Screw	Key Size	Adjusting Screw	Driver
OP1-WC05	2	MS-13M-1	5mm	AS-10T9-1	8T-9
OP2-WC05	2	MS-15M-1	5mm	AS-10T9-1	8T-9
OP3-WC05	2	MS-15M-1	5mm	AS-12T9-1	8T-9
OP4-WC05	3	MS-15M-1	5mm	AS-14T9-1	8T-9

IC Inserts

Carbide Grade	Geometry	Part No.			Insert Screws	Driver
		AM300®	AM200®	TiN		
C5 (P35)	Standard	OP-05T308-P	OP-05T308-H	OP-05T308-T	IS-10-1	8T-9
C1 (K35)	Standard	OP-05T308-1P	OP-05T308-1H	OP-05T308-1T	IS-10-1	8T-9
C2 (K25)	Standard	OP-05T308-2P	OP-05T308-2H	–	IS-10-1	8T-9
C5 (P35)	High Rake	OP-05T308-PHR	OP-05T308-HHR	–	IS-10-1	8T-9

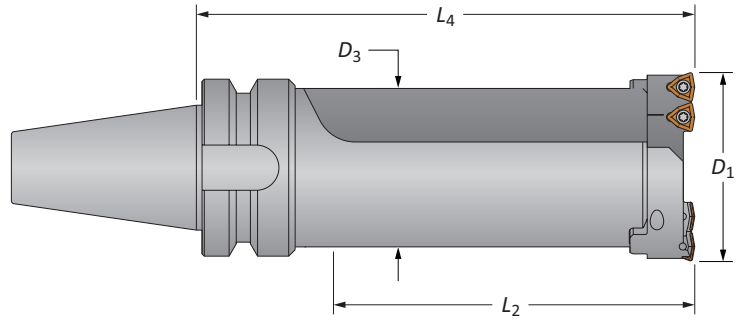


Mounting screws sold in multiples of 4 | Adjusting screws sold in multiples of 4
 IC inserts sold in multiples of 10 | Insert screws sold in multiples of 10

i = Imperial (in)
m = Metric (mm)

Opening Drill Holders

BT40 Shank | Diameter Range: 2.00" - 5.62" (50.8mm - 142.8mm)



Holder

Length	D ₁ Range	D ₃	Holder		Part No.	Cartridges
			L ₂	L ₄		
Short	50.8 - 63.5	1.840	83.5	137.8	OP1-1S-BT40	OP1-WC05
			140.6	195.0	OP1-1L-BT40	OP1-WC05
Long	50.8 - 63.5	1.840	118.5	174.7	OP2-1S-BT40	OP2-WC05
			194.7	250.9	OP2-1L-BT40	OP2-WC05
Short	63.5 - 76.2	2.220	129.9	187.4	OP3-1S-BT40	OP3-WC05
			231.5	289.0	OP3-1L-BT40	OP3-WC05
Long	63.5 - 76.2	2.220	127.4	187.4	OP4-1S-BT40	OP4-WC05
			127.4	187.4	OP4-1S-BT40	OP4-WC05

*Holder includes cartridges; however, inserts are sold separately.

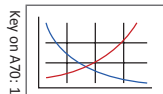
Cartridges

Replacement Cartridges	Qty. Inserts Needed	Mounting Screw	Key Size	Adjusting Screw	Driver
OP1-WC05	2	MS-13M-1	5mm	AS-10T9-1	8T-9
OP2-WC05	2	MS-15M-1	5mm	AS-10T9-1	8T-9
OP3-WC05	2	MS-15M-1	5mm	AS-12T9-1	8T-9
OP4-WC05	3	MS-15M-1	5mm	AS-14T9-1	8T-9

IC Inserts

Carbide Grade	Geometry	Part No.			Insert Screws	Driver
		AM300®	AM200®	TiN		
C5 (P35)	Standard	OP-05T308-P	OP-05T308-H	OP-05T308-T	IS-10-1	8T-9
C1 (K35)	Standard	OP-05T308-1P	OP-05T308-1H	OP-05T308-1T	IS-10-1	8T-9
C2 (K25)	Standard	OP-05T308-2P	OP-05T308-2H	-	IS-10-1	8T-9
C5 (P35)	High Rake	OP-05T308-PHR	OP-05T308-HHR	-	IS-10-1	8T-9

A70: 14 - 17



A70: 2 - 3



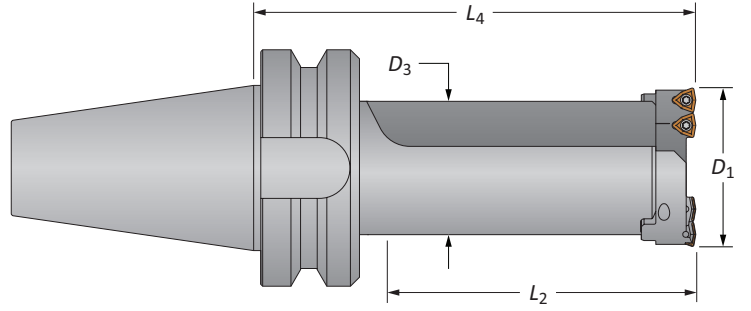
Mounting screws sold in multiples of 4 | Adjusting screws sold in multiples of 4
 IC inserts sold in multiples of 10 | Insert screws sold in multiples of 10

i = Imperial (in)
m = Metric (mm)

A DRILLING
 B BORING
 C REAMING
 D BURNISHING
 E THREADING
 X SPECIALS

Opening Drill Holders

BT50 Shank | Diameter Range: 2.00" - 5.62" (50.8mm - 142.8mm)



Holder

Length	D ₁ Range	Holder			Part No.	Cartridges
		D ₃	L ₂	L ₄		
Short	50.8 - 63.5	1.840	83.5	147.4	OP1-1S-BT50	OP1-WC05
			140.6	204.5	OP1-1L-BT50	OP1-WC05
Long	50.8 - 63.5	1.840	118.5	174.7	OP2-1S-BT50	OP2-WC05
			194.7	260.4	OP2-1L-BT50	OP2-WC05
Short	63.5 - 76.2	2.220	129.9	196.9	OP3-1S-BT50	OP3-WC05
			231.5	298.5	OP3-1L-BT50	OP3-WC05
Long	63.5 - 76.2	2.220	127.4	196.9	OP4-1S-BT50	OP4-WC05
			254.4	336.5	OP4-1L-BT50	OP4-WC05

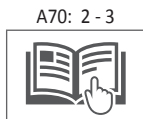
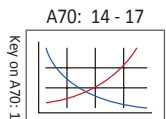
*Holder includes cartridges; however, inserts are sold separately.

Cartridges

Replacement Cartridges	Qty. Inserts Needed	Mounting Screw	Key Size	Adjusting Screw	Driver
OP1-WC05	2	MS-13M-1	5mm	AS-10T9-1	8T-9
OP2-WC05	2	MS-15M-1	5mm	AS-10T9-1	8T-9
OP3-WC05	2	MS-15M-1	5mm	AS-12T9-1	8T-9
OP4-WC05	3	MS-15M-1	5mm	AS-14T9-1	8T-9

IC Inserts

Carbide Grade	Geometry	Part No.			Insert Screws	Driver
		AM300®	AM200®	TiN		
C5 (P35)	Standard	OP-05T308-P	OP-05T308-H	OP-05T308-T	IS-10-1	8T-9
C1 (K35)	Standard	OP-05T308-1P	OP-05T308-1H	OP-05T308-1T	IS-10-1	8T-9
C2 (K25)	Standard	OP-05T308-2P	OP-05T308-2H	-	IS-10-1	8T-9
C5 (P35)	High Rake	OP-05T308-PHR	OP-05T308-HHR	-	IS-10-1	8T-9

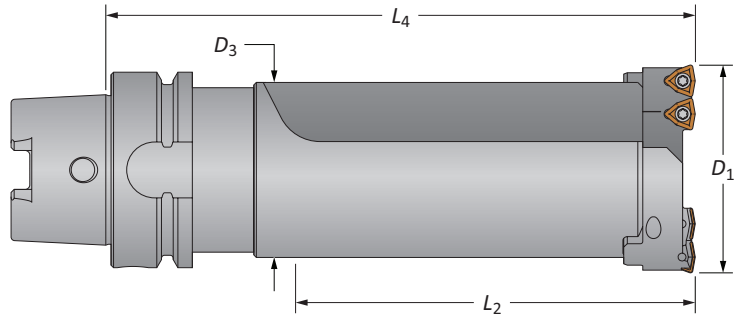


Mounting screws sold in multiples of 4 | Adjusting screws sold in multiples of 4
 IC inserts sold in multiples of 10 | Insert screws sold in multiples of 10

 = Imperial (in)
 = Metric (mm)

Opening Drill Holders

HSK63 Shank | Diameter Range: 2.00" - 5.62" (50.8mm - 142.8mm)



Holder

Length	D ₁ Range	D ₃	Holder		Part No.	Cartridges
			L ₂	L ₄		
Short	2.00 - 2.50	1.840	3-9/32	5-59/64	OP1-1S-HSK63	OP1-WC05
Long	2.00 - 2.50	1.840	5-17/32	8-11/64	OP1-1L-HSK63	OP1-WC05
Short	2.50 - 3.00	2.220	4-43/64	7-3/8	OP2-1S-HSK63	OP2-WC05
Long	2.50 - 3.00	2.220	7-43/64	10-3/8	OP2-1L-HSK63	OP2-WC05
Short	3.00 - 4.12	2.806	5-7/64	7-7/8	OP3-1S-HSK63	OP3-WC05
Long	3.00 - 4.12	2.806	9-7/64	11-7/8	OP3-1L-HSK63	OP3-WC05
Short	4.12 - 5.62	3.500	5-1/64	7-7/8	OP4-1S-HSK63	OP4-WC05

*Holder includes cartridges; however, inserts are sold separately.

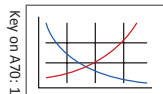
Cartridges

Replacement Cartridges	Qty. Inserts Needed	Mounting Screw	Key Size	Adjusting Screw	Driver
OP1-WC05	2	MS-13M-1	5mm	AS-10T9-1	8T-9
OP2-WC05	2	MS-15M-1	5mm	AS-10T9-1	8T-9
OP3-WC05	2	MS-15M-1	5mm	AS-12T9-1	8T-9
OP4-WC05	3	MS-15M-1	5mm	AS-14T9-1	8T-9

IC Inserts

Carbide Grade	Geometry	Part No.			Insert Screws	Driver
		AM300®	AM200®	TiN		
C5 (P35)	Standard	OP-05T308-P	OP-05T308-H	OP-05T308-T	IS-10-1	8T-9
C1 (K35)	Standard	OP-05T308-1P	OP-05T308-1H	OP-05T308-1T	IS-10-1	8T-9
C2 (K25)	Standard	OP-05T308-2P	OP-05T308-2H	–	IS-10-1	8T-9
C5 (P35)	High Rake	OP-05T308-PHR	OP-05T308-HHR	–	IS-10-1	8T-9

A70: 14 - 17



A70: 2 - 3



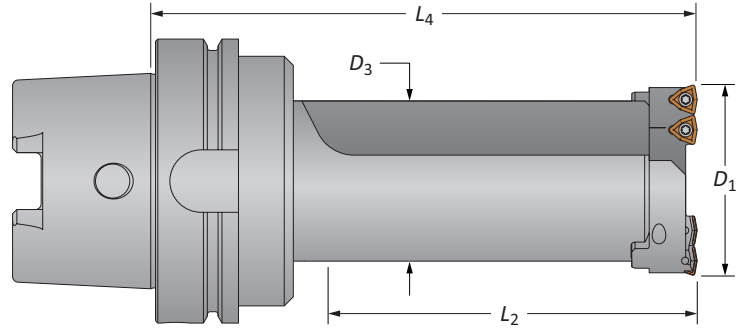
Mounting screws sold in multiples of 4 | Adjusting screws sold in multiples of 4
 IC inserts sold in multiples of 10 | Insert screws sold in multiples of 10

i = Imperial (in)
m = Metric (mm)

A
DRILLING
B
BORING
C
REAMING
D
BURNISHING
E
THREADING
X
SPECIALS

Opening Drill Holders

HSK100 Shank | Diameter Range: 2.00" - 5.62" (50.8mm - 142.8mm)



Holders

Length	D ₁ Range	D ₃	Holder		Part No.	Cartridges
			L ₂	L ₄		
Short	2.00 - 2.50	1.840	3-9/32	6-1/64	OP1-1S-HSK100	OP1-WC05
			5-17/32	8-17/64	OP1-1L-HSK100	OP1-WC05
Long	2.50 - 3.00	2.220	4-43/64	7-15/32	OP2-1S-HSK100	OP2-WC05
			7-43/64	10-15/32	OP2-1L-HSK100	OP2-WC05
Short	3.00 - 4.12	2.806	5-7/64	7-31/32	OP3-1S-HSK100	OP3-WC05
			9-7/64	11-31/32	OP3-1L-HSK100	OP3-WC05
Long	4.12 - 5.62	3.500	5-1/64	7-31/32	OP4-1S-HSK100	OP4-WC05
			10-33/64	13-15/32	OP4-1L-HSK100	OP4-WC05

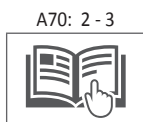
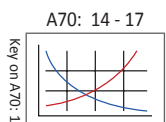
*Holder includes cartridges; however, inserts are sold separately.

Cartridges

Replacement Cartridges	Qty. Inserts Needed	Mounting Screw	Key Size	Adjusting Screw	Driver
OP1-WC05	2	MS-13M-1	5mm	AS-10T9-1	8T-9
OP2-WC05	2	MS-15M-1	5mm	AS-10T9-1	8T-9
OP3-WC05	2	MS-15M-1	5mm	AS-12T9-1	8T-9
OP4-WC05	3	MS-15M-1	5mm	AS-14T9-1	8T-9

IC Inserts

Carbide Grade	Geometry	Part No.			Insert Screws	Driver
		AM300®	AM200®	TiN		
C5 (P35)	Standard	OP-05T308-P	OP-05T308-H	OP-05T308-T	IS-10-1	8T-9
C1 (K35)	Standard	OP-05T308-1P	OP-05T308-1H	OP-05T308-1T	IS-10-1	8T-9
C2 (K25)	Standard	OP-05T308-2P	OP-05T308-2H	–	IS-10-1	8T-9
C5 (P35)	High Rake	OP-05T308-PHR	OP-05T308-HHR	–	IS-10-1	8T-9

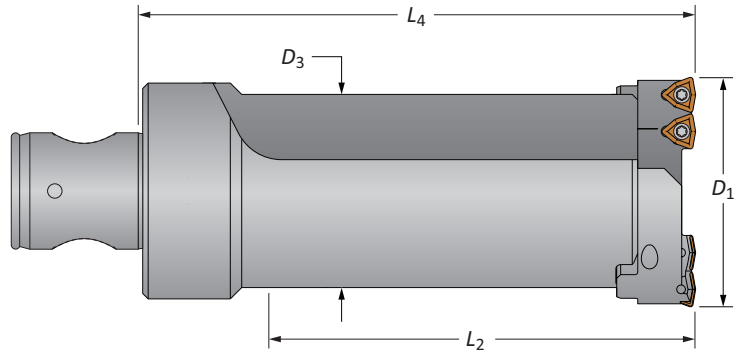


Mounting screws sold in multiples of 4 | Adjusting screws sold in multiples of 4
 IC inserts sold in multiples of 10 | Insert screws sold in multiples of 10

I = Imperial (in)
M = Metric (mm)

Opening Drill Holders

ABS63 Shank | Diameter Range: 2.00" - 5.62" (50.8mm - 142.8mm)



Holder

Length	D ₁ Range	D ₃	Holder		Part No.	Cartridges
			L ₂	L ₄		
Short	2.00 - 2.50	1.840	3-9/32	5-1/2	OP1-1S-ABS63	OP1-WC05
Long	2.00 - 2.50	1.840	5-17/32	7-3/4	OP1-1L-ABS63	OP1-WC05
Short	2.50 - 3.00	2.220	4-43/64	6-1/4	OP2-1S-ABS63	OP2-WC05
Long	2.50 - 3.00	2.220	7-43/64	9-1/4	OP2-1L-ABS63	OP2-WC05
Short	3.00 - 4.12	2.806	5-7/64	6-3/4	OP3-1S-ABS63	OP3-WC05
Long	3.00 - 4.12	2.806	9-7/64	10-3/4	OP3-1L-ABS63	OP3-WC05
Short	4.12 - 5.62	3.500	5-1/64	6-3/4	OP4-1S-ABS63	OP4-WC05

*Holder includes cartridges; however, inserts are sold separately.

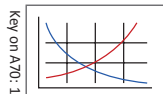
Cartridges

Replacement Cartridges	Qty. Inserts Needed	Mounting Screw	Key Size	Adjusting Screw	Driver
OP1-WC05	2	MS-13M-1	5mm	AS-10T9-1	8T-9
OP2-WC05	2	MS-15M-1	5mm	AS-10T9-1	8T-9
OP3-WC05	2	MS-15M-1	5mm	AS-12T9-1	8T-9
OP4-WC05	3	MS-15M-1	5mm	AS-14T9-1	8T-9

IC Inserts

Carbide Grade	Geometry	Part No.			Insert Screws	Driver
		AM300®	AM200®	TiN		
C5 (P35)	Standard	OP-05T308-P	OP-05T308-H	OP-05T308-T	IS-10-1	8T-9
C1 (K35)	Standard	OP-05T308-1P	OP-05T308-1H	OP-05T308-1T	IS-10-1	8T-9
C2 (K25)	Standard	OP-05T308-2P	OP-05T308-2H	-	IS-10-1	8T-9
C5 (P35)	High Rake	OP-05T308-PHR	OP-05T308-HHR	-	IS-10-1	8T-9

A70: 14 - 17



A70: 2 - 3



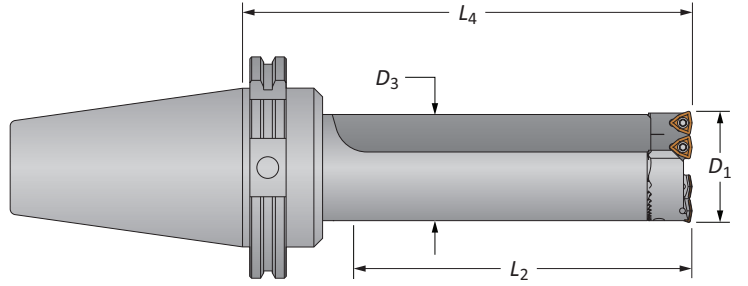
Mounting screws sold in multiples of 4 | Adjusting screws sold in multiples of 4
 IC inserts sold in multiples of 10 | Insert screws sold in multiples of 10

i = Imperial (in)
m = Metric (mm)

A DRILLING
 B BORING
 C REAMING
 D BURNISHING
 E THREADING
 X SPECIALS

Opening Drill Holders

DIN50 Shank | Diameter Range: 2.00" - 5.62" (50.8mm - 142.8mm)



Holders

	Length	D ₁ Range	Holder			Part No.	Cartridges
			D ₃	L ₂	L ₄		
m	Short	50.8 - 63.5	1.840	83.5	137.9	OP1-1S-DV50	OP1-WC05
	Long	50.8 - 63.5	1.840	140.6	195.1	OP1-1L-DV50	OP1-WC05
	Short	63.5 - 76.2	2.220	118.5	174.8	OP2-1S-DV50	OP2-WC05
	Long	63.5 - 76.2	2.220	194.7	251.0	OP2-1L-DV50	OP2-WC05
	Short	76.2 - 104.7	2.806	129.9	187.5	OP3-1S-DV50	OP3-WC05
	Long	76.2 - 104.7	2.806	231.5	289.1	OP3-1L-DV50	OP3-WC05
	Short	104.7 - 142.8	3.500	127.4	187.5	OP4-1S-DV50	OP4-WC05
	Long	104.7 - 142.8	3.500	254.4	327.2	OP4-1L-DV50	OP4-WC05

*Holder includes cartridges; however, inserts are sold separately.

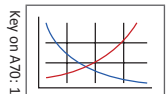
Cartridges

Replacement Cartridges	Qty. Inserts Needed	Mounting Screw	Key Size	Adjusting Screw	Driver
OP1-WC05	2	MS-13M-1	5mm	AS-10T9-1	8T-9
OP2-WC05	2	MS-15M-1	5mm	AS-10T9-1	8T-9
OP3-WC05	2	MS-15M-1	5mm	AS-12T9-1	8T-9
OP4-WC05	3	MS-15M-1	5mm	AS-14T9-1	8T-9

IC Inserts

Carbide Grade	Geometry	Part No.			Insert Screws	Driver
		AM300®	AM200®	TiN		
C5 (P35)	Standard	OP-05T308-P	OP-05T308-H	OP-05T308-T	IS-10-1	8T-9
C1 (K35)	Standard	OP-05T308-1P	OP-05T308-1H	OP-05T308-1T	IS-10-1	8T-9
C2 (K25)	Standard	OP-05T308-2P	OP-05T308-2H	-	IS-10-1	8T-9
C5 (P35)	High Rake	OP-05T308-PHR	OP-05T308-HHR	-	IS-10-1	8T-9

A70: 14 - 17



A70: 2 - 3



Mounting screws sold in multiples of 4 | Adjusting screws sold in multiples of 4
 IC inserts sold in multiples of 10 | Insert screws sold in multiples of 10

I = Imperial (in)
M = Metric (mm)

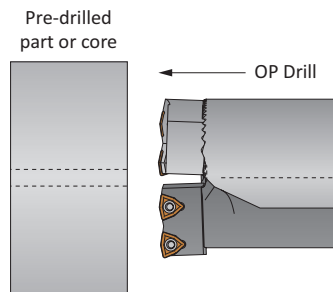
Recommended Cutting Data | Imperial (inch)

ISO	Material	Hardness (BHN)	Speed (SFM)			Feed Rate (IPR)
			AM300®	AM200®	TiN	
P	Free Machining Steel 1118, 1215, 12L14, etc.	100 - 250	900 - 1300	850 - 1200	700 - 900	.0035 - .007
	Low Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 275	850 - 1250	800 - 1150	650 - 850	.003 - .0065
	Medium Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 325	800 - 1050	750 - 950	600 - 850	.0035 - .0065
	Alloy Steel 4140, 5140, 8640, etc.	125 - 375	750 - 1000	700 - 900	600 - 850	.0035 - .0065
	High Strength Alloy 4340, 4330V, 300M, etc.	225 - 400	600 - 850	550 - 750	400 - 650	.003 - .005
	Structural Steel A36, A285, A516, etc.	100 - 350	850 - 1050	800 - 950	650 - 850	.003 - .0065
	Tool Steel H-13, H-21, A-4, O-2, S-3, etc.	150 - 250	400 - 800	350 - 700	250 - 650	.0025 - .005
	S	High Temp Alloy Hastelloy B, Inconel 600, etc.	140 - 310	250 - 450	250 - 350	150 - 300
M	Stainless Steel 400 Series 416, 420, etc.	185 - 350	600 - 850	550 - 750	400 - 650	.003 - .006
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.	135 - 275	600 - 850	550 - 750	400 - 650	.003 - .006
	Super Duplex Stainless Steel	135 - 275	500 - 750	450 - 650	300 - 550	.002 - .005
K	Nodular, Grey, Ductile Cast Iron	120 - 320	700 - 900	650 - 800	500 - 700	.004 - .008
N	Cast Aluminum	30 - 180	1250 - 1650	1200 - 1550	950 - 1100	.006 - .012
	Wrought Aluminum	30 - 180	1250 - 1650	1200 - 1550	950 - 1100	.006 - .012
	Brass	30 - 100	950 - 1350	900 - 1250	750 - 1100	.005 - .009

Minimum Pilot Hole Diameter = Finish Diameter - C

Ex: To open an existing diameter hole to 2.75" diameter, an OP2 tool would be used. The minimum pilot hole diameter would be: **2.750 - 1.880 = 0.870"**

Opening Drill Series	Drill Diameter Range	C
OP1	2.00 - 2.50	1.880
OP2	2.50 - 3.00	1.880
OP3	3.00 - 4.12	1.880
OP4	4.12 - 5.62	2.680



IMPORTANT: The speeds and feeds listed above are considered a general starting point for all applications. Factory technical assistance is available for your specific applications through our Application Engineering department.

Formulas and Constants | Imperial (inch)

Material Constants




Type of Material	Hardness (BHN)	K _m (lbs/in ²)
Free Machining Steel	100 - 250	0.75
Low Carbon Steel	85 - 275	0.85
Medium Carbon Steel	125 - 325	0.90
Alloy Steel	125 - 375	1.00
High Strength Steel	225 - 400	1.15
Structural Steel	100 - 350	1.00
Tool Steel	150 - 250	0.90
High Temperature Alloy	140 - 310	1.44
Titanium Alloy	140 - 310	0.72
Aerospace Alloy	185 - 350	0.70
Stainless Steel 400 Series	185 - 350	1.08
Stainless Steel 300 Series	135 - 275	0.94
Super Duplex Stainless Steel	135 - 275	0.94
Wear Plate	400 - 600	1.60
Hardened Steel	300 - 500	1.40
Nodular, Ductile Cast Iron	120 - 320	0.65
Grey Cast Iron	120 - 320	0.75
Cast Aluminum	30 - 180	0.40
Wrought Aluminum	30 - 180	0.40
Aluminum Bronze	100 - 250	0.50
Brass	100	0.35
Copper	60	0.30

Formulas

1. RPM	= (3.82 • SFM) / DIA_F
<i>where:</i>	
RPM	= revolutions per minute (rev/min)
SFM	= speed (ft/min)
DIA _F	= finish diameter of drill (inch)
2. HP	= (0.5891 • (DIA_F² – DIA_P²) • IPR • RPM • K_m) / 0.80
<i>where:</i>	
Tool Power	= tool power (HP)
DIA _F	= finish diameter of drill (inch)
DIA _P	= pre-drill diameter (inch)
IPR	= feed rate (in/rev)
RPM	= revolutions per minute (rev/min)
K _m	= specific cutting energy (lbs/in ²) machine efficiency (using 0.80 as constant)
3. Thrust	= 148,500 • IPR • (DIA_F – DIA_P) • K_m
<i>where:</i>	
Thrust	= axial thrust (lbs)
IPR	= feed rate (in/rev)
DIA _F	= finish diameter of drill (inch)
DIA _P	= pre-drill diameter (inch)
K _m	= specific cutting energy (lbs/in ²)
5. Torque	= (HP • 5252) / RPM
<i>where:</i>	
Torque	= torque (ft/lbs)
HP	= tool power (HP)
RPM	= revolutions per minute (rev/min)

The table and equations on this page are found in the *Machinery's Handbook*. Permission to simplify and print the equations is granted by the Editor of the *Machinery's Handbook*.

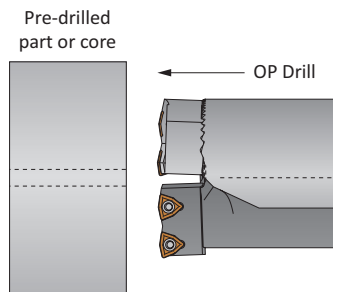
Recommended Cutting Data | Metric (mm)

ISO	Material	Hardness (BHN)	Speed (M/min)			Feed Rate (mm/rev)
			 AM300®	 AM200®	 TiN	
P	Free Machining Steel 1118, 1215, 12L14, etc.	100 - 250	274 - 396	259 - 366	213 - 274	0.09 - 0.18
	Low Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 275	259 - 381	244 - 351	198 - 259	0.08 - 0.17
	Medium Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 325	244 - 320	229 - 290	183 - 259	0.09 - 0.17
	Alloy Steel 4140, 5140, 8640, etc.	125 - 375	229 - 305	213 - 274	183 - 259	0.09 - 0.17
	High Strength Alloy 4340, 4330V, 300M, etc.	225 - 400	183 - 259	168 - 229	122 - 198	0.08 - 0.13
	Structural Steel A36, A285, A516, etc.	100 - 350	259 - 320	244 - 290	198 - 259	0.08 - 0.17
	Tool Steel H-13, H-21, A-4, O-2, S-3, etc.	150 - 250	122 - 244	107 - 213	76 - 198	0.06 - 0.13
	High Temp Alloy Hastelloy B, Inconel 600, etc.	140 - 310	76 - 137	76 - 107	46 - 91	0.06 - 0.11
M	Stainless Steel 400 Series 416, 420, etc.	185 - 350	183 - 259	168 - 229	122 - 198	0.08 - 0.15
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.	135 - 275	183 - 259	168 - 229	122 - 198	0.08 - 0.15
	Super Duplex Stainless Steel	135 - 275	152 - 228	137 - 198	91 - 152	0.05 - 0.12
K	Nodular, Grey, Ductile Cast Iron	120 - 320	213 - 274	198 - 244	152 - 213	0.10 - 0.20
N	Cast Aluminum	30 - 180	381 - 503	381 - 472	290 - 335	0.15 - 0.30
	Wrought Aluminum	30 - 180	381 - 503	381 - 472	290 - 335	0.15 - 0.30
	Brass	30 - 100	290 - 411	274 - 381	229 - 335	0.13 - 0.23

Minimum Pilot Hole Diameter = Finish Diameter – C

Ex: To open an existing diameter hole to 69.85mm diameter, an OP2 tool would be used. The minimum pilot hole diameter would be: **69.85 - 47.75 = 22.10**

Opening Drill Series	Drill Diameter Range	C
OP1	50.8 - 63.5	47.75
OP2	63.5 - 76.2	47.75
OP3	76.2 - 104.6	47.75
OP4	104.6 - 142.7	68.07



IMPORTANT: The speeds and feeds listed above are considered a general starting point for all applications. Factory technical assistance is available for your specific applications through our Application Engineering department.

Formulas and Constants | Metric (mm)

Material Constants

Type of Material	Hardness (BHN)	K _m (lbs/in ²)
Free Machining Steel	100 - 250	5.17
Low Carbon Steel	85 - 275	5.86
Medium Carbon Steel	125 - 325	6.21
Alloy Steel	125 - 375	6.90
High Strength Steel	225 - 400	7.93
Structural Steel	100 - 350	6.90
Tool Steel	150 - 250	6.21
High Temperature Alloy	140 - 310	9.93
Titanium Alloy	140 - 310	4.97
Aerospace Alloy	185 - 350	4.48
Stainless Steel 400 Series	185 - 350	7.45
Stainless Steel 300 Series	135 - 275	6.48
Super Duplex Stainless Steel	135 - 275	6.48
Wear Plate	400 - 600	11.04
Hardened Steel	300 - 500	9.66
Nodular, Ductile Cast Iron	120 - 320	4.48
Grey Cast Iron	120 - 320	5.17
Cast Aluminum	30 - 180	2.76
Wrought Aluminum	30 - 180	2.76
Aluminum Bronze	100 - 250	3.45
Brass	100	2.41
Copper	60	2.07

Formulas

1. RPM	= (318.31 • M/min) / DIA_F
<i>where:</i>	
RPM	= revolutions per minute (rev/min)
M/min	= speed (M/min)
DIA _F	= finish diameter of drill (mm)
2. kW	= ((DIA_F² - DIA_P²) • mm/rev • RPM • K_m) / 205,154
<i>where:</i>	
kW	= tool power (kW)
DIA _F	= finish diameter of drill (mm)
DIA _P	= pre-drill diameter (mm)
mm/rev	= feed rate (mm/rev)
RPM	= revolutions per minute (rev/min)
K _m	= specific cutting energy (kPa) machine efficiency (using 205,154 as constant)
3. Thrust	= 148.78 • mm/rev • (DIA_F - DIA_P) • K_m
<i>where:</i>	
Thrust	= axial thrust (N)
IPR	= feed rate (mm/rev)
DIA _F	= finish diameter of drill (mm)
DIA _P	= pre-drill diameter (mm)
K _m	= specific cutting energy (kPa)
4. Torque	= (kW • 9549.3) / RPM
<i>where:</i>	
Torque	= torque (Nm)
kW	= tool power (kW)
RPM	= revolutions per minute (rev/min)

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Guaranteed Test / Demo Application Form

Distributor PO # _____

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

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.)
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: _____ (CAT50 / Morse taper, etc.)		Power: _____ HP/KW
Rigidity: _____	Orientation: _____	Tool Rotating: _____
<input type="checkbox"/> Excellent	<input type="checkbox"/> Vertical	<input type="checkbox"/> Yes
<input type="checkbox"/> Good	<input type="checkbox"/> Horizontal	<input type="checkbox"/> No
<input type="checkbox"/> Poor		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
 Fax: (330) 602-3400

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Allied Machine & Engineering
Registered to ISO 9001
10001329

United States

Allied Machine & Engineering

120 Deeds Drive
Dover OH 44622
United States

Phone:
+1.330.343.4283

Fax:
+1.330.602.3400

Toll Free USA and Canada:
800.321.5537

Toll Free USA and Canada:
800.223.5140

Allied Machine & Engineering

485 W Third Street
Dover OH 44622
United States

Phone:
+1.330.343.4283

Fax:
+1.330.364.7666
(Engineering Dept.)

Toll Free USA and Canada:
800.321.5537

Europe

Allied Machine & Engineering Co. (Europe) Ltd.

93 Vantage Point
Pensnett Estate
Kingswinford
West Midlands
DY6 7FR England

Phone:
+44 (0) 1384.400900

Wohlhaupter GmbH

Maybachstrasse 4
Postfach 1264
72636 Frickenhausen
Germany

Phone:
+49 (0) 7022.408.0

Fax:
+49 (0) 7022.408.212

Asia

Wohlhaupter India Pvt. Ltd.

B-23, 2nd Floor
B Block Community Centre
Janakpuri, New Delhi - 110058
India

Phone:
+91 (0) 11.41827044

Your local Allied Machine representative:

www.alliedmachine.com

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