



**ALLIED MACHINE
& ENGINEERING**

WOHLHAUPTER®

Holemaking Solutions for Today's Manufacturing



Boring



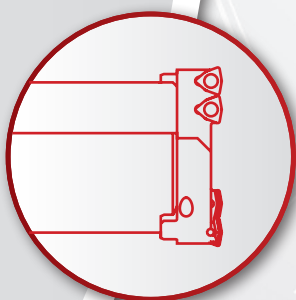
Reaming



Burnishing



Threading



Specials



Drilling

► Opening Drill™

Large Diameter Replacable
IC Insert Drilling System

Opening Drill™

Large Diameter Replaceable IC Insert Drilling System

► **Diameter Range:** 50.80mm - 142.75mm (2.000" - 5.620")



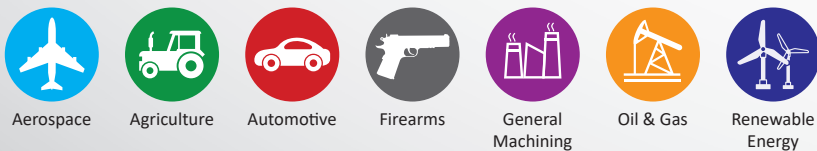
Need larger holes? No problem.

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
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Applicable Industries



Your safety and the safety of others is very important. This catalogue 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 catalogue, 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 catalogue. 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.

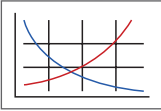
Visit www.alliedmachine.com for the most up-to-date information and procedures.

Reference Icons

The following icons will appear throughout the catalogue 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	
	Metric (mm)	Imperial (inch)
OP1	50.80 - 63.50	2.00 - 2.50
OP2	63.50 - 76.20	2.50 - 3.00
OP3	76.20 - 104.64	3.00 - 4.12
OP4	104.64 - 142.80	4.12 - 5.62

Introduction Information

Product Overview 2

Set-up Instructions 3

Product Nomenclature 4

Drill Shank Style

Straight 5

BT40 6

BT50 7

HSK63 8

HSK100 9

ABS63 10

DIN50 11

Recommended Cutting Data

Metric (mm) 12 - 13

Imperial (inch) 14 - 15



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 3.175mm (1/8") 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

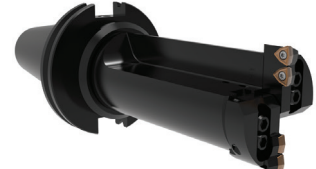
Shank Options



Straight



CAT40



CAT50



BT40



BT50



HSK63



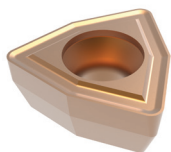
HSK100



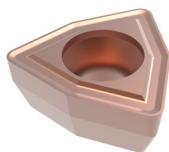
DIN50



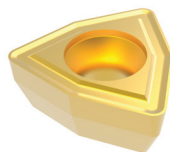
ABS63



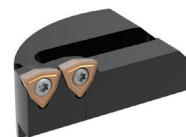
AM300°



AM200°



TiN

**2 Inserts**
(OP1 - OP3 series)**3 Inserts**
(OP4 series)

Insert Application Recommendations

Carbide Grade Options

P35 (C5)	General purpose carbide grade suitable for most applications. ▶ <i>Common application in steels and stainless steels.</i>
K35 (C1)	Toughest carbide grade. Provides the best combination of edge strength and tool life. ▶ <i>Recommended for less rigid applications.</i>
K25 (C2)	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.
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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

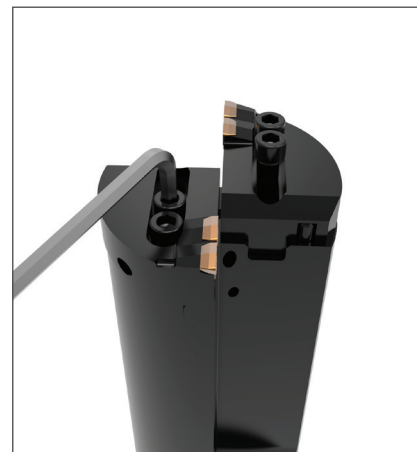
Set-up Instructions



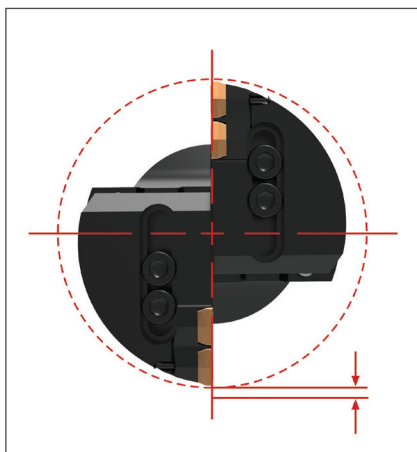
Step 1:
Loosen the mounting screws on both cartridges.



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



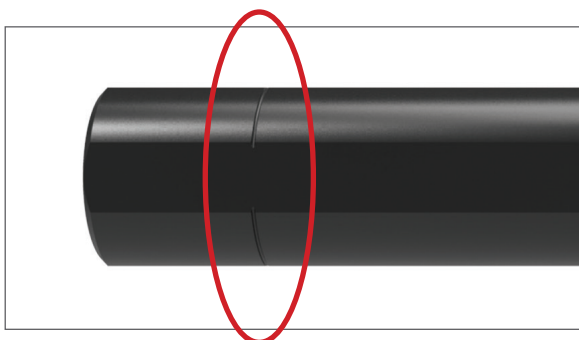
Step 3:
Tighten the mounting screws on the cartridge to 15-19 Nm (11-14 ft-lbf).



Step 4:
Set the opposing cartridge with 4mm to 5mm 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 15-19 Nm (11-14 ft-lbf).



Straight Shanks

- Designed for lathe applications
- Can be cut off for use in end-mill holders
- The score mark (circled above) 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

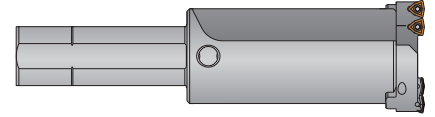




Product Nomenclature

Opening Drill™ Holders

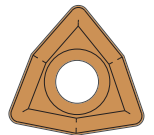
OP1	–	1S	–	SS1.5
1		2		3



1. Series	2. Length	3. Shank Type
OP1 = 50.8mm - 63.5mm (2.00" - 2.50") OP2 = 63.5mm - 76.2mm (2.50" - 3.00") OP3 = 76.2mm - 104.7mm (3.00" - 4.12") OP4 = 104.7mm - 142.8mm (4.12" - 5.62")	1S = Short 1L = Long	SS1.5 = 38.1mm (1.5") Ø straight SS2.5 = 63.5mm (2.5") Ø 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

Opening Drill™ Inserts

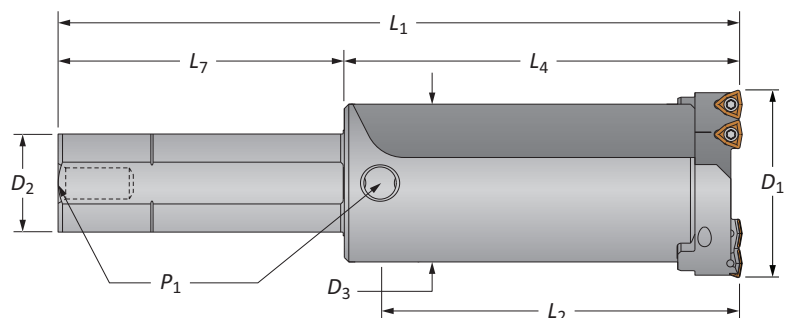
OP	–	05	T3	08	–	1	H	HR
1		2	3	4		5	6	7



1. Compatible with:	2. IC Type	3. Thickness	4. Radius	5. Carbide Grade
Opening Drill™ Revolution Drill™	05 = 7.94mm	T3 = 3.97mm	08 = 0.79mm	Blank = P35 (C5) 1 = K35 (C1) 2 = K25 (C2)
6. Coating	7. Geometry			
P = AM300® H = AM200® T = TiN A = TiAlN N = TiCN U = Uncoated	Blank = General Purpose HR = High Rake			

Reference Key

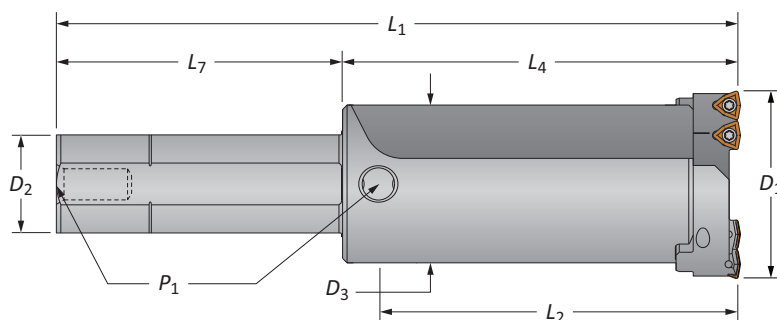
Symbol	Attribute
D₁	Drill diameter range
D₂	Shank diameter
D₃	Body diameter
L₁	Overall length
L₂	Maximum drill depth
L₄	Holder length
L₇	Shank length
P₁	Rear pipe tap





Opening Drill™ Holders

Straight Shank | Diameter Range: 50.80mm - 142.80mm (2.00" - 5.62")



Holder

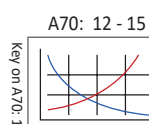
	Length	D ₁ Range	Holder				Shank			Part No.	Cartridges
			D ₃	L ₂	L ₄	L ₁	D ₂	L ₇	P ₁		
m	Short	50.8 - 63.5	46.74	83.5	102.9	172.9	40	70	–	OP1-1S-40M	OP1-WC05
	Long	50.8 - 63.5	46.74	140.6	160.1	230.1	40	70	–	OP1-1L-40M	OP1-WC05
	Short	63.5 - 76.2	56.39	118.5	139.8	209.8	40	70	–	OP2-1S-40M	OP2-WC05
	Long	63.5 - 76.2	56.39	194.7	216.0	286.0	40	70	–	OP2-1L-40M	OP2-WC05
	Short	76.2 - 104.7	71.27	129.9	152.5	222.5	40	70	–	OP3-1S-40M	OP3-WC05
	Long	76.2 - 104.7	71.27	231.5	254.1	324.1	40	70	–	OP3-1L-40M	OP3-WC05
	Short	104.7 - 142.8	88.90	127.4	152.5	232.5	50	80	–	OP4-1S-50M	OP4-WC05
	Long	104.7 - 142.8	88.90	254.4	292.2	372.2	50	80	–	OP4-1L-50M	OP4-WC05
i	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

Cartridges

Replacement Cartridges	Qty. Inserts Needed	Mounting Screw	Adjusting Screw
OP1-WC05	2	MS-13M-1	AS-10T9-1
OP2-WC05	2	MS-15M-1	AS-10T9-1
OP3-WC05	2	MS-15M-1	AS-12T9-1
OP4-WC05	3	MS-15M-1	AS-14T9-1

IC Inserts

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



A70: 2 - 3



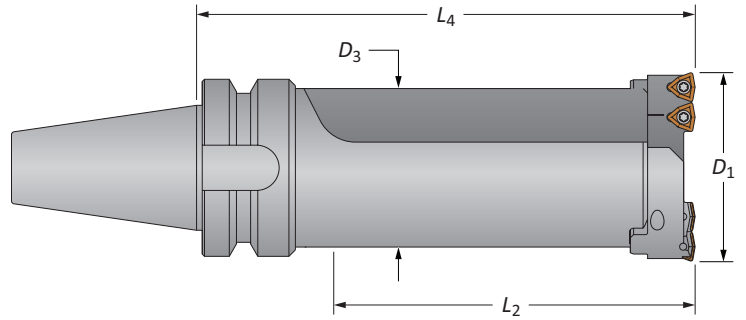
Mounting screws sold in multiples of 4 | Adjusting screws sold in multiples of 4
IC inserts sold in multiples of 10 | Insert screws sold in multiples of 10

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



Opening Drill™ Holders

BT40 Shank | Diameter Range: 50.80mm - 142.80mm (2.00" - 5.62")



Holder

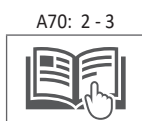
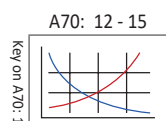
			Holder				
Length		D ₁ Range	D ₃	L ₂	L ₄	Part No.	Cartridges
m	Short	50.8 - 63.5	46.73	83.5	137.8	OP1-1S-BT40	OP1-WC05
	Long	50.8 - 63.5	46.73	140.6	195.0	OP1-1L-BT40	OP1-WC05
	Short	63.5 - 76.2	56.39	118.5	174.7	OP2-1S-BT40	OP2-WC05
	Long	63.5 - 76.2	56.39	194.7	250.9	OP2-1L-BT40	OP2-WC05
	Short	76.2 - 104.7	71.27	129.9	187.4	OP3-1S-BT40	OP3-WC05
	Long	76.2 - 104.7	71.27	231.5	289.0	OP3-1L-BT40	OP3-WC05
	Short	104.7 - 142.8	88.90	127.4	187.4	OP4-1S-BT40	OP4-WC05

Cartridges

Replacement Cartridges	Qty. Inserts Needed	Mounting Screw	Adjusting Screw
OP1-WC05	2	MS-13M-1	AS-10T9-1
OP2-WC05	2	MS-15M-1	AS-10T9-1
OP3-WC05	2	MS-15M-1	AS-12T9-1
OP4-WC05	3	MS-15M-1	AS-14T9-1

IC Inserts

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



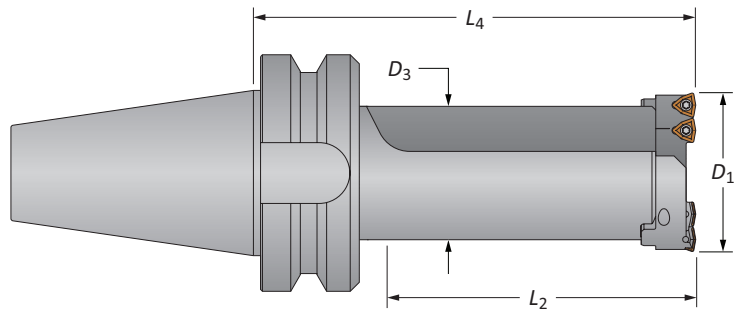
Mounting screws sold in multiples of 4 | Adjusting screws sold in multiples of 4
IC inserts sold in multiples of 10 | Insert screws sold in multiples of 10

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



Opening Drill™ Holders

BT50 Shank | Diameter Range: 50.80mm - 142.80mm (2.00" - 5.62")



Holdings

	Length	D ₁ Range	Holder			Part No.	Cartridges
			D ₃	L ₂	L ₄		
M	Short	50.8 - 63.5	46.73	83.5	147.4	OP1-1S-BT50	OP1-WC05
	Long	50.8 - 63.5	46.73	140.6	204.5	OP1-1L-BT50	OP1-WC05
	Short	63.5 - 76.2	56.39	118.5	174.7	OP2-1S-BT50	OP2-WC05
	Long	63.5 - 76.2	56.39	194.7	260.4	OP2-1L-BT50	OP2-WC05
	Short	76.2 - 104.7	71.27	129.9	196.9	OP3-1S-BT50	OP3-WC05
	Long	76.2 - 104.7	71.27	231.5	298.5	OP3-1L-BT50	OP3-WC05
	Short	104.7 - 142.8	88.90	127.4	196.9	OP4-1S-BT50	OP4-WC05
	Long	104.7 - 142.8	188.90	254.4	336.5	OP4-1L-BT50	OP4-WC05

Cartridges

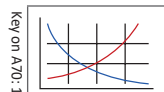
Replacement Cartridges	Qty. Inserts Needed	Mounting Screw	Adjusting Screw
OP1-WC05	2	MS-13M-1	AS-10T9-1
OP2-WC05	2	MS-15M-1	AS-10T9-1
OP3-WC05	2	MS-15M-1	AS-12T9-1
OP4-WC05	3	MS-15M-1	AS-14T9-1

IC Inserts

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

A70: 12 - 15

A70: 2 - 3



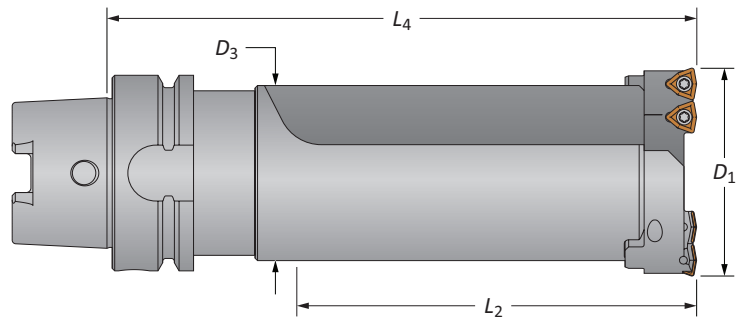
Mounting screws sold in multiples of 4 | Adjusting screws sold in multiples of 4
IC inserts sold in multiples of 10 | Insert screws sold in multiples of 10

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



Opening Drill™ Holders

HSK63 Shank | Diameter Range: 50.80mm - 142.80mm (2.00" - 5.62")



Holders

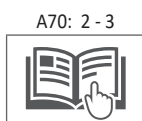
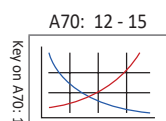
		Holder					
Length		D ₁ Range	D ₃	L ₂	L ₄	Part No.	Cartridges
m	Short	50.80 - 63.50	46.74	82.55	143.51	OP1-1S-HSK63	OP1-WC05
	Long	50.80 - 63.50	46.74	139.70	200.66	OP1-1L-HSK63	OP1-WC05
	Short	63.50 - 76.20	56.39	120.65	181.61	OP2-1S-HSK63	OP2-WC05
	Long	63.50 - 76.20	56.39	196.85	257.81	OP2-1L-HSK63	OP2-WC05
	Short	76.20 - 104.65	71.27	127.00	194.31	OP3-1S-HSK63	OP3-WC05
	Long	76.20 - 104.65	71.27	228.60	295.91	OP3-1L-HSK63	OP3-WC05
	Short	104.65 - 142.75	88.90	127.00	194.31	OP4-1S-HSK63	OP4-WC05

Cartridges

Replacement Cartridges	Qty. Inserts Needed	Mounting Screw	Adjusting Screw
OP1-WC05	2	MS-13M-1	AS-10T9-1
OP2-WC05	2	MS-15M-1	AS-10T9-1
OP3-WC05	2	MS-15M-1	AS-12T9-1
OP4-WC05	3	MS-15M-1	AS-14T9-1

IC Inserts

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



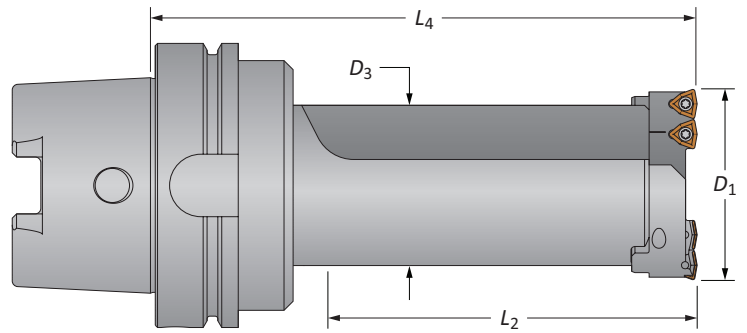
Mounting screws sold in multiples of 4 | Adjusting screws sold in multiples of 4
IC inserts sold in multiples of 10 | Insert screws sold in multiples of 10

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



Opening Drill™ Holders

HSK100 Shank | Diameter Range: 50.80mm - 142.80mm (2.00" - 5.62")



Holdings

	Length	D ₁ Range	Holder			Part No.	Cartridges
			D ₃	L ₂	L ₄		
i	Short	50.80 - 63.50	46.74	82.55	149.86	OP1-1S-HSK100	OP1-WC05
	Long	50.80 - 63.50	46.74	139.70	207.01	OP1-1L-HSK100	OP1-WC05
	Short	63.50 - 76.20	56.39	120.65	187.96	OP2-1S-HSK100	OP2-WC05
	Long	63.50 - 76.50	56.39	196.85	264.16	OP2-1L-HSK100	OP2-WC05
	Short	76.20 - 104.65	71.27	127.00	200.66	OP3-1S-HSK100	OP3-WC05
	Long	76.20 - 106.65	71.27	228.60	302.26	OP3-1L-HSK100	OP3-WC05
	Short	104.65 - 142.75	88.90	127.00	200.66	OP4-1S-HSK100	OP4-WC05
	Long	104.65 - 142.75	88.90	266.70	340.36	OP4-1L-HSK100	OP4-WC05

Cartridges

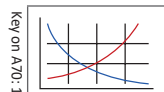
Replacement Cartridges	Qty. Inserts Needed	Mounting Screw	Adjusting Screw
OP1-WC05	2	MS-13M-1	AS-10T9-1
OP2-WC05	2	MS-15M-1	AS-10T9-1
OP3-WC05	2	MS-15M-1	AS-12T9-1
OP4-WC05	3	MS-15M-1	AS-14T9-1

IC Inserts

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

A70: 12 - 15

A70: 2 - 3



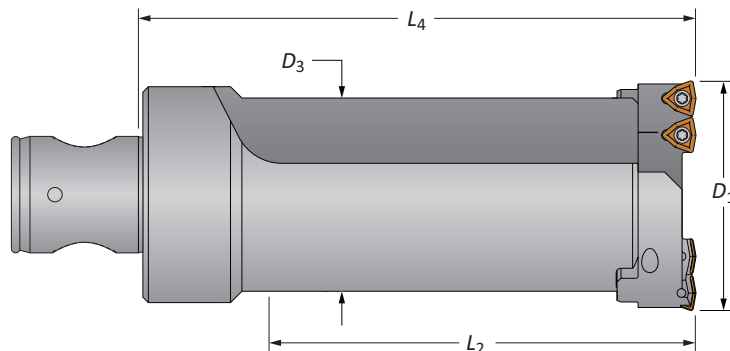
Mounting screws sold in multiples of 4 | Adjusting screws sold in multiples of 4
IC inserts sold in multiples of 10 | Insert screws sold in multiples of 10

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



Opening Drill™ Holders

ABS63 Shank | Diameter Range: 50.80mm - 142.80mm (2.00" - 5.62")



Holdings

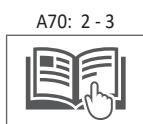
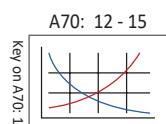
		Holder					
Length		D ₁ Range	D ₃	L ₂	L ₄	Part No.	Cartridges
i	Short	50.80 - 63.50	82.55	82.55	139.70	OP1-1S-ABS63	OP1-WC05
	Long	50.80 - 63.50	139.70	139.70	196.85	OP1-1L-ABS63	OP1-WC05
	Short	63.50 - 76.20	120.65	120.65	158.75	OP2-1S-ABS63	OP2-WC05
	Long	63.50 - 76.20	196.85	196.85	234.95	OP2-1L-ABS63	OP2-WC05
	Short	76.20 - 104.65	127.00	127.00	171.45	OP3-1S-ABS63	OP3-WC05
	Long	76.20 - 104.65	228.60	228.60	273.05	OP3-1L-ABS63	OP3-WC05
	Short	104.65 - 142.75	127.00	127.00	171.45	OP4-1S-ABS63	OP4-WC05

Cartridges

Replacement Cartridges	Qty. Inserts Needed	Mounting Screw	Adjusting Screw
OP1-WC05	2	MS-13M-1	AS-10T9-1
OP2-WC05	2	MS-15M-1	AS-10T9-1
OP3-WC05	2	MS-15M-1	AS-12T9-1
OP4-WC05	3	MS-15M-1	AS-14T9-1

IC Inserts

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



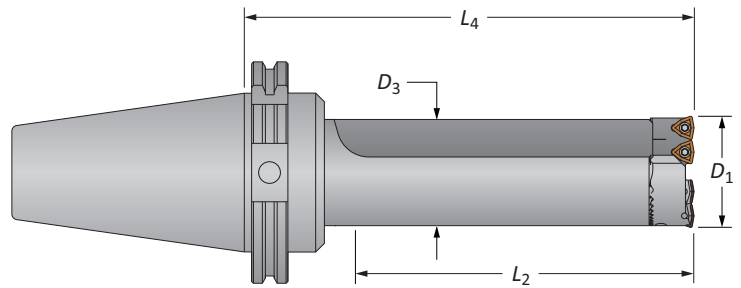
Mounting screws sold in multiples of 4 | Adjusting screws sold in multiples of 4
IC inserts sold in multiples of 10 | Insert screws sold in multiples of 10

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



Opening Drill™ Holders

DIN50 Shank | Diameter Range: 50.80mm - 142.80mm (2.00" - 5.62")



Holder

	Length	D ₁ Range	Holder			Part No.	Cartridges
			D ₃	L ₂	L ₄		
m	Short	50.8 - 63.5	59.44	83.5	137.9	OP1-1S-DV50	OP1-WC05
	Long	50.8 - 63.5	59.44	140.6	195.1	OP1-1L-DV50	OP1-WC05
	Short	63.5 - 76.2	69.01	118.5	174.8	OP2-1S-DV50	OP2-WC05
	Long	63.5 - 76.2	69.01	194.7	251.0	OP2-1L-DV50	OP2-WC05
	Short	76.2 - 104.7	83.97	129.9	187.5	OP3-1S-DV50	OP3-WC05
	Long	76.2 - 104.7	83.97	231.5	289.1	OP3-1L-DV50	OP3-WC05
	Short	104.7 - 142.8	101.60	127.4	187.5	OP4-1S-DV50	OP4-WC05
	Long	104.7 - 142.8	101.60	254.4	327.2	OP4-1L-DV50	OP4-WC05

Note: there is an extended delivery time for this item. Please check when ordering.

Cartridges

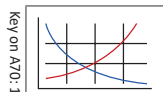
Replacement Cartridges	Qty. Inserts Needed	Mounting Screw	Adjusting Screw
OP1-WC05	2	MS-13M-1	AS-10T9-1
OP2-WC05	2	MS-15M-1	AS-10T9-1
OP3-WC05	2	MS-15M-1	AS-12T9-1
OP4-WC05	3	MS-15M-1	AS-14T9-1

IC Inserts

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

A70: 12 - 15

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

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



Recommended Cutting Data | Metric (mm)

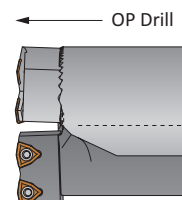
ISO	Material	Hardness (BHN)	Speed (M/min)			Feed Rate (mm/rev)
			 AM300®	 AM200®	 TiN	
P	Free Machining Steel 1118, 1215, 12L14, etc.	100 - 250	274 - 396	259 - 366	213 - 274	0.09 - 0.18
	Low Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 275	259 - 381	244 - 351	198 - 259	0.08 - 0.17
	Medium Carbon 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 Aluminium	30 - 180	381 - 503	381 - 472	290 - 335	0.15 - 0.30
	Wrought Aluminium	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 – Opening Range

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	Opening Range Diameter
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

Pre-drilled
part or core



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 Aluminium	30 - 180	2.76
Wrought Aluminium	30 - 180	2.76
Aluminium Bronze	100 - 250	3.45
Brass	100	2.41
Copper	60	2.07

Formulas

1.	RPM = $(318.31 \cdot M/min) / DIA_F$ where: RPM = revolutions per minute (rev/min) M/min = speed (M/min) DIA _F = finish diameter of drill (mm)
2.	kW = $((DIA_F^2 - DIA_P^2) \cdot mm/rev \cdot RPM \cdot K_m) / 205,154$ where: 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 = $148.78 \cdot mm/rev \cdot (DIA_F - DIA_P) \cdot K_m$ where: 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 = $(kW \cdot 9549.3) / RPM$ where: Torque = torque (Nm) kW = tool power (kW) 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 | Imperial (inch)

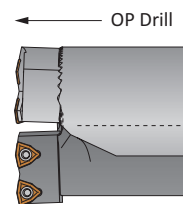
ISO	Material	Hardness (BHN)	Speed (SFM)			Feed Rate (IPR)
			 AM300®	 AM200®	 TiN	
P	Free Machining Steel 1118, 1215, 12L14, etc.	100 - 250	900 - 1300	850 - 1200	700 - 900	.0035 - .007
	Low Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 275	850 - 1250	800 - 1150	650 - 850	.003 - .0065
	Medium Carbon 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
	High Temp Alloy Hastelloy B, Inconel 600, etc.	140 - 310	250 - 450	250 - 350	150 - 300	.0025 - .005
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 Aluminium	30 - 180	1250 - 1650	1200 - 1550	950 - 1100	.006 - .012
	Wrought Aluminium	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 – Opening Range

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	Opening Range Diameter
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

Pre-drilled
part or core



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 Aluminium	30 - 180	0.40
Wrought Aluminium	30 - 180	0.40
Aluminium Bronze	100 - 250	0.50
Brass	100	0.35
Copper	60	0.30

Formulas

1.	RPM = $(3.82 \cdot \text{SFM}) / \text{DIA}_F$ where: RPM = revolutions per minute (rev/min) SFM = speed (ft/min) DIA _F = finish diameter of drill (inch)
2.	HP = $(0.5891 \cdot (\text{DIA}_F^2 - \text{DIA}_P^2) \cdot \text{IPR} \cdot \text{RPM} \cdot \text{K}_m) / 0.80$ where: 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 = $148,500 \cdot \text{IPR} \cdot (\text{DIA}_F - \text{DIA}_P) \cdot \text{K}_m$ where: 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 = $(\text{HP} \cdot 5252) / \text{RPM}$ where: 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*.



Notes

A

DRILLING

B

BORING

C

REAMING

D

BURNISHING

E

THREADING

X

SPECIALS

Notes

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

Europe

Allied Machine & Engineering Co. (Europe) Ltd.

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

Phone:

+44 (0)1384 400900

Email:

enquiries.eu@alliedmachine.com

Web:

www.alliedmachine.com

Wohlhaupter GmbH

Maybachstraße 4
72636 Frickenhausen
Germany

Phone:

+49 (0)7022 408 0

Email:

info@wohlhaupter.de

Web:

www.wohlhaupter.com

United States

Allied Machine & Engineering

120 Deeds Drive
Dover OH 44622
United States

Phone:

+1 330 343 4283

Toll Free USA and Canada:

800 321 5537

Fax:

+1 330 602 3400

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

Toll Free USA and Canada:

800 321 5537

Fax:

+1 330 364 7666
(Engineering Dept.)

Asia

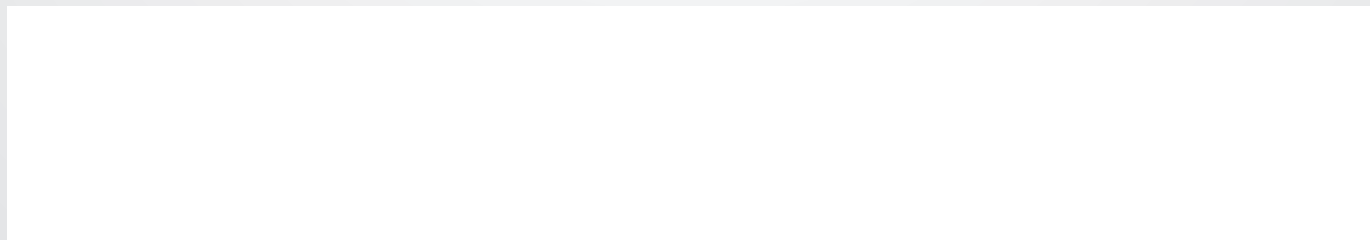
Wohlhaupter India Pvt. Ltd.

B-23, 3rd Floor
B Block Community Centre
Janakpuri, New Delhi - 110058
India

Phone:

+91 11 41827044

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