DIA EDGE

TOOL NEWS

2021.3 Update
B267G

Solid Carbide **TRISTAR** Drill Series

DVAS

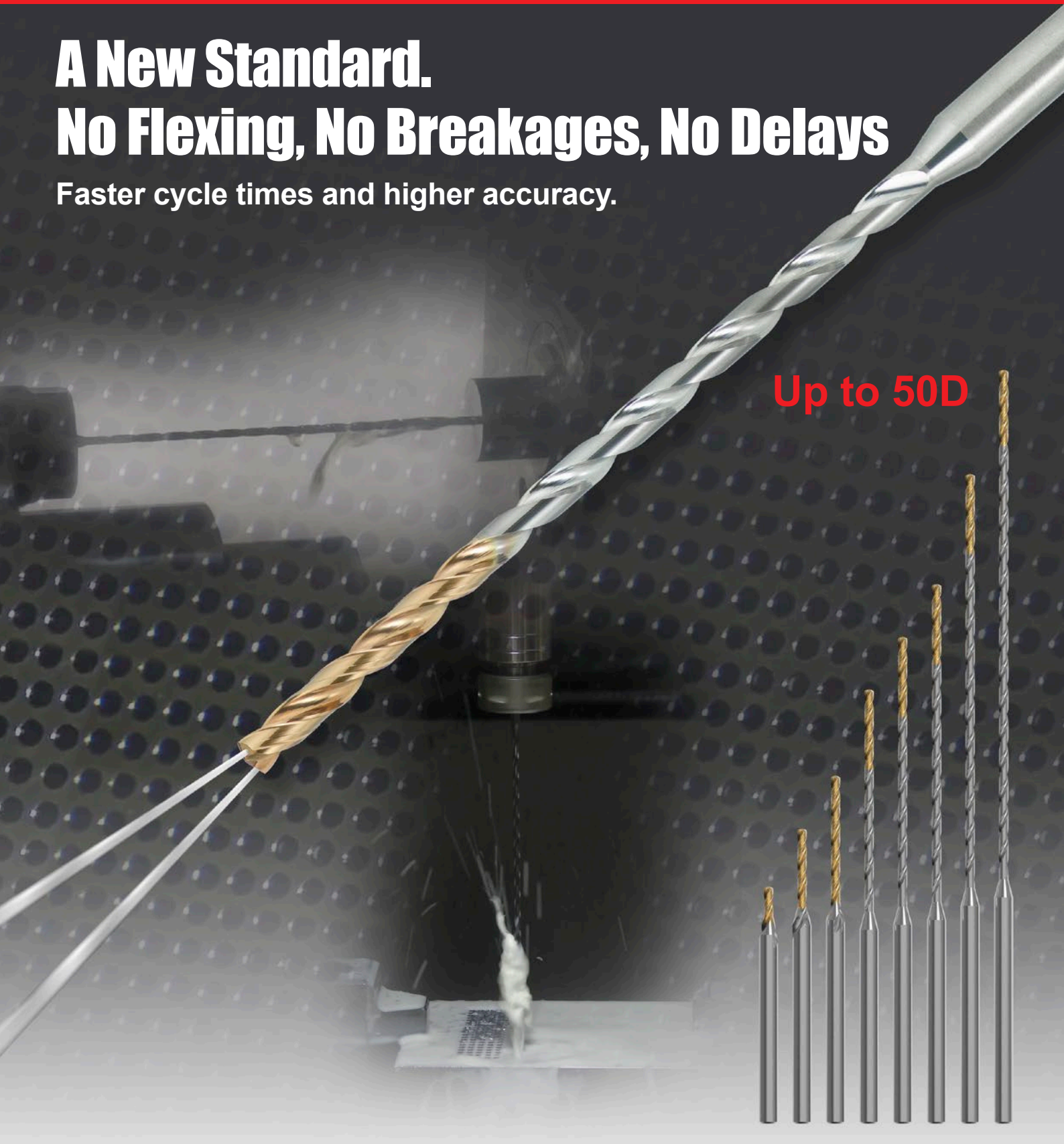
Mini Size

ø1.0mm – ø2.9mm
L/D=2 – 50

New Products

A New Standard.
No Flexing, No Breakages, No Delays

Faster cycle times and higher accuracy.



MITSUBISHI MATERIALS CORPORATION

New Drills from Mitsubishi Materials

TRISTAR Drill Series

High Efficiency - Long Tool Life - High Precision

TRISTAR, a new generation drill series from Mitsubishi Materials provides 3 strong advantages.

The first of the Tristar series is a small diameter drill with 5 technological features for FAST, RELIABLE and ACCURATE drilling.

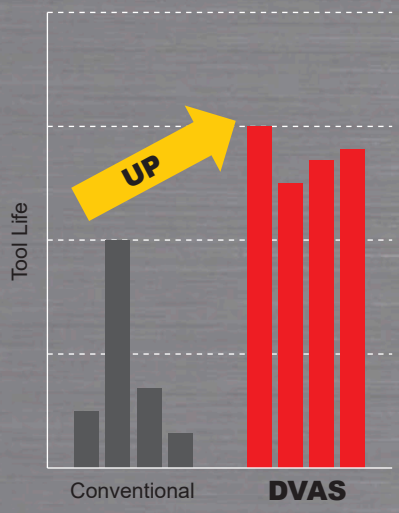
FAST

"Deep hole drilling is usually a slow process."

Deep holes can be drilled quickly and efficiently.

RELIABLE

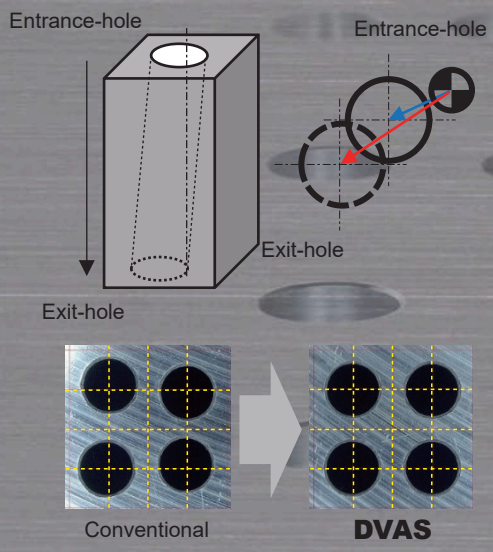
"Breakages, short tool life and lack of coolant can be common."



Tool life exceeds all normal expectations.

ACCURATE

"Holes can wander considerably and have poor positioning."



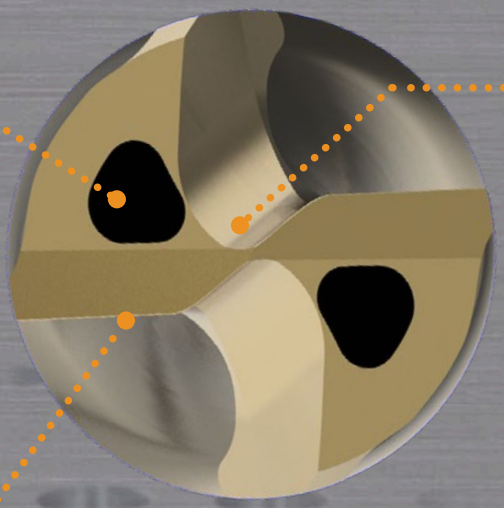
Straighter holes and improved dimensional accuracy.

Solid Carbide Drill
TRISTAR Drill Series
DVAS

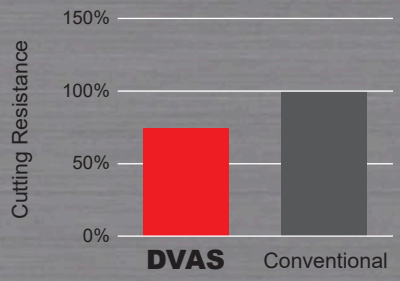
Mini Size ø1.0mm – ø2.9mm
L/D=2 – 50

FAST, RELIABLE and ACCURATE.
New standards enabled by the Five Technologies.

Advanced Coolant Hole



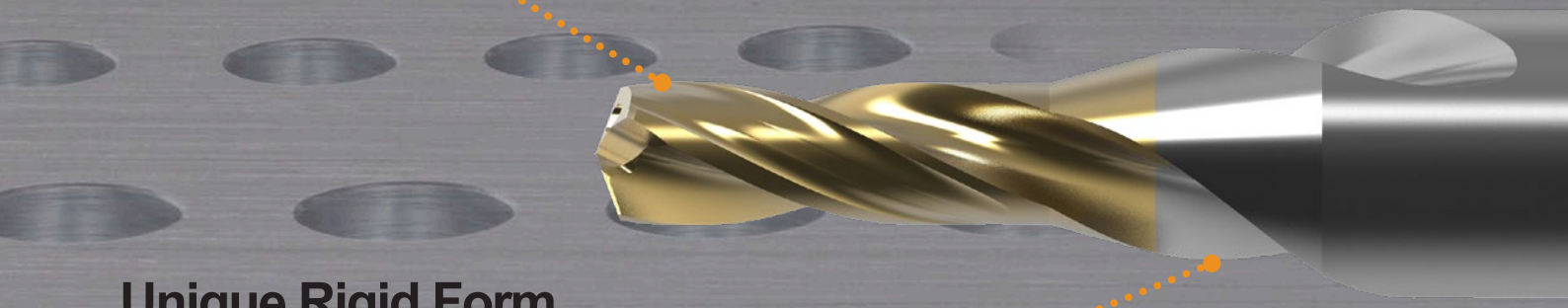
New XR Point Thinning



<Cutting Conditions>
Workpiece Material : JIS SCM440
Tool : DC=ø1.0mm, L/D=20
Cutting Speed : vc= 70m/min
Feed per Rev. : fr= 0.04mm/rev.

Tough and Sharp Cutting Edge Design

New Coated Grade DP1120

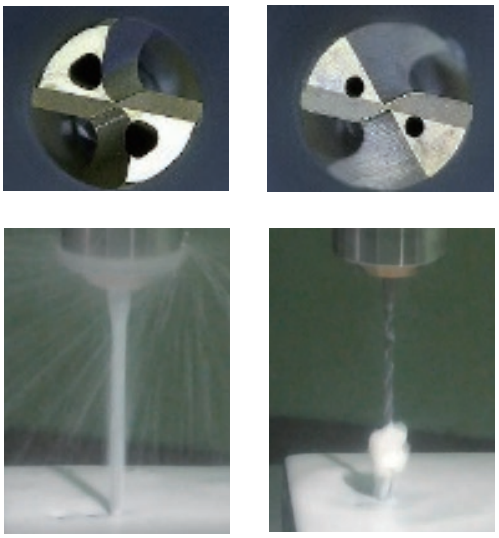


Unique Rigid Form

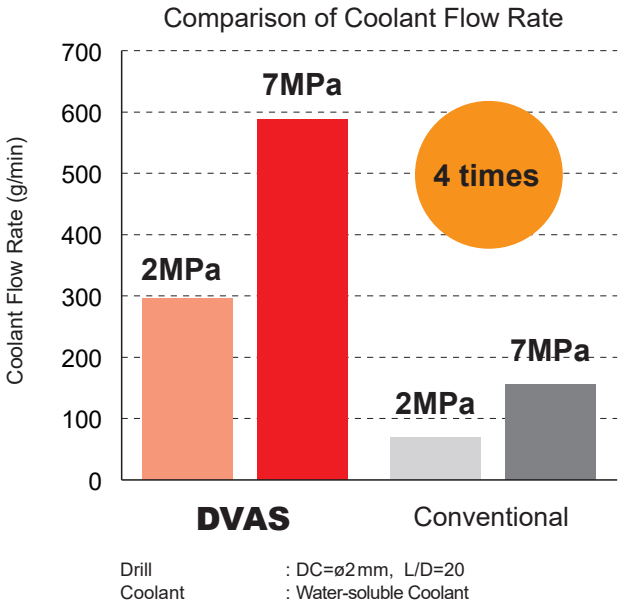
*By CG image

Mitsubishi Material's unique coolant holes with TRI-Cooling Technology.

TRI-Cooling is optimal for small-diameter drills and can achieve more than double the conventional coolant discharge volume. This can dramatically improve chip discharge and heat dissipation, contributing greatly to tool life stability.



DVAS Conventional

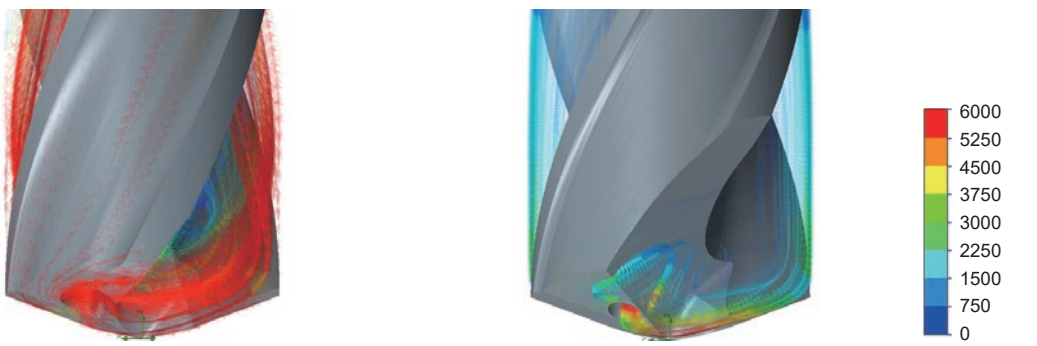


Drill : DC=ø2mm, L/D=20
Coolant : Water-soluble Coolant

Large coolant holes reduce tool damage due to the improved cooling effect thereby greatly increasing tool life.

Increased coolant flow provides effective cooling even in difficult applications or when using an oil based cutting fluid.

Coolant Flow Speed Simulation

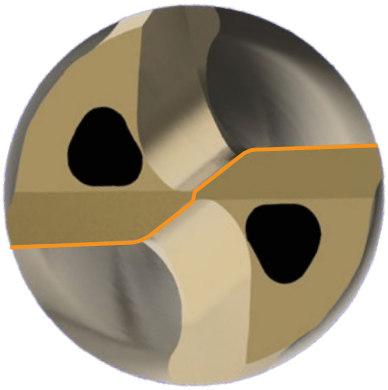


DVAS Conventional

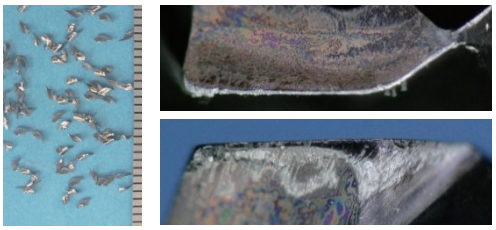
YouTube

Tough, sharp cutting edge design.

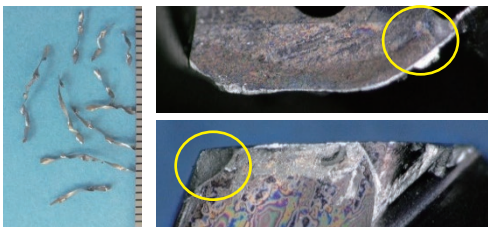
The straight cutting edge and thinned point are connected with a smoothly curved geometry that significantly improves fracture resistance. The geometry of the rake angles and lands also improves wear and chip disposal.



Large crater wear and fracture of the outer edge.



DVAS



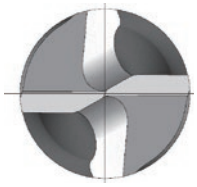
Conventional

<Cutting Conditions>
Workpiece Material : JIS SCM440
Tool : DC=ø2mm, L/D=20
Cutting Speed : vc= 50m/min
Feed per Rev. : fr= 0.06mm/rev.
Cutting Mode : Wet Cutting
Water-soluble Coolant, 2MPa

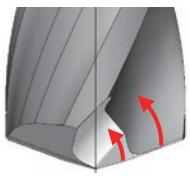
New XR point thinning, reduces cutting load and optimises chip flow.

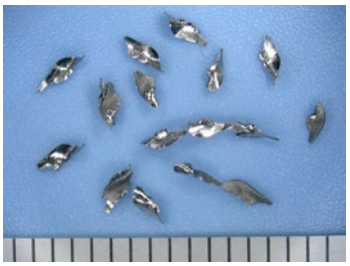
The new point thinning breaks chips into the optimum shape for streamlined flow and achieves a much lower cutting resistance.

DVAS

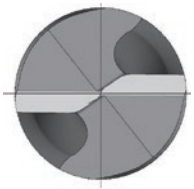


The R shaped space created by the point thinning forms compact chips that aids chip flow.

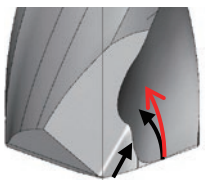


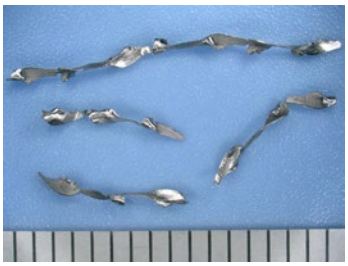


Conventional



Larger chips are created that means a lower rate of chip flow that can cause chip clogging.



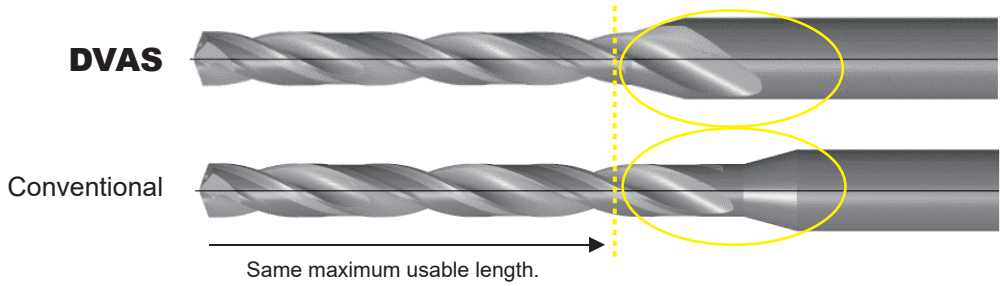


<Cutting Conditions>
Workpiece Material : JIS SCM440
Tool : DC=ø2mm, L/D=20
Cutting Speed : vc= 50m/min
Feed per Rev. : fr= 0.06mm/rev.
Cutting Mode : Wet Cutting
Water-soluble Coolant, 2MPa

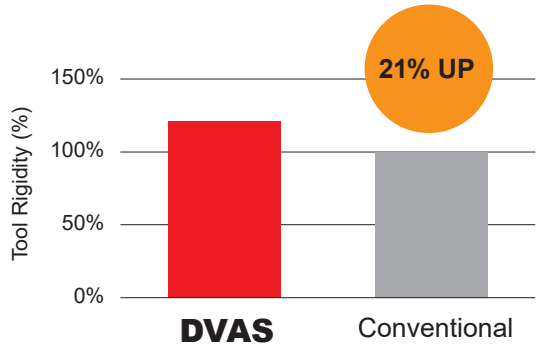
Unique flute form for greater rigidity.

Applies to L/D=2, 7, 12

The short drill is designed for high rigidity and good chip evacuation by minimizing the neck length. A chip discharge area is provided over the tapered section, increasing the tool rigidity by 20% more than the conventional model as well as improving the positional accuracy of the hole.

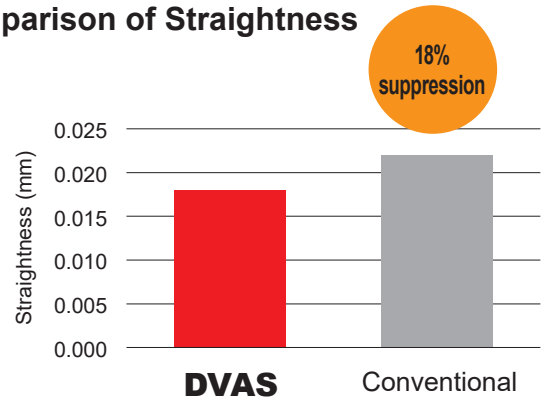


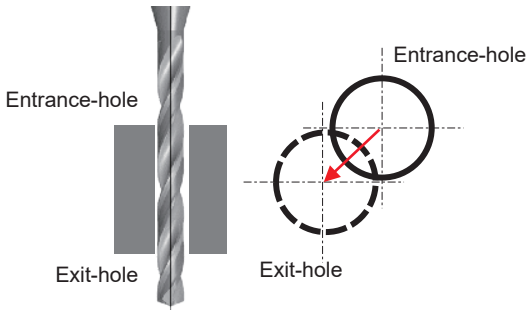
Comparison of Tool Rigidity



<Analysis Conditions>
Analysis Model : DC=ø2mm, L/D=7
Overall Length : OAL= 60mm
Constraints : Shank to tip range of 0-30 mm
Load : Distributed load of 140N in Z axis direction.

Comparison of Straightness

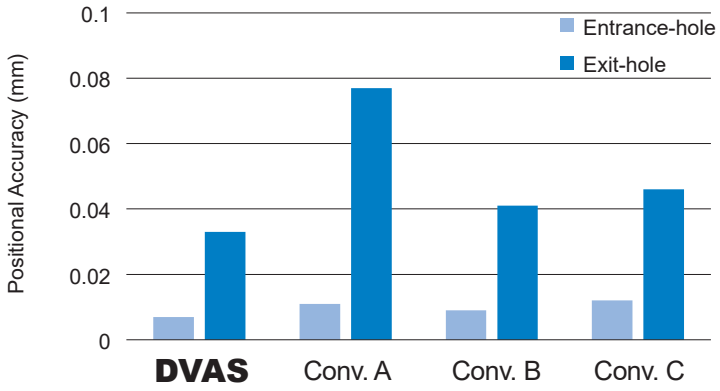


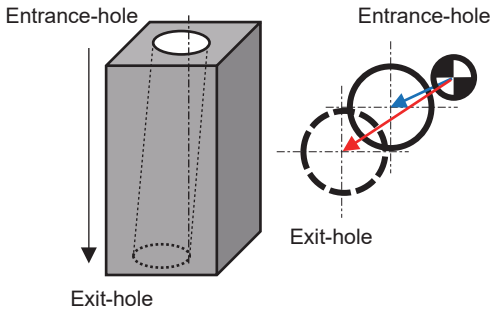


<Cutting Conditions>
Workpiece Material : JIS SCM440
Tool : DC=ø2mm, L/D=7
Cutting Speed : vc= 70m/min
Feed per Rev. : fr= 0.08mm/rev.
Hole Depth :10mm
Cutting Mode : Wet Cutting, Water-soluble Coolant, 5MPa Hydro Chuck
Number of Holes : 100 holes

Deep Hole Machining Example

For deep holes it is recommended to use a pilot drill to improve hole entry and reduce deviation at the exit point.



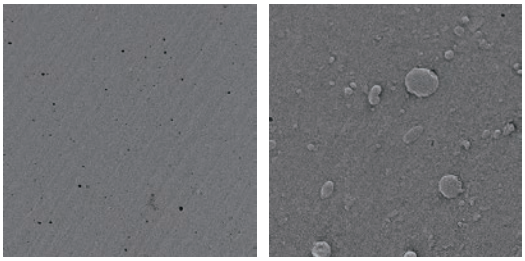


<Cutting Conditions>
Workpiece Material : JIS SCM440
Tool : Pilot Drill DC=ø2mm, L/D=2
Long Drill DC=ø2mm, L/D=20
Cutting Speed : vc= 70m/min
Feed per Rev. : fr= 0.07mm/rev.
Cutting Mode : Wet Cutting, Water-soluble Coolant, 2MPa
Number of Holes : 100 holes

New Coated Grade **DP1120**

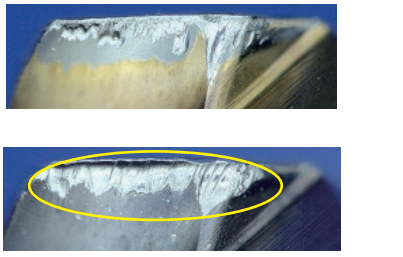
DP1120 has a special multi-layer PVD coating and a micro-grain, cemented carbide substrate. The outstanding surface smoothness prevents chip clogging that reduces breakage. Additionally the excellent crater wear resistance maintains cutting edge sharpness to enable long tool life.

Enlarged view of the flute surface.



DVAS Conventional

DVAS



Conventional Large crater wear

<Cutting Conditions>
Tool : DC=ø2mm, L/D=20
Cutting Speed : vc= 50m/min
Feed per Rev. : fr= 0.06mm/rev.
Cutting Mode : Wet Cutting,
Water-soluble Coolant, 2MPa
Number of Holes : 500 holes

DRILLS SELECTION CHART

Applications	Product Code	Size Range	Size	Item	Hole Depth (L/D)	Work Material P Steel	Work Material M Stainless Steel	Work Material K Cast Iron	Work Material N Non-ferrous Metal	Work Material S Heat Resistant Alloy	Shape
For Small Diameter	**DVAS…X02**	ϕ1.0 −ϕ2.9	0.1	20	2	◎	◎	○	○	◎	Pilot drill etc.
	DVAS…X07	ϕ1.0 −ϕ2.9	0.1	20	7	◎	◎	○	○	◎	
	DVAS…X12	ϕ1.0 −ϕ2.9	0.1	20	12	◎	◎	○	○	◎	
	DVAS…X20 Coming Soon	ϕ1.0 −ϕ2.9	0.1	20	20	◎	◎	○	○	◎	
	DVAS…X25 Coming Soon	ϕ1.0 −ϕ2.9	0.1	20	25	◎	◎	○	○	◎	
	DVAS…X30 Coming Soon	ϕ1.0 −ϕ2.9	0.1	20	30	◎	◎	○	○	◎	
	DVAS…X40 Coming Soon	ϕ1.0 −ϕ2.9	0.1	20	40	◎	◎	○	○	◎	
	DVAS…X50 Coming Soon	ϕ1.0 −ϕ2.5	0.5	4	50	◎	◎	○	○	◎	

IDENTIFICATION

DVA **S** **0100** **X50** **S040**

Applications	Coolant	Diameter	L/D	Type of Shank
DVA : General-purpose	**S** : Internal Coolant	0100 → ϕ1.0mm 0290 → ϕ2.9mm	**X50** : L/D=50 **X02** : L/D=2	**S040** : Shank Diameter 4mm

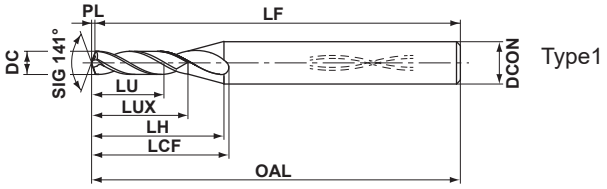
DVAS
TRISTAR Drills

Pilot Drills Mini Size

NEW

P M K N S H

Internal Coolant



Type1

DC<3
0.006 −0.004
DCON=4
0 −0.008

(mm)

DC	Hole Depth (L/D)	DP1120	Order Number	LU	LUX	LCF	LH	OAL	LF	PL	DCON	Type
1.0	2	●	**DVAS0100X02S040**	2.2	3.2	8.6	8.8	50.0	49.8	0.2	4	1
1.1	2	●	**DVAS0110X02S040**	2.4	3.5	9.0	8.9	50.0	49.8	0.2	4	1
1.2	2	●	**DVAS0120X02S040**	2.6	3.9	9.4	9.0	50.0	49.8	0.2	4	1
1.3	2	●	**DVAS0130X02S040**	2.8	4.2	9.9	9.2	50.0	49.8	0.2	4	1
1.4	2	●	**DVAS0140X02S040**	3.0	4.5	10.3	9.3	50.0	49.8	0.2	4	1
1.5	2	●	**DVAS0150X02S040**	3.3	4.8	10.7	9.4	50.0	49.7	0.3	4	1
1.6	2	●	**DVAS0160X02S040**	3.5	5.1	11.1	9.6	50.0	49.7	0.3	4	1
1.7	2	●	**DVAS0170X02S040**	3.7	5.5	11.6	9.7	50.0	49.7	0.3	4	1
1.8	2	●	**DVAS0180X02S040**	3.9	5.8	12.0	9.8	50.0	49.7	0.3	4	1
1.9	2	●	**DVAS0190X02S040**	4.1	6.1	12.4	10.0	50.0	49.7	0.3	4	1
2.0	2	●	**DVAS0200X02S040**	4.4	6.4	12.9	10.1	50.0	49.6	0.4	4	1
2.1	2	●	**DVAS0210X02S040**	4.6	6.7	13.3	10.2	50.0	49.6	0.4	4	1
2.2	2	●	**DVAS0220X02S040**	4.8	7.0	13.7	10.3	50.0	49.6	0.4	4	1
2.3	2	●	**DVAS0230X02S040**	5.0	7.4	14.1	10.5	55.0	54.6	0.4	4	1
2.4	2	●	**DVAS0240X02S040**	5.2	7.7	14.6	10.6	55.0	54.6	0.4	4	1
2.5	2	●	**DVAS0250X02S040**	5.5	8.0	15.0	10.7	55.0	54.6	0.4	4	1
2.6	2	●	**DVAS0260X02S040**	5.7	8.3	15.4	10.9	55.0	54.5	0.5	4	1
2.7	2	●	**DVAS0270X02S040**	5.9	8.6	15.8	11.0	55.0	54.5	0.5	4	1
2.8	2	●	**DVAS0280X02S040**	6.1	8.9	16.3	11.1	55.0	54.5	0.5	4	1
2.9	2	●	**DVAS0290X02S040**	6.3	9.3	16.7	11.3	55.0	54.5	0.5	4	1

DC = Cutting Diameter
LU = Usable Length
LUX = Max. Usable Length
LCF = Length Chip Flute
LH = Neck Length
OAL = Overall Length
LF = Functional Length
PL = Point Length
DCON = Connection Diameter

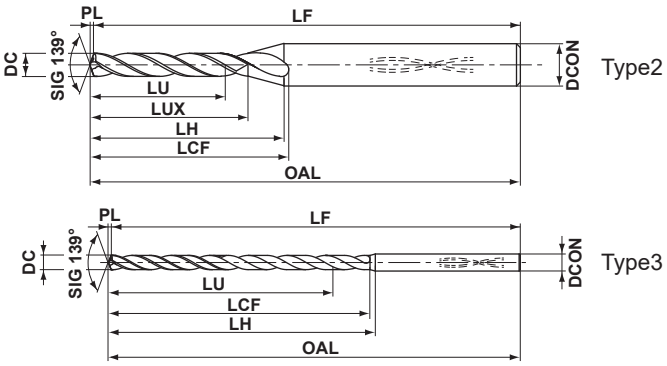
● : **Inventory maintained in Japan.**

DVAS Mini Size NEW

TRISTAR Drills

P M K N S H

Internal Coolant



DC<3 $^{0}_{-0.010}$

DCON=4 $^{0}_{-0.008}$

(mm)

DC	Hole Depth (L/D)	DP1120	Order Number	LU	LUX	LCF	LH	OAL	LF	PL	DCON	Type
1.0	7	●	DVAS0100X07S040	7.2	8.2	13.6	13.8	55.0	54.8	0.2	4	2
1.0	12	●	DVAS0100X12S040	12.2	13.2	18.6	18.8	58.0	57.8	0.2	4	2
1.0	20	●	DVAS0100X20S040	20.2	–	23.2	28.8	67.0	66.8	0.2	4	3
1.0	25	●	DVAS0100X25S040	25.2	–	28.2	33.8	73.0	72.8	0.2	4	3
1.0	30	●	DVAS0100X30S040	30.2	–	33.2	38.8	79.0	78.8	0.2	4	3
1.0	40	●	DVAS0100X40S040	40.2	–	43.2	48.8	90.0	89.8	0.2	4	3
1.0	50	●	DVAS0100X50S040	50.2	–	53.2	58.8	102.0	101.8	0.2	4	3
1.1	7	●	DVAS0110X07S040	7.9	9.1	14.5	14.4	55.0	54.8	0.2	4	2
1.1	12	●	DVAS0110X12S040	13.4	14.6	20.0	19.9	58.0	57.8	0.2	4	2
1.1	20	●	DVAS0110X20S040	22.2	–	25.5	30.9	67.0	66.8	0.2	4	3
1.1	25	●	DVAS0110X25S040	27.7	–	31.0	36.4	73.0	72.8	0.2	4	3
1.1	30	●	DVAS0110X30S040	33.2	–	36.5	41.9	79.0	78.8	0.2	4	3
1.1	40	●	DVAS0110X40S040	44.2	–	47.5	52.9	90.0	89.8	0.2	4	3
1.2	7	●	DVAS0120X07S040	8.6	9.9	15.4	15.0	55.0	54.8	0.2	4	2
1.2	12	●	DVAS0120X12S040	14.6	15.9	21.4	21.0	60.0	59.8	0.2	4	2
1.2	20	●	DVAS0120X20S040	24.2	–	27.8	33.0	71.0	70.8	0.2	4	3
1.2	25	●	DVAS0120X25S040	30.2	–	33.8	39.0	77.0	76.8	0.2	4	3
1.2	30	●	DVAS0120X30S040	36.2	–	39.8	45.0	84.0	83.8	0.2	4	3
1.2	40	●	DVAS0120X40S040	48.2	–	51.8	57.0	97.0	96.8	0.2	4	3
1.3	7	●	DVAS0130X07S040	9.3	10.7	16.4	15.7	55.0	54.8	0.2	4	2
1.3	12	●	DVAS0130X12S040	15.8	17.2	22.9	22.2	60.0	59.8	0.2	4	2
1.3	20	●	DVAS0130X20S040	26.2	–	30.1	35.2	71.0	70.8	0.2	4	3
1.3	25	●	DVAS0130X25S040	32.7	–	36.6	41.7	77.0	76.8	0.2	4	3
1.3	30	●	DVAS0130X30S040	39.2	–	43.1	48.2	84.0	83.8	0.2	4	3
1.3	40	●	DVAS0130X40S040	52.2	–	56.1	61.2	97.0	96.8	0.2	4	3
1.4	7	●	DVAS0140X07S040	10.1	11.5	17.3	16.3	55.0	54.7	0.3	4	2
1.4	12	●	DVAS0140X12S040	17.1	18.5	24.3	23.3	63.0	62.7	0.3	4	2
1.4	20	●	DVAS0140X20S040	28.3	–	32.5	37.3	75.0	74.7	0.3	4	3
1.4	25	●	DVAS0140X25S040	35.3	–	39.5	44.3	82.0	81.7	0.3	4	3
1.4	30	●	DVAS0140X30S040	42.3	–	46.5	51.3	90.0	89.7	0.3	4	3
1.4	40	●	DVAS0140X40S040	56.3	–	60.5	65.3	105.0	104.7	0.3	4	3
1.5	7	●	DVAS0150X07S040	10.8	12.3	18.2	16.9	55.0	54.7	0.3	4	2
1.5	12	●	DVAS0150X12S040	18.3	19.8	25.7	24.4	63.0	62.7	0.3	4	2
1.5	20	●	DVAS0150X20S040	30.3	–	34.8	39.4	75.0	74.7	0.3	4	3
1.5	25	●	DVAS0150X25S040	37.8	–	42.3	46.9	82.0	81.7	0.3	4	3
1.5	30	●	DVAS0150X30S040	45.3	–	49.8	54.4	90.0	89.7	0.3	4	3

● : Inventory maintained in Japan.

(mm)

DC	Hole Depth (L/D)	DP1120	Order Number	LU	LUX	LCF	LH	OAL	LF	PL	DCON	Type
1.5	40	●	**DVAS0150X40S040**	60.3	–	64.8	69.4	105.0	104.7	0.3	4	3
1.5	50	●	**DVAS0150X50S040**	75.3	–	79.8	84.4	120.0	119.7	0.3	4	3
1.6	7	●	**DVAS0160X07S040**	11.5	13.1	19.2	17.6	57.0	56.7	0.3	4	2
1.6	12	●	**DVAS0160X12S040**	19.5	21.1	27.2	25.6	66.0	65.7	0.3	4	2
1.6	20	●	**DVAS0160X20S040**	32.3	–	37.1	41.6	79.0	78.7	0.3	4	3
1.6	25	●	**DVAS0160X25S040**	40.3	–	45.1	49.6	88.0	87.7	0.3	4	3
1.6	30	●	**DVAS0160X30S040**	48.3	–	53.1	57.6	99.0	98.7	0.3	4	3
1.6	40	●	**DVAS0160X40S040**	64.3	–	69.1	73.6	113.0	112.7	0.3	4	3
1.7	7	●	**DVAS0170X07S040**	12.2	14.0	20.1	18.2	57.0	56.7	0.3	4	2
1.7	12	●	**DVAS0170X12S040**	20.7	22.5	28.6	26.7	66.0	65.7	0.3	4	2
1.7	20	●	**DVAS0170X20S040**	34.3	–	39.4	43.7	79.0	78.7	0.3	4	3
1.7	25	●	**DVAS0170X25S040**	42.8	–	47.9	52.2	88.0	87.7	0.3	4	3
1.7	30	●	**DVAS0170X30S040**	51.3	–	56.4	60.7	99.0	98.7	0.3	4	3
1.7	40	●	**DVAS0170X40S040**	68.3	–	73.4	77.7	113.0	112.7	0.3	4	3
1.8	7	●	**DVAS0180X07S040**	12.9	14.8	21.0	18.8	59.0	58.7	0.3	4	2
1.8	12	●	**DVAS0180X12S040**	21.9	23.8	30.0	27.8	69.0	68.7	0.3	4	2
1.8	20	●	**DVAS0180X20S040**	36.3	–	41.7	45.8	84.0	83.7	0.3	4	3
1.8	25	●	**DVAS0180X25S040**	45.3	–	50.7	54.8	94.0	93.7	0.3	4	3
1.8	30	●	**DVAS0180X30S040**	54.3	–	59.7	63.8	104.0	103.7	0.3	4	3
1.8	40	●	**DVAS0180X40S040**	72.3	–	77.7	81.8	123.0	122.7	0.3	4	3
1.9	7	●	**DVAS0190X07S040**	13.7	15.6	21.9	19.5	59.0	58.6	0.4	4	2
1.9	12	●	**DVAS0190X12S040**	23.2	25.1	31.4	29.0	69.0	68.6	0.4	4	2
1.9	20	●	**DVAS0190X20S040**	38.4	–	44.1	48.0	84.0	83.6	0.4	4	3
1.9	25	●	**DVAS0190X25S040**	47.9	–	53.6	57.5	94.0	93.6	0.4	4	3
1.9	30	●	**DVAS0190X30S040**	57.4	–	63.1	67.0	104.0	103.6	0.4	4	3
1.9	40	●	**DVAS0190X40S040**	76.4	–	82.1	86.0	123.0	122.6	0.4	4	3
2.0	7	●	**DVAS0200X07S040**	14.4	16.4	22.9	20.1	62.0	61.6	0.4	4	2
2.0	12	●	**DVAS0200X12S040**	24.4	26.4	32.9	30.1	73.0	72.6	0.4	4	2
2.0	20	●	**DVAS0200X20S040**	40.4	–	46.4	50.1	91.0	90.6	0.4	4	3
2.0	25	●	**DVAS0200X25S040**	50.4	–	56.4	60.1	102.0	101.6	0.4	4	3
2.0	30	●	**DVAS0200X30S040**	60.4	–	66.4	70.1	113.0	112.6	0.4	4	3
2.0	40	●	**DVAS0200X40S040**	80.4	–	86.4	90.1	136.0	135.6	0.4	4	3
2.0	50	●	**DVAS0200X50S040**	100.4	–	106.4	110.1	158.0	157.6	0.4	4	3
2.1	7	●	**DVAS0210X07S040**	15.1	17.2	23.8	20.7	62.0	61.6	0.4	4	2
2.1	12	●	**DVAS0210X12S040**	25.6	27.7	34.3	31.2	73.0	72.6	0.4	4	2
2.1	20	●	**DVAS0210X20S040**	42.4	–	48.7	52.2	91.0	90.6	0.4	4	3
2.1	25	●	**DVAS0210X25S040**	52.9	–	59.2	62.7	102.0	101.6	0.4	4	3
2.1	30	●	**DVAS0210X30S040**	63.4	–	69.7	73.2	113.0	112.6	0.4	4	3
2.1	40	●	**DVAS0210X40S040**	84.4	–	90.7	94.2	136.0	135.6	0.4	4	3
2.2	7	●	**DVAS0220X07S040**	15.8	18.1	24.7	21.4	62.0	61.6	0.4	4	2
2.2	12	●	**DVAS0220X12S040**	26.8	29.1	35.7	32.4	73.0	72.6	0.4	4	2
2.2	20	●	**DVAS0220X20S040**	44.4	–	51.0	54.4	91.0	90.6	0.4	4	3
2.2	25	●	**DVAS0220X25S040**	55.4	–	62.0	65.4	102.0	101.6	0.4	4	3
2.2	30	●	**DVAS0220X30S040**	66.4	–	73.0	76.4	113.0	112.6	0.4	4	3
2.2	40	●	**DVAS0220X40S040**	88.4	–	95.0	98.4	136.0	135.6	0.4	4	3
2.3	7	●	**DVAS0230X07S040**	16.5	18.9	25.7	22.0	65.0	64.6	0.4	4	2
2.3	12	●	**DVAS0230X12S040**	28.0	30.4	37.2	33.5	78.0	77.6	0.4	4	2
2.3	20	●	**DVAS0230X20S040**	46.4	–	53.3	56.5	98.0	97.6	0.4	4	3

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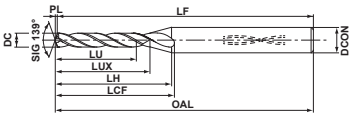
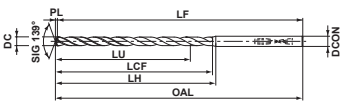
Solid Carbide TRISTAR Drill Series



Type2



Type3

(mm)

DC	Hole Depth (L/D)	DP1120	Order Number	LU	LUX	LCF	LH	OAL	LF	PL	DCON	Type
2.3	25	●	**DVAS0230X25S040**	57.9	–	64.8	68.0	111.0	110.6	0.4	4	3
2.3	30	●	**DVAS0230X30S040**	69.4	–	76.3	79.5	124.0	123.6	0.4	4	3
2.3	40	●	**DVAS0230X40S040**	92.4	–	99.3	102.5	150.0	149.6	0.4	4	3
2.4	7	●	**DVAS0240X07S040**	17.2	19.7	26.6	22.6	65.0	64.6	0.4	4	2
2.4	12	●	**DVAS0240X12S040**	29.2	31.7	38.6	34.6	78.0	77.6	0.4	4	2
2.4	20	●	**DVAS0240X20S040**	48.4	–	55.6	58.6	98.0	97.6	0.4	4	3
2.4	25	●	**DVAS0240X25S040**	60.4	–	67.6	70.6	111.0	110.6	0.4	4	3
2.4	30	●	**DVAS0240X30S040**	72.4	–	79.6	82.6	124.0	123.6	0.4	4	3
2.4	40	●	**DVAS0240X40S040**	96.4	–	103.6	106.6	150.0	149.6	0.4	4	3
2.5	7	●	**DVAS0250X07S040**	18.0	20.5	27.5	23.3	65.0	64.5	0.5	4	2
2.5	12	●	**DVAS0250X12S040**	30.5	33.0	40.0	35.8	78.0	77.5	0.5	4	2
2.5	20	●	**DVAS0250X20S040**	50.5	–	58.0	60.8	98.0	97.5	0.5	4	3
2.5	25	●	**DVAS0250X25S040**	63.0	–	70.5	73.3	111.0	110.5	0.5	4	3
2.5	30	●	**DVAS0250X30S040**	75.5	–	83.0	85.8	124.0	123.5	0.5	4	3
2.5	40	●	**DVAS0250X40S040**	100.5	–	108.0	110.8	150.0	149.5	0.5	4	3
2.5	50	●	**DVAS0250X50S040**	125.5	–	133.0	135.8	176.0	175.5	0.5	4	3
2.6	7	●	**DVAS0260X07S040**	18.7	21.3	28.4	23.9	65.0	64.5	0.5	4	2
2.6	12	●	**DVAS0260X12S040**	31.7	34.3	41.4	36.9	78.0	77.5	0.5	4	2
2.6	20	●	**DVAS0260X20S040**	52.5	–	60.3	62.9	98.0	97.5	0.5	4	3
2.6	25	●	**DVAS0260X25S040**	65.5	–	73.3	75.9	111.0	110.5	0.5	4	3
2.6	30	●	**DVAS0260X30S040**	78.5	–	86.3	88.9	124.0	123.5	0.5	4	3
2.6	40	●	**DVAS0260X40S040**	104.5	–	112.3	114.9	150.0	149.5	0.5	4	3
2.7	7	●	**DVAS0270X07S040**	19.4	22.2	29.4	24.5	68.0	67.5	0.5	4	2
2.7	12	●	**DVAS0270X12S040**	32.9	35.7	42.9	38.0	83.0	82.5	0.5	4	2
2.7	20	●	**DVAS0270X20S040**	54.5	–	62.6	65.0	107.0	106.5	0.5	4	3
2.7	25	●	**DVAS0270X25S040**	68.0	–	76.1	78.5	122.0	121.5	0.5	4	3
2.7	30	●	**DVAS0270X30S040**	81.5	–	89.6	92.0	137.0	136.5	0.5	4	3
2.7	40	●	**DVAS0270X40S040**	108.5	–	116.6	119.0	167.0	166.5	0.5	4	3
2.8	7	●	**DVAS0280X07S040**	20.1	23.0	30.3	25.2	68.0	67.5	0.5	4	2
2.8	12	●	**DVAS0280X12S040**	34.1	37.0	44.3	39.2	83.0	82.5	0.5	4	2
2.8	20	●	**DVAS0280X20S040**	56.5	–	64.9	67.2	107.0	106.5	0.5	4	3
2.8	25	●	**DVAS0280X25S040**	70.5	–	78.9	81.2	122.0	121.5	0.5	4	3
2.8	30	●	**DVAS0280X30S040**	84.5	–	92.9	95.2	137.0	136.5	0.5	4	3
2.8	40	●	**DVAS0280X40S040**	112.5	–	120.9	123.2	167.0	166.5	0.5	4	3
2.9	7	●	**DVAS0290X07S040**	20.8	23.8	31.2	25.8	68.0	67.5	0.5	4	2
2.9	12	●	**DVAS0290X12S040**	35.3	38.3	45.7	40.3	83.0	82.5	0.5	4	2
2.9	20	●	**DVAS0290X20S040**	58.5	–	67.2	69.3	107.0	106.5	0.5	4	3
2.9	25	●	**DVAS0290X25S040**	73.0	–	81.7	83.8	122.0	121.5	0.5	4	3
2.9	30	●	**DVAS0290X30S040**	87.5	–	96.2	98.3	137.0	136.5	0.5	4	3
2.9	40	●	**DVAS0290X40S040**	116.5	–	125.2	127.3	167.0	166.5	0.5	4	3

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Recommended Cutting Conditions

(mm)

Workpiece Material		Mild Steel Carbon Steel, Alloy Steel JIS SS400, S10C, S45C, SCM440 etc			Austenitic Stainless Steel, Ferritic Stainless Steel Ferritic and Martensitic Stainless Steel Precipitation Hardening Stainless Steel JIS SUS410, SUS420J2, SUS304, SUS316, SUS630 etc		
DC	Hole Depth **L/D**	Cutting Speed **vc** (Min.—Max.) (m/min)	Revolution **n** (min^{-1})	Feed **fr** (Min.—Max.) (mm/rev.)	Cutting Speed **vc** (Min.—Max.) (m/min)	Revolution **n** (min^{-1})	Feed **fr** (Min.—Max.) (mm/rev.)
1.0	**2–30**	65(30—100)	20700	0.035(0.020—0.050)	60(20—100)	19100	0.025(0.010—0.040)
1.0	**40, 50**	65(30—100)	20700	0.030(0.020—0.040)	60(20—100)	19100	0.020(0.010—0.030)
1.5	**2–30**	65(30—100)	13800	0.053(0.030—0.075)	60(20—100)	12700	0.038(0.015—0.060)
1.5	**40, 50**	65(30—100)	13800	0.045(0.030—0.060)	60(20—100)	12700	0.030(0.015—0.045)
2.0	**2–30**	70(40—100)	11100	0.070(0.040—0.100)	60(20—100)	9500	0.050(0.020—0.080)
2.0	**40, 50**	70(40—100)	11100	0.060(0.040—0.080)	60(20—100)	9500	0.040(0.020—0.060)
2.5	**2–30**	70(40—100)	8900	0.088(0.050—0.125)	60(20—100)	7600	0.063(0.025—0.100)
2.5	**40, 50**	70(40—100)	8900	0.075(0.050—0.100)	60(20—100)	7600	0.050(0.025—0.075)
2.9	**2–30**	70(40—100)	7700	0.102(0.058—0.145)	60(20—100)	6600	0.073(0.029—0.116)
2.9	**40, 50**	70(40—100)	7700	0.087(0.058—0.116)	60(20—100)	6600	0.058(0.029—0.087)

Workpiece Material		Cast Iron Ductile Cast Iron JIS FC300, FCD450 etc			Aluminium Alloys JIS A5052, A6061, A7075		
DC	Hole Depth **L/D**	Cutting Speed **vc** (Min.—Max.) (m/min)	Revolution **n** (min^{-1})	Feed **fr** (Min.—Max.) (mm/rev.)	Cutting Speed **vc** (Min.—Max.) (m/min)	Revolution **n** (min^{-1})	Feed **fr** (Min.—Max.) (mm/rev.)
1.0	**2–30**	70(40—100)	22300	0.035(0.020—0.050)	140(100—180)	31800	0.040(0.020—0.060)
1.0	**40, 50**	70(40—100)	22300	0.030(0.020—0.040)	140(100—180)	31800	0.035(0.020—0.050)
1.5	**2–30**	70(40—100)	14900	0.053(0.030—0.075)	140(100—180)	21200	0.060(0.030—0.090)
1.5	**40, 50**	70(40—100)	14900	0.045(0.030—0.060)	140(100—180)	21200	0.053(0.030—0.075)
2.0	**2–30**	70(40—100)	11100	0.070(0.040—0.100)	140(100—180)	15900	0.080(0.040—0.120)
2.0	**40, 50**	70(40—100)	11100	0.060(0.040—0.080)	140(100—180)	15900	0.070(0.040—0.100)
2.5	**2–30**	70(40—100)	8900	0.088(0.050—0.125)	140(100—180)	12700	0.100(0.050—0.150)
2.5	**40, 50**	70(40—100)	8900	0.075(0.050—0.100)	140(100—180)	12700	0.088(0.050—0.125)
2.9	**2–30**	70(40—100)	7700	0.102(0.058—0.145)	140(100—180)	11000	0.116(0.058—0.174)
2.9	**40, 50**	70(40—100)	7700	0.087(0.058—0.116)	140(100—180)	11000	0.102(0.058—0.145)

Workpiece Material		Heat Resistant Alloys Inconel718 etc			Titanium Alloys Ti-6Al-4V etc		
DC	Hole Depth **L/D**	Cutting Speed **vc** (Min.—Max.) (m/min)	Revolution **n** (min^{-1})	Feed **fr** (Min.—Max.) (mm/rev.)	Cutting Speed **vc** (Min.—Max.) (m/min)	Revolution **n** (min^{-1})	Feed **fr** (Min.—Max.) (mm/rev.)
1.0	**2–30**	30(10—50)	9500	0.015(0.010—0.020)	30(20—40)	9500	0.020(0.010—0.030)
1.0	**40, 50**	30(10—50)	9500	0.015(0.010—0.020)	30(20—40)	9500	0.020(0.010—0.030)
1.5	**2–30**	30(10—50)	6400	0.023(0.015—0.030)	30(20—40)	6400	0.030(0.015—0.045)
1.5	**40, 50**	30(10—50)	6400	0.023(0.015—0.030)	30(20—40)	6400	0.030(0.015—0.045)
2.0	**2–30**	30(10—50)	4800	0.030(0.020—0.040)	30(20—40)	4800	0.040(0.020—0.060)
2.0	**40, 50**	30(10—50)	4800	0.030(0.020—0.040)	30(20—40)	4800	0.040(0.020—0.060)
2.5	**2–30**	30(10—50)	3800	0.038(0.025—0.050)	30(20—40)	3800	0.050(0.025—0.075)
2.5	**40, 50**	30(10—50)	3800	0.038(0.025—0.050)	30(20—40)	3800	0.050(0.025—0.075)
2.9	**2–30**	30(10—50)	3300	0.044(0.029—0.058)	30(20—40)	3300	0.058(0.029—0.087)
2.9	**40, 50**	30(10—50)	3300	0.044(0.029—0.058)	30(20—40)	3300	0.058(0.029—0.087)

Workpiece Material		Cobalt Chrome Alloys T7402-2, ASTM F1537, F799 etc		
DC	Hole Depth **L/D**	Cutting Speed **vc** (Min.—Max.) (m/min)	Revolution **n** (min^{-1})	Feed **fr** (Min.—Max.) (mm/rev.)
1.0	**2–30**	60(30—90)	19100	0.020(0.010—0.030)
1.0	**40, 50**	60(30—90)	19100	0.020(0.010—0.030)
1.5	**2–30**	60(30—90)	12700	0.030(0.015—0.045)
1.5	**40, 50**	60(30—90)	12700	0.030(0.015—0.045)
2.0	**2–30**	60(30—90)	9500	0.040(0.020—0.060)
2.0	**40, 50**	60(30—90)	9500	0.040(0.020—0.060)
2.5	**2–30**	60(30—90)	7600	0.050(0.025—0.075)
2.5	**40, 50**	60(30—90)	7600	0.050(0.025—0.075)
2.9	**2–30**	60(30—90)	6600	0.058(0.029—0.087)
2.9	**40, 50**	60(30—90)	6600	0.058(0.029—0.087)

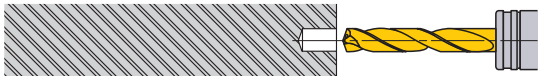
Note 1) This recommended condition is only when using internal coolant.
Note 2) Check the condition of chips and perform step machining if necessary. * Reference step length: 0.2 to 1.0 DC
Note 3) Adjust the cutting conditions according to machine tool and workpiece clamp rigidity and machining geometry, etc.
Note 4) Machining depths exceeding flute length (LU) are not recommended.
Note 5) Ensure the drill runout is within 0.03mm.
Note 6) Do not clamp the flute part of the drill.

Operational Guidance

■ Operational Guidance for the DVAS L/D=2–40

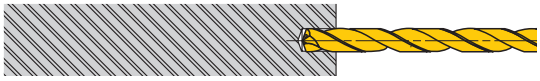
Flat Face Drilling ●Drilling a Blind Hole

1. Drilling a Pilot Hole



①Use a drill with a larger (flatter) point angle than the super long type. Use the shortest flute possible.
A DVAS drill with L/D = 2 can be machined up to L/D = 3 when drilling pilot holes.
②Ensure a high precision hole is drilled for the guide.
③Drill depth : Approx DC×3.
(Adjust the pilot hole depth according to the length of the long type drill.)

2. Initial Cutting with the Long Type Drill



①Insert drill into pilot hole using a low revolution speed.
(spindle speed 500—1000 min^{-1}, feed rate 1000—2000 mm/min)
②Stop the drill in the pilot hole 0.5—1 mm away from the bottom of the hole.

3. Drill the Deep Hole

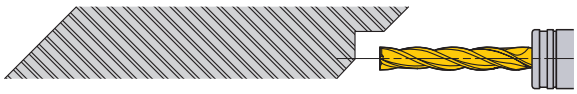
①Start cutting at the recommended speed and feed with a non-peck (continuous feed) cycle.

4. Drill Retraction

①After drilling, lower the cutting revolution about 0.5—1 mm away from the bottom of the hole. (revolutions around 500—1000 min^{-1})
②Next, pull out the drill at a feed rate of 1000 to 2000 mm/min.

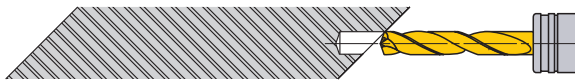
Interruped Drilling ●Drilling and Breaking Through on Irregular Faces or Angles

1. Spot Facing



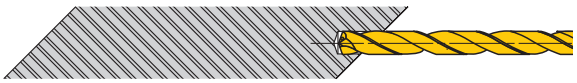
①Machine a flat or the irregular face by using an end mill or slot drill capable of spot facing. Make the spot face diameter the same size as the required deep hole diameter.

2. Drilling a Pilot Hole



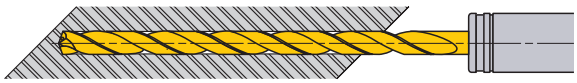
①Use a drill with a larger (flatter) point angle than the super long type. Use the shortest flute possible.
②Ensure a high precision hole is drilled for the guide.
③Drill depth : Approx DC×2.
(Adjust the pilot hole depth according to the length of the long type drill.)

3. Initial Cutting with the Long Type Drill



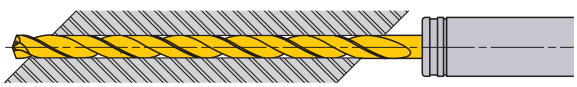
①Insert drill into pilot hole using a low revolution speed.
(spindle speed 500—1000 min^{-1}, feed rate 1000—2000 mm/min)
②Stop the drill in the pilot hole 0.5-1 mm away from the bottom of the hole.

4. Drill the Deep Hole



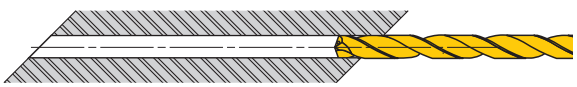
①Start cutting at the recommended speed and feed with a non-peck (continuous feed) cycle.

5. Breaking Through



①When breaking through, the cutting edge can be damaged.
②Lower the feed rate when penetrating.

6. Drill Retraction

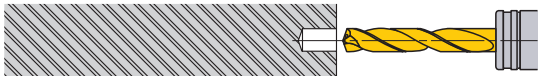


①After penetrating, change the spindle speed to 500—1000 min^{-1}.
②Next, pull out the drill at a feed rate of 1000—2000 mm/min.

■ Operational Guidance for the DVAS L/D=50

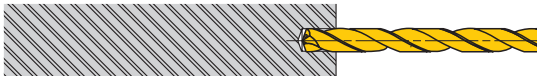
Flat Face Drilling ●Drilling a Blind Hole

1. Drilling a Pilot Hole



①Use a drill with a larger (flatter) point angle than the super long type.
Use a DVAS drill with L/D = 7.
②Ensure a high precision hole is drilled for the guide.
③Drill depth : Approx DC×7.
(Adjust the pilot hole depth according to the length of the long type drill.)

2. Initial Cutting with the Long Type Drill



①Insert drill into pilot hole using a low revolution speed.
(spindle speed 500—1000 min^{-1}, feed rate 1000—2000 mm/min)
②Stop the drill in the pilot hole 0.5—1 mm away from the bottom of the hole.

3. Drill the Deep Hole

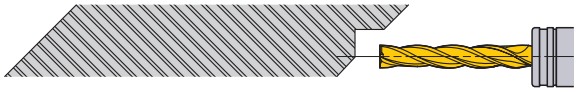
①Start cutting at the recommended speed and feed with a non-peck (continuous feed) cycle.

4. Drill Retraction

①After drilling, lower the cutting revolution about 0.5—1 mm away from the bottom of the hole. (revolutions around 500—1000 min^{-1})
②Next, pull out the drill at a feed rate of 1000 to 2000 mm/min.

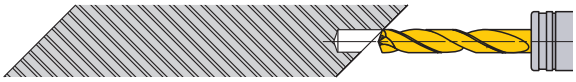
Interruped Drilling ●Drilling and Breaking Through on Irregular Faces or Angles

1. Spot Facing



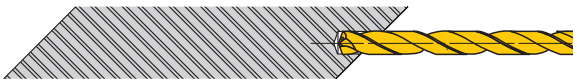
①Machine a flat or the irregular face by using an end mill or slot drill capable of spot facing. Make the spot face diameter the same size as the required deep hole diameter.

2. Drilling a Pilot Hole



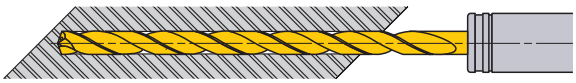
①Use a drill with a larger (flatter) point angle than the super long type.
Use a DVAS drill with L/D = 7.
②Ensure a high precision hole is drilled for the guide.
③Drill depth : Approx DC×7.
(Adjust the pilot hole depth according to the length of the long type drill.)

3. Initial Cutting with the Long Type Drill



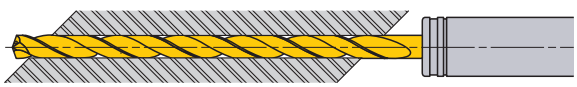
①Insert drill into pilot hole using a low revolution speed.
(spindle speed 500—1000 min^{-1}, feed rate 1000—2000 mm/min)
②Stop the drill in the pilot hole 0.5-1 mm away from the bottom of the hole.

4. Drill the Deep Hole



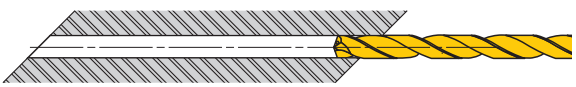
①Start cutting at the recommended speed and feed with a non-peck (continuous feed) cycle.

5. Breaking Through



①When breaking through, the cutting edge can be damaged.
②Lower the feed rate when penetrating.

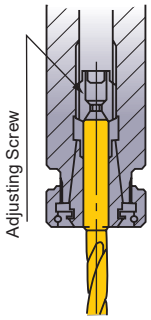
6. Drill Retraction



①After penetrating, change the spindle speed to 500—1000 min^{-1}.
②Next, pull out the drill at a feed rate of 1000—2000 mm/min.

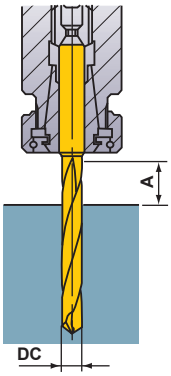
Operational Guidance

Drill Holding



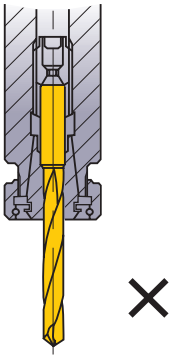
Thrust bearing type collet chuck holds the drill securely.

Drill Length



A ≥ DC x 2

Drill Installation



Do not clamp on the flutes.

Coolant Pressure

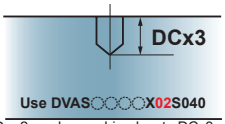
Adjust the coolant pressure according to the type and concentration of coolant.

Drii Dia. **DC**	Water-soluble	Water-insoluble
DC<2mm	≥ 3MPa	≥ 7MPa
DC<3mm	≥ 2MPa	≥ 5MPa

Pilot Drill

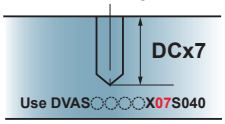
For deep hole drilling, refer to the figure below.

L/D≤40



*L/D = 2 can be machined up to DCx3 when drilling pilot holes.

L/D>40

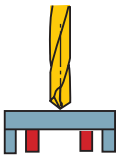


Coolant Handling

Small particles of swarf will jam in the oil hole of small diameter drills.
Always use a fine mesh filter as a preventive measure.

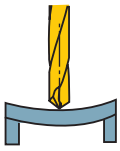
Drill Dia. **DC**	Fine Mesh Filter
DC<2mm	≤ 10μm
DC<3mm	≤ 20μm

Thin Workpiece



Support the Workpiece

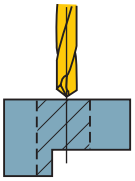
OK



If Bending Occurs

×

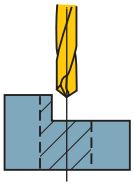
Interrupted Cutting



One Process

OK

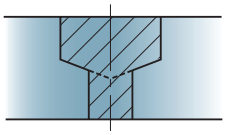
①Lower the feed when drilling the interrupted part.



Requires Prior Machining

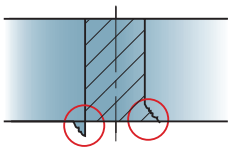
①Spot face with an end mill prior to drilling.

Stepped Holes



①Divide the two processes.
②Drill the larger hole first.
*A tool for machining both chamfer and spot face can be produced to order.

Burring and Workpiece Chipping



①Lower the feed rate by 50% at the end of through cutting.
②Change the point angle.

Tips for drilling a deep hole exceeding L/D = 40

Workpiece rotation method: small lathes, automatic lathes, etc.

(1) Face countersink (DLE drill is recommended)

(2) Drill the pilot hole to a depth of approx. 3D (DVAS drill is recommended)

(3) Drill the deep hole using DVAS○○○○X50S040.

Tool rotation method: Machining centres, composite machines, etc.

(1) Drill the pilot hole to a depth of approx. 3D (DVAS drill is recommended)

(2) Drill the pilot hole deeper to a approx. 7D
If extra stability is required, drill a pilot hole deeper than 7D.

(3) Drill the deep hole using DVAS○○○○X50S040.

Cutting Example

Comparison of Drilling Efficiency on Automatic Lathe

Drilling efficiency is 10 times higher compared to gun drills.
It provides high efficiency and stability even when machining stainless and alloy steels.

Drilling for SCM435

General Cutting Conditions for Gun Drills

<Cutting Conditions>
Tool : DC=ø2mm, L/D=50
Cutting Speed : vc= 50m/min
Feed per Rev. : fr= 0.007mm/rev.
Hole Depth : 100mm
Cutting Mode : Wet Cutting, Oil, 15MPa

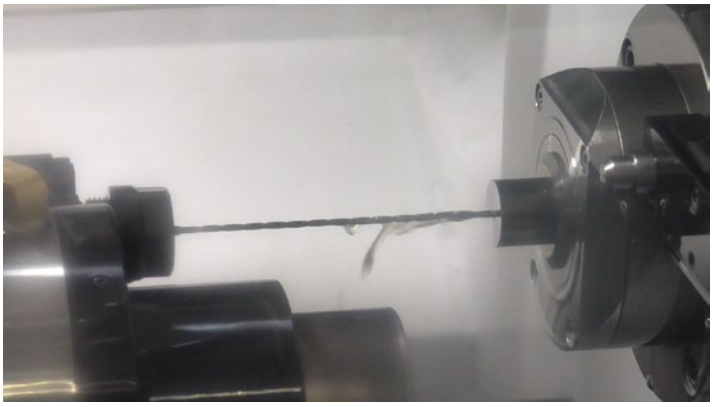
Cutting Time 107.8 sec./hole

DVAS Cutting Conditions

<Cutting Conditions>
Tool : DC=ø2mm, L/D=50
Cutting Speed : vc= 50m/min
Feed per Rev. : fr= 0.07mm/rev.
Hole Depth : 100mm
Cutting Mode : Wet Cutting, Oil, 15MPa

Cutting Time 10.8 sec./hole

DVAS Drill



YouTube

Drilling for SUS304

General Cutting Conditions for Gun Drills

<Cutting Conditions>
Tool : DC=ø2mm, L/D=50
Cutting Speed : vc= 40m/min
Feed per Rev. : fr= 0.005mm/rev.
Hole Depth : 100mm
Cutting Mode : Wet Cutting, Oil, 15MPa

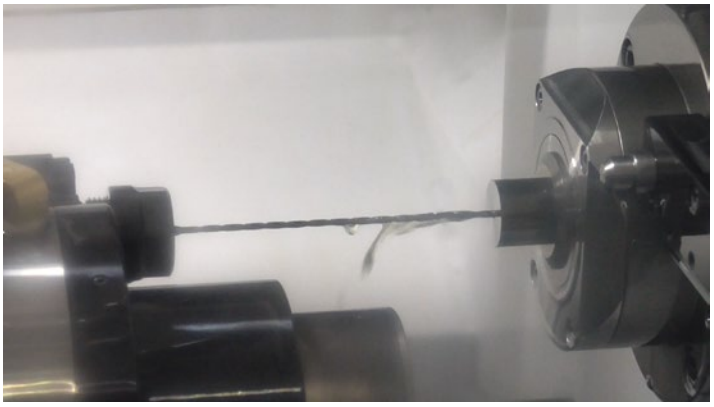
Cutting Time 188.4 sec./hole

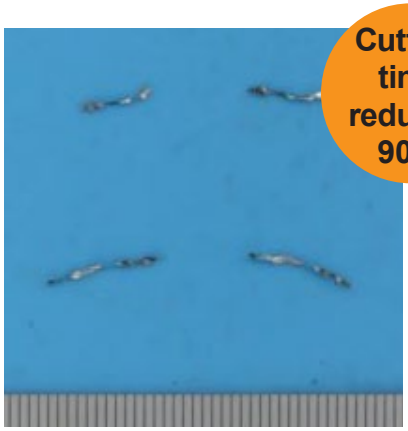
DVAS Cutting Conditions

<Cutting Conditions>
Tool : DC=ø2mm, L/D=50
Cutting Speed : vc= 40m/min
Feed per Rev. : fr= 0.05mm/rev.
Hole Depth : 100mm
Cutting Mode : Wet Cutting, Oil, 15MPa

Cutting Time 18.8 sec./hole

DVAS Drill





YouTube

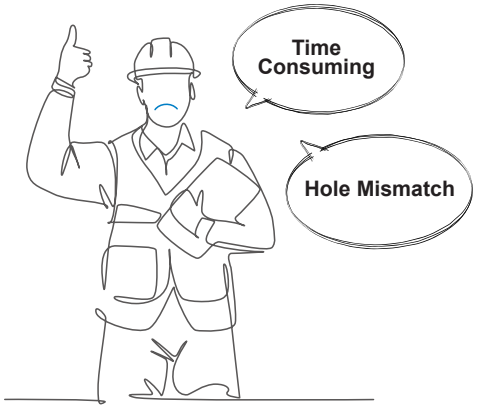
Example of Improved Drilling Efficiency on Automatic Lathes

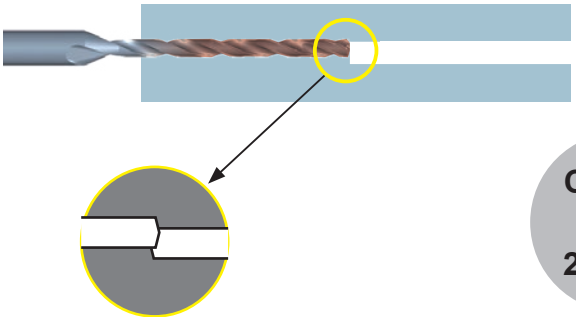
DVAS significantly reduces cycle times and ensures consistent drilling.

Drilling from both ends method

First step: One side drilled with a blind hole.

Second step: Workpiece is inverted to produce a through hole.





Hole mismatch is likely to occur.

Cutting Time 20 min.

Drilling Process with a **DVAS** drill

First step: Drilling a through hole from one side only.

Cutting Time is Approx 1 Minute

DVAS

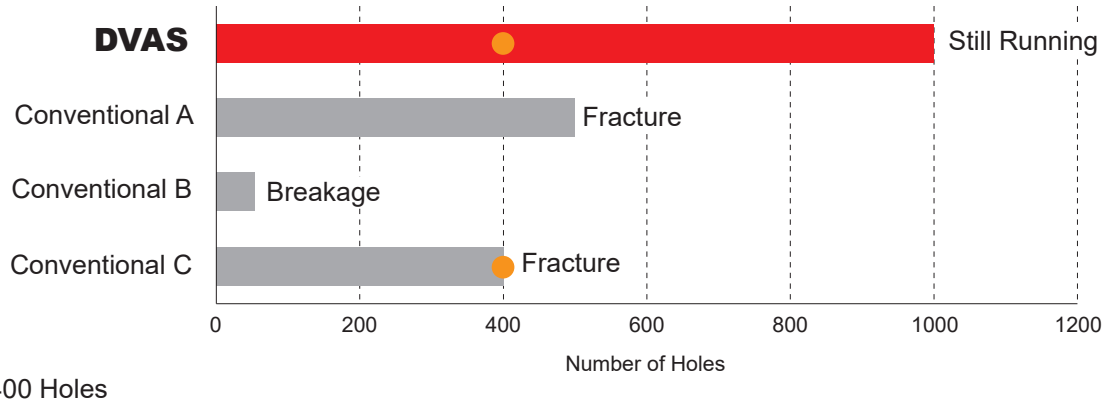
<Cutting Conditions>

Workpiece Material	: JIS S45C
Tool	: DC=ø2.5mm, L/D=50
Cutting Speed	: vc= 70m/min
Feed per Rev.	: fr= 0.09-0.12mm/rev.
Hole Depth	: 117mm
Cutting Mode	: Wet Cutting, Oil, 7MPa

Cutting Performance

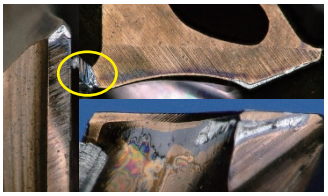
SCM440 Comparison of Fracture Resistance

DVAS has excellent fracture resistance and double tool life compared to conventional products.



After 400 Holes

DVAS

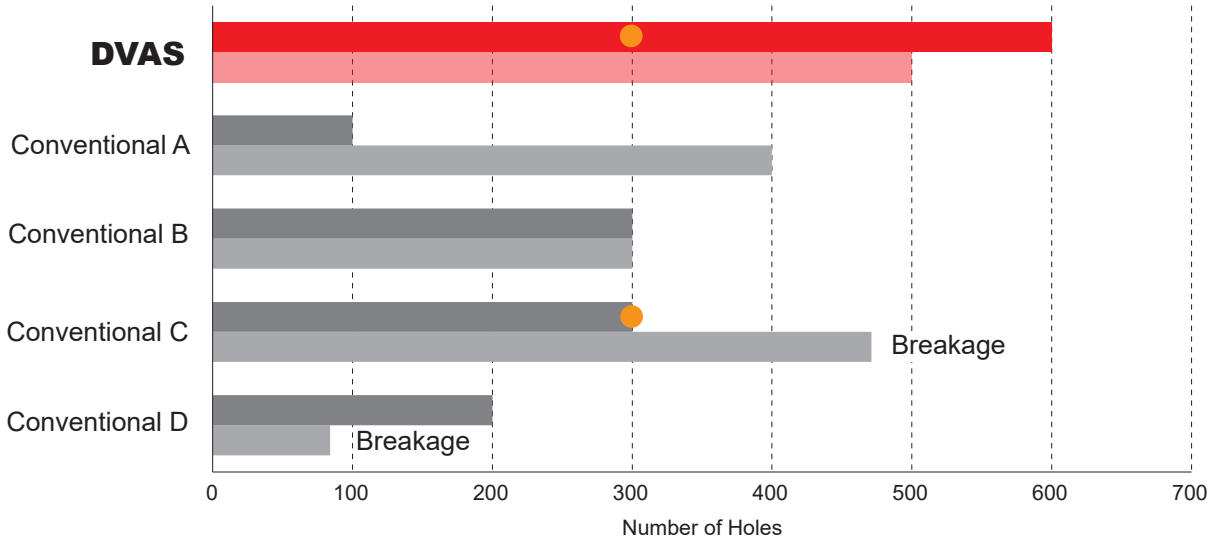


Conventional C

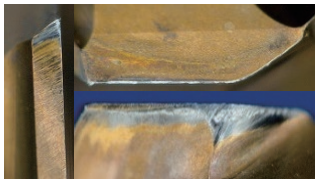
<Cutting Conditions>
Workpiece Material : JIS SCM440
Tool : DC=ø2mm, L/D=20
Cutting Speed : vc= 50m/min
Feed per Rev. : fr= 0.06mm/rev.
Hole Depth : 40mm
Cutting Mode : Wet Cutting
Water-soluble Coolant, 2MPa
Pilot Drills : DC=ø2mm L/D=2
Hole Depth 4mm/holes

SCM440 Comparison of Fracture Resistance in High-efficiency Cutting

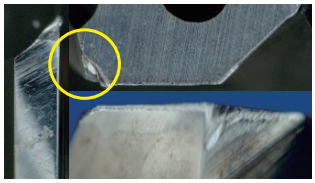
DVAS drill is highly stable even under high-efficiency cutting conditions.



After 300 Holes



DVAS



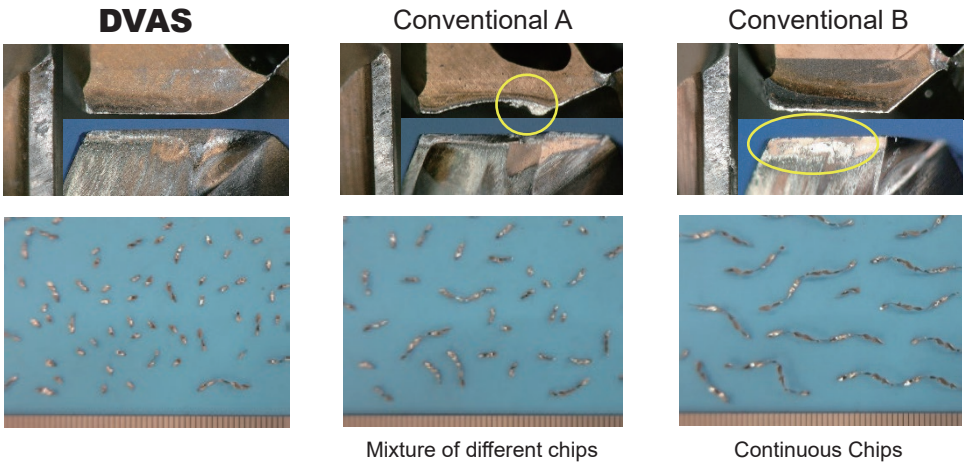
Conventional C

<Cutting Conditions>
Workpiece Material : JIS SCM440
Tool : DC=ø2mm, L/D=20
Cutting Speed : vc= 70m/min
Feed per Rev. : fr= 0.07mm/rev.
Hole Depth : 40mm
Cutting Mode : Wet Cutting
Water-soluble Coolant, 2MPa
Pilot Drills : DC=ø2mm, L/D=2
Hole Depth 4mm/holes

SUS304 Comparison of Welding Resistance and Chip Disposal under High-efficiency Cutting

Displays excellent welding resistance and chip control when drilling stainless steels.

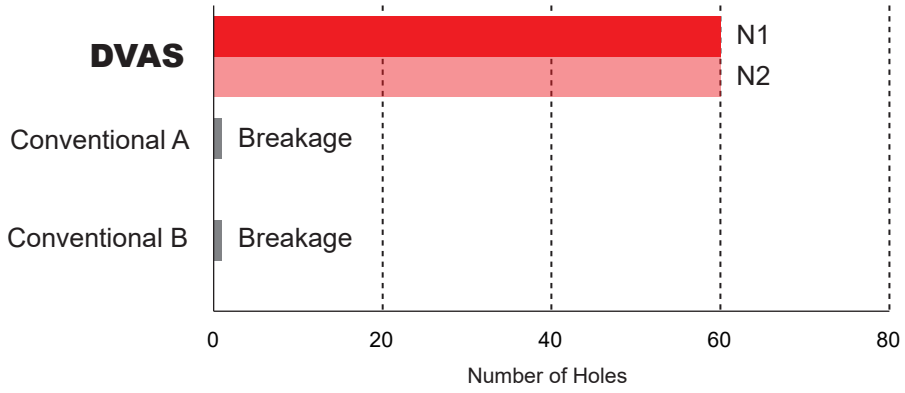
After 1200 Holes



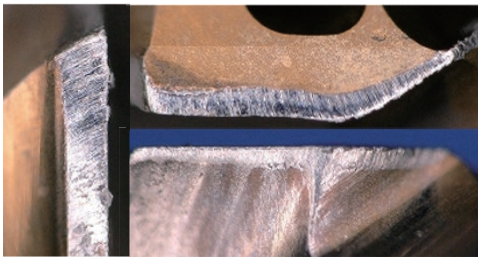
<Cutting Conditions>
Workpiece Material : JIS SUS304
Tool : Pilot Drill
DC=ø2mm, L/D=2
Hole Depth 4mm
Long Drill
DC=ø2mm, L/D=20
Hole Depth 40mm
Cutting Speed : vc= 50m/min
Feed per Rev. : fr= 0.06mm/rev.
Cutting Mode : Wet Cutting
Water-soluble Coolant
2MPa

Inconel718 Comparison of Breakage Resistance

Increased coolant discharge rate achieves stable machining of heat-resistant alloys when compared to conventional products.



After 60 Holes



DVAS

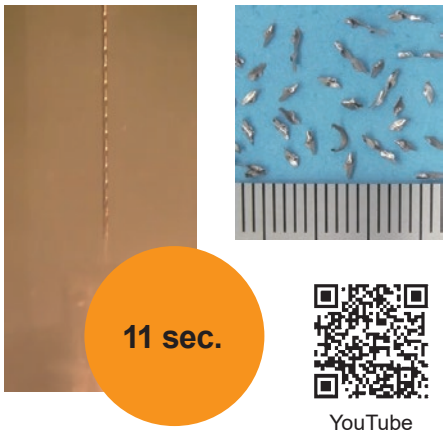
<Cutting Conditions>
Workpiece Material : Inconel718
Tool : Pilot Drill
DC=ø2mm, L/D=2
Hole Depth 4mm
Long Drill
DC=ø2mm, L/D=12
Hole Depth 20mm
Cutting Speed : vc= 30m/min
Feed per Rev. : fr= 0.03mm/rev.
Hole Depth : 20mm
Cutting Mode : Wet Cutting
Water-soluble Coolant
2MPa

Cutting Performance

SUS304 L/D =50 High-efficiency Cutting Example

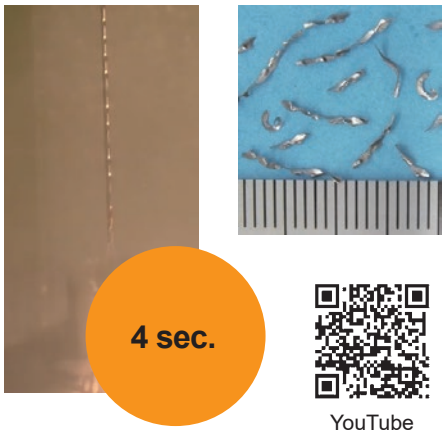
Achieves excellent chip disposal and high efficiency in deep hole drilling of stainless steels.

Cutting Speed : vc= 60m/min
Feed per Rev. : fr= 0.05mm/rev.



YouTube

Cutting Speed : vc= 100m/min
Feed per Rev. : fr= 0.08mm/rev.

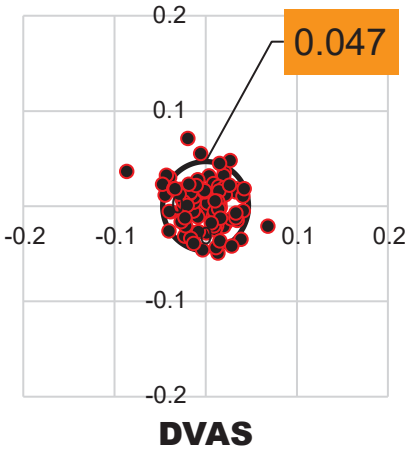


YouTube

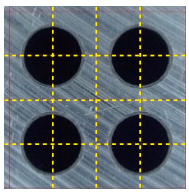
<Cutting Conditions>
Workpiece Material : JIS SUS304
Tool : Pilot Drill
DC=ø2mm, L/D=2
Hole Depth 6mm
Short Drill
DC=ø2mm, L/D=7
Hole Depth 14mm
Long Drill
DC=ø2mm, L/D=12
Hole Depth 100mm
Cutting Mode : Wet Cutting
Water-soluble Coolant
7Mpa

SCM440 L/D=40 Comparison of True Straightness

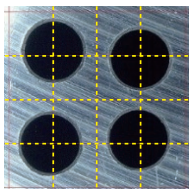
Hole wandering is greatly reduced when compared to conventional products.



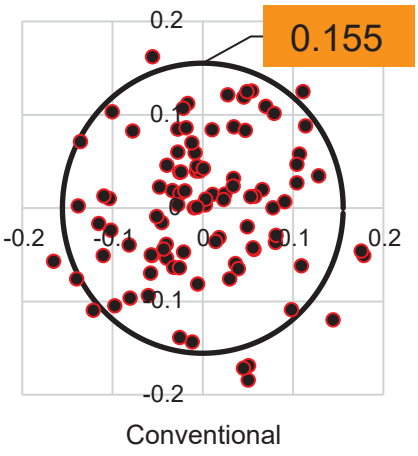
DVAS



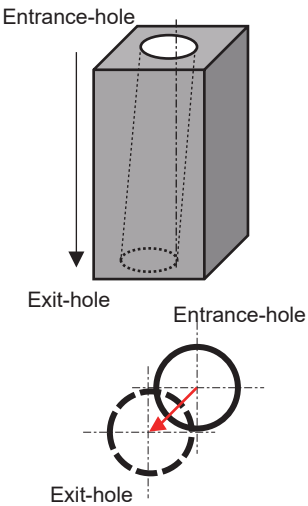
DVAS



Conventional



Conventional



<Cutting Conditions>
Workpiece Material : JIS SCM440
Tool : Pilot Drill
DC=ø2mm, L/D=2
Hole Depth 6mm
Long Drill
DC=ø2mm, L/D=40
Hole Depth 80mm

Feed per Rev.: fr= 0.07mm/rev.
Cutting Mode : Wet Cutting
Water-soluble Coolant, 7Mpa

Memo

Solid Carbide **TRISTAR** Drill Series

DVAS

For Your Safety
●Don't handle inserts and chips without gloves. ●Please machine within the recommended application range and exchange expired tools with new ones in advance of breakage. ●Please use safety covers and wear safety glasses. ●When using compounded cutting oils, please take fire precautions. ●When using rotating tools, please make a trial run to check run-out, vibration and abnormal sounds etc. ●Grinding or heating of cutting tools produces dust and mist. Inhaling large amount of dust or contacting with eyes and skins may harm your body.

MITSUBISHI MATERIALS CORPORATION

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http://www.mmc-carbide.com/
(Tools specifications subject to change without notice.)

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